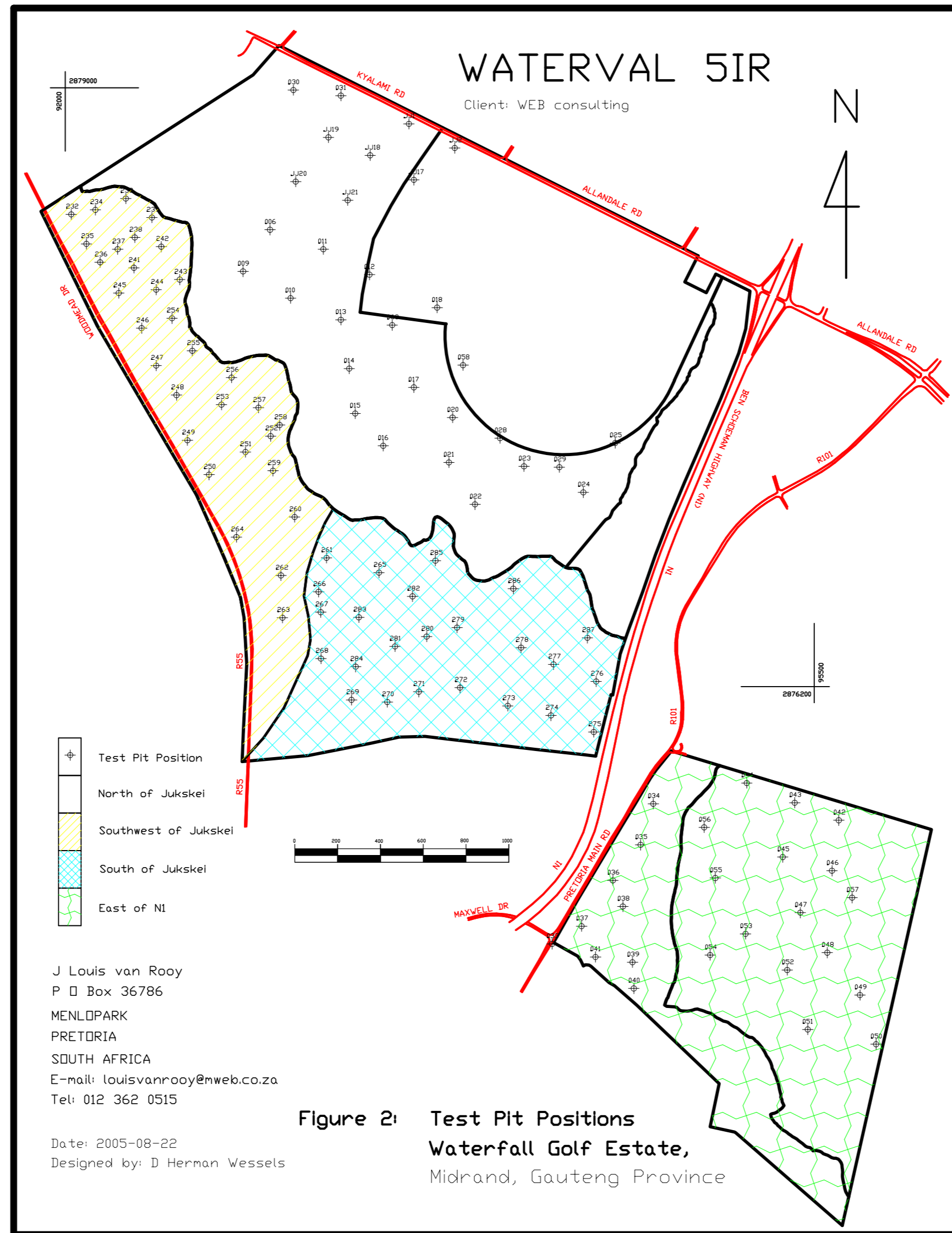
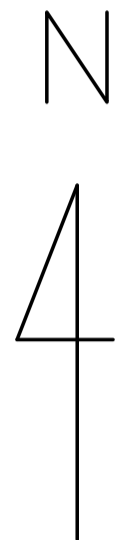


APPENDIX A: FIGURES AND REFERENCE TABLES










WATERVAL 5IR

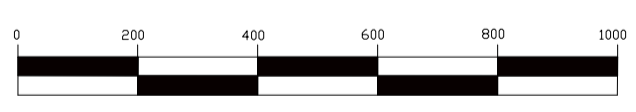
Client: WEB consulting



2879000
92000

2876200
00556

-  Zone I
-  Zone II
-  Zone III
-  Zone IV
-  Granite outcrop
-  Quartz veins
-  Existing structures



J Louis van Rooy
P O Box 36786
MENLOPARK
PRETORIA
SOUTH AFRICA
E-mail: louisvanrooy@mweb.co.za
Tel: 012 362 0515

Date: 2005-08-22
Designed by: D Herman Wessels

Figure 3: Zonation Map
Waterfall Golf Estate,
Midrand, Gauteng Province

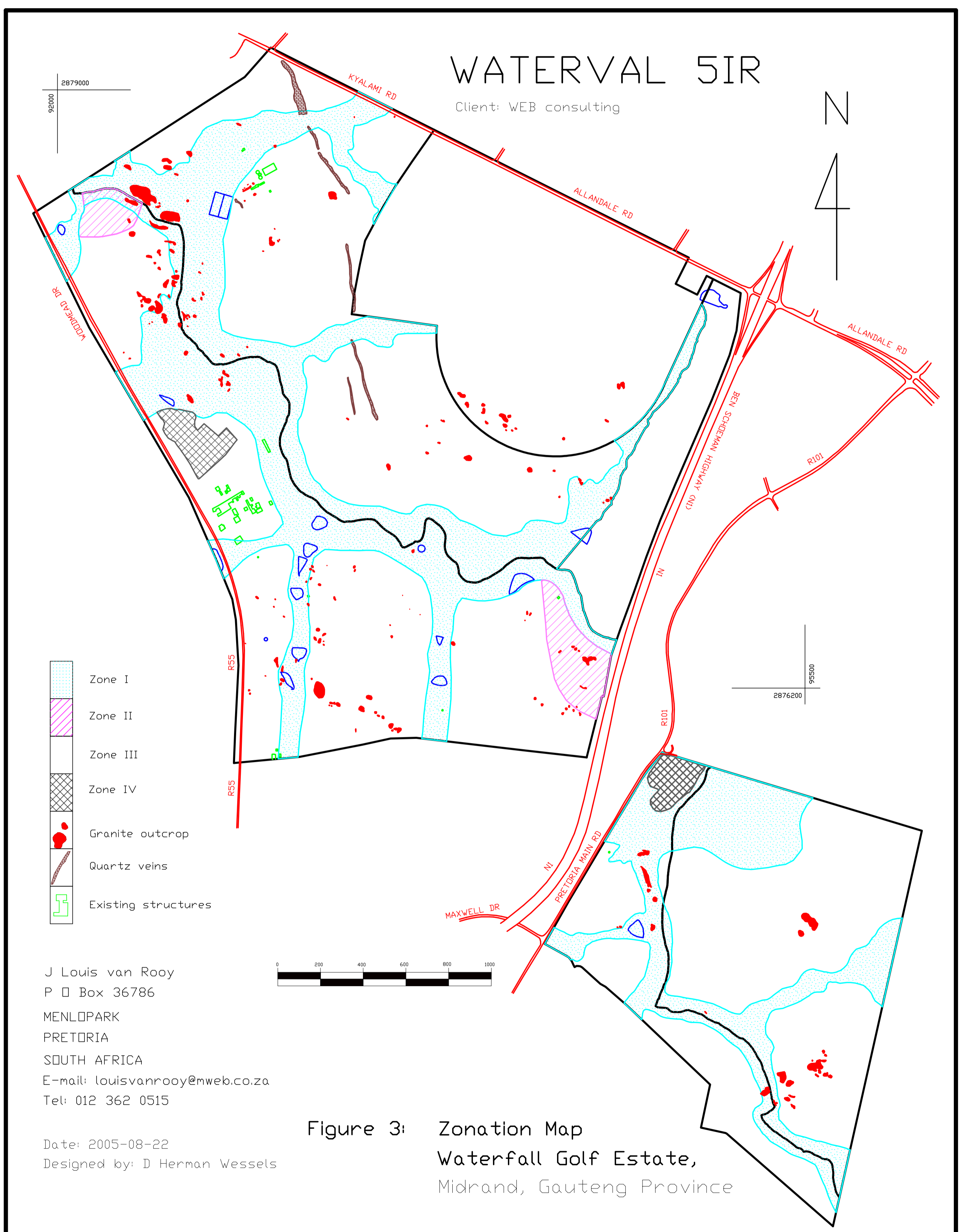


TABLE 4. RESIDENTIAL SITE CLASSIFICATIONS (SAICE 1995)

TIPIAL FOUNDATION MATERIAL	CHARACTER OF FOUNDATION MATERIAL	PERCENTAGE RANGE OF TOTAL SOIL MOVEMENTS (%)	ASSUMED DIFFERENTIAL MOVEMENT (% OF TOTAL)	SITE CLASS
Rock (excluding mud rocks which exhibit swelling to some depth)	STABLE	NEGLIGIBLE	-	R
Fine-grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sand clays)	EXPANSIVE SOILS	7-15 15-30 30	50 50 50 50	H H1 H2 H3
Silt-sands, sands and gravelly soils	COMPRESSIBLE AND POTENTIALLY COLLAPSIBLE SOILS	5-10 10-20 20	75 75 75	C C1 C2
Fine-grained soils (clayey silts and clayey sands of low plasticity) and sand and gravelly soils	COMPRESSIBLE SOIL	10-20 20	50 50 50	S S1 S2
Contaminated soils Controlled fill Dolomitic areas Land fill Marsh areas Mine waste fill Mining subsidence Reclaimed areas Very soft silt/silty clays Uncontrolled fill	VARIABLE	VARIABLE		P

NOTES

- The classifications C, H, R and S are not intended for dolomitic area sites unless specific investigations are carried out to assess the stability (risk of sinkholes and doline formation) of the dolomites. Where this risk is found to be acceptable, the site shall be designated as Class P (dolomitic areas).
- Site classes are based on the assumption that differential movements experienced by single-store residential buildings expressed as a percentage of the total movements are equal to about 50% for soils that exhibit expansive or compressive characteristics and 75% for soils that exhibit both compressible and collapse characteristics. Where this assumption is incorrect or inappropriate, the total soil movements must be adjusted so that the resultant differential movements implied by the table is equal to that which is expected in the field.
- In some instances, it may be more appropriate to use a composite description to describe a site note full e.g. C1/H2 or S1 and/or H2. Composite Site Classes may lead to higher differential movements and result in design solutions appropriate to a higher range of differential movement e.g. a Class R/C1 site. Alternatively, a further site investigation may be necessary since the final design solution may depend on the location of the building on a particular site.
- Where it is not possible to provide a single site designation and a composite description is inappropriate, sites may be given multiple descriptions to indicate the range of possible conditions e.g. H-H1-H2 or C1-C2.
- Soft silts and clays usually exhibit high consolidation and low bearing characteristics. Structures founded on these horizons may experience high settlements and such sites should be designated as being Class S1 or S2 as relevant and appropriate.
- Sites containing contaminated soils include those associated with reclaimed mine land, land down-slope of mine tailings and old land fills.
- Where a site is designated as Class P, full particulars relating to the founding conditions on the site must be provided.
- Where sites are designated as being Class P, the reason for such classification shall be placed in brackets immediately after the suffix i.e. P(contaminated soils). Under certain circumstances, composite description may be more appropriate e.g. P(dolomite areas)-C1.
- Certain fills may contain contaminants which present a health risk. The nature of such fill should be evaluated and should be clearly demarcated as such.

TYPICAL FOUNDATION DESIGN CRITERIA IN PROJECTIONS AND PRELIMINARY MEASURES FOR SINGLE-STORE RESIDENTIAL BUILDINGS FOUND ON HORIZONTAL SURFACE TO BOTH CONSOLIDATION AND COLLAPSE SETTLEMENT (SAICE 1995)

SITE CLASS	ESTIMATE TOTAL SETTLEMENT (mm)	CONSTRUCTION TYPE	FOUNDATION DESIGN AND CRITERIA IN PROJECTIONS
C	≤ 5	Normal	<ul style="list-style-type: none"> - Normal construction (strip footing or slab-on-grade foundations) - Good site drainage
C1	5 - 10	Modified normal Compaction of in situ soils below individual footings Deep strip foundations Soil raft	<ul style="list-style-type: none"> - Reinforced strip footings - Articulation joints at some internal and all external doors - Light reinforcement in masonry - Site drainage and service/plumbing precautions - Foundation pressure not to exceed 50 kPa - Remove in situ material below foundations to a depth and width of 1.5 times the foundation width or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at 1% to +2% of optimum moisture content. - Normal construction with light reinforced strip foundations and light reinforcement in masonry - Normal construction with drainage requirements. - Founding on a competent horizon below the problem horizon - Remove in situ material to 1.0m beyond perimeter of building to a depth and width of 1.5 times the widest foundation or to a competent horizon and replace with material compacted to 93% MOD AASHTO density at 1% to +2% of optimum moisture content. - Normal construction with light reinforced strip footings and light reinforcement in masonry
C2	≤ 10	Stiffened strip footings/stiffened or cellular raft Deep strip foundations Compaction of in situ soils below individual footings Piled or pier foundations Soil raft	<ul style="list-style-type: none"> - Stiffened strip footing or stiffened or cellular raft with articulation joints or solid light reinforced masonry - Bearing pressure not to exceed 50kPa. - Fabric reinforcement in floor slabs. - Site drainage and service/plumbing precautions. - As for C1 but with fabric reinforcement in floor slabs - As for C1. - Reinforced concrete ground beams or solid slabs on piled or pier foundations. - Ground slabs with fabric reinforcement. - Good site drainage. - As for C1.

NOTES

1. Differential settlement assumed to equal 75% of total settlement
2. The relaxation of some of these requirements (e.g. the reduction or omission of steel or articulation joints) may result in a Category 2 level of expected damage.

T 6.

FOUNDATION DESIGN AND PROVISIONS AND PRELIMINARY MEASURES FOR SINGLE-STORE RESIDENTIAL BUILDINGS FOUND ON HORIZONTAL SURFACE TO BOTH CONSOLIDATION AND COLLAPSE SETTLEMENT (SAICE 1995)

SITE CLASS	ESTIMATE TOTAL SETTLEMENT	CONSTRUCTION TYPE	FOUNDATION DESIGN AND PROVISIONS
H	7.5	Normal	<ul style="list-style-type: none"> - Normal construction (strip footing or slab-on-grade foundations) - Good site drainage and service/plumbing precautions recommended.
H1	7.5 - 15	Modified normal Soil raft	<ul style="list-style-type: none"> - Light reinforced strip footings - Articulation joints at all internal/external doors - Light reinforcement in masonry - Site drainage and service/plumbing precautions - Remove in situ material to 10m beyond perimeter of the structure and replace with inert backfill compacted to 93% MOD AASHTO density at 1% to +2% of optimum moisture content. - Normal construction with light reinforced strip footings and light reinforcement in masonry if residual movements are < 7.5mm or construction type appropriate to residual movements. - Site drainage and plumbing/service precautions.
H2	30	Stiffened or cellular raft Piled construction Split construction Soil raft	<ul style="list-style-type: none"> - Stiffened or cellular raft with articulation joints or light reinforced masonry - Site drainage and plumbing/service precautions. - Piled foundations with suspended floor slabs with or without ground beams. - Site drainage and plumbing/service precautions. - Combination of reinforced brickwork/block work and full movement joints. - Suspended floors of fabric-reinforced ground slabs acting independent from the structure. - Site drainage and plumbing/service precautions. - As for H1.
H3	30	Stiffened or cellular raft Piled construction Soil raft	<ul style="list-style-type: none"> - As for H2. - As for H2. - As for H1.

NOTES

1. Differential settlement assumed to equal 75% of total settlement
2. The relaxation of some of these requirements e.g. the reduction or omission of steel or articulation joints may result in a Category 2 level of expected damage.

APPENDIX B: SOIL PROFILES

Scale
1:15



0.00

Dry light grey medium dense intact gravelly silty SAND. Colluvium. Abundant roots.

0.20

Slightly moist yellowish brown medium dense intact silty sandy GRAVEL with subangular quartz pebbles and cobbles. Pebble marker with an overall consistency of medium dense to dense. Abundant Roots.

0.50

Slightly moist orange brown mottled black with grey blodges medium dense intact clayey silty SAND. Reworked granite. Few roots.

1.30

Slightly moist orange brown medium dense becoming dense intact clayey silty SAND. Residual granite.

2.40

NOTES

- 1) No refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
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PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

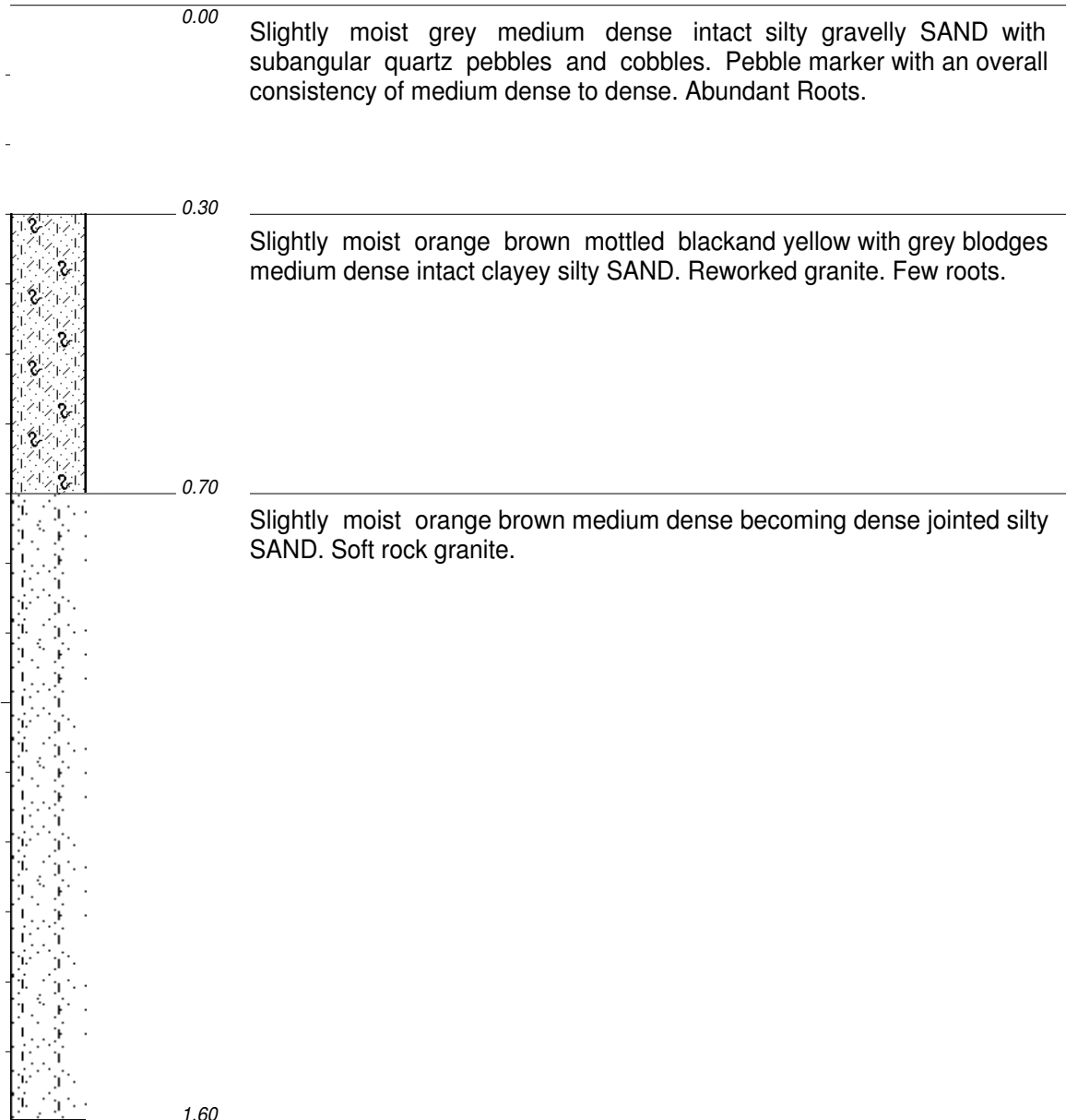
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ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP2
Sheet 1 of 1

JOB NUMBER: 537/3

Scale
1:10



NOTES

- 1) Refusal.
- 2) No seepage.

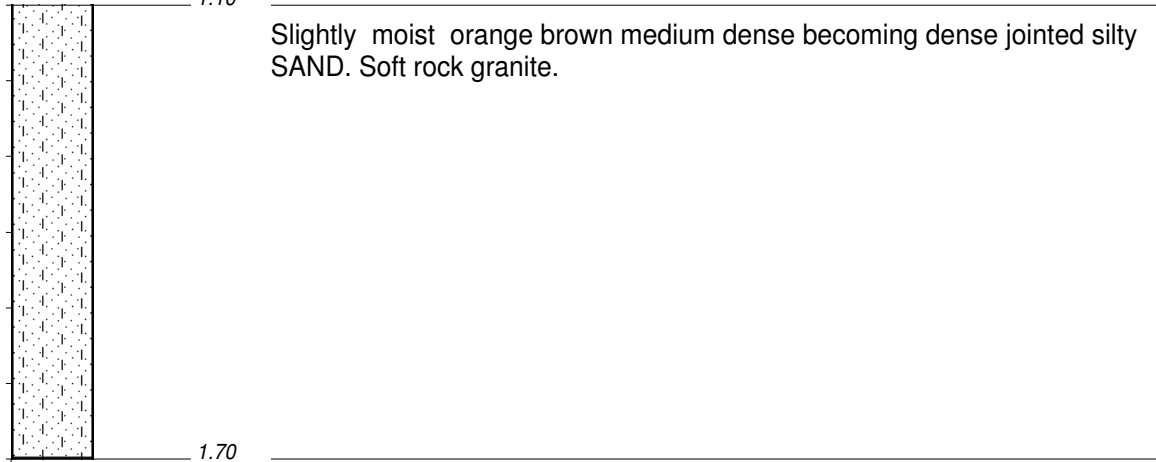
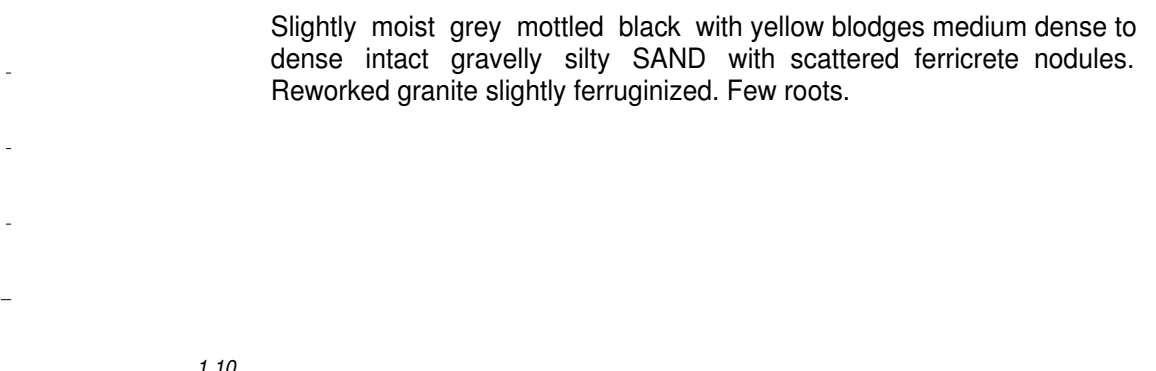
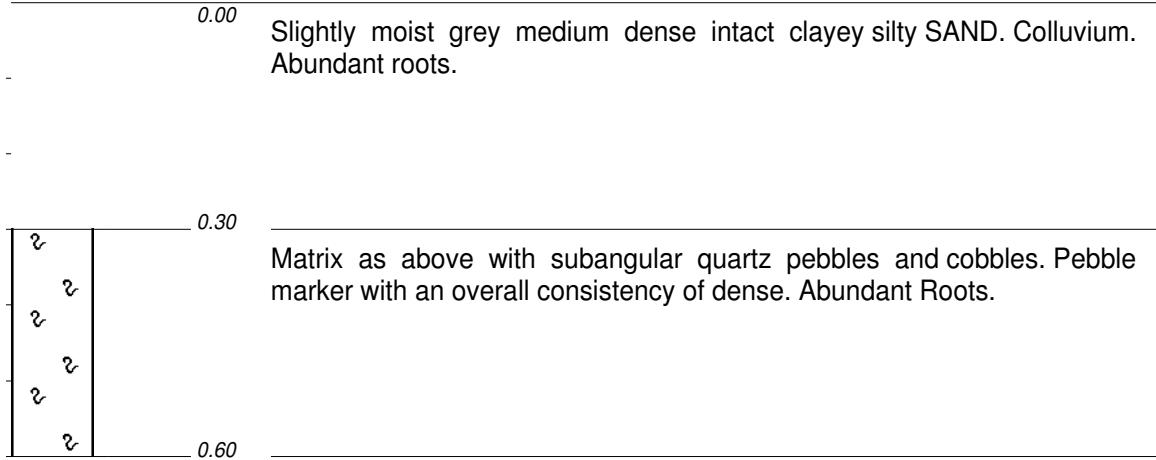
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MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

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ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP2

Scale
1:10



NOTES

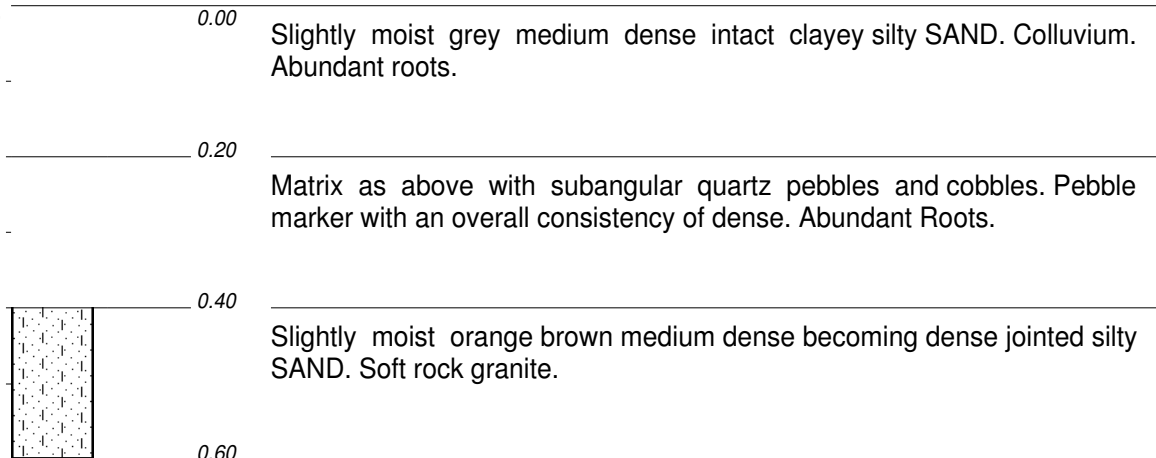
- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

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DIAM :
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DATE : 01/08/05 17:39
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ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

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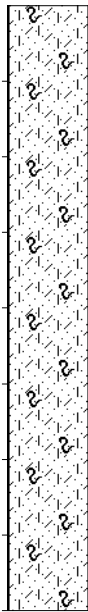
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Y-COORD :

HOLE No: TP5

Sheet 1 of 1

JOB NUMBER: 537/3

Scale
1:10



0.00

Slightly moist grey medium dense intact clayey silty SAND. Colluvium.
Abundant roots.

0.80

Refusal on Hardpan ferricrete.

0.90

NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant

MACHINE : CAT 416B

DRILLED BY :

PROFILED BY : GJ JOUBERT

TYPE SET BY :

SETUP FILE : STANDARD.SET

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DATE :

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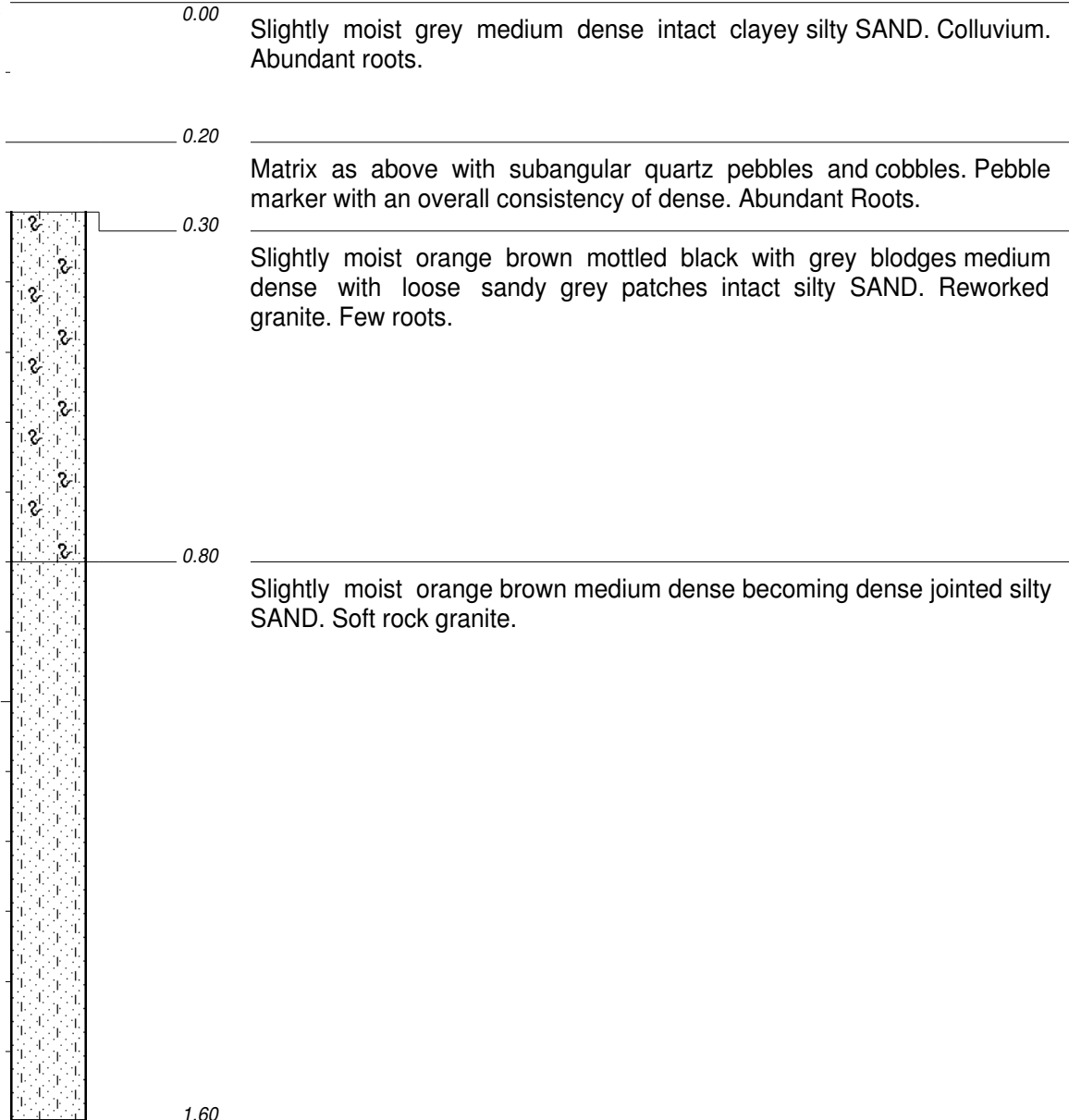
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Y-COORD :

HOLE No: TP5

Scale
1:10



NOTES

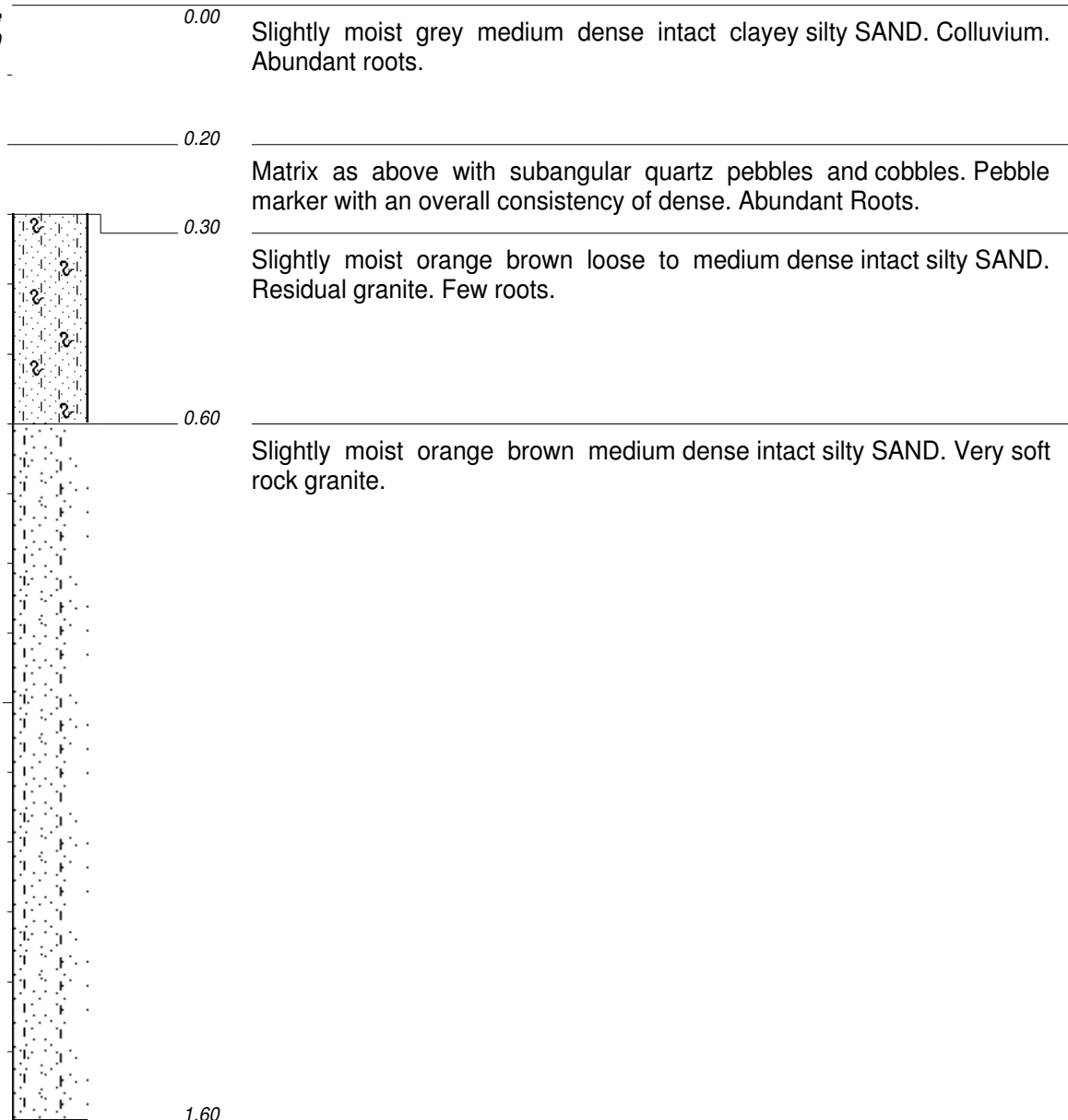
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- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

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DIAM :
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ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

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ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP8
Sheet 1 of 1

JOB NUMBER: 537/3

Scale
1:10



0.00

Slightly moist light brown loose to medium dense intact silty SAND.
Colluvium. Abundant roots.

0.60

Refusal on Hardpan ferricrete.

0.70

NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
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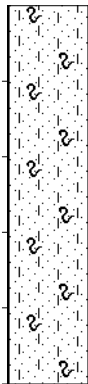
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X-COORD :
Y-COORD :

HOLE No: TP8

HOLE No: TP9
Sheet 1 of 1

JOB NUMBER: 537/3

Scale
1:10



0.00

Slightly moist light grey loose to medium dense intact silty SAND.
Alluvium. Abundant roots.

0.50

Refusal on Hardpan ferricrete.

0.60

NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

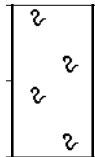
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X-COORD :
Y-COORD :

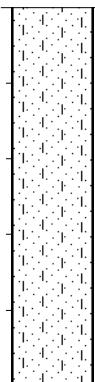
HOLE No: TP9

Scale
1:10

0.00 Slightly moist light brown medium dense intact silty SAND. Colluvium. Abundant roots.

0.30

 0.50 Matrix as above with subangular quartz pebbles and cobbles. Pebble marker with an overall consistency of loose to medium dense. Abundant Roots.

0.50 Matrix as above with a honeycomb structure ferricrete. Honeycomb ferricrete.

1.00

 1.50 Slightly moist orange brown mottled black and yellow with grey blotches medium dense to dense intact silty SAND with scattered Fe and Mg nodules. Reworked granite Slightly ferruginized.

NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
 MACHINE : CAT 416B
 DRILLED BY :
 PROFILED BY : GJ JOUBERT
 TYPE SET BY :
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE :
 DATE : 23/06/2005
 DATE : 01/08/05 17:39
 TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
 X-COORD :
 Y-COORD :

Scale 1:10

0.00 Slightly moist light brown medium dense intact silty sandy GRAVEL with subangular quartz pebbles and cobbles. Pebble marker with an overall consistency of medium dense to dense. Abundant Roots.

0.30 Slightly moist orange brown mottled black medium dense intact silty SAND. Residual granite.

2.00

NOTES

1) Refusal.

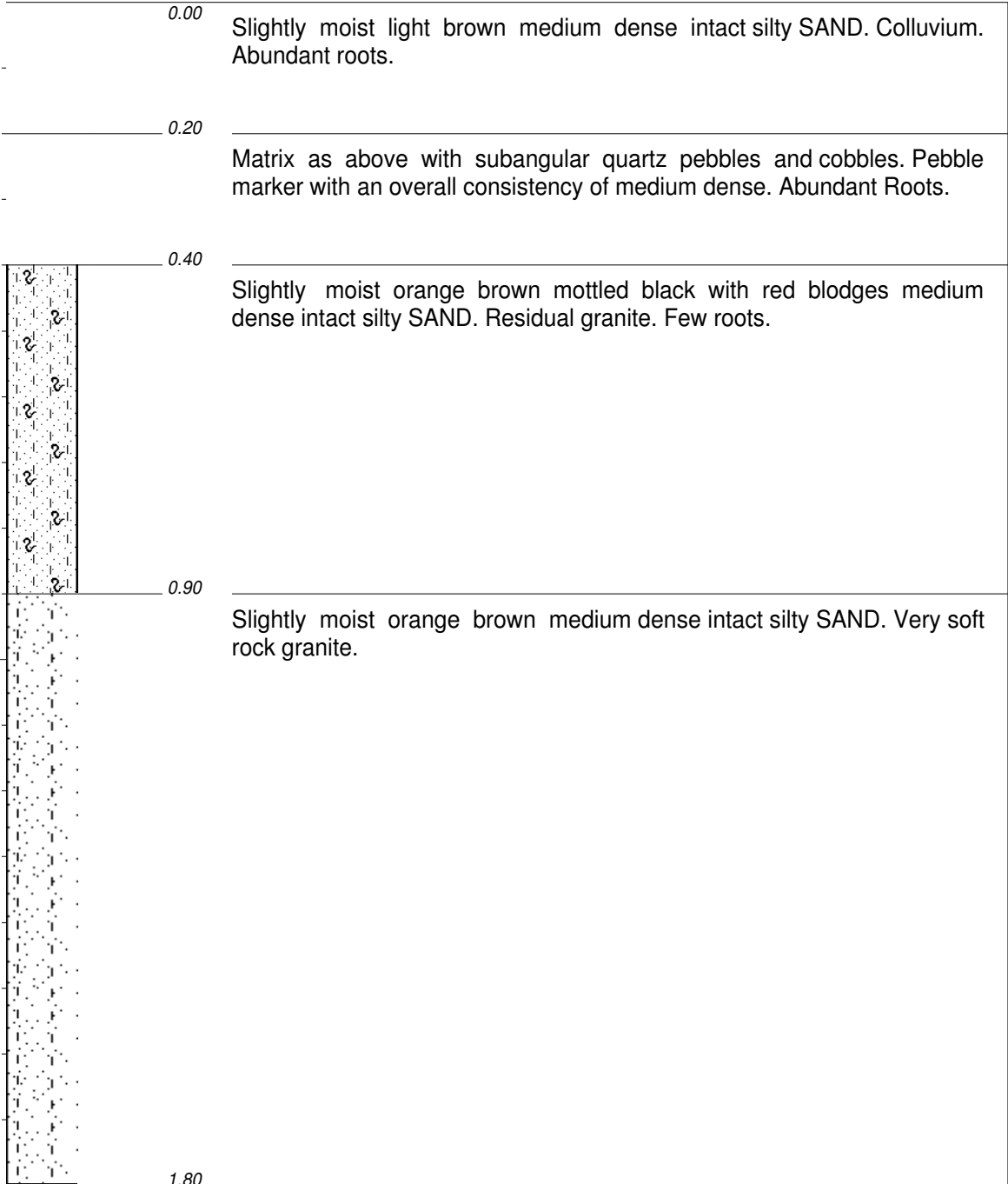
2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
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PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
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ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

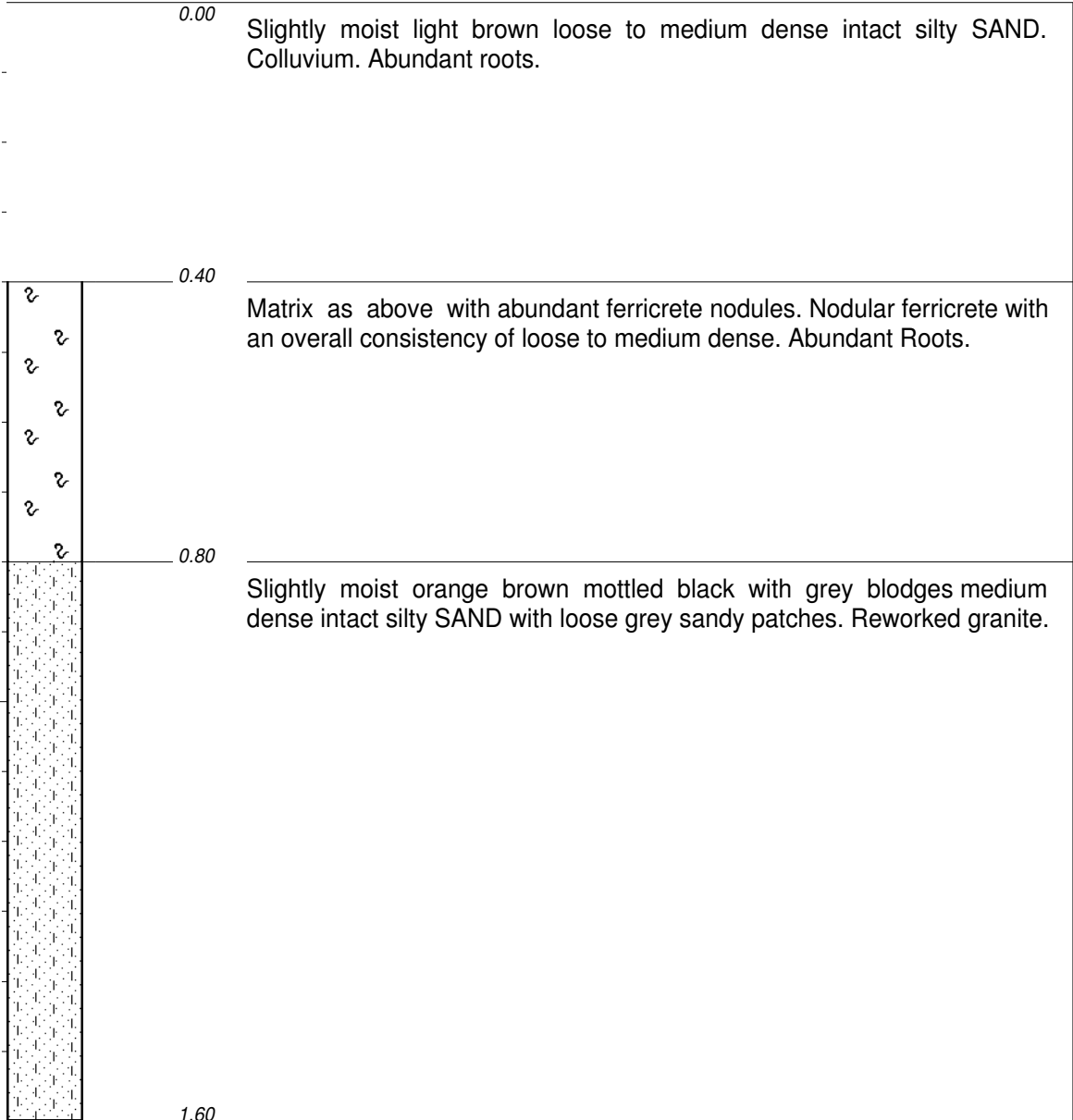
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- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
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Y-COORD :

Scale
1:10



NOTES

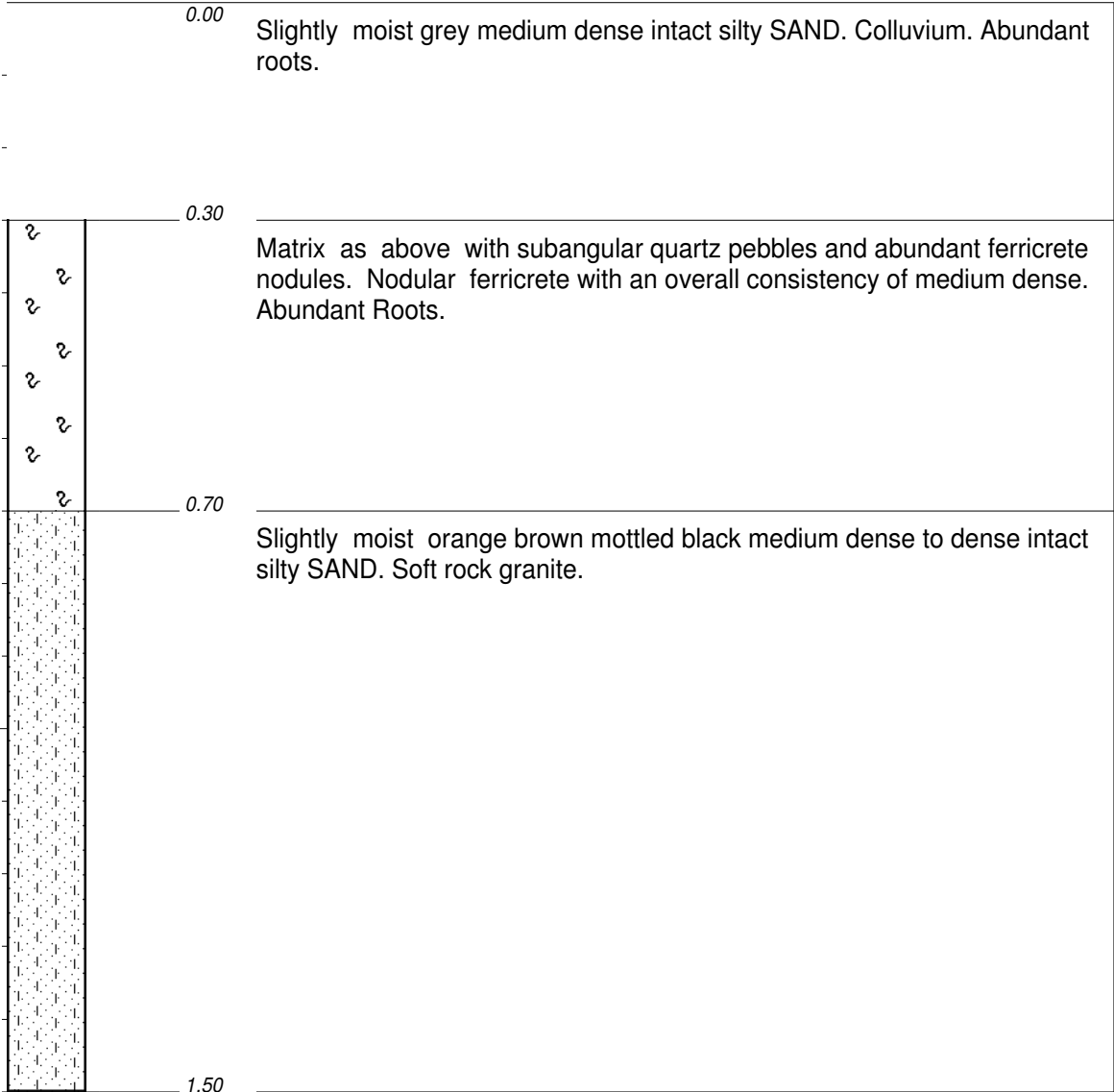
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- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
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PROFILED BY : GJ JOUBERT
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SETUP FILE : STANDARD.SET

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DATE : 23/06/2005
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ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

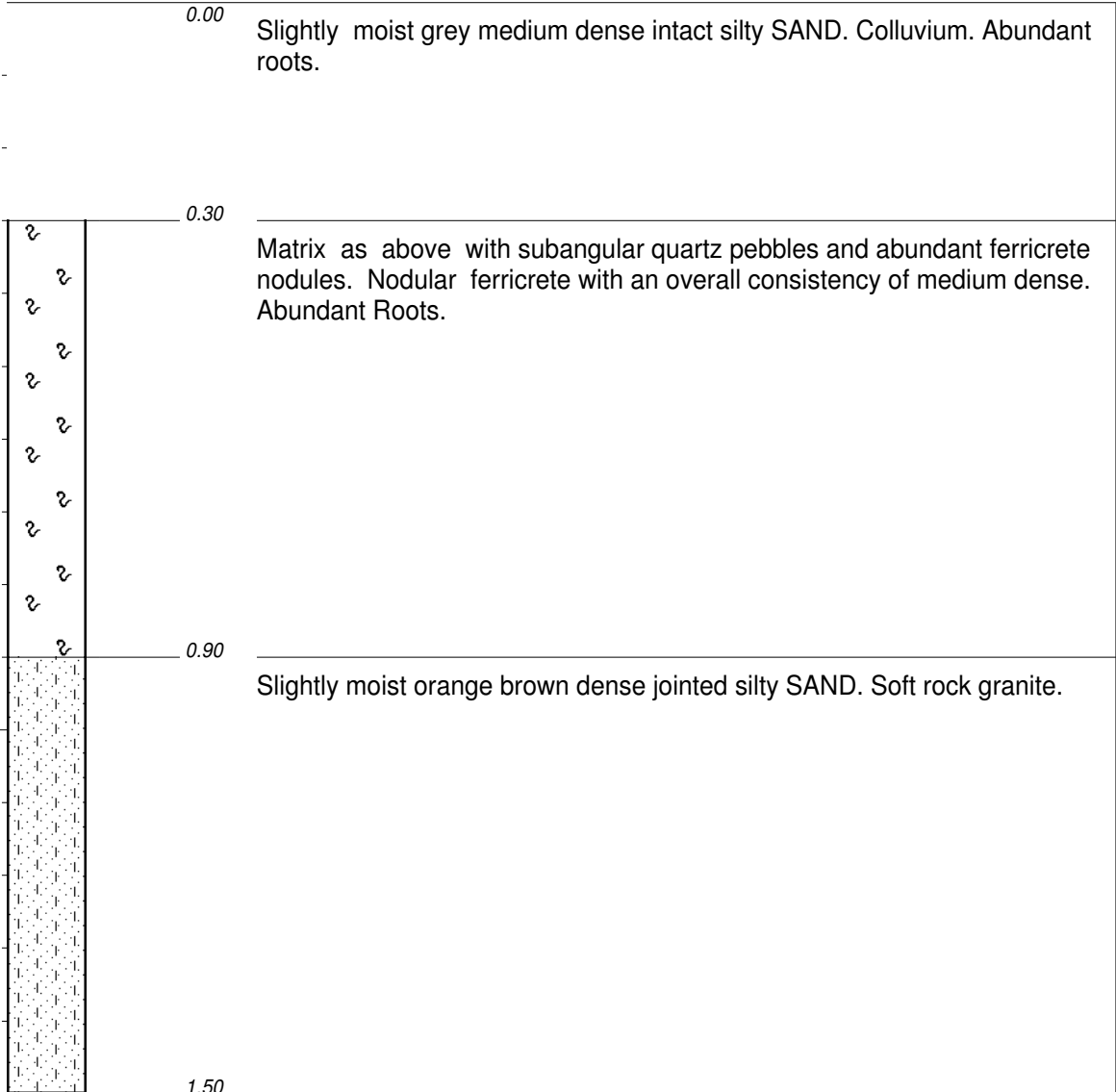
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- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
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PROFILED BY : GJ JOUBERT
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SETUP FILE : STANDARD.SET

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ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

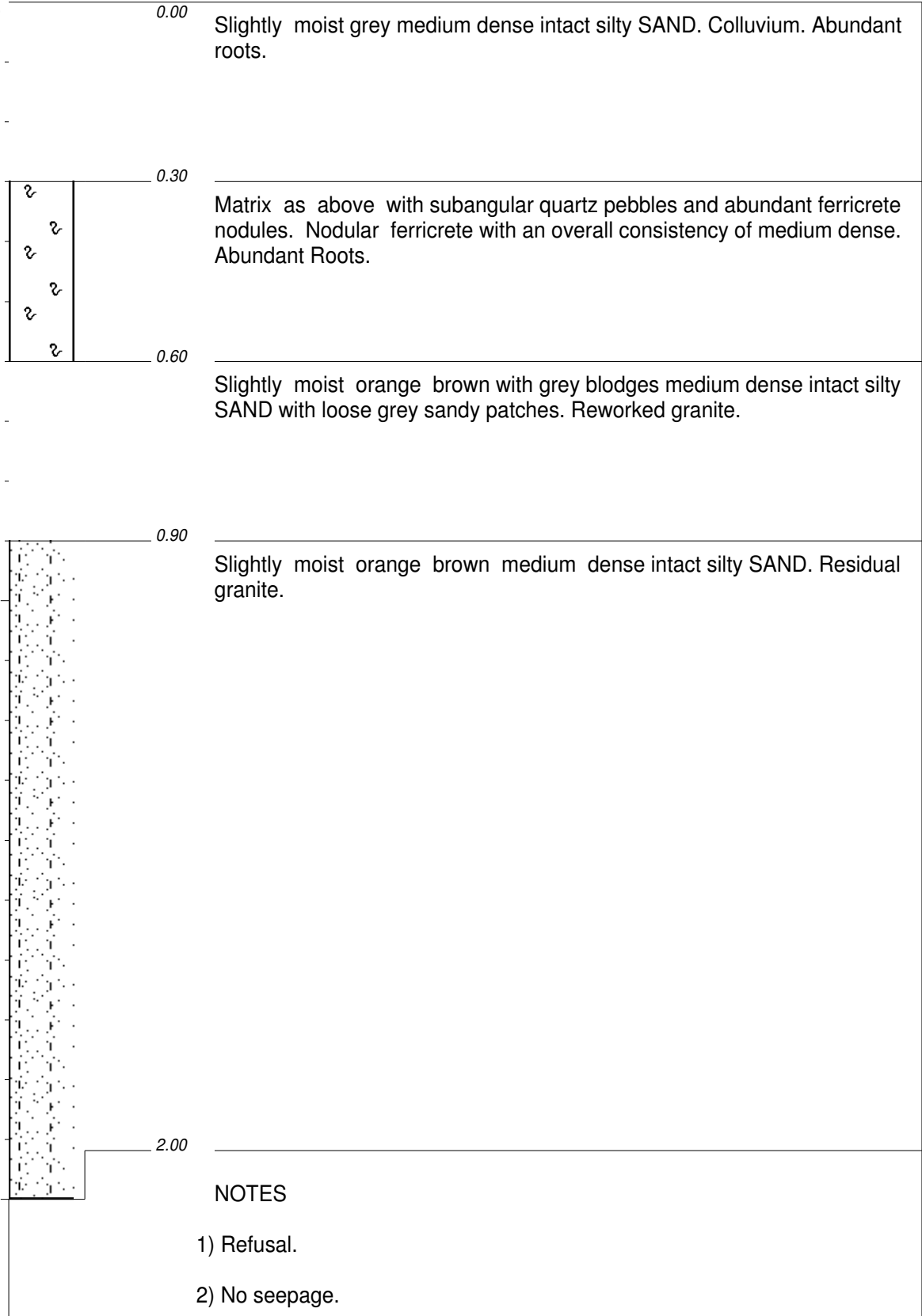
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- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
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PROFILED BY : GJ JOUBERT
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ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

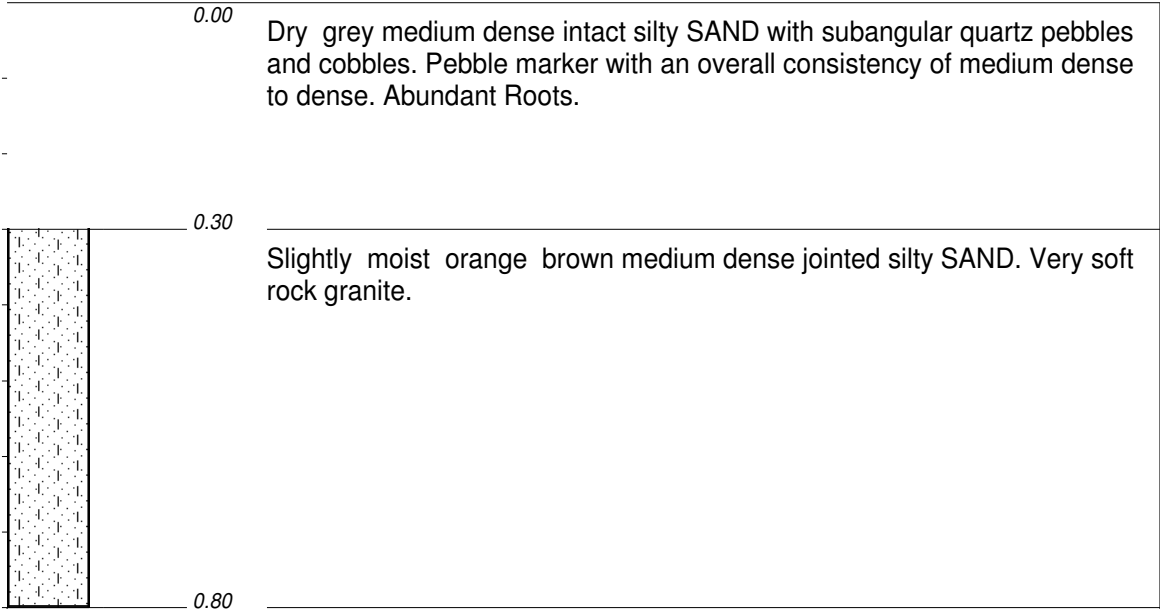


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ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/06/2005
DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale 1:10 0.00 Slightly moist grey medium dense intact silty SAND. Colluvium. Abundant roots.

0.40
Matrix as above with subangular quartz pebbles and abundant ferricrete nodules. Nodular ferricrete with an overall consistency of medium dense. Abundant Roots.

0.60
Slightly moist orange brown mottled black dense intact silty SAND. Soft rock granite Slightly ferruginized.

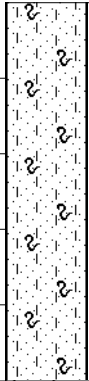
1.10
NOTES
1) Refusal.
2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
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DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



0.00

Dry grey medium dense intact silty SAND with subangular quartz pebbles and cobbles. Pebble marker with an overall consistency of medium dense to dense. Abundant Roots.

0.50

Slightly moist orange brown mottled black medium dense to dense intact silty SAND. Residual granite Slightly ferruginized.

1.50

NOTES

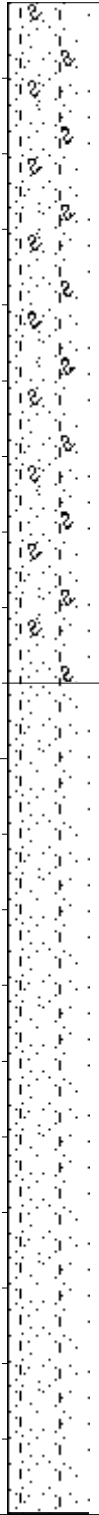
- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/06/2005
DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



0.00

Dry grey mottled black loose to medium dense intact silty SAND with abundant ferricrete nodules and scattered quartz pebbles. Nodular ferricrete with an overall consistency of medium dense. Abundant Roots.

0.90

Slightly moist orange brown medium dense to dense intact silty SAND. Residual granite.

2.00

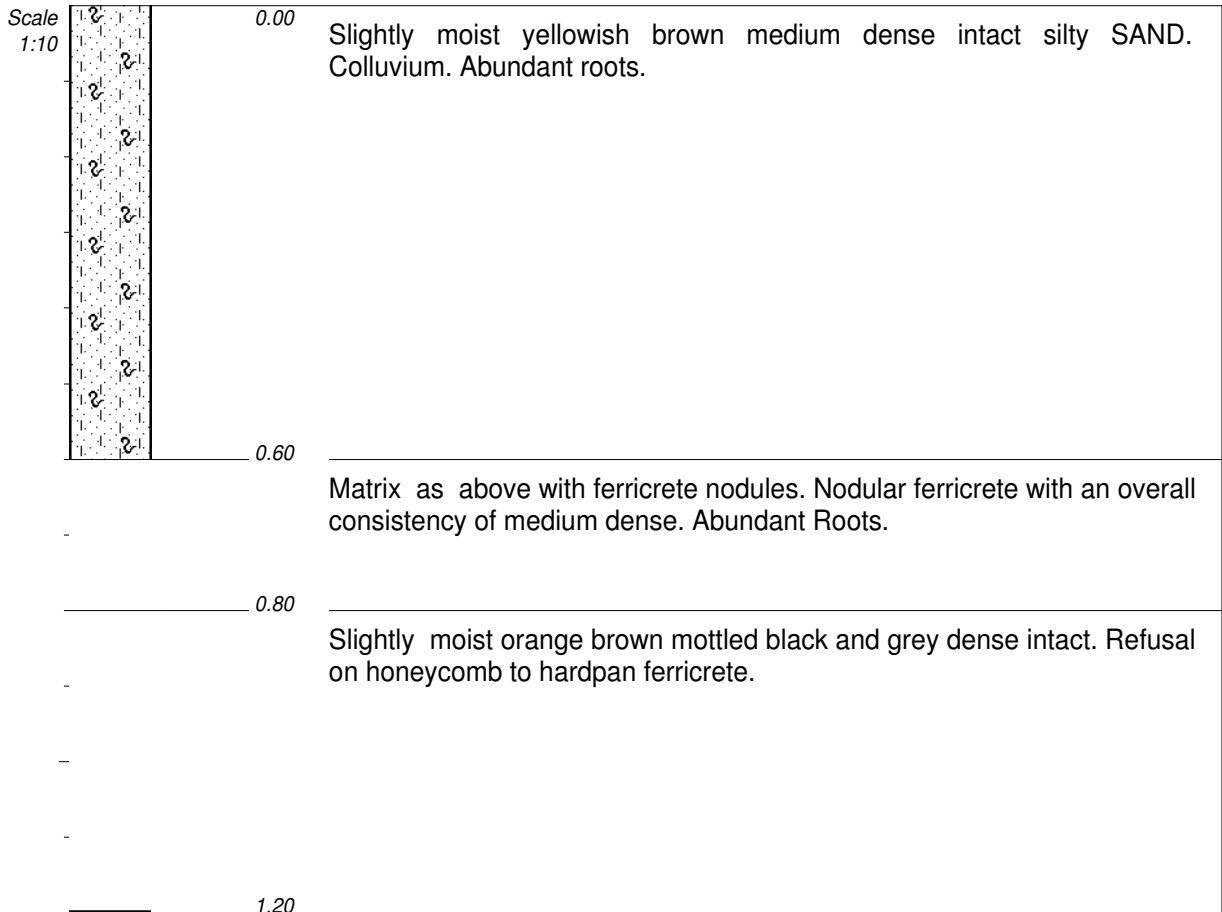
NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/06/2005
DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :



NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/06/2005
DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale 1:10 0.00 Slightly moist light brown medium dense intact silty SAND. Colluvium. Abundant roots.

0.40
Matrix as above with subangular quartz pebbles and cobbles. Pebble marker with an overall consistency of medium dense. Abundant Roots.

0.80 Slightly moist orange brown mottled black jointed silty SAND. Soft rock granite.

1.20

NOTES

1) Refusal.

2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/06/2005
DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



0.00

Slightly moist light brown medium dense intact silty SAND. Colluvium. Abundant roots.

0.50

Matrix as above with subangular quartz pebbles and cobbles. Pebble marker with an overall consistency of medium dense. Abundant Roots.

0.70

Slightly moist orange brown mottled red and grey blotches intact silty SAND with loose sandy patches. Reworked granite.

1.60

NOTES

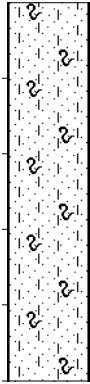
- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/06/2005
DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



0.00

Slightly moist yellowish brown medium dense intact silty SAND. Colluvium. Abundant roots.

0.50

Matrix as above with quartz pebbles and cobbles. Pebble marker with an overall consistency of medium dense. Abundant Roots.

0.80

Slightly moist orange brown mottled black and red dense intact. Refusal on honeycomb to hardpan ferricrete.

1.20

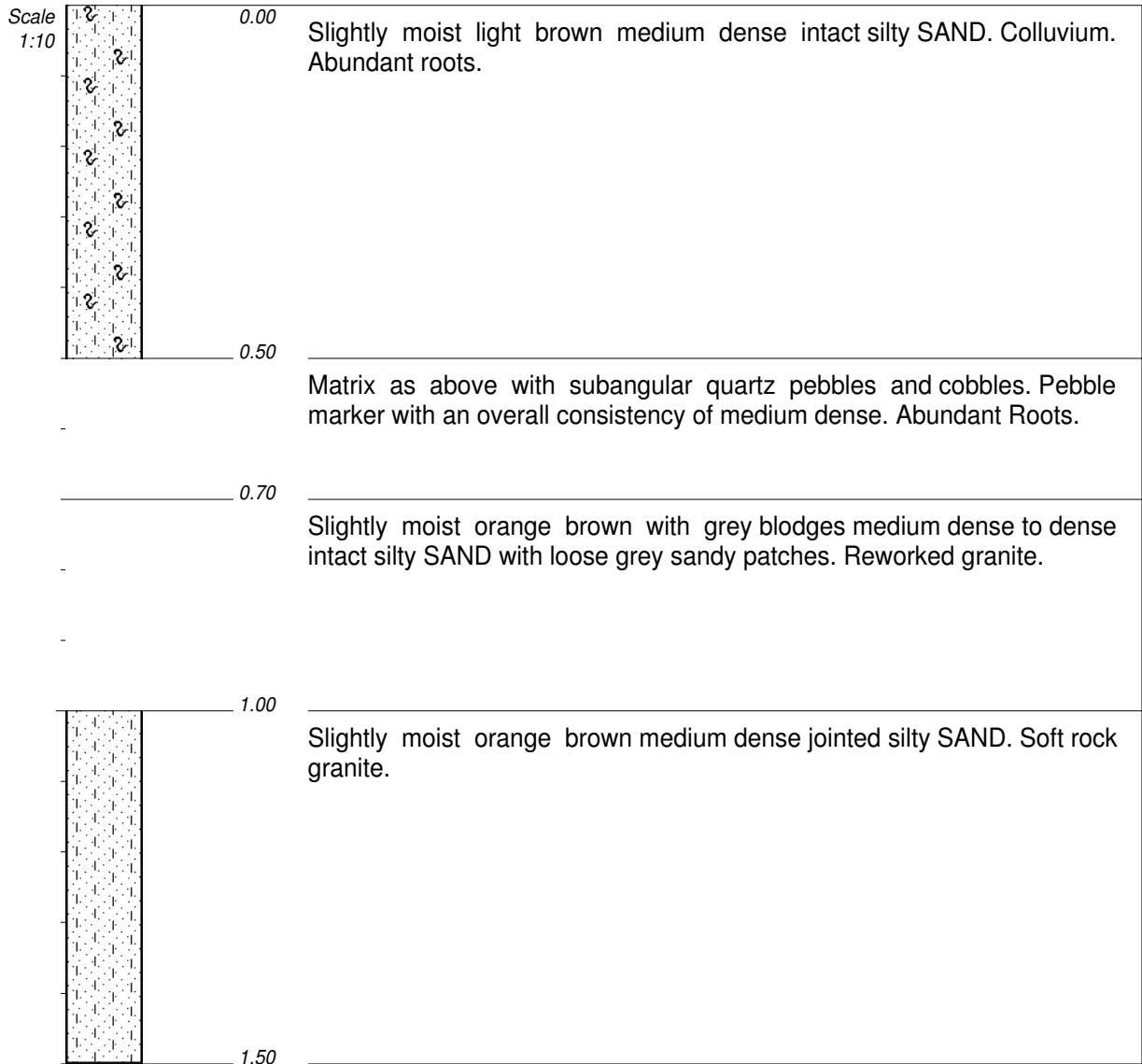
NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/06/2005
DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :



NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/06/2005
DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

Outcrop.

NOTES

1) Refusal.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/06/2005
DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

Outcrop.

NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFIED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/06/2005
DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

0.00 Slightly moist grey medium dense to dense intact silty SAND. Colluvium. Abundant roots.

0.30 Matrix as above with a honeycomb structure ferricrete. Honeycomb ferricrete with an overall consistency of dense to very dense.

0.60 Slightly moist orange brown with grey blodges medium dense intact silty clayey SAND. Reworked granite.

2.00 NOTES

- 1) Near refusal.
- 2) No seepage.

CONTRACTOR : Paul Heslop Plant
MACHINE : CAT 416B
DRILLED BY :
PROFILED BY : GJ JOUBERT
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/06/2005
DATE : 01/08/05 17:39
TEXT : ..C:\DOT4000\ZONE3.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



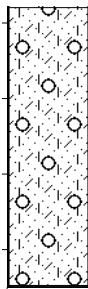
0.00

Slightly moist, light grey-brown, loose, intact, clayey silty sandy GRAVEL with abundant quartz gravel and pebbles. Colluvium. Abundant roots.

0.25

Slightly moist, light pinkish-brown with vertical grey weathering zones, medium dense, intact, silty gravelly SAND. Reworked residual granite.

0.48



0.85

Slightly moist, pinkish-brown mottled black and stained black, dense becoming very dense, intact, clayey silty gravelly SAND. Residual granite.

NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

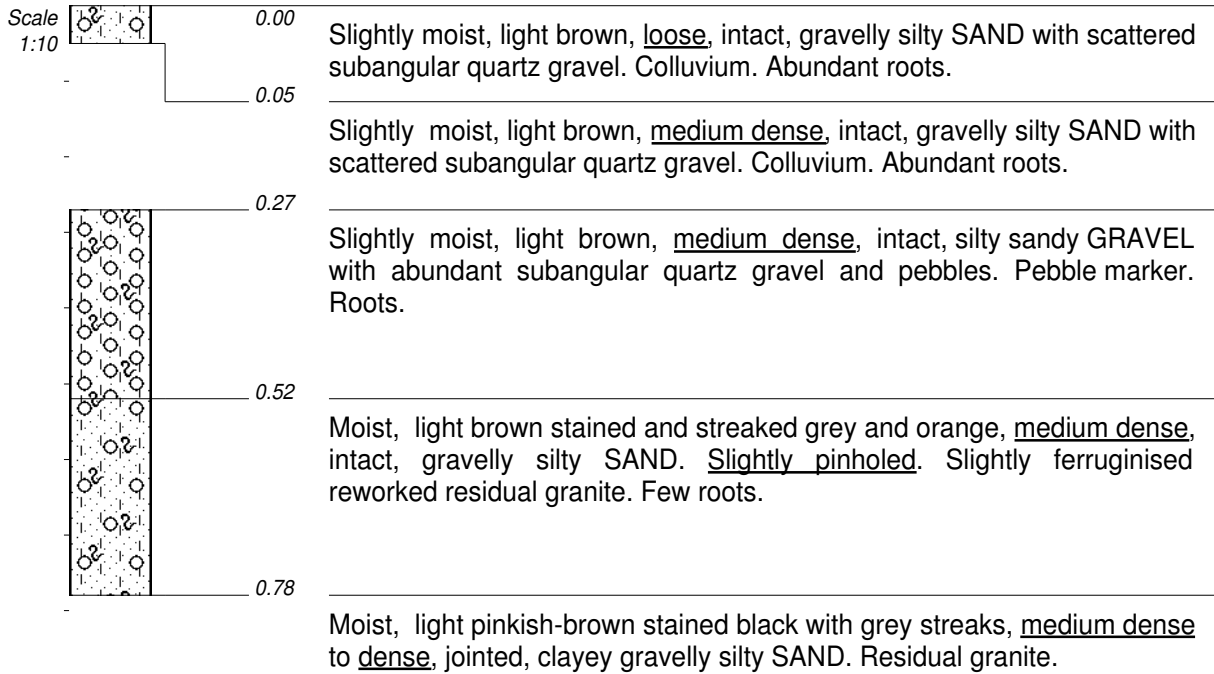
ELEVATION :
X-COORD :
Y-COORD :

Waterval 5IR zone4

HOLE No: GPS006

Sheet 1 of 1

JOB NUMBER: 537/4



1.87

NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:40
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS006

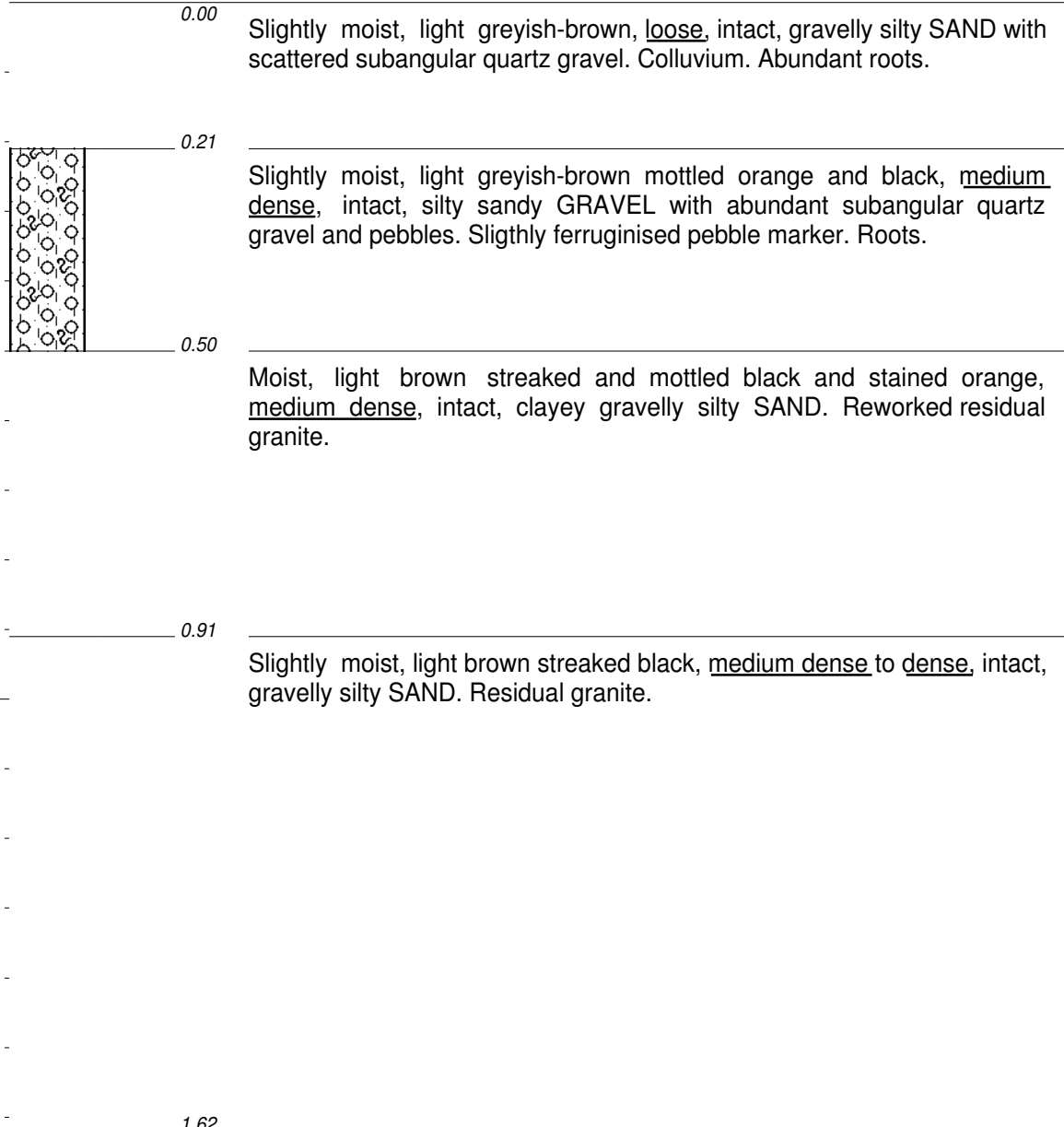
Waterval 5IR zone4

HOLE No: GPS009

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:40
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS009

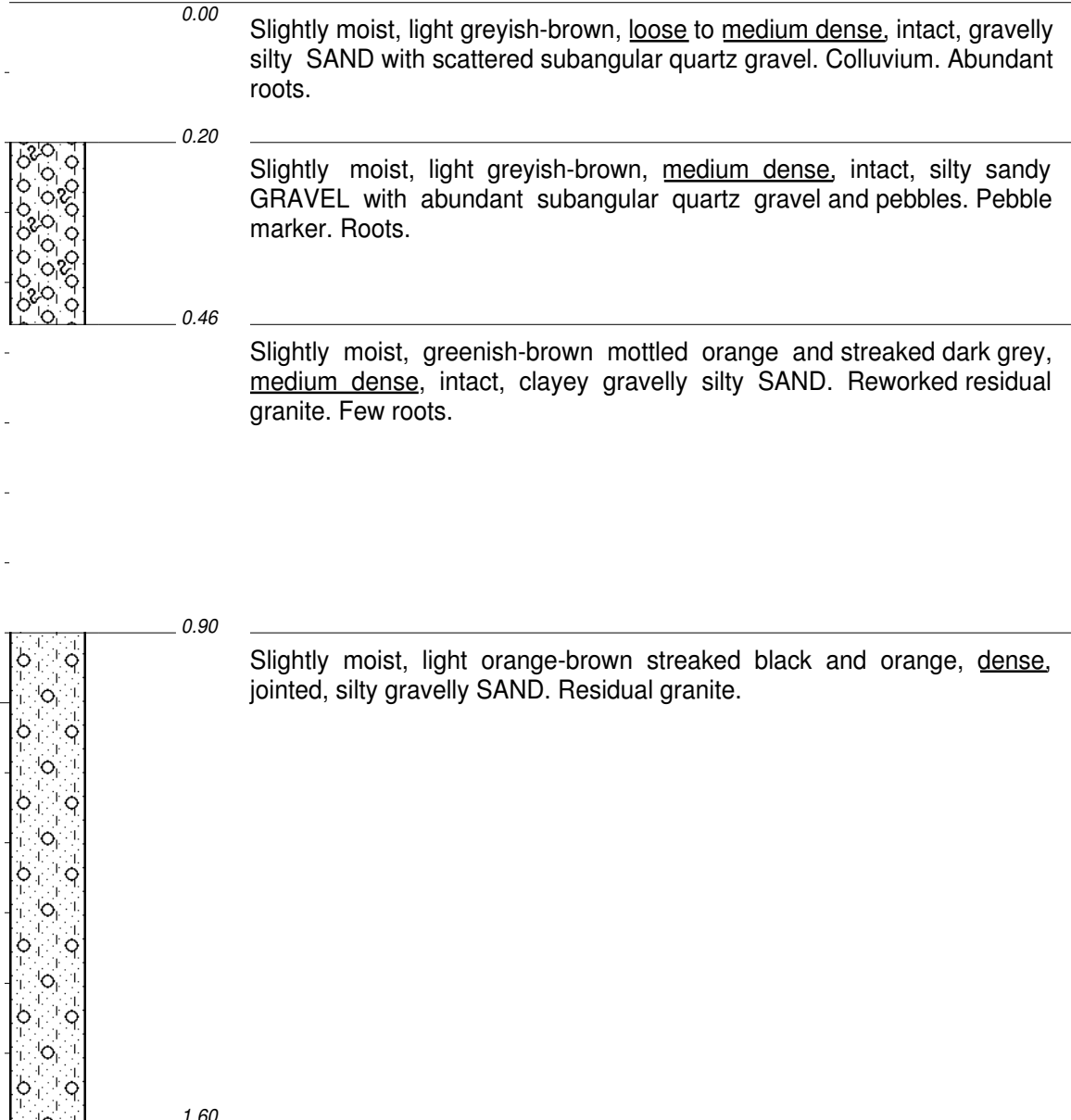
Waterval 5IR zone4

HOLE No: GPS010

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:40
TEXT : ..C:\DOT4000\ZONE4.TXT

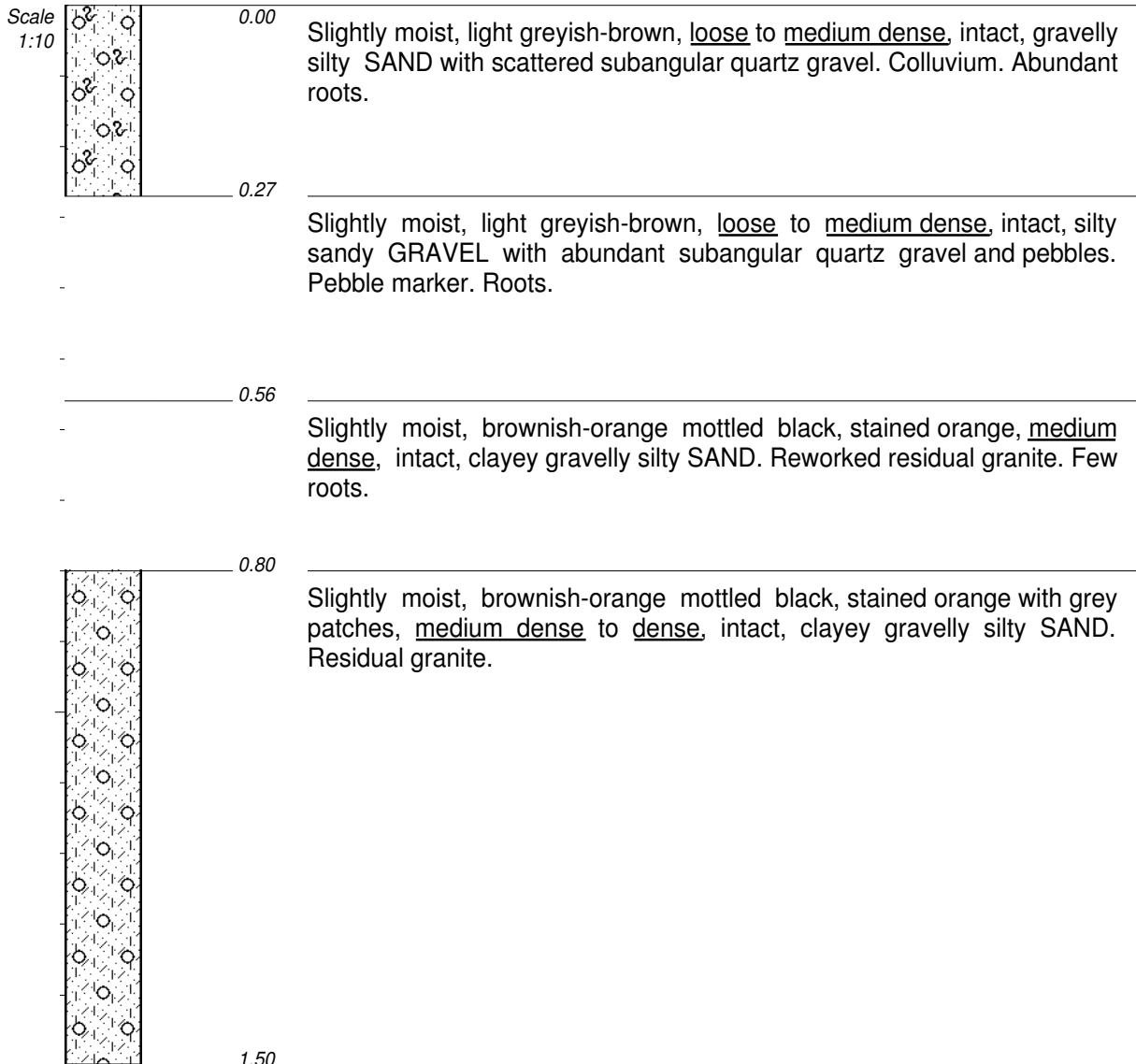
ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS010

Waterval 5IR zone4

HOLE No: GPS011
Sheet 1 of 1

JOB NUMBER: 537/4



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:40
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS011

Waterval 5IR zone4

HOLE No: GPS012

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10

0.00

Slightly moist, light greyish-brown, loose to medium dense, intact, gravelly silty SAND with scattered quartz gravel. Colluvium. Abundant roots.

0.10

Slightly moist, light greyish-brown, loose to medium dense, intact, silty sandy GRAVEL with abundant quartz gravel and pebbles. Pebble marker. Roots.

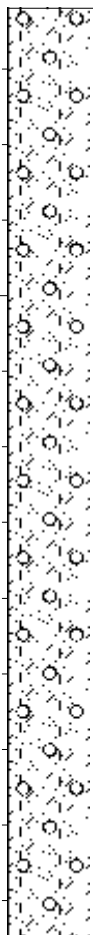
0.30

Slightly moist, light orange-brown with grey vertical weathering zones, medium dense, intact, gravelly silty SAND. Reworked residual granite. Roots.

0.62

Slightly moist, brownish-orange, speckled light yellow, medium dense to dense, jointed with black joint stainings, clayey gravelly silty SAND. Residual granite.

0.80m--1.00m



1.85

NOTES

- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,80m--1,00m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:40
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS012

Waterval 5IR zone4

HOLE No: GPS013

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10

0.00

Slightly moist, light greyish-brown, medium dense, intact, gravelly silty SAND with scattered quartz gravel. Colluvium. Abundant roots.

0.40

Slightly moist, light greyish-brown, medium dense, intact, silty sandy GRAVEL with abundant quartz gravel and pebbles. Pebble marker. Roots.

0.66

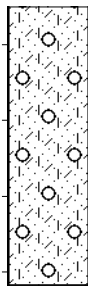
Slightly moist, light brownish grey mottled orange and black, medium dense to dense, intact, gravelly clayey silty SAND. Pinholed. Reworked residual granite.

0.70m--1.00m

1.15

Slightly moist, brownish-orange stained black, medium dense to dense, jointed, gravelly clayey silty SAND. Residual granite.

1.52



NOTES

- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,70m--1,00m.
- 4) Undisturbed sample between 0,70m--1,00m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

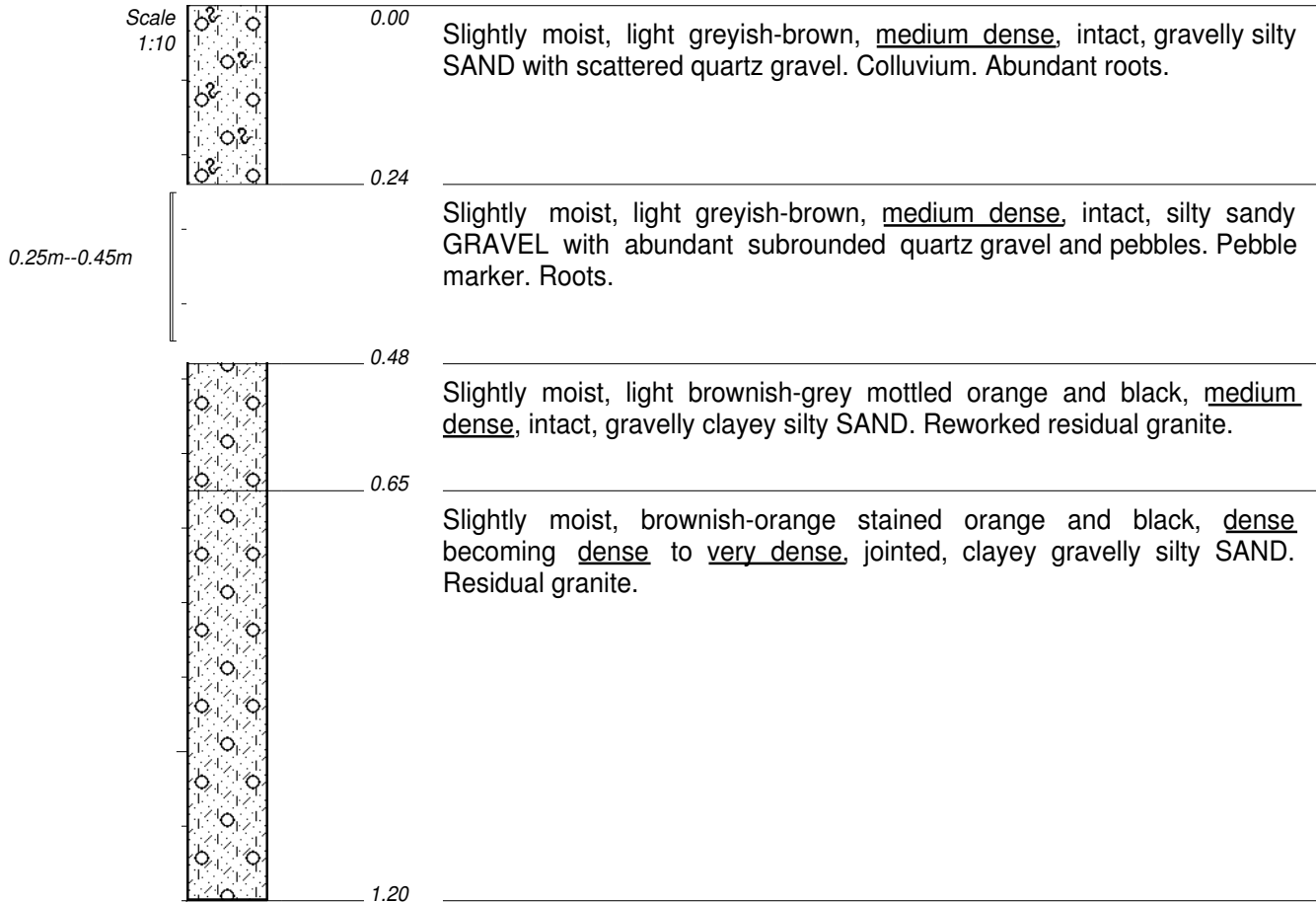
ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS013

Waterval 5IR zone4

HOLE No: GPS014
Sheet 1 of 1

JOB NUMBER: 537/4



NOTES

- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,25m--0,45m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

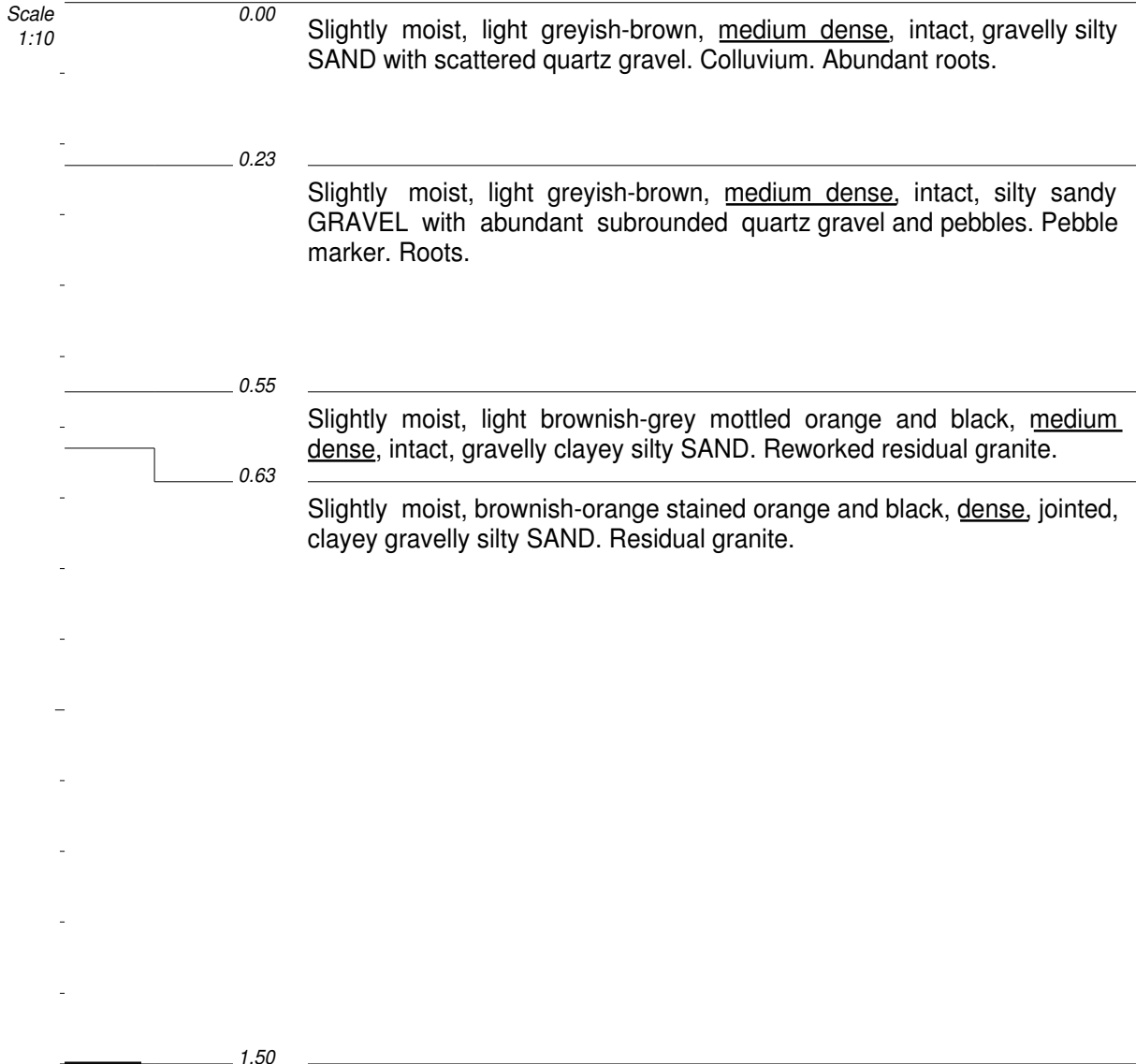
HOLE No: GPS014

Waterval 5IR zone4

HOLE No: GPS015

Sheet 1 of 1

JOB NUMBER: 537/4



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

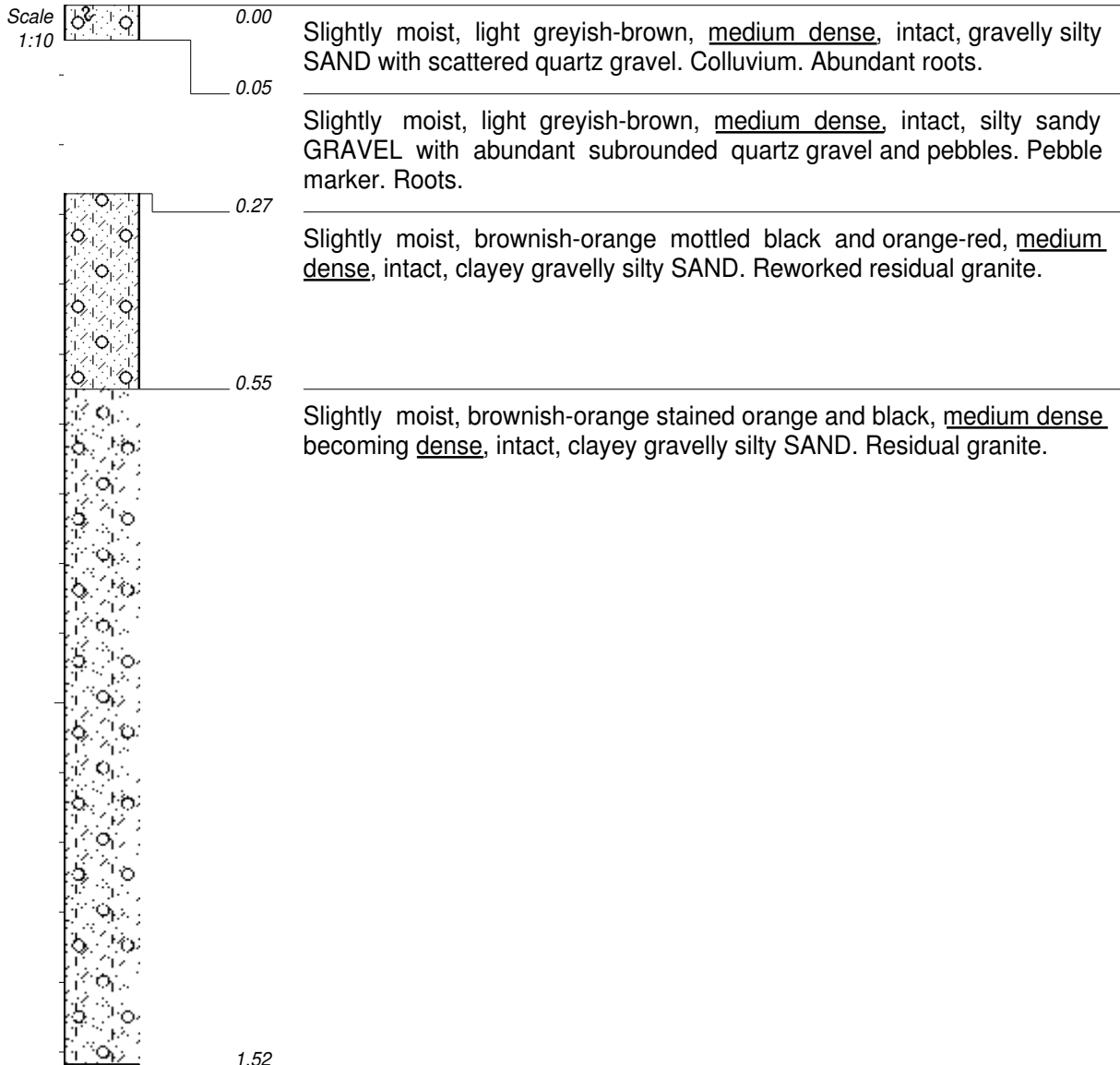
HOLE No: GPS015

Waterval 5IR zone4

HOLE No: GPS016

Sheet 1 of 1

JOB NUMBER: 537/4



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

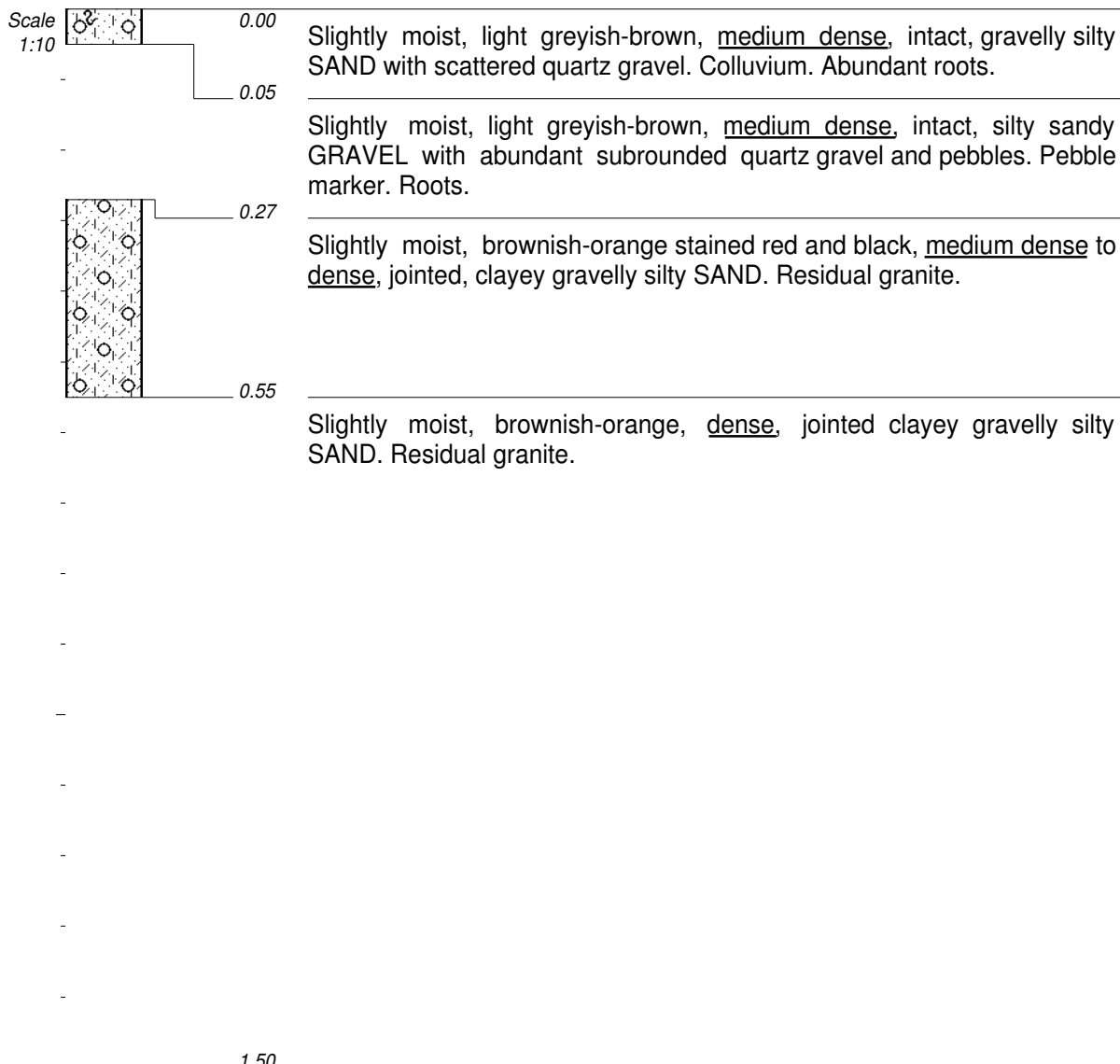
ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS016

Waterval 5IR zone4

HOLE No: GPS017
Sheet 1 of 1

JOB NUMBER: 537/4



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS017

Waterval 5IR zone4

HOLE No: GPS018

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10



0.00

Slightly moist, light brownish-grey, loose, intact, gravelly silty SAND with scattered quartz gravel. Colluvium. Abundant roots.

0.15

Slightly moist, light brownish-grey slightly stained and scattered mottled orange, medium dense, intact, silty SAND. Colluvium. Roots.

0.75

Slightly moist, brownih-orange mottled black with grey patches, very dense, intact, highly ferruginised colluvium and pebblesmarker.

0.85

NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS018

Waterval 5IR zone4

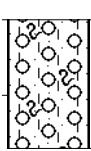
HOLE No: GPS019

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10

0.00 Slightly moist, light greyish-brown, medium dense, intact, gravelly silty SAND with scattered quartz gravel. Colluvium. Abundant roots.



0.20 Slightly moist, light greyish-brown, medium dense, intact, silty sandy GRAVEL with abundant subrounded quartz gravel and pebbles. Pebble marker. Roots.

0.37 Slightly moist, light orange-brown stained orange scattered mottled black and orange, medium dense, intact, clayey gravelly silty SAND. Reworked residual granite. Few roots.

0.82 Slightly moist, brownish-orange slightly stained orange and black, medium dense to dense, intact, clayey gravelly silty SAND. Residual granite.

1.96

NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
 MACHINE :
 DRILLED BY :
 PROFILED BY : D.H. Wessels
 TYPE SET BY :
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE :
 DATE :
 DATE : 01/08/05 17:41
 TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
 X-COORD :
 Y-COORD :

HOLE No: GPS019

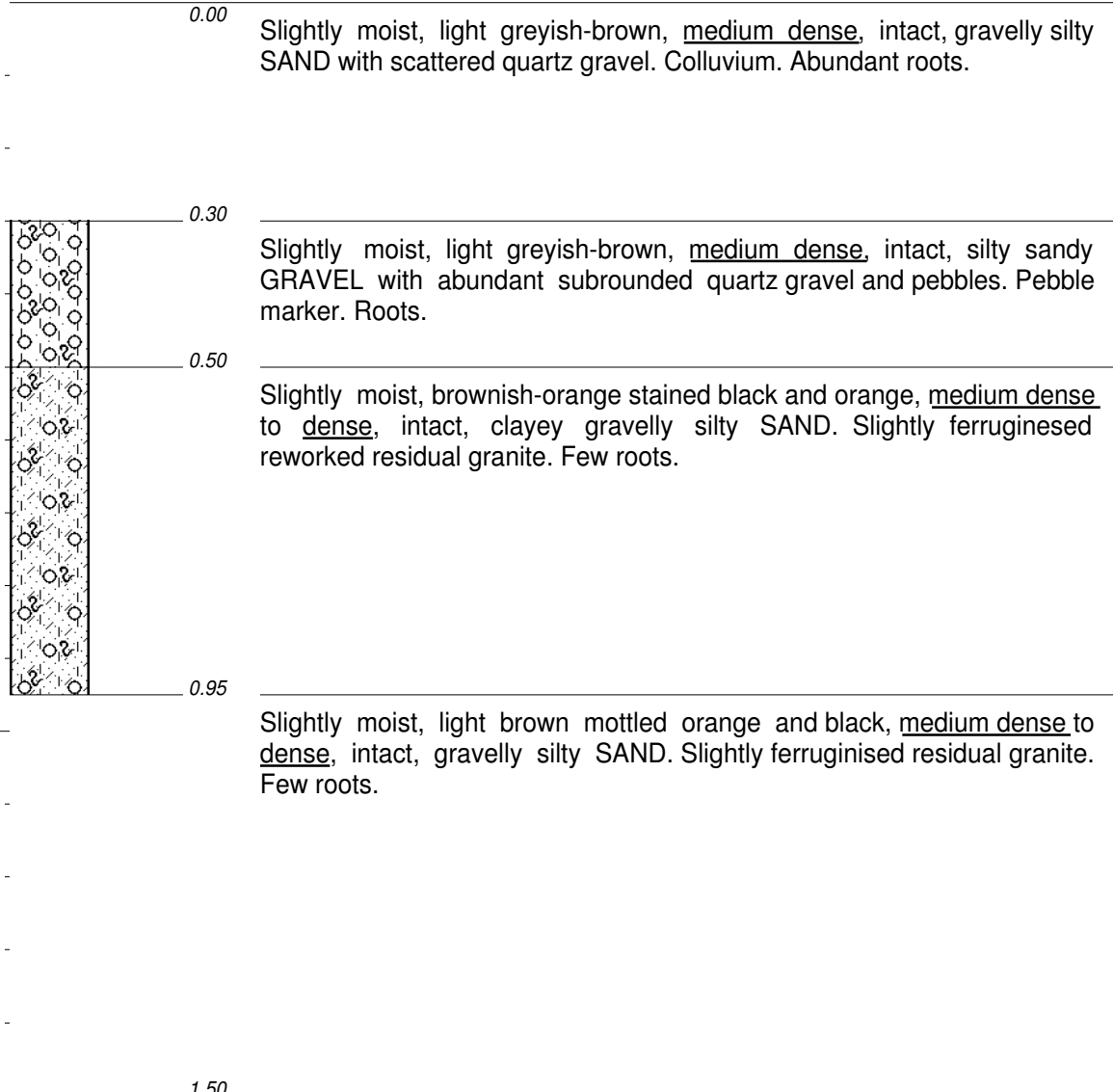
Waterval 5IR zone4

HOLE No: GPS020

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10



NOTES

- 1) Near refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS020

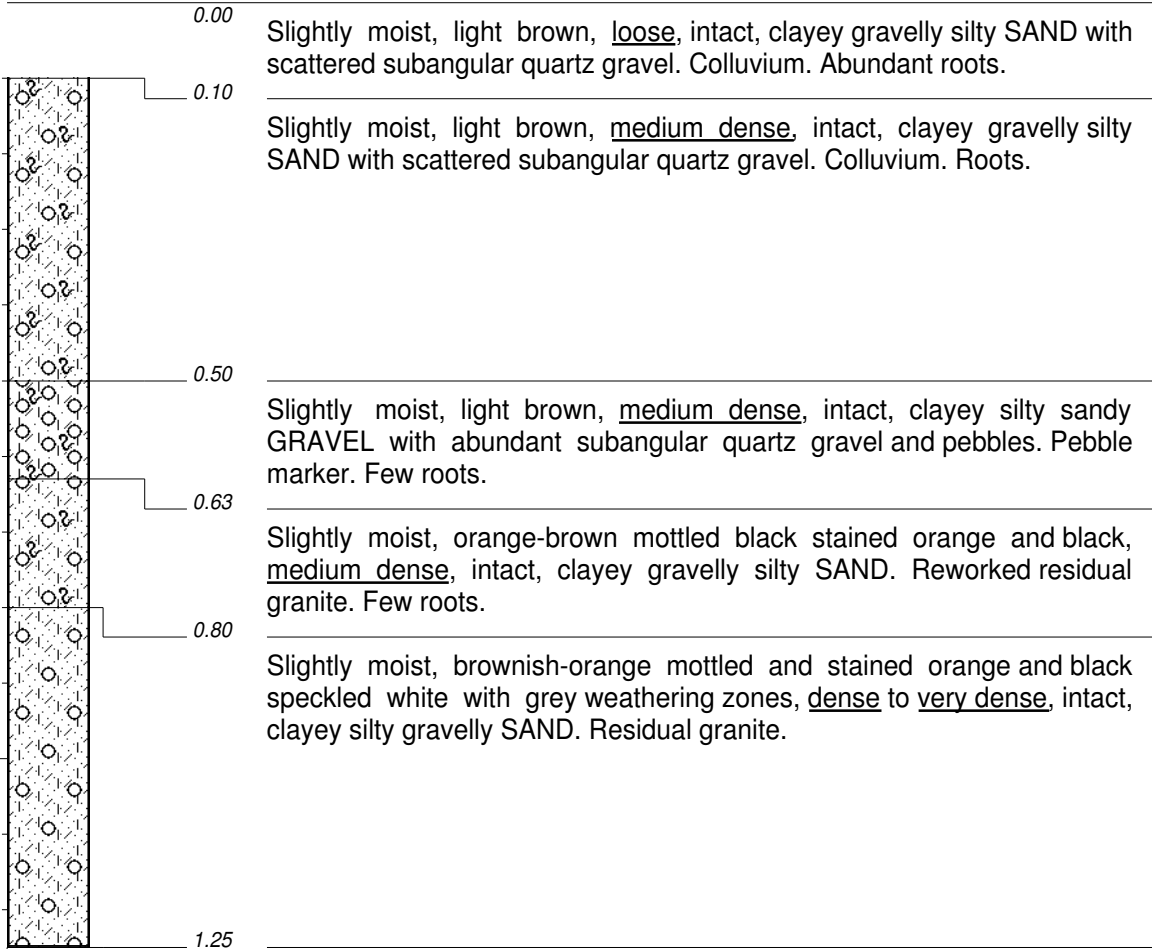
Waterval 5IR zone4

HOLE No: GPS021

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS021

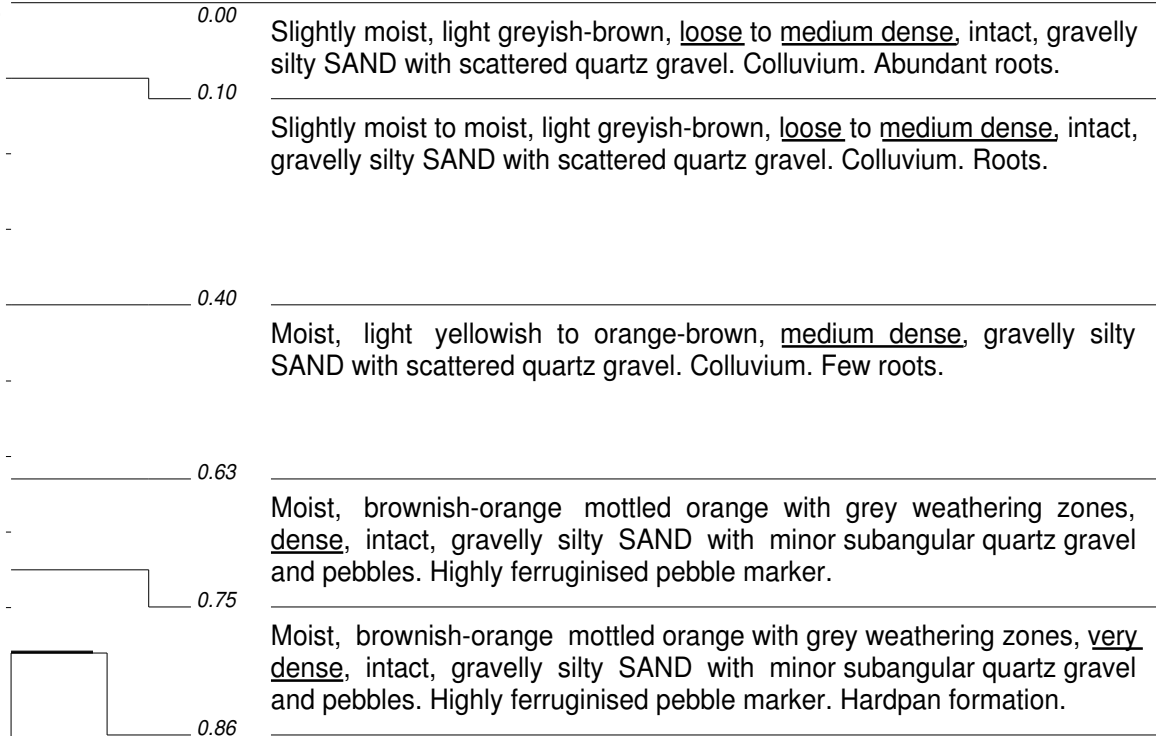
Waterval 5IR zone4

HOLE No: GPS022

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10



NOTES

- 1) Refusal on hardpan formation.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS022

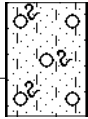
Waterval 5IR zone4

HOLE No: GPS023

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10



0.00

Slightly moist, brownish-grey, medium dense, intact, gravelly silty SAND with scattered quartz gravel. Colluvium. Abundant roots.

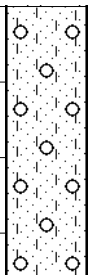
0.15

Slightly moist, brownish-grey, medium dense, intact, silty sandy GRAVEL with abundant subrounded quartz gravel and pebbles. Pebble marker. Roots.

0.35

Slightly moist, orange-brown stained orange scattered mottled black and orange, medium dense, intact, silty gravelly SAND with vertical grey weathering zones. Reworked residual granite. Few roots.

0.60



0.96

Slightly moist, orange-brown slightly stained orange-red and streaked black, dense becoming dense to very dense, intact, silty gravelly SAND with black and orange-red joint stainings. Residual granite.

NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

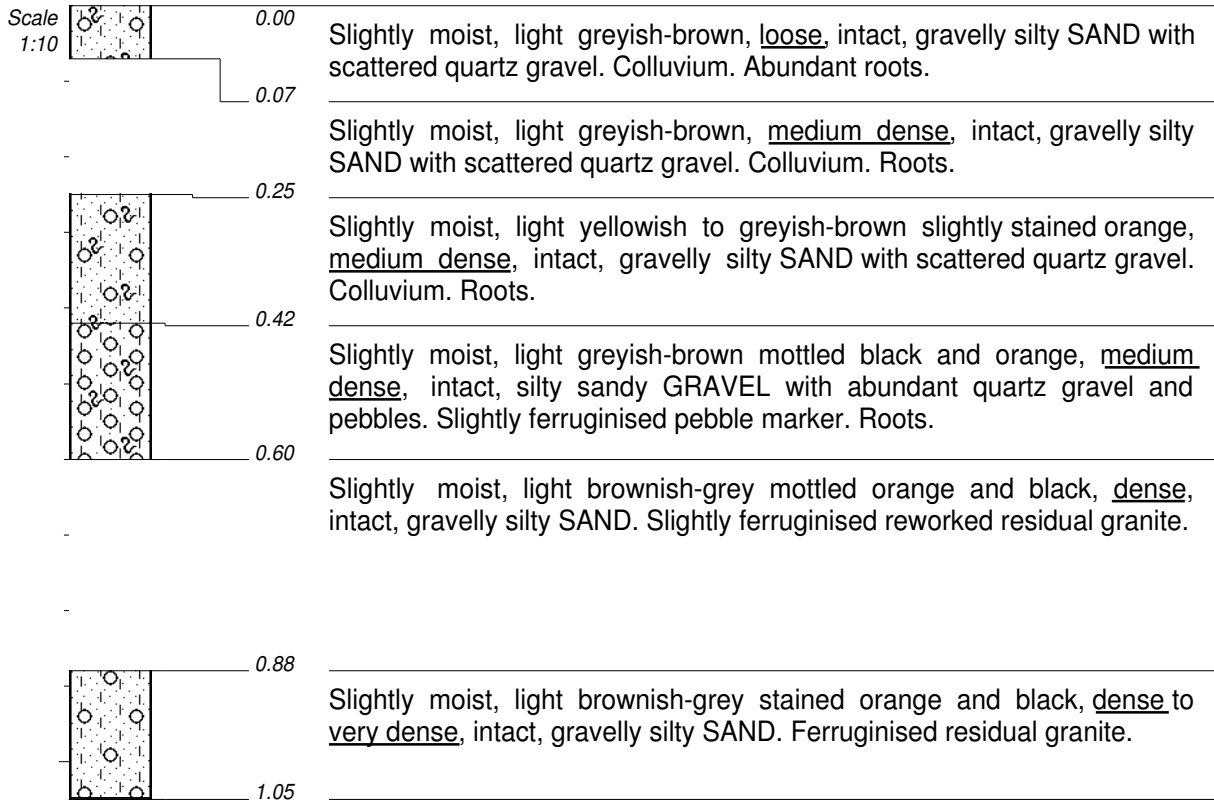
ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS023

Waterval 5IR zone4

HOLE No: GPS024
Sheet 1 of 1

JOB NUMBER: 537/4



NOTES

- 1) Near refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS024

Waterval 5IR zone4

HOLE No: GPS025

Sheet 1 of 1

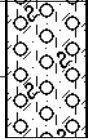
JOB NUMBER: 537/4

Scale
1:10

0.00

Slightly moist, grey, medium dense, intact, clayey gravelly silty SAND with scattered subangular quartz gravel. Colluvium. Roots.

0.30



Slightly moist, grey slightly stained and scattered mottled orange, medium dense, intact, clayey silty sandy GRAVEL with abundant subangular quartz gravel and pebbles. Pebble marker. Roots.

0.48

Slightly moist, greyish-orange-brown, mottled orange with grey patches, dense, intact, clayey silty SAND. Residual granite.

1.10

NOTES

- 1) Near refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

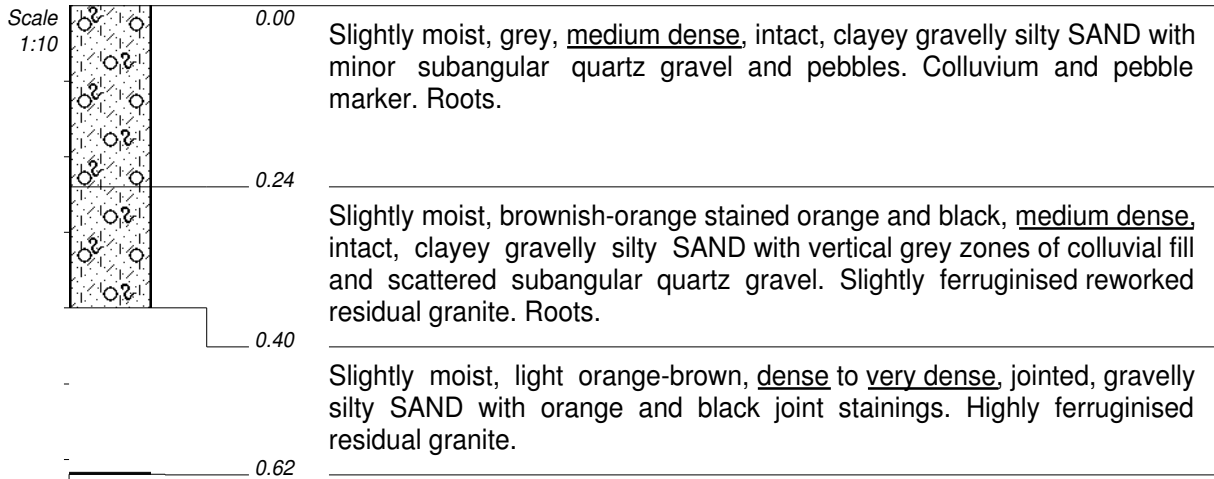
HOLE No: GPS025

Waterval 5IR zone4

HOLE No: GPS026

Sheet 1 of 1

JOB NUMBER: 537/4



NOTES

- 1) Gradual refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

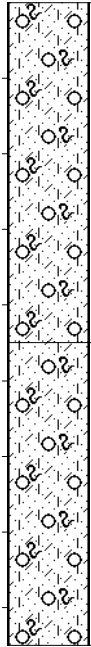
HOLE No: GPS026

Waterval 5IR zone4

HOLE No: GPS027
Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10



0.00

Slightly moist, grey-brown, medium dense, intact, clayey gravelly silty SAND with minor subangular quartz gravel and pebbles. Colluvium and pebble marker. Roots.

0.45

Slightly moist, light orange-brown, mottled black and stained orange, medium dense to dense, intact, gravelly clayey silty SAND. Slightly pinholed. Slightly ferruginised reworked residual granite. Few roots.

0.85

Slightly moist, brownish-orange speckled white streaked black and slightly stained orange and black, dense, jointed, clayey gravelly silty SAND. Residual granite.

1.80

NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS027

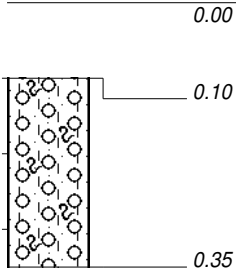
Waterval 5IR zone4

HOLE No: GPS028

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10



Slightly moist, light greyish-brown, medium dense, intact, gravelly silty SAND with scattered quartz gravel. Colluvium. Abundant roots.

Slightly moist, light greyish-brown, medium dense, intact, silty sandy GRAVEL with abundant subangular quartz gravel and pebbles. Pebble marker. Roots.

Slightly moist, greyish-brown mottled black and orange, stained orange, medium dense, intact, gravelly clayey silty SAND. Pinholed. Reworked residual granite.

Slightly moist, brownish-orange slightly stained orange and black, medium dense to dense, intact, clayey gravelly silty SAND. Residual granite.

NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
 MACHINE :
 DRILLED BY :
 PROFILED BY : D.H. Wessels
 TYPE SET BY :
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE :
 DATE :
 DATE : 01/08/05 17:41
 TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
 X-COORD :
 Y-COORD :

HOLE No: GPS028

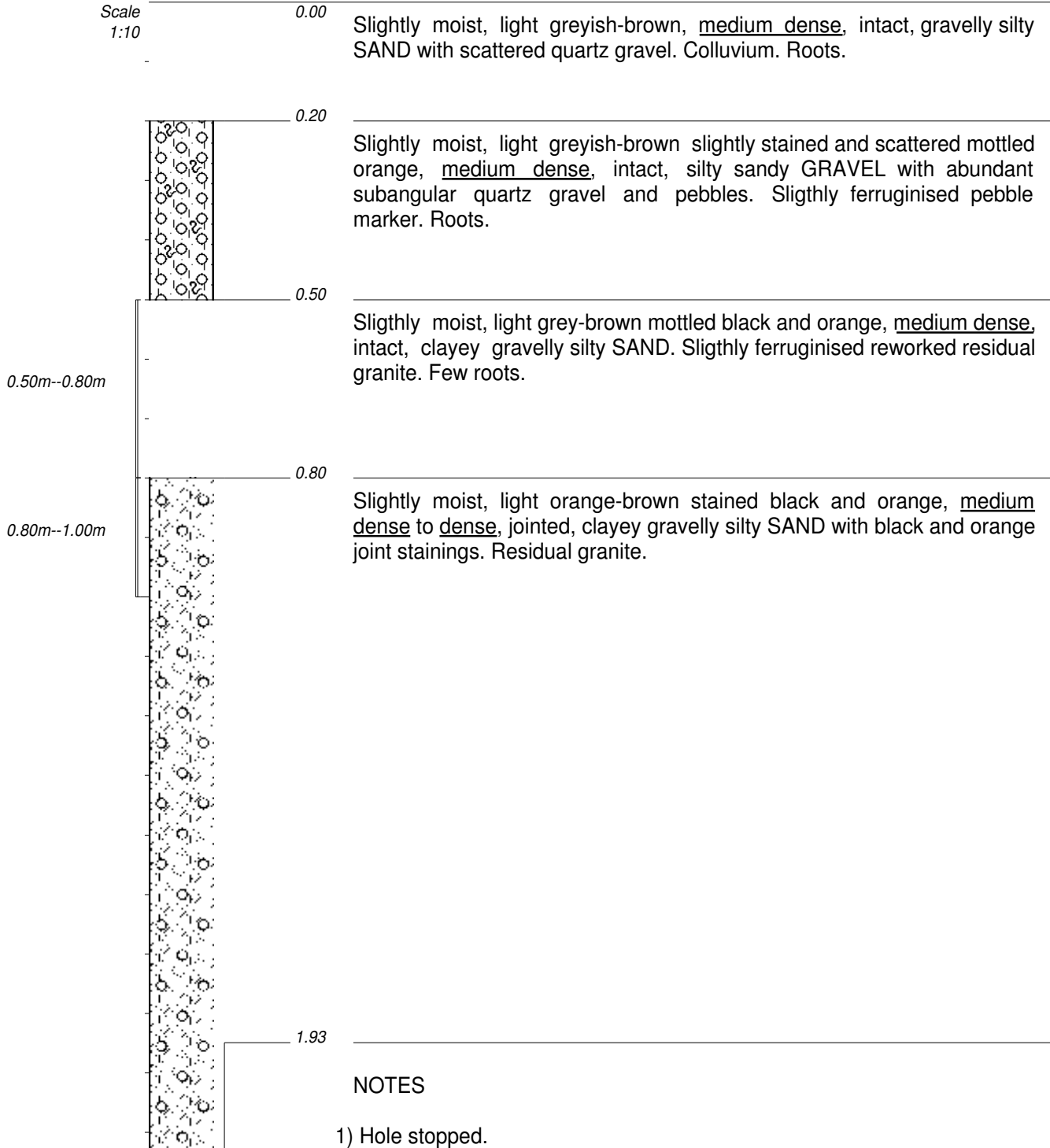
Waterval 5IR zone4

HOLE No: GPS029

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10



NOTES

- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,50m--0,80m.
- 4) Disturbed sample between 0,80m--1,00m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS029

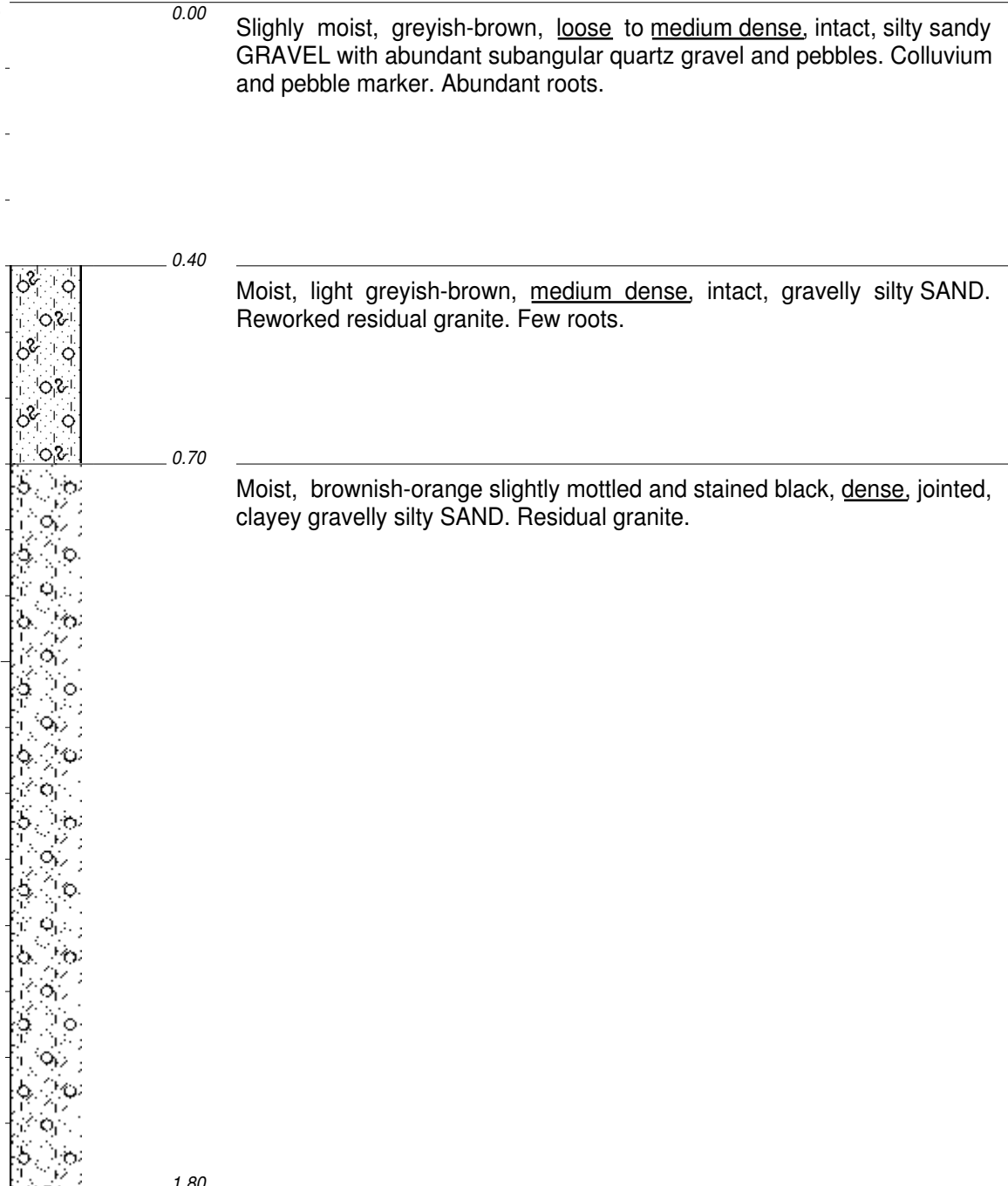
Waterval 5IR zone4

HOLE No: GPS030

Sheet 1 of 1

JOB NUMBER: 537/4

Scale
1:10



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

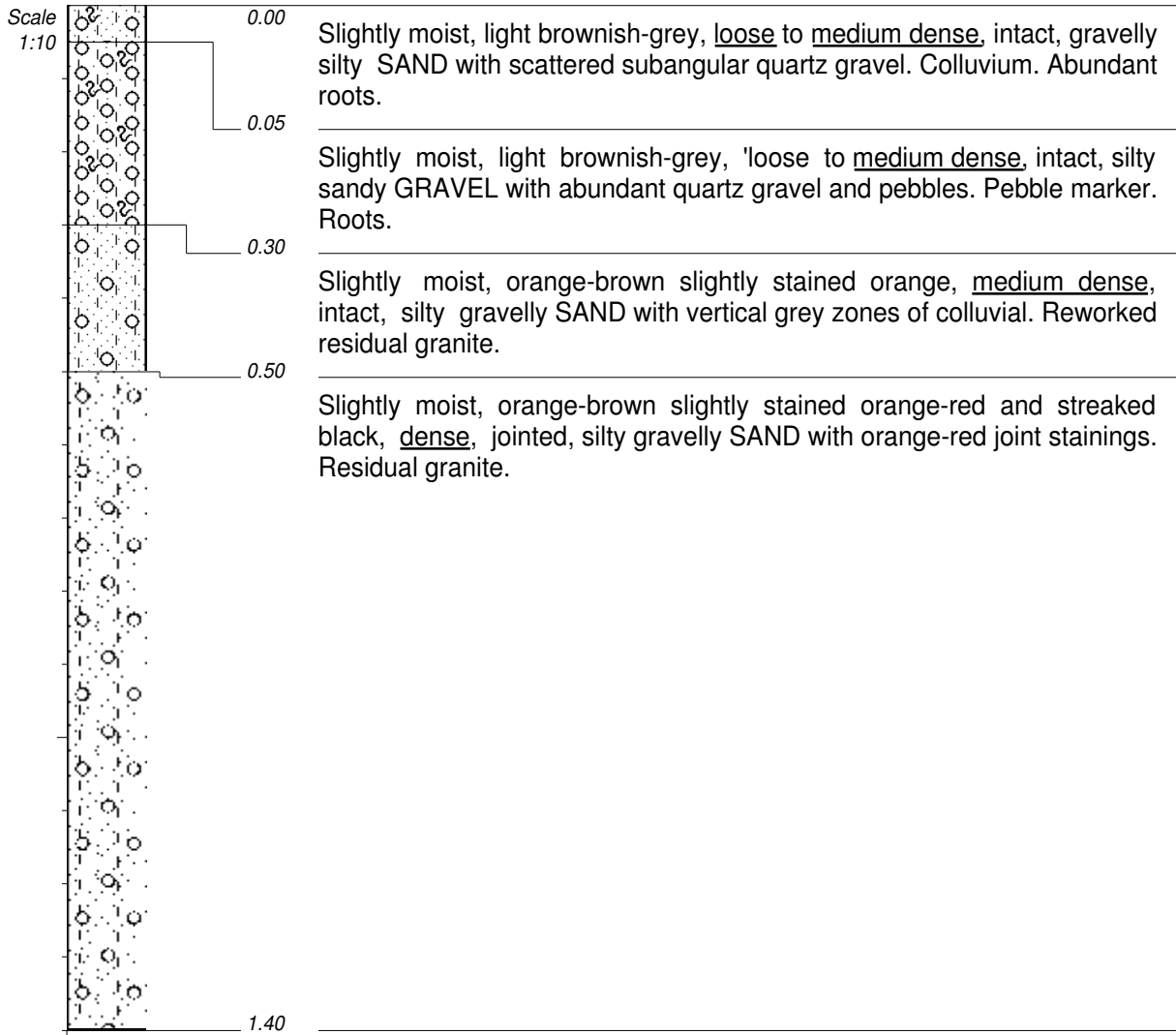
ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS030

Waterval 5IR zone4

HOLE No: GPS031
Sheet 1 of 1

JOB NUMBER: 537/4



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE4.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS031

Scale
1:10



0.00

Slightly moist, light brown, loose, intact, gravelly silty SAND with scattered quartz gravel. Colluvium. Roots.

0.57

Slightly moist, light brown mottled orange and black, loose, intact, gravelly silty SAND with abundant Fe and Mn concretions and scattered quartz gravel. Ferruginised colluvium. Roots.

0.64

Slightly moist, brownish-orange mottled and stained black and orange, very dense, intact highly ferruginised colluvium and pebble marker. Hardpan formation.

0.70

NOTES

- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,00m--0,55m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

0.00 Slightly moist, light brown, loose, intact, gravelly silty SAND with scattered quartz gravel. Colluvium. Roots.

0.30 Slightly moist, light brown, medium dense, intact, silty sandy GRAVEL with abundant subrounded quartz gravel and pebbles. Pebble marker. Roots.

0.40 Slightly moist, brownish-orange mottled black and stained orange, medium dense, intact, gravelly clayey silty SAND. Slightly ferruginised reworked residual granite. Few roots.

1.50 Slightly moist, brownish-orange mottled and streaked black, dense, intact, clayey gravelly silty SAND. Residual granite.

1.83

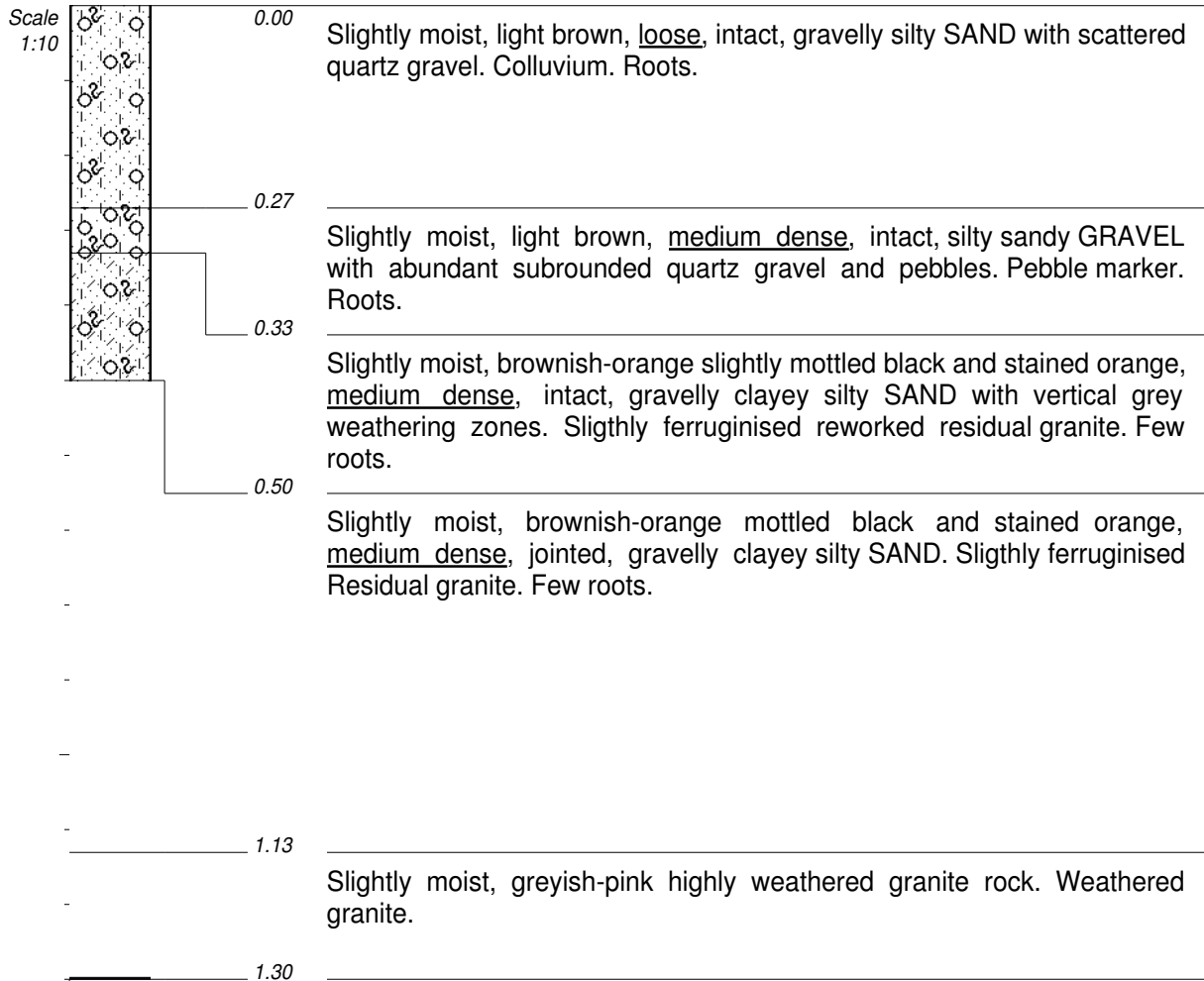
NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :



NOTES

- 1) Refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale 1:10
0.00

Slightly moist, light brown, loose to medium dense, intact, gravelly silty SAND with scattered subangular quartz gravel. Colluvium. Roots.

0.20

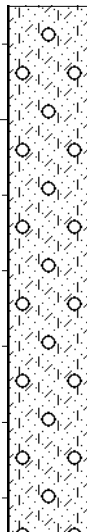
Slightly moist, light brown mottled orange and black, medium dense, intact, silty sandy GRAVEL with abundant subangular quartz gravel and pebbles. Pebble marker. Roots.

0.43

Moist, orange-brown mottled orange and black stained orange with grey patches, medium dense, intact, gravelly silty SAND. Reworked residual granite. Few roots.

0.50m--0.80m

0.85



Moist, brownish-orange stained orange with grey patches, medium dense to dense, intact, gravelly clayey silty SAND. Residual granite.

1.55

NOTES

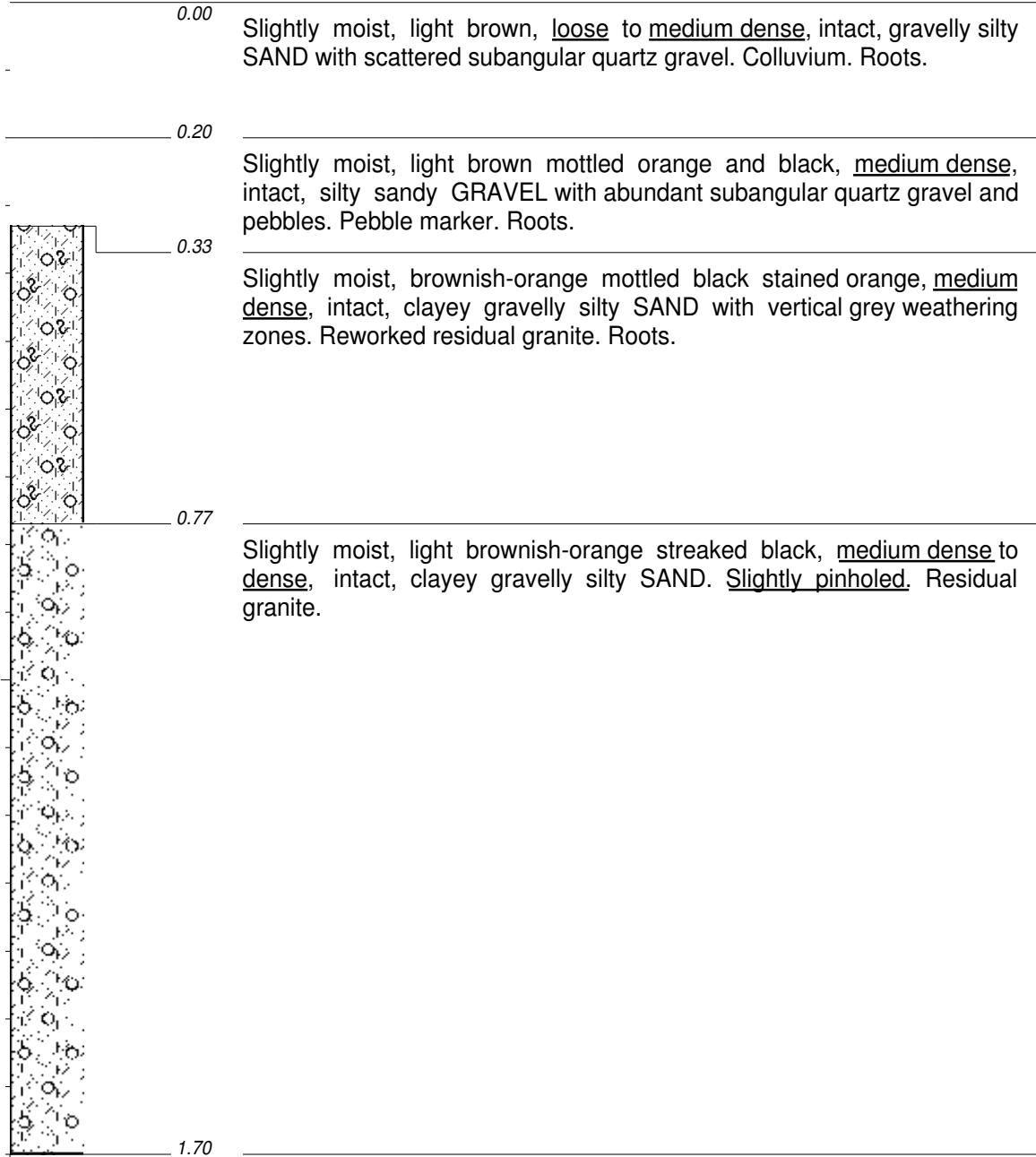
- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,50m--0,80m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

- 1) Hole stopped.
- 2) No seepage.

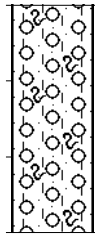
CONTRACTOR :
 MACHINE :
 DRILLED BY :
 PROFILED BY : D.H. Wessels
 TYPE SET BY :
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE :
 DATE :
 DATE : 01/08/05 17:41
 TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
 X-COORD :
 Y-COORD :

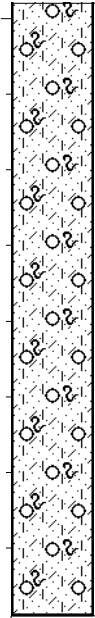
Scale
1:10

0.00 Slightly moist, grey becoming light greyish-brown, loose to medium dense, intact, gravelly silty SAND with scattered subangular quartz gravel. Colluvium. Roots.



0.30 Slightly moist, brown mottled orange and black, medium dense, intact, silty sandy GRAVEL with abundant subangular quartz gravel and pebbles. Pebble marker. Roots.

0.60 Moist, orange-brown mottled red and scattered mottled black, medium dense, intact, gravelly silty SAND. Slightly ferruginised reworked residual granite. Few roots.



0.98 Slightly moist, light brownish-orange stained and mottled orange, streaked black, dense, intact, clayey gravelly silty SAND. Residual granite. Few roots.

1.79

NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
 MACHINE :
 DRILLED BY :
 PROFILED BY : D.H. Wessels
 TYPE SET BY :
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE :
 DATE :
 DATE : 01/08/05 17:41
 TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
 X-COORD :
 Y-COORD :

Scale
1:10

0.00

Slightly moist, brownish-grey, loose to medium dense, intact, gravelly silty SAND with scattered subangular quartz gravel. Colluvium. Abundant roots.

0.20

Slightly moist, greyish-brown, medium dense, intact, silty sandy GRAVEL with abundant subangular quartz gravel and pebbles. Pebble marker. Roots.

0.67

Moist, brownish-orange mottled black and orange, stained orange and grey, medium dense, intact, gravelly clayey silty SAND. Reworked residual granite. Few roots.

0.70m--1.10m

1.70

Slightly moist to moist, brownish-orange, medium dense to dense, intact, clayey silty SAND with black joint stainings. Residual granite.

2.15

NOTES

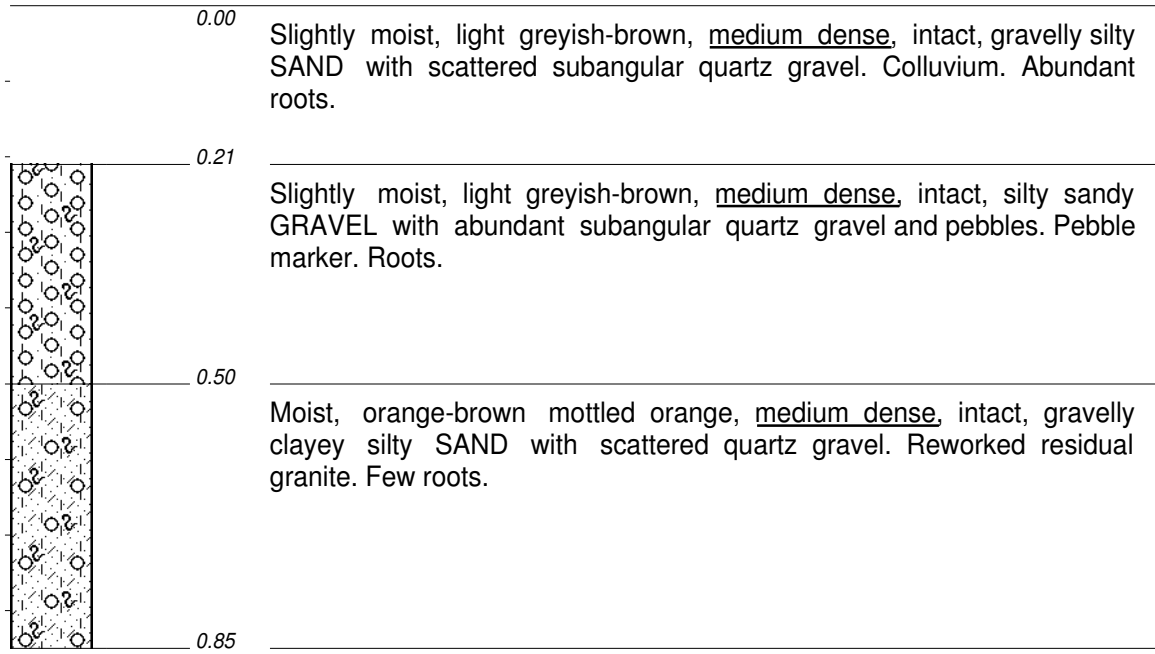
- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,70m--1,10m.

CONTRACTOR :
 MACHINE :
 DRILLED BY :
 PROFILED BY : D.H. Wessels
 TYPE SET BY :
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE :
 DATE :
 DATE : 01/08/05 17:41
 TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
 X-COORD :
 Y-COORD :

Scale
1:10



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS042

Sheet 1 of 1

JOB NUMBER: 537/6

Scale
1:10

0.00

Slightly moist, light greyish-brown, medium dense, intact, gravelly clayey silty SAND with scattered subangular quartz gravel. Colluvium. Abundant roots.

0.30

Slightly moist, light greyish-brown mottled black and orange, medium dense, intact, clayey silty sandy GRAVEL with major quartz gravel and pebbles and Fe and Mn concretions. Highly ferruginised pebble marker and reworked residual granite. Roots.

0.83

Slightly moist, brownish-orange mottled black, stained orange and grey, dense, intact, gravelly clayey silty SAND. Highly ferruginised residual granite.

1.40

NOTES

- 1) Gradual refusal.
- 2) No seepage.

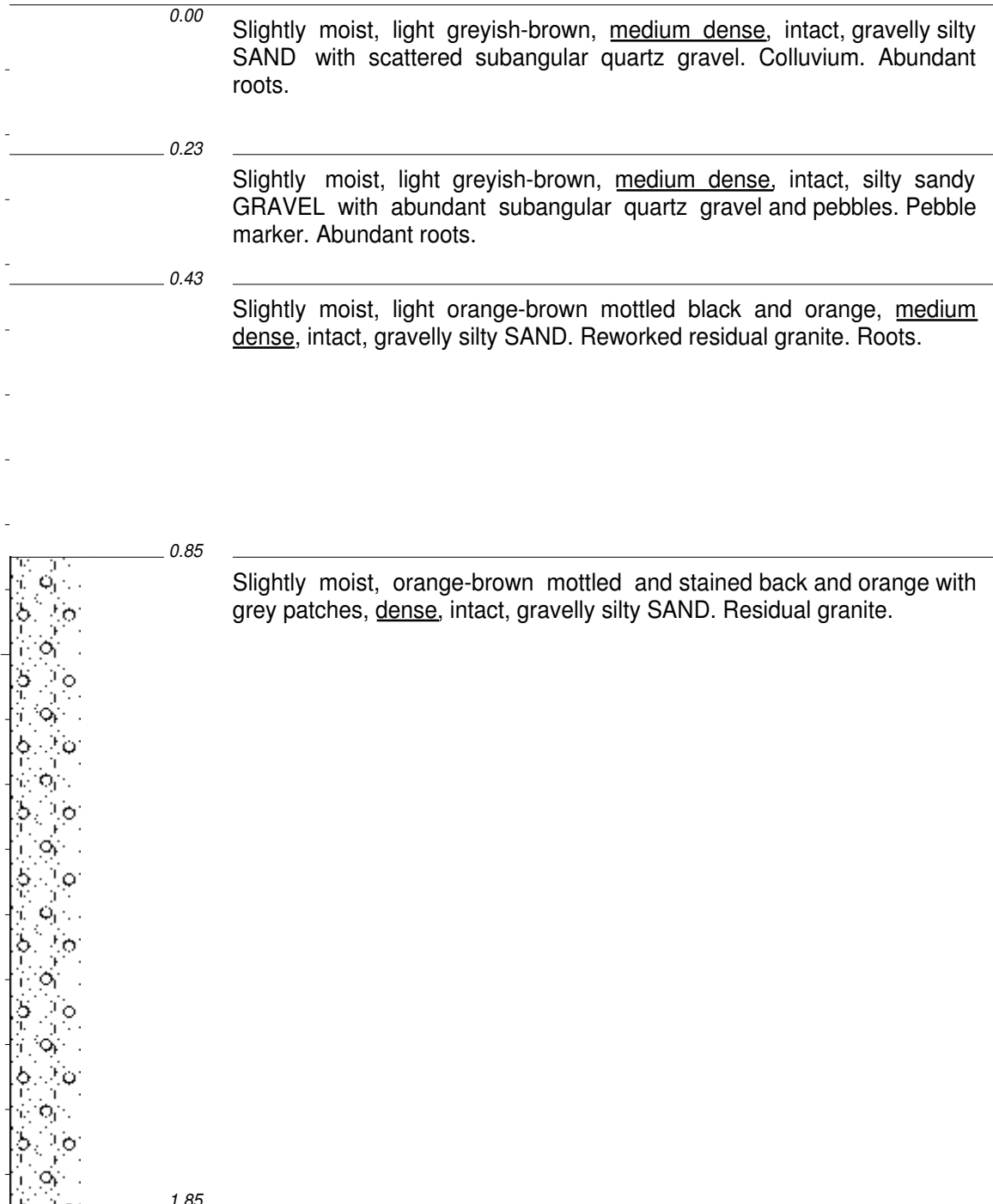
CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS042

Scale
1:10



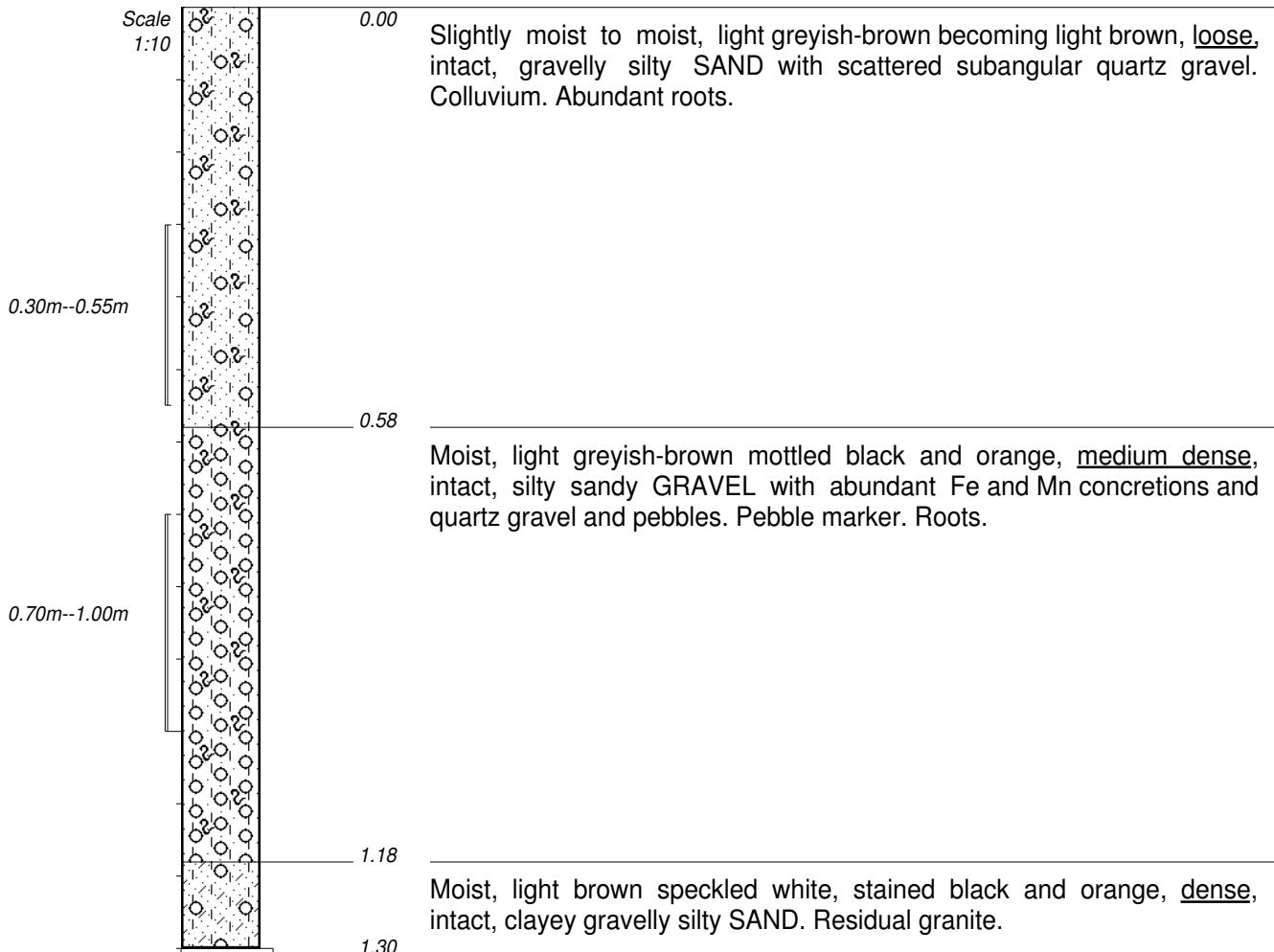
NOTES

- 1) Gradual refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :



NOTES

- 1) Near refusal.
- 2) No seepage.
- 3) Disturbed sample between 0,30m--0,55m.
- 4) Disturbed sample between 0,70m--1,00m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



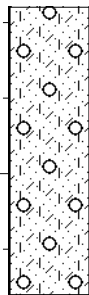
0.00

Slightly moist, greyish-brown, medium dense, intact, gravelly silty SAND with scattered subangular quartz gravel. Colluvium. Abundant roots.

0.50

Slightly moist, orange-brown scattered mottled black, medium dense, intact, silty sandy GRAVEL with abundant quartz gravel and pebbles. Pebble marker. Roots.

0.78



Slightly moist, light orange-brown mottled orange and black, medium dense, intact, clayey gravelly silty SAND. Reworked residual granite.

1.16

Slightly moist, light pinkish-orange, dense, intact, gravelly silty SAND. Residual granite.

1.80

NOTES

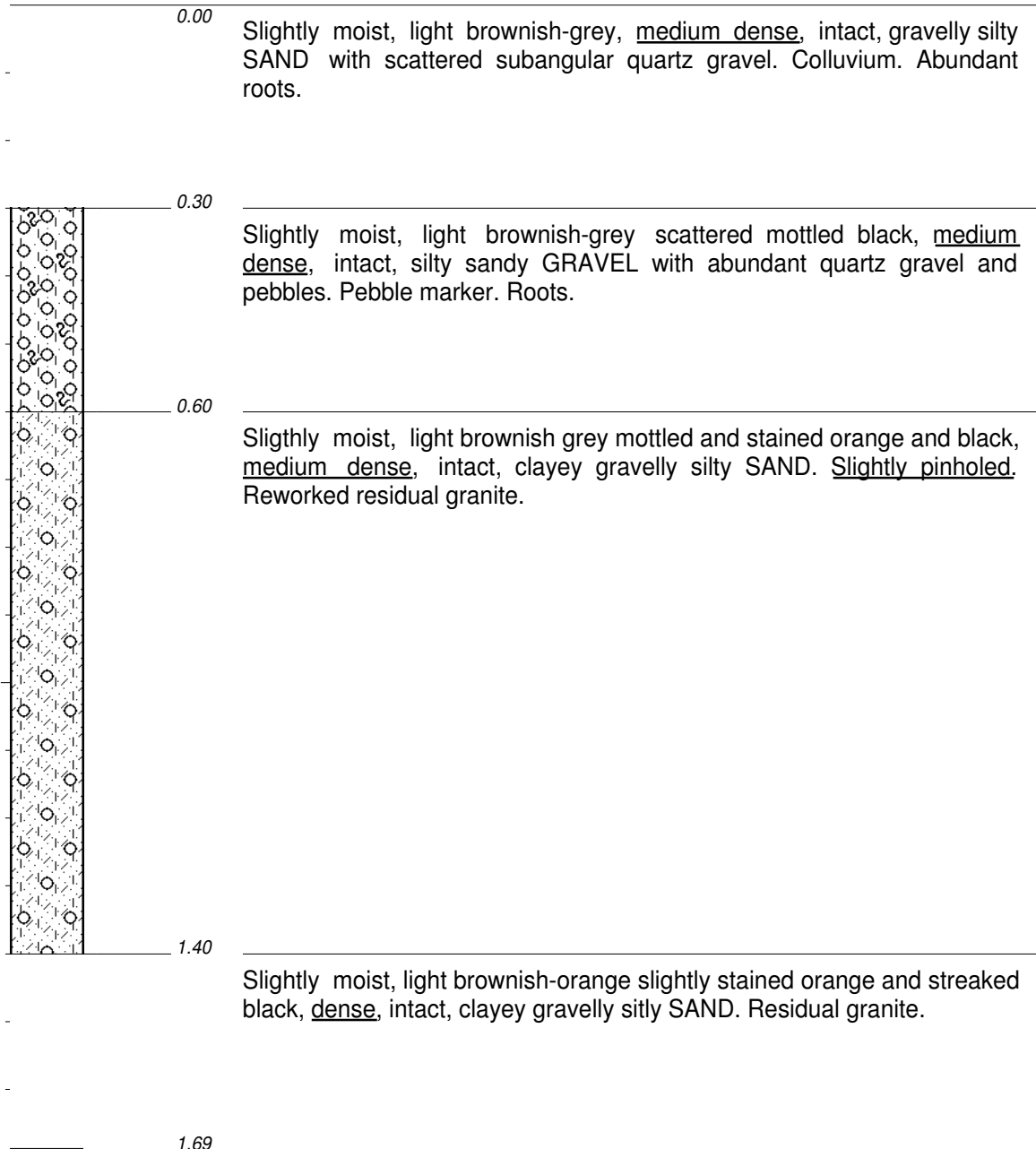
- 1) Near refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

0.00 Slightly moist, greyish-brown becoming orange-brown, loose to medium dense, intact, gravelly clayey silty SAND with scattered subangular quartz gravel. Colluvium. Abundant roots.

0.10 Slightly moist, greyish-brown becoming orange-brown, medium dense, intact, gravelly clayey silty SAND with scattered subangular quartz gravel. Colluvium. Roots.

0.53 Slightly moist, light orange-brown mottled dark purple black with orange rims, stained orange, medium dense, intact, silty sandy GRAVEL with abundant quartz gravel and pebbles and Fe and Mn concretions. Ferruginised reworked pebble marker and residual granite.

1.29 Slightly moist, orange-brown mottled black, stained orange with black streaks, dense, intact, gravelly silty SAND. Residual granite.

1.59

NOTES

1) Hole stopped.

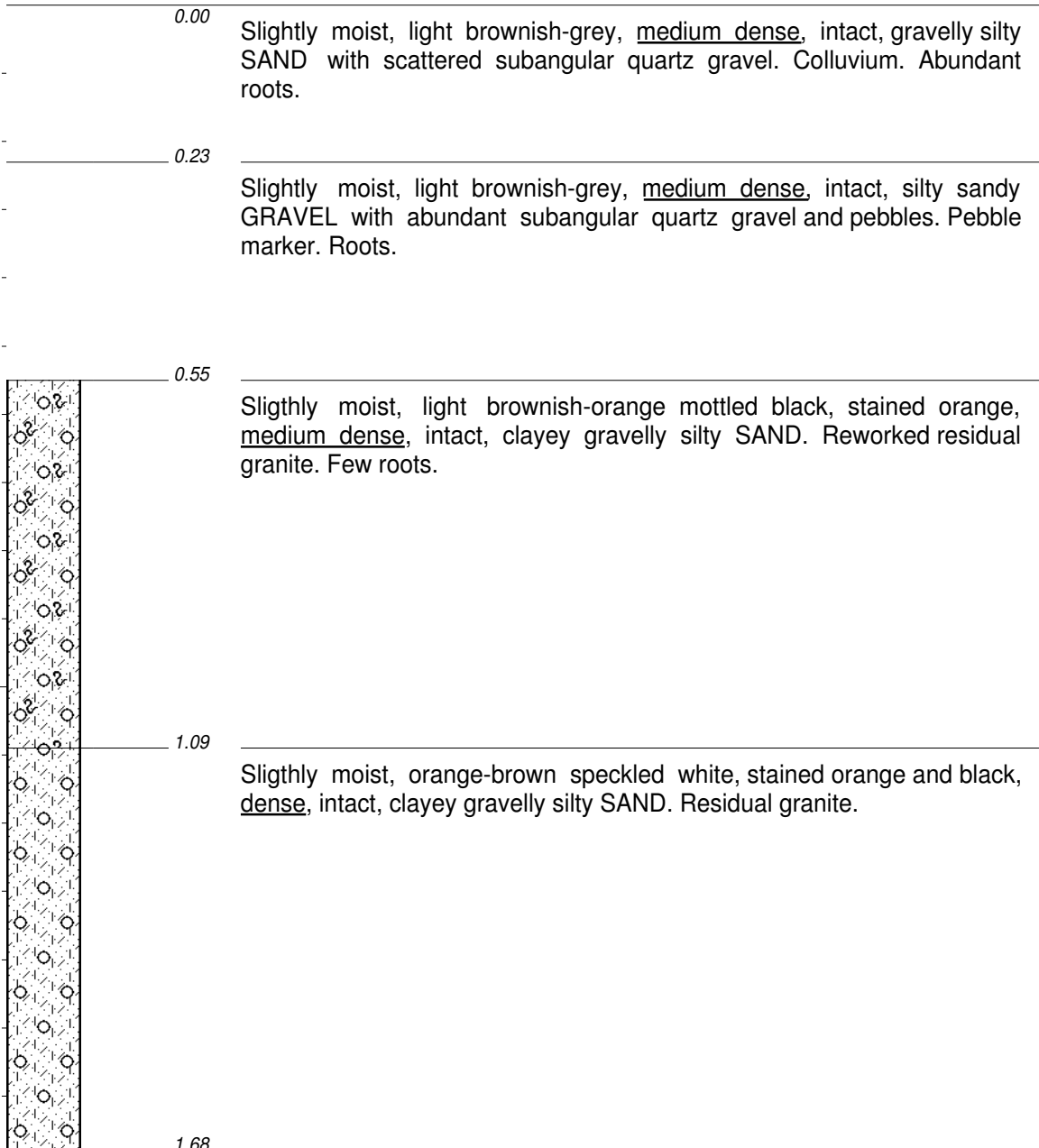
2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



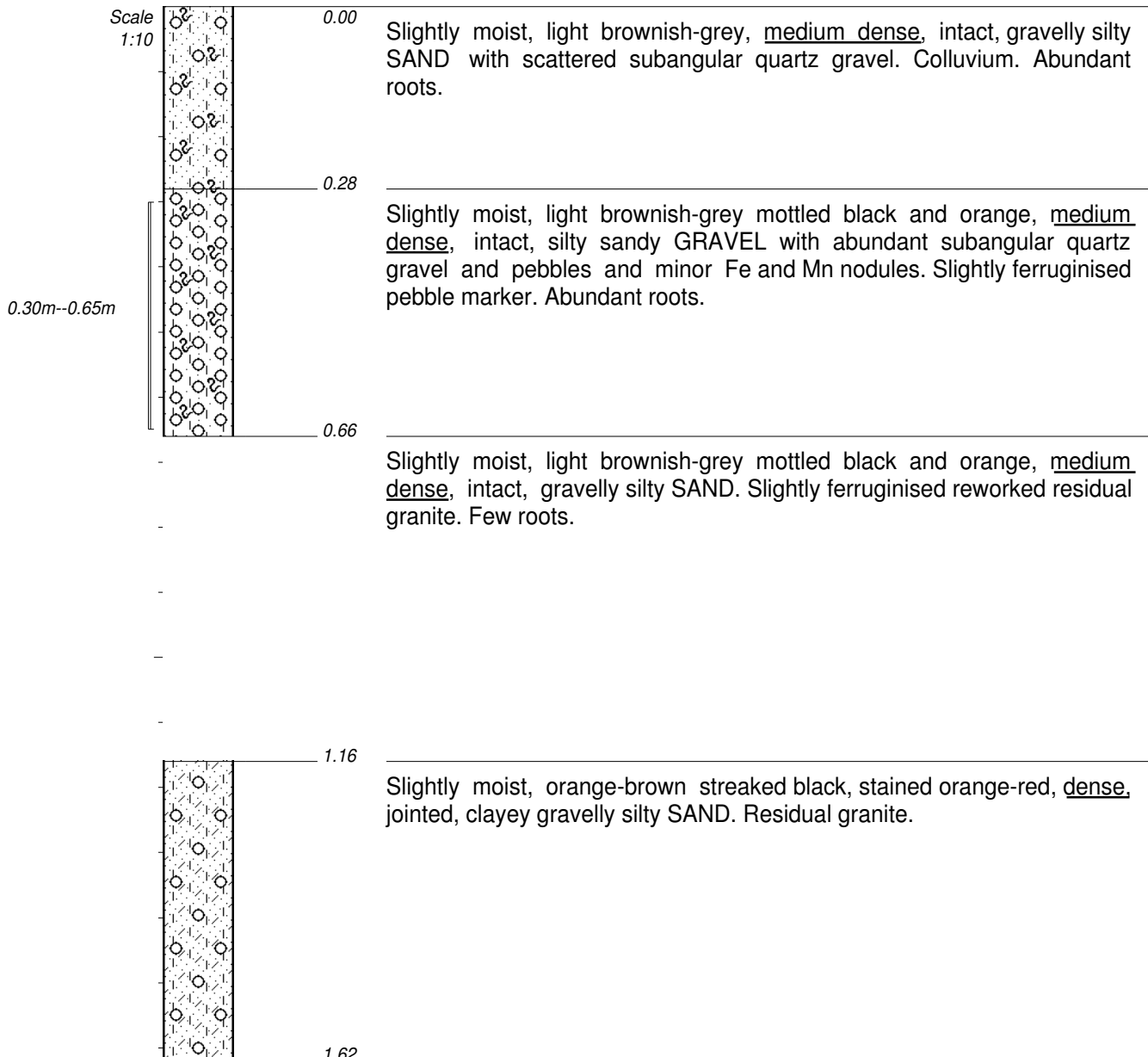
NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :



NOTES

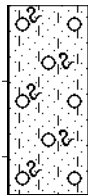
- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,30m--0,65m.

CONTRACTOR :
 MACHINE :
 DRILLED BY :
 PROFILED BY : D.H. Wessels
 TYPE SET BY :
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE :
 DATE :
 DATE : 01/08/05 17:41
 TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
 X-COORD :
 Y-COORD :

Scale
1:10



0.00

Slightly moist, light brownish-grey, loose to medium dense, intact, gravelly silty SAND with scattered subangular quartz gravel. Colluvium. Abundant roots.

0.25

Slightly moist, light brownish-grey mottled black and orange, loose to medium dense, intact, silty sandy GRAVEL with abundant subangular quartz gravel and pebbles. Slightly ferruginised pebble marker. Roots.

0.60

Slightly moist, light greyish-brown stained and mottled orange, scattered mottled black, medium dense, intact, gravelly silty SAND. Reworked residual granite. Few roots.

0.93

Slightly moist, light brownish-grey stained and mottled orange, scattered mottled black, dense, intact, gravelly silty SAND. Residual granite.

1.77

NOTES

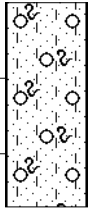
- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



0.00

Slightly moist, light brownish-grey, loose to medium dense, intact, gravelly silty SAND with minor subangular quartz gravel. Colluvium. Anundant roots.

0.27

Slightly moist, light orange-brown stained orange-red and black, medium dense to dense, jointed, clayey gravelly silty SAND. Reworked residual granite. Few roots.

0.82

Slightly moist, light brown, medium dense, jointed, clayey gravelly silty SAND with black joints stainings. Residual granite.

1.55

NOTES

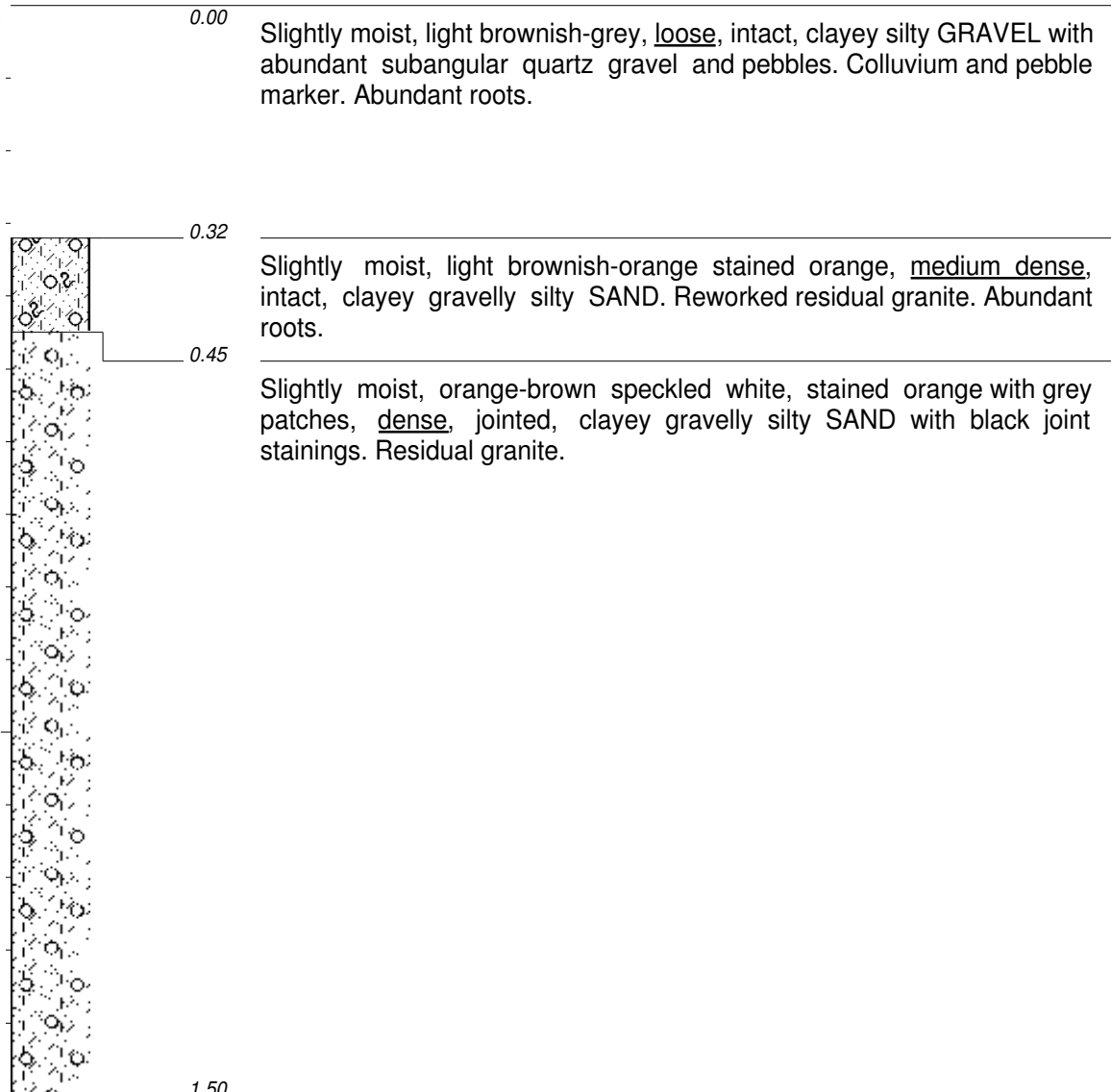
- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

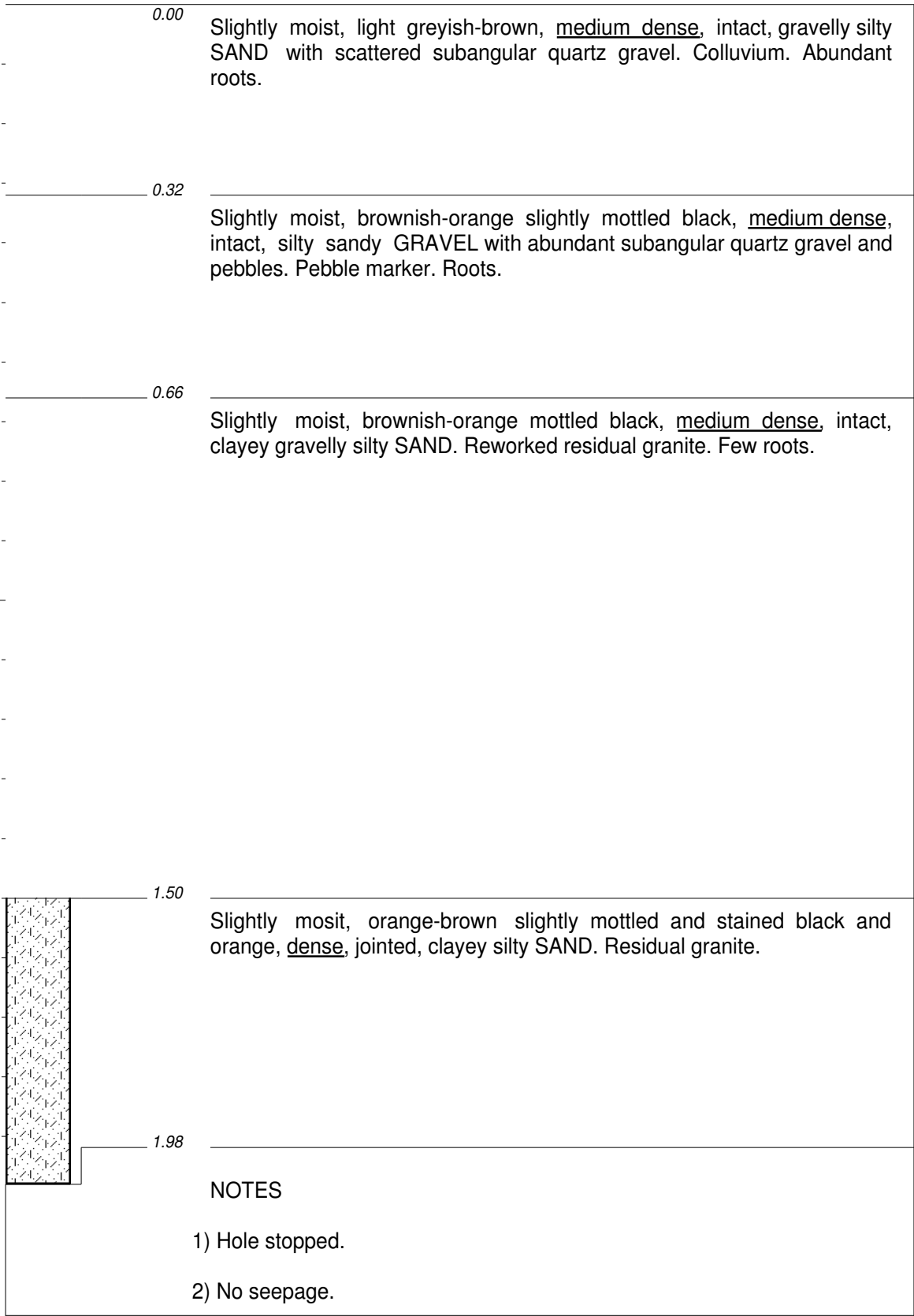
- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



0.00

Slightly moist, light brownish-grey, loose to medium dense, intact, gravelly silty SAND with scattered subangular quartz gravel. Colluvium. Abundant roots.

0.07

Slightly moist, light brownish-grey, loose to medium dense, intact, silty sandy GRAVEL with abundant subangular quartz gravel and pebbles. Pebble marker. Roots.

0.35

Slightly moist, brown stained orange and speckled white, medium dense, intact, clayey gravelly silty SAND. Reworked residual granite. Few roots.

0.90

Moist, greyish-brown stained orange, medium dense to dense, jointed, gravelly silty SAND with black joint stainings. Residual granite.

1.76

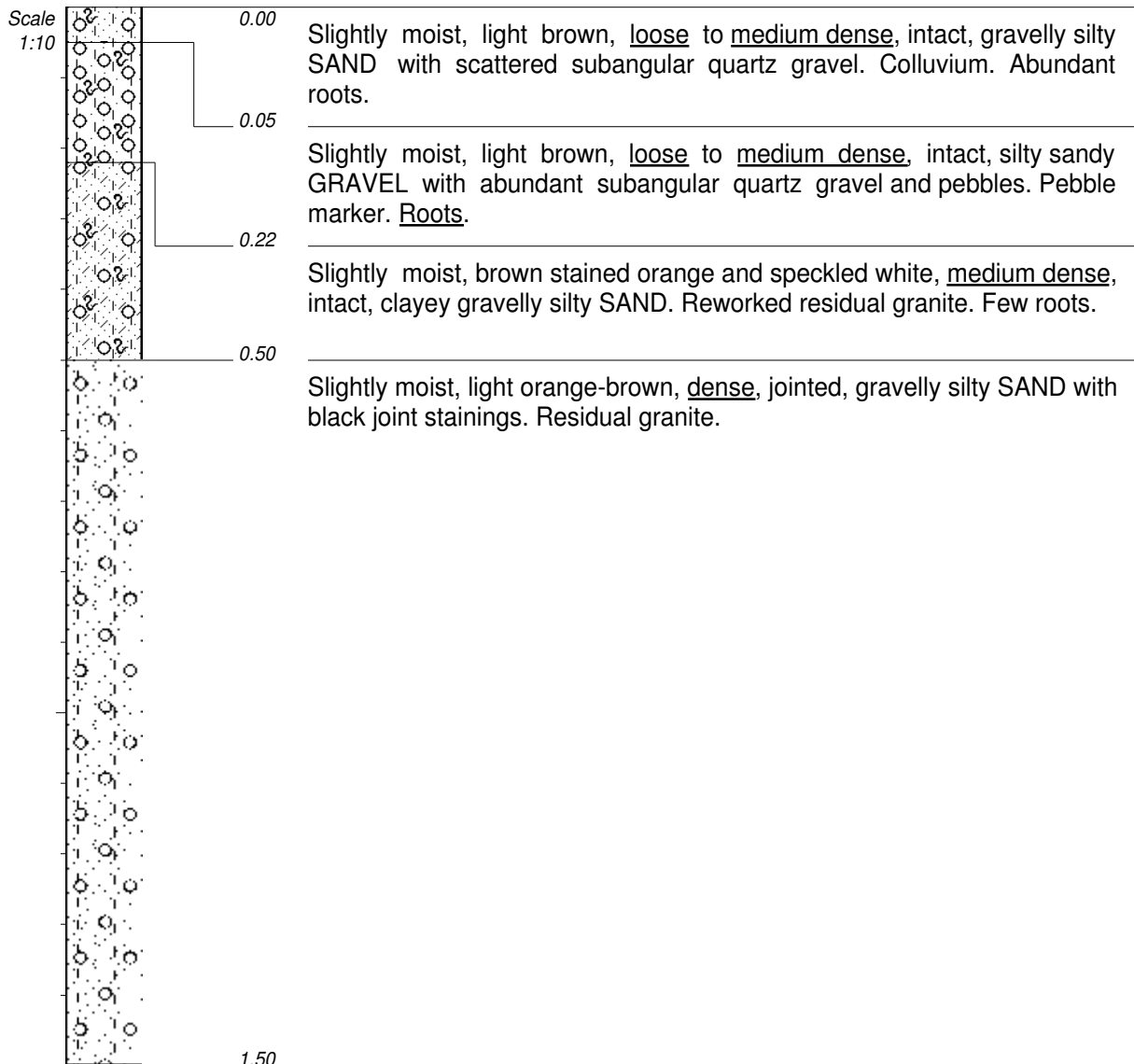
NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :



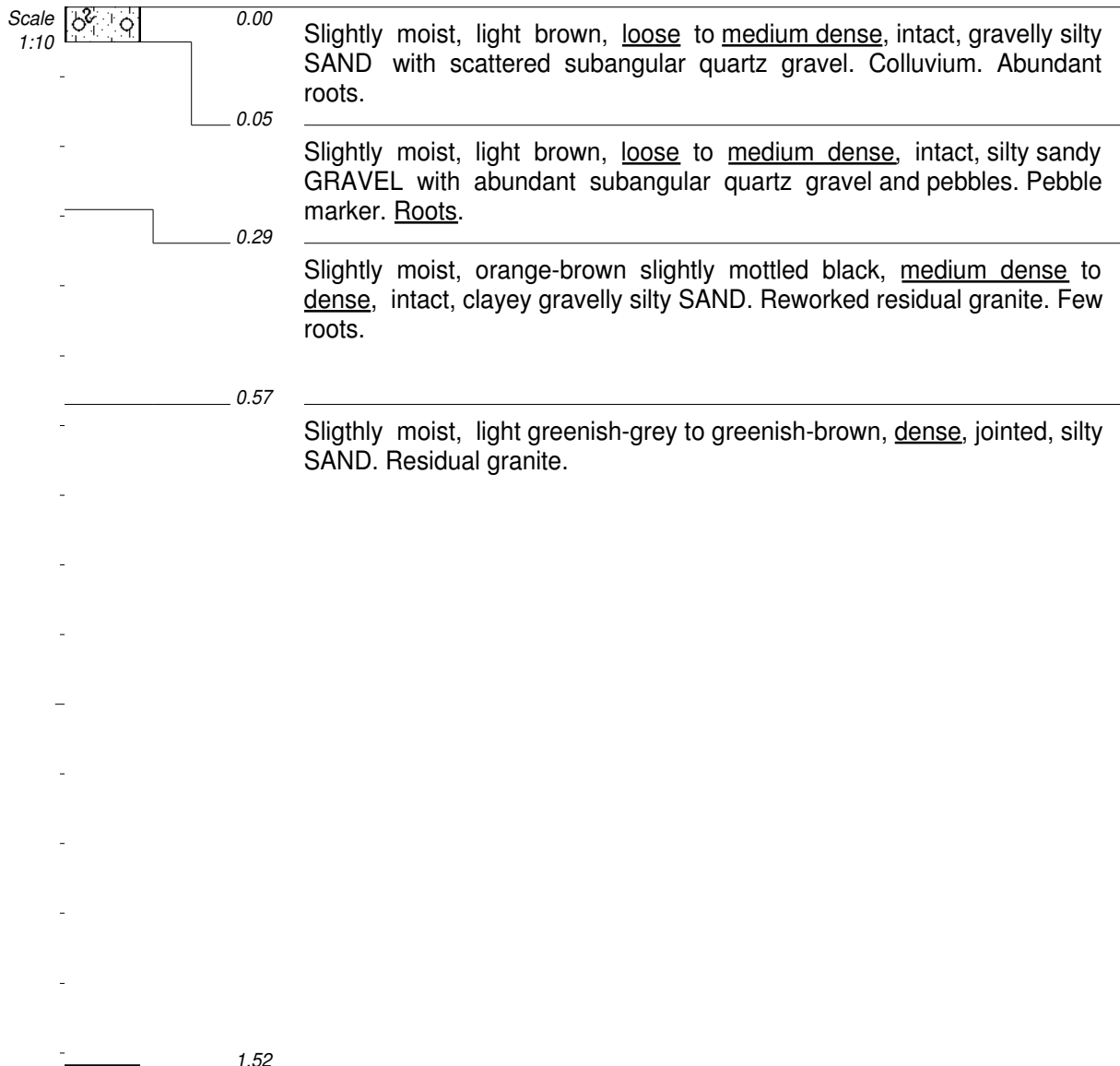
NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :



NOTES

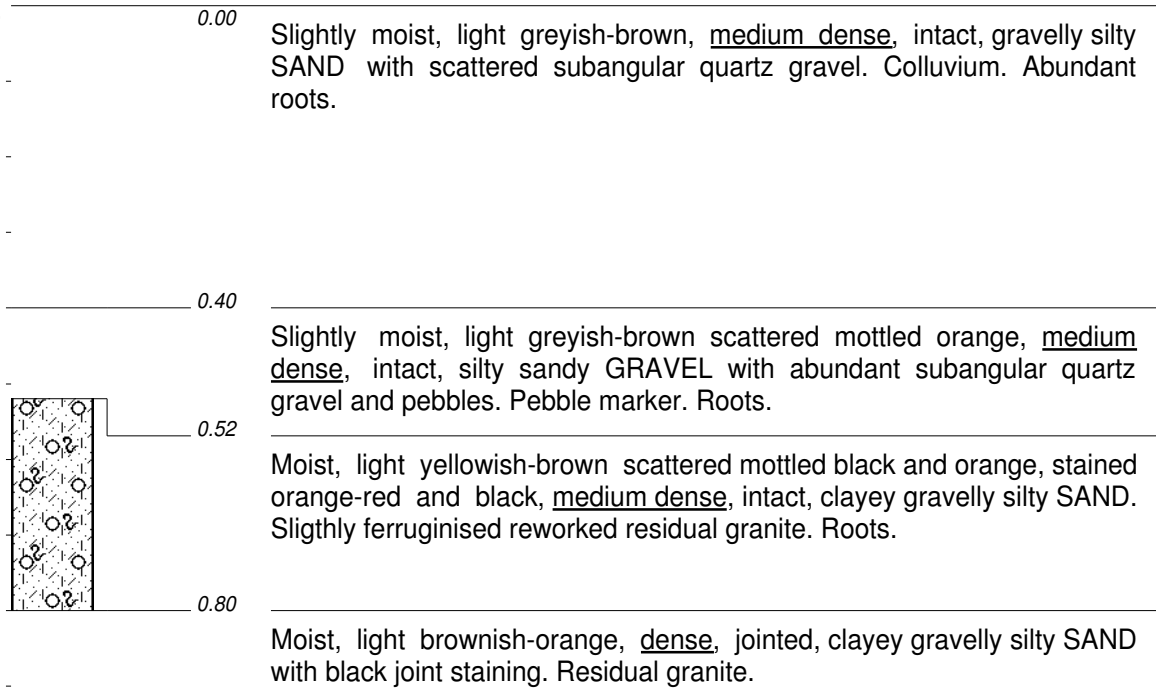
- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:41
TEXT : ..C:\DOT4000\ZONE6.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

0.00

Slightly moist, light brown, medium dense, intact, gravelly silty SAND with scattered subangular quartz gravel and pebbles. Colluvium. Roots.

0.75

Moist, light greyish-brown streaked and mottled orange, sandy silty CLAY with scattered quartz gravel and rounded moderately weathered diabase boulders. Transported.

1.92

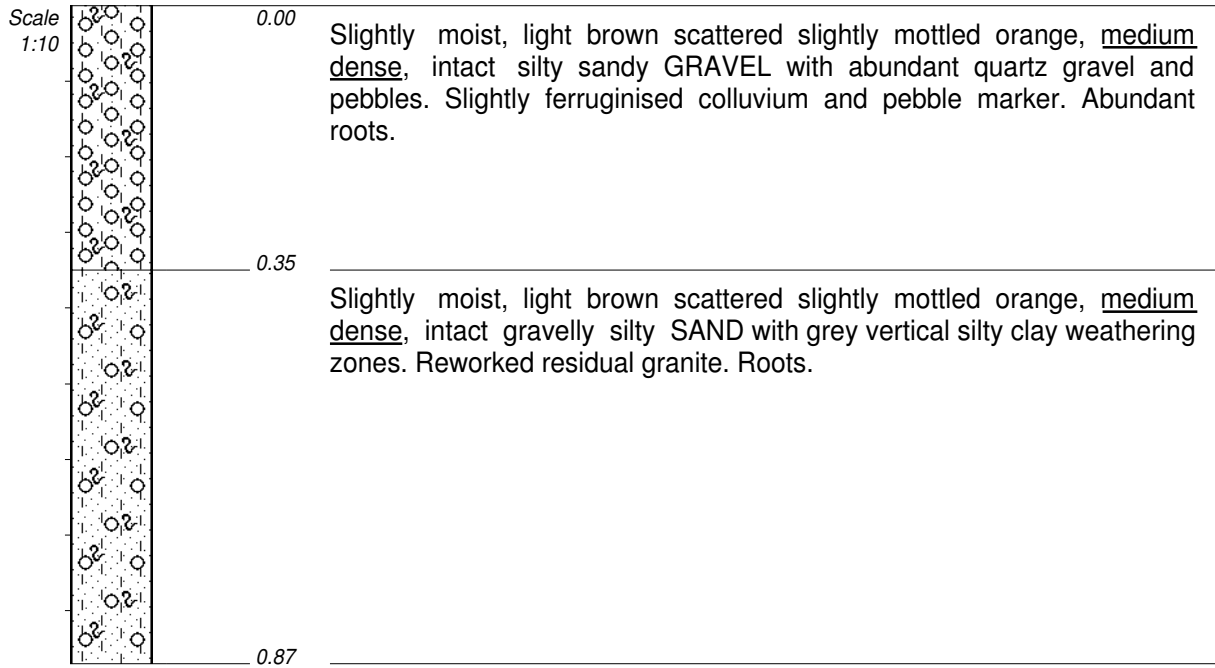
NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :



0.90m--1.20m

Moist, light orange-brown speckled white, streaked and stained black and orange, dense, intact, gravelly silty SAND. Residual granite.

1.50

NOTES

- 1) Slow excavation.
- 2) No seepage.
- 3) Disturbed sample between 0,90m--1,20m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



0.00

Slightly moist, darkish grey-brown mottled orange, medium dense to dense, intact, clayey gravelly silty SAND with minor becoming abundant quartz gravel and pebbles. Colluvium and pebble marker. Roots.

0.45

Slightly moist, grey-brown becoming orange-brown, medium dense to dense, intact, gravelly silty SAND. Reworked residual granite. Few roots.

0.45m--1.20m



1.23

Slightly moist, orange-brown, mottled orange and black, dense to very dense, intact, gravelly silty SAND. Slightly ferruginised residual granite. Few roots.

1.50

NOTES

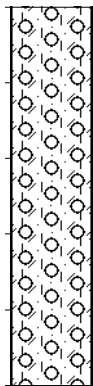
- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,45m--1,20m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



0.00

Slightly moist, light brown, loose, intact, clayey gravelly silty SAND with scattered subangular quartz gravel. Colluvium.

0.10

Slightly moist, light brown mottled orange and black, dense, intact, clayey silty sandy GRAVEL with abundant quartz gravel and pebbles. Slightly ferruginised pebble marker.

0.60

Slightly moist, brown mottled black with orange rims, stained orange, dense to very dense, intact, clayey gravelly silty SAND. Slightly ferruginised residual granite.

0.75m--1.00m

1.95

NOTES

- 1) Gradual refusal.
- 2) No seepage.
- 3) Disturbed sample between 0,75m--1,00m.

CONTRACTOR :
 MACHINE :
 DRILLED BY :
 PROFILED BY : D.H. Wessels
 TYPE SET BY :
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE :
 DATE :
 DATE : 01/08/05 17:35
 TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
 X-COORD :
 Y-COORD :

Scale
1:10

0.00

Slightly moist, brown, medium dense, intact, gravelly silty SAND with scattered subangular quartz gravel. Colluvium. Roots.

0.20



Slightly moist, brown mottled orange and black, dense, intact, clayey silty gravelly SAND with abundant quartz gravel and pebbles. Reworked colluvium and pebble marker. Few roots.

0.35

Slightly moist, brown mottled orange and black, dense to very dense, intact, clayey silty sandy GRAVEL with abundant quartz gravel and pebbles. Ferruginised pebble marker.

0.35m--0.90m

1.10

NOTES

- 1) Near refusal.
- 2) No seepage.
- 3) Disturbed sample between 0,35m--0,90m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

0.00

Abundant brown highly weathered subrounded diabase boulders, matrix supported in a matrix of moist, brown gravelly clayey silty SAND. Overall consistency medium dense. Colluvium. Abundant roots.

0.53

Moist, orange-brown mottled orange and black, medium dense, intact, clayey silty sandy gravel. Slightly ferruginised reworked residual diabase.

0.55m--0.90m

0.94



Moist, brown mottled orange and black, medium dense, intact, gravelly sandy clay with abundant rounded Fe and Mn nodules and major rounded highly weathered diabase pebbles, cobbles and boulders. Residual diabase.

1.54

NOTES

- 1) Hole refused on boulder.
- 2) No seepage.
- 3) Disturbed sample between 0,55m--0,90m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

0.00 Slightly moist, light grey, loose to medium dense, intact, gravelly silty SAND. Colluvium. Abundant roots.

0.40 Slightly moist, light grey mottled black and stained orange, medium dense, pinholed, gravelly silty SAND with major quartz gravel and pebbles. slightly ferruginised pebble marker.

0.60 Moist, light greyish-orange, mottled black and stained orange, medium dense, intact, gravelly clayey silty SAND. Reworked residual granite. Few roots.

1.50 Moist, light greyish-orange, mottled black and stained orange, dense to very dense, jointed, gravelly clayey silty SAND. Reworked residual granite. Few roots.

2.00

NOTES

1) Hole stopped.

2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

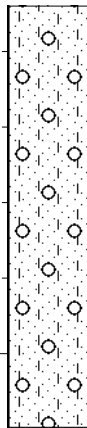
0.00

Slightly moist, greyish-brown, medium dense, intact, clayey gravelly silty SAND with abundant brownish orange highly weathered granite boulders and quartzite gravel and pebbles. Colluvium. Roots.

0.30

Slightly moist, orange-brown speckled white, medium dense to dense, jointed silty SAND with greyish-brown clayey silty sand joint filling. Reworked residual granite. Roots.

0.54



Slightly moist, light orange-brown, dense, jointed, silty gravelly SAND. Residual granite.

1.10

NOTES

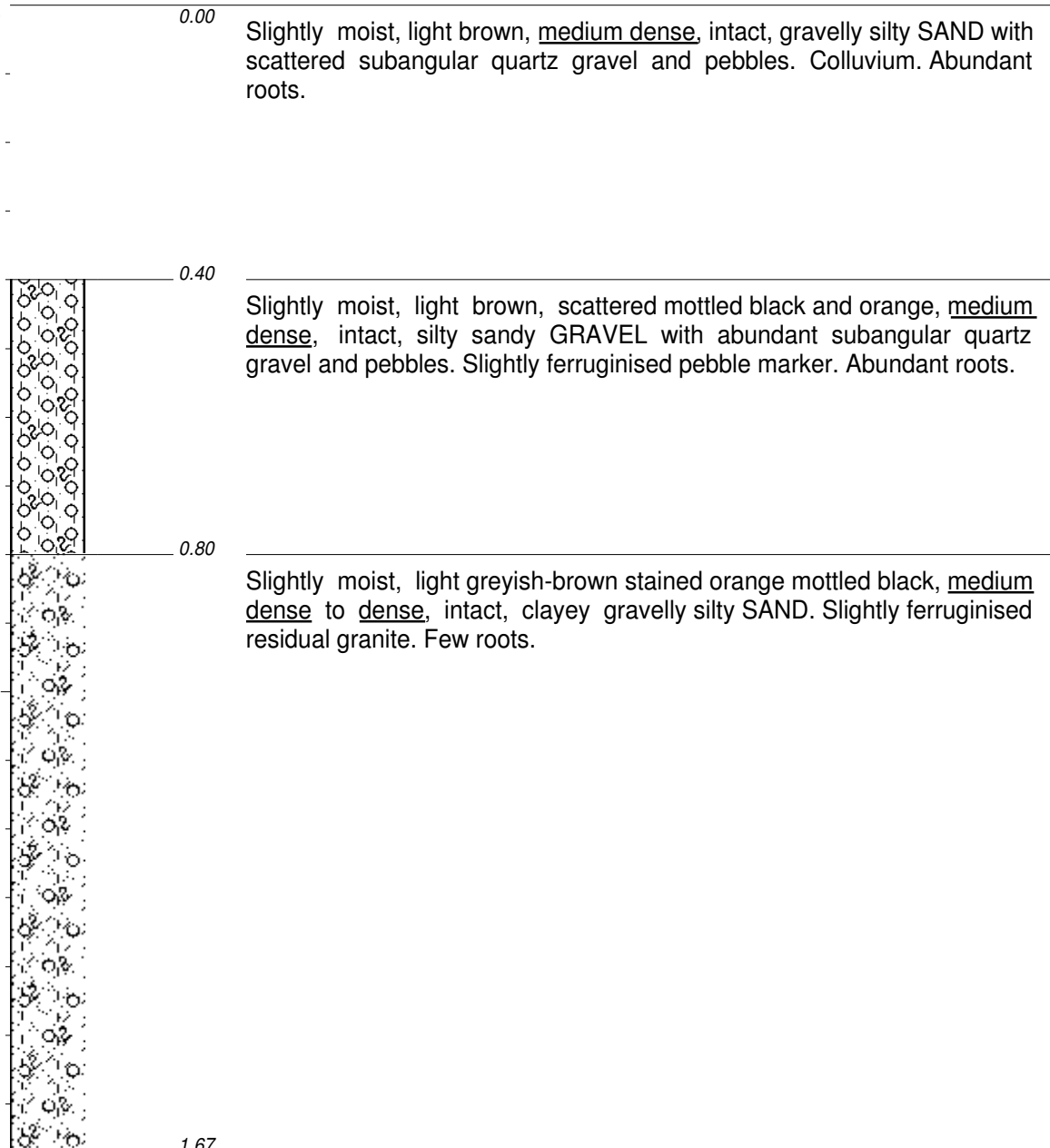
- 1) Gradual refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

0.00

Slightly moist, light grey, medium dense, intact, gravelly silty SAND with scattered quartz gravel. Colluvium. Abundant roots.

0.43

Slightly moist, light grey mottled orange and black, medium dense, intact, silty sandy GRAVEL with large orange Fe concretions (30cm). Highly ferruginised pebble marker. Roots.

0.92

Moist, orange-brown stained orange, medium dense to dense, intact, clayey silty SAND with vertical grey sandy clayey weathering zones. Slightly ferruginised reworked residual granite.

0.95m--1.20m

1.38

Slightly moist, orange-brown stained black and orange, dense becoming dense to very dense, jointed, clayey silty SAND. Slightly ferruginised residual granite.

1.70

NOTES

- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,95m--1,20m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

0.00

Slightly moist, grey, medium dense, intact, gravelly silty SAND with scattered subangular quartz gravel. Colluvium. Abundant roots.

0.20

Slightly moist, light grey mottled orange and black, medium dense to dense, intact, silty sandy GRAVEL with abundant subangular quartz gravel and pebbles. Pebble marker. Few roots.

0.65



Slightly moist, orange, mottled black and stained black and red, hardpan formation. Highly ferruginised pebble marker and reworked residual granite.

0.80

NOTES

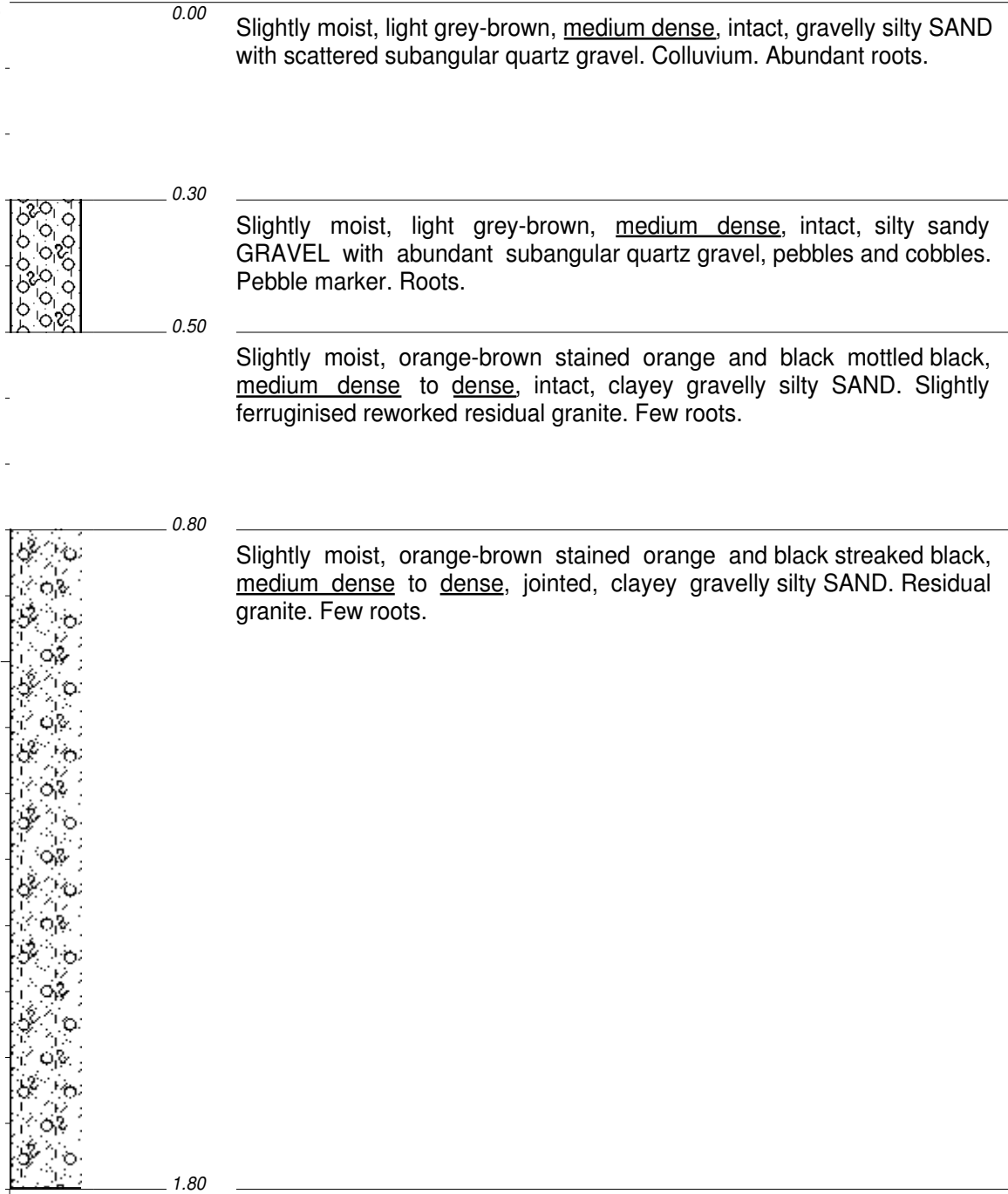
- 1) Refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

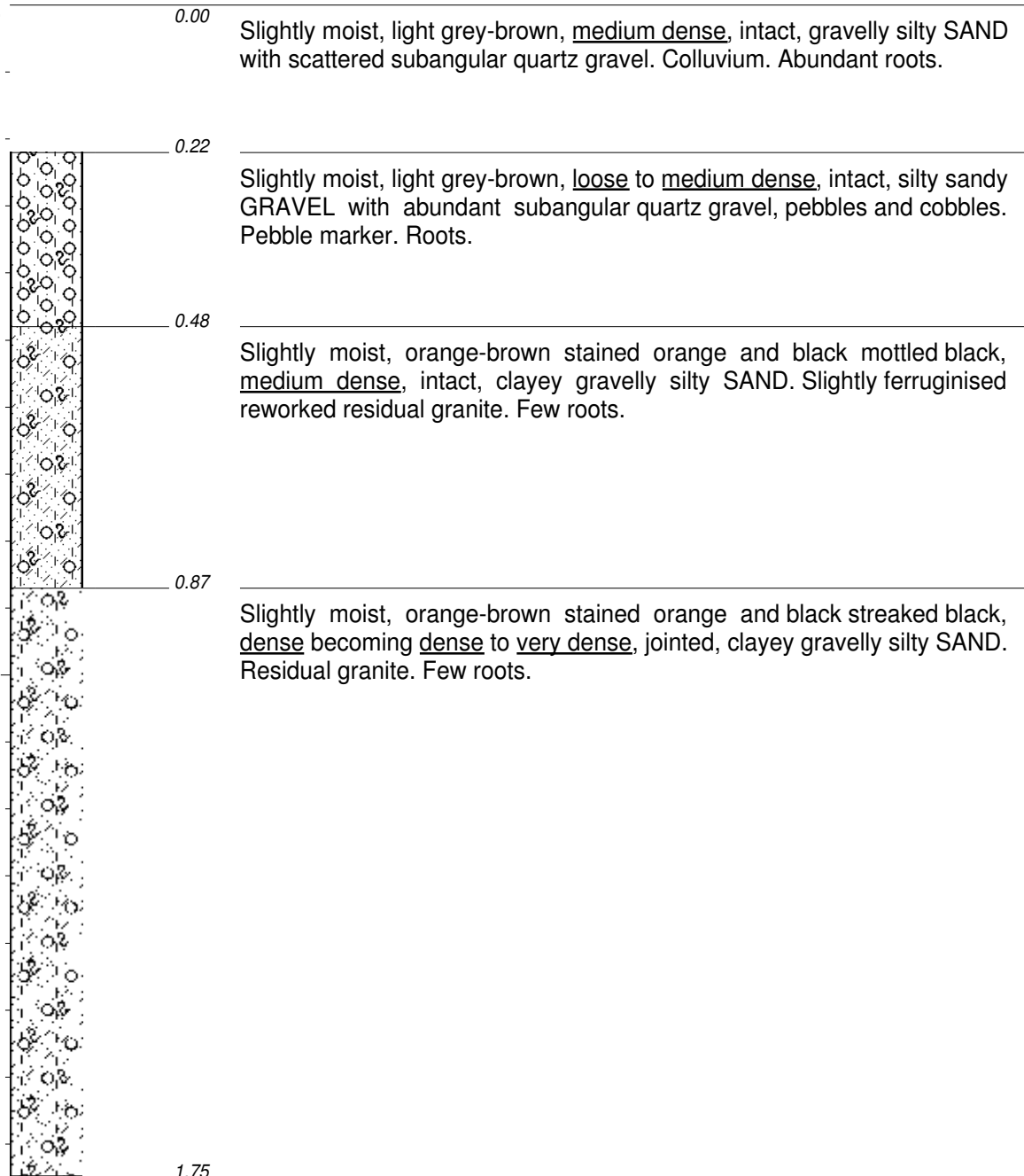
- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



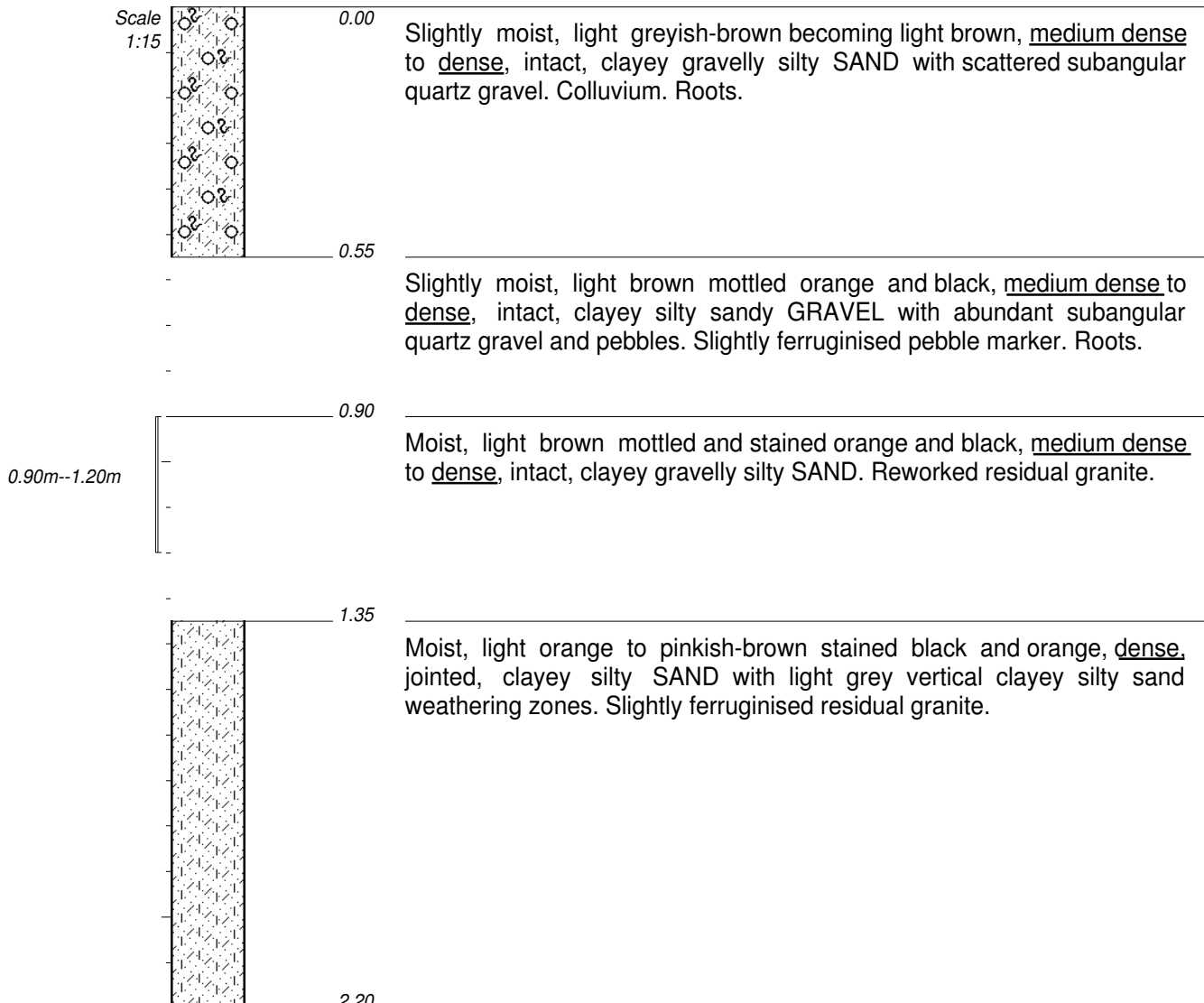
NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
 MACHINE :
 DRILLED BY :
 PROFILED BY : D.H. Wessels
 TYPE SET BY :
 SETUP FILE : STANDARD.SET

INCLINATION :
 DIAM :
 DATE :
 DATE :
 DATE : 01/08/05 17:35
 TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
 X-COORD :
 Y-COORD :



NOTES

- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,90m--1,20m.

CONTRACTOR :
 MACHINE :
 DRILLED BY :
 PROFILED BY : D.H. Wessels
 TYPE SET BY :
 SETUP FILE : STANDARD.SET

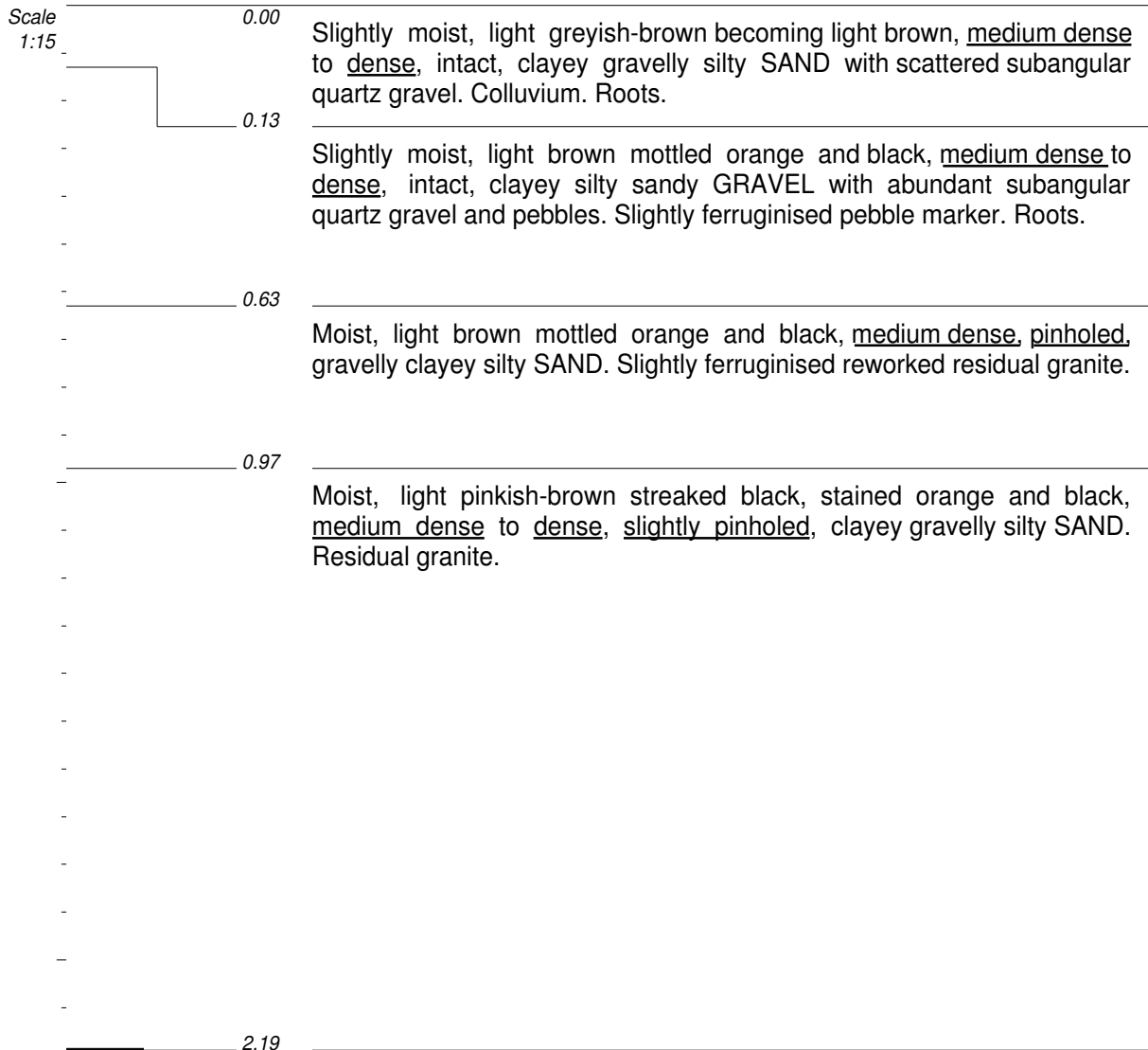
INCLINATION :
 DIAM :
 DATE :
 DATE :
 DATE : 01/08/05 17:35
 TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
 X-COORD :
 Y-COORD :

HOLE No: GPS276

Sheet 1 of 1

JOB NUMBER: 537/2



NOTES

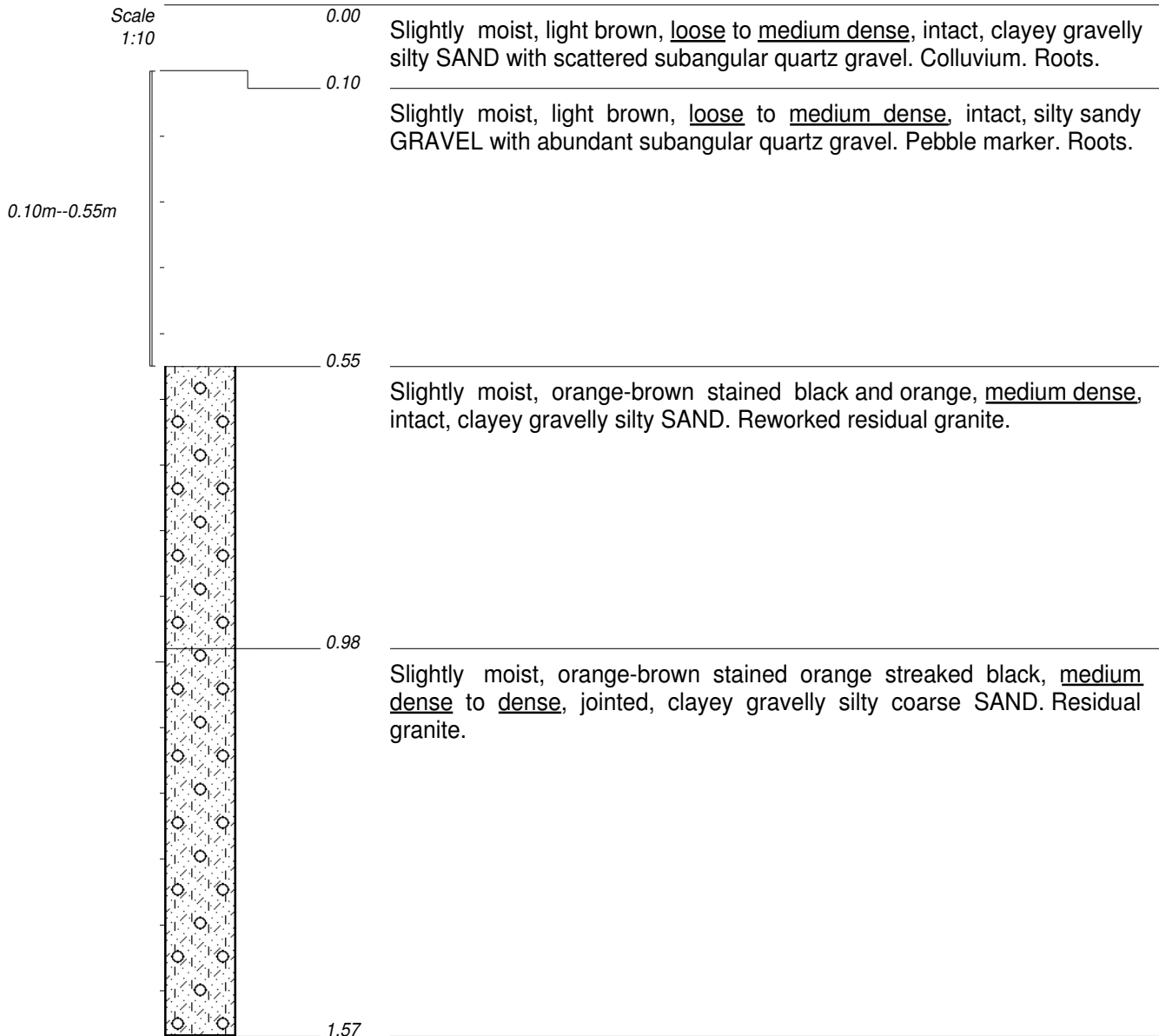
- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS276



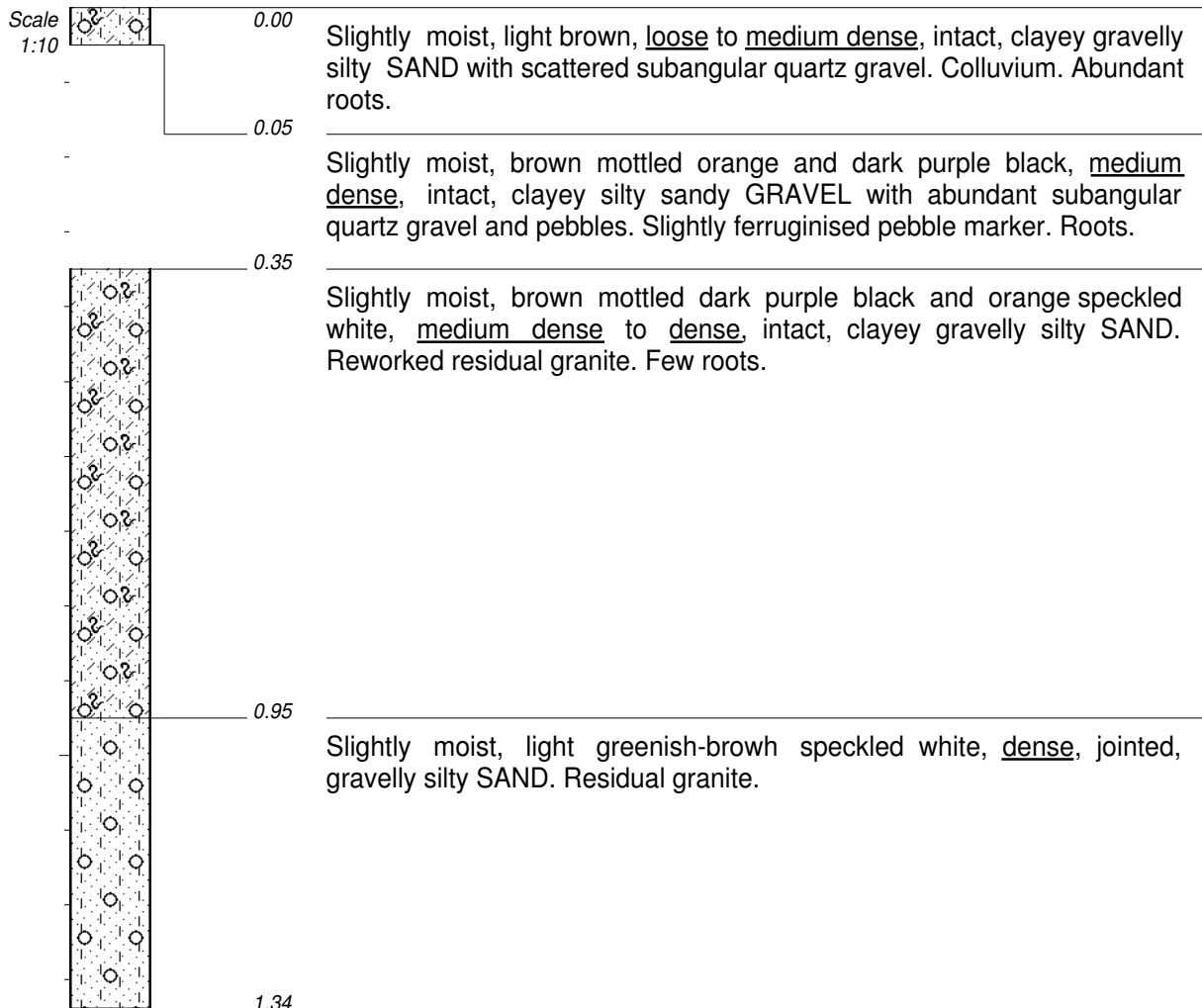
NOTES

- 1) Hole stopped.
- 2) No seepage.
- 3) Disturbed sample between 0,10m--0,55m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :



NOTES

- 1) Gradual refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS279

Sheet 1 of 1

JOB NUMBER: 537/2

Scale
1:10

0.00

Slightly moist, darkish grey-brown, medium dense, intact, gravelly clayey silty SAND. Colluvium. Abundant roots.

0.55

Abundant grey weathered brown subrounded diabase boulders clast supported in a matrix of darkish brown clayey silty sand infill. Weathered diabase.

0.65

NOTES

- 1) Refusal on extremely dense diabase boulder.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: GPS279

Scale
1:10



0.00

Slightly moist, light greyish-brown, loose to medium dense, intact, clayey gravelly silty SAND with scattered subangular quartz gravel. Colluvium. Abundant roots.

0.05

Moist, grey-brown mottled and stained orange and black, medium dense to dense, intact, silty sandy GRAVEL with abundant subangular quartz gravel and pebbles and Fe concretions. Highly ferruginised reworked pebble marker and colluvium.

0.50

Moist, grey-brown mottled and stained orange scattered mottled black, dense, intact, silty gravelly SAND with abundant Fe concretions. Ferruginised reworked residual granite.

1.05

Moist, orange-brown mottled black stained orange and black, dense, intact, clayey gravelly silty SAND with scattered subrounded to subangular quartz pebbles. Slightly reworked residual granite.

1.83

NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10

0.00

Slightly moist, light greyish-brown, loose, intact, silty sandy GRAVEL with abundant subangular quartz gravel and pebbles and highly weathered granite pebbles. Colluvium.

0.10

Slightly moist, light grey speckled dark grey weathered brown and orange, dense, highly jointed with black and orange joint stainings. Highly weathered granite.

1.17

NOTES

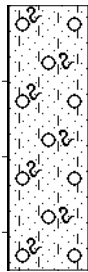
- 1) Gradual refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



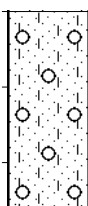
0.00

Slightly moist, light greyish-brown, medium dense, intact, gravelly silty SAND with scattered subangular quartz gravel. Colluvium. Abundant roots.

0.35

Slightly moist, light brown mottled black and orange, medium dense, intact, silty sandy GRAVEL with abundant subangular quartz gravel and pebbles. Slightly ferruginised pebble marker. Roots.

0.60



Slightly moist, light orange-brown mottled and stained orange scattered mottled black with vertical grey weathering zones, dense, intact, silty gravelly SAND with abundant Fe concretions. Ferruginised reworked residual granite.

0.86

Slightly moist, light orange-brown streaked black with scattered grey clayey sandy patches, dense, jointed, silty SAND. Residual granite.

1.86

NOTES

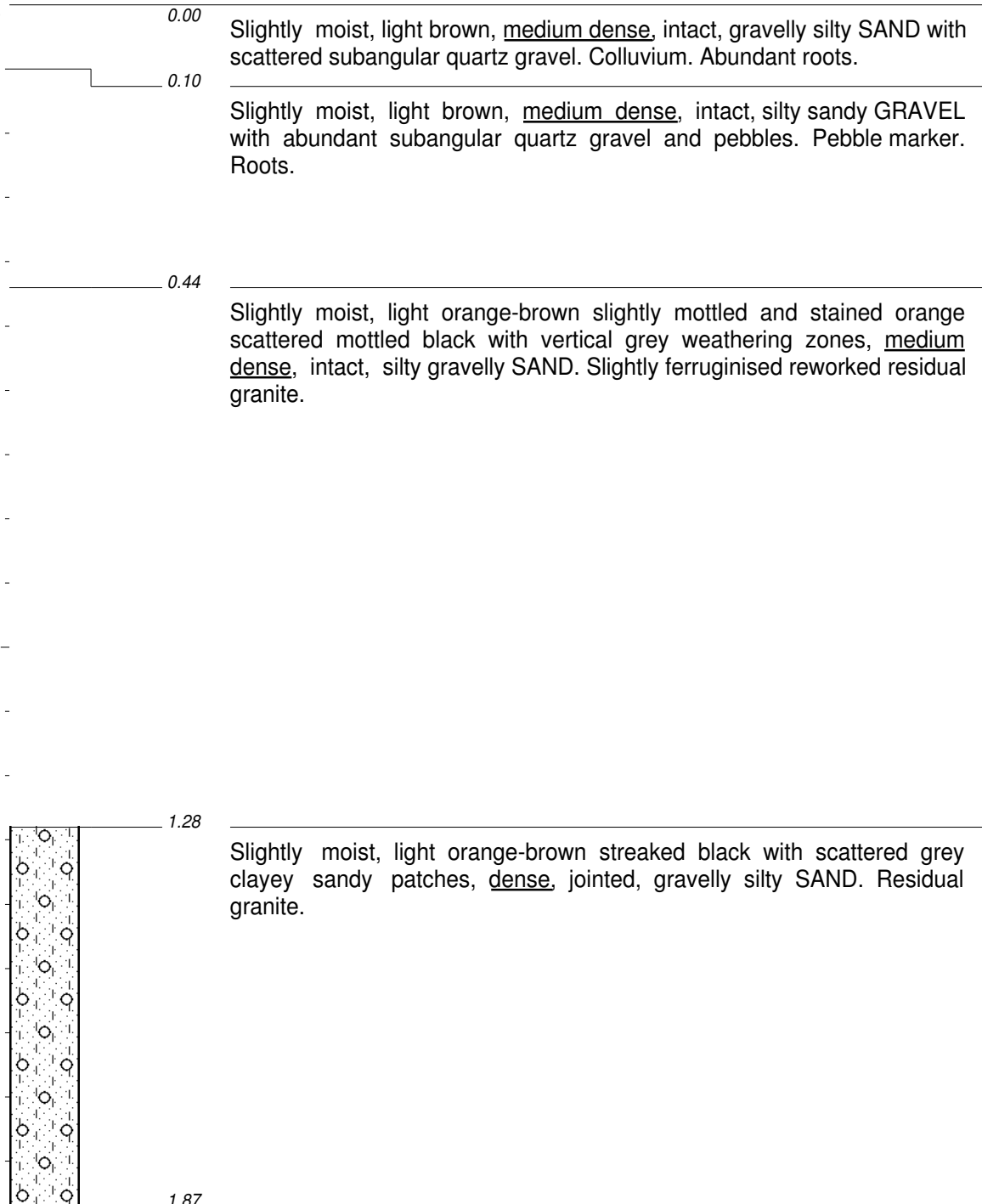
- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

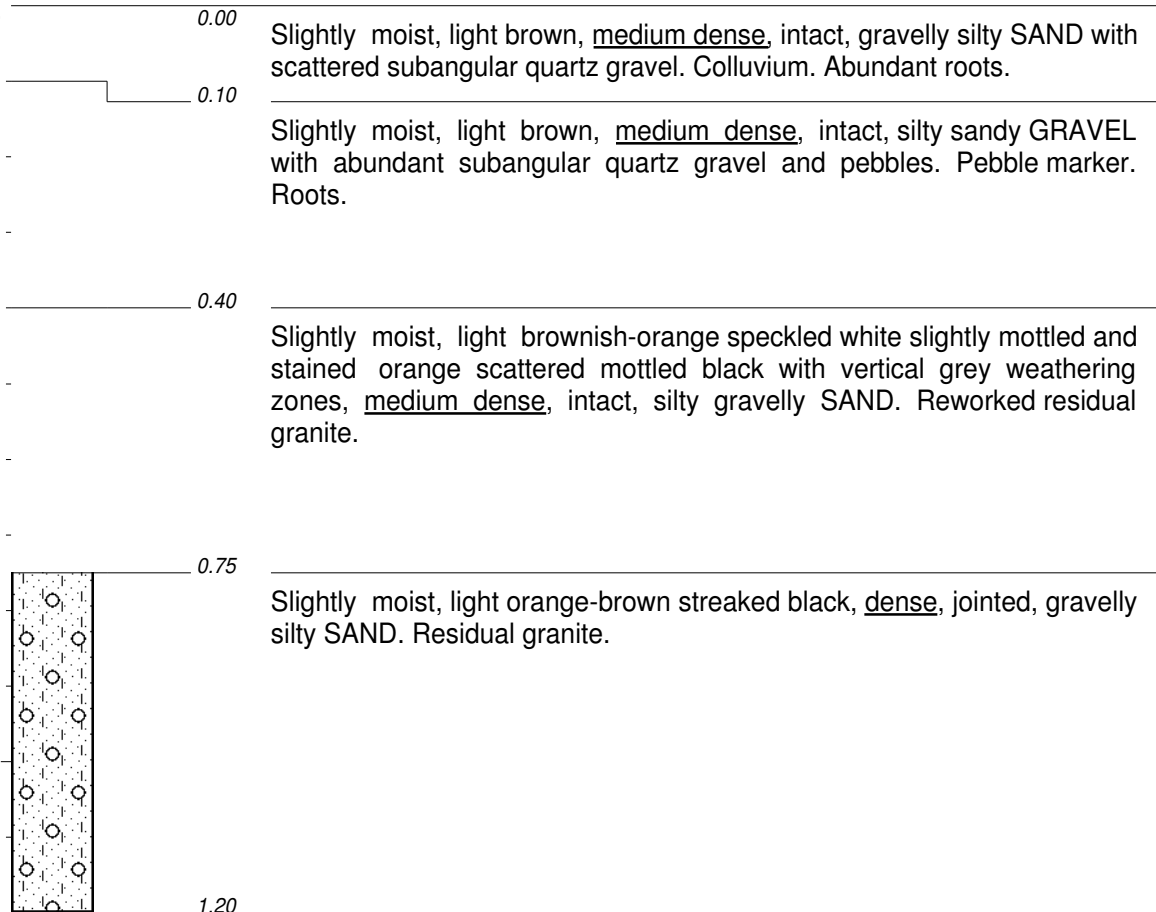
- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

Scale
1:10



NOTES

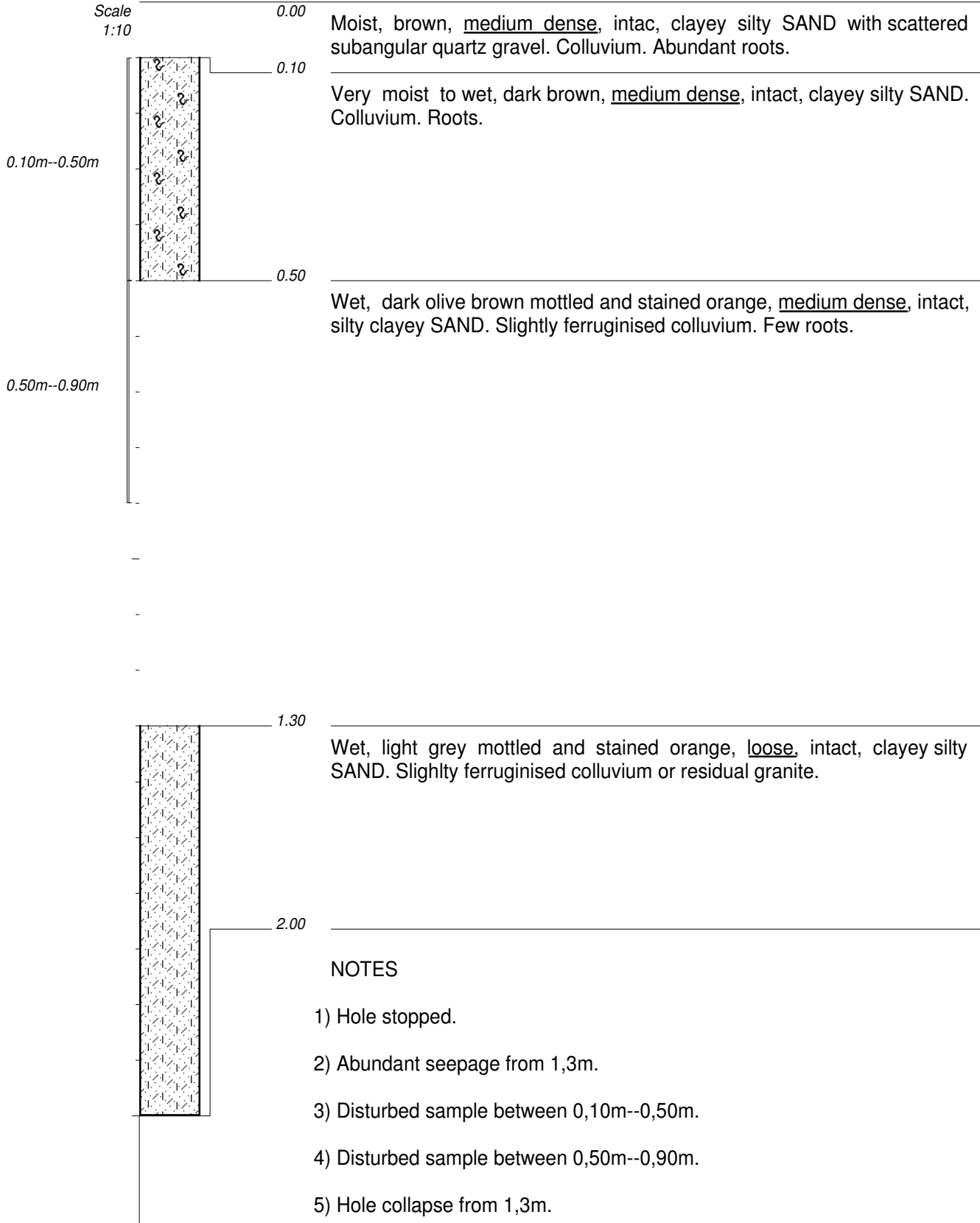
- 1) Gradual refusal.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

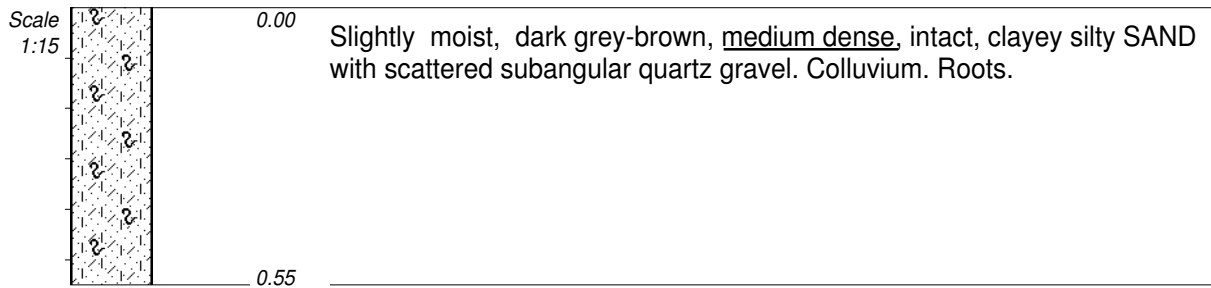
Scale
1:10



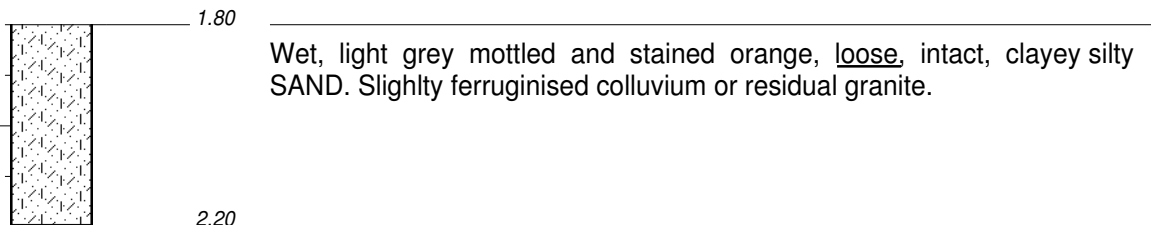
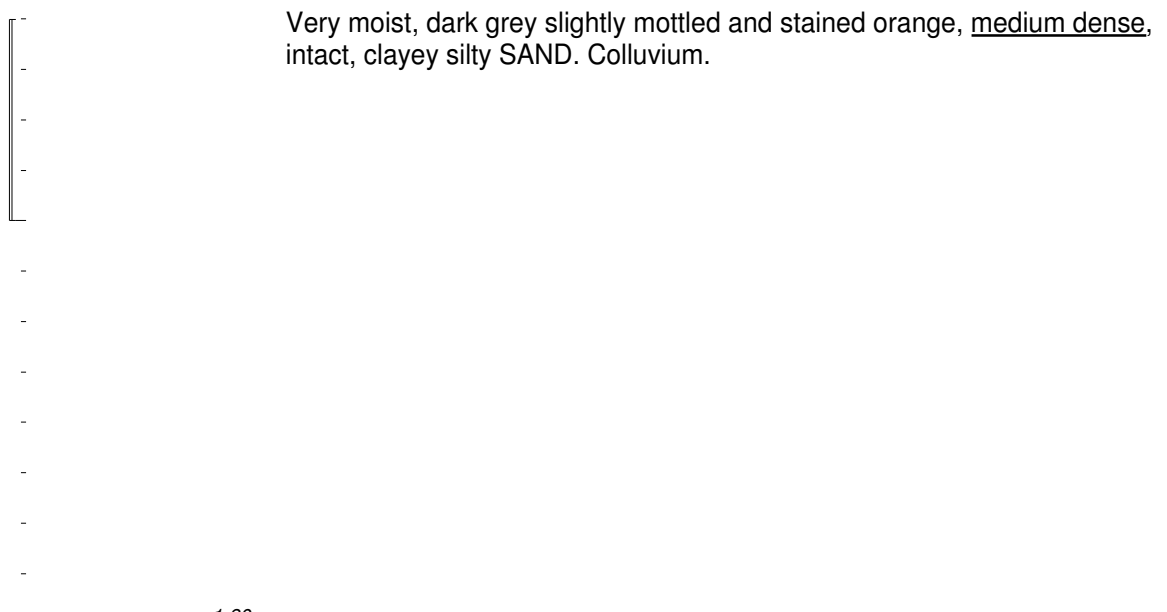
CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :



0.60m--1.00m



NOTES

- 1) Hole stopped.
- 2) Abundant seepage from 1,8m.
- 3) Disturbed sample between 0,60m--1,00m.
- 4) Hole collapse from 1.8m.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

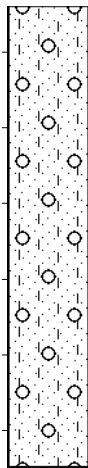
Scale
1:10

0.00 Slightly moist, light grey-brown, medium dense, intact, gravelly silty SAND with scattered quartz gravel. Colluvium. Abundant roots.

0.22 Slightly moist, light grey-brown scattered mottled black and orange, medium dense to dense, intact, gravelly silty SAND with minor quartz gravel and pebbles. Pebble marker. Roots.

0.55 Slightly moist, light grey-brown mottled black and orange, medium dense, intact, gravelly silty SAND. Reworked residual granite. Pinholed.

1.04 Slightly moist, light orange-brown streaked black, dense, jointed, layey silty gravelly SAND. Residual granite.



NOTES

- 1) Hole stopped.
- 2) No seepage.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : D.H. Wessels
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 01/08/05 17:35
TEXT : ..C:\DOT4000\ZONE2.TXT

ELEVATION :
X-COORD :
Y-COORD :

APPENDIX C: SOIL PROFILE SUMMARY

T0000 01 Test Pit Summar (Area Nort of Jukskei)

T000P	0000000	P0000 M0000	R0000 d R0000 d0000 000000	R0000 d0000 r000000	H0000000 0000 00000	0000000000	T00000 d0000 0000
0PS006	0-0.27	0.27-0.52	0.52-0.78	0.78-1.87			1.87
0PS000	0-0.21	0.21-0.50	0.21-0.91	0.91-1.62			1.62
0PS010	0-0.20	0.20-0.46	0.46-0.90	0.90-1.60			1.60
0PS011	0-0.27	0.27-0.56	0.56-0.80	0.80-1.50			1.50
0PS012	0-0.10	0.10-0.30	0.30-0.62	0.62-1.85			1.85
0PS010	0-0.40	0.40-0.66	0.66-1.15	1.15-1.52			1.52
0PS014	0-0.24	0.24-0.48	0.48-0.65	0.65-1.20			1.20
0PS010	0-0.23	0.23-0.55	0.55-0.63	0.63-1.50			1.50
0PS016	0-0.05	0.05-0.27	0.27-0.55	0.55-1.52			1.52
0PS010	0-0.05	0.05-0.27	0.27-0.55	0.55-1.50			1.50
0PS010	0-0.75				0.75-0.85		0.8500
0PS020	0-0.30	0.30-0.50	0.50-0.95	0.95-1.50			1.500
0PS021	0-0.50	0.50-0.63	0.63-0.80	0.80-1.25			1.25
0PS022	0-0.63	0.63-0.75			0.75-0.86		0.8600
0PS020	0-0.15	0.15-0.35	0.35-0.60	0.60-0.96			0.9600
0PS024	0-0.42	0.42-0.60	0.60-0.88	0.88-1.05			1.050
0PS020	0-0.30	0.30-0.48		0.48-1.10			1.100
0PS020	0-0.10	0.10-0.35	0.35-0.70	0.70-1.54			1.54
0PS020	0-0.20	0.20-0.50	0.50-0.80	0.80-1.93			1.93
0PS000	0-0.40		0.40-0.70	0.70-1.80			1.80
0PS001	0-0.05	0.05-0.30	0.30-0.50	0.50-1.40			1.40
0PS062	0-0.55				0.55-0.76		0.7600
0PS060	0-0.24		0.24-0.55	0.55-1.54			1.540

Table C1 (continue): Test Pit Summary (Area North of Jukskei)

Test Pit	Colluvium	Pebble Marker	Reworked Residual granite	Residual granite	Hardpan formation	Granite rock	Test pit depth (m)
TP1	0-0.20	00.20-0.50	0.50-1.30	1.30-2.40			2.40
TP2	0-0.30		0.30-0.70	0.70-1.60			1.60**
TP17	0-0.30			0.30-0.80			0.80**
TP18	0-0.40	0.40-0.60		0.60-1.10			1.10**
TP19	0-0.50			0.50-1.50			1.50**
TP20	0-0.90			0.90-2.00			2.00**
TP21	0-0.60	0.60-0.80			0.80-1.20		1.20**

* - gradual refusal; ** - refusal

Table C2: Test Pit Summary (Area Southwest of Jukskei)

Test Pit	Colluvium	Pebble Marker	Reworked Residual granite	Residual granite	Hardpan formation	Granite rock	Test pit depth (m)
GPS232	0-0.40	0.40-0.75	0.75-1.02	1.02-1.40			1.40*
GPS233	0-0.68	0.68-1.65	1.65-2.27	2.27-2.60			2.60
GPS234	0-0.89			0.89-2.10			2.10*
GPS235	0-1.06		1.06-1.40	1.40-1.66			1.66
GPS236	0-0.23	0.23-0.59	0.59-0.81	0.81-1.97			1.97
GPS237	0-0.30	0.30-0.56		0.56-1.20			1.20**
GPS238	0-0.15	0.15-0.36	0.36-0.88	0.88-1.90			1.90
GPS240	0-1.90			1.90-2.15			2.15
GPS241	0-0.20	0.20-0.50	0.50-1.62	1.62-2.40			2.40
GPS242	0-0.20	0.20-0.50		0.50-2.05			2.05
GPS243	0-0.26	0.26-0.47	0.47-0.80	0.80-1.25			1.25*
GPS244	0-0.15	0.15-0.45		0.45-0.75			0.75*
GPS245	0-0.10	0.10-0.30	0.30-0.90	0.90-2.38			2.38
GPS246	0-0.20	0.20-0.44	0.44-1.30	1.30-2.18			2.18
GPS247	0-0.90				0.90-1.00		1.00**
GPS248	0-0.05					0.05-0.70	0.70**
GPS249	0-0.20		0.20-0.50	0.50-1.10			1.10**
GPS250	0-0.07	0.07-0.40	0.40-0.94	0.94-1.90			1.90
GPS251	0-0.35	0.35-0.67	0.67-1.40	1.40-1.79			1.79
GPS252	0-0.05	0.05-0.40	0.40-0.93	0.93-1.95			1.95
GPS253	0-0.26	0.26-0.55			0.55-0.70		0.70**
GPS254	0-0.15	0.15-0.44	0.44-0.90	0.90-1.87			1.87*
GPS255	0-0.10	0.10-0.60	0.60-1.62	1.62-2.20			2.20

Table C2 (continue): Test Pit Summary (Area Southwest of Jukskei)

Test Pit	Colluvium	Pebble Marker	Reworked Residual granite	Residual granite	Hardpan formation	Granite rock	Test pit depth (m)
GPS256	0-0.10	0.1-0.48	0.48-0.74	0.74-1.53			1.53*
GPS257	0-0.60	0.60-1.00		1.00-1.90			1.90
GPS258	0-0.50		0.50-1.10	1.10-1.40			1.40**
GPS259	0-0.30					0.30-0.60	0.60**
GPS260	0-0.50			0.50-1.99			1.99
GPS262	0-1.92						1.92
GPS263	0-0.35		0.35-0.87	0.87-1.50			1.50
GPS264	0-0.45		0.45-1.23	1.23-1.50			1.50

* - gradual refusal; ** - refusal

Table C3: Test Pit Summary (Area South of Jukskei)

Test Pit	Colluvium	Pebble Marker	Reworked Residual granite	Residual granite	Residual diabase	Hardpan formation	Granite rock	Test pit depth (m)
GPS261	0-0.25		0.25-0.48	0.48-0.85				0.85**
GPS265	0-0.10	0.10-0.60		0.60-1.95				1.95*
GPS266	0-0.20	0.20-1.10						1.10*
GPS267	0-0.53				0.53-1.54			1.54**
GPS268	0-0.40	0.40-0.60	0.60-2.00					2.00
GPS269	0-0.30		0.30-0.54	0.54-1.10				1.10*
GPS270	0-0.40	0.40-0.80		0.80-1.67				1.67
GPS271	0-0.43	0.43-0.92	0.92-1.38	1.38-1.70				1.70
GPS272	0-0.20	0.20-0.65				0.65-0.80		0.80**
GPS273	0-0.30	0.30-0.50	0.50-0.80	0.80-1.80				1.80
GPS274	0-0.22	0.22-0.48	0.48-0.87	0.87-1.75				1.75
GPS275	0-0.55	0.55-0.90	0.90-1.35	1.35-2.20				2.20
GPS276	0-0.13	0.13-0.63	0.63-0.97	0.97-2.19				2.19
GPS277	0-0.10	0.10-0.55	0.55-0.98	0.98-1.57				1.57
GPS278	0-0.05	0.05-0.35	0.35-0.95	0.95-1.34				1.34
GPS279	0-0.55				0.55-0.65			0.65**
GPS280	0-0.05	0.05-0.50	0.50-1.05	1.05-1.83				1.83
GPS281	0-0.10						0.10-1.17	1.17**
GPS282	0-0.35	0.35-0.60	0.60-0.86	0.86-1.86				1.86
GPS283	0-0.10	0.10-0.44	0.44-1.28	1.28-1.87				1.87
GPS284	0-0.10	0.10-0.40	0.40-0.75	0.75-1.20				1.20*
GPS285	0-1.30			1.30-2.00				2.00
GPS286	0-1.80			1.80-2.20				2.20
GPS287	0-0.22	0.22-0.55	0.55-1.04	1.04-1.65				1.65

* - gradual refusal; ** - refusal

Table C4: Test Pit Summary (Area East of N1)

Test Pit	Colluvium	Pebble Marker	Reworked Residual granite	Residual granite	Residual diabase	Granite rock	Test pit depth (m)
GPS034	0-0.64	0.64-0.70					0.70
GPS035	0-0.30	0.30-0.40	0.40-1.50	1.50-1.83			1.83
GPS036	0-0.27	0.27-0.33	0.33-0.50	0.50-1.13		1.13-1.30	1.30**
GPS037	0-0.20	0.20-0.43	0.43-0.85	0.85-1.55			1.55
GPS038	0-0.20	0.20-0.33	0.33-0.77	0.77-1.70			1.70
GPS039	0-0.30	0.30-0.60	0.60-0.98	0.98-1.79			1.79
GPS040	0-0.20	0.20-0.67	0.67-1.70	1.70-2.15			2.15
GPS041	0-0.21	0.21-0.50	0.50-0.85	0.85-1.80			1.80
GPS042	0-0.30	0.30-0.83		0.83-1.40			1.40*
GPS043	0-0.23	0.23-0.43	0.43-0.85	0.85-1.85			1.85*
GPS044	0-0.58	0.58-1.18		1.18-1.30			1.30*
GPS045	0-0.50	0.50-0.78	0.78-1.16	1.16-1.80			1.80*
GPS046	0-0.30	0.30-0.60	0.60-1.40	1.40-1.69			1.69
GPS047	0-0.53	0.53-1.29		1.29-1.59			1.59
GPS048	0-0.23	0.23-0.55	0.55-1.09	1.09-1.68			1.68
GPS049	0-0.28	0.28-0.66	0.66-1.16	1.16-1.62			1.62
GPS050	0-0.25	0.25-0.60	0.60-0.93	0.93-1.77			1.77
GPS051	0-0.27		0.27-0.82	0.82-1.55			1.55
GPS052	0-0.32		0.32-0.45	0.45-1.50			1.50
GPS053	0-0.32	0.32-0.66	0.66-1.50	1.50-1.98			1.98
GPS054	0-0.07	0.07-0.35	0.35-0.90	0.90-1.76			1.76
GPS055	0-0.05	0.05-0.22	0.22-0.50	0.50-1.50			1.50
GPS056	0-0.05	0.05-0.29	0.29-0.57	0.57-1.52			1.52
GPS057	0-0.40	0.40-0.52	0.52-0.80	0.80-1.65			1.65

* - gradual refusal; ** - refusal

APPENDIX D: LABORATORY TEST RESULTS

TEST REPORT S05-0592

For: J Louis van Rooij
PO Box 36786
Menlo Park
0102

Date: 2005-07-19

Attention: Mr JL van Rooij

Your Reference: Waterval 5IR

Sample(s)	Date requested	Test Method(s) used	Sample Condition/Description	Sampling method/Date	Test(s) done at	Test(s) dates	Sampling Environmental conditions
S05-0592-01 □ 34□36 - 48	2005-07-01	TMH 1 A1 □ A6	Good□Disturbed	Client Not given	Soillab Pretoria	2005-07-14	Not given
S05-0592-35		TMH 6 ST 10	Good□Undisturbed				



□□□□□□□□□□□□□□□□
PJ Fourie
General/Technical Manager.

The results relate only to the items tested. Any opinions, comments and interpretations do not fall within the scope of accreditation.

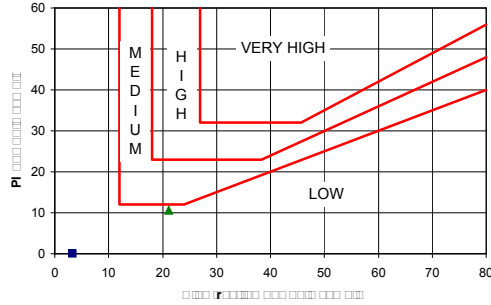
SOILLAB	(PTY) LTD Reg No 1971/00112/07	230 Albertus Street La Montagne Tel (012) 481-3999	P O Box 72928 Lynnwood Ridge 0040 Fax (012) 481-3812
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PARTICLE SIZE ANALYSIS

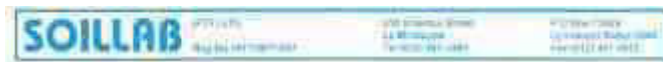
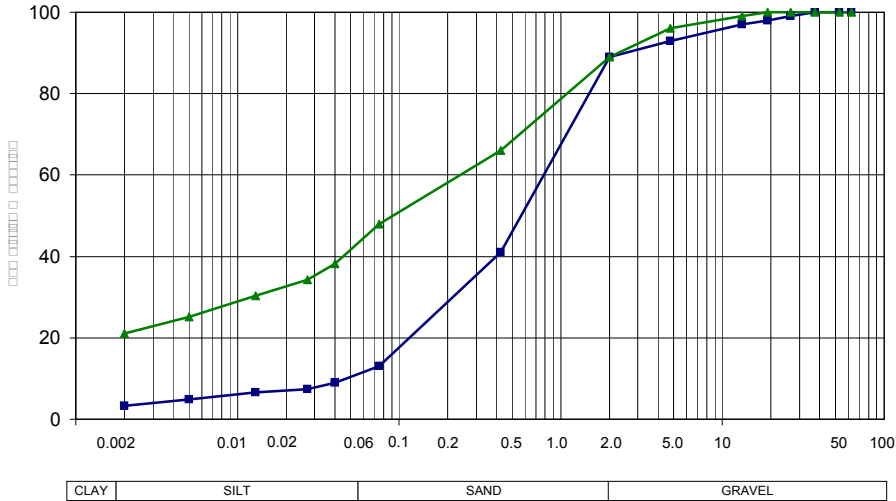
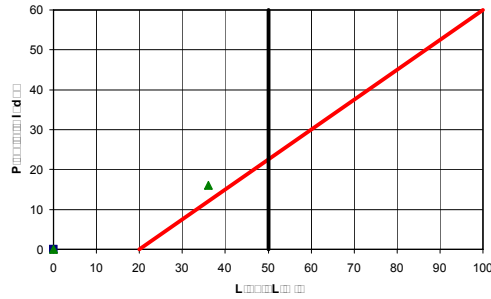
Sample No.	16756	16757
Soillab sample no.	S05-0592-01	S05-0592-02
Position	TP 09	TP 28
Depth (m)	0.0-0.5	0.6-2.0
Material Description	DARK GREY GRAVELLY SAND	DARK YELLOW SILTY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	99	100
19.0 mm	98	100
13.2 mm	97	99
4.75 mm	93	96
2.00 mm	89	89
0.425 mm	41	66
0.075 mm	13	48
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	9	38
0.027 mm	7	34
0.013 mm	7	30
0.005 mm	5	25
0.002 mm	3	21
Clay	3	21
Silt	8	23
Sand	78	45
Gravel	11	11
ATTERBERG LIMITS		
Liquid Limit		36
Plasticity Index	NP	16
Linear Shrinkage (%)	0.0	7.0
Grading Modulus	1.57	0.97
Classification	A-1-b(0)	A-6(5)
Unified Classification	SC	SC
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

PROJECT : WATERVAL 5IR PHASE I
 JOB No. : S05-0592
 DATE : 2005-07-15

POTENTIAL EXPANSIVENESS



PLASTICITY CHART



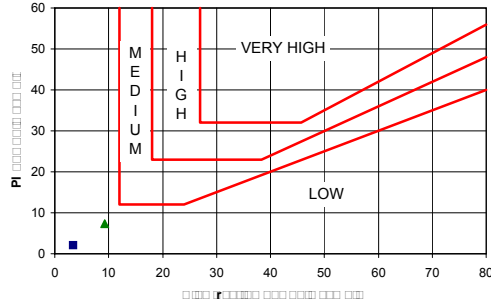
HIDROMETER/0592-01

PARTICLE SIZE ANALYSIS

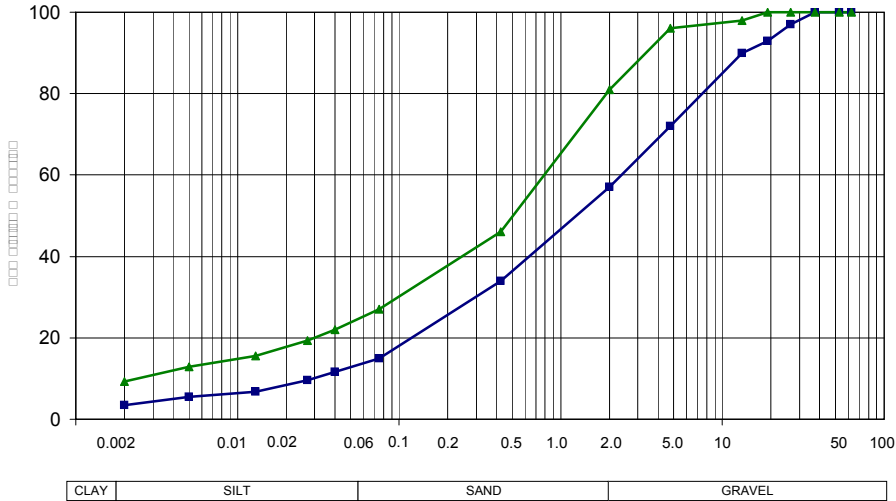
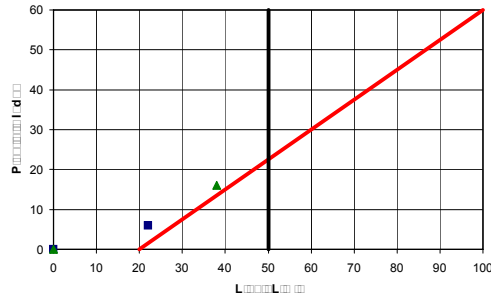
Sample No.	16758	16759
Soillab sample no.	S05-0592-03	S05-0592-04
Position	TP 20	TP 11
Depth (m)	0.0-0.9	0.3-2.0
Material Description	DARK GREY FERRICRETE GRAVELLY SAND	DARK YELLOW W/GRANITE GRAVELLY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	97	100
19.0 mm	93	100
13.2 mm	90	98
4.75 mm	72	96
2.00 mm	57	81
0.425 mm	34	46
0.075 mm	15	27
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	12	22
0.027 mm	10	19
0.013 mm	7	16
0.005 mm	5	13
0.002 mm	3	9
Clay (%)	3	9
Silt (%)	10	16
Sand (%)	43	56
Gravel (%)	43	19
ATTERBERG LIMITS		
Liquid Limit	22	38
Plasticity Index	6	16
Linear Shrinkage (%)	2.5	7.0
Grading Modulus	1.91	1.46
Classification	A-1-b(0)	A-2-6(1)
Unified Classification	SP-SC	SC
Chart Reference	■-■-■	▲-▲-▲

PROJECT : WATERVAL 5IR PHASE I
 JOB No. : S05-0592
 DATE : 2005-07-15

POTENTIAL EXPANSIVENESS



PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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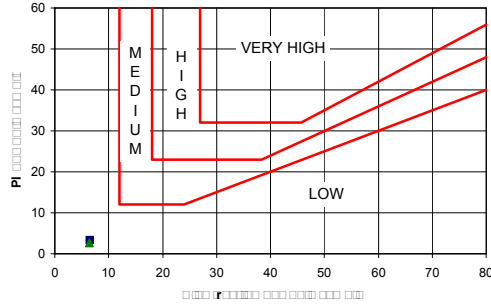


PARTICLE SIZE ANALYSIS

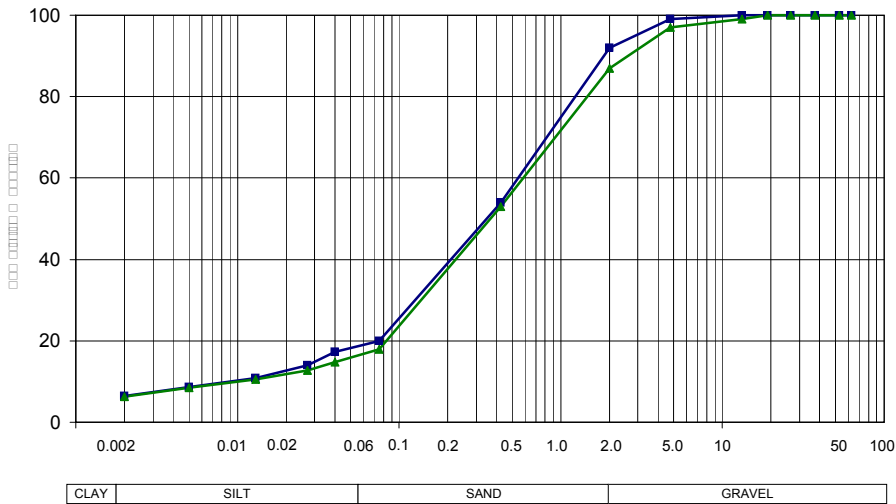
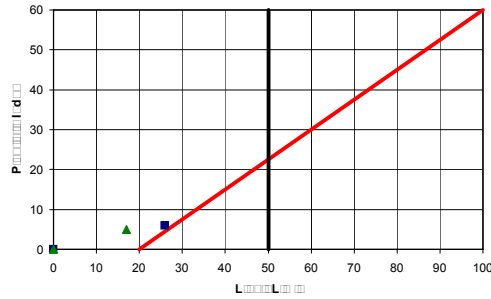
Sample No.	16760	16761
Soillab sample no.	S05-0592-05	S05-0592-06
Position	TP 03	K 23
Depth (m)	0.0-0.3	0.0-0.5
Material Description	DARK GREY SILTY SAND	DARK GREY GRAVELLY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	99
4.75 mm	99	97
2.00 mm	92	87
0.425 mm	54	53
0.075 mm	20	18
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	17	15
0.027 mm	14	13
0.013 mm	11	11
0.005 mm	9	8
0.002 mm	6	6
Clay	6	6
Silt	12	10
Sand	73	70
Gravel	8	13
ATTERBERG LIMITS		
Liquid Limit	26	17
Plasticity Index	6	5
Linear Shrinkage (%)	2.0	1.5
Grading Modulus	1.34	1.42
Classification	A-2-4(0)	A-2-4(0)
Unified Classification	SP-SC	SP-SC
Chart Reference	■-■-■	▲-▲-▲

PROJECT : WATERVAL 5IR PHASE I
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POTENTIAL EXPANSIVENESS



PLASTICITY CHART



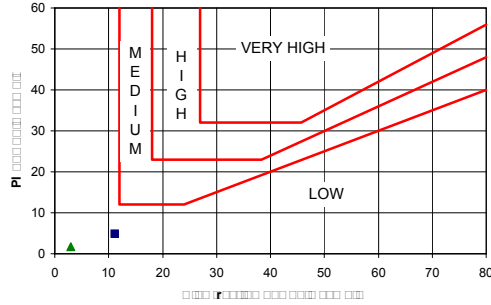
HIDROMETER/0592-03

PARTICLE SIZE ANALYSIS

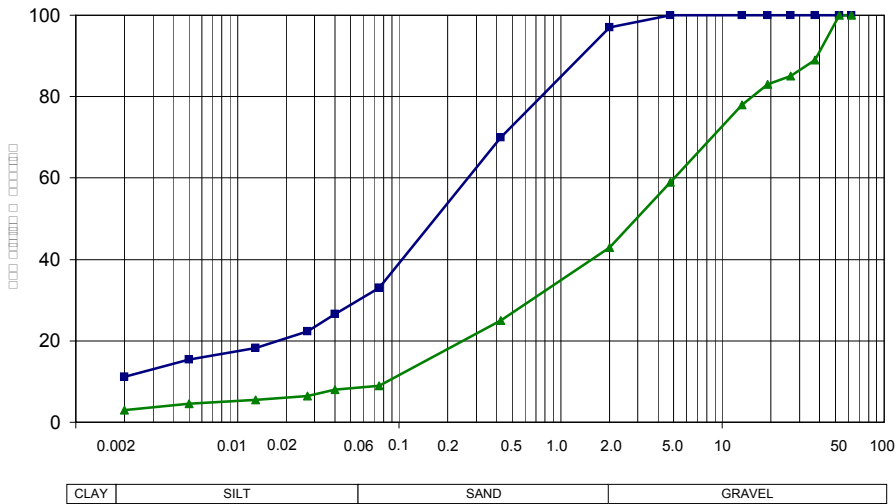
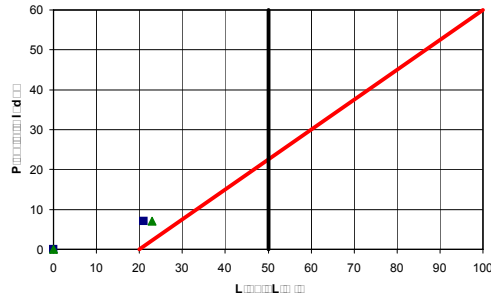
Sample No.	16762	16763
Soillab sample no.	S05-0592-07	S05-0592-08
Position	K 05	K02
Depth (m)	0.0-0.8	0.0-0.3
Material Description	DARK GREY SILTY SAND	DARK GREY SANDY GRAVEL
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	89
19.0 mm	100	85
13.2 mm	100	83
4.75 mm	100	78
2.00 mm	100	59
0.425 mm	97	43
0.075 mm	70	25
	33	9
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	27	8
0.027 mm	22	7
0.013 mm	18	6
0.005 mm	15	5
0.002 mm	11	3
Clay	11	3
Silt	19	6
Sand	67	34
Gravel	3	57
ATTERBERG LIMITS		
Liquid Limit	21	23
Plasticity Index	7	7
Linear Shrinkage (%)	3.5	2.5
Grading Modulus	1.00	2.23
Classification	A-2-4(0)	A-2-4(0)
Unified Classification	SP - SC	SP - SC
Chart Reference	■-■-■	▲-▲-▲

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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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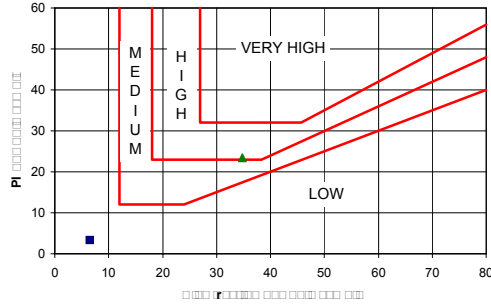


PARTICLE SIZE ANALYSIS

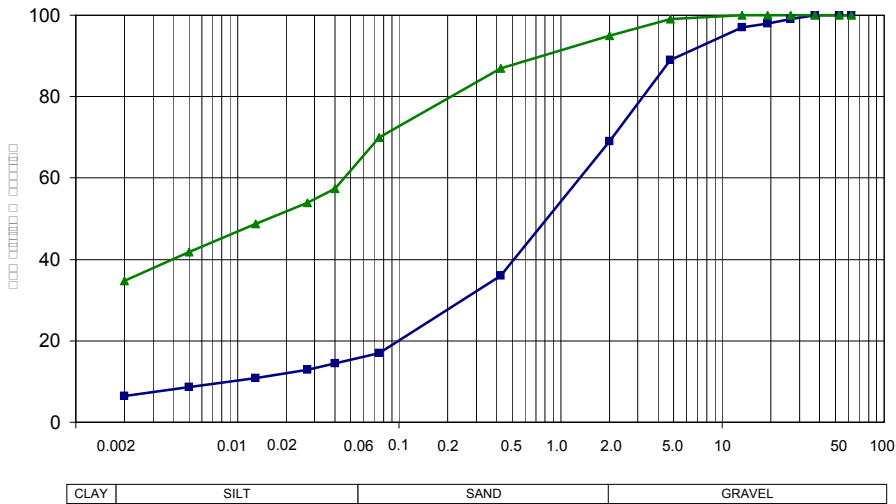
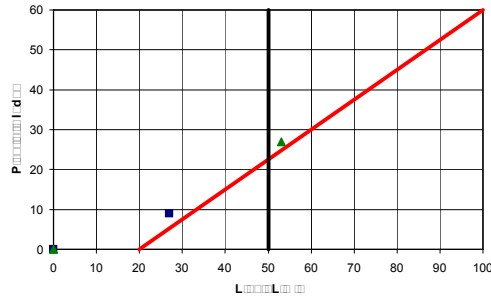
Sample No.	16764	16765
Soillab sample no.	S05-0592-09	S05-0592-10
Position	K 02	GPS 040
Depth (m)	0.3-0.7	0.7-1.1
Material Description	LIGHT BROWN □ UART □ GRAVELLY SAND	DARK R/ORANGE □ UART □ SANDY CLAY
Dispersion (%)		
SCREEN ANALYSIS (□ PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	99	100
19.0 mm	98	100
13.2 mm	97	100
4.75 mm	89	99
2.00 mm	69	95
0.425 mm	36	87
0.075 mm	17	70
HYDROMETER ANALYSIS (□ PASSING)		
0.040 mm	14	57
0.027 mm	13	54
0.013 mm	11	49
0.005 mm	9	42
0.002 mm	6	35
Clay	6	35
Silt	9	30
Sand	53	30
Gravel	31	5
ATTERBERG LIMITS		
Liquid Limit	27	53
Plasticity Index	9	27
Linear Shrinkage (%)	4.5	12.5
Grading Modulus	1.78	0.48
Classification	A-2-4(0)	A-7-6(16)
Unified Classification	SC	CH
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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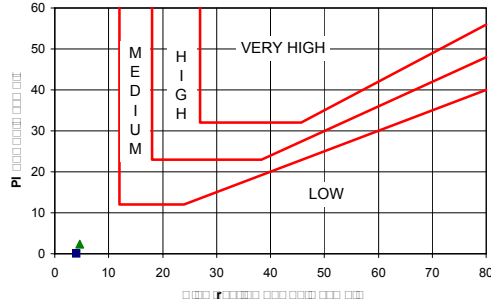
HIDROMETER/0592-05

PARTICLE SIZE ANALYSIS

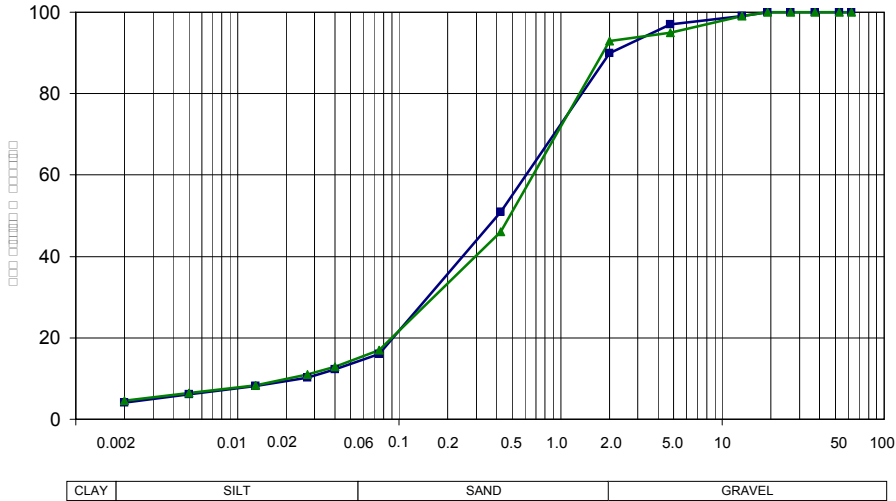
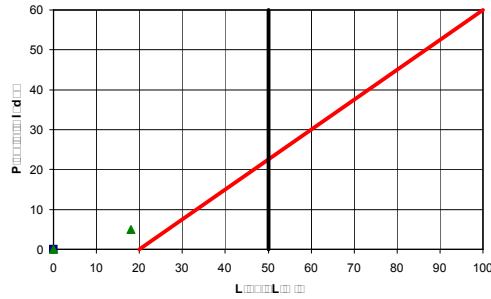
Sample No.	16766	16767
Soillab sample no.	S05-0592-11	S05-0592-12
Position	GPS 044	GPS 034
Depth (m)	0.3-0.55	0.0-0.55
Material Description	LIGHT GREY	DARK GREY
	UART	FERRICRETE
	SILTY SAND	SILTY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	99	99
4.75 mm	97	95
2.00 mm	90	93
0.425 mm	51	46
0.075 mm	16	17
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	12	13
0.027 mm	10	11
0.013 mm	8	8
0.005 mm	6	6
0.002 mm	4	5
Clay	4	5
Silt	10	11
Sand	76	78
Gravel	10	7
ATTERBERG LIMITS		
Liquid Limit		18
Plasticity Index	NP	5
Linear Shrinkage (%)	0.0	1.5
Grading Modulus	1.43	1.44
Classification	A-2-4(0)	A-1-b(0)
Unified Classification	SC	SP-SC
Chart Reference	■-■-■	▲-▲-▲

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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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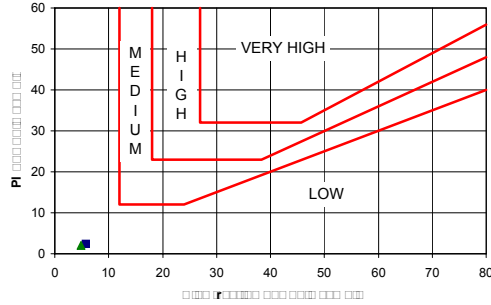
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PARTICLE SIZE ANALYSIS

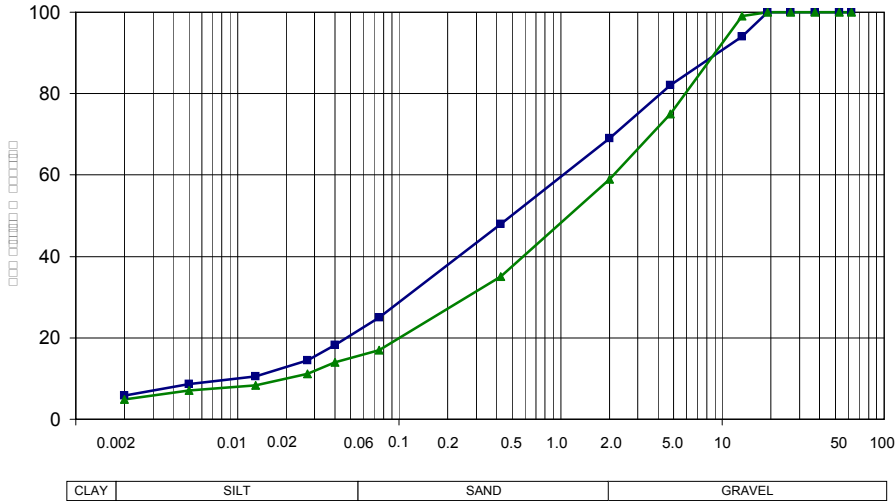
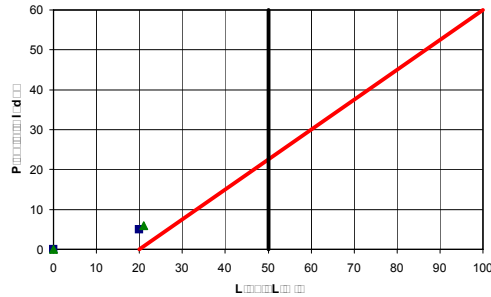
Sample No.	16768	16769
Soillab sample no.	S05-0592-13	S05-0592-14
Position	GPS 037	GP 049
Depth (m)	0.5-0.8	0.3-0.65
Material Description	DARK YELLOW FERRICRETE GRAVELLY SAND	DARK BROWN FERRICRETE GRAVELLY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	94	99
4.75 mm	82	75
2.00 mm	69	59
0.425 mm	48	35
0.075 mm	25	17
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	18	14
0.027 mm	14	11
0.013 mm	11	8
0.005 mm	9	7
0.002 mm	6	5
Clay (%)	6	5
Silt (%)	16	11
Sand (%)	47	43
Gravel (%)	31	41
ATTERBERG LIMITS		
Liquid Limit	20	21
Plasticity Index	5	6
Linear Shrinkage (%)	2.0	2.5
Grading Modulus	1.58	1.89
Classification	A-1-b(0)	A-1-b(0)
Unified Classification	SP - SC	SP - SC
Chart Reference	■-■-■	▲-▲-▲

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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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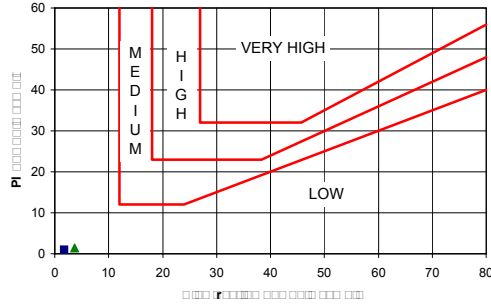


PARTICLE SIZE ANALYSIS

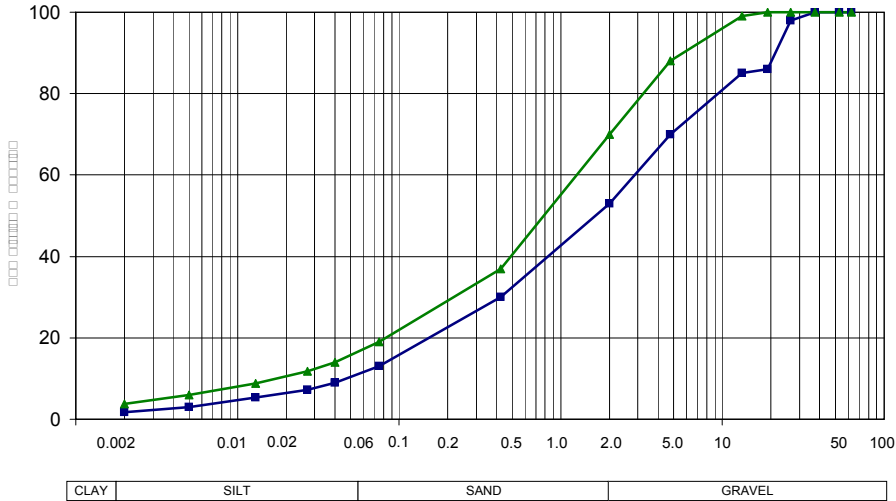
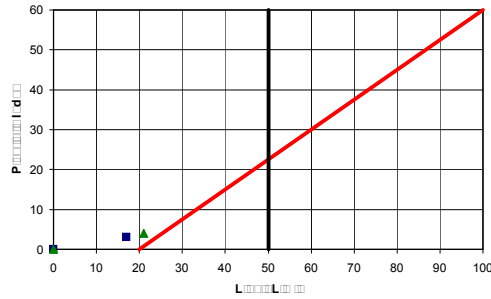
Sample No.	16770	16771
Soillab sample no.	S05-0592-15	S05-0592-16
Position	GPS 044	GPS 029
Depth (m)	0.7-1.0	0.5-0.8
Material Description	DARK BROWN FERRICRETE SANDY GRAVEL	LIGHT BROWN FERRICRETE GRAVELLY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	98	100
19.0 mm	86	100
13.2 mm	85	99
4.75 mm	70	88
2.00 mm	53	70
0.425 mm	30	37
0.075 mm	13	19
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	9	14
0.027 mm	7	12
0.013 mm	5	9
0.005 mm	3	6
0.002 mm	2	4
Clay	2	4
Silt	9	13
Sand	42	53
Gravel	47	30
ATTERBERG LIMITS		
Liquid Limit	17	21
Plasticity Index	3	4
Linear Shrinkage (%)	1.5	2.0
Grading Modulus	2.04	1.74
Classification	A-1-b(0)	A-1-b(0)
Unified Classification	SM	SP-SC
Chart Reference	■-■-■	▲-▲-▲

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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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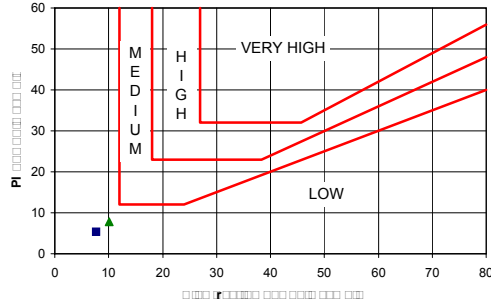
HIDROMETER/0592-08

PARTICLE SIZE ANALYSIS

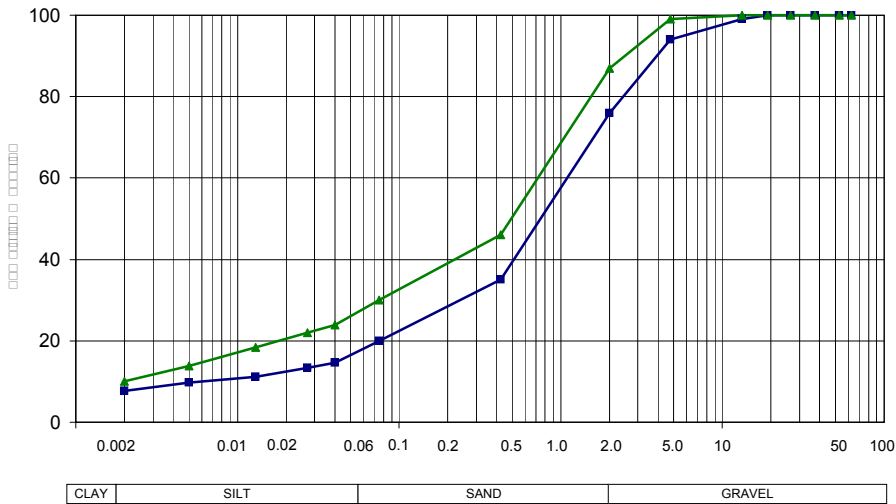
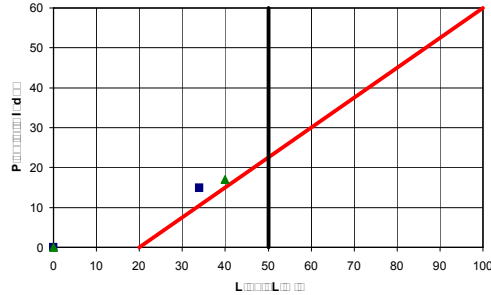
Sample No.	16772	16773
Soillab sample no.	S05-0592-17	S05-0592-18
Position	GPS 029	GPS 012
Depth (m)	0.8-1.0	0.8-1.0
Material Description	DARK YELLOW W/GRANITE GRAVELLY SAND	DARK R/ORANGE W/GRANITE SILTY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	99	100
4.75 mm	94	99
2.00 mm	76	87
0.425 mm	35	46
0.075 mm	20	30
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	15	24
0.027 mm	13	22
0.013 mm	11	18
0.005 mm	10	14
0.002 mm	8	10
Clay (%)	8	10
Silt (%)	10	17
Sand (%)	58	60
Gravel (%)	24	13
ATTERBERG LIMITS		
Liquid Limit	34	40
Plasticity Index	15	17
Linear Shrinkage (%)	6.5	8.0
Grading Modulus	1.69	1.37
Classification	A-2-6(0)	A-2-6(1)
Unified Classification	SC	SC
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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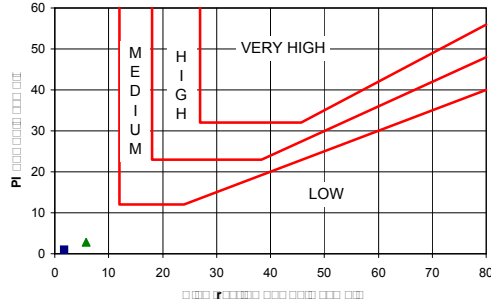


PARTICLE SIZE ANALYSIS

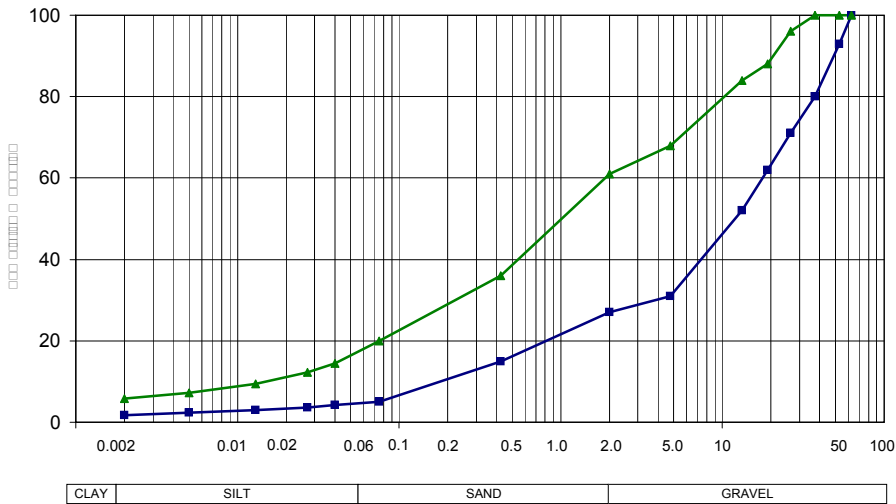
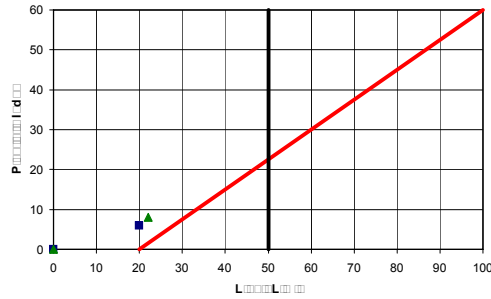
Sample No.	16774	16775
Soillab sample no.	S05-0592-19	S05-0592-20
Position	GPS 014	GPS 013
Depth (m)	0.25-0.45	0.7-1.0
Material Description	DARK GREY SANDY GRAVEL	DARK BROWN FERRICRETE GRAVELLY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	93	100
37.5 mm	80	100
26.5 mm	71	96
19.0 mm	62	88
13.2 mm	52	84
4.75 mm	31	68
2.00 mm	27	61
0.425 mm	15	36
0.075 mm	5	20
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	4	14
0.027 mm	4	12
0.013 mm	3	9
0.005 mm	2	7
0.002 mm	2	6
Clay	2	6
Silt	3	12
Sand	22	43
Gravel	73	39
ATTERBERG LIMITS		
Liquid Limit	20	22
Plasticity Index	6	8
Linear Shrinkage (%)	2.0	4.0
Grading Modulus	2.53	1.83
Classification	A-1-a(0)	A-2-4(0)
Unified Classification	GP GC	SC
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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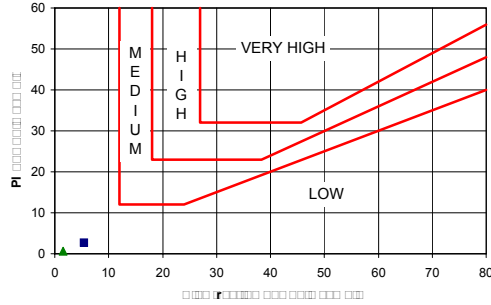


PARTICLE SIZE ANALYSIS

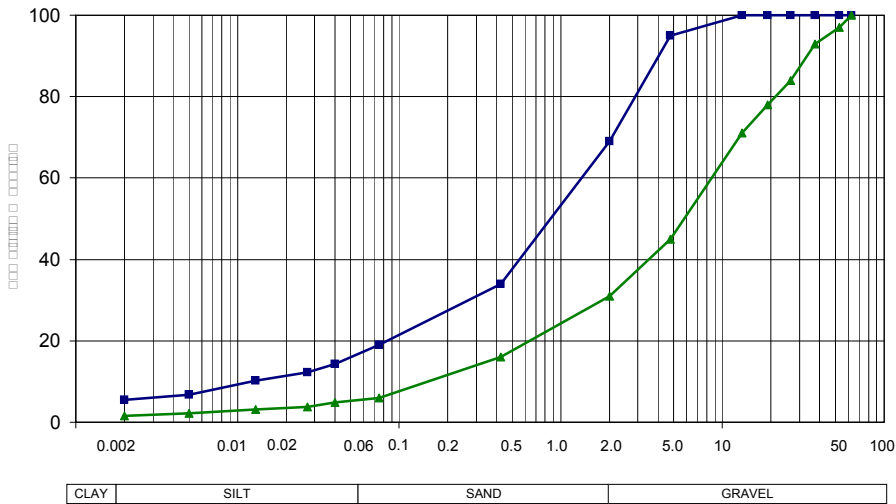
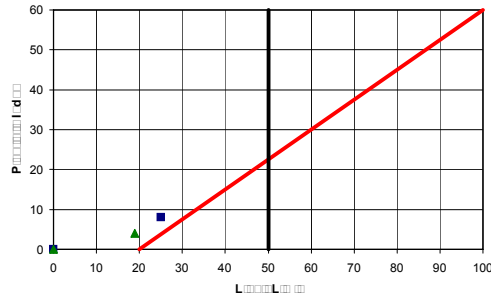
Sample No.	16776	16805
Soillab sample no.	S05-0592-21	S05-0592-22
Position	GPS 246	GPS 232
Depth (m)	0.45-1.2	0.4-0.75
Material Description	LIGHT BROWN	DARK BROWN
	□ UART □	□ UART □
	GRAVELLY SAND	SANDY GRAVEL
Dispersion (□)		
SCREEN ANALYSIS (□ PASSING)		
63.0 mm	100	100
53.0 mm	100	97
37.5 mm	100	93
26.5 mm	100	84
19.0 mm	100	78
13.2 mm	100	71
4.75 mm	95	45
2.00 mm	69	31
0.425 mm	34	16
0.075 mm	19	6
HYDROMETER ANALYSIS (□ PASSING)		
0.040 mm	14	5
0.027 mm	12	4
0.013 mm	10	3
0.005 mm	7	2
0.002 mm	5	2
Clay	5	2
Silt	12	4
Sand	52	26
Gravel	31	69
ATTERBERG LIMITS		
Liquid Limit	25	19
Plasticity Index	8	4
Linear Shrinkage (□)	4.0	1.5
Grading Modulus	1.78	2.47
Classification	A-2-4(0)	A-1-a(0)
Unified Classification	SC	GP □ GC
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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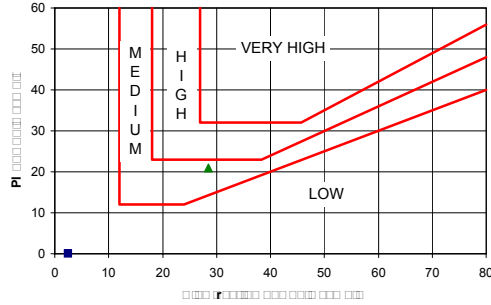


PARTICLE SIZE ANALYSIS

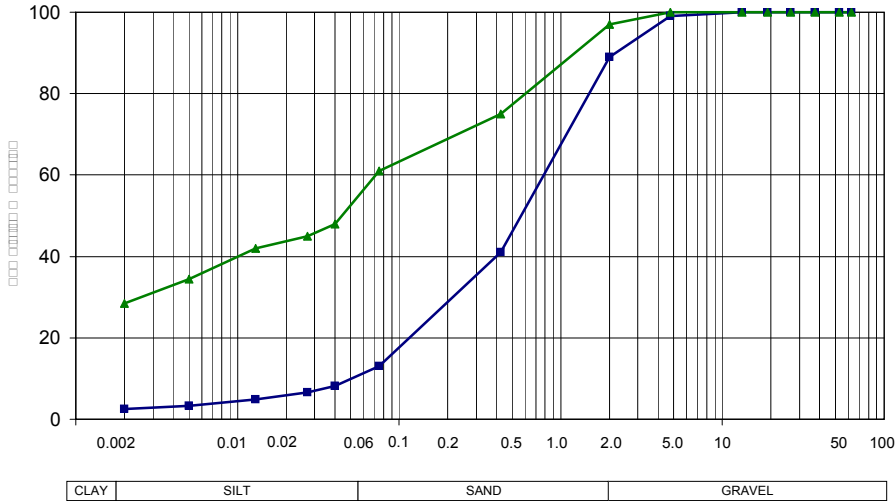
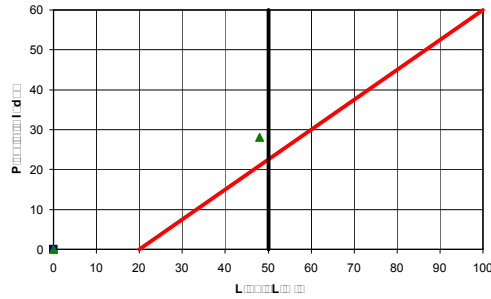
Sample No.	16778	16779
Soillab sample no.	S05-0592-23	S05-0592-24
Position	GPS 234	GPS 233
Depth (m)	0.9-1.2	0.7-1.5
Material Description	DARK YELLOW FERRICRETE GRAVELLY SAND	DARK GREY CLAYEY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	99	100
2.00 mm	89	97
0.425 mm	41	75
0.075 mm	13	61
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	8	48
0.027 mm	7	45
0.013 mm	5	42
0.005 mm	3	35
0.002 mm	2	29
Clay (%)	2	29
Silt (%)	8	27
Sand (%)	78	42
Gravel (%)	11	3
ATTERBERG LIMITS		
Liquid Limit		48
Plasticity Index	NP	28
Linear Shrinkage (%)	0.0	13.0
Grading Modulus	1.57	0.67
Classification	A-1-b(0)	A-7-6(13)
Unified Classification	SC	CL
Chart Reference	■-■-■	▲-▲-▲

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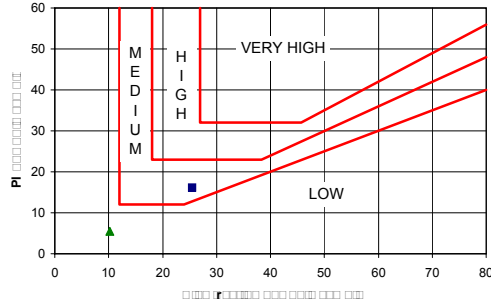


PARTICLE SIZE ANALYSIS

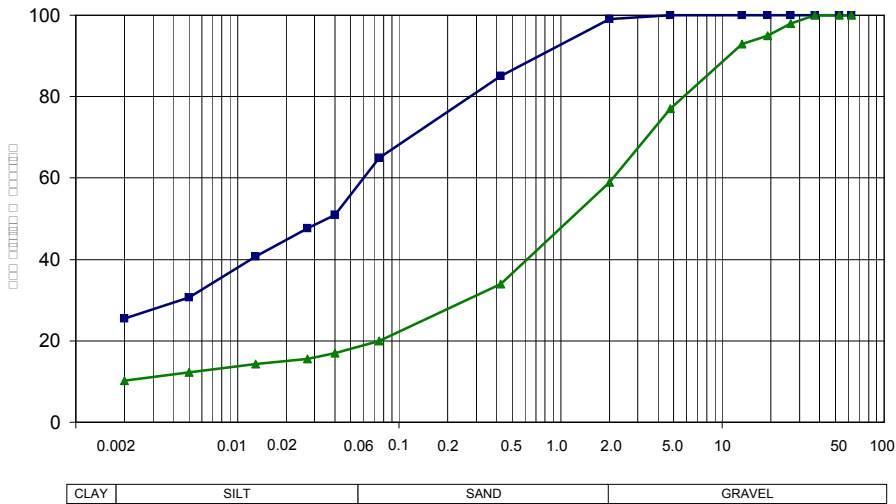
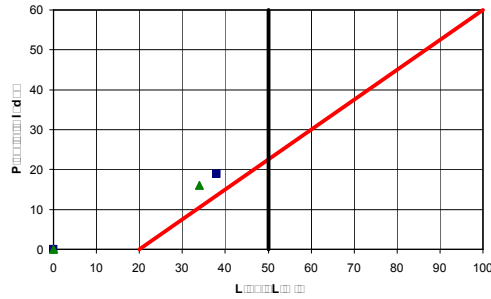
Sample No.	16780	16781
Soillab sample no.	S05-0592-25	S05-0592-26
Position	GPS 286	GPS 266
Depth (m)	0.6-1.0	0.35-0.9
Material Description	DARK GREY	DARK OLIVE
		UART
	SILTY SAND	SANDY GRAVEL
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	98
19.0 mm	100	95
13.2 mm	100	93
4.75 mm	100	77
2.00 mm	99	59
0.425 mm	85	34
0.075 mm	65	20
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	51	17
0.027 mm	48	16
0.013 mm	41	14
0.005 mm	31	12
0.002 mm	26	10
Clay	26	10
Silt	34	9
Sand	40	40
Gravel	1	41
ATTERBERG LIMITS		
Liquid Limit	38	34
Plasticity Index	19	16
Linear Shrinkage (%)	8.5	7.0
Grading Modulus	0.51	1.87
Classification	A-6(10)	A-2-6(0)
Unified Classification	CL	SC
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

PROJECT : WATERVAL 5IR PHASE I
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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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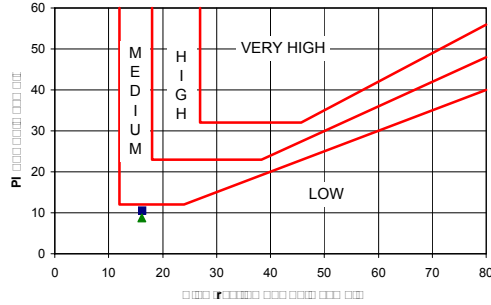


PARTICLE SIZE ANALYSIS

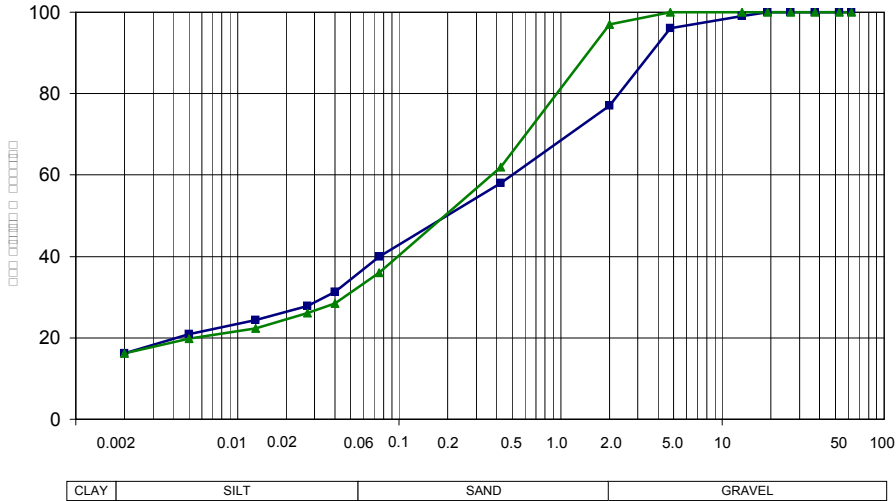
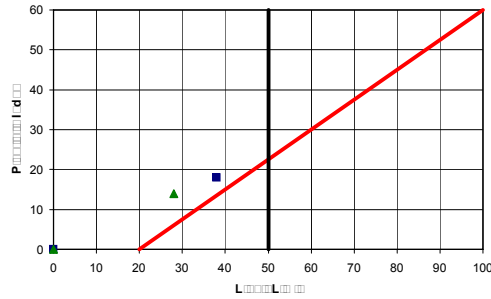
Sample No.	16782	16783
Soillab sample no.	S05-0592-27	S05-0592-28
Position	GPS 267	GPS 285
Depth (m)	0.55-0.9	0.1-0.5
Material Description	DARK BROWN FERRICRETE GRAVELLY SAND	DARK BROWN SILTY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	99	100
4.75 mm	96	100
2.00 mm	77	97
0.425 mm	58	62
0.075 mm	40	36
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	31	29
0.027 mm	28	26
0.013 mm	24	22
0.005 mm	21	20
0.002 mm	16	16
Clay (%)	16	16
Silt (%)	20	17
Sand (%)	41	64
Gravel (%)	23	3
ATTERBERG LIMITS		
Liquid Limit	38	28
Plasticity Index	18	14
Linear Shrinkage (%)	8.0	6.0
Grading Modulus	1.25	1.05
Classification	A-6(3)	A-6(1)
Unified Classification	SC	SC
Chart Reference	■-■-■	▲-▲-▲

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PLASTICITY CHART

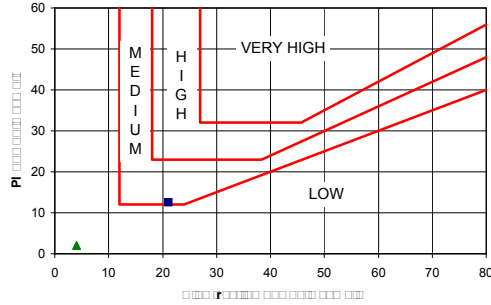


PARTICLE SIZE ANALYSIS

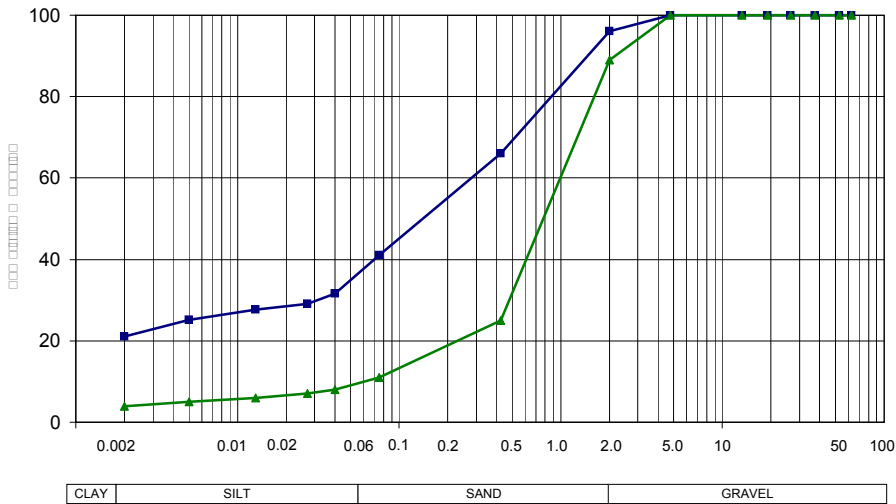
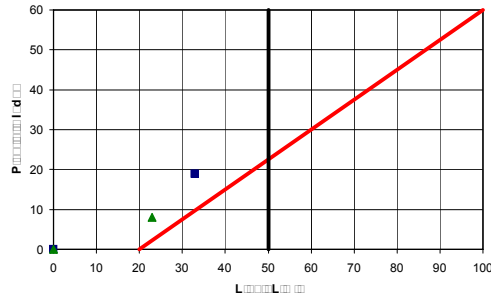
Sample No.	16784	16785
Soillab sample no.	S05-0592-29	S05-0592-30
Position	GPS 285	GPS 263
Depth (m)	0.5-0.9	0.9-1.2
Material Description	DARK OLIVE CLAYEY SAND	LIGHT OLIVE CLAYEY SAND
		CLAYEY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	100	100
2.00 mm	96	89
0.425 mm	66	25
0.075 mm	41	11
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	32	8
0.027 mm	29	7
0.013 mm	28	6
0.005 mm	25	5
0.002 mm	21	4
Clay (%)	21	4
Silt (%)	16	6
Sand (%)	59	79
Gravel (%)	4	11
ATTERBERG LIMITS		
Liquid Limit	33	23
Plasticity Index	19	8
Linear Shrinkage (%)	9.0	4.0
Grading Modulus	0.97	1.75
Classification	A-6(4)	A-2-4(0)
Unified Classification	SC	CL
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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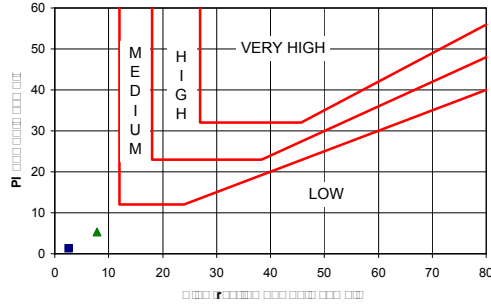


PARTICLE SIZE ANALYSIS

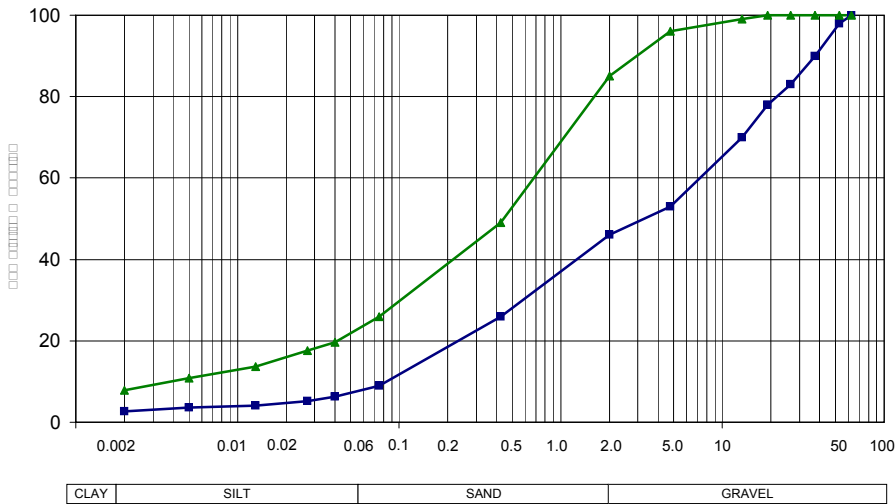
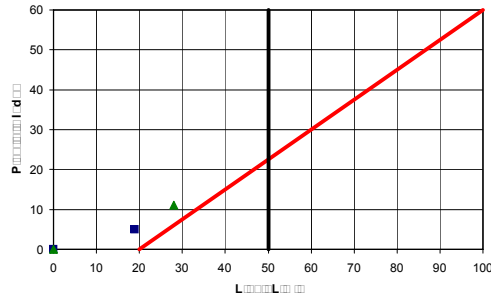
Sample No.	16786	16787
Soillab sample no.	S05-0592-31	S05-0592-32
Position	GPS 277	GPS 275
Depth (m)	0.1-0.55	0.9-1.2
Material Description	DARK GREY SANDY GRAVEL	DARK Y/ORANGE SILTY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	98	100
37.5 mm	90	100
26.5 mm	83	100
19.0 mm	78	100
13.2 mm	70	99
4.75 mm	53	96
2.00 mm	46	85
0.425 mm	26	49
0.075 mm	9	26
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	6	20
0.027 mm	5	18
0.013 mm	4	14
0.005 mm	4	11
0.002 mm	3	8
Clay	3	8
Silt	5	15
Sand	38	62
Gravel	54	15
ATTERBERG LIMITS		
Liquid Limit	19	28
Plasticity Index	5	11
Linear Shrinkage (%)	2.0	5.0
Grading Modulus	2.19	1.40
Classification	A-1-a(0)	A-6(2)
Unified Classification	SW-SC	SC
Chart Reference	■-■-■	▲-▲-▲

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PLASTICITY CHART

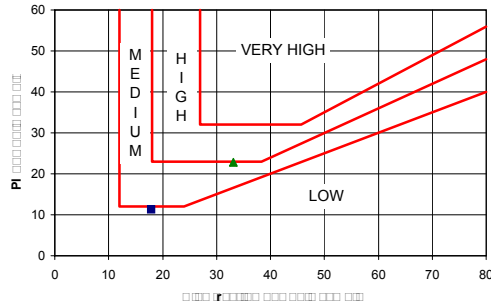


PARTICLE SIZE ANALYSIS

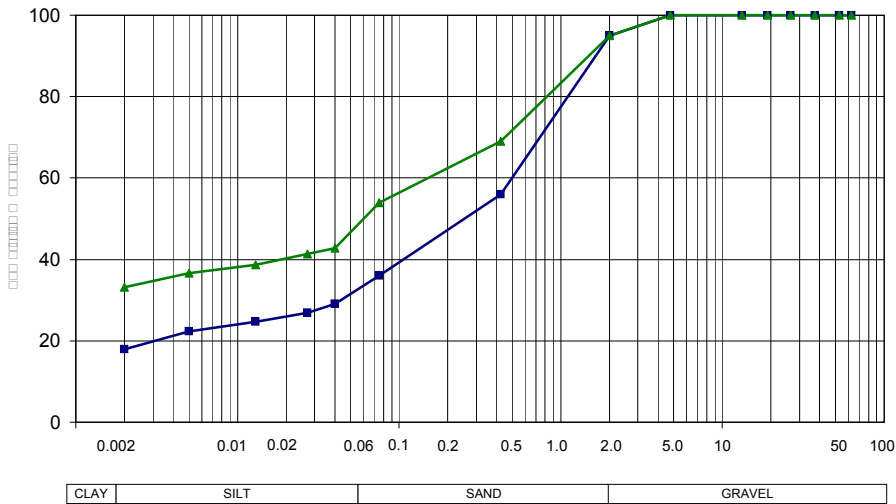
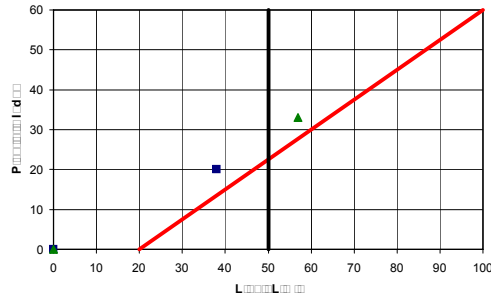
Sample No.	16788	16789
Soillab sample no.	S05-0592-33	S05-0592-34
Position	GPS 271	GPS 262
Depth (m)	0.95-1.2	0.75-1.0
Material Description	DARK YELLOW CLAYEY SAND	LIGHT OLIVE CLAYEY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	100	100
2.00 mm	95	95
0.425 mm	56	69
0.075 mm	36	54
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	29	43
0.027 mm	27	41
0.013 mm	25	39
0.005 mm	22	37
0.002 mm	18	33
Clay	18	33
Silt	15	16
Sand	62	46
Gravel	5	5
ATTERBERG LIMITS		
Liquid Limit	38	57
Plasticity Index	20	33
Linear Shrinkage (%)	8.5	14.5
Grading Modulus	1.13	0.82
Classification	A-6(2)	A-7-6(13)
Unified Classification	SC	CH
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

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POTENTIAL EXPANSIVENESS



PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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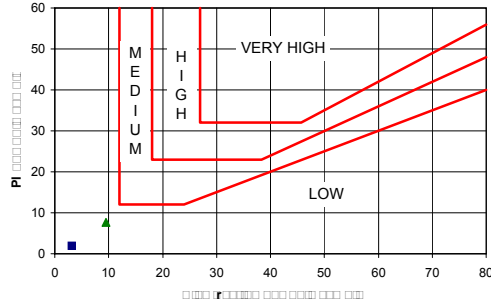


PARTICLE SIZE ANALYSIS

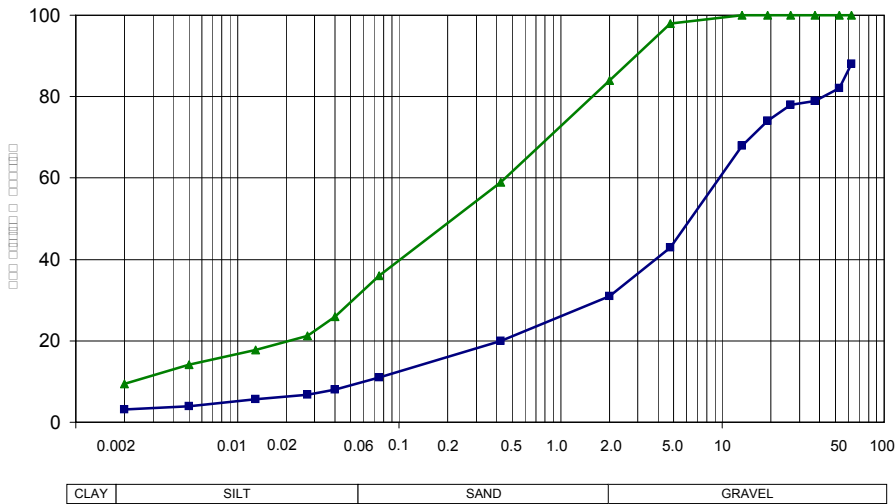
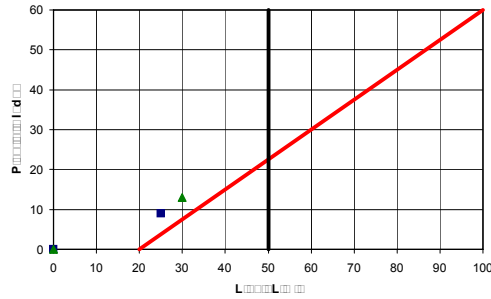
Sample No.	16790	16791
Soillab sample no.	S05-0592-36	S05-0592-37
Position	GPS 61	GPS 61
Depth (m)	0.1-0.5	0.6-1.0
Material Description	DARK BROWN □ UART SANDY GRAVEL	DARK R/ORANGE □ UART SILTY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	88	100
53.0 mm	82	100
37.5 mm	79	100
26.5 mm	78	100
19.0 mm	74	100
13.2 mm	68	100
4.75 mm	43	98
2.00 mm	31	84
0.425 mm	20	59
0.075 mm	11	36
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	8	26
0.027 mm	7	21
0.013 mm	6	18
0.005 mm	4	14
0.002 mm	3	9
Clay	3	9
Silt	7	22
Sand	21	52
Gravel	69	16
ATTERBERG LIMITS		
Liquid Limit	25	30
Plasticity Index	9	13
Linear Shrinkage (%)	4.0	6.5
Grading Modulus	2.38	1.21
Classification	A-2-4(0)	A-6(1)
Unified Classification	GP □ GC	SC
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

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PLASTICITY CHART

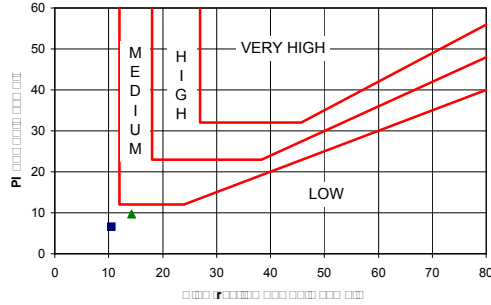


PARTICLE SIZE ANALYSIS

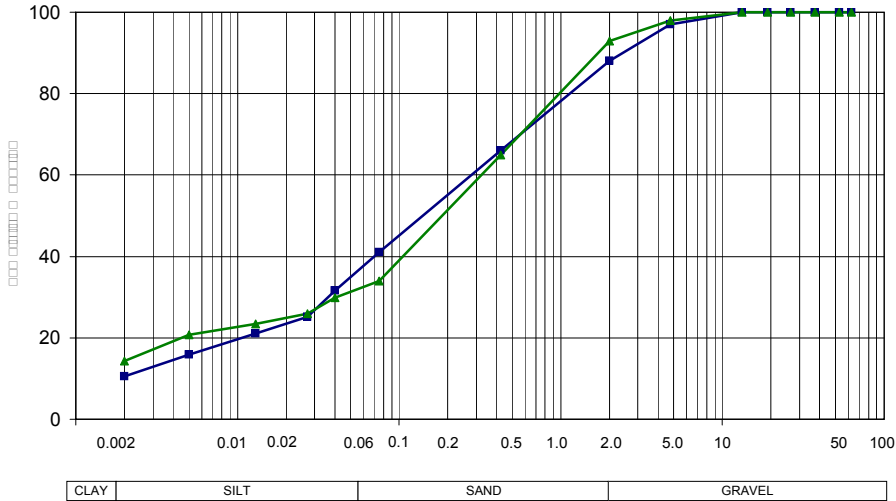
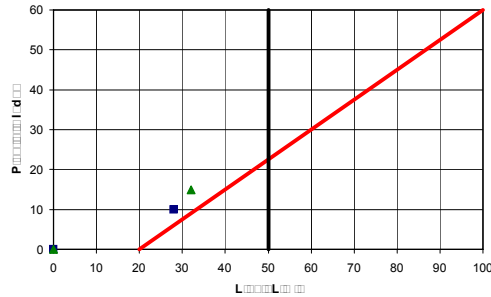
Sample No.	16792	16793
Soillab sample no.	S05-0592-38	S05-0592-39
Position	GPS 61	GPS 66
Depth (m)	1.2-1.5	0.0-0.4
Material Description	LIHGT	DARK
	BROWN	GREY
	UART	FERRICRETE
	SILTY SAND	SILTY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	100
4.75 mm	97	98
2.00 mm	88	93
0.425 mm	66	65
0.075 mm	41	34
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	32	30
0.027 mm	25	26
0.013 mm	21	23
0.005 mm	16	21
0.002 mm	11	14
Clay	11	14
Silt	26	18
Sand	51	61
Gravel	12	7
ATTERBERG LIMITS		
Liquid Limit	28	32
Plasticity Index	10	15
Linear Shrinkage (%)	4.0	6.5
Grading Modulus	1.05	1.08
Classification	A-4(1)	A-2-6(1)
Unified Classification	SC	SC
Chart Reference	■-■-■	▲-▲-▲

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PLASTICITY CHART

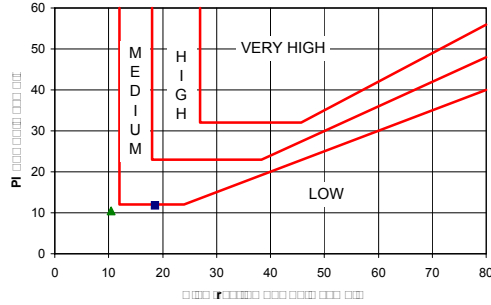


PARTICLE SIZE ANALYSIS

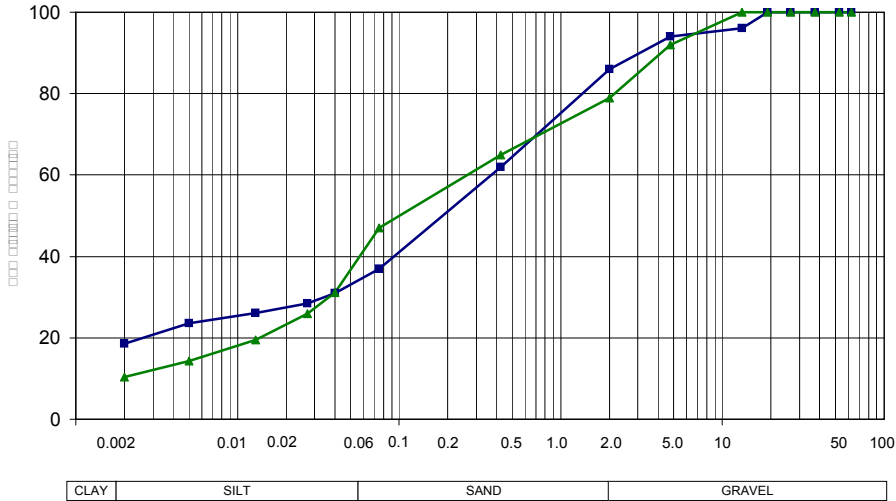
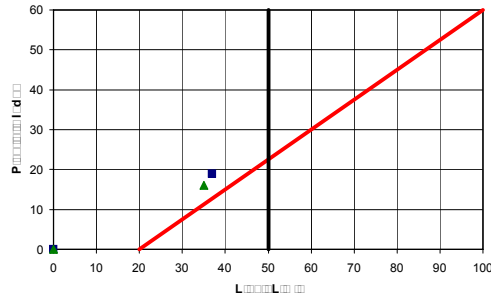
Sample No.	16794	16795
Soillab sample no.	S05-0592-40	S05-0592-41
Position	GPS 66	GPS 66
Depth (m)	0.4-0.7	1.0-1.3
Material Description	DARK BROWN CLAYEY SAND	PALE RED FERRICRETE SILTY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	96	100
4.75 mm	94	92
2.00 mm	86	79
0.425 mm	62	65
0.075 mm	37	47
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	31	31
0.027 mm	29	26
0.013 mm	26	20
0.005 mm	24	14
0.002 mm	19	10
Clay (%)	19	10
Silt (%)	16	30
Sand (%)	52	39
Gravel (%)	14	21
ATTERBERG LIMITS		
Liquid Limit	37	35
Plasticity Index	19	16
Linear Shrinkage (%)	9.0	8.0
Grading Modulus	1.15	1.09
Classification	A-6(2)	A-6(4)
Unified Classification	SC	SC
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

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PLASTICITY CHART



CLAY SILT SAND GRAVEL

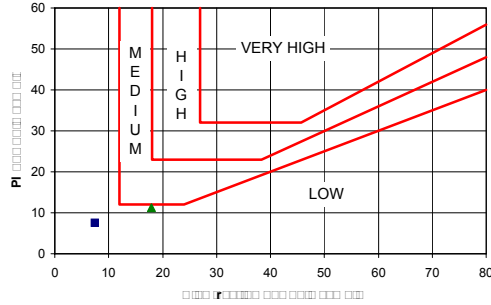


PARTICLE SIZE ANALYSIS

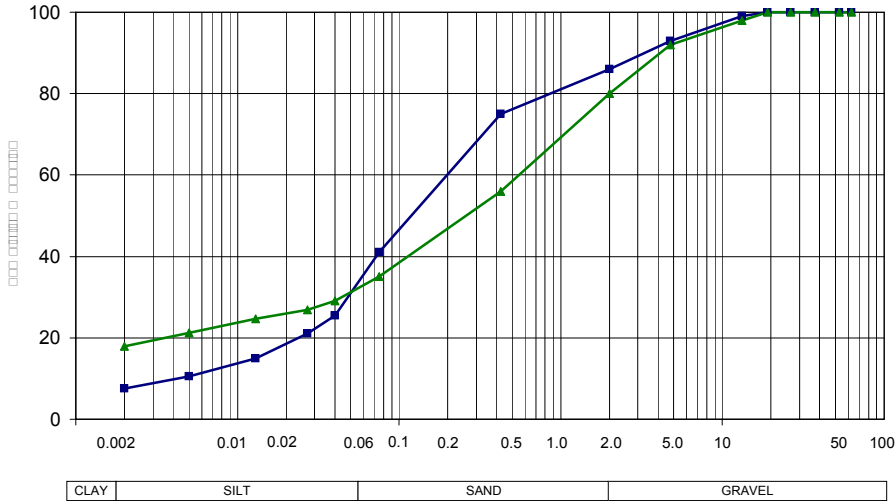
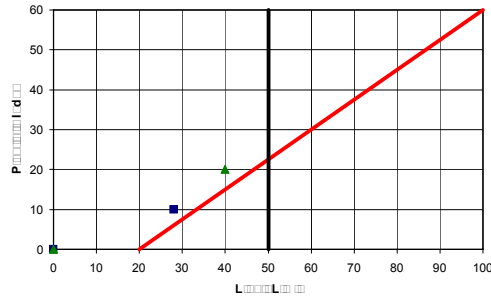
Sample No.	16796	16797
Soillab sample no.	S05-0592-42	S05-0592-43
Position	GPS 66	GPS 69
Depth (m)	1.66-1.8	0.4-0.6
Material Description	DARK BROWN FERRICRETE SILTY SAND	DARK BROWN FERRICRETE GRAVELLY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	99	98
4.75 mm	93	92
2.00 mm	86	80
0.425 mm	75	56
0.075 mm	41	35
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	26	29
0.027 mm	21	27
0.013 mm	15	25
0.005 mm	11	21
0.002 mm	8	18
Clay	8	18
Silt	27	15
Sand	52	48
Gravel	14	20
ATTERBERG LIMITS		
Liquid Limit	28	40
Plasticity Index	10	20
Linear Shrinkage (%)	5.0	9.5
Grading Modulus	0.98	1.29
Classification	A-4(1)	A-2-6(2)
Unified Classification	SC	SC
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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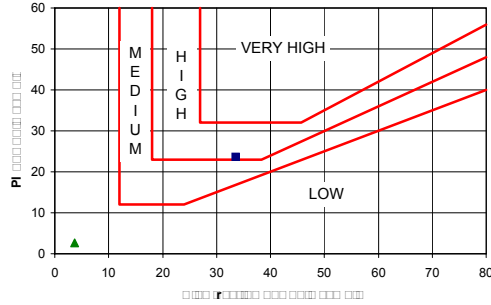
HIDROMETER/0592-21

PARTICLE SIZE ANALYSIS

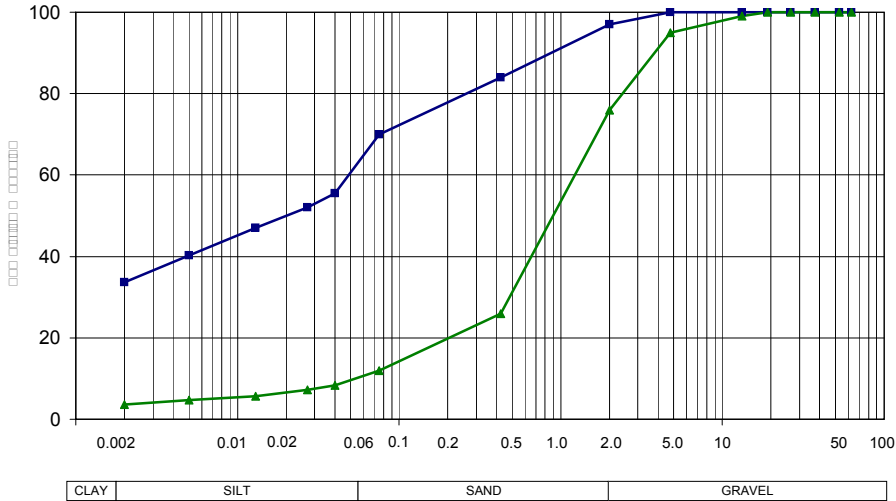
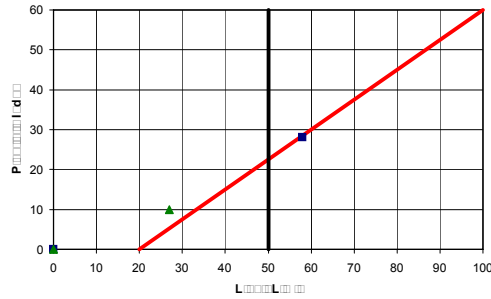
Sample No.	16798	16799
Soillab sample no.	S05-0592-44	S05-0592-45
Position	GPS 69	GPS 71
Depth (m)	1.3-1.8	0.75-1000
Material Description	DARK YELLOW SANDY CLAY	DARK YELLOW W/GRANITE GRAVELLY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	99
4.75 mm	100	95
2.00 mm	97	76
0.425 mm	84	26
0.075 mm	70	12
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	55	8
0.027 mm	52	7
0.013 mm	47	6
0.005 mm	40	5
0.002 mm	34	4
Clay	34	4
Silt	30	7
Sand	33	66
Gravel	3	24
ATTERBERG LIMITS		
Liquid Limit	58	27
Plasticity Index	28	10
Linear Shrinkage (%)	13.0	5.0
Grading Modulus	0.49	1.86
Classification	A-7-5(17)	A-2-4(0)
Unified Classification	MH	SC
Chart Reference	■-■-■	▲-▲-▲

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PLASTICITY CHART



CLAY	SILT	SAND	GRAVEL
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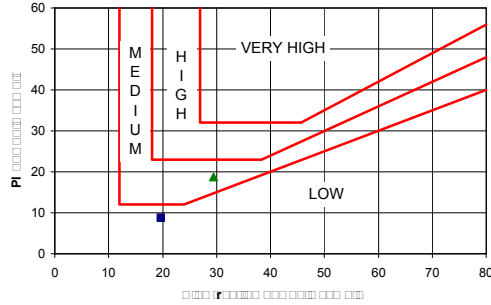
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PARTICLE SIZE ANALYSIS

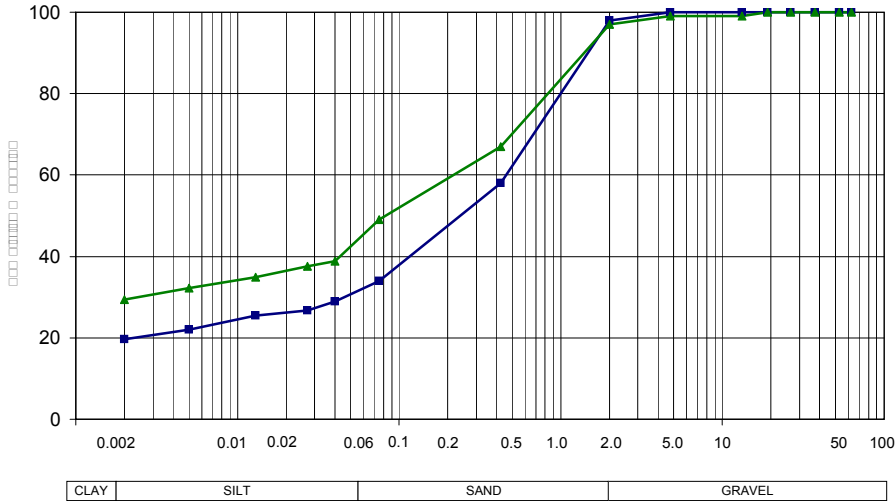
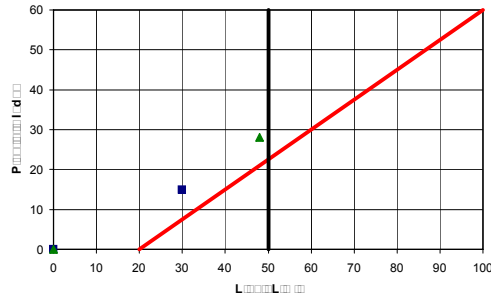
Sample No.	16800	16801
Soillab sample no.	S05-0592-46	S05-0592-47
Position	GPS 77	TRANSPORTED
Depth (m)	0.5-0.8	A
Material Description	DARK YELLOW	LIGHT GREY
	CLAYEY SAND	CLAYEY SAND
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	100
53.0 mm	100	100
37.5 mm	100	100
26.5 mm	100	100
19.0 mm	100	100
13.2 mm	100	99
4.75 mm	100	99
2.00 mm	98	97
0.425 mm	58	67
0.075 mm	34	49
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	29	39
0.027 mm	27	38
0.013 mm	26	35
0.005 mm	22	32
0.002 mm	20	29
Clay (%)	20	29
Silt (%)	12	15
Sand (%)	66	52
Gravel (%)	2	3
ATTERBERG LIMITS		
Liquid Limit	30	48
Plasticity Index	15	28
Linear Shrinkage (%)	6.5	13.0
Grading Modulus	1.10	0.87
Classification	A-2-6(1)	A-7-6(9)
Unified Classification	SC	SC
Chart Reference	■ ■ ■ ■ ■	▲ ▲ ▲ ▲ ▲

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PLASTICITY CHART

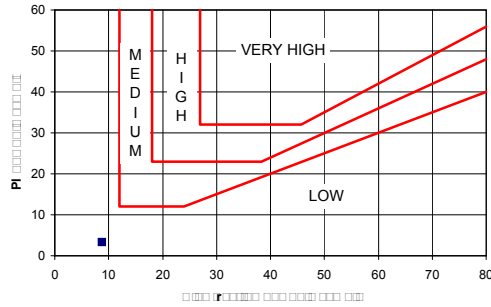


PARTICLE SIZE ANALYSIS

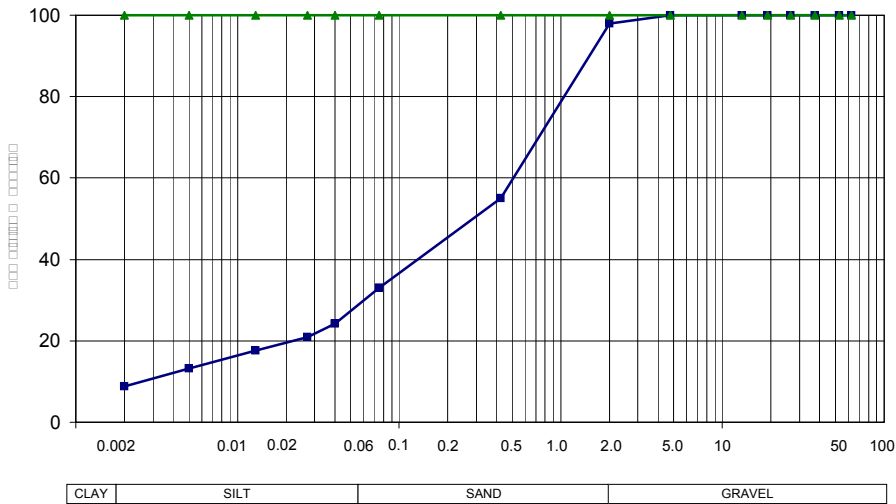
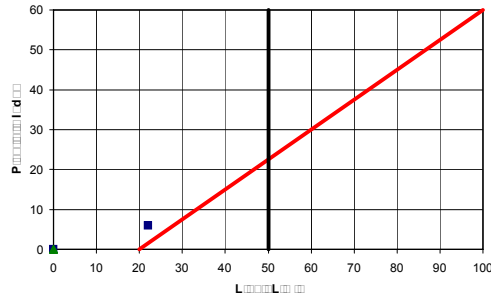
Sample No.	16802	
Soillab sample no.	S05-0592-48	
Position	COLLUVIUM	
Depth (m)	A	
Material Description	DARK	
	GREY	
	SILTY SAND	
Dispersion (%)		
SCREEN ANALYSIS (% PASSING)		
63.0 mm	100	
53.0 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	100	
4.75 mm	100	
2.00 mm	98	
0.425 mm	55	
0.075 mm	33	
HYDROMETER ANALYSIS (% PASSING)		
0.040 mm	24	
0.027 mm	21	
0.013 mm	18	
0.005 mm	13	
0.002 mm	9	
Clay	9	
Silt	20	
Sand	69	
Gravel	2	
ATTERBERG LIMITS		
Liquid Limit	22	
Plasticity Index	6	
Linear Shrinkage (%)	2.0	
Grading Modulus	1.14	
Classification	A-2-4(0)	
Unified Classification	SP-SC	
Chart Reference	■-■-■	▲-▲-▲

PROJECT : WATERVAL 5IR PHASE I
 JOB No. : S05-0592
 DATE : 2005-07-15

POTENTIAL EXPANSIVENESS



PLASTICITY CHART



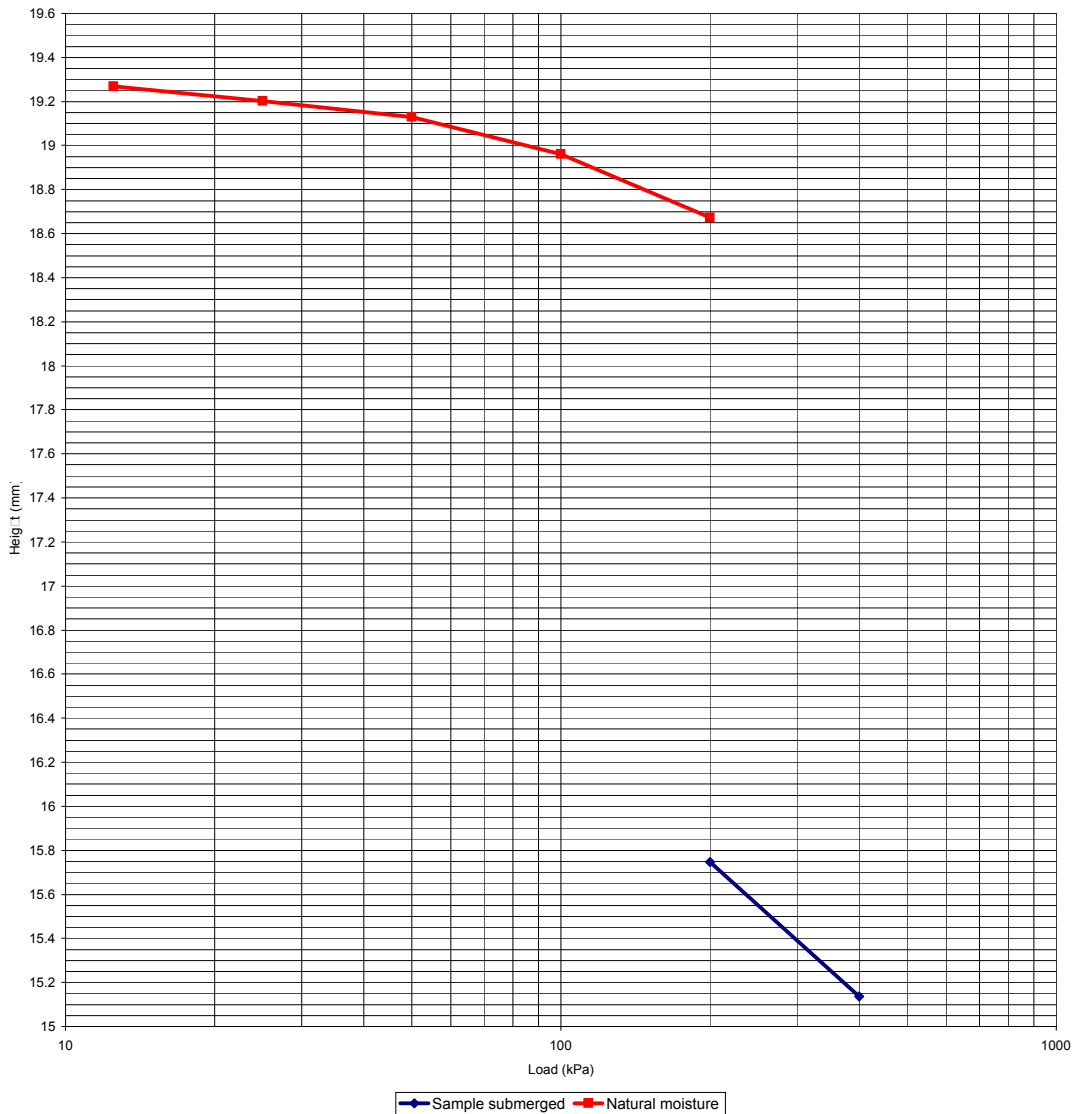
CLAY	SILT	SAND	GRAVEL
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COLLAPSE POTENTIAL

PROJECT:	WATERVAL SIR	INITIAL DRY DENSITY (kg/m.)	1466
SAMPLE No.	GPS 13	INITIAL MOISTURE (%)	5.9
DEPTH (m):	0.7-1.0	MOISTURE AFTER TEST (%)	14.8
INITIAL HEIGHT OF SAMPLE (mm)	19.3	RELATIVE DENSITY	2.675
SAMPLE CONDITION	UNDISTURBED	INITIAL VOID RATIO	0.825
SOILLAB SAMPLE No.	S05-592-35	VOID RATIO AFTER SOAKING	0.489
		□ COLLAPSE	15.15

LOAD (kPa)	0	12.5	25	50	100	200	W	400
HEIGHT (mm)	19.300	19.268	19.202	19.128	18.962	18.672	15.748	15.136
VOID RATIO	0.825	0.822	0.816	0.809	0.793	0.765	0.489	0.431



KONS/SWGPOTENTIAL/0592-01

APPENDIX H: EMPR

**ENVIRONMENTAL
MANAGEMENT PROGRAMME
(EMPr)**

**PROPOSED JUKSKEI VIEW
EXTENSION 128**

**PART OF THE REMAINDER OF
PORTION 1 OF THE FARM
WATERVAL 5 IR, GAUTENG**

OCTOBER 2016

LEBOMBO GARDEN BUILDING
36 LEBOMBO ROAD
ASHLEA GARDENS
0081
P.O. BOX 11375
MAROELANA
0161
Tel: (012) 346 3810
Fax: 086 570 5659
E-mail: reception@bokamoso.net
Website: www.bokamoso.net



1 Project Outline

1.1 Background

Balwin Properties (Ltd) (The Applicant) is planning to develop a Residential Township. **Bokamoso Landscape Architects and Environmental Consultants CC** was appointed to compile a Basic Assessment Report (BAR) for the proposed **Jukskei View Extension 128** development and its associated infrastructure. The Report has been prepared to comply with the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998).

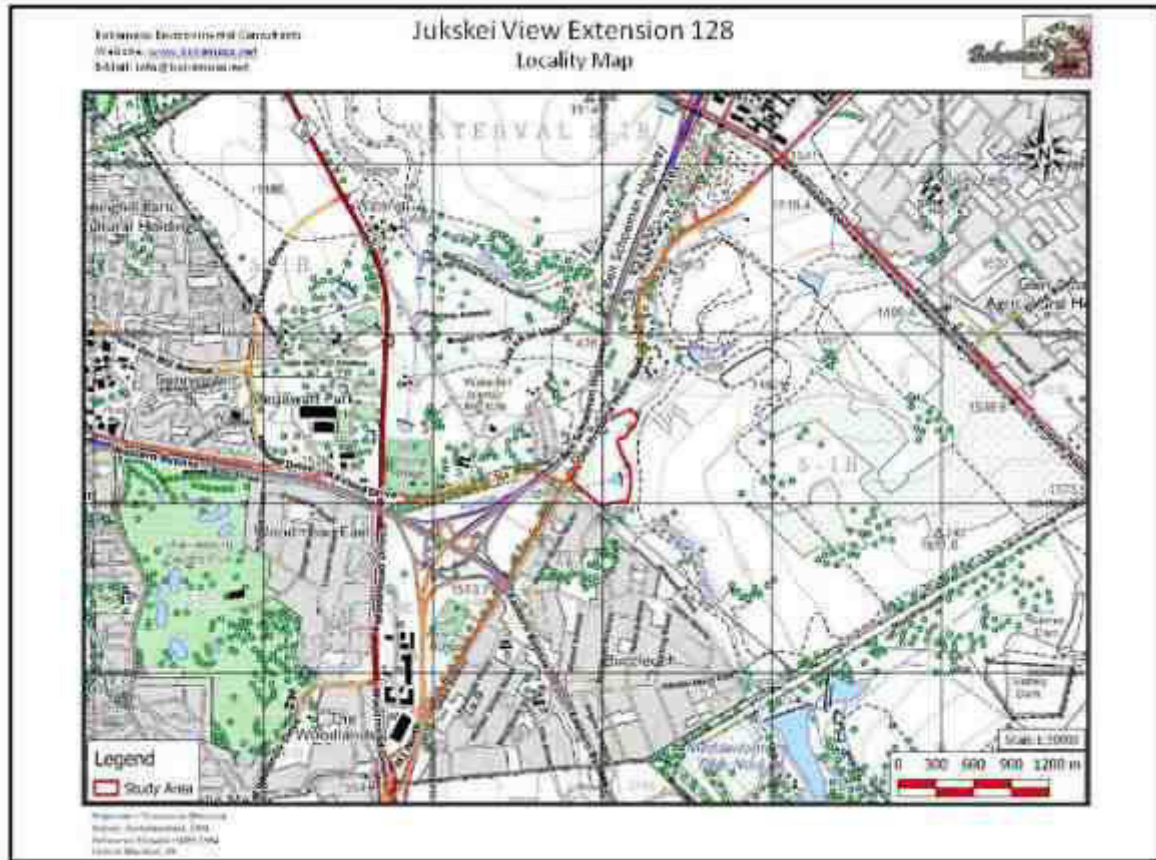


Figure 1: Locality Map

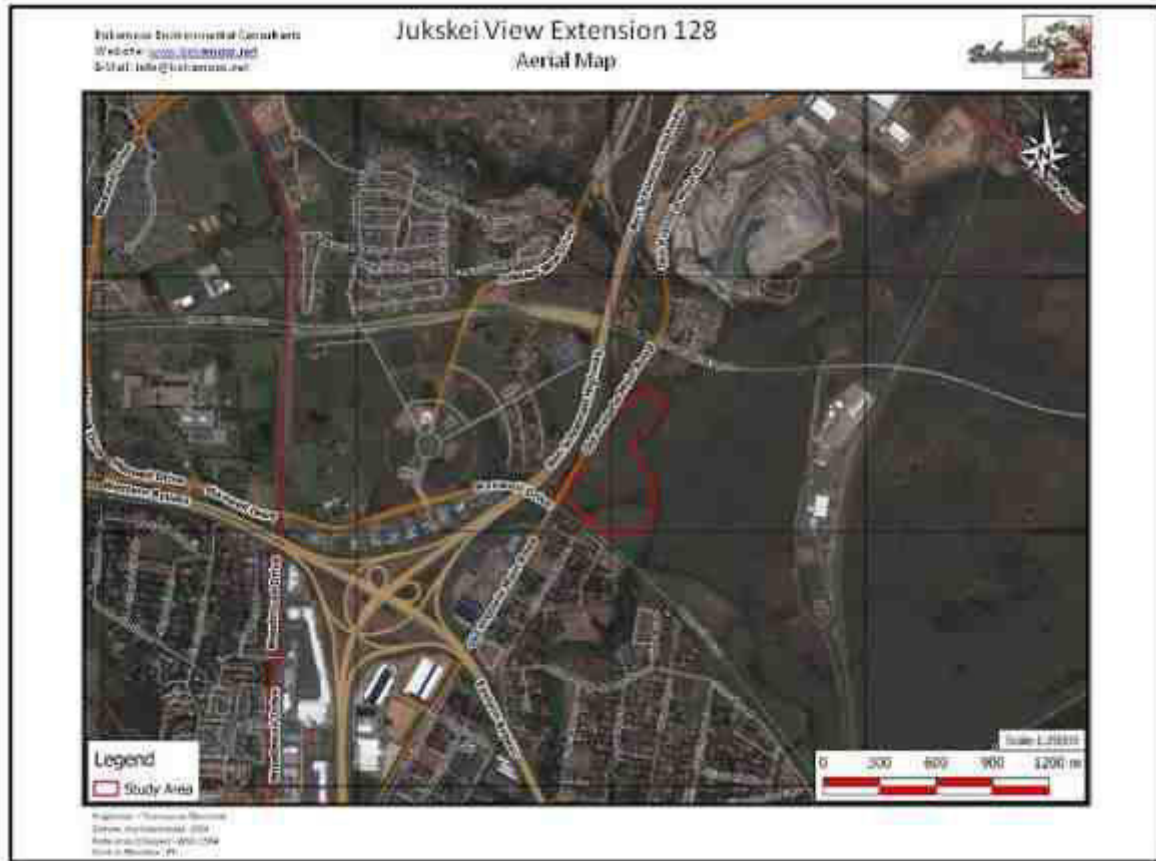


Figure 2: Aerial Map

1.2 Project description

The proposed **Jukskei View X128 development** is situated on the **Remainder of Portion 1 of the Farm Waterval 5 IR, Gauteng Province (Refer to Figure 1 for the Locality Map)**. The study area is approximately **22 hectares**, however the actual development area measures approximately **14 hectares**.

Timeframe for construction:

The construction for the proposed Development of Jukskei View X128 will commence as soon as approval for the proposed development has been granted from the relevant authorities.

The EMP will be a binding document for purposes of compliance.

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 of other Authorities; and
- Monitor the project.

EMP context

This EMP fits into the overall planning process of the project by carrying out the conditions of consent as 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 and/or proponent (D), Environmental Control Officer (ECO), Project Manager (PM), Contractors

(C), Environmental Assessment Practitioner (EAP), Environmental Site Officer – internal officer (ESO), Operational Phase Leasing Company (OPLC), Operational Phase Maintenance, Management and Compliance Monitoring Team (OPMMCMT), Construction and Operational Phase Security Management (COPSM) and Health and Safety Officer (HSO). Landowners, interested and affected parties and the relevant environmental and project specialists' are 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 Decision. 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 by the developer, for the duration of the construction and operational phases of the development in order to ensure compliance with the requirements of this EMP.

Contact details of appointed ECO

ECO details must be made available as soon as the developer appointed the relevant person/ company.

- The Environmental Control Officer (ECO) shall ensure that the contractor is aware of all the specifications pertaining to the project.
- Any damage to the environment must be repaired immediately after consultation between the Environmental Control Officer (ECO), Project Management, appointed Contractors, Development Management, Engineers.
- The Environmental Control Officer (ECO) shall ensure that the developer staff and/or contractor are adhering to all stipulations of the EMP.
- The Environmental Control Officer (ECO) 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 (ECO) shall be responsible for the environmental training program.
- The Environmental Control Officer (ECO) 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 internal environmental representative to monitor, review and verify overall compliance with the EMP during construction and operational phases. The ESO is not an independent appointment but must be a member of

the contractor's management team and the developer's operational phase management team. The ESO must ensure that he/she is involved with all aspects of the construction phase (from site clearance to rehabilitation) and the operational phase. The ESO must report to the developer and to the appointed independent ECO.

Authority (A):

The authority referred to is the Gauteng Department of Agriculture and Rural Development (GDARD).

Other Authorities (OA):

Other authorities referred to are:

- The National Department of Environmental Affairs (DEA);
- The Department of Water and Sanitation (DWS); and
- The South-African Heritage Resources Council (SAHRA).

Environmental Assessment Practitioner (EAP):

According to section 1 of the 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".

Operational Phase Leasing Company (OPLC)/ Developer

The company/party responsible for the leasing of the commercial/business, residential and other leasable structures/ facilities provided as part of the mixed-use development. The contact details and responsibilities of the person/s or company/s must be supplied to the ECO and GDARD prior to commencement with construction.

Operational Phase Maintenance, Management and Compliance Monitoring Team (OPMMCMT)

The team responsible for the maintenance, management and monitoring of the operational phase compliance with the EMP and all other management plans, guidelines etc.

Construction and Operational Phase Security Management (COPSM)

The team responsible for the management of the construction and operational phase security management.

Health and Safety Officer (HSO)

External Construction Phase Health and Safety Officer.

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 Control 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 responsible party (project manager/management company, engineer etc.) will be required for specific sensitive actions on request of the authorities/ECO/ESO. 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 the relevant authority/ the ECO of the 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 and/ or a sketch map of the locality of work; and
- When- the sequencing of actions with due commencement dates and completion date estimate.

The responsible party 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 relevant authority/ ECO/ESO.

3.7 Record Keeping

All records related to the implementation of this management plan (e.g. site instruction book, ESA and/ or ESO diary, 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 and should be available at any time for scrutiny by any relevant authorities.

3.8 Acts

Title of legislation, policy or guideline: Administering authority: Promulgation Date:

<p>National Environmental Management Act, 1998 (Act No. 107 of 1998 as amended).</p>	<p>National & Provincial</p>	<p>27 November 1998</p>
<p>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.</p> <p>The Act also promotes sustainable development.</p> <p><i>Implications to the development:</i></p> <p>Not Significant: The proposed development will be in line with the principles contained in NEMA and it will promote sustainable development.</p>		
<p>Environmental Impact Assessment Regulations in terms of Chapter 5 of the National Environmental Management Act, 1998 (Act No 107 of 1998)</p>	<p>National</p>	<p>2014</p>
<p>The Minister of Environmental Affairs passed (in December 2014) the Amended Environmental Impact Assessment Regulations in terms of Chapter 5 of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA). The Amended Regulations came into effect on 8 December 2014, and therefore all new applications must be made in terms of the Amended NEMA regulations and not in terms of the 2006 NEMA Regulations or the New Regulations of the ECA. The purpose of this process is to determine the possible negative and positive impacts of the proposed development on the surrounding environment and to provide measures for the mitigation of negative impacts and to maximize positive impacts.</p> <p>Notice No. R 983, R 984 and R985 of the Amended Regulations lists the activities that indicate</p>		

the process to be followed. The activities listed in Notice No. R 983 requires that a Basic Assessment process be followed and the Activities listed in terms of Notice No. R 984 requires that the Scoping and EIA process be followed. Notice No. R 985 has been introduced to make provision for Activities in certain geographical and sensitive areas.

Subsequently, Listing 1 (R. 983) requires that a Basic Assessment Process be followed. It should however be noted that the Draft Guideline Document of DEA [Department of Environmental Affairs, (previously known as the Department of Environmental Affairs and Tourism)] states that if an activity being applied for is made up of more than one listed activity, and the Scoping and EIA process is required for one or more of these activities, the Scoping and EIA process must be followed for the whole application.

Implications for development:

Significant– The application for the proposed development consist of activities listed under Notice R. 983 (Listing No. 1) and R. 985 (Listing No. 3) and therefore a Basic Assessment Report will be submitted to GDARD for consideration.

National Water Act, 1998 (Act No. 36 of 1998)

National & Provincial

20 August 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.

In terms of the section 21 of the National Water Act, the developer must obtain water use licences if the following activities are taking place:

- a) Taking water from a water resource;
- b) Storing water;
- c) Impeding or diverting the flow of water in a water course;
- d) Engaging in a stream flow reduction activity contemplated in section 36;
- e) Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
- f) Discharging waste or water containing waste into a water resource through a pipeline, canal, sewer, sea outfall or other conduit;
- g) Disposing of waste in a manner which may detrimentally impact on a water resource;
- h) Disposing in any manner which contains waste from or which has been heated in any industrial or power generation process;
- i) Altering the bed, banks, course or disposing of water found underground if it is necessary for the safety of people;
- j) Removing, discharging, or disposing of water found underground if it is necessary for

- the efficient continuation of an activity or for the safety of people; and
- k) Using water for recreational purposes.

The National Water Act also requires that (where applicable) the 1:50 and 1:100 year flood line be indicated on all the development drawings (even the drawings for the external services) that are submitted for approval.

Implications for the Development:

Significant - The proposed development is subjected to flood lines of a natural stream / water course within an expected frequency of 1:50 and 1:100 years. The stream located on the southern portion of the site flows west to east into the Jukskei River which is located to the east of the site. The proposed development will require the construction of a bridge over the watercourse. A Water Use Licence Application (WULA) will be applied for in terms of Section 21 (i) and (c) of the National Water Act, 1998 (Act 36 of 1998) which is administered by the Department of Water and Sanitation (**Refer to Figure 3 – Hydrology Map**).

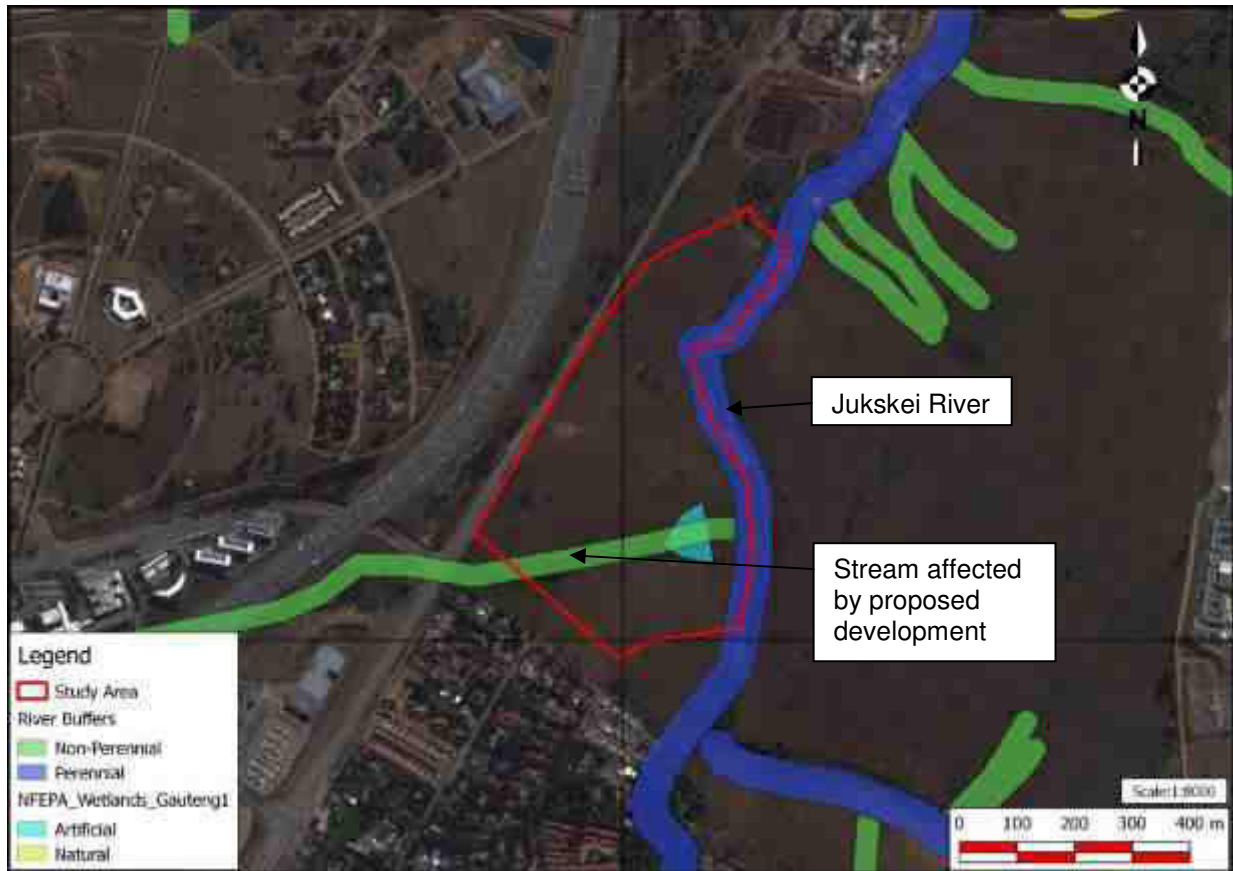


Figure 3: Hydrology Map

<p>National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004)</p>	<p>National & Provincial</p>	<p>2004</p>
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<p>The NEMA: AQA serves to repeal the Atmospheric Pollution Prevention Act (45 of 1965) and various other laws dealing with air pollution and it provides a more comprehensive framework within which the critical question of air quality can be addressed.</p> <p>The purpose of the Act is to set norms and standards that relate to:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Institutional frameworks, roles and responsibilities <input type="checkbox"/> Air quality management planning <input type="checkbox"/> Air quality monitoring and information management <input type="checkbox"/> Air quality management measures <input type="checkbox"/> General compliance and enforcement. <p>Amongst other things, it is intended that the setting of norms and standards will achieve the following:</p> <ul style="list-style-type: none"> • The protection, restoration and enhancement of air quality in South Africa. • Increased public participation in the protection of air quality and improved public access to relevant and meaningful information about air quality. • The reduction of risks to human health and the prevention of the degradation of air quality. <p>The Act describes various regulatory tools that should be developed to ensure the implementation and enforcement of air quality management plans. These include:</p> <ul style="list-style-type: none"> • Priority Areas, which are air pollution ‘hot spots’. • Listed Activities, which are ‘problem’ processes that require an Atmospheric Emission Licence. • Controlled Emitters, which includes the setting of emission standards for ‘classes’ of emitters, such as motor vehicles, incinerators, etc. • Control of Noise. • Control of Odours. <p>Implications for the development</p> <p>Not Significant - During the construction phase, dust and the generation of noise can become a significant factor, especially to the surrounding landowners. However if the development is well planned and if the mitigating measures are successfully implemented the proposed development’s contribution to air pollution and the generation of air pollution can become less significant.</p>		
<p>National Heritage Resources Act, 1999 (Act No. 45 of 1965 (NHRA)</p>	<p>National & Provincial</p>	<p>April 1965</p>
<p>The National Heritage Resources Act legislates the necessity and Heritage Impact Assessment</p>		

in areas earmarked for development, which exceed 0.5 ha. 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).

Implications for the development

Not Significant - No heritage sites were identified on/near the site earmarked for development.

If during construction any evidence of archaeological sites or artefacts, paleontological fossils, graves or other heritage resources are found, the operations must be stopped and a qualified archaeologist or SAHRA must be contacted immediately for an assessment of the find. **(Refer to Appendix G1: Heritage Impact Assessment and Appendix H - EMPr)**

<p>National Environmental Management Protected Areas Act, 2003 (Act No. 57 of 2003)</p>	<p>National</p>	<p>2003</p>
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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 and seascapes, for the management of those areas in accordance with national norms and standards, as well as for intergovernmental co-operation and public consultation in matters concerning protected areas. Protected areas are to be conserved for their biodiversity and ecological integrity.

Implications for the development

Not Significant- The subject property is not located within a protected area **(Refer to Figure 4 – Ridges)**.



Figure 4: Ridges

<p>National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)</p>	<p>National</p>	<p>2004</p>
<p>The Biodiversity Act provides for the management and protection of the country’s biodiversity within the framework established by NEMA. It provides for the protection of species and ecosystems in need of protection, sustainable use of indigenous biological resources, equity and bioprospecting, and the establishment of a regulatory body on biodiversity- South African Biodiversity Institute.</p> <p>Objectives of the Act:</p> <p>(a) Within the framework of the National Environmental Management Act, to provide for:</p> <ul style="list-style-type: none"> (i) The management and conservation of biological diversity within the Republic and of the components of such biological diversity; (ii) The use of indigenous biological resources in a sustainable manner; and (iii) The fair and equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources; <p>(b) To give effect to ratified international agreements relating to biodiversity which are</p>		

binding on the republic;

- (c) To provide for co-operative governance in biodiversity management and conservation; and**
- (d) To provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act.**

Implications for proposed development:

Significant- The study area is regarded as 'Irreplaceable' (a 'Critical Biodiversity Area' (CBA) as defined in the C-Plan 3.3) (**Refer to Figure 7: Biodiversity Map and Figure 8: C-Plan 3.3 Irreplaceable Site**).

Flora

The study area falls within the area designated as Egoli Granite Grassland situated in the Grassland Biome. Two study units were identified on the study site which includes Grassland and a Drainage Line cutting through it. Approximately 23% of the remainder of Portion 1 of the Farm Waterval 51R has a high sensitivity in terms of flora with 77% of the surface area having a low sensitivity. The proposed 22 ha development layout caters for 8 ha of private open space with the purpose of protecting sensitive environments occurring on site.

The development site has been identified as 'Irreplaceable' according to the GDARD C-Plan 3.3 due to the occurrence of the Orange List species *Hypoxis hemerocallidea* which were recorded in abundance in the study site and identified as having a moderate sensitivity according to the Flora Assessment (Refer to Figure 10: Flora Sensitivity Map and Appendix G2: Flora Assessment).

Although the development site is covered by Egoli Granite Grassland, a vegetation unit which is considered endangered, its isolation from natural grassland on neighbouring sites is not favorable to its continued pristine status and is deemed to have a low sensitivity. The Drainage Line on the other hand remains connected with the Jukskei River system.

It is recommended that the relocation of the Orange List species *Hypoxis hemerocallidea* be implemented prior to construction.

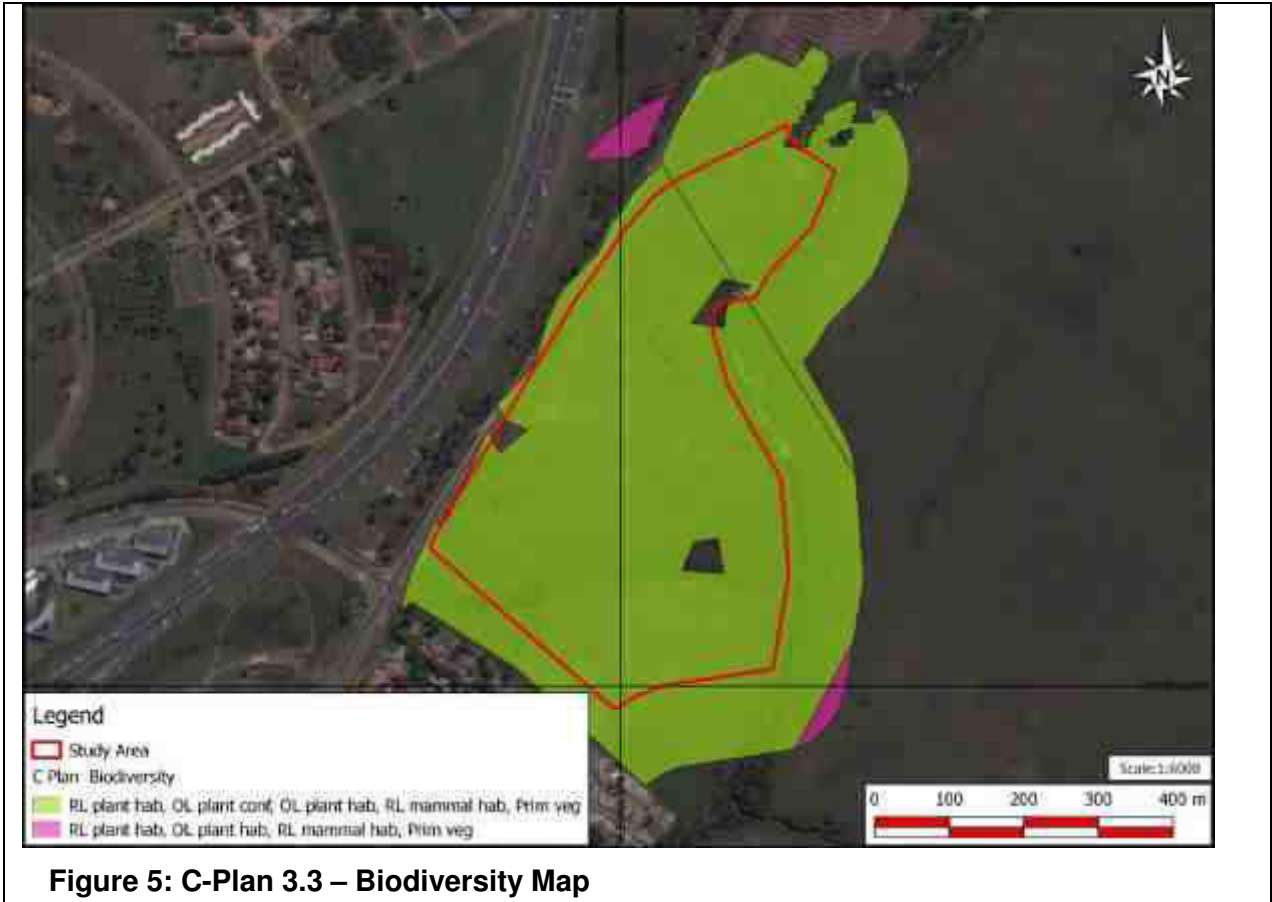


Figure 5: C-Plan 3.3 – Biodiversity Map



Figure 6: C-Plan 3.3 Irreplaceable Site.

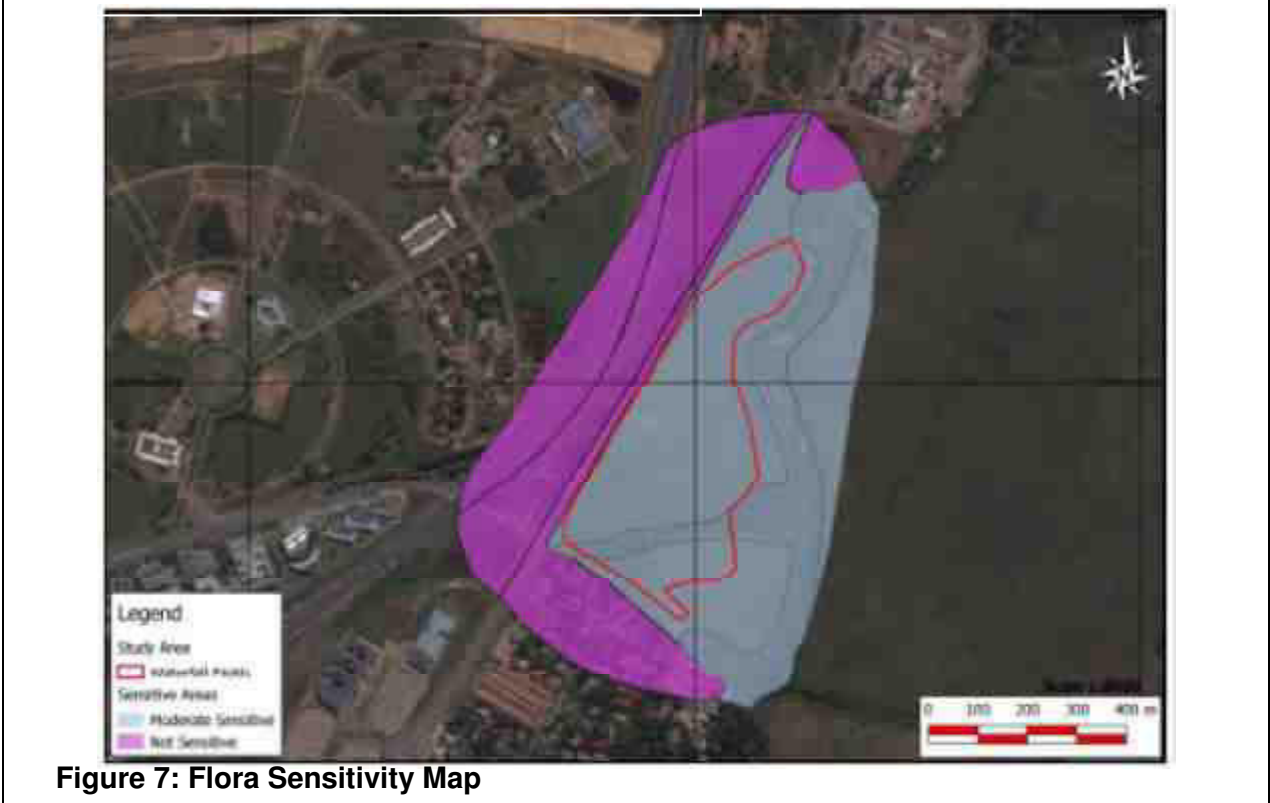


Figure 7: Flora Sensitivity Map

Fauna

The majority of the terrestrial habitats present on the study area remain in its natural state, although alien plant species tend to invade some of the habitats. The current terrestrial habitats do however provide good habitat for a number of small mammals deduced to be present. The Grassland habitat is expected to support several small mammal species on account of the availability of their food source and maintained connectivity with homogenous habitats.

The Riverine habitat is deemed to be **highly sensitive** from a faunal perspective as it produces suitable habitats for Otter and Vlei Rat species. The probability of Red List Otter or Vlei Rat species selecting this particular stretch of the Jukskei River suitable for their nesting area is unlikely, on account of some pollution and degradation of the habitat. Otter and Vlei Rat species are however expected to use this part of the Jukskei River as a corridor or passage way to areas suitable for nesting purposes.

The Drainage Line is deemed to be **moderately sensitive** from a faunal perspective as it acts as a tributary to the Jukskei River. No Red Data faunal nesting areas were identified in the Drainage Line; however this habitat is expected to be utilized as a forage resource by these species (**Refer to Figure 8: Fauna Sensitivity Map and Appendix G3: Fauna Assessment**).



Figure 8: Fauna Sensitivity Map

Avifauna

The discrete habitats identified on the study area supports a moderate richness of bird species. Approximately 162 species have a high to medium occurrence probability, of which one near threatened bird species has a medium probability of occurring and/or being resident within the study area. The following findings were made for each of the associated habitat units within the larger study area (**Refer to Figure 9: Avifauna Sensitivity Map**).

Grassland: No suitable breeding habitat for any threatened or near threatened bird species were observed on site. However, could provide potential foraging habitat for certain threatened species such the Lanner Falcon. On account of the lack of suitable breeding habitat for species with conservation concern, and the overall low avifaunal species composition, this study unit was identified with a **low avifaunal sensitivity**.

Wetland and drainage line: The intact and largely undisturbed nature of the wetland

and drainage line habitat unit, along with the pollution prevention function and high number of observed bird species, renders this study unit as **highly sensitive** from an avifaunal perspective.

Riverine: The riverine area contains fast flowing, clear water with a number of small rapids, as well as vertical sandbanks and dense overhanging vegetation. Connectivity with neighbouring homogeneous habitat is relatively high, especially towards the north-east and west. Although the connectivity is regarded to be high, the water quality of the Jukskei River is questionable as a result of downstream pollution in the form of solid and chemical waste making its way into the river system. Apart from possible pollution, the riverine habitat unit provides optimal foraging habitat for the near threatened Half-collared Kingfisher, provided that a sustainable food source is available. A single Malachite Kingfisher was however observed within the riverine habitat unit, indicating that it is likely that a food source in the form of small fish, tadpoles and aquatic invertebrates is present. Due to the connectivity function, high avifaunal diversity and optimal habitat for the near threatened Half-collared Kingfisher, this habitat unit was identified to be **highly sensitive (Refer to Appendix G4: Avifauna Assessment)**.

Wetland

The site contains a channeled valley bottom wetland, with a PES rating of C. The channeled stream enters the Jukskei River, which is a known critically modified river in terms of water quality (**Refer to Figure 10: Wetland Delineation**). It is recommended that the delineated wetland be excluded from development. However, due to the state of the hydrology in the area, it would be recommended that the buffer be considered insignificant, where the focus should be placed on rehabilitation and upgrading of the watercourse.

The buffer will contribute very little to the protection of the watercourse, it is for this reason that the buffer be removed, and development incorporate and rehabilitate the functionality of the wetland. It should be noted that the development should always be designed outside of the floodlines to reduce risk to flooding (as wetlands on the Halfway House granite dome cannot attenuate flooding) (**Refer to Appendix G5: Wetland Assessment**).

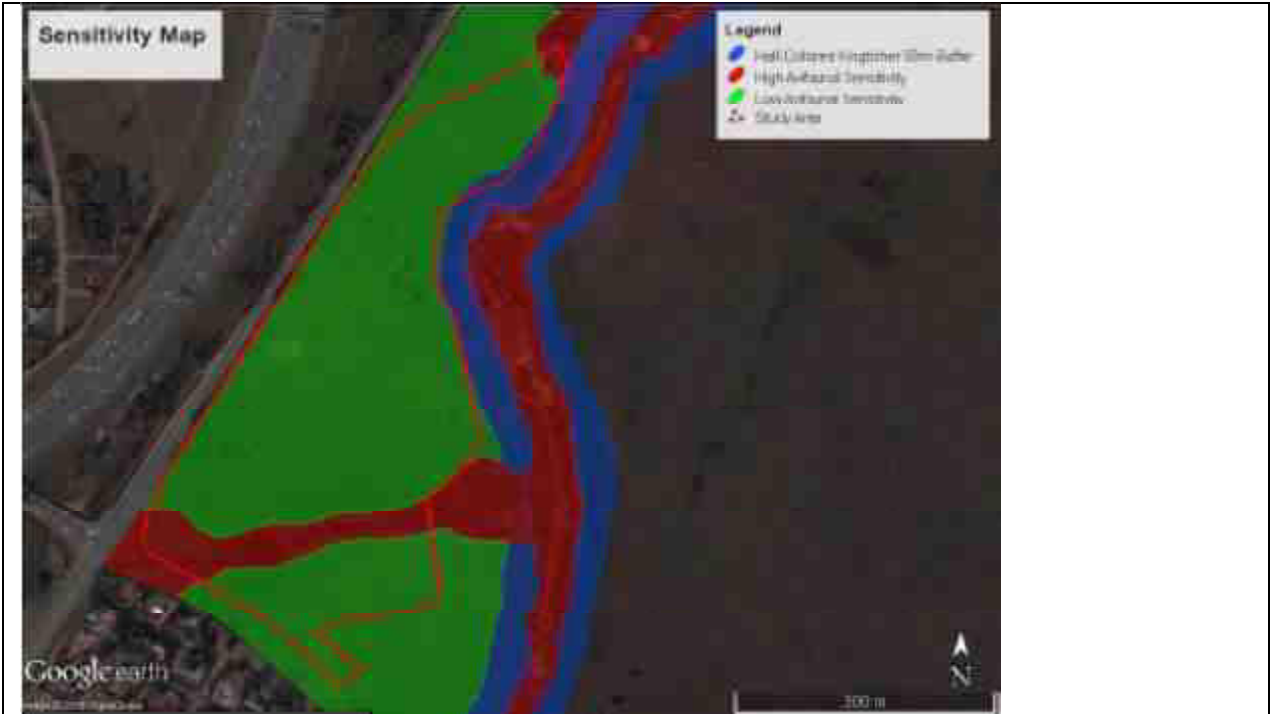


Figure 9: Avifauna Sensitivity Map



Figure 10: Wetland Delineation

The Land Exchange Matter/Offset Agreement

All the portions of land on the Farm Waterval 5 IR, which belong to the Mias Family, were included in a land swap transaction with GDARD.

The land swap transaction is applicable to the study area and therefore the conservation of Egoli Granite Grassland on site is not recommended. Refer to **Figure 11** for detail regarding land donated to GDARD for conservation purposes as well as **Appendix I of the Draft Basic Assessment Report** for the Land Exchange Memorandum of Agreement concluded with GDARD.

According to the Land Exchange Memorandum of Agreement the following properties comprising of Egoli Granite Grassland were donated to GDARD as offset area for the proposed development of the Remaining Extent of Portion 1 of the Farm Waterval 5 IR:

- Portion 6 of Doorinrandjie Farm;
- Portion 112 of Doorinrandjie Farm;
- Portion 106 of Doorinrandjie Farm; and
- Portion 39 of Doorinrandjie Farm.

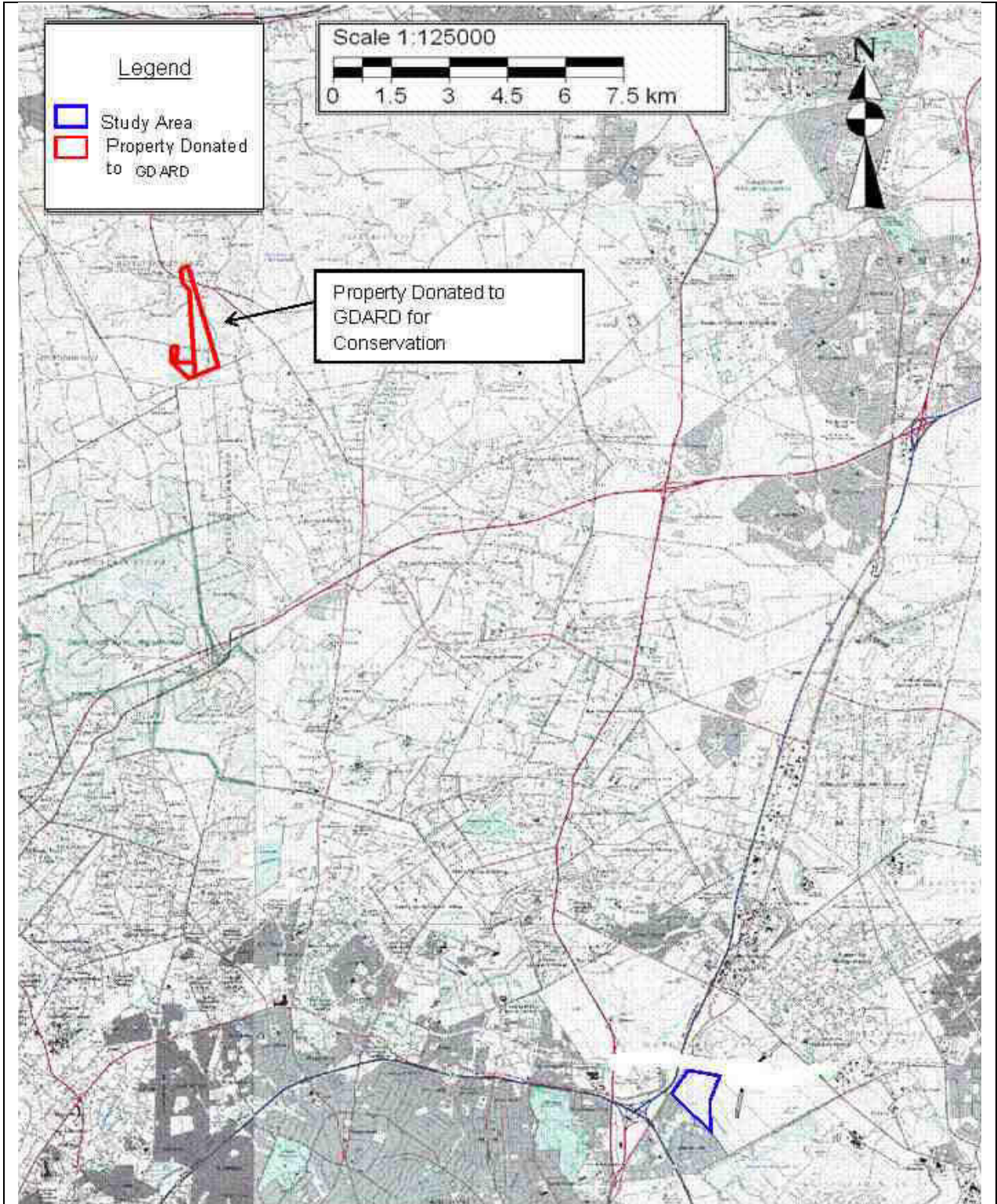


Figure 11: Property Donated to GDARD for Conservation

<p>Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)</p>	<p>National</p>	<p>1 June 1983</p>
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This act provides for control over the utilization of natural agricultural resources of South Africa in order to promote the conservation of soil, water sources and the vegetation as well as the combating of weeds and invader plants; and for matters connecting therewith.

Implications for the development

Not Significant – According to the Gauteng Agricultural Potential Atlas (GAPA 4), the site has a **low** agricultural potential (**Refer to Figure 12: Agricultural Potential**). In addition, GIS Data and GIDS data from GDARD also clearly indicates that the development is located with in the Gauteng Urban Edge (2010) (**Refer to Figure 13: Urban Edge**), and does not fall within any of the Seven Agriculture Hubs identified for the Gauteng province.



Figure 12: Agricultural Potential



Figure 13: Urban Edge

<p>National Environmental Management: Waste Act (Act 59 of 2009)</p>	<p>National</p>	<p>11 June 2010</p>
<p>This Act came into effect on 11 June 2009. It aims to consolidate waste management in South Africa, and contains a number of commendable provisions, including:</p> <ul style="list-style-type: none"> • The establishment of a national waste management strategy, and national and provincial norms and standards, for amongst other, the classification of waste, waste service delivery, and tariffs for such waste services; • Addressing reduction, reuse, recycling and recovery of waste; • The requirements for industry and local government to prepare integrated waste management plans; • The establishment of control over contaminated land; • Identifying waste management activities that requires a license, which currently include facilities for the storage, transfer, recycling, recovery, treatment and disposal of waste on land; • Co-operative governance in issuing licenses for waste management facilities, by means of which a licensing authority can issue an integrated or consolidated license jointly with 		

<p>other organs of state that has legislative control over the activity; and</p> <ul style="list-style-type: none"> • The establishment of a national waste information system. <p>Implication for the development:</p> <p>Not Significant – No waste management license will be required during the construction or operational phases of the proposed Township. Due to the fact that a limited amount of solid construction waste will be stored and handled on the site, before it is hauled away and dumped at the nearest registered landfill site.</p>		
Red List Plant Species Guidelines	Provincial	26 June 2006
<p>The purpose of these guidelines is to promote the conservation of Red List Plant Species in Gauteng, which are species of flora that face risk of extinction in the wild. By protecting Red List Plant Species, conservation of diverse landscapes is promoted which forms part of the overall environmental preservation of diverse ecosystems, habitats, communities, populations, species and genes in Gauteng.</p> <p>These Guidelines are intended to provide a decision-making support tool to any person or organization that is responsible for managing, or whose actions affect, areas in Gauteng where populations of Red List Plant Species grow, whether such person or organization be an organ of state or private entity or individual; thereby enabling the conservation of the Red List Plant Species that occur in Gauteng.</p> <p>Implication for the development:</p> <p>Not Significant – No Red Listed species have been recorded on site. The Riverine area does however provide for an optimal habitat for the near threatened Half-collared Kingfisher.</p>		
GDARD Draft Ridges Policy	Provincial	2007
<p>This policy is provided for the protection, conservation and maintenance of ridges within the Gauteng Province. Ridges play an important role in biodiversity and ecosystem functioning as they provide niche habitats for a number of species. Ridges must be viewed as playing a critical role in the preservation of migratory corridors for faunal and floral species.</p> <p>Implications for the development:</p> <p>Not Significant- According to the GDARD Draft Ridges Policy no development should take place on slopes steeper than 8.8%. The existing development does not occur in an area classified as a ridge in terms of GDARDs draft ridges policy (Refer to Figure 6 – Ridges).</p>		

<p>Draft Policy on the protection of Agricultural Land, 2006</p>	<p>Provincial</p>	<p>2006</p>
<p>GDARD identified 7 Agricultural Hubs in Gauteng Province. These hubs are earmarked for agricultural activities and there are policies and guidelines that should be taken into consideration when one plans to develop in these hubs areas. Urban development is usually not supported in these hubs.</p> <p>Implications for the development:</p> <p>Not Significant. The study area is not situated within any of the 7 agricultural hubs identified for Gauteng.</p>		
<p>Gauteng Noise Control Regulations, 1999</p>	<p>Provincial</p>	<p>1999</p>
<p>The regulation controls noise pollution. According to the acceptable noise levels in a residential area situated within an urban area is 55dBA and the maximum acceptable noise levels in a rural area is 45dBA.</p> <p>Implications for the Development:</p> <p>During the construction phase of the proposed development, the impact of noise could be problematic, but such impacts are generally short term. One should note that practical mitigation measures for noise pollution are low, but certain measures can be implemented to mitigate the severity (Refer to Appendix H (EMPr) for a list of suitable guidelines and mitigation measures).</p>		
<p>The Gauteng Transport Infrastructure Act, 2001</p>	<p>Provincial</p>	<p>2001</p>
<p>The Act was created to consolidate the laws relating to roads and other types of 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; and to provide for matter connected therewith.</p> <p>Implications for the proposed development</p>		

Not Significant - All developments in Gauteng must take the Gauteng Road network into consideration and no development may be planned across any provincial or K-route indicated on the published alignments.

The proposed K60 is located approximately 200 m to the north of the site and the proposed K101 adjacent to and west of the site. There are no K-routes planned through the proposed application site.

Gauteng Transport Infrastructure Amendment Act; 2003	Provincial	2003
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The aim of this Amendment Act is to amend the Gauteng Transport Infrastructure Act, 2001 so as to amend and insert certain definitions; to provide for the necessary land use rights with respect to stations and for the necessary powers of the MEC to enter into contracts for road and rail projects; to amend the procedure in relation to route determination; to make a second environmental investigation at the stage of preliminary design of a road or railway line unnecessary where the competent environmental authority decides that the environmental investigation at the stage of route determination is adequate; and to provide for incidental matters.

Implications for the Development:

Not significant- The development has already taken the existing and planned provincial roads into consideration.

4 Environmental Management Plan (EMP)

Role Players and Abbreviations: Authorities (A), other Authorities (OA), Developer and/ or proponent (D), Environmental Control Officer (ECO), Project Manager (PM), Contractors (C), Environmental Assessment Practitioner (EAP), Environmental Site Officer – internal officer (ESO), Operational Phase Leasing Company (OPLC), Operational Phase Maintenance, Management and Compliance Monitoring Team (OPMMCMT), Construction and Operational Phase Security Management (COPSM) and Health and Safety Officer (HSO), Cultural and Heritage Specialist (CHS), Fauna and Flora Specialist (FFS), Wetland Specialist (WS), Engineer (E).

4.1 Pre-Construction Phase

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
General	Project contract	To make the EMP enforceable under the general conditions of the contract.	The EMP document must be included as part of the tender documentation for all contractor appointments	The EMP is included as part of the tender documentation	D, ESO, ECO, HSO, PM, COPSM,	-	2014 NEMA EIA Regs
Design and planning	Stability of structures and restriction of land use due to geology	To ensure that precaution is implemented during trench excavations	To ensure a well-managed site all activities need to be properly structured and planned ahead. All risks should be properly mitigated. Care should be taken during the foundations and all other excavations due to the localized difficulty. According to the specialist team, the soils of the study area are shallow. It is unlikely that any additional waste sites or graves will be discovered during the construction phase. We however already addressed the possible discovery of additional graveyards/ waste sites. 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.	The EMP is strictly implemented and adhered to Signage boards are bright and clear Clearly demarcated and/ or co-ordained off areas with a fence or barrier tape	ECO, ESO, HSO, D, PM, E, C, COPSM	-	Heritage Act, NEMWA, 2014 NEMA EIA Regs
		To ensure the	To ensure stabilization of the channel		E, D, ECO, PM	-	NWA;

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
		stabilization of channels' banks through significant engineering intervention	banks and limiting erosion and the collapsing of the banks, the engineer should properly design the reinforcements. Vegetative-based structural reinforcements are preferred. Steep embankment along roads and in other sections of the development should also be planted with vegetative based structural reinforcements.				2014 NEMA EIA Regs; NEMA
	Potential moderate heave transported and residual soils	To prevent the heave and/ or motion of transported material, and the monitoring thereof	Special foundation designs will most probably be required in such areas.	Precautionary measures implemented	D, PM, E, C	-	
	Development below the 1:100 year flood line	Prevent the alteration of the flood line on the study area and up-stream and down –stream impacts	Prevent the erection of any permanent structures below the 1:100 year flood line. Prevent extensive cutting and filling exercises below the 1:100 year flood line. Indicate the 1:100 year flood line on all the planning drawings	No impacts on the floodlines No flood risks Improved flood management	E, PM, C	Continuous	Section 144 of the NWA
	Collapse settlement in the loose colluvium and residual granite horizons		Mark all excavated areas clearly during the construction phase and erect signs on site to warn workers and passers-by of possible collapsible soil conditions. Put temporary precautionary measures in place during the construction phase to prevent accidents associated with the collapsing of soils.	Areas with collapsible soil to be demarcated. No occurrence of accidents	D, PM, E, C	-	
	Removal of clayish soils	To remove clayish soils	Identify areas that will require the removal of clayish soils prior to the construction phase. Identify temporary storage positions (not in	Clayish soils removed	D, PM, E, C	When Required	NWA, 2014 NEMA EIA Regs; NEMA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			<p>the flood line areas/ within any watercourses/ against steep slopes) for such soils and confirm what will happen to the soils that area removed. Some of the clayish soils could be used for the lining of dams to be constructed on other sites/ attenuation features. This will prevent the loss of valuable soils dumped and polluted at landfill sites.</p>				
	<p>The soils on the site is not regarded as suitable for usage as construction materials</p>	<p>To ensure the sustainable usage of soils on the site</p>	<p>Promote the usage of construction materials obtained from the site. This will promote re-use and recycling and it will eliminate high transport and soil importation costs.</p> <p>Store sub-soils that are suitable for construction purposes in designated areas on the study area. Separate the sub-soil to be used for construction purposes from the topsoil. The temporary storm water management measures as proposed for stockpiles on the study area are also applicable to sub-soil storage.</p> <p>From a landscaping point of view it is always better to prevent the import of soils that are not in line with the soil types of the study area. The application of imported and different soils layers above the soils of the study area could lead to the formation of even more parched water conditions/ higher water tables.</p> <p>If soils are imported for landscaping purposes, the imported soils must preferably be mixed with the soils on the site to improve drainage and permeability and to prevent the occurrence of "finger drainage" patterns.</p> <p>According to the specialists, the acidity of</p>	<p>Topsoils separated from sub-soils and neatly stored on the site, above the flood line and on areas already disturbed</p> <p>ECO to address this matter prior to construction, during the site hand-over meeting. Must also be item in tender documents.</p>	<p>D, PM, E, C, ECO</p>	<p>Continuous</p>	
	<p>Acidity of soils</p>			<p>Services can</p>	<p>E, C</p>	<p>When</p>	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			<p>the soils on the study area is high. Anthrax spores cannot survive in soils with high acidity and bone remains of animal carcasses and humans will decompose at increased rates in such soil conditions.</p> <p>The services to be installed for the proposed development must be able to tolerate the acidity of the soils.</p>	tolerate the acidity of the soils		required	
	Storm water design	To prevent and restrict erosion, siltation and groundwater pollution	<p>A storm water management plan must be compiled for the construction and operational phases of the proposed development.</p> <p>Compilation of a storm water management plan that will address storm water management during the construction and operational phases of the project and would mitigate the increased runoff due to vegetation removal.</p> <p>A comprehensive storm water management plan indicating the management of all surface runoff generated as a result of the development (during both the construction and operational phases) prior to entering any natural drainage system or wetland, must be submitted and approved by the local authority and DWS and submitted to GDARD prior to construction activities commencing.</p> <p>The storm water management plan must be submitted to the local authority for approval.</p> <p>Attenuation ponds and energy dissipaters must be installed on the study area to</p>	Compilation and approval of storm water management plan	E, ESO, ECO, D, C, PM	Continuous	2014 NEMA EIA Regs; NEMA; NWA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			<p>break the speed of the water and to act as siltation ponds.</p> <p>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"> • Peak discharge for any given storm; • Total volume of runoff for any given storm; • Frequency of runoff; and • Pollutant and debris concentrations reaching water courses. <p>Adequate storm water planning and design is required to avoid wetlands being compromised.</p> <p>The storm water management plan must indicate how surface runoff will be retained outside of the demarcated buffer/flood zone and how the natural release of retained surface runoff will be simulated.</p> <p>Bio-swale and bio-filters could be installed to minimize the risk of pollutants entering the natural drainage system of the area.</p> <p>In order to prevent erosion, siltation and water pollution during the construction phase of the development, it will be necessary to implement temporary storm water management measures during the construction phase. This will assist with the management of run-off from the construction areas.</p> <p>In areas where excavations are done (i.e.</p>				

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			excavations for the installation of pipes/ for basements/ foundations, especially against the steeper slopes, a temporary shallow channel just below the stored excavation materials could assist with the prevention of siltation/ the washing of the excavated materials into the watercourses lower down. The usage of sand bags/ temporary stone weirs are also recommended in areas that are prone to erosion. The temporary storm water management measures for each phase must be attached to the EMP prior to commencement with such phase.				
		To ensure good drainage	Identify perched water tables early and provide adequate drainage for these trigger points. These areas must be indicated on a plan and contractors and other members of the team must be notified of possible perched water conditions and the mitigation measures for the drainage of the areas and for construction in these areas must be discussed with all relevant parties. The wetland specialist must be involved in the ground water drainage planning and the proposed drainage concepts must also be tested with the Department of Water Affairs, because they will be responsible for the issuing of the Section 21 (C) and (f) licenses required for the construction and operational phases of the development.	No problems with problems with dampness in surface structures or with installation of services	E, WS, C, PM, D	Continuous	2014 NEMA EIA Regs; NEMA; NWA
		To reduce recharge and erosion impact on the soil layers in	Uncontrolled runoff water can have a significant impact on the soil layers of the study area, therefore the total runoff water must be identified and confirm toe reduce	Plan reviews take place. Reduced to no	D, E	Continuous	2014 NEMA EIA Regs; NEMA; NWA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
		the study area	<p>recharge and erosion impact on the soil layers.</p> <p>Plan reviews are conducted to ensure they provide for adequate construction and post-construction storm water runoff pollution control.</p> <p>Pre-construction meetings help to identify potential storm water runoff problem areas on the construction site and ensure they are addressed as part of the SWMP.</p> <p>Pre-construction meetings help to identify potential storm water runoff problem areas on the construction site and ensure they are addressed as part of the SWPPP.</p> <p>Implement temporary storm water management measures during the construction phase in order to prevent erosion, siltation and water pollution.</p>	<p>erosion impact on the soil layers</p>	E, C, PM, D, WS	Continuous	2014NEMA EIA Regs; NEMA; NWA
		To implement storm water mitigation outside wetland areas	<p>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.</p>	<p>No storm water entering wetlands areas, and areas directly outside the wetland</p> <p>Lightning effectively designed.</p>	A, D, E	When planned and installed	
		To minimize light pollution	<p>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.</p> <p>The buildings must be built according to environmental sustainable principles; the orientation of the building and the use of a passive ventilation system.</p>	<p>Architectural guidelines minimizes visual impact</p>	A, D, E	When planned and implemented	
		To minimize the visual impact of the proposed development.	<p>Architectural and landscaping guidelines must be supplied in the EMP and the</p>		A, D, E	When planned and implemented	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			<p>proposed Architectural theme must blend in with the surrounding area.</p> <p>The colour scheme should be taken from the palette of colours in the natural surroundings.</p> <p>If planned and managed correctly, the proposed development will enhance the "Sense of Place" and value of the study area and its surroundings.</p> <p>Existing trees should be retained as far as possible on the site in order to soften the impact of the proposed permanent structures and to bring the scale of the higher structures down to a more human scale.</p> <p>Landscaping should be done in concurrence with the building construction in order to create an instant visual enhancement of the development.</p> <p>The landscaping of the proposed development should blend in with the natural vegetation of the area. Trees, shrubs and groundcovers that are endemic to the area and/or indigenous should preferably be used – landscaping that is in line with the natural vegetation of the area will not only help to reduce the visual impact of the development, but it will also create habitats for fauna and flora species.</p>				
	Negative impact on the sense of place	To ensure an enhanced sense of place and ambience	The proposed development should be designed and planned in such a way that it fits in with the surrounding environment.		A, E, D	When planned and implemented	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
Fauna and flora		To ensure protection of water resources and wetlands	No construction or dumping of activities should take place within the 1:50 year or 1:100 year floodline or a horizontal distance of 100m from a water resource unless authorized by DWA.		E, C, PM, ESO, ECO, D	Continuous	2014 NEMA EIA Regs; NEMA; NWA
	Loss of sensitive vegetation	To ensure protection of medicinal plants	<p>Although some disturbed natural grassland and natural primary grassland areas will be lost due to the proposed development the sensitive natural primary grassland will be conserved and will be linked to the larger regional open space system.</p> <p>As much as possible of the medicinal plant species should be removed prior to construction and be transplanted in a suitable area by a vegetation specialist.</p> <p>GDARD must be contacted prior to the removal of medicinal plants and the Department must be afforded the opportunity to remove some of the plants for Departmental usage.</p>	Medicinal plants rescued prior to construction	Qualified specialist	Continuous	2014 NEMA EIA Regs; NEMA; NEM:BA; C-Plan
		To permit the dispersal of faunal species to undisturbed areas	Where possible, work should be restricted to one area at a time. This will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories.		ECO, ESO, PM, C, FS, D	Continuous	
		Relocation of bullfrogs	If any bullfrogs are found on the site during excavations, the bullfrogs should preferably be relocated to areas as identified by GDARD. The applicant will require a permit for the relocation of the bullfrogs. Such a permit can be obtained from GDARD.	Obtain permits for the relocation of bullfrogs	ECO, ESO, PM, C, FS, D	Continuous	GDARD Permit
		Hedgehogs and birds	Where possible, work should be restricted to one area at a time, as this will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural		FS, ECO, ESO, C, D, PM, D	Continuous	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			territories. Should any mammals (such as hedgehogs) be encountered during the construction phase of the development, these should be relocated to natural grassland areas in the vicinity. Plan heavy vehicle and machinery circulation routes prior to the construction phase and identify temporary storage areas for excavated sub-soil. Clearly mark the site access point and routes on site to be used by construction vehicles and pedestrians. Put temporary precautionary measures in place during the construction phase to prevent accidents associated with mechanical excavation exercises. 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.				
Preparing Site Access	Environmental integrity	To avoid erosion and disturbance to indigenous vegetation		Access to site is erosion free. Minimum disturbance to surrounding vegetation. Vehicles make use of established access routes.	PM, C, D, E,	Continuous	
	Waste storage	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.		C, E, PM, ECO, ESO, D	Continuous	2014 NEMA EIA Regulations, Section 19 of the NWA, NEMWA, also Section 8 of the Waste Act and the contaminate d land Regulations
		To control and minimise waste during all the development	Compile a waste management plan for the construction and operational phases of the proposed mixed-use development.	Waste sorted on site Regular removal of waste Waste register on	ECO, ESO, C, E, D	Continuous	2014 NEMA EIA Regulations, Section 19 of

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
		phases and to comply with the requirements of GDARD.	<p>The waste management plan must also supply emergency waste management measures that deals with exposure to waste sites/ hazardous waste during the construction phase.</p> <p>The contaminated land section of the waste Act as well as other relevant provisions in the Waste Act and other relevant legislation must also be taken into consideration.</p> <p>Build a bund around waste storage area to stop overflow into storm water and the drainage channel on the application site.</p> <p>Demarcated areas for dumping of construction waste.</p> <p>Dumping of materials should be controlled.</p>	<p>site</p> <p>Prove of waste disposal at registered landfill site</p> <p>Waste incidents register on site</p>			the NWA, NEMWA, also Section 8 of the Waste Act and the contaminate dland Regulations
Social	Illegal occupation of property.	Ensure waste storage area does not generate pollution	<p>To ensure a limitation of petty and major crimes in the area</p> <p>Introducing a development (such as the preferred alternative) on this open land that complements the surrounding environment will limit the chance/occurrence of petty crimes establishing in the area.</p> <p>Compile a construction and operational phase security management plan, which will allow for 24 hour security of the area.</p>	<p>The bund is clearly visible and secure, with no signs of overflow</p> <p>In accordance with the master layout plan</p> <p>No signs nor records of petty or major crimes in the area</p> <p>Improved security in the area.</p>	ECO, C, PM, ESO, D, E	When implemented	2014 NEMA EIA Regulations, Section 19 of the NWA, NEMWA, also Section 8 of the Waste Act and the contaminate dland Regulations
	Construction and operational phase related impact on the security of the area	To address the security risks associated with the construction and operational phases of the development			ECO, ESO, PM, D, E, COPSM	Continuous	

4.2 Construction Phase

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
Contractor's Camp	Loss of Vegetation and topsoil	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.	C, D, PM, FS, ESO, ECO	Before any construction activity commences and as and when required	2014 NEMA EIA Regulations , NEMA, GDARD Red Data Species Policy, NEM:BA
	Surface and ground water pollution	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</p>	<p>Effluents managed Effectively.</p> <p>No pollution of water resources from site.</p> <p>Workforce use toilets provided.</p>	C, ECO, ESO, PM, DS, D	As and when required	2014 NEMA EIA Regulations , NEMA, NWA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>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 close proximity of the adjacent dwellings to prevent odors from causing uncomfortable situations.</p> <p>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.</p>				
	<p>To minimize pollution of surface and groundwater resources due to spilling of materials.</p>		<p>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.</p> <p>2) Repair and storage of vehicles only within the demarcated site area.</p> <p>3) Spill kits must be available on site.</p> <p>4) Oils and chemicals must be confined to specific secured areas within the site camp. These areas must be banded with adequate containment (at least 1.5 times the volume of the fuel) for potential spills or leaks.</p> <p>5) All spilled hazardous substances must be contained in impermeable containers for removal to a licensed hazardous waste site.</p> <p>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.</p>	<p>No pollution of the environment</p>	<p>C, ECO, ESO, PM, DS, D</p>	<p>As and when required</p>	<p>2014NEMA EIA Regulations , NEMA, NWA</p>

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>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.</p> <p>8) If any pollution incident is experienced, DWA must be notified immediately.</p>				
		To minimize pollution of surface and groundwater resources by cement	The mixing of concrete shall only be done at specifically selected sites, as close as possible to the entrance, on mortar boards or similar structures to prevent run-off into drainage line, streams and natural vegetation.	No evidence of contaminated soil on the construction site.	C, ESO, ECO, PM	Daily	
		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, especially the drainage channel on site.	No evidence of contaminated water resources.	C, ESO, ECO, PM	Daily	
	Pollution of the environment	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 AND NOT WITHIN CLOSE PROXIMITY OF DRAINAGE LINES. 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</p>	<p>No waste bins overflowing</p> <p>No litter or building waste lying in or around the site</p>	C, D, ESO, ECO, PM	Daily Weekly	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>should comply with the following:</p> <ul style="list-style-type: none"> • Skips for the containment and disposal of waste that could cause soil and water pollution, i.e. paint, lubricants, etc.; • Small lightweight waste items should be contained in skips with lids to prevent wind littering; • Bunded areas for containment and holding of dry building waste. <p>4) No solid waste may be disposed of on the site.</p> <p>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).</p> <p>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.</p> <p>7) Cover any wastes that are likely to wash away or contaminate storm water.</p>				
		Control and designate areas for dumping	Demarcated areas for dumping of construction waste	Areas designated for dumping are adhered to	Contractor	Weekly	
		Recycle material where possible and correctly dispose of unusable wastes	<p>Dumping of materials should be controlled.</p> <p>1) Waste shall be separated into recyclable and non-recyclable waste, and shall be separated as follows:</p> <ul style="list-style-type: none"> • General waste: including (but not limited to) construction rubble, • Reusable construction material. <p>2) Recyclable waste shall preferably be deposited in separate bins.</p>	Sufficient containers available on site No visible signs of pollution	Contractor ESO	Daily Weekly	Section 19 of the NWA; Section 28 of NEMA; Duty of Care (NEMA and NWA) NEM:WA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>3) All solid waste including excess spoil (soil, rock, rubble etc.) must be removed to a permitted waste disposal site on a weekly basis.</p> <p>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.</p> <p>5) Keep records of waste reuse, recycling and disposal for future reference. Provide information to ESO.</p> <p>6) Comply with the Waste Management Plan</p>				
	Increased fire risk to site and surrounding areas	To decrease fire risk.	<p>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.</p> <p>2) Food vendors shall be allowed within specified areas.</p> <p>3) Fire extinguishers to be provided in all vehicles and fire beaters must be available on site.</p> <p>4) Emergency numbers/ contact details must be available on site, where applicable.</p>	No open fires on site that have been left unattended	C, ESO, ECO, PM	Monitor daily	NEM:AQA
Construction site	Geology and soils	<p>To prevent the loss of topsoil</p> <p>To prevent siltation & water pollution.</p>	<p>1) Stockpiling will only be done in designated places where it will not interfere with the natural drainage paths of the environment.</p> <p>2) In order to minimize erosion and siltation</p>	Excavated materials correctly stockpiled No visible signs of	C, D, E, ESO, ECO, PM	Monitor daily	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>and disturbance to existing vegetation, it is 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) The proposed rehabilitation plan for the study area must also address the phased implementation of formal landscaping along new roads and in other open space areas that will not form part of the proposed natural open space area associated with the river system.</p> <p>6) All compacted areas should be ripped prior to them being rehabilitated/ landscaped</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 beginning 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</p>	<p>erosion and sedimentation</p> <p>Minimal invasive weed growth</p> <p>Vegetation only removed in designated areas</p>			

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			<p>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>10) Stockpiles should be covered correctly.</p> <p>11) If possible, implement the development in phases and clear the vegetation in phases and as required for the implementation of the phases.</p> <p>12) Where possible the proposed construction circulation routes must be restricted to disturbed areas and existing dirt roads. Avoid unnecessary circulation routes through watercourse/ flood line areas.</p> <p>13) A ground coverage of at least 75% must be achieved in areas where natural areas and formal landscaping are to be implemented. This coverage must be achieved by the appointed landscape contractor prior to the handing-over of the completed works.</p>				
	<p>Erosion and siltation</p>	<p>To prevent erosion and siltation in general</p>	<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 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.</p>	<p>No erosion scars</p> <p>No loss of topsoil</p> <p>All damaged areas successfully rehabilitated</p>	<p>C, ECO, ESO, PM, E</p>	<p>Monitor daily</p>	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>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) Rehabilitate exposed areas immediately after construction in these areas is completed (not at the end of the project).</p> <p>6) Unnecessary clearing of flora resulting in exposed soil prone to erosive conditions should be avoided.</p> <p>7) Specifications for topsoil storage and replacement to ensure sufficient soil coverage as soon as possible after construction must be implemented</p> <p>8) 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>9) Storm water diversion measures are recommended to control peak flows during thunder storms.</p> <p>10) The eradication of alien vegetation should commence as soon as possible. The areas cleared adjacent of the river must be covered with suitable indigenous vegetation to ensure quick and sufficient coverage of exposed areas</p> <p>11) Storm water outlets shall be correctly designed to prevent any possible soil erosion.</p>				

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>12) All surface run-offs shall be managed in such a way so as to ensure erosion of soil does not occur.</p> <p>13) 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>14) All surfaces that are susceptible to erosion shall be covered with a suitable vegetative cover as soon as construction is completed by the individual erf owner / developer.</p>				
		To prevent erosion and sedimentation during cut and fill exercises'	<p>Proper mitigation measures need to be implemented during these cut and fill exercises to ensure that erosion and sedimentation is limited.</p> <p>Some of the soils on the study area are associated with unstable conditions. This must be taken into consideration during cut and fill exercises and during the remainder of the construction phase</p> <p>The storm water design for the proposed development must be designed to:</p> <ul style="list-style-type: none"> - Address the construction and operational phase storm water management. - Prevent bank and riparian zone erosion especially in the upper section of the main tributary. - Reduce and/ or prevent siltation, erosion and water pollution. If erosion, siltation and water pollution is not addressed, the sustainability of the drainage and the open space systems especially in the upper section of the main tributary can be negatively impacted by the 	Limited to no erosion and sedimentation	C, PM, ESO, ECO, E	Daily	
		To prevent siltation, erosion and water pollution in the Jukskei River		Storm water design approved and implemented	E, ESO, ECO, C, PM	When Required	

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			<p>development.</p> <ul style="list-style-type: none"> - Storm water runoff should not be concentrated as far as possible and sheet runoff from paved surfaces need to be curtailed. - Runoff from paved surfaces should be slowed down by the strategic placement of berms. - The vegetation must be retained as far as possible, and rehabilitated if disturbed by construction activities to ensure that erosion and siltation do not take place. 				
			<p>No trees should be planted within five meters of the line of the water bearing services</p> <p>Excavate only where necessary and mark out the areas to be excavated.</p> <p>The top layer of all areas to be excavated for the purpose of construction must be stripped and stockpiled in areas where this material will not be damaged, removed or compacted. This stockpiled material shall be used for the rehabilitation of the site and for landscaping purposes.</p> <p>When the stripping of topsoil takes place, the grass component shall be included in the stripped topsoil. The soil will contain a natural grass seed mixture that may assist in the re-growth of grass once the soil is used for back filling and landscaping.</p> <p>Mechanisms are required for dissipating water energy of storm water</p>	<p>Topsoil is stockpiled</p> <p>Only necessary areas are excavated</p>	<p>C, ECO, ESO, PM, E</p>	<p>When Required</p>	
	<p>Blasting</p>	<p>Safety during blasting operations</p>	<p>Blasting may only be done by specialists in the field and should be limited to localised areas.</p>	<p>Blasting done by specialists</p>	<p>C, HSO, ECO, ESO, PM, E</p>	<p>When Required</p>	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>Surrounding land-owners of properties in close proximity of blasting exercises must be informed/ warned (at least one week in advance) of blasting exercises that will take place on the study area.</p> <p>Surrounding residents must be informed of blasting exercises at least one week in advance.</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>Allowance should be made in the quantities and specifications for the excavation of wad (or other soft material) selectively from the floor of cuttings and between pinnacles.</p>	<p>Surrounding land owners informed in advance</p> <p>Warning signs erected and barrier tape in place.</p>			
	Hydrology	Groundwater management and managing of groundwater pollution	<p>On-going monitoring of groundwater levels on and in the immediate vicinity of the site is essential. The monitoring positions to be indicated by the appointed geo-hydrologist. The geo-hydrologist must also assist with the compilation of a ground water management programme and plan.</p> <p>Establish man-made wetland-like systems at storm water outlets and in and around storm water attenuation features. This will assist with the purification of surface water prior to it entering the riverine systems and the ground water.</p>	<p>No deviation from baseline data during regular sampling</p> <p>The system is established to purify surface water</p>	E, DS, ECO, ESO, PM	Monthly	NWA, NEMA

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			<p>The establishment of weirs (even if made out of stone that were collected on the study area) in existing and newly created drainage channels/lines will also help to break the speed of the water, it will distribute the storm water across the surface, it purify the storm water and it will act as silt traps. It will also be possible to establish some vlei-type vegetation behind the weirs, where soils are deposited.</p> <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>3) Minimising disturbance and controlling run-off from construction areas.</p>	<p>No visible signs of erosion.</p> <p>No visible signs of pollution</p>	<p>C, E, PM, ESO, ECO, DS</p>	<p>Monitor daily</p>	
		<p>To minimise pollution of soil, surface and groundwater</p>	<p>A specialist needs to provide advice and be on the site during the demolishing of the hospital. Ground water tests need to be done prior and after the hospital is demolished to ensure the ground water results does not fluctuate.</p>	<p>Ground water tests were conducted</p>	<p>C, ECO, ESO, DS, PM</p>	<p>When Required</p>	
	Groundwater	<p>To limit impact and associated issues to the seasonal shallow groundwater, perched water and seepage near the flood plain.</p>	<p>Areas that could potentially be affected by perched water conditions must be identified on a layout plan. It will be better to limit construction in these areas to the dryer months. It is however understood this will not always be possible and that it could become necessary to drain some of the areas in order to make construction possible.</p> <p>The areas to be drained must be identified and discussed with the appointed ECO and wetland specialist and draining plans/possible cut-off trenches must be discussed</p>		<p>ESO, ECO, WS, E, PM, C</p>	<p>When required</p>	

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			<p>with the wetland specialist and the ECO prior to commencement with such works. The wetland specialist and ECO must supply temporary mitigation measures where required in order to minimise impacts on the surface and ground water movement patterns that sustain the watercourses of the study area.</p> <p>The water and soil quality of the areas to be drained must be monitored prior to construction. The monitoring tests must then be repeated (every month) during the construction phase. If any pollution (mainly associated with lead, anthrax, other diseases etc. are detected during the testing exercises, the construction works must be stopped and suitably qualified specialists must be appointed to assist with the compilation of the required mitigation measures and to supply advice regarding the proposed way forward.</p> <p>The ground water movement across the study area is towards the Jukskei River. Ground water monitoring points (at the point where the ground water seeps into the riverine system) must be determined prior to the commencement with the development and ground water quality samples at this monitoring points must also be taken during the water and soil quality test intervals.</p>				
	<p>Surface water flows will be altered during the construction phase</p>	<p>To control the surface water flows</p>	<p>Construction activities should preferably take place during the winter months.</p> <p>If it is not possible for construction activities to take place during the winter months, construction activities should take place in phases in order to prevent large exposed areas that will cause an increase in the</p>	<p>No alteration of surface water flows</p> <p>No aquatic biota affected by altered surface water flows</p>	<p>C, E, ECO, ESO, PM</p>	<p>When required</p>	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>speed of surface water.</p> <p>When storm water planning is done, every attempt possible should be made to keep the post construction and pre-construction flows similar.</p> <p>Where required temporary storm water attenuation features must be implemented. The feature/s must preferably be located outside the wetland and watercourse buffers and such features must also be designed to act as silt traps that can be maintained/cleaned by mechanical equipment. The proposed features must be designed to break the speed of the water and to prevent concentrated storm water flow in sensitive areas (i.e. areas with higher erosion potential, against steeper slopes).</p> <p>The temporary and permanent storm water and drainage measures must take the long term sustainability of the wetland systems into consideration. At present the systems receive a certain amount of ground water and surface water and the water flows into and across such wetland in a specific pattern. Adjustments to this flow pattern could have a negative impact on the co-existence of the wetland and riverine systems. The appointed storm water engineers and the wetland specialist must liaise in order to ensure that that matter is sufficiently addressed.</p>				
	<p>Drainage lines</p> <p>To ensure the protection of the ecological value of the drainage lines</p>		<p>1) The necessary Section 21 Water-Use License applications must be submitted to DWA and no construction are allowed to commence without the necessary licenses.</p> <p>2) Higher up in the middle region where</p>	<p>Guidelines implemented</p>	<p>C, ESO, ECO, E, PM</p>	<p>When Required</p>	

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			<p>severe alteration of the stream has taken place, a narrower buffer zone of 20 meters is deemed adequate to protect this resource once it is rehabilitated.</p> <p>3) The area upstream of the road crossing should have the 32 meter buffer zone maintained to protect the riparian area of this section of the stream.</p> <p>4) Although no wetland conditions have formed along the temporary drainage line it is deemed necessary to allow natural flow of storm water down this drainage line and to provide natural habitat in the area for herpetofauna, invertebrates and some bird species.</p> <p>5) The drainage feature should therefore be left intact as part of the proposed development with a narrow buffer zone of ten meters left undeveloped on either side of the feature.</p> <p>6) Adequate stormwater management must be implemented for the proposed development in order to prevent bank and riparian zone erosion especially in the upper section of the main tributary.</p> <ul style="list-style-type: none"> - Sheet runoff from paved surfaces needs to be curtailed. - Runoff from paved surfaces should be slowed down by the strategic placement of berms. - As much vegetation growth as possible should be promoted within the proposed development area in order to protect soils and to reduce the percentage of the surface area which is paved. 				

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			<p>7) Due to the increased rate of runoff owing to the increased percentage of impermeable surface area in the catchment of the unnamed tributary, which will be created by the proposed development (and possibly future developments in the catchment), it is recommended that building regulations in terms of the flood line positions are strictly adhered to should these occur outside of the delineated buffer zones of the riparian areas.</p> <p>8) Special mention is made of the lower section of the catchment where runoff volumes which will be generated will be higher during storm events.</p> <p>9) No dumping shall be allowed the areas below the flood line/ sensitive open space areas to be conserved.</p> <p>10) No parking areas or structures should be planned in this area</p> <p>11) No service or waste yard should be planned in this area</p> <p>12) All disturbed open spaces along water bodies, especially the areas below the 1:100 year flood line should, where possible, be rehabilitated with vlei/ suitable riparian vegetation.</p> <p>13) The wetland delineation conducted by Terrasoil must be taken into consideration. The wetland and riparian areas together with the proposed buffer zones must be marked out on the study area prior to commencement with construction. The ECO must supply the GPS co-ordinates and must</p>				

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			<p>confirm that the areas were correctly marked out. The sensitive areas must then be demarcated by a conservation fence/ barrier tape and all contractors and workers must be informed of this "no-go" zone. Only workers and equipment required for rehabilitation and the installation of services will be allowed to enter this zone. The ECO must be informed prior to the commencement of work in this zone. The work in this area can only commence once the Section 21 Water-Use License have been issued by DWA.</p> <p>14) Qualified engineer to be appointed to confirm the 1:100 flood line (pre-construction and post-construction flood lines).</p> <p>15) Use agricultural drainage methods in fill materials to remove water that could trigger slumping.</p> <p>16) Identify perched water tables early and provide adequate drainage for these trigger points.</p> <p>17) Implementing of a good drainage system</p> <p>18) Grading of land should be away from the building to allow for adequate drainage.</p> <p>19) Drainage for storm water run-off should be adequate, and blocked drains and gutters should be kept clear.</p>				
	To prevent siltation	To prevent	Stockpiles should not be stored in any watercourses/drainage lines or within the flood plain/ below the 1:100 year flood line	No stockpiles within the drainage line	Contractor	Weekly	
	To	prevent	The temporary drainage feature should be	Contractor strictly	C, ESO, ECO,	Monitored	2014NEMA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
		<p>impacts on wetlands in the riparian zone</p>	<p>left intact with a narrow buffer zone of ten meters to allow natural flow of storm water down the drainage line. The wetland and associated buffer zones must be excluded from development.</p> <p>Riparian vegetation along the main stream channel needs to be rehabilitated in order to increase the amount of surface flow of the stream and in order to improve the integrity of the riparian and in stream habitat integrity of the resource. Ongoing maintenance of the riparian zone will be required in order to prevent the re-establishment of the alien tree community after the initial clearance has taken place.</p> <p>It is essential that the stream continuity of the main drainage line be reinstated. In this regard the following points are made:</p> <ul style="list-style-type: none"> • If public open spaces within the buffer zones of the stream and wetland areas are provided it should be adequate to maintain the ecological connectivity of the riparian and in-stream ecology of the area. • It is recommended that these areas are managed adequately by restricting the movement of people to a limited number of allocated pathways and pets (e.g. dogs) should be restrained by a lead at all times. • It is recommended that alien and invasive vegetation (trees) are removed. This will increase the water volume flowing within the streams associated with the property and will improve the 	<p>abides to avoid the wetland areas as reasonably practicable</p> <p>Where there are strictly no-go, sensitive or demarcated areas that vehicles (especially heavy duty) are to strictly avoid, and no disturbance or impacts noticed</p> <p>Access roads, parking areas, etc., should be clearly illustrated on the master layout plan and should be strictly adhered to</p>	D, WS, FS, PM	daily	EIA Regulations, NEMA, NWA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>connectivity of the riparian zone.</p> <p>No vehicles should be allowed to indiscriminately drive through the wetland areas. Fence-off sensitive areas prior to construction and apply temporary storm water management measures outside the watercourse and watercourse buffer zones to prevent entry into the wetland areas and drainage line by construction vehicles and prevent storing or dumping of topsoil, construction material and other waste in the wetland/drainage line.</p> <p>All areas affected by construction should be rehabilitated upon completion of the construction phase. Areas should be reseeded with indigenous grasses as required.</p> <p>Site offices, parking areas for construction vehicles, etc. should be confined to non-sensitive areas.</p> <p>All the mitigation measures as proposed by the wetland specialist must also be taken into consideration.</p>				
	<p>Landscaping</p>	<p>To ensure that the landscaping and storm water management is done in collaboration</p>	<p>The incorporation of berms into the landscaping of the development could also assist in storm water management if such embankments/ berms are planned in conjunction of the storm water engineers and the wetland specialist. Such integrated planning measures could reduce the sizes of the required storm water attenuation features, which often appear unattractive and which tend to cover developable areas.</p> <p>The appointed Landscape Architects must</p>	<p>Landscape Architect is part of the planning team</p>	<p>Landscape Architect, E, C, ECO, ESO, PM</p>	<p>When required</p>	<p>2014NEMA EIA Regulations, NEMA, NWA</p>

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			become part of the integrated planning team from the early stages of the development in order to place the proposed landscaping berms at strategic points as identified by engineers.				
	Fauna and flora	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 interfere with the nature of the area</p>	No exotic plants used for landscaping	C, ESO, ECO, PM, FS, LA	As and when required Every 6 months	
		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) 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>5) Where possible, work should be restricted to one area at a time.</p>	No measurable signs of habitat destruction or faunal species hunted, trapped or killed	C, ESO, ECO, PM, FS	As and when required	

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			<p>6) 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>7) 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> <p>8) The contractor must ensure that no fauna species are disturbed, trapped, hunted or killed during the construction phase. Caught animals should be relocated to the conservation areas in the vicinity. Council shall prosecute offenders.</p> <p>9) Should hedgehogs be encountered during the development, these should be relocated to natural grassland areas in the vicinity.</p> <p>10) 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>11) Rehabilitate/ cover, where possible, exposed areas immediately after construction of a phase has been completed. If this is not possible, temporary</p>				

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			<p>mitigation measures must be applied until rehabilitation or coverage of such areas are possible.</p> <p>No vehicles must be allowed to move in or across the wet areas or drainage lines and possibly get stuck. This leaves visible scars and destroys habitat. It is important to conserve areas where there are tall reeds or grass and areas where there are short grass and mud.</p> <ul style="list-style-type: none"> - With proper cultivation of specific indigenous plant species the bird numbers and species in the area could even increase. Lists of plant species that attract birds to gardens are available. The area must however be kept as natural as possible. - Dumping of builders' rubble and other waste in the areas earmarked for exclusion must be prevented, through fencing or other management measures. These areas must be connected to one another and be properly managed throughout the lifespan of the project in terms of fire, eradication of exotics etc. to ensure continuous biodiversity. <p>All mitigation measures for impacts on the indigenous flora of the area should be implemented in order to limit habitat loss as far as possible and maintain and improve available habitat, in order to maintain and possibly increase numbers and species of indigenous fauna.</p>	<p>Fauna and for a on the site is protected as far as possible</p> <p>Fauna and flora is protected within the drainage lines</p>	C, ESO, ECO, FS, PM	As and when required	2014NEMA EIA Regulations , NEMA, NWA, NEM:BA
Social	Noise impact	To maintain noise levels below "disturbing" as defined in the national Noise Regulations.	<p>Site workers must comply with the Provincial noise requirements as outlined in order to keep the noise levels to the required level.</p> <p>During the construction phase noise should be kept to a minimum to reduce the impact of the development on the fauna residing</p>	No complaints from surrounding residents and I & AP	C, E, ESO, ECO, affected parties to report noise	Monitored daily	NEM:AQA; Gauteng Noise Regulations

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
	Dust impact	Minimise dust from the site	<p>on the site.</p> <p>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.</p> <p>2) When necessary, these working areas should be damped down in the mornings and afternoons.</p> <p>3) Sweeping of the construction site, clearing of builders' rubble and debris as well as the regular watering of the construction site (storage areas, roads etc.) must take place at least once a day during the dry and windy season. In severe circumstances the watering down of the construction site (the exposed areas) must take place twice a day (early in the morning and late in the afternoon).</p> <p>4) Even though there are almost no risks of getting infected by anthrax if the soil layers are disturbed, dust control during construction must be treated as a priority. Dust control will eliminate possible health risks associated with the inhalation of dust, especially if one take the fact that old aged people resides in close proximity of the hospital into consideration. This will also eliminate any possibility of the spreading of anthrax spores by means of dust.</p>	<p>No visible signs of dust pollution</p> <p>No complaints from surrounding residents and I & AP</p>	Contractor	Monitored daily	NEM:AQA
Safety and security	To ensure the safety and security of the public.		<p>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</p>	No incidences reported	C, D, ECO, ESO, COPSM	On-going	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>roads or even in the development site if necessary.</p> <p>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)</p> <p>3) Construction vehicles and activities to avoid peak hour traffic times</p> <p>4) Presence of law enforcement officials at strategic places must be ensured</p> <p>5) Following actions would assist in management of safety along the road</p> <ul style="list-style-type: none"> ▪ Adequate road marking ▪ Adequate roadside recovery areas ▪ Allowance for pedestrians and cyclists where necessary ▪ 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. <p>6) Adequate security personnel need to be appointed as soon as the study area is being prepared for construction as well as during the entire construction period.</p> <p>7) Surrounding landowners need to be notified when construction commences.</p> <p>8) Implement the security management plan for the construction phase. The security management plan must be kept in the site office and must also be supplied to the HSO</p>				

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>and ECO. The HSO and ECO must also report on compliance. Security incidences in the area must be reported to the ECO and ESO and a security incidences book must be attached to the management plan.</p> <p>9) Implement road safety measures in order to ensure road safety and effective traffic movement during the construction phase. The traffic engineers must compile a road construction phasing and management plan in order to identify the phases of road construction and upgrades, the measures to put in place for every construction phase in order to allow for better traffic flow, better accessibility, alternative routes if roads/ accesses are temporarily closed, temporary road signs (for the evening and daytime) to be erected, temporary safe pedestrian and cycling routes. The plan must be discussed with and supported by the road safety division of the local authority.</p>				
	<p>Influx of people from other areas</p>	<p>In order to limit the influx of people from other areas</p>	<p>It is recommended that (where possible) only people from the local communities in and around the application site are employed.</p> <p>Keep record of all the construction workers. A workers register must be kept at the site. This register must contain the ID numbers and employee details of all the workers. No workers will be allowed to sleep on the site and they will only be allowed on the property during working hours and when there is supervision on the study area.</p>	<p>People from local community employed.</p>	<p>C, D, PM, ESO, ECO</p>	<p>When required</p>	
<p>Infrastructure and services</p>			<p>The road and services upgrading as recommended by the involved engineers to be implemented.</p> <p>The bulk water network system will be</p>	<p>Road and services upgrading according to recommendation</p>	<p>E, ESO, ECO, PM, C, D</p>	<p>When required</p>	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>upgraded and expanded on behalf of the local authority to allow capacity for municipal water.</p> <p>Surrounding landowners should be notified of any disruptions that may occur during the construction phase.</p> <p>The storm water management plan should be followed during the installation of services.</p> <p>Excavate only where necessary and mark out the areas to be excavated.</p> <p>When the stripping of topsoil takes place, the grass component shall be included in the stripped topsoil. The soil will contain a natural grass seed mixture that may assist in the re-growth of grass once the soil is used for back filling and landscaping.</p> <p>Mechanisms are required for dissipating water energy of storm water.</p> <p>Construction vehicles and activities as well as other heavy vehicles to avoid peak hour traffic times.</p>	Road and services upgrading according to recommendation	E, ESO, ECO, PM, C	When required	
		To limit the impact during the installation of services.	<p>Construction activities should preferably take place during the winter months.</p> <p>If it is not possible for construction activities to take place during the winter months, construction activities should take place in phases in order to prevent large exposed areas that will cause an increase in the speed of surface water.</p> <p>When storm water planning is done, every attempt possible should be made to keep the post construction and pre-construction</p>	Road and services upgrading according to recommendation	E, ESO, ECO, C, PM, WS	When required	
		To limit impact on the wetlands during the construction of roads and installation of services.					

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>flows similar.</p> <p>The time spent in the wetland/ riparian zone should be limited at a time.</p> <p>Access into the wetland areas should be avoided as far as possible.</p> <p>No riparian vegetation may be removed from the riparian zone.</p> <p>The area should be prepared with sandbags or other applicable measures to avoid siltation into the wetland/ river area.</p> <p>All disturbed and damaged areas need to be rehabilitated after the construction activities.</p>				
	<p>Damage to the existing services and infrastructure during the construction phase and disruptions in services</p> <p>Traffic</p>	<p>To prevent and/ or limit service disruptions</p> <p>To limit the traffic increase during construction</p>	<p>Determine areas where services will be upgraded and relocated well in advance.</p> <p>Discuss possible disruptions with affected parties in the surrounding area to determine most convenient times for service disruptions and warn affected parties well in advance of dates that service disruptions will take place.</p> <p>Construction vehicles to avoid peak hour traffic.</p> <p>Inform surrounding residents, businesses, schools etc. if the construction activities will have impacts on traffic flow (i.e. if a lane will be closed/ are accesses to properties will be temporarily closed/ affected). Notices must be distributed to the affected parties at least 4 weeks prior to the planned disruptions. In cases where temporary service roads are to be provided, a representative of the developer must discuss the matter with the</p>	<p>Affected parties informed of the interruptions</p>	<p>E, D, PM, C, ESO, ECO</p>	<p>When Required</p>	
			<p>Construction vehicles to avoid peak hour traffic.</p> <p>Inform surrounding residents, businesses, schools etc. if the construction activities will have impacts on traffic flow (i.e. if a lane will be closed/ are accesses to properties will be temporarily closed/ affected). Notices must be distributed to the affected parties at least 4 weeks prior to the planned disruptions. In cases where temporary service roads are to be provided, a representative of the developer must discuss the matter with the</p>		<p>C, ESO, ECO, E, PM, D</p>	<p>When Required</p>	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>affected parties at least 4 weeks in advance.</p> <p>The road upgrading recommended by the traffic engineers to be implemented.</p> <p>All feasible / possible road upgrades should be implemented. Public transport system should be coordinated in the area to lighten the traffic load.</p> <p>Determine areas where services will be upgraded and relocated well in advance.</p> <p>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</p>	No complaints from I & AP	C, ESO, ECO, PM, E	When required	
		Installation of services	<p>1) The disturbed areas shall be rehabilitated immediately after the involved construction works are completed.</p> <p>2) Shade cloth must be used to conceal and minimise the visual impact of the site camps and storage areas.</p> <p>3) All equipment and materials should be stored in a designated area indicated by the ECO.</p> <p>4) All areas must be kept neat and tidy and waste should be stored in the designated areas and removed on a weekly basis.</p>	Visual impacts minimized	C, ESO, ECO, E, PM, A, Town planner, D	Monitor daily	
	Visual impact	In order to minimise the visual impact	<p>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.</p>	Landscaping done according to landscape development plan	Landscape Architect, C, D, PM, ESO, ECO	When required	
	Vegetation	Landscaping					

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>2) The proposed planting materials for the areas to be landscaped should preferably be endemic and indigenous.</p> <p>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.</p> <p>4) The inspection shall be carried out by the maintenance contractor at the property of the supplier and not on the study area.</p> <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, FS, C, ESO, ECO, PM	When required	
	To prevent a loss of natural grassland areas		<p>Although some disturbed natural grassland and natural primary grassland areas will be lost due to the proposed development the sensitive natural primary grassland will be conserved and will be linked to the larger</p>	Adequate regrowth of grassland Red-Listed plant	FS, ESO, ECO, C, PM, D	When required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			regional open space system. The Red-Listed plant species will be relocated to a suitable habitat on the site which will be identified by a specialist.	species conserved under nursery conditions and illustrate ability to flourish			
		Spread of weeds	Ensure that materials used for mulching and topsoil/ fertilisers are certified weed free. Collect certifications where available. Control weed growth that appears during construction.	Weed growth controlled	ECO, ESO, C, Landscape Architect, PM, D	When required	
		To ensure rehabilitation of the site	<ol style="list-style-type: none"> 1) Compacted soils shall be ripped at least 200mm. 2) All clumps and rocks larger than 30mm diameter shall be removed from the soil to be rehabilitated. 3) The soil shall be leveled before seeding. 4) Hydro-seed the soil with Potch mixture or plant with suitable indigenous ground covering as specified). 5) Watering shall take place at least once per day for the first 14 days until germination of seeds have taken place. 6) Thereafter watering should take place at least for 20 minutes every 4 days until grass have hardened off. 	Grass have hardened off	Landscape Architect, E, C, PM, ESO, ECO	Once a day Then every 4 days	
		To ensure rehabilitation due to wet conditions in the rainy season	Where possible, limit construction exercises (especially construction in and around watercourse areas and areas with perched water conditions) to the dryer periods. Construction workers and construction vehicles and machinery must stay out of the soggy areas during the wet periods. Barrier tape should be used to demarcate the areas that are drenched with water	Strictly demarcated wet areas adhered to with no sign of entry	C, ESO, ECO, PM, E	When Required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			(especially the ecologically sensitive areas and the areas covered with valuable topsoil) and it should only be removed when the appointed Environmental Control Officer (ECO)/ site supervisor/ project manager/ main contractor regard the conditions in the affected areas as favorable.				
		To prevent dumping of builders' rubble and other waste in the area earmarked for exclusion	All areas designated sensitive in a sensitive mapping exercise should be incorporated into the system. The open space system should be managed in accordance with an Ecological Management Plan that complies with the Minimum Requirements for Ecological Management Plans and forms part of the EMP.	No evidence of reporting of rubble dumping in the open space system	Contractor ESO	Continuous	
			The open space system should be fenced off prior to construction commencing. Rubble should not be stored in or directly adjacent any open space areas or areas marked as sensitive.				

4.3 Operational Phase

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Responsibility	Frequency of Action	Applicable Act no.
SITE CLEAN UP AND PREPARED FOR USE	Storm water pollution	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 revegetated. 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	-	
ESTABLISHING PLANTS	Slow or no re-vegetation to stabilise soil; loss or degradation of habitat	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	
DRAINAGE FAILURE	On-site and downstream drainage pollution or flooding	Storm water management plan	Inspect all site drainage works and repair any failures. Confer with design engineer and to correct site problems.	Contractor	-	
GROUND WATER MONITORING	Seasonal shallow groundwater, perched water and seepage near the flood plain		Groundwater quality and level monitoring as appropriate to assess the performance of the mitigation measures	Contractor	-	
	Potential moderate heave of transported and residual greenstone soils		A leak detection system must be put in place to identify any potential leaks in underground tanks. The fuel tanks must be installed in accordance with the relevant SANS standards.			
SITE AUDIT	Eventual project failure	Successful project establishment	Routinely audit the works and adjust maintenance schedule accordingly.	Contractor	-	
GENERAL			Open fires and smoking during maintenance works are strictly prohibited.	Contractor	-	6
GEOLOGY	Erosion of topsoil	Prevent topsoil erosion	Due to loose topsoil, the soil must be covered by means of re-seeding and vegetation with suitable ground covering.	Engineer / Contractor /	Once off	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Responsibility	Frequency of Action	Applicable Act no.
REHABILITATION	Open Space System	To ensure alien and weeds are eradicated To ensure the proper management of the open space system	Alien vegetation (as identified in the Fauna & Flora Assessment) and all weeds must be eradicated on a regular basis even during the operational phase. -The proposed public open space must be maintained during the operational phase of the proposed development. -An ecological maintenance plan be compiled and be implemented during the operational phase. - 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. - 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. - Proper Veld Management Practices, such as fire management, should be implemented in the open space areas.	Contractor/ each home owner Contractor HOA	Every 6 months	
SOCIAL	Increase in traffic	To upgrade the existing roads and to construct new roads that will improve the traffic flow in the area	The road improvements proposed for the area must increase the road safety conditions, accessibility of the area and the traffic flow.			

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Responsibility	Frequency of Action	Applicable Act no.
		and that will accommodate all the traffic generated by the development. The road safety conditions must also be improved.				
	Security risks associated with the lower income development	To improve the security situation in the area	The security management plan compiled by the developer is implemented with success.			

5 Procedures For Environmental Incidents

5.1 Leakages & spills

- Identify the source of the problem.
- Stop goods from leaking, if safe to do so.
- Contain the spilt material, using the spills kit or sand.
- Notify the Environmental Control Officer
- Remove spilt material and place in a sealed container for disposal (if possible).
- Environmental Control Officer to follow the Incident Management Plan.

5.2 Failure of erosion/sediment control devices

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

5.3 Bank/slope failure

- Stabilize the toe of the slope to prevent sediment escape using aggregate bags, silt fence, logs, hay bales, pipes, etc.
- Notify the ECO.
- ECO to follow the Incident Management plan.
- Divert water upslope from the failed fence.
- Protect the area from further collapse as appropriate.
- Restore as advised by the ECO.
- Monitor for effectiveness until stabilized.

5.4 Discovery of rare or endangered species

- Stop work.
- Notify the ECO.
- If a plant is found, mark the location of plants.
- If an animal, mark the location where sighted.
- ECO to identify or arrange for the identification of species and/ or the relocation of the species if possible.
- If confirmed significant, the ECO is to liaise with the Endangered Wildlife Trust.
- Recommence with work when cleared or instructed to do so by the ECO.

5.5 Discovery of archeological or heritage items

- Stop work.
- Do not disturb the area any further.
- Notify the ECO.
- If confirmed significant, ECO to liaise cultural and heritage specialist.
- Cultural and heritage specialist to communicate with SAHRA and give recommendations regarding the way forward.

5.6 Discovery of waste sites/ potential polluted areas during excavation

- Stop work immediately and fence-off the area.
- Erect “stay away” signs.
- Do not disturb the area any further.
- Notify the ECO.
- ECO to contact Dr. De Vos and Cultural and Historical Specialist.
- Conduct pollution tests if required.
- Involve the geo-hydrologist and soil scientist to assist with tests if required, must also include leachate tests.
- Appointed specialists to recommend the way forward.

5.7 Safety and Security Problems Experienced by the Surrounding Residents

- Incidents/ problems to be reported to the ECO and GDARD law enforcement.
- ECO to react within 24 – 48 hours.
- ECO and Developer to supply feedback regarding measures implemented to address problem.
- If required, security management plan must be amended to prevent any similar future incidences.

6 EMP review

1. The EMP must be regarded as a dynamic document. Where necessary the EMP must be amended to improve the environmental management and monitoring of the site. The ECO or appointed EAP will be responsible for the required amendments to the EMP and GDARD must be notified of the amendments. If required, an EMP amendment application must be submitted to GDARD for consideration and no amendments are to be implemented until formal approval of the proposed amendments are received from GDARD. The 2014 amendment application forms make provision for EMP amendment processes.
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.

7 Management Plans That Must Be Compiled In Order To Ensure Compliance With the Various Acts and Regulations

- Environmental Management Plan;
- Storm Water Management Plan;
- Water Quality and Quantity Management and Monitoring Plan;
- Security Management Plan;
- Waste Management Plan;
- Heritage Management plan;
- Road Construction and Upgrading Management Plan;
- Health and Safety Management Plan (to be compiled by safety officer); and
- Wetland and open space rehabilitation and management plan.

All the management plans listed above must be attached as part of the EMP and must be kept on the site during all the development phases. The management plans must be read in conjunction with the EMP, the BAR and S21 WUL decisions and the guidelines and mitigation measures as supplied in the EIA, S21 WULA report and specialist reports.

1 Project Outline

1.1 Background

Balwin Properties (Ltd) (The Applicant) is planning to develop a Residential Township. **Bokamoso Landscape Architects and Environmental Consultants CC** was appointed to compile a Basic Assessment Report (BAR) for the proposed **Jukskei View Extension 128** development and its associated infrastructure. The Report has been prepared to comply with the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998).

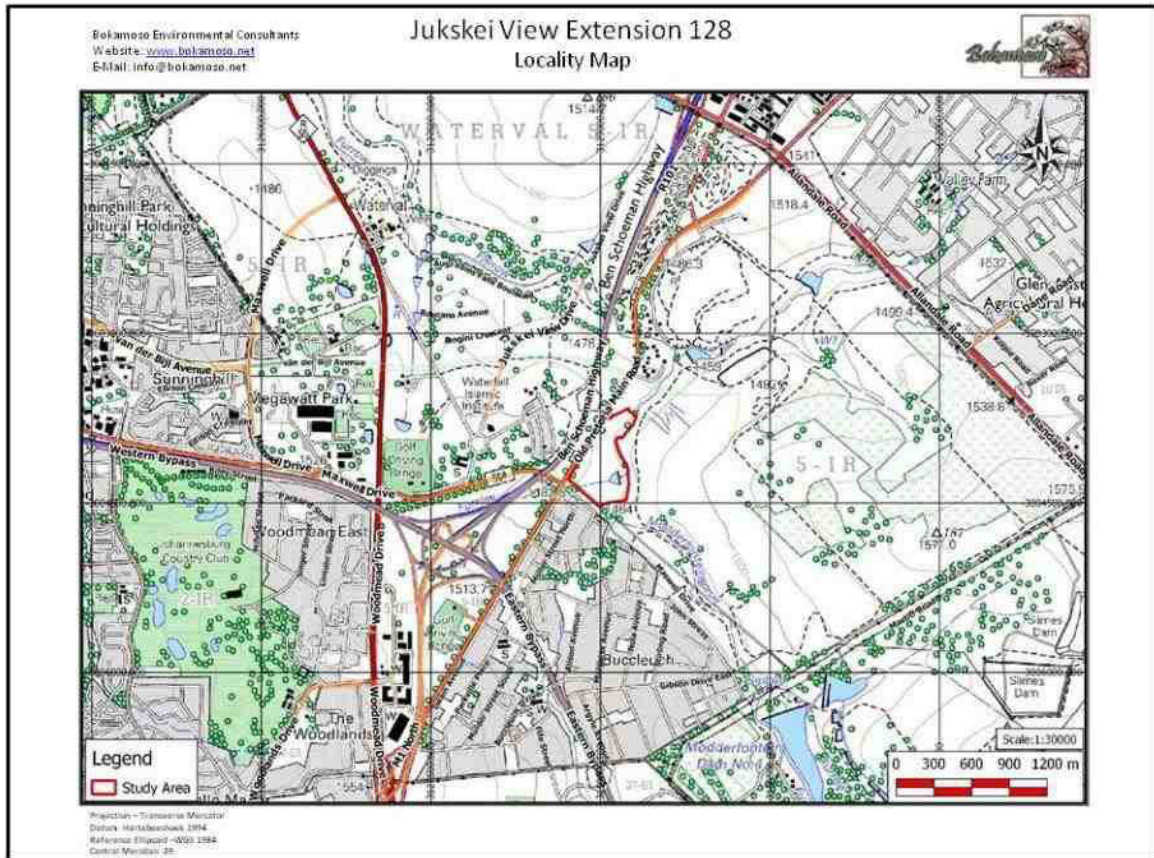


Figure 1: Locality Map



Figure 2: Aerial Map

1.2 Project description

The proposed **Jukskei View X128 development** is situated on the **Remainder of Portion 1 of the Farm Waterval 5 IR, Gauteng Province (Refer to Figure 1 for the Locality Map)**. The study area is approximately **22 hectares**, however the actual development area measures approximately **14 hectares**.

Timeframe for construction:

The construction for the proposed Development of Jukskei View X128 will commence as soon as approval for the proposed development has been granted from the relevant authorities.

The EMP will be a binding document for purposes of compliance.

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 of other Authorities; and
- Monitor the project.

EMP context

This EMP fits into the overall planning process of the project by carrying out the conditions of consent as 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 and/or proponent (D), Environmental Control Officer (ECO), Project Manager (PM), Contractors

(C), Environmental Assessment Practitioner (EAP), Environmental Site Officer – internal officer (ESO), Operational Phase Leasing Company (OPLC), Operational Phase Maintenance, Management and Compliance Monitoring Team (OPMMCMT), Construction and Operational Phase Security Management (COPSM) and Health and Safety Officer (HSO). Landowners, interested and affected parties and the relevant environmental and project specialists' are 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 Decision. 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 by the developer, for the duration of the construction and operational phases of the development in order to ensure compliance with the requirements of this EMP.

Contact details of appointed ECO

ECO details must be made available as soon as the developer appointed the relevant person/ company.

- The Environmental Control Officer (ECO) shall ensure that the contractor is aware of all the specifications pertaining to the project.
- Any damage to the environment must be repaired immediately after consultation between the Environmental Control Officer (ECO), Project Management, appointed Contractors, Development Management, Engineers.
- The Environmental Control Officer (ECO) shall ensure that the developer staff and/or contractor are adhering to all stipulations of the EMP.
- The Environmental Control Officer (ECO) 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 (ECO) shall be responsible for the environmental training program.
- The Environmental Control Officer (ECO) 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 internal environmental representative to monitor, review and verify overall compliance with the EMP during construction and operational phases. The ESO is not an independent appointment but must be a member of

the contractor's management team and the developer's operational phase management team. The ESO must ensure that he/she is involved with all aspects of the construction phase (from site clearance to rehabilitation) and the operational phase. The ESO must report to the developer and to the appointed independent ECO.

Authority (A):

The authority referred to is the Gauteng Department of Agriculture and Rural Development (GDARD).

Other Authorities (OA):

Other authorities referred to are:

- The National Department of Environmental Affairs (DEA);
- The Department of Water and Sanitation (DWS); and
- The South-African Heritage Resources Council (SAHRA).

Environmental Assessment Practitioner (EAP):

According to section 1 of the 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".

Operational Phase Leasing Company (OPLC)/ Developer

The company/party responsible for the leasing of the commercial/business, residential and other leasable structures/ facilities provided as part of the mixed-use development. The contact details and responsibilities of the person/s or company/s must be supplied to the ECO and GDARD prior to commencement with construction.

Operational Phase Maintenance, Management and Compliance Monitoring Team (OPMMCMT)

The team responsible for the maintenance, management and monitoring of the operational phase compliance with the EMP and all other management plans, guidelines etc.

Construction and Operational Phase Security Management (COPSM)

The team responsible for the management of the construction and operational phase security management.

Health and Safety Officer (HSO)

External Construction Phase Health and Safety Officer.

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 Control 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 responsible party (project manager/management company, engineer etc.) will be required for specific sensitive actions on request of the authorities/ECO/ESO. 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 the relevant authority/ the ECO of the 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 and/ or a sketch map of the locality of work; and
- When- the sequencing of actions with due commencement dates and completion date estimate.

The responsible party 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 relevant authority/ ECO/ESO.

the process to be followed. The activities listed in Notice No. R 983 requires that a Basic Assessment process be followed and the Activities listed in terms of Notice No. R 984 requires that the Scoping and EIA process be followed. Notice No. R 985 has been introduced to make provision for Activities in certain geographical and sensitive areas.

Subsequently, Listing 1 (R. 983) requires that a Basic Assessment Process be followed. It should however be noted that the Draft Guideline Document of DEA [Department of Environmental Affairs, (previously known as the Department of Environmental Affairs and Tourism)] states that if an activity being applied for is made up of more than one listed activity, and the Scoping and EIA process is required for one or more of these activities, the Scoping and EIA process must be followed for the whole application.

Implications for development:

Significant– The application for the proposed development consist of activities listed under Notice R. 983 (Listing No. 1) and R. 985 (Listing No. 3) and therefore a Basic Assessment Report will be submitted to GDARD for consideration.

National Water Act, 1998 (Act No. 36 of 1998)	National & Provincial	20 August 1998
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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.

In terms of the section 21 of the National Water Act, the developer must obtain water use licences if the following activities are taking place:

- a) Taking water from a water resource;
- b) Storing water;
- c) Impeding or diverting the flow of water in a water course;
- d) Engaging in a stream flow reduction activity contemplated in section 36;
- e) Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
- f) Discharging waste or water containing waste into a water resource through a pipeline, canal, sewer, sea outfall or other conduit;
- g) Disposing of waste in a manner which may detrimentally impact on a water resource;
- h) Disposing in any manner which contains waste from or which has been heated in any industrial or power generation process;
- i) Altering the bed, banks, course or disposing of water found underground if it is necessary for the safety of people;
- j) Removing, discharging, or disposing of water found underground if it is necessary for

- the efficient continuation of an activity or for the safety of people; and
- k) Using water for recreational purposes.

The National Water Act also requires that (where applicable) the 1:50 and 1:100 year flood line be indicated on all the development drawings (even the drawings for the external services) that are submitted for approval.

Implications for the Development:

Significant - The proposed development is subjected to flood lines of a natural stream / water course within an expected frequency of 1:50 and 1:100 years. The stream located on the southern portion of the site flows west to east into the Jukskei River which is located to the east of the site. The proposed development will require the construction of a bridge over the watercourse. A Water Use Licence Application (WULA) will be applied for in terms of Section 21 (i) and (c) of the National Water Act, 1998 (Act 36 of 1998) which is administered by the Department of Water and Sanitation (**Refer to Figure 3 – Hydrology Map**).

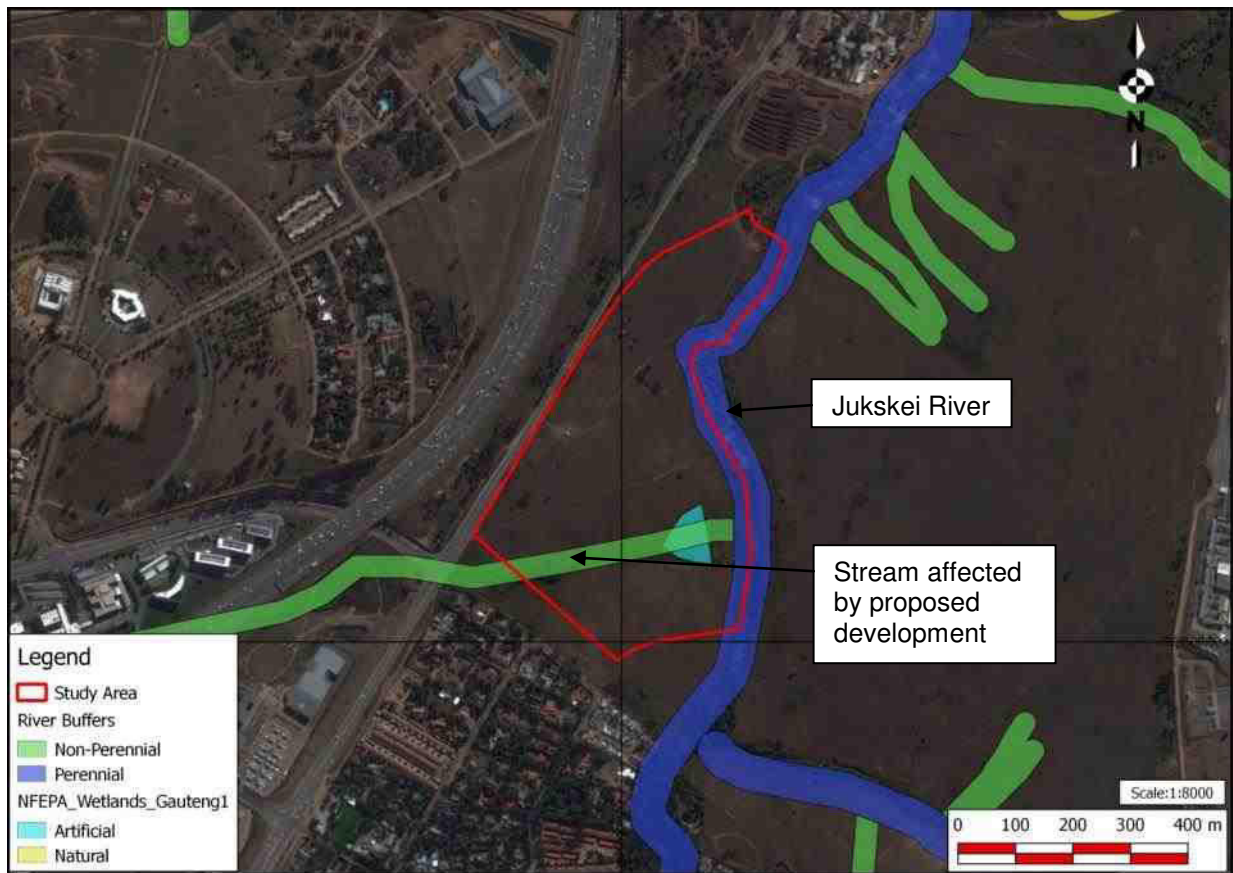


Figure 3: Hydrology Map

National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004)	National & Provincial	2004
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<p>The NEMA: AQA serves to repeal the Atmospheric Pollution Prevention Act (45 of 1965) and various other laws dealing with air pollution and it provides a more comprehensive framework within which the critical question of air quality can be addressed.</p> <p>The purpose of the Act is to set norms and standards that relate to:</p> <ul style="list-style-type: none"> ❑ Institutional frameworks, roles and responsibilities ❑ Air quality management planning ❑ Air quality monitoring and information management ❑ Air quality management measures ❑ General compliance and enforcement. <p>Amongst other things, it is intended that the setting of norms and standards will achieve the following:</p> <ul style="list-style-type: none"> • The protection, restoration and enhancement of air quality in South Africa. • Increased public participation in the protection of air quality and improved public access to relevant and meaningful information about air quality. • The reduction of risks to human health and the prevention of the degradation of air quality. <p>The Act describes various regulatory tools that should be developed to ensure the implementation and enforcement of air quality management plans. These include:</p> <ul style="list-style-type: none"> • Priority Areas, which are air pollution ‘hot spots’. • Listed Activities, which are ‘problem’ processes that require an Atmospheric Emission Licence. • Controlled Emitters, which includes the setting of emission standards for ‘classes’ of emitters, such as motor vehicles, incinerators, etc. • Control of Noise. • Control of Odours. <p>Implications for the development</p> <p>Not Significant - During the construction phase, dust and the generation of noise can become a significant factor, especially to the surrounding landowners. However if the development is well planned and if the mitigating measures are successfully implemented the proposed development’s contribution to air pollution and the generation of air pollution can become less significant.</p>		
<p>National Heritage Resources Act, 1999 (Act No. 45 of 1965 (NHRA)</p>	<p>National & Provincial</p>	<p>April 1965</p>
<p>The National Heritage Resources Act legislates the necessity and Heritage Impact Assessment</p>		

in areas earmarked for development, which exceed 0.5 ha. 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).

Implications for the development

Not Significant - No heritage sites were identified on/near the site earmarked for development.

If during construction any evidence of archaeological sites or artefacts, paleontological fossils, graves or other heritage resources are found, the operations must be stopped and a qualified archaeologist or SAHRA must be contacted immediately for an assessment of the find. **(Refer to Appendix G1: Heritage Impact Assessment and Appendix H - EMPr)**

<p>National Environmental Management Protected Areas Act, 2003 (Act No. 57 of 2003)</p>	<p>National</p>	<p>2003</p>
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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 and seascapes, for the management of those areas in accordance with national norms and standards, as well as for intergovernmental co-operation and public consultation in matters concerning protected areas. Protected areas are to be conserved for their biodiversity and ecological integrity.

Implications for the development

Not Significant- The subject property is not located within a protected area **(Refer to Figure 4 – Ridges)**.

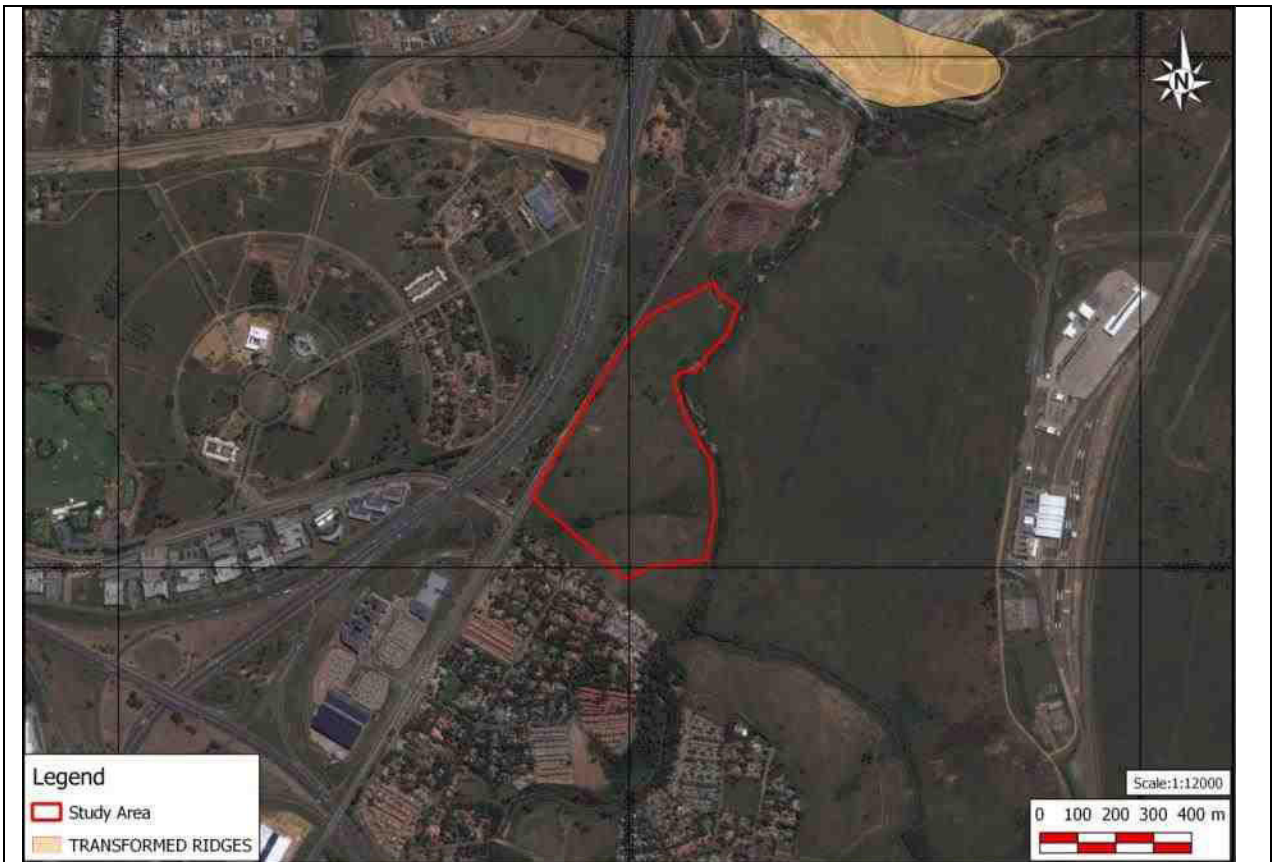


Figure 4: Ridges

<p>National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)</p>	<p>National</p>	<p>2004</p>
<p>The Biodiversity Act provides for the management and protection of the country’s biodiversity within the framework established by NEMA. It provides for the protection of species and ecosystems in need of protection, sustainable use of indigenous biological resources, equity and bioprospecting, and the establishment of a regulatory body on biodiversity- South African Biodiversity Institute.</p>		
<p>Objectives of the Act:</p>		
<p>(a) Within the framework of the National Environmental Management Act, to provide for:</p>		
<ul style="list-style-type: none"> (i) The management and conservation of biological diversity within the Republic and of the components of such biological diversity; (ii) The use of indigenous biological resources in a sustainable manner; and (iii) The fair and equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources; 		
<p>(b) To give effect to ratified international agreements relating to biodiversity which are</p>		

binding on the republic;

- (c) To provide for co-operative governance in biodiversity management and conservation; and**
- (d) To provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act.**

Implications for proposed development:

Significant- The study area is regarded as 'Irreplaceable' (a 'Critical Biodiversity Area' (CBA) as defined in the C-Plan 3.3) (**Refer to Figure 7: Biodiversity Map and Figure 8: C-Plan 3.3 Irreplaceable Site**).

Flora

The study area falls within the area designated as Egoli Granite Grassland situated in the Grassland Biome. Two study units were identified on the study site which includes Grassland and a Drainage Line cutting through it. Approximately 23% of the remainder of Portion 1 of the Farm Waterval 51R has a high sensitivity in terms of flora with 77% of the surface area having a low sensitivity. The proposed 22 ha development layout caters for 8 ha of private open space with the purpose of protecting sensitive environments occurring on site.

The development site has been identified as 'Irreplaceable' according to the GDARD C-Plan 3.3 due to the occurrence of the Orange List species *Hypoxis hemerocallidea* which were recorded in abundance in the study site and identified as having a moderate sensitivity according to the Flora Assessment (Refer to Figure 10: Flora Sensitivity Map and Appendix G2: Flora Assessment).

Although the development site is covered by Egoli Granite Grassland, a vegetation unit which is considered endangered, its isolation from natural grassland on neighbouring sites is not favorable to its continued pristine status and is deemed to have a low sensitivity. The Drainage Line on the other hand remains connected with the Jukskei River system.

It is recommended that the relocation of the Orange List species *Hypoxis hemerocallidea* be implemented prior to construction.

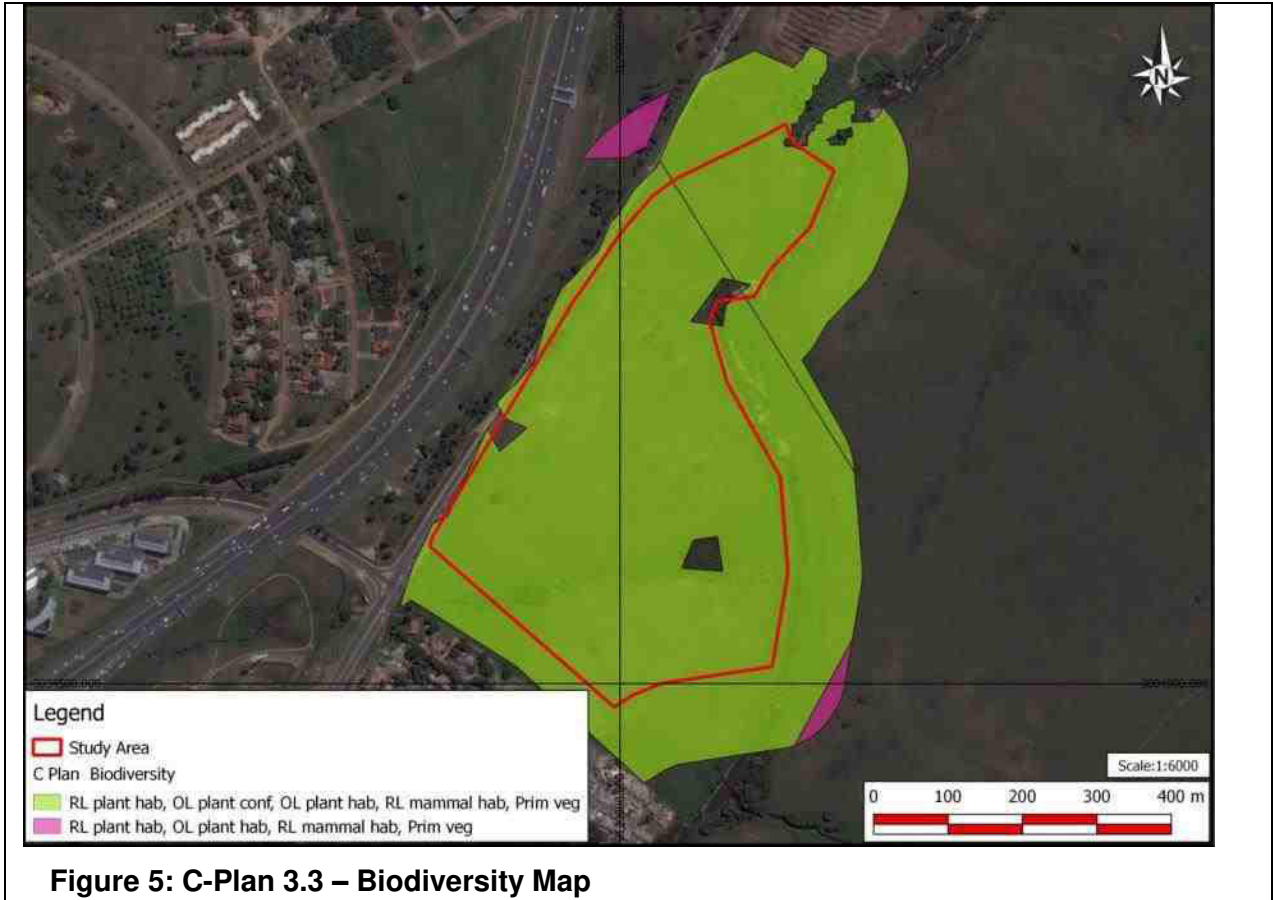




Figure 6: C-Plan 3.3 Irreplaceable Site.



Figure 7: Flora Sensitivity Map

Fauna

The majority of the terrestrial habitats present on the study area remain in its natural state, although alien plant species tend to invade some of the habitats. The current terrestrial habitats do however provide good habitat for a number of small mammals deduced to be present. The Grassland habitat is expected to support several small mammal species on account of the availability of their food source and maintained connectivity with homogenous habitats.

The Riverine habitat is deemed to be **highly sensitive** from a faunal perspective as it produces suitable habitats for Otter and Vlei Rat species. The probability of Red List Otter or Vlei Rat species selecting this particular stretch of the Jukskei River suitable for their nesting area is unlikely, on account of some pollution and degradation of the habitat. Otter and Vlei Rat species are however expected to use this part of the Jukskei River as a corridor or passage way to areas suitable for nesting purposes.

The Drainage Line is deemed to be **moderately sensitive** from a faunal perspective as it acts as a tributary to the Jukskei River. No Red Data faunal nesting areas were identified in the Drainage Line; however this habitat is expected to be utilized as a forage resource by these species (**Refer to Figure 8: Fauna Sensitivity Map and Appendix G3: Fauna Assessment**).

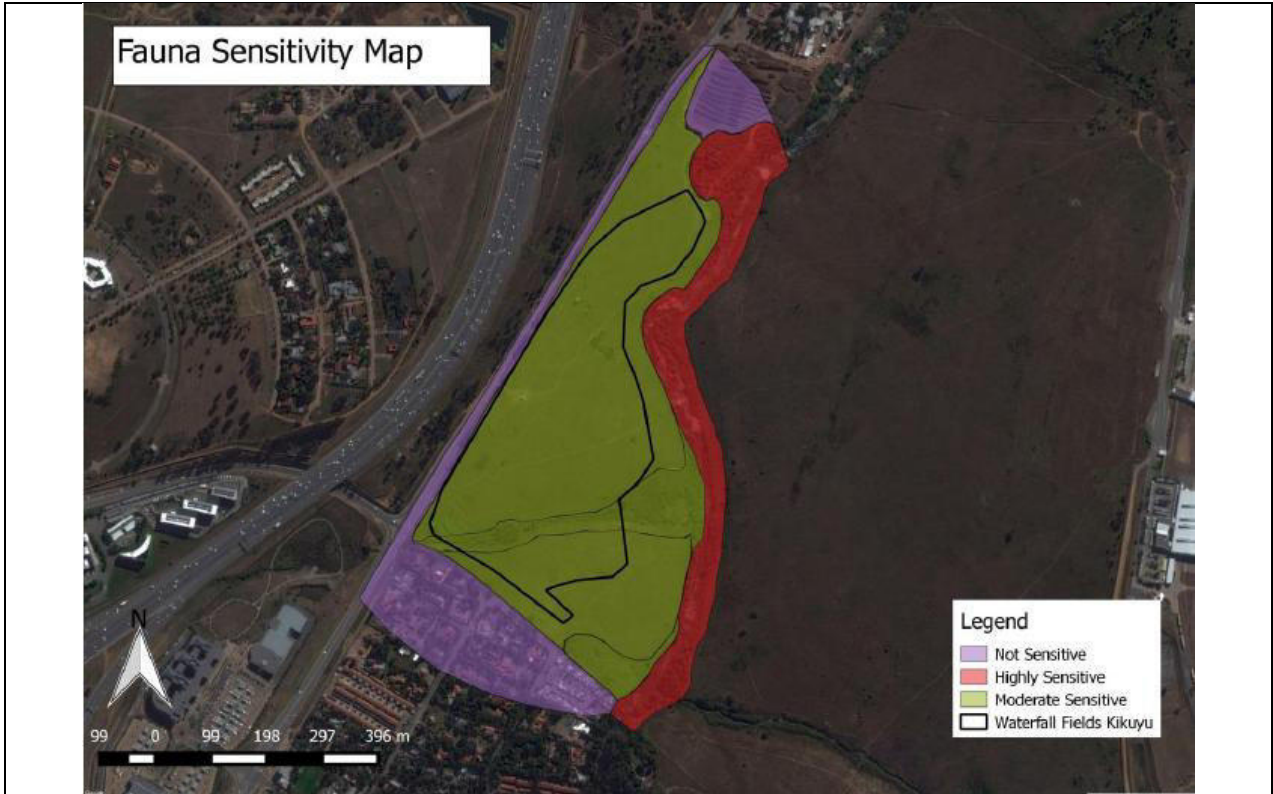


Figure 8: Fauna Sensitivity Map

Avifauna

The discrete habitats identified on the study area supports a moderate richness of bird species. Approximately 162 species have a high to medium occurrence probability, of which one near threatened bird species has a medium probability of occurring and/or being resident within the study area. The following findings were made for each of the associated habitat units within the larger study area (**Refer to Figure 9: Avifauna Sensitivity Map**).

Grassland: No suitable breeding habitat for any threatened or near threatened bird species were observed on site. However, could provide potential foraging habitat for certain threatened species such the Lanner Falcon. On account of the lack of suitable breeding habitat for species with conservation concern, and the overall low avifaunal species composition, this study unit was identified with a **low avifaunal sensitivity**.

Wetland and drainage line: The intact and largely undisturbed nature of the wetland

and drainage line habitat unit, along with the pollution prevention function and high number of observed bird species, renders this study unit as **highly sensitive** from an avifaunal perspective.

Riverine: The riverine area contains fast flowing, clear water with a number of small rapids, as well as vertical sandbanks and dense overhanging vegetation. Connectivity with neighbouring homogeneous habitat is relatively high, especially towards the north-east and west. Although the connectivity is regarded to be high, the water quality of the Jukskei River is questionable as a result of downstream pollution in the form of solid and chemical waste making its way into the river system. Apart from possible pollution, the riverine habitat unit provides optimal foraging habitat for the near threatened Half-collared Kingfisher, provided that a sustainable food source is available. A single Malachite Kingfisher was however observed within the riverine habitat unit, indicating that it is likely that a food source in the form of small fish, tadpoles and aquatic invertebrates is present. Due to the connectivity function, high avifaunal diversity and optimal habitat for the near threatened Half-collared Kingfisher, this habitat unit was identified to be **highly sensitive (Refer to Appendix G4: Avifauna Assessment)**.

Wetland

The site contains a channeled valley bottom wetland, with a PES rating of C. The channeled stream enters the Jukskei River, which is a known critically modified river in terms of water quality (**Refer to Figure 10: Wetland Delineation**). It is recommended that the delineated wetland be excluded from development. However, due to the state of the hydrology in the area, it would be recommended that the buffer be considered insignificant, where the focus should be placed on rehabilitation and upgrading of the watercourse.

The buffer will contribute very little to the protection of the watercourse, it is for this reason that the buffer be removed, and development incorporate and rehabilitate the functionality of the wetland. It should be noted that the development should always be designed outside of the floodlines to reduce risk to flooding (as wetlands on the Halfway House granite dome cannot attenuate flooding) (**Refer to Appendix G5: Wetland Assessment**).

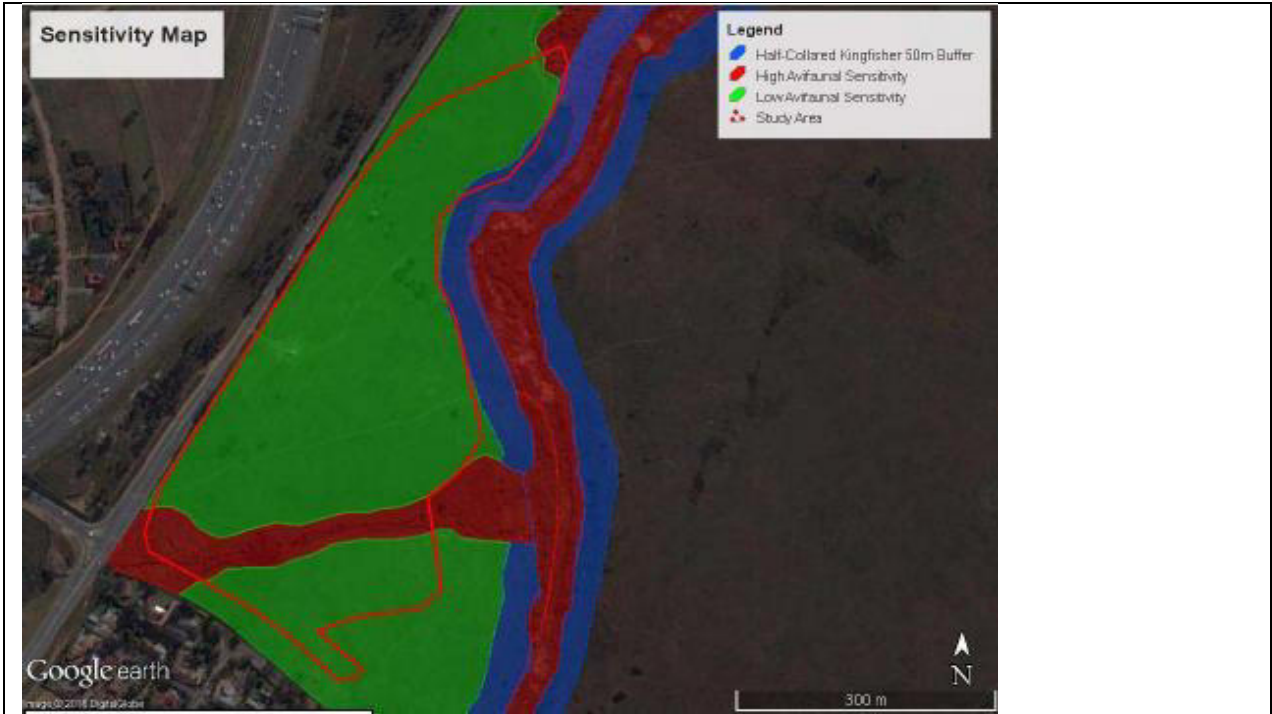


Figure 9: Avifauna Sensitivity Map



Figure 10: Wetland Delineation

The Land Exchange Matter/Offset Agreement

All the portions of land on the Farm Waterval 5 IR, which belong to the Mias Family, were included in a land swap transaction with GDARD.

The land swap transaction is applicable to the study area and therefore the conservation of Egoli Granite Grassland on site is not recommended. Refer to **Figure 11** for detail regarding land donated to GDARD for conservation purposes as well as **Appendix I of the Draft Basic Assessment Report** for the Land Exchange Memorandum of Agreement concluded with GDARD.

According to the Land Exchange Memorandum of Agreement the following properties comprising of Egoli Granite Grassland were donated to GDARD as offset area for the proposed development of the Remaining Extent of Portion 1 of the Farm Waterval 5 IR:

- Portion 6 of Doorinrandjie Farm;
- Portion 112 of Doorinrandjie Farm;
- Portion 106 of Doorinrandjie Farm; and
- Portion 39 of Doorinrandjie Farm.

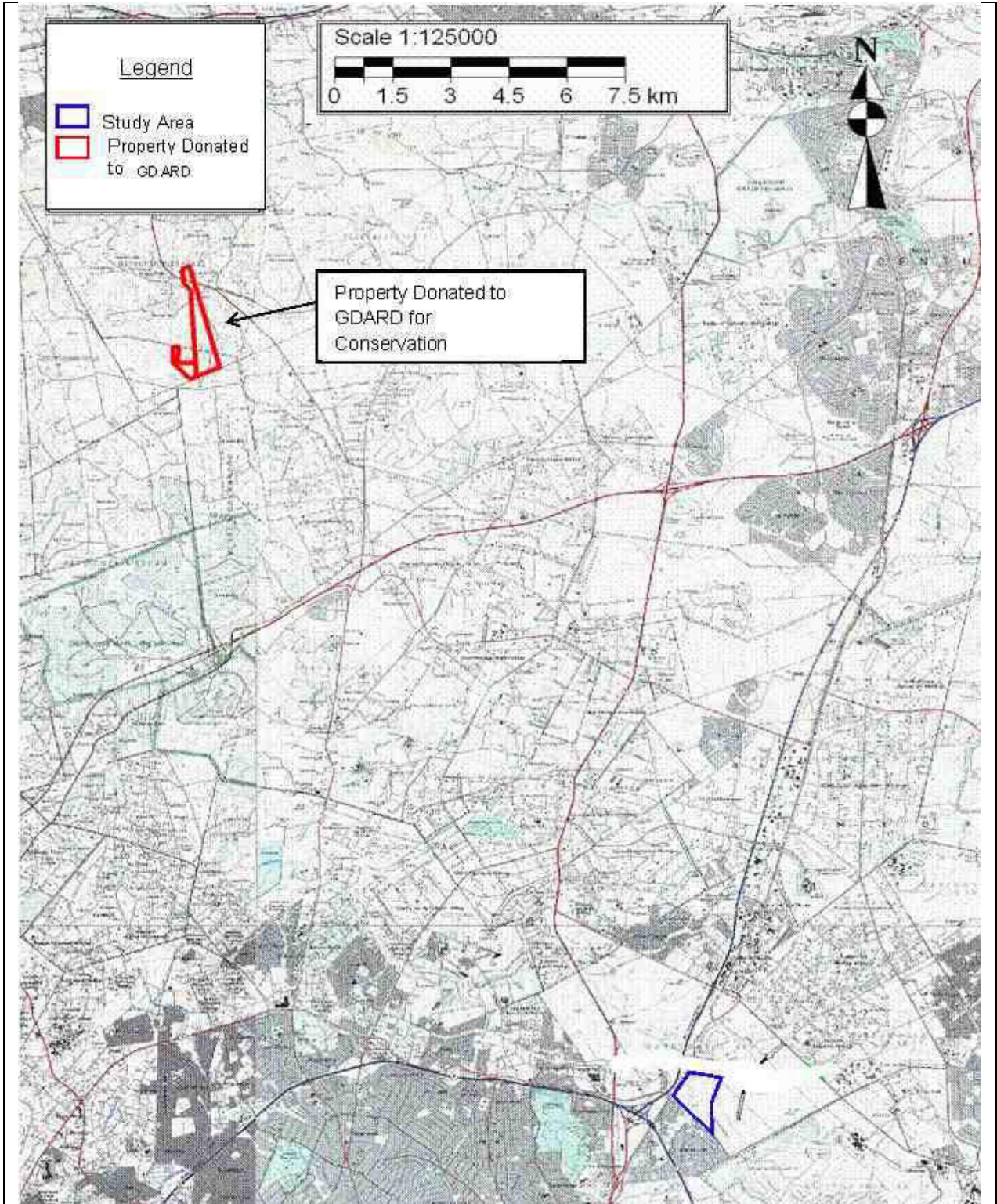


Figure 11: Property Donated to GDARD for Conservation

<p>Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)</p>	<p>National</p>	<p>1 June 1983</p>
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This act provides for control over the utilization of natural agricultural resources of South Africa in order to promote the conservation of soil, water sources and the vegetation as well as the combating of weeds and invader plants; and for matters connecting therewith.

Implications for the development

Not Significant – According to the Gauteng Agricultural Potential Atlas (GAPA 4), the site has a **low** agricultural potential (**Refer to Figure 12: Agricultural Potential**). In addition, GIS Data and GIDS data from GDARD also clearly indicates that the development is located with in the Gauteng Urban Edge (2010) (**Refer to Figure 13: Urban Edge**), and does not fall within any of the Seven Agriculture Hubs identified for the Gauteng province.



Figure 12: Agricultural Potential

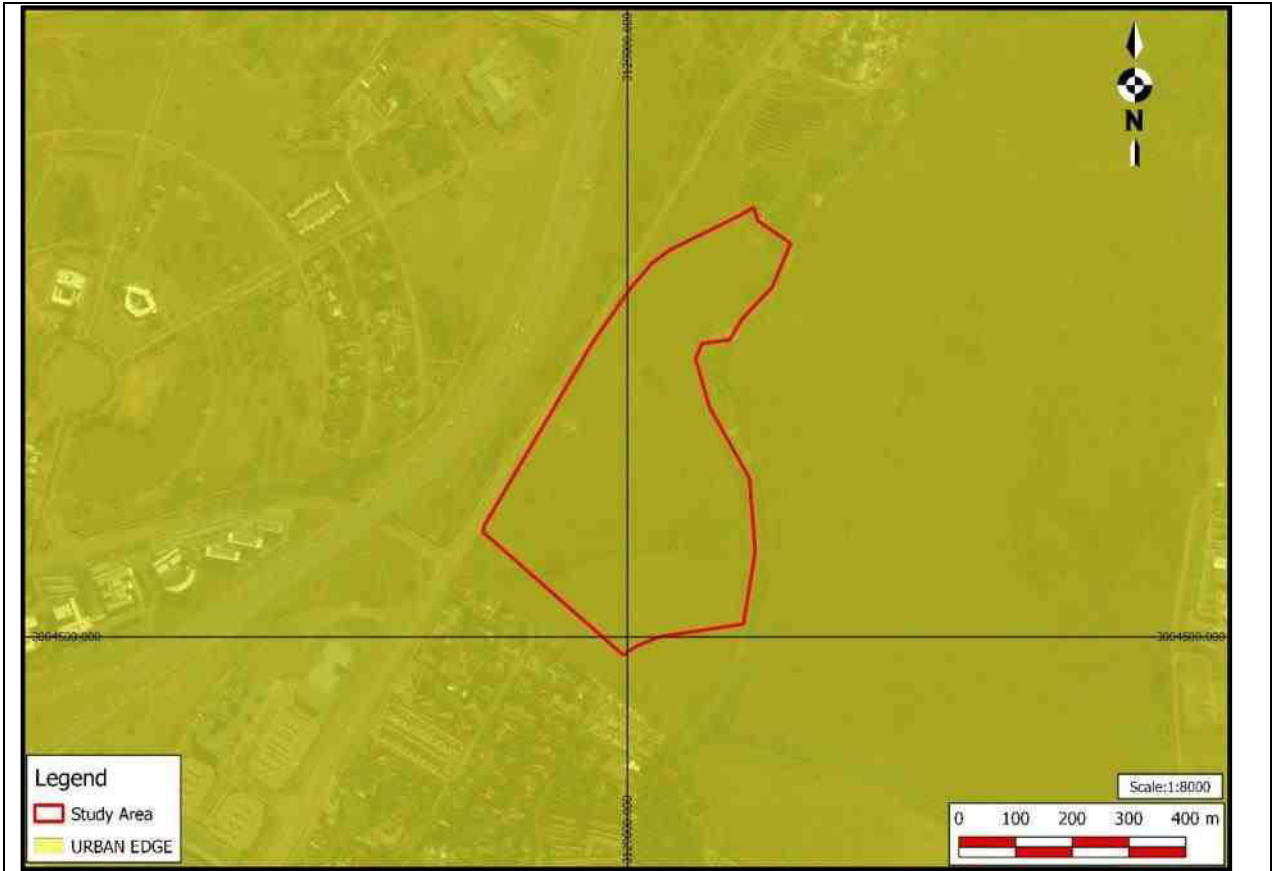


Figure 13: Urban Edge

National Environmental Management: Waste Act (Act 59 of 2009)	National	11 June 2010
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This Act came into effect on 11 June 2009. It aims to consolidate waste management in South Africa, and contains a number of commendable provisions, including:

- The establishment of a national waste management strategy, and national and provincial norms and standards, for amongst other, the classification of waste, waste service delivery, and tariffs for such waste services;
- Addressing reduction, reuse, recycling and recovery of waste;
- The requirements for industry and local government to prepare integrated waste management plans;
- The establishment of control over contaminated land;
- Identifying waste management activities that requires a license, which currently include facilities for the storage, transfer, recycling, recovery, treatment and disposal of waste on land;
- Co-operative governance in issuing licenses for waste management facilities, by means of which a licensing authority can issue an integrated or consolidated license jointly with

<p>other organs of state that has legislative control over the activity; and</p> <ul style="list-style-type: none"> • The establishment of a national waste information system. <p>Implication for the development:</p> <p>Not Significant – No waste management license will be required during the construction or operational phases of the proposed Township. Due to the fact that a limited amount of solid construction waste will be stored and handled on the site, before it is hauled away and dumped at the nearest registered landfill site.</p>		
Red List Plant Species Guidelines	Provincial	26 June 2006
<p>The purpose of these guidelines is to promote the conservation of Red List Plant Species in Gauteng, which are species of flora that face risk of extinction in the wild. By protecting Red List Plant Species, conservation of diverse landscapes is promoted which forms part of the overall environmental preservation of diverse ecosystems, habitats, communities, populations, species and genes in Gauteng.</p> <p>These Guidelines are intended to provide a decision-making support tool to any person or organization that is responsible for managing, or whose actions affect, areas in Gauteng where populations of Red List Plant Species grow, whether such person or organization be an organ of state or private entity or individual; thereby enabling the conservation of the Red List Plant Species that occur in Gauteng.</p> <p>Implication for the development:</p> <p>Not Significant – No Red Listed species have been recorded on site. The Riverine area does however provide for an optimal habitat for the near threatened Half-collared Kingfisher.</p>		
GDARD Draft Ridges Policy	Provincial	2007
<p>This policy is provided for the protection, conservation and maintenance of ridges within the Gauteng Province. Ridges play an important role in biodiversity and ecosystem functioning as they provide niche habitats for a number of species. Ridges must be viewed as playing a critical role in the preservation of migratory corridors for faunal and floral species.</p> <p>Implications for the development:</p> <p>Not Significant- According to the GDARD Draft Ridges Policy no development should take place on slopes steeper than 8.8%. The existing development does not occur in an area classified as a ridge in terms of GDARDs draft ridges policy (Refer to Figure 6 – Ridges).</p>		

<p>Draft Policy on the protection of Agricultural Land, 2006</p>	<p>Provincial</p>	<p>2006</p>
<p>GDARD identified 7 Agricultural Hubs in Gauteng Province. These hubs are earmarked for agricultural activities and there are policies and guidelines that should be taken into consideration when one plans to develop in these hubs areas. Urban development is usually not supported in these hubs.</p> <p>Implications for the development:</p> <p>Not Significant. The study area is not situated within any of the 7 agricultural hubs identified for Gauteng.</p>		
<p>Gauteng Noise Control Regulations, 1999</p>	<p>Provincial</p>	<p>1999</p>
<p>The regulation controls noise pollution. According to the acceptable noise levels in a residential area situated within an urban area is 55dBA and the maximum acceptable noise levels in a rural area is 45dBA.</p> <p>Implications for the Development:</p> <p>During the construction phase of the proposed development, the impact of noise could be problematic, but such impacts are generally short term. One should note that practical mitigation measures for noise pollution are low, but certain measures can be implemented to mitigate the severity (Refer to Appendix H (EMPr) for a list of suitable guidelines and mitigation measures).</p>		
<p>The Gauteng Transport Infrastructure Act, 2001</p>	<p>Provincial</p>	<p>2001</p>
<p>The Act was created to consolidate the laws relating to roads and other types of 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; and to provide for matter connected therewith.</p> <p>Implications for the proposed development</p>		

Not Significant - All developments in Gauteng must take the Gauteng Road network into consideration and no development may be planned across any provincial or K-route indicated on the published alignments.

The proposed K60 is located approximately 200 m to the north of the site and the proposed K101 adjacent to and west of the site. There are no K-routes planned through the proposed application site.

Gauteng Transport Infrastructure Amendment Act; 2003	Provincial	2003
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The aim of this Amendment Act is to amend the Gauteng Transport Infrastructure Act, 2001 so as to amend and insert certain definitions; to provide for the necessary land use rights with respect to stations and for the necessary powers of the MEC to enter into contracts for road and rail projects; to amend the procedure in relation to route determination; to make a second environmental investigation at the stage of preliminary design of a road or railway line unnecessary where the competent environmental authority decides that the environmental investigation at the stage of route determination is adequate; and to provide for incidental matters.

Implications for the Development:

Not significant- The development has already taken the existing and planned provincial roads into consideration.

4 Environmental Management Plan (EMP)

Role Players and Abbreviations: Authorities (A), other Authorities (OA), Developer and/ or proponent (D), Environmental Control Officer (ECO), Project Manager (PM), Contractors (C), Environmental Assessment Practitioner (EAP), Environmental Site Officer – internal officer (ESO), Operational Phase Leasing Company (OPLC), Operational Phase Maintenance, Management and Compliance Monitoring Team (OPMMCMT), Construction and Operational Phase Security Management (COPSM) and Health and Safety Officer (HSO), Cultural and Heritage Specialist (CHS), Fauna and Flora Specialist (FFS), Wetland Specialist (WS), Engineer (E).

4.1 Pre-Construction Phase

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
General	Project contract	To make the EMP enforceable under the general conditions of the contract.	The EMP document must be included as part of the tender documentation for all contractor appointments	The EMP is included as part of the tender documentation	D, ESO, ECO, HSO, PM, COPSM,	-	2014 NEMA EIA Regs
			To ensure a well-managed site all activities need to be properly structured and planned ahead. All risks should be properly mitigated.	The EMP is strictly implemented and adhered to	ECO,ESO, HSO, D, PM, E, C, COPSM	-	
Design and planning	Stability of structures and restriction of land use due to geology	To ensure that precaution is implemented during trench excavations	<p>Care should be taken during the foundations and all other excavations due to the localized difficulty.</p> <p>According to the specialist team, the soils of the study area are shallow. It is unlikely that any additional waste sites or graves will be discovered during the construction phase. We however already addressed the possible discovery of additional graveyards/ waste sites.</p> <p>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.</p>	<p>Signage boards are bright and clear</p> <p>Clearly demarcated and/ or co-ordained off areas with a fence or barrier tape</p>	ECO,ESO, HSO, D, PM, E, C, COPSM, HSO, DS	-	Heritage Act, NEMWA; 2014 NEMA EIA Regs
		To ensure the	To ensure stabilization of the channel		E, D, ECO, PM	-	NWA;

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
		stabilization of channels' banks through significant engineering intervention	banks and limiting erosion and the collapsing of the banks, the engineer should properly design the reinforcements. Vegetative-based structural reinforcements are preferred. Steep embankment along roads and in other sections of the development should also be planted with vegetative based structural reinforcements.				2014 NEMA EIA Regs; NEMA
	Potential moderate heave of transported and residual soils	To prevent the heave and/ or motion of transported material, and the monitoring thereof	Special foundation designs will most probably be required in such areas.	Precautionary measures implemented	<i>D, PM, E, C</i>	-	
	Development below the 1:100-year flood line/ within the watercourse ad buffer areas	Prevent/restrict the alteration of the flood line/ hydrological functioning on the study area and up-stream and down – stream impacts	When implementing permanent infrastructure in the watercourse, such features and associated measures must be designed to reduce/ prevent damage to the watercourse and watercourse buffer areas during the construction and operational phases. It must be designed to assist with storm water management, water attenuation, the prevention of siltation, the prevention of erosion and the prevention of water pollution. It must furthermore (where possible) be applied to assist with the creation of habitats. Temporary measures must be implemented during the construction phase to prevent erosion, siltation, the obstruction of surface water and sub-surface water flows and water pollution. The proposed temporary measures must be forwarded to GDARD, the COJ and	No impacts on the floodlines No flood risks Improved flood management	<i>E, PM, C</i>	Continuous	Section 144 of the NWA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			<p>DWS prior to implementation. DWS and CoJ must confirm that they support such measures.</p> <p>A wetland and watercourse management and rehabilitation plan must be compiled and submitted to GDARD, CoJ and DWS after the proposed bridge structure and attenuation structure and features designs have been finalised. Such plan must be implemented and read in conjunction with this EMP.</p>				
	Collapse settlement in the loose colluvium and residual granite horizons		<p>Mark all excavated areas clearly during the construction phase and erect signs on site to warn workers and passers-by of possible collapsible soil conditions.</p> <p>Put temporary precautionary measures in place during the construction phase to prevent accidents associated with the collapsing of soils.</p>	<p>Areas with collapsible soil to be demarcated.</p> <p>No occurrence of accidents</p>	<i>D, PM, E, C</i>	-	
	The soils on the site is not regarded as suitable for usage as construction materials	To ensure the sustainable usage of soils on the site	<p>Promote the usage of construction materials obtained from the site. This will promote re-use and recycling and it will eliminate high transport and soil importation costs.</p> <p>Store sub-soils that are suitable for construction purposes in designated areas on the study area. Separate the sub-soil to be used for construction purposes from the topsoil. The temporary storm water management measures as proposed for stockpiles on the study area are also applicable to sub-soil storage.</p> <p>From a landscaping point of view it is always better to prevent the import of soils that are not in line with the soil types of the study area. The application of imported</p>	<p>Topsoils separated from sub-soils and neatly stored on the site, above the flood line and on areas already disturbed</p> <p>ECO to address this matter prior to construction, during the site hand-over meeting. Must also be item in tender documents.</p>	<i>D, PM, E, C, ECO</i>	Continuous	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			<p>and different soils layers above the soils of the study area could lead to the formation of even more perched water conditions/ higher water tables.</p> <p>If soils are imported for landscaping purposes, the imported soils must preferably be mixed with the soils on the site to improve drainage and permeability and to prevent the occurrence of "finger drainage" patterns.</p>				
	Acidity of soils		<p>According to the specialists, the acidity of the soils on the study area is high. Anthrax spores cannot survive in soils with high acidity and bone remains of animal carcasses and humans will decompose at increased rates in such soil conditions.</p> <p>The services to be installed for the proposed development must be able to tolerate the acidity of the soils.</p>	Services can tolerate the acidity of the soils	E, C	When required	
	Storm water design	To prevent and restrict erosion, siltation and groundwater pollution	<p>A storm water management plan must be compiled for the construction and operational phases of the proposed development.</p> <p>Compilation of a storm water management plan that will address storm water management during the construction and operational phases of the project and would mitigate the increased runoff due to vegetation removal.</p> <p>A comprehensive storm water management plan indicating the management of all surface runoff generated as a result of the development (during both the construction and operational phases) prior to entering any</p>	Compilation and approval of storm water management plan	E, ESO, ECO, D, C, PM	Continuous	2014 NEMA EIA Regs; NEMA; NWA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			<p>natural drainage system or wetland, must be submitted and approved by the local authority and DWS and submitted to GDARD prior to construction activities commencing.</p> <p>The storm water management plan must be submitted to the local authority for approval.</p> <p>Attenuation features and energy dissipaters must be installed on the study area to break the speed of the water and to act as siltation ponds.</p> <p>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"> •Peak discharge for any given storm; •Total volume of runoff for any given storm; •Frequency of runoff; and •Pollutant and debris concentrations reaching water courses. <p>Adequate storm water planning and design is required to avoid impacts on the hydrology and more specifically the watercourses connected to the watercourses on the study area.</p> <p>The storm water management must be designed to prevent major impacts on the areas lower down in the catchment area.</p> <p>The storm water management plan must indicate how surface runoff will be retained outside of the demarcated</p>				

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			<p>buffer/flood zone and how the natural release of retained surface runoff will be simulated.</p> <p>Bio-swale and bio-filters could be installed to minimize the risk of pollutants entering the natural drainage system of the area.</p> <p>In order to prevent erosion, siltation and water pollution during the construction phase of the development, it will be necessary to implement temporary storm water management measures during the construction phase. This will assist with the management of run-off from the construction areas.</p> <p>In areas where excavations are done (i.e. excavations for the installation of pipes/ for basements/ foundations, especially against the steeper slopes, a temporary shallow channel just below the stored excavation materials could assist with the prevention of siltation/ the washing of the excavated materials into the watercourses lower down. The usage of sand bags/ temporary stone weirs are also recommended in areas that are prone to erosion.</p> <p>The temporary storm water management measures for each phase must be attached to the EMP prior to commencement with such phase.</p>				
		To ensure good drainage	Identify perched water tables early and provide adequate drainage for these trigger points. These areas must be indicated on a plan and contractors and other members of the team must be notified of possible perched water	No problems with problems with dampness in surface structures or with installation of services	E, WS, C, PM, D	Continuous	2014 NEMA EIA Regs; NEMA; NWA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			<p>conditions and the mitigation measures for the drainage of the areas and for construction in these areas must be discussed with all relevant parties.</p> <p>The wetland specialist must be involved in the ground water drainage planning and the proposed drainage concepts must also be tested with the Department of Water Affairs, because they will be responsible for the issuing of the Section 21 (C) and (i) licenses required for the construction and operational phases of the development.</p>				
		To reduce recharge and erosion impact on the soil layers in the study area	<p>Uncontrolled runoff water can have a significant impact on the soil layers of the study area, therefore the total runoff water must be identified and confirm to reduce recharge and erosion impact on the soil layers.</p> <p>Plan reviews are conducted to ensure they provide for adequate construction and post-construction storm water runoff pollution control.</p> <p>Pre-construction meetings help to identify potential storm water runoff problem areas on the construction site and ensure they are addressed as part of the SWMP.</p>	<p>Plan reviews take place.</p> <p>Reduced to no erosion impact on the soil layers</p>	D, E	Continuous	2014 NEMA EIA Regs; NEMA; NWA
		To implement storm water mitigation outside wetland areas	<p>Pre-construction meetings help to identify potential storm water runoff problem areas on the construction site and ensure they are addressed as part of the SWPPP.</p> <p>Implement temporary storm water management measures during the construction phase in order to prevent erosion, siltation and water pollution.</p>	<p>Pre-construction meetings take place.</p> <p>No storm water entering wetlands areas, and areas directly outside the wetland</p>	E, C, PM, D, WS	Continuous	2014 NEMA EIA Regs; NEMA; NWA
	Light pollution	To minimise light	The generation of light by night events,	Lightning effectively	A, D, E	When	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
		pollution	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.	designed.		planned and installed	
	Visual impact	To minimize the visual impact of the proposed development.	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.	Architectural guidelines minimizes visual impact	A, D, E	When planned and implemented	
			<p>The buildings must be built according to environmental sustainable principles; the orientation of the building and the use of a passive ventilation system.</p> <p>Architectural and landscaping guidelines must be supplied in the EMP and the proposed Architectural theme must blend in with the surrounding area.</p> <p>The colour scheme should be taken from the palette of colours in the natural surroundings.</p> <p>If planned and managed correctly, the proposed development will enhance the "Sense of Place" and value of the study area and its surroundings.</p> <p>Existing trees should be retained as far as possible on the site in order to soften the impact of the proposed permanent structures and to bring the scale of the higher structures down to a more human scale.</p> <p>Landscaping should be done in concurrence with the building construction in order to create an instant</p>		A, D, E	When planned and implemented	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			visual enhancement of the development. The landscaping of the proposed development should blend in with the natural vegetation of the area. Trees, shrubs and groundcovers that are endemic to the area and/or indigenous should preferably be used – landscaping that is in line with the natural vegetation of the area will not only help to reduce the visual impact of the development, but it will also create habitats for fauna and flora species.				
	Negative impact on the sense of place	To ensure an enhanced sense of place and ambience	The proposed development should be designed and planned in such a way that it fits in with the surrounding environment.		A, E, D	When planned and implemented	
Fauna and flora		To ensure protection of water resources and wetlands	No construction or dumping of activities should take place within watercourse buffer area as delineated and clearly demarcated prior to the construction phase. Only construction activities authorised by the involved authorities will be permitted in such areas.		E, C, PM, ESO, ECO, D	Continuous	2014 NEMA EIA Regs; NEMA; NWA
	Loss of sensitive vegetation	To ensure protection of medicinal plants	Although some disturbed natural grassland and natural primary grassland areas will be lost, the proposed protection, rehabilitation and management of the open spaces associated with the watercourse will, in the long term have a positive impact on the river ecology and the hydrology. The <i>Hypoxiss sp</i> identified in the grassland areas must be relocated to the areas as identified by the ECO and flora specialist prior to construction. GDARD must be contacted prior to the	Medicinal plants rescued prior to construction	Qualified specialist	Continuous	2014 NEMA EIA Regs; NEMA; NEM:BA; C-Plan

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			relocation of the <i>Hypoxis sp</i> Department must be afforded the opportunity to assist with the relocation process.				
		To permit the dispersal of faunal species to undisturbed areas	Where possible, work should be restricted to one area at a time. This will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories.		ECO, ESO, PM, C, FS, D	Continuous	
		Relocation of bullfrogs	If any bullfrogs are found on the site during excavations, the bullfrogs should preferably be relocated to areas as identified by GDARD. The applicant will require a permit for the relocation of the bullfrogs. Such a permit can be obtained from GDARD.	Obtain permits for the relocation of bullfrogs	ECO, ESO, PM, C, FS, D	Continuous	GDARD Permit
		Hedgehogs and birds	Where possible, work should be restricted to one area at a time, as this will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories. Should any mammals (such as hedgehogs) be encountered during the construction phase of the development, these should be relocated to natural grassland areas in the vicinity.		FS, ECO, ESO, C, D, PM, D	Continuous	
Preparing Site Access	Environmental integrity	To avoid erosion and disturbance to indigenous vegetation	Plan heavy vehicle and machinery circulation routes prior to the construction phase and identify temporary storage areas for excavated sub-soil. Clearly mark the site access point and routes on site to be used by construction vehicles and pedestrians. Put temporary precautionary measures in place during the construction phase to prevent accidents associated with	Access to site is erosion free. Minimum disturbance to surrounding vegetation. Vehicles make use of established access routes.	PM, C, D, E,	Continuous	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act
			<p>mechanical excavation exercises.</p> <p>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.</p>				
	Waste storage	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.		C, E, PM, ECO, ESO, D	Continuous	2014NEMA EIA Regulations, Section 19 of the NWA, NEMWA, also Section 8 of the Waste Act and the contaminated land Regulations
		To control and minimise waste during all the development phases and to comply with the requirements of GDARD.	<p>Compile a waste management plan for the construction and operational phases of the proposed mixed-use development.</p> <p>The waste management plan must also supply emergency waste management measures that deals with exposure to waste sites/ hazardous waste during the construction phase.</p> <p>The contaminated land section of the waste Act as well as other relevant provisions in the Waste Act and other relevant legislation must also be taken into consideration.</p>	<p>Waste sorted on site</p> <p>Regular removal of waste</p> <p>Waste register on site</p> <p>Prove of waste disposal at registered landfill site</p> <p>Waste incidents register on site</p>	ECO, ESO, C, E, D	Continuous	2014 NEMA EIA Regulations, Section 19 of the NWA, NEMWA, also Section 8 of the Waste Act and the contaminated land Regulations
		Ensure waste storage area does not generate pollution	<p>Build a bund around waste storage area to stop overflow into storm water and the drainage channel on the application site.</p> <p>Demarcated areas for dumping of construction waste.</p> <p>Dumping of materials should be</p>	<p>The bund is clearly visible and secure, with no signs of overflow</p> <p>In accordance with the master layout plan</p>	ECO, C, PM, ESO, D, E	When implemented	2014 NEMA EIA Regulations, Section 19 of the NWA, NEMWA, also Section 8 of the Waste Act and the

<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</i>
			controlled.				contaminated land Regulations
Social	Illegal occupation of property.	To ensure a limitation of petty and major crimes in the area	Introducing a development (such as the preferred alternative) on this open land that complements the surrounding environment will limit the chance/occurrence of petty crimes establishing in the area.	No signs nor records of petty or major crimes in the area	ECO, ESO, PM, D, E, COPSM	Continuous	
	Construction and operational phase related impact on the security of the area	To address the security risks associated with the construction and operational phases of the development	Compile a construction and operational phase security management plan, which will allow for 24 hour security of the area.	Improved security in the area.	COPSM	Continuous	

4.2 Construction Phase

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
Contractor's Camp	Loss of Vegetation and topsoil	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.	C, D, PM, FS, ESO, ECO	Before any construction activity commences and as and when required	2014 NEMA EIA Regulations, NEMA, GDARD Red Data Species Policy, NEM:BA
	Surface and ground water pollution	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</p>	<p>Effluents managed Effectively.</p> <p>No pollution of water resources from site.</p> <p>Workforce use toilets provided.</p>	C, ECO, ESO, PM, DS, D	As and when required	2014 NEMA EIA Regulations, NEMA, NWA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>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 close proximity of the adjacent dwellings to prevent odors from causing uncomfortable situations.</p> <p>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.</p>				
		To minimize pollution of surface and groundwater resources due to spilling of materials.	<p>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.</p> <p>2) Repair and storage of vehicles only within the demarcated site area.</p> <p>3) Spill kits must be available on site.</p> <p>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.</p> <p>5) All spilled hazardous substances must be contained in impermeable containers for removal to a licensed hazardous waste site.</p> <p>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.</p>	No pollution of the environment	C, ECO, ESO, PM, DS, D	As and when required	2014NEMA EIA Regulations , NEMA, NWA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>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.</p> <p>8) If any pollution incident is experienced, DWA must be notified immediately.</p>				
		To minimize pollution of surface and groundwater resources by cement	The mixing of concrete shall only be done at specifically selected sites, as close as possible to the entrance, on mortar boards or similar structures to prevent run-off into drainage line, streams and natural vegetation.	No evidence of contaminated soil on the construction site.	C, ESO, ECO, PM	Daily	
		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, especially the drainage channel on site.	No evidence of contaminated water resources.	C, ESO, ECO, PM	Daily	
	Pollution of the environment	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 AND NOT WITHIN CLOSE PROXIMITY OF DRAINAGE LINES. 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</p>	<p>No waste bins overflowing</p> <p>No litter or building waste lying in or around the site</p>	C, D, ESO, ECO, PM	Daily Weekly	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>should comply with the following:</p> <ul style="list-style-type: none"> • Skips for the containment and disposal of waste that could cause soil and water pollution, i.e. paint, lubricants, etc.; • Small lightweight waste items should be contained in skips with lids to prevent wind littering; • Bunded areas for containment and holding of dry building waste. <p>4) No solid waste may be disposed of on the site.</p> <p>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).</p> <p>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.</p> <p>7) Cover any wastes that are likely to wash away or contaminate storm water.</p>				
		Control and designate areas for dumping	<p>Demarcated areas for dumping of construction waste</p> <p>Dumping of materials should be controlled.</p>	Areas designated for dumping are adhered to	Contractor	Weekly	
		Recycle material where possible and correctly dispose of unusable wastes	<p>1) Waste shall be separated into recyclable and non-recyclable waste, and shall be separated as follows:</p> <ul style="list-style-type: none"> • General waste: including (but not limited to) construction rubble, • Reusable construction material. <p>2) Recyclable waste shall preferably be deposited in separate bins.</p>	<p>Sufficient containers available on site</p> <p>No visible signs of pollution</p>	Contractor ESO	Daily Weekly	Section 19 of the NWA; Section 28 of NEMA; Duty of Care (NEMA and NWA) NEM:WA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>3) All solid waste including excess spoil (soil, rock, rubble etc.) must be removed to a permitted waste disposal site on a weekly basis.</p> <p>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.</p> <p>5) Keep records of waste reuse, recycling and disposal for future reference. Provide information to ESO.</p> <p>6) Comply with the Waste Management Plan</p>				
	Increased fire risk to site and surrounding areas	To decrease fire risk.	<p>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.</p> <p>2) Food vendors shall be allowed within specified areas.</p> <p>3) Fire extinguishers to be provided in all vehicles and fire beaters must be available on site.</p> <p>4) Emergency numbers/ contact details must be available on site, where applicable.</p>	No open fires on site that have been left unattended	C, ESO, ECO, PM	Monitor daily	NEM:AQA
Construction site	Geology and soils	<p>To prevent the loss of topsoil</p> <p>To prevent siltation & water pollution.</p>	<p>1) Stockpiling will only be done in designated places where it will not interfere with the natural drainage paths of the environment.</p> <p>2) In order to minimize erosion and siltation</p>	<p>Excavated materials correctly stockpiled</p> <p>No visible signs of</p>	C, D, E, ESO, ECO, PM	Monitor daily	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>and disturbance to existing vegetation, it is 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) The proposed rehabilitation plan for the study area must also address the phased implementation of formal landscaping along new roads and in other open space areas that will not form part of the proposed natural open space area associated with the river system.</p> <p>6) All compacted areas should be ripped prior to them being rehabilitated/ landscaped</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 beginning 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</p>	<p>erosion and sedimentation</p> <p>Minimal invasive weed growth</p> <p>Vegetation only removed in designated areas</p>			

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>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>10) Stockpiles should be covered correctly.</p> <p>11) If possible, implement the development in phases and clear the vegetation in phases and as required for the implementation of the phases.</p> <p>12) Where possible the proposed construction circulation routes must be restricted to disturbed areas and existing dirt roads. Avoid unnecessary circulation routes through watercourse/ flood line areas.</p> <p>13) A ground coverage of at least 75% must be achieved in areas where natural areas and formal landscaping are to be implemented. This coverage must be achieved by the appointed landscape contractor prior to the handing-over of the completed works.</p>				
	Erosion and siltation	To prevent erosion and siltation in general	<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 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.</p>	<p>No erosion scars</p> <p>No loss of topsoil</p> <p>All damaged areas successfully rehabilitated</p>	C, ECO, ESO, PM, E	Monitor daily	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>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) Rehabilitate exposed areas immediately after construction in these areas is completed (not at the end of the project).</p> <p>6) Unnecessary clearing of flora resulting in exposed soil prone to erosive conditions should be avoided.</p> <p>7) Specifications for topsoil storage and replacement to ensure sufficient soil coverage as soon as possible after construction must be implemented</p> <p>8) 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>9) Storm water diversion measures are recommended to control peak flows during thunder storms.</p> <p>10) The eradication of alien vegetation should commence as soon as possible. The areas cleared adjacent of the river must be covered with suitable indigenous vegetation to ensure quick and sufficient coverage of exposed areas</p> <p>11) Storm water outlets shall be correctly designed to prevent any possible soil erosion.</p>				

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>12) All surface run-offs shall be managed in such a way so as to ensure erosion of soil does not occur.</p> <p>13) 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>14) All surfaces that are susceptible to erosion shall be covered with a suitable vegetative cover as soon as construction is completed by the individual erf owner / developer.</p>				
		To prevent erosion and sedimentation during cut and fill exercises'	<p>Proper mitigation measures need to be implemented during these cut and fill exercises to ensure that erosion and sedimentation is limited.</p> <p>Some of the soils on the study area are associated with unstable conditions. This must be taken into consideration during cut and fill exercises and during the remainder of the construction phase</p>	Limited to no erosion and sedimentation	C, PM, ESO, ECO, E	Daily	
		To prevent siltation, erosion and water pollution in the Jukskei River	<p>The storm water design for the proposed development must be designed to:</p> <ul style="list-style-type: none"> - Address the construction and operational phase storm water management. - Prevent bank and riparian zone erosion especially in the upper section of the main tributary. - Reduce and/ or prevent siltation, erosion and water pollution. If erosion, siltation and water pollution is not addressed, the sustainability of the drainage and the open space systems especially in the upper section of the main tributary can be negatively impacted by the 	Storm water design approved and implemented	E, ESO, ECO, C, PM	When Required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>development.</p> <ul style="list-style-type: none"> - Storm water runoff should not be concentrated as far as possible and sheet runoff from paved surfaces need to be curtailed. - Runoff from paved surfaces should be slowed down by the strategic placement of berms. - The vegetation must be retained as far as possible, and rehabilitated if disturbed by construction activities to ensure that erosion and siltation do not take place. <p>No trees should be planted within five meters of the line of the water bearing services</p>				
			<p>Excavate only where necessary and mark out the areas to be excavated.</p> <p>The top layer of all areas to be excavated for the purpose of construction must be stripped and stockpiled in areas where this material will not be damaged, removed or compacted. This stockpiled material shall be used for the rehabilitation of the site and for landscaping purposes.</p> <p>When the stripping of topsoil takes place, the grass component shall be included in the stripped topsoil. The soil will contain a natural grass seed mixture that may assist in the re-growth of grass once the soil is used for back filling and landscaping.</p> <p>Mechanisms are required for dissipating water energy of storm water</p>	<p>Topsoil is stockpiled</p> <p>Only necessary areas are excavated</p>	C, ECO, ESO, PM, E	When Required	
	Blasting	Safety during blasting operations	Blasting may only be done by specialists in the field and should be limited to localised areas.	Blasting done by specialists	C, HSO, ECO, ESO, PM, E	When Required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>Surrounding land-owners of properties in close proximity of blasting exercises must be informed/ warned (at least one week in advance) of blasting exercises that will take place on the study area.</p> <p>Surrounding residents must be informed of blasting exercises at least one week in advance.</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>Allowance should be made in the quantities and specifications for the excavation of wad (or other soft material) selectively from the floor of cuttings and between pinnacles.</p>	<p>Surrounding land owners informed in advance</p> <p>Warning signs erected and barrier tape in place.</p>			
	Hydrology	Groundwater management and managing of groundwater pollution	If DWS require that a ground water monitoring plan be compiled and implemented, such management and monitoring plan must also be provided to the developer and the appointed contractor prior to the commencement of construction.	<p>No deviation from baseline data during regular sampling</p> <p>The system is established to purify surface water</p>	E, DS, ECO, ESO, PM	Monthly	NWA, NEMA
		To minimise pollution of soil, surface and groundwater	<p>1) Increased run-off during construction must be managed using attenuation features and other suitable structures as required to ensure flow velocities are reduced.</p> <p>2) The contractor shall ensure that excessive</p>	<p>No visible signs of erosion.</p> <p>No visible signs of pollution</p>	C, E, PM, ESO, ECO, DS	Monitor daily	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			quantities of sand, silt and silted water do not enter the storm water system. 3) Minimising disturbance and controlling run-off from construction areas.				
		To monitor possible ground water contamination when hospital is demolished	A specialist needs to provide advice and be on the site during the demolishing of the hospital. Ground water tests need to be done prior and after the hospital is demolished to ensure the ground water results does not fluctuate.	Ground water tests were conducted	C, ECO, ESO, DS, PM	When Required	
	Groundwater	To limit impact and associated issues to the Seasonal shallow groundwater, perched water and seepage near the flood plain.	<p>Areas that could potentially be affected by perched water conditions must be identified on a layout plan. It will be better to limit construction in these areas to the dryer months. It is however understood this this will not always be possible and that it could become necessary to drain some of the areas in order to make construction possible.</p> <p>The areas to be drained must be identified and discussed with the appointed ECO and wetland specialist and draining plans/ possible cut-off trenches must be discussed with the wetland specialist and the ECO prior to commencement with such works. The wetland specialist and ECO must supply temporary mitigation measures where required in order to minimise impacts on the surface and ground water movement patterns that sustain the watercourses of the study area.</p> <p>The water and soil quality of the areas to be drained must be monitored prior to construction. The monitoring tests must then be repeated (every month) during the construction phase. If any pollution (mainly associated with lead, anthrax, other diseases etc. are detected during the testing</p>		ESO, ECO, WS, E, PM, C	When required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>exercises, the construction works must be stopped and suitably qualified specialists must be appointed to assist with the compilation of the required mitigation measures and to supply advice regarding The proposed way forward.</p>				
	<p>Surface water flows will be altered during the construction phase</p>	<p>To control the surface water flows</p>	<p>Construction activities should preferably take place during the winter months.</p> <p>It is recommended that the developer/ contractor/ ECO identify water monitoring points in the Jukskei river (up-stream and down-stream) in order to monitor and manage water pollution during the construction and operational phases of the project.</p> <p>Pre-construction sampling at such points are recommended, because the pre-construction water quality results can be used as baseline information in cases of pollution during the construction and operational phases.</p> <p>Water quality sampling should take place once a month during the construction phase and once in six months during the operational phase.</p> <p>If it is not possible for construction activities to take place during the winter months, construction activities should take place in phases in order to prevent large exposed areas that will cause an increase in the speed of surface water.</p> <p>When storm water planning is done, every</p>	<p>No alteration of surface water flows</p> <p>No aquatic biota affected by altered surface water flows</p>	<p>C, E, ECO, ESO, PM</p>	<p>When required</p>	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>attempt possible should be made to keep the post construction and pre-construction flows similar.</p> <p>Where required temporary storm water attenuation features must be implemented. The feature/s must preferably be located outside the wetland and watercourse buffers and such features must also be designed to act as silt traps that can be maintained/cleaned by mechanical equipment. The proposed features must be designed to break the speed of the water and to prevent concentrated storm water flow in sensitive areas (i.e. areas with higher erosion potential, against steeper slopes).</p> <p>The temporary and permanent storm water and drainage measures must take the long term sustainability of the wetland systems into consideration. At present the systems receive a certain amount of ground water and surface water and the water flows into and across such wetland in a specific pattern. Adjustments to this flow pattern could have a negative impact on the co-existence of the wetland and riverine systems. The appointed storm water engineers and the wetland specialist must liaise in order to ensure that that matter is sufficiently addressed.</p>				
	Drainage lines	To ensure the protection of the ecological value of the drainage lines	<p>1) The necessary Section 21 Water-Use License applications must be submitted to DWA and no construction are allowed to commence without the necessary licenses.</p> <p>2) Adequate stormwater management must be implemented for the proposed development in order to prevent bank and riparian zone erosion especially in the upper</p>	Guidelines implemented	C, ESO, ECO, E, PM	When Required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>section of the main tributary.</p> <ul style="list-style-type: none"> - Sheet runoff from paved surfaces needs to be curtailed. - Runoff from paved surfaces should be slowed down by the strategic placement of berms. - As much vegetation growth as possible should be promoted within the proposed development area in order to protect soils and to reduce the percentage of the surface area which is paved. <p>3) Due to the increased rate of runoff owing to the increased percentage of impermeable surface area in the catchment of the unnamed tributary, which will be created by the proposed development (and possibly future developments in the catchment), it is recommended that building regulations in terms of the flood line positions are strictly adhered to should these occur outside of the delineated buffer zones of the riparian areas.</p> <p>4) Special mention is made of the lower section of the catchment where runoff volumes which will be generated will be higher during storm events.</p> <p>5) No dumping shall be allowed the areas below the flood line/ sensitive open space areas to be conserved.</p> <p>6) No service or waste yard should be planned in this area</p> <p>7) All disturbed open spaces along water bodies must be rehabilitated with vlei/ suitable riparian vegetation.</p>				

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>8) The wetland delineation conducted by by the wetland specialist must be taken into consideration. The wetland and riparian areas together with the proposed buffer zones must be marked out on the study area prior to commencement with construction. The ECO must supply the GPS co-ordinates and must confirm that the areas were correctly marked out. The sensitive areas must then be demarcated by a conservation fence/ barrier tape and all contractors and workers must be informed of this "no-go" zone. Only workers and equipment required for rehabilitation and the installation of services will be allowed to enter this zone. The ECO must be informed prior to the commencement of work in this zone. The work in this area can only commence once the Section 21 Water-Use License have been issued by DWA.</p> <p>9) Qualified engineer to be appointed to confirm the 1:100 flood line (pre-construction and post-construction flood lines).</p> <p>10) Use agricultural drainage methods in fill materials to remove water that could trigger slumping.</p> <p>11) Identify perched water tables early and provide adequate drainage for these trigger points.</p> <p>12) Implementing of a good drainage system</p> <p>13) Grading of land should be away from the building to allow for adequate drainage.</p> <p>14) Drainage for storm water run-off should</p>				

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			be adequate, and blocked drains and gutters should be kept clear.				
		To prevent siltation	Stockpiles should not be stored in any watercourses/drainage lines/ watercourse buffer areas or within the flood plain/ below the 1:100 year flood line	No stockpiles within the drainage line	Contractor	Weekly	
		To prevent impacts on wetlands in the riparian zone	<p>The temporary drainage feature should be left intact with a narrow buffer zone of ten meters to allow natural flow of storm water down the drainage line. The wetland and associated buffer zones must be excluded from development.</p> <p>Riparian vegetation along the main stream channel needs to be rehabilitated in order to increase the amount of surface flow of the stream and in order to improve the integrity of the riparian and in stream habitat integrity of the resource. Ongoing maintenance of the riparian zone will be required in order to prevent the re-establishment of the alien tree community after the initial clearance has taken place.</p> <p>It is essential that the stream continuity of the main drainage line be reinstated. In this regard the following points are made:</p> <ul style="list-style-type: none"> • If public open spaces within the buffer zones of the stream and wetland areas are provided it should be adequate to maintain the ecological connectivity of the riparian and in-stream ecology of the area. • It is recommended that these areas are managed adequately by restricting the movement of people to a limited number of allocated pathways and pets (e.g. dogs) 	<p>Contractor strictly abides to avoid the wetland areas as reasonably practicable</p> <p>Where there are strictly no-go, sensitive or demarcated areas that vehicles (especially heavy duty) are to strictly avoid, and no disturbance or impacts noticed</p> <p>Access roads, parking areas, etc., should be clearly illustrated on the master layout plan and should be strictly adhered to</p>	C, ESO, ECO, D, WS, FS, PM	Monitored daily	2014NEMA EIA Regulations, NEMA, NWA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>should be restrained by a lead at all times.</p> <ul style="list-style-type: none"> It is recommended that alien and invasive vegetation (trees) are removed. This will increase the water volume flowing within the streams associated with the property and will improve the connectivity of the riparian zone. <p>No vehicles should be allowed to indiscriminately drive through the wetland areas. Fence-off sensitive areas prior to construction and apply temporary storm water management measures outside the watercourse and watercourse buffer zones to prevent entry into the wetland areas and drainage line by construction vehicles and prevent storing or dumping of topsoil, construction material and other waste in the wetland/drainage line.</p> <p>All areas affected by construction should be rehabilitated upon completion of the construction phase. Areas should be reseeded with indigenous grasses as required.</p> <p>Site offices, parking areas for construction vehicles, etc. should be confined to non-sensitive areas.</p> <p>All the mitigation measures as proposed by the wetland specialist must also be taken into consideration.</p>				
	Landscaping	To ensure that the landscaping and storm water management is done in	The incorporation of berms into the landscaping of the development could also assist in storm water management if such embankments/ berms are planned in conjunction of the storm water engineers	Landscape Architect is part of the planning team	Landscape Architect, E, C, ECO, ESO, PM	When required	2014NEMA EIA Regulations , NEMA, NWA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
		collaboration	<p>and the wetland specialist. Such integrated planning measures could reduce the sizes of the required storm water attenuation features, which often appear unattractive and which tend to cover developable areas.</p> <p>The appointed Landscape Architects must become part of the integrated planning team from the early stages of the development in order to place the proposed landscaping berms at strategic points as identified by engineers.</p>				
	Fauna and flora	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 interfere with the nature of the area</p>	No exotic plants used for landscaping	C, ESO, ECO, PM, FS, LA	<p>As and when required</p> <p>Every 6 months</p>	
		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) Wood harvesting of any trees or shrubs on</p>	No measurable signs of habitat destruction or faunal species hunted, trapped or killed	C, ESO, ECO, PM, FS	As and when required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>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>5) Where possible, work should be restricted to one area at a time.</p> <p>6) 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>7) 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> <p>8) The contractor must ensure that no fauna species are disturbed, trapped, hunted or killed during the construction phase. Caught animals should be relocated to the conservation areas in the vicinity. Council shall prosecute offenders.</p> <p>9) Should hedgehogs be encountered during the development, these should be relocated to natural grassland areas in the vicinity.</p> <p>10) Vegetation clumps and natural grassland areas to be retained and incorporated within the proposed development formal landscaping, must be marked and demarcated before any</p>				

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>commencement of construction activities. These areas must be fenced off (will be seen as "No-Go" areas).</p> <p>11) Rehabilitate/ cover, where possible, exposed areas immediately after construction of a phase has been completed. If this is not possible, temporary mitigation measures must be applied until rehabilitation or coverage of such areas are possible.</p>				
		<p>To protect the existing fauna and flora.</p>	<p>No vehicles must be allowed to move in or across the wet areas or drainage lines and possibly get stuck. This leaves visible scars and destroys habitat. It is important to conserve areas where there are tall reeds or grass and areas where there are short grass and mud.</p> <ul style="list-style-type: none"> - With proper cultivation of specific indigenous plant species the bird numbers and species in the area could even increase. Lists of plant species that attract birds to gardens are available. The area must however be kept as natural as possible. - Dumping of builders' rubble and other waste in the areas earmarked for exclusion must be prevented, through fencing or other management measures. These areas must be connected to one another and be properly managed throughout the lifespan of the project in terms of fire, eradication of exotics etc. to ensure continuous biodiversity. <p>All mitigation measures for impacts on the indigenous flora of the area should be implemented in order to limit habitat loss as far as possible and maintain and improve available habitat, in order to maintain and possibly increase numbers and species of</p>	<p>Fauna and for a on the site is protected as far as possible</p> <p>Fauna and flora is protected within the drainage lines</p>	<p>C, ESO, ECO, FS, PM</p>	<p>As and when required</p>	<p>2014NEMA EIA Regulations , NEMA, NWA, NEM:BA</p>

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			indigenous fauna.				
Social	Noise impact	To maintain noise levels below "disturbing" as defined in the national Noise Regulations.	<p>Site workers must comply with the Provincial noise requirements as outlined in order to keep the noise levels to the required level.</p> <p>During the construction phase noise should be kept to a minimum to reduce the impact of the development on the fauna residing on the site.</p>	No complaints from surrounding residents and I & AP	C, E, ESO, ECO, affected parties to report noise	Monitored daily	NEM:AQA; Gauteng Noise Regulations
	Dust impact	Minimise dust from the site	<p>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.</p> <p>2) When necessary, these working areas should be damped down in the mornings and afternoons.</p> <p>3) Sweeping of the construction site, clearing of builders' rubble and debris as well as the regular watering of the construction site (storage areas, roads etc.) must take place at least once a day during the dry and windy season. In severe circumstances the watering down of the construction site (the exposed areas) must take place twice a day (early in the morning and late in the afternoon).</p> <p>4) Even though there are almost no risks of getting infected by anthrax if the soil layers are disturbed, dust control during construction must be treated as a priority. Dust control will eliminate possible health risks associated with the inhalation of dust, especially if one take the fact that old aged</p>	<p>No visible signs of dust pollution</p> <p>No complaints from surrounding residents and I & AP</p>	Contractor	Monitored daily	NEM:AQA

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			people resides in close proximity of the hospital into consideration. This will also eliminate any possibility of the spreading of anthrax spores by means of dust.				
	Safety and security	To ensure the safety and security of the public.	<p>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.</p> <p>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)</p> <p>3) Construction vehicles and activities to avoid peak hour traffic times</p> <p>4) Presence of law enforcement officials at strategic places must be ensured</p> <p>5) Following actions would assist in management of safety along the road</p> <ul style="list-style-type: none"> ▪ Adequate road marking ▪ Adequate roadside recovery areas ▪ Allowance for pedestrians and cyclists where necessary ▪ 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. <p>6) Adequate security personnel need to be appointed as soon as the study area is being prepared for construction as well as during the entire construction period.</p>	No incidences reported	C, D, ECO, ESO, COPSM	On -going	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>7) Surrounding landowners need to be notified when construction commences.</p> <p>8) Implement the security management plan for the construction phase. The security management plan must be kept in the site office and must also be supplied to the HSO and ECO. The HSO and ECO must also report on compliance. Security incidences in the area must be reported to the ECO and ESO and a security incidences book must be attached to the management plan.</p> <p>9) Implement road safety measures in order to ensure road safety and effective traffic movement during the construction phase. The traffic engineers must compile a road construction phasing and management plan in order to identify the phases of road construction and upgradings, the measures to put in place for every construction phase in order to allow for better traffic flow, better accessibility, alternative routes if roads/ accesses are temporarily closed, temporary road signs (for the evening and daytime) to be erected, temporary safe pedestrian and cycling routes. The plan must be discussed with and supported by the road safety division of the local authority.</p>				
	Influx of people from other areas	In order to limit the influx of people from other areas	<p>It is recommended that (where possible) only people from the local communities in and around the application site are employed.</p> <p>Keep record of all the construction workers. A workers register must be kept at the site. This register must contain the ID numbers and employee details of all the workers. No workers will be allowed to sleep on the site</p>	People from local community employed.	C, D, PM, ESO, ECO	When required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			and they will only be allowed on the property during working hours and when there is supervision on the study area.				
	Infrastructure and services		<p>The road and services upgrading as recommended by the involved engineers to be implemented.</p> <p>The bulk water network system will be upgraded and expanded on behalf of the local authority to allow capacity for municipal water.</p>	Road and services upgrading according to recommendation	E, ESO, ECO, PM, C, D	When required	
		To limit the impact during the Installation of services.	<p>Surrounding landowners should be notified of any disruptions that may occur during the construction phase.</p> <p>The storm water management plan should be followed during the installation of services.</p> <p>Excavate only where necessary and mark out the areas to be excavated.</p> <p>When the stripping of topsoil takes place, the grass component shall be included in the stripped topsoil. The soil will contain a natural grass seed mixture that may assist in the re-growth of grass once the soil is used for back filling and landscaping.</p> <p>Mechanisms are required for dissipating water energy of storm water.</p> <p>Construction vehicles and activities as well as other heavy vehicles to avoid peak hour traffic times.</p>	Road and services upgrading according to recommendation	E, ESO, ECO, PM, C	When required	
		To limit impact on the wetlands during the construction of roads and	<p>Construction activities should preferably take place during the winter months.</p> <p>If it is not possible for construction activities to take place during the winter months,</p>	Road and services upgrading according to recommendation	E, ESO, ECO, C, PM, WS	When required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
		installation of services.	<p>construction activities should take place in phases in order to prevent large exposed areas that will cause an increase in the speed of surface water.</p> <p>When storm water planning is done, every attempt possible should be made to keep the post construction and pre-construction flows similar.</p> <p>The time spent in the wetland/ riparian zone should be limited at a time.</p> <p>Access into the wetland areas should be avoided as far as possible.</p> <p>No riparian vegetation may be removed from the riparian zone.</p> <p>The area should be prepared with sandbags or other applicable measures to avoid siltation into the wetland/ river area.</p> <p>All disturbed and damaged areas need to be rehabilitated after the construction activities.</p>				
	Damage to the existing services and infrastructure during the construction phase and disruptions in services	To prevent and/ or limit service disruptions	<p>Determine areas where services will be upgraded and relocated well in advance.</p> <p>Discuss possible disruptions with affected parties in the surrounding area to determine most convenient times for service disruptions and warn affected parties well in advance of dates that service disruptions will take place.</p>	Affected parties informed of the interruptions	E, D, PM, C, ESO, ECO	When Required	
	Traffic	To limit the traffic increase during construction	<p>Construction vehicles to avoid peak hour traffic.</p> <p>Inform surrounding residents, businesses, schools etc. if the construction activities will</p>		C, ESO, ECO, E, PM, D	When Required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			<p>have impacts on traffic flow (i.e. if a lane will be closed/ are accesses to properties will be temporarily closed/ affected). Notices must be distributed to the affected parties at least 4 weeks prior to the planned disruptions. In cases where temporary service roads are to be provided, a representative of the developer must discuss the matter with the affected parties at least 4 weeks in advance.</p> <p>The road upgrading recommended by the traffic engineers to be implemented.</p> <p>All feasible / possible road upgrades should be implemented. Public transport system should be coordinated in the area to lighten the traffic load.</p>				
		Installation of services	<p>Determine areas where services will be upgraded and relocated well in advance.</p> <p>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</p>	No complaints from I & AP	C, ESO, ECO, PM, E	When required	
	Visual impact	In order to minimise the visual impact	<p>1) The disturbed areas shall be rehabilitated immediately after the involved construction works are completed.</p> <p>2) Shade cloth must be used to conceal and minimise the visual impact of the site camps and storage areas.</p> <p>3) All equipment and materials should be stored in a designated area indicated by the ECO.</p> <p>4) All areas must be kept neat and tidy and waste should be stored in the designated</p>	Visual impacts minimized	C, ESO, ECO, E, PM, A, Town planner, D	Monitor daily	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			areas and removed on a weekly basis.				
	Vegetation	Landscaping	<p>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.</p> <p>2) The proposed planting materials for the areas to be landscaped should preferably be endemic and indigenous.</p> <p>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.</p> <p>4) The inspection shall be carried out by the maintenance contractor at the property of the supplier and not on the study area.</p> <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>	Landscaping done according to landscape development plan	Landscape Architect, C, D, PM, ESO, ECO	When required	
		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</p>	Landscaping done according to landscape development plan	Landscape Architect, FS, C, ESO, ECO, PM	When required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
			techniques specified by the Landscape Architect in the Landscape Development plans for the site.				
		To prevent a loss of natural grassland areas	Although some disturbed natural grassland and natural primary grassland areas will be lost due to the proposed development the sensitive natural primary grassland will be conserved and will be linked to the larger regional open space system. The Red-Listed plant species will be relocated to a suitable habitat on the site which will be identified by a specialist.	Adequate regrowth of grassland Red-Listed plant species conserved under nursery conditions and illustrate ability to flourish	FS, ESO, ECO, C, PM, D	When required	
		Spread of weeds	Ensure that materials used for mulching and topsoil/ fertilisers are certified weed free. Collect certifications where available. Control weed growth that appears during construction.	Weed growth controlled	ECO, ESO, C, Landscape Architect, PM, D	When required	
		To ensure rehabilitation of the site	1) Compacted soils shall be ripped at least 200mm. 2) All clumps and rocks larger than 30mm diameter shall be removed from the soil to be rehabilitated. 3) The soil shall be leveled before seeding. 4) Hydro-seed the soil with Potch mixture or plant with suitable indigenous ground covering as specified). 5) Watering shall take place at least once per day for the first 14 days until germination of seeds have taken place. 6) Thereafter watering should take place at least for 20 minutes every 4 days until grass have hardened off.	Grass have hardened off	Landscape Architect, E, C, PM, ESO, ECO	Once a day Then every 4 days	
		To ensure rehabilitation	Where possible, limit construction exercises (especially construction in and around	Strictly demarcated wet	C, ESO, ECO, PM, E	When Required	

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Performance indicator	Responsibility	Frequency of Action	Applicable Act no.
		due to wet conditions in the rainy season	<p>watercourse areas and areas with perched water conditions) to the dryer periods.</p> <p>Construction workers and construction vehicles and machinery must stay out of the soggy areas during the wet periods. Barrier tape should be used to demarcate the areas that are drenched with water (especially the ecologically sensitive areas and the areas covered with valuable topsoil) and it should only be removed when the appointed Environmental Control Officer (ECO)/ site supervisor/ project manager/ main contractor regard the conditions in the affected areas as favorable.</p>	areas adhered to with no sign of entry			
		To prevent dumping of builders' rubble and other waste in the area earmarked for exclusion	<p>All areas designated sensitive in a sensitive mapping exercise should be incorporated into the system.</p> <p>The open space system should be managed in accordance with an Ecological Management Plan that complies with the Minimum Requirements for Ecological Management Plans and forms part of the EMP.</p> <p>The open space system should be fenced off prior to construction commencing.</p> <p>Rubble should not be stored in or directly adjacent any open space areas or areas marked as sensitive.</p>	No evidence or reporting of rubble dumping in the open space system	Contractor ESO	Continuous	

4.3 Operational Phase

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Responsibility	Frequency of Action	Applicable Act no.
SITE CLEAN UP AND PREPARED FOR USE	Storm water pollution	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. Monitor the water quality of the Jukskei River on a 6 monthly basis until GDARD confirm hat they area satisfied with the pollution prevention measures during the operational phase.	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	-	
ESTABLISHING PLANTS	Slow or no re-vegetation to stabilise soil; loss or degradation of habitat	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	
DRAINAGE FAILURE	On-site and downstream drainage pollution or flooding	Storm water management plan	Inspect all site drainage works and repair any failures. Confer with design engineer and to correct site problems.	Contractor	-	
GROUND WATER MONITORING	Seasonal shallow groundwater, perched water and seepage near the flood plain		Groundwater quality and level monitoring as appropriate to assess the performance of the mitigation measures	Contractor	-	
	Potential moderate heave of transported and residual greenstone soils		A leak detection system must be put in place to identify any potential leaks in underground tanks. The fuel tanks must be installed in accordance with the relevant SANS standards.			

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Responsibility	Frequency of Action	Applicable Act no.
SITE AUDIT	Eventual project failure	Successful project establishment	Routinely audit the works and adjust maintenance schedule accordingly.	Contractor	-	
GENERAL			Open fires and smoking during maintenance works are strictly prohibited.	Contractor	-	6
GEOLOGY	Erosion of topsoil	Prevent topsoil erosion	Due to loose topsoil, the soil must be covered by means of re-seeding and vegetation with suitable ground covering.	Engineer / Contractor /	Once off	
REHABILITATION		To ensure alien and weeds are eradicated	Alien vegetation (as identified in the Fauna & Flora Assessment) and all weeds must be eradicated on a regular basis even during the operational phase.	Contractor/ each home owner	Every 6 months	
	Open Space System	To ensure the proper management of the open space system	<p>-The proposed public open space must be maintained during the operational phase of the proposed development.</p> <p>-An ecological maintenance plan be compiled and be implemented during the operational phase.</p> <p>- 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.</p> <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</p>	Contractor HOA		

TYPE	Environmental risk or issue	Objective or requirement	Mitigation measure	Responsibility	Frequency of Action	Applicable Act no.
			implemented in the open space areas.			
SOCIAL	Increase in traffic	To upgrade the existing roads and to construct new roads that will improve the traffic flow in the area and that will accommodate all the traffic generated by the development. The road safety conditions must also be improved.	The road improvements proposed for the area must increase the road safety conditions, accessibility of the area and the traffic flow.			
	Security risks associated with the lower income development	To improve the security situation in the area	The security management plan compiled by the developer is implemented with success.			

5 Procedures For Environmental Incidents

5.1 Leakages & spills

- Identify the source of the problem.
- Stop goods from leaking, if safe to do so.
- Contain the spilt material, using the spills kit or sand.
- Notify the Environmental Control Officer
- Remove spilt material and place in a sealed container for disposal (if possible).
- Environmental Control Officer to follow the Incident Management Plan.

5.2 Failure of erosion/sediment control devices

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

5.3 Bank/slope failure

- Stabilize the toe of the slope to prevent sediment escape using aggregate bags, silt fence, logs, hay bales, pipes, etc.
- Notify the ECO.
- ECO to follow the Incident Management plan.
- Divert water upslope from the failed fence.
- Protect the area from further collapse as appropriate.
- Restore as advised by the ECO.
- Monitor for effectiveness until stabilized.

5.4 Discovery of rare or endangered species

- Stop work.
- Notify the ECO.
- If a plant is found, mark the location of plants.
- If an animal, mark the location where sighted.
- ECO to identify or arrange for the identification of species and/ or the relocation of the species if possible.
- If confirmed significant, the ECO is to liaise with the Endangered Wildlife Trust.
- Recommence with work when cleared or instructed to do so by the ECO.

5.5 Discovery of archeological or heritage items

- Stop work.
- Do not disturb the area any further.
- Notify the ECO.
- If confirmed significant, ECO to liaise cultural and heritage specialist.
- Cultural and heritage specialist to communicate with SAHRA and give recommendations regarding the way forward.

5.6 Discovery of waste sites/ potential polluted areas during excavation

- Stop work immediately and fence-off the area.
- Erect “stay away” signs.
- Do not disturb the area any further.
- Notify the ECO.
- ECO to contact Dr. De Vos and Cultural and Historical Specialist.
- Conduct pollution tests if required.
- Involve the geo-hydrologist and soil scientist to assist with tests if required, must also include leachate tests.
- Appointed specialists to recommend the way forward.

5.7 Safety and Security Problems Experienced by the Surrounding Residents

- Incidents/ problems to be reported to the ECO and GDARD law enforcement.
- ECO to react within 24 – 48 hours.
- ECO and Developer to supply feedback regarding measures implemented to address problem.
- If required, security management plan must be amended to prevent any similar future incidences.

6 EMP review

1. The EMP must be regarded as a dynamic document. Where necessary the EMP must be amended to improve the environmental management and monitoring of the site. The ECO or appointed EAP will be responsible for the required amendments to the EMP and GDARD must be notified of the amendments. If required, an EMP amendment application must be submitted to GDARD for consideration and no amendments are to be implemented until formal approval of the proposed amendments are received from GDARD. The 2014 amendment application forms make provision for EMP amendment processes.
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.

7 Management Plans That Must Be Compiled In Order To Ensure Compliance With the Various Acts and Regulations

- Environmental Management Plan;
- Storm Water Management Plan;
- Water Quality and Quantity Management and Monitoring Plan;
- An Environmental Management Plan and Rehabilitation Plan that will guide the implementation of infrastructure within the watercourse and watercourse buffer areas as delineated on the drawings and on site;
- Security Management Plan;
- Waste Management Plan;
- Heritage Management plan;

- Health and Safety Management Plan (to be compiled by safety officer); and
- A General wetland and open space rehabilitation and management plan.

All the management plans listed above must be attached as part of the EMP and must be kept on the site during all the development phases. The management plans must be read in conjunction with the EMP, the BAR and S21 WUL decisions and the guidelines and mitigation measures as supplied in the EIA, S21 WULA report and specialist reports.

APPENDIX I: LAND EXCHANGE AGREEMENT

MEMORANDUM OF AGREEMENT

between

WITWATERSRAND ESTATES LIMITED

WATERVAL ISLAMIC INSTITUTE

WATERFALL GOLF ESTATE (PROPRIETARY) LIMITED

WATERFALL PROPERTIES WUQF (PROPRIETARY) LIMITED

and

GAUTENG DEPARTMENT OF AGRICULTURE, CONSERVATION AND ENVIRONMENT

I. Mial



Y.M.

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MEMORANDUM OF AGREEMENT

1 PARTIES

- 1.1 The parties to this Agreement are –
- 1.1.1 **Witwatersrand Estates Limited;**
 - 1.1.2 **Waterval Islamic Institute;**
 - 1.1.3 **Waterfall Golf Estate (Proprietary) Limited;**
 - 1.1.4 **Waterfall Properties WUQF (Proprietary) Limited; and**
 - 1.1.5 **Gauteng Department of Agriculture, Conservation and Environment.**
- 1.2 The parties agree as set out below.

2 INTERPRETATION

- 2.1 In this Agreement, unless inconsistent with or otherwise indicated by the context –
- 2.1.1 **"the/this Agreement"** means the Agreement contained in this document including all appendices hereto;
 - 2.1.2 **"the Application"** means the application submitted under reference number GAUT.002/05-06/1476 for environmental authorisation for the land described therein, submitted by the Institute and/or the Developer, in terms of Section 22 of the Environment Conservation Act, 73 of 1989 (as amended) and the relevant Regulations, including without limitation a scoping report, specialist studies and other correspondence in relation thereto;
 - 2.1.3 **"Attorneys"** means Hofmeyr Herbststein & Gihwala Inc, 6 Sandown Valley Crescent, Sandown, Sandton, Ref: Mr A Pretorius/J Coetzee, Tel: (011) 286-1121;

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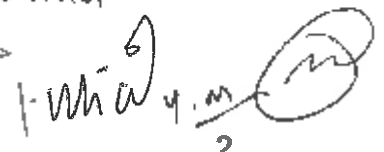
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- 2.1.4 "Business Day" means a day which is not a Saturday, Sunday or official public holiday in the Republic of South Africa;
- 2.1.5 "Development" means an Eco Estate to be developed by the Developer on the Development Land in terms of the Development Agreement and as set out in the Application;
- 2.1.6 "Development Agreement" means a Construction and Development Agreement dated 25 April 2007, in terms whereof the Developer was *inter alia* appointed by WEL and the Institute to undertake the Development on the Development Land (as amended from time to time);
- 2.1.7 "Development Land" means substantially those portions of land forming part of the Application as identified and more fully described in the Development Agreement on part of which the Developer intends to undertake the Development;
- 2.1.8 "Developer" means Waterfall Golf Estate (Proprietary) Limited, registration number 2004/034615/07, a private company duly incorporated in terms of the laws of the Republic of South Africa;
- 2.1.9 "Farm Property" means the Remaining Extent of Portion 1 Farm Waterval No 5, Registration Division I.R., Province of Gauteng held by WEL in terms of Deed of Transfer No T6167/1934;
- 2.1.10 "GDACE" means the Gauteng Department of Agriculture, Conservation and Environment, herein represented by the Head of Department, Dr Steven Thomas Cornelius, duly authorised;
- 2.1.11 "the Institute" means the Waterval Islamic Institute (a charitable institution) herein represented by Ibrahim Mia, duly authorised;
- 2.1.12 "Institute Lease" means the existing notarial deed of lease in terms of which the Farm Property is leased by WEL to the Institute;
- 2.1.13 "the Parties" means the parties identified in 1.1.1 to 1.1.5;

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- 2.1.14 **"the Proposed Property"** means a property or properties to be identified by the Developer and/or the Department and to be agreed upon by the Parties, which property or properties will in total be approximately 300 hectares in size and will have the presence of Egoli Granite Grassland, which property will serve as an offset area as set out in this agreement;
- 2.1.15 **"Propco"** means Waterfall Properties WUQF (Proprietary) Limited, registration number 2004/013493/07 the transferee of the Development Land to be transferred by WEL in terms of the Development Agreement;
- 2.1.16 **"ROD"** means a Record Of Decision in respect of the Application contemplated in terms Regulations 6(3)(a) and 9(1)(a) of GN R1183 of 5 September 1997 setting out the relevant environmental conditions as determined by GDACE;
- 2.1.17 **"Signature Date"** means the date on which this Agreement is signed by the party signing last in time;
- 2.1.18 **"Transfer"** means registration of transfer of the Proposed Property in the relevant Deeds Registry;
- 2.1.19 **"WEL"** means Witwatersrand Estates Limited, registration number 1905/005481/06, a company with limited liability duly incorporated according to the laws of the Republic of South Africa, herein represented by Ibrahim Mia, duly authorised.

2.2 Any reference to –

2.2.1 the singular includes the plural and vice versa;

2.2.2 natural persons includes juristic persons and vice versa;

2.2.3 any one sex or gender includes the other sexes or genders, as the case may be;

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- 2.2.4 any statute, constitution, decree, treaty, regulation, directive, ordinance, by-law, order or any other enactment or legislative measure of government (including local or provincial government) statutory or regulatory body which has the force of law means the relevant enactment or legislative measure as at the Date of Signature of this Agreement and as amended or re-enacted from time to time;
- 2.2.5 a party includes a reference to that party's successors in title and assigns allowed at law.
- 2.3 The words "shall" and "will" and "must" used in the context of any obligation or restriction imposed on a party have the same meaning.
- 2.4 The clause headings in this Agreement have been inserted for convenience only and shall not be taken into account in its interpretation.
- 2.5 Words and expressions defined in any sub-clause shall, for the purpose of the clause of which that sub-clause forms part, bear the meaning assigned to such words and expressions in that sub-clause.
- 2.6 If any provision in a definition is a substantive provision conferring rights or imposing obligations on any party, effect shall be given to that provision as if it were a substantive clause in the body of the Agreement, notwithstanding that it is only contained in the interpretation clause.
- 2.7 If any period is referred to in this Agreement by way of a reference to a number of days or weeks or months or other intervals, the period shall be reckoned exclusively of the 1st (first) day and inclusively of the last day of the relevant interval, unless the last day falls on a day which is not a Business Day, in which case the last day shall be the next succeeding Business Day.
- 2.8 If the due date for performance of any obligation in terms of this Agreement is a day which is not a Business Day then (unless otherwise stipulated) the due date for performance of the relevant obligation shall be the immediately preceding Business Day.

[Signature]

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- 2.9 If any obligation or act is required to be performed on a particular day it shall be performed (unless otherwise stipulated) by 16h00 (local time at the place where the obligation or act is required to be performed) on that day.
- 2.10 This Agreement shall be governed, interpreted and enforced in accordance with the laws of the Republic of South Africa from time to time.
- 2.11 If amounts or figures are specified in numerals and in words and if there is any discrepancy between the numerals and the words then the words shall apply.
- 2.12 No provision of this Agreement shall (unless otherwise stipulated) constitute a stipulation for the benefit of any Person (*stipulatio alteri*) who is not a party to this Agreement.
- 2.13 The rule of construction that this Agreement shall be interpreted against the party responsible for the drafting of this Agreement, shall not apply.

3 INTRODUCTION

- 3.1 WEL is the owner of the portions the Farm Property as described in the Application.
- 3.2 The portions of the Farm Property as described in the Application are leased by WEL to the Institute in terms of the Institute Lease.
- 3.3 In terms of the Development Agreement WEL has *inter alia*:
- 3.3.1 agreed to transfer the Development Land to Propco; and
- 3.3.2 appointed the Developer to construct the Development on a portion of the Development Land.
- 3.4 WEL and/or the Developer have lodged an application for township establishment in respect of at least part of the land described in the

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Application, inter alia in accordance with the provisions of the Townplanning and Townships Ordinance, Ordinance 15 of 1986.

- 3.5 The Institute and/or the Developer have lodged the Application including a specialist study on the possible impact associated with developments on identified areas which may be considered to be suitable habitats for Egoli Granite Grassland.
- 3.6 GDACE must consider the Application and after reaching a decision issue a ROD in respect of the Application including the Development Land.
- 3.7 The parties enter into this Agreement, subject to the terms and conditions set out herein.

4 RECORDAL

- 4.1 The Developer shall start a process of identifying the Proposed Property after the Signature Date.
- 4.2 GDACE shall issue an ROD in respect of the Application including the Development Land, which ROD will take into account the acquisition of the Proposed Property for the purposes set out in this agreement.
- 4.3 The Developer undertakes to acquire the Proposed Property for GDACE at the cost of the Developer, and the Proposed Property will be transferred to GDACE.
- 4.4 No activity authorised by the ROD will be commenced with on the Development Land prior to the transfer of 87% of the Proposed Property to GDACE.

4.5 It is recorded that the Proposed Property is to be transferred to GDACE:

- 4.5.1 as an ecological proxy consisting of a habitat that is ecologically similar to the areas allegedly affected by the developments on the land as described in the Application having comparable patterns and processes and delivering comparable ecosystem services;

(Signature)

(Signature)

(Signature)

5 POSSESSION

- 5.1 It is recorded that GDACE shall take possession of the Proposed Property on date of Transfer, or as otherwise agreed between the Parties.
- 5.2 The Parties agree that from date of Transfer as provided in 5.1 above, the Proposed Property becomes the sole risk, benefit and profit of GDACE. GDACE shall become liable for all costs relating to the Proposed Property as from date of Transfer, which shall include but not limited to rates and taxes, water and electricity usage and refuse removal.

6 TRANSFER

- 6.1 Transfer of the Proposed Property in the name of GDACE, shall be effected by the Attorneys by not later than 60 (sixty) days (or such later date as advised by the Attorneys if Transfer cannot be effected for any reason beyond the Parties' control) after the Proposed Property has been identified and agreed upon by the Parties, or not later than 60 (sixty) days (or such later date as advised by the Attorneys if Transfer cannot be effected for any reason beyond the Parties' control) after the issuance of the ROD, whichever date is the later.
- 6.2 The Developer will upon written request by the Attorneys, pay all costs of Transfer, transfer duty or VAT (whichever is applicable), and any other costs relating to the Transfer.

7 RIGHT OF TERMINATION

- 7.1 WEL, the Institute, Propco and the Developer may jointly by written notice to GDACE terminate this Agreement if, after issuance of the ROD, the ROD or any relevant condition contained therein is deleted, set aside, withdrawn or amended in any manner including an appeal, review or similar process in such a way that the Developer cannot proceed with the Development, provided that the process to delete, set aside,

I. M. A. *[Signature]* *[Signature]* *I. M. A.* *[Signature]*

withdraw or amend is not brought by WEL, the Institute, Propco or the Developer.

- 7.2 If this Agreement is terminated as contemplated in 7.1, the parties shall forthwith be restored to the position that they would have been in had implementation of the Agreement not occurred.

8 BREACH

In the event of any of the parties ("the defaulting party") committing a breach of any of the terms of this agreement and failing to remedy such breach within a period of 10 (ten) days after receipt of a written notice from another party ("the aggrieved party") calling upon the defaulting party so to remedy, then the aggrieved party shall be entitled, at its sole discretion and without prejudice to any of its other rights in law, either to claim specific performance of the terms of this agreement or to cancel this agreement forthwith and without further notice, claim and recover damages from the defaulting party.

9 CONFIDENTIALITY

The Parties agree to keep the existence and nature of this Agreement confidential and not to use the same or the name any of the other Parties (or of any other company in the group of companies of which the other Parties forms part) in any publicity, advertisement or other disclosure with regard to this agreement without the prior written consent of the other Parties.

10 NOTICES AND DOMICILIA

- 10.1 The parties choose as their *domicilia citandi et executandi* their respective addresses set out in this clause for all purposes arising out of or in connection with this Agreement at which addresses all processes and notices arising out of or in connection with this Agreement, its breach or termination may validly be served upon or delivered to the parties.

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Law


10.2 For purposes of this Agreement the parties' respective addresses shall be -

10.2.1 **Witwatersrand Estates Limited, Waterval Islamic Institute and Propco** at 20 Waterval Crescent, Woodmead, Sandton, 2157;

Facsimile: (011) 802-1563;

10.2.2 **Waterfall Golf Estate (Proprietary) Limited** at c/o Sanlam Properties (Pty) Limited, 4th Floor Meersig, Constantia Boulevard, Constantia Kloof, Roodepoort, Gauteng, 1709;

facsimile: (011) 375-2935;

10.2.3 **GDACE** at Glencairn Building, 73 Market Street, Johannesburg, 2001;

Facsimile: (011) 333-0667

or at such other address in the Republic of South Africa of which the party concerned may notify the others in writing provided that no street address mentioned in this sub-clause shall be changed to a post office box or *poste restante*.

10.3 Any notice given in terms of this Agreement shall be in writing and shall -

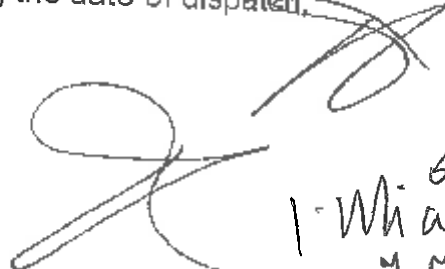
10.3.1 if delivered by hand be deemed to have been duly received by the addressee on the date of delivery;

10.3.2 if posted by prepaid registered post be deemed to have been received by the addressee on the 8th (eighth) day following the date of such posting;

10.3.3 if transmitted by facsimile be deemed to have been received by the addressee on the day following the date of dispatch.

unless the contrary is proved.

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10.4 Notwithstanding anything to the contrary contained or implied in this Agreement, a written notice or communication actually received by one of the parties from another including by way of facsimile transmission shall be adequate written notice or communication to such party.

11 COSTS

11.1 The Developer shall be liable to pay the legal costs of its own Attorneys appointed by it for the drafting of this Agreement and GDACE shall be liable to pay its own legal costs for such purposes.

12 SEVERABILITY

Each and every provision of this Agreement (excluding only those provisions which are essential at law for a valid and binding agreement to be constituted) shall be deemed to be separate and severable from the remaining provisions of this Agreement. If any of the provisions of this Agreement (excluding only those provisions which are essential at law for a valid and binding agreement to be constituted) is found by any court of competent jurisdiction to be invalid and/or unenforceable then, notwithstanding such invalidity and/or unenforceability, the remaining provisions of this Agreement shall be and remain of full force and effect.

13 WHOLE AGREEMENT

This Agreement constitutes the whole agreement between the parties as to the subject matter hereof and no agreements, representations or warranties between the parties regarding the subject matter hereof other than those set out herein are binding on the parties.

14 VARIATION

No addition to or variation, consensual cancellation or novation of this Agreement and no waiver of any right arising from this Agreement or its breach or termination shall be of any force or effect unless reduced to writing and signed by the Parties.

The bottom of the page contains several handwritten signatures in black ink. From left to right, there are four distinct signatures. The first and third signatures appear to be 'I. Mial' with a stylized flourish. The second and fourth signatures are more complex and less legible, possibly representing the other party or a witness.

15 RELAXATION

No latitude, extension of time or other indulgence which may be given or allowed by any party to the other parties in respect of the performance of any obligation hereunder, and no delay or forbearance in the enforcement of any right of any party arising from this Agreement, and no single or partial exercise of any right by any party under this Agreement, shall in any circumstances be construed to be an implied consent or election by such party or operate as a waiver or a novation of or otherwise affect any of the party's rights in terms of or arising from this Agreement or estop or preclude any such party from enforcing at any time and without notice, strict and punctual compliance with each and every provision or term hereof.

16 SIGNATURE

- 16.1 This Agreement is signed by the parties on the dates and at the places indicated opposite their respective names.
- 16.2 This Agreement may be executed in one or more counterparts, each of which shall be deemed an original and all of which shall be taken together and deemed to be one instrument.
- 16.3 The persons signing this Agreement in a representative capacity warrant their authority to do so.

Abraham Mica

Witwatersrand Estates Limited

(Duly authorised)

Abraham Mica

Waterval Islamic Institute

(Duly authorised)

Abraham Mica

I. Mica

12/10/2007

Date:

Johannesburg

Place:

12/10/2007

Date:

Johannesburg

Place:

12/10/2007

H.M.

Johannesburg

I. Mica

(Signature)

**Waterfall Properties WUQF
(Pty) Limited**

(Duly authorised)

Date:

Place:

12/10/2007 Johannesburg

Waterfall Golf Estate (Pty)

Limited

(Duly authorised)

Date:

Place:

12/10/2007 Johannesburg

Gauteng Department of

Agriculture, Conservation and

Environment

(Duly authorised)

Date:

Place:

1-Mia⁶

Y.M

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1-Mia⁶



DEPARTMENT OF AGRICULTURE, CONSERVATION AND ENVIRONMENT

Office of the Head of Department

Diamond Corner Building, 68 Eloff & Market Street, Johannesburg
P O Box 8759, Johannesburg, 2000

Telephone: (011) 355-1928

Fax: (011) 333-0667

Email: gdate@gauteng.gov.za

Website: <http://www.gpp.gov.za>

Reference: Northern Golf Course (Waterfall Country Estate)

Enquiries: Mr John Nesidoni

Tel: (011) 355 1317

Century Property Developments (Pty) Limited
Holding 5 Treesbank
MIDRAND

Per facsimile: (011) 464 1316

Attention: Mr Mark Corbett

Dear Sir

RE: NORTHERN GOLF COURSE (WATERFALL COUNTRY ESTATE)

The above matter and your reference. 13

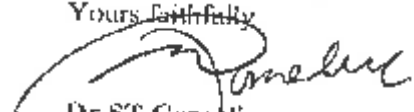
The Department hereby confirms the approval of the purchase of the Doornkraagdjie Farm portions (Portions 6/112/106 and 39) as part of the offset requirements stipulated in the Memorandum of Agreement signed between the Department and yourselves.

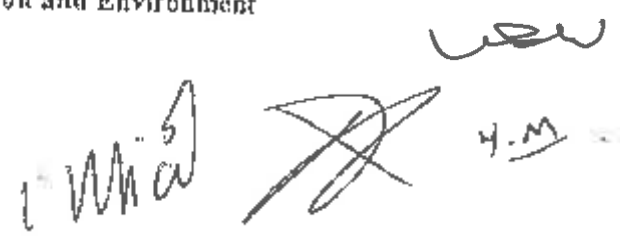
We note that an additional adjoining property of 33ha would be purchased for fulfillment of the offset requirements stipulated in the Agreement.

Please be advised that you may commence the activity/activities authorised in the Record of Decision upon transfer by the Seller to the Department of the approved portions indicated above.

I trust you find the above to be in order.

Yours faithfully


Dr ST Cornelius
Head: Agriculture, Conservation and Environment
Date: 05/03/2008



ANNEXURE C:

**FOR THE
SPECIALIST REPORTS
REFER TO ANNEXURE G OF THE
FBAR**



Proposed township development

Analytical computations for the purpose of optimal stormwater drainage

Waterfall Kikuyu – Extension 128

*Stormwater
management
design*



C-PLAN CIVIL ENGINEERS (PTY) LTD
Reg No 2000/006107/07

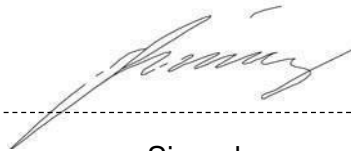
Proposed township development
Waterfall Kikuyu – Extension 128

(Dam hydrological and hydraulic analysis)

Stormwater management design

By:

J.B.Besseling Pr. Tech. (Eng.) 200270026
FWISA, SARF



Signed

24 October 2016

Date



C-PLAN CIVIL ENGINEERS (PTY) LTD
Reg No 2000/006107/07

459 ONTDEKKERS RD
FLORIDA HILLS
JOHANNESBURG
1709

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TEL: +27 11 472-2277
FAX: +27 11 472-2305

Web : www.cplan.co.za
E-mail : kc@cplan.co.za



No.	Description	Date
0.	Stormwater management design	25 Oct. 2016

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1) Executive summary

Two separate simulations were performed for the development, please refer to the following below:

Only the effective hydrological catchment areas were taken into account, when analysing the flow conditions of the proposed refurbished dam.

A portion of the proposed development (Waterfall Kikuyu – Extension 128) also falls into the effective region.

A flood analysis was also done, to establish, the required Pre and Post runoff conditions, and the volumes required for the proposed refurbished dam, thus enabling offset flows generated from Waterfall Kikuyu – Extension 128 into the dam and balancing the flow conditions down stream of the proposed dam.

Numerous methods of analysis were conducted. Based on these results, the following be Pre and Post runoff flows could established as specified in this document

Regional Catchment hydrological area, comprises of a variety of developments, however, as identified from aerial images, these catchments have been attenuated, therefore allowing the proposed refurbished to act as a function of a spillway.

However when performing a modelled analysis of the proposed development Waterfall Kikuyu Extension 128, indicated that the spillway / holding dam, reduces the Post development of the effective catchment area to Pre development runoff.

The Outlet drainage system within the buffer zone, accommodates a minor flow of a 1:2 year.

2) Desk Study

Methodology

The methodology used, commences with the identification of the catchment areas, which were grouped into various hydrological catchments areas.

Hydrological Parameters

(a) Catchment area

Total regional hydrological effective catchment is 98.54 ha excluding the offset areas.

(b) Hydrological Models

Below are the hydrological methods utilized in obtaining the average flows.

- Kinematic hydrological method utilised in the field of this study
- Rational method
- Alternative Rational
- Standard Design Flood
- Empirical Method
- RMF (Regional Maximum Flood)

(c) Geology :

Granite Gneiss and Migmatite of the Halfway house granite.

(d) Soil type:

Plinthic catena: upland duplex and marginalitic soils it is a Dystrophic and / or mesotrophic; red not soils widespread.

(e) Vegetation region:

Grasslands :- Short veld grass

(f) Veld type region:

Type iv

(g) Urban surface types

The surface conditions identified, were divided into 3 basic surface types:

- Residential
- Streets
- Parks

(h) Development type

Townhouse Complex

(i) Rate of infiltration decay

0.0015 k(sec⁻¹)
(60% of the equivalent Horton parameter)

(j) Gradient determination

The 1085 method of determining Slope of each catchment was used.

Average slope 2% to 9% sloping downwards towards the stream.

(k) Depression storage

This is dependent on the gradient determination as mentioned above, which has a direct consequence on the individual catchments.

Table 2

Pervious (mm)	Impervious (mm)
2 to 4	0.5 to 1.5

(l) Rainfall distribution type

Triangular

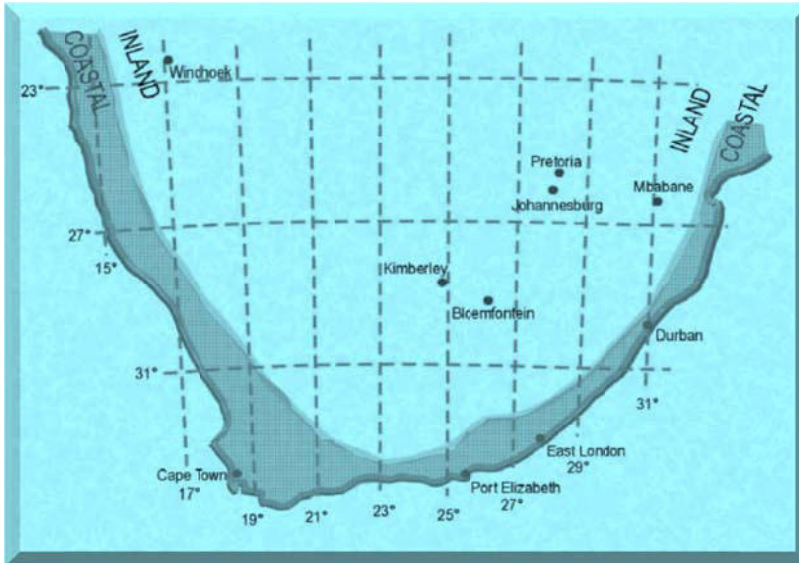
Triangular distribution is preferable for small catchments while rectangular distribution is more appropriate for larger catchment areas.

Yen and Chow (1980)

Chicago type of distribution is adequate for estimating peak flows at locations in a catchment where response times vary, BUT should not be used where storage considerations are important.

(m) Storm region

Inland



(n) Thunder days

69 days heard

(o) Weather station

Leeuwkop 0476031 W
Latitude: 26°0'
Longitude: 28°0'

Mean Annual Precipitation : 679 mm

(p) Pie Chart : Regional catchment

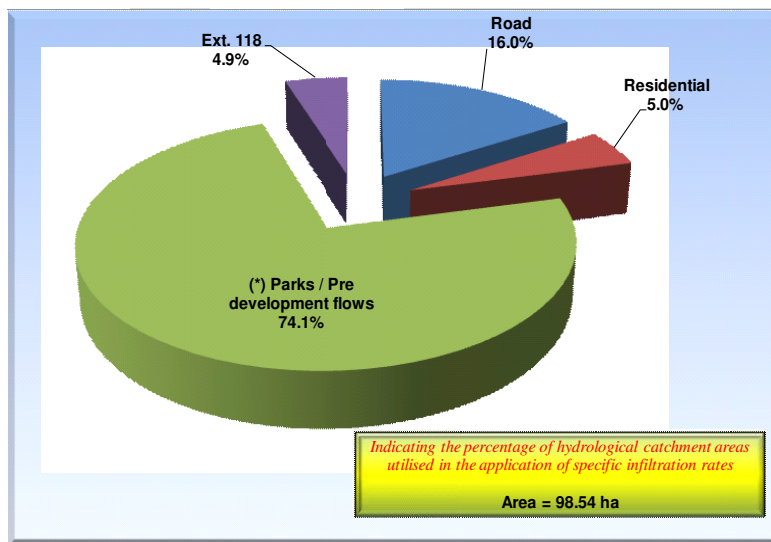


Figure 1 Pie chart : (Regional catchment)

- (*) The area indicated as (Parks / Pre development) signifies developed drainage attenuated areas and parks.

The residential areas have not been attenuated, therefore Post development conditions apply.

(q) Pie chart : Waterfall Kikuyu Extension 118

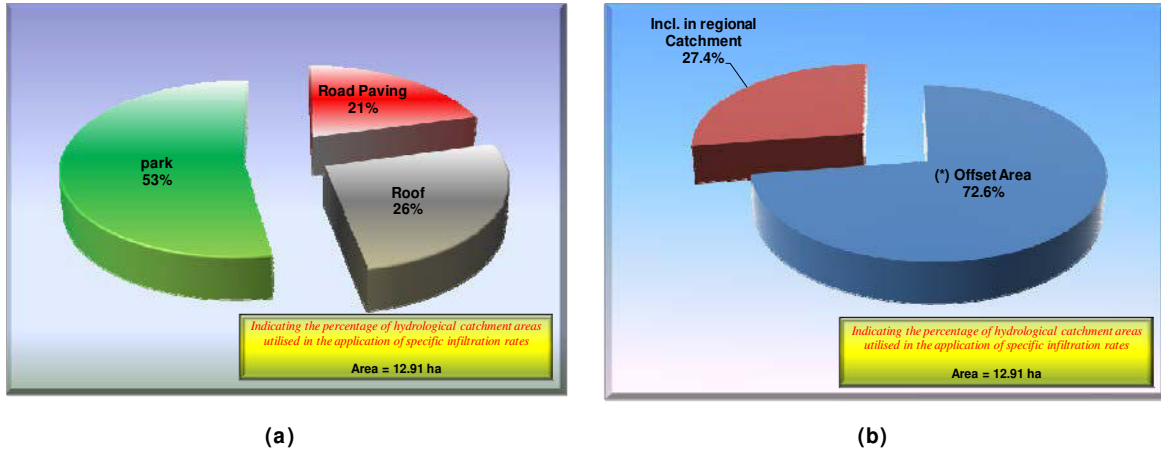


Figure 2 Pie charts : (Waterfall Kikuyu Ext. 118 catchment)

- (a) Indicates the proportions of surface runoff area
- (b) Indicates proportional areas within ext.118, that are included within the regional catchment area.
The offset area to be included as runoff leading into the spillway dam is 9.38ha.

(*) The offset area is calculated into the regional spillway dam area.

(r) Curve Numbers

Initial Curve Numbers for selected land cover and treatment classes, stormflow potentials and hydrological soil groups

Land Cover	Land treatment	Stormflow Potential	Hydrological Soil group							
			A	A/B	B	B/C	C	C/D	D	
Urban /	1 = Open spaces, parks, cemeteries	75% grass cover	39	51	61	68	74	78	80	
Sub-urban	2 = Open spaces, parks, cemeteries	75% grass cover	49	61	69	75	79	82	84	
	3 = Commercial / Business	85% impervious	89	91	92	93	94	95	95	
	4 = Industrial districts	75% impervious	81	85	88	90	91	92	93	
	5 = Residential: stand size 500m ²	65% impervious	77	81	85	88	90	91	92	

Reference:

- Federal Highway Administration Publication No. FHWA-NHI-02-001 published in October 2002
- National engineering handbook published in August 1972

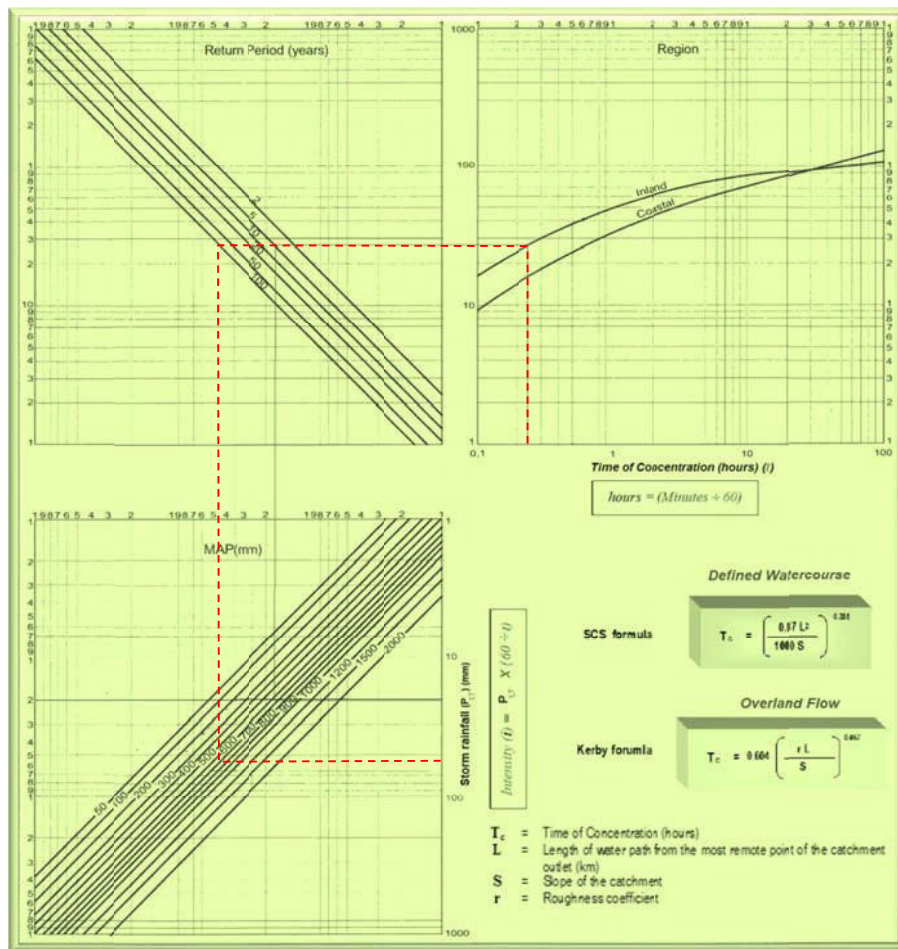
85%

(s) C- Factor : (Rational method)

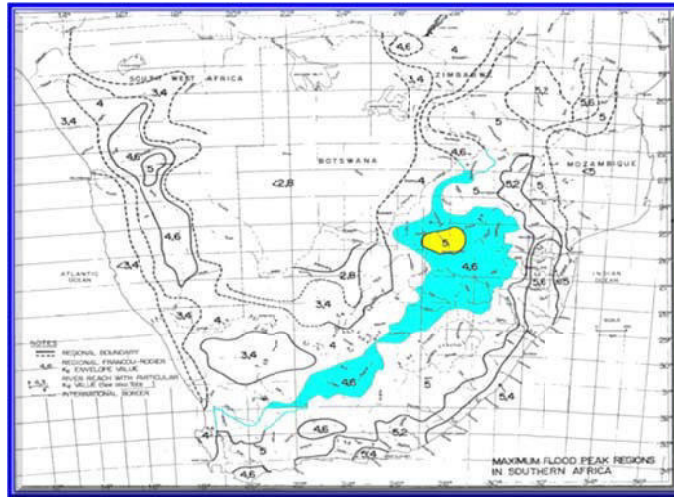
Sub-Catchment	Peak-Outlet (m ³ /sec)	"C" Factor
Sandy, flat (< 2%)	5%	0.10
Sandy, steep (> 7%)	0%	
Heavy flat (< 2%)	9%	0.17
Heavy steep (> 7%)	40%	0.35
Residential	5%	0.50
Business suburban	25%	0.70
Streets	16%	0.95
	100%	

C_{Total} 0.512

Rainfall Intensity



(t) Regional Maxium Flood



Area = 0.9 Km²

K_{e(max)} = 5

K_{e(min)} = 4.6

RMF_(Max) 96.1 (m³/s)

RMF_(Min) 94.9 (m³/s)

RMF_(Mean) 95.5 (m³/s)

(*) The above calculation was done to indicate the worst case scenarios under flood conditions.

The above is for information purposes only. It was not used in the regional catchment areas.

i. Locality



Figure 3(Locality)

ii. Summary of Maxima (Out-flows): Waterfall Kikuyu Ext. 118

The results as indicated below is for the proposed development (Waterfall Kikuyu Ext.18). Based on numerous simulation runs performed on the development, the following criteria meet the Council requirements, Please refer to the tables below.

a) Return Period 1:5 year storm

Pre Development				Post Development			
Node No.	Peak outlet m ³ /s	Storm Duration	Page No.	Node No.	Peak outlet m ³ /s	Storm duration	Page No.
Zone 1	1.61	35 (Minutes)	17	Spillway	0.272		19

b) Return Period 1:25 year storm

Pre Development				Post Development			
Node No.	Peak outlet m ³ /s	Storm Duration	Page No.	Node No.	Peak outlet m ³ /s	Storm duration	Page No.
Zone 1	3.11	35 (Minutes)	17	Spillway	0.597		19

c) Sizing of attenuation pond

Res 1	11,250 m ³
Total	11,250 m³

The purpose of this document is to establish whether spillway dam has enough capacity to accommodate the 1:5 and 1:25 year Pre and Post developments.

3) Attenuation dam design

i) Spillway / Reservoir

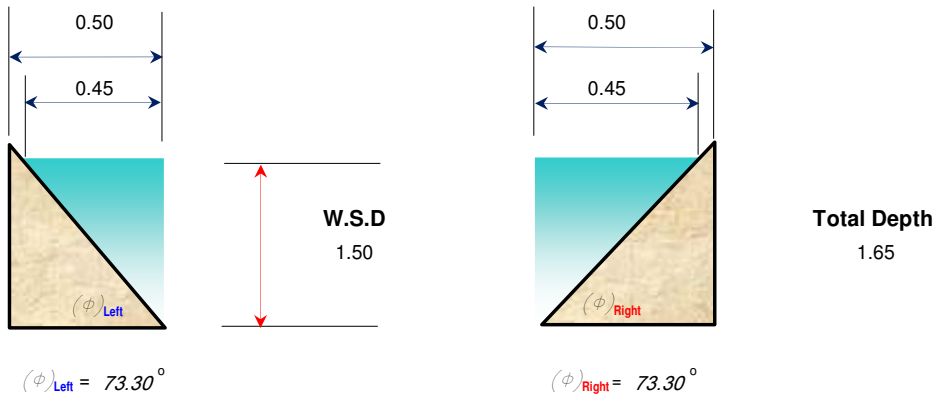
Spillway : Volumes			
No	Level	Volume	Depth
1	0.00	0	0.00
2	0.10	759	0.10
3	0.20	1,516	0.20
4	0.30	2,273	0.30
5	0.40	3,028	0.40
6	0.50	3,782	0.50
7	0.60	4,534	0.60
8	0.70	5,285	0.70
9	0.80	6,035	0.80
10	0.90	6,784	0.90
11	1.00	7,531	1.00
12	1.10	8,278	1.10
13	1.20	9,023	1.20
14	1.30	9,766	1.30
15	1.40	10,509	1.40
16	1.50	11,250	1.50

Output Data		<u>Required Volume</u>
Water surface volume =	11,249.91 m ³	12,359.28 m³
Water Depth =	1.50 m	<u>Total depth</u>
		1.65 m

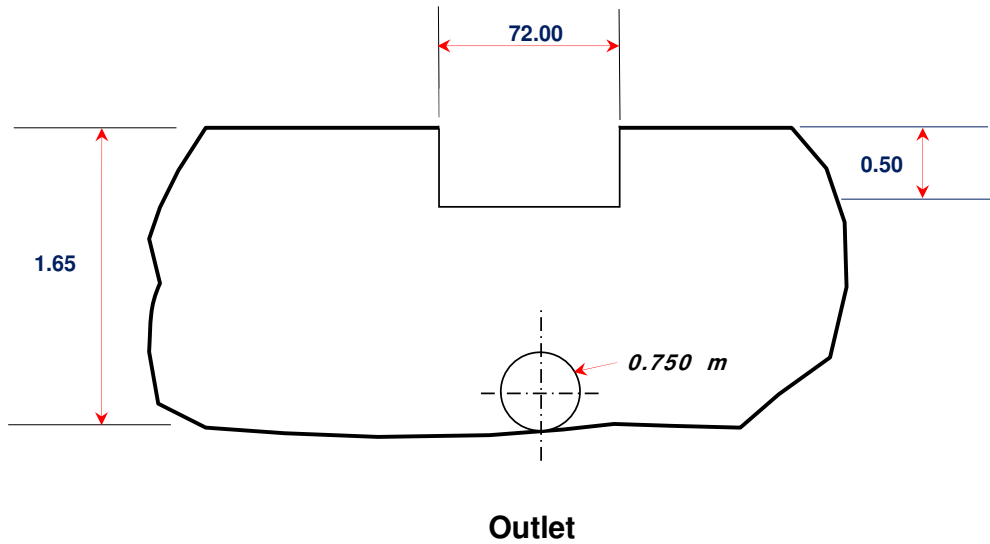
Input Data			
Slope <i>(Left)</i>	Slope <i>(Right)</i>	Perimeter =	420.74
1	1	Area =	7594.61
0.30	0.30	depth =	1.50
<u>Left Embankment</u>	<u>Right Embankment</u>	increment	0.10
<i>Loffelstein retaining wall !</i>	<i>Loffelstein retaining wall !</i>	M.S.L	0.00
		freeboard	10%

Figure 4 (Spillway : volumes)

Spillway : Geometrics



Pond Depth



WATER VOLUME
12,359.28 m³

Figure 5 (Spillway : Geometrics)

Spillway Data

Design discharge $Q_{(100)} = 35.55 \text{ m}^3/\text{s}$

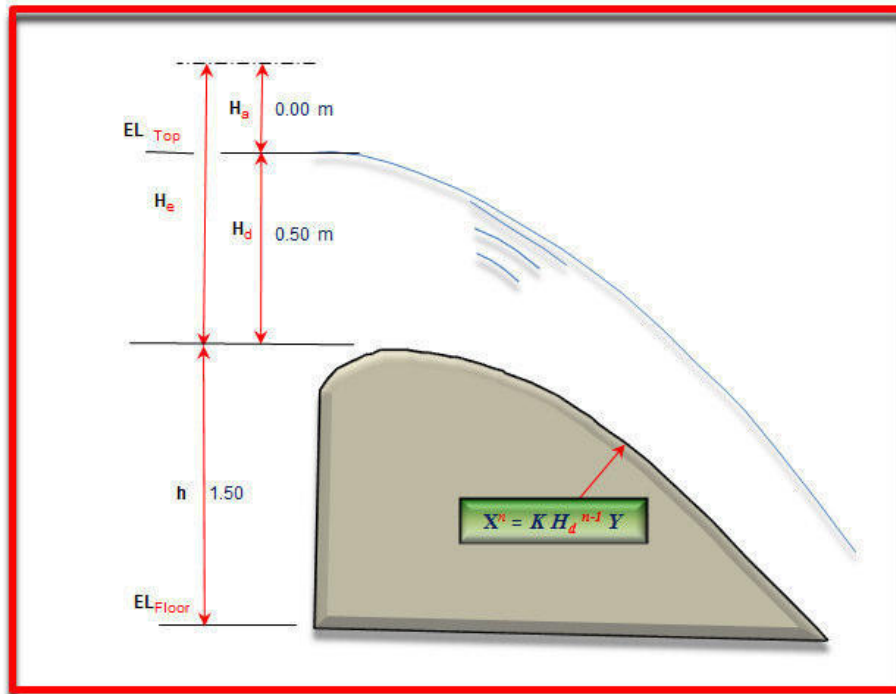
Crest Length = 71.00 m

EL_{Top} = 1464.50 m

EL_{Floor} = 1462.00 m

Input **1**

- | | |
|---|------------------------------|
| 1 | If h = 0.5 He then C = 1.42 |
| 2 | If h = 1.00 He then C = 0.50 |
| 3 | If h = 1.33 He then C = 0.33 |
| 4 | If h = 2.00 He then C = 0.18 |



$$Q = C L H_e^{1.5}$$

He = 0.50 m

h = 1.50 m

Approach velocity = 0.20 m/s

Ha = 0.00 m

Hd = 0.50 m

Figure 6 (Spillway data)

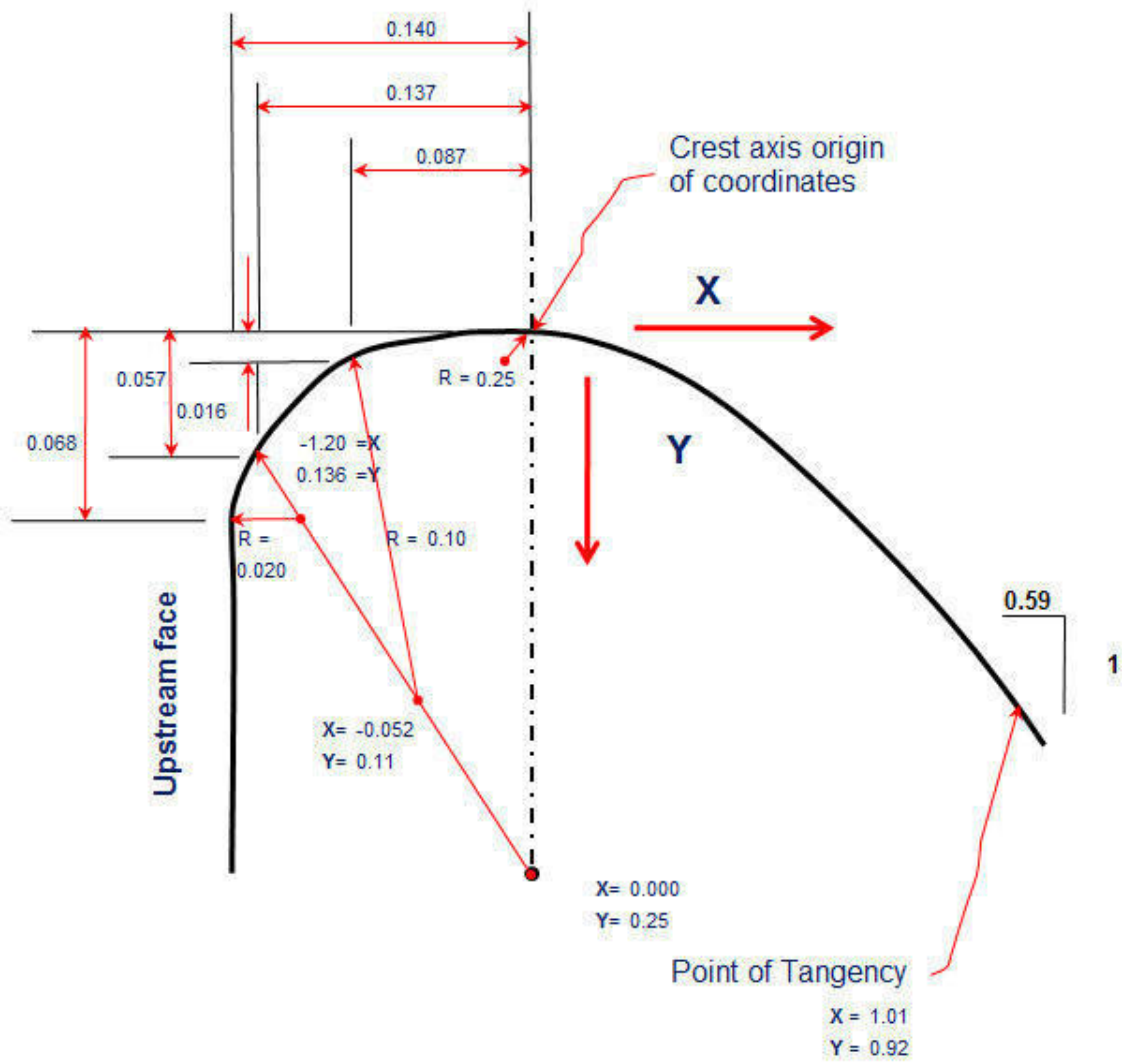
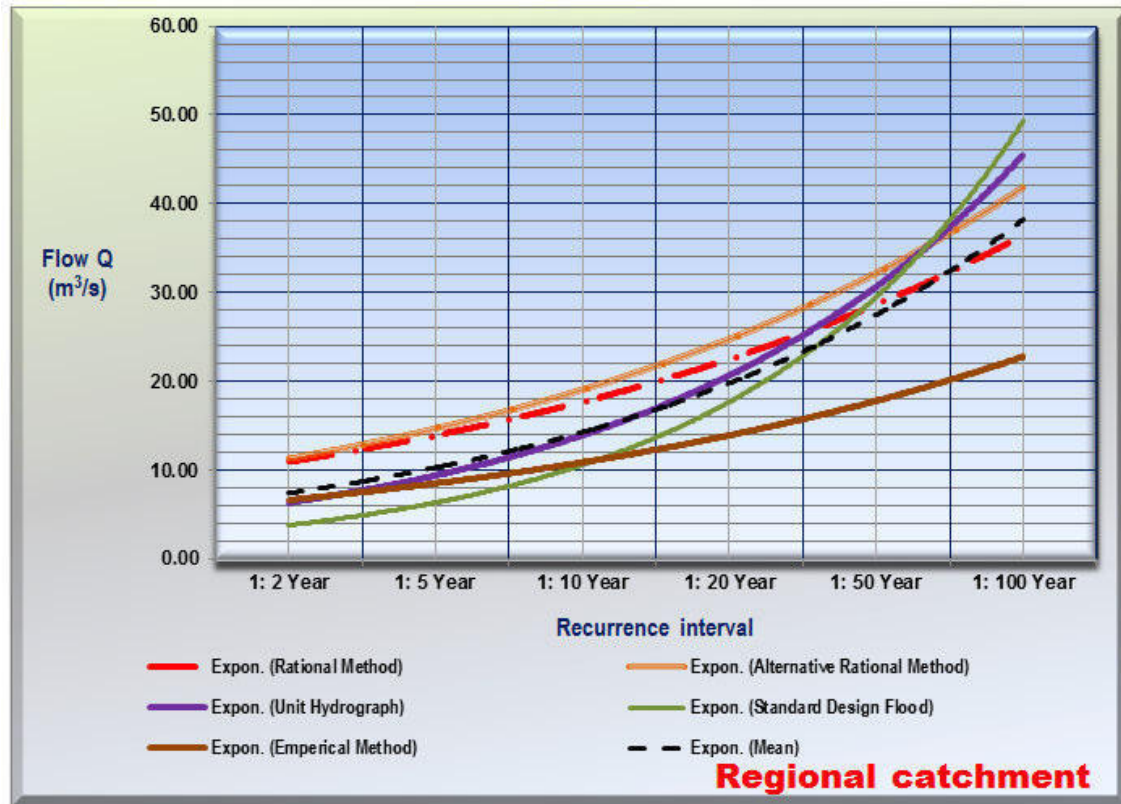


Figure 7 Spillway Geometrics

4) Runoff ((MAXIMA design analysis)MAXIMA)

i) Pre Development

I. Regional catchment



Hydrological design method	1: 2 Year	1: 5 Year	1: 10 Year	1: 20 Year	1: 50 Year	1: 100 Year
Rational Method	10.530	14.330	18.120	22.350	29.020	35.680
Alternative Rational Method	9.581	16.160	21.140	26.120	32.700	37.680
Unit Hydrograph	5.876	9.931	14.640	20.590	31.310	43.560
Standard Design Flood	2.404	8.442	14.050	20.390	29.870	37.820
Emperical Method			11.300	13.020	18.190	22.980
Mean	7.098	9.773	15.850	20.494	28.218	35.544

Effective Catchment Area 107.92 ha

The effective Catchment region includes the offset area.

II. Regional catchment (Pre and current) results

1:2 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duratiom(Min)
EXT.118	1.22	36	20
RESIDENTIAL	0.64	52	20
ROADS	0.92	50	40
PARKS	7.52	40	35

1:5 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duratiom(Min)
EXT.118	1.78	36	20
RESIDENTIAL	0.92	52	20
ROADS	1.32	50	35
PARKS	10.90	40	30

1:10 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duratiom(Min)
EXT.118	2.29	36	20
RESIDENTIAL	1.19	52	20
ROADS	1.76	50	35
PARKS	14.44	40	30

1:25 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duratiom(Min)
EXT.118	3.27	36	15
RESIDENTIAL	1.69	52	20
ROADS	2.53	50	35
PARKS	20.68	40	25

1:50 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duratiom(Min)
EXT.118	4.24	36	20
RESIDENTIAL	2.22	52	20
ROADS	3.34	50	30
PARKS	27.08	40	20

1:100 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duratiom(Min)
EXT.118	5.46	36	20
RESIDENTIAL	2.85	52	15
ROADS	4.38	50	25
PARKS	35.55	40	25

III. Extension 128 total catchment runoff results

i. 1:5 year return intervals

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp (Present)	Storm Duratiom(Min)
Zone A1	1.61	5	35

ii. 1:25 year return intervals

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp (Present)	Storm Duratiom(Min)
Zone A1	3.11	5	35

ii) Post Development runoff results

I. Regional (with spillway)

1:2 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duration(Min)
EXT.118	1.22	36	20
PARKS	7.52	40	35
RESIDENTIAL	0.64	52	20
ROADS	0.92	50	40
SPILLWAY	6.93		

1:5 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duration(Min)
EXT.118	1.78	36	20
PARKS	10.90	40	30
RESIDENTIAL	0.92	52	20
ROADS	1.32	50	35
SPILLWAY	11.41		

1:10 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duration(Min)
EXT.118	2.29	36	20
PARKS	14.44	40	30
RESIDENTIAL	1.19	52	20
ROADS	1.76	50	35
SPILLWAY	16.22		

1:25 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duration(Min)
EXT.118	3.27	36	15
PARKS	20.68	40	25
RESIDENTIAL	1.69	52	20
ROADS	2.53	50	35
SPILLWAY	25.08		

1:50 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duration(Min)
EXT.118	4.24	36	20
PARKS	27.08	40	20
RESIDENTIAL	2.22	52	20
ROADS	3.34	50	30
SPILLWAY	35.04		

1:100 YEAR FLOW

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duration(Min)
EXT.118	5.46	36	20
PARKS	35.55	40	25
RESIDENTIAL	2.85	52	15
ROADS	4.38	50	25
SPILLWAY	47.07		

II. Extension 128

(a) Sub catchment runoff 1:5 year return intervals

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duration(Min)
PARKS	4.21	85	15
ROADS	0.70	83	15
ROOF	1.81	100	15
SPILLWAY	0.272		

(b) Sub catchment runoff 1:25 year return intervals

Sub-Catchment	Peak-Outlet (m ³ /sec)	%Imp	Storm Duration(Min)
PARKS	7.33	85	15
ROADS	1.27	83	15
ROOF	2.96	100	15
SPILLWAY	0.597		

(*) Both the Post 1:5 and 1:25 post developments is runoff generated from the total Extension 128 runoff, draining into the spillway dam.

For ease of reference, hydrographs have been drawn up to indicate visually the Pre and Post developments.

5) HYDROGRAPHS

a. (Pre development)

Region : current

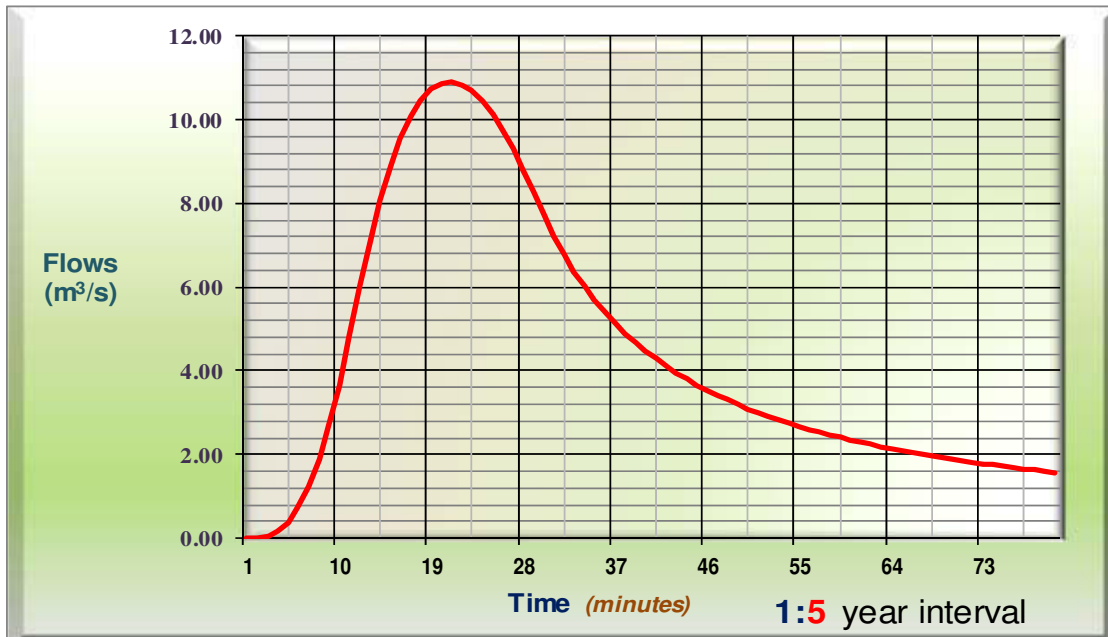


Figure 8 (Hydrograph Pre development 1:5 year)

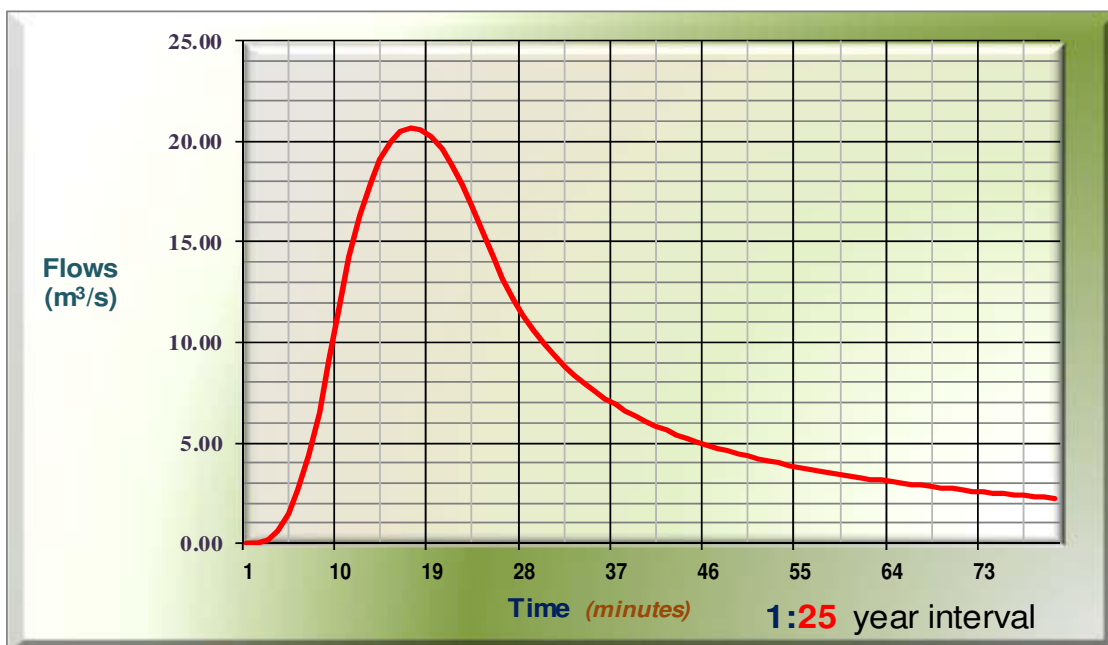


Figure 9 (Hydrograph Pre development 1:25 year)

Ext. 128 Pre

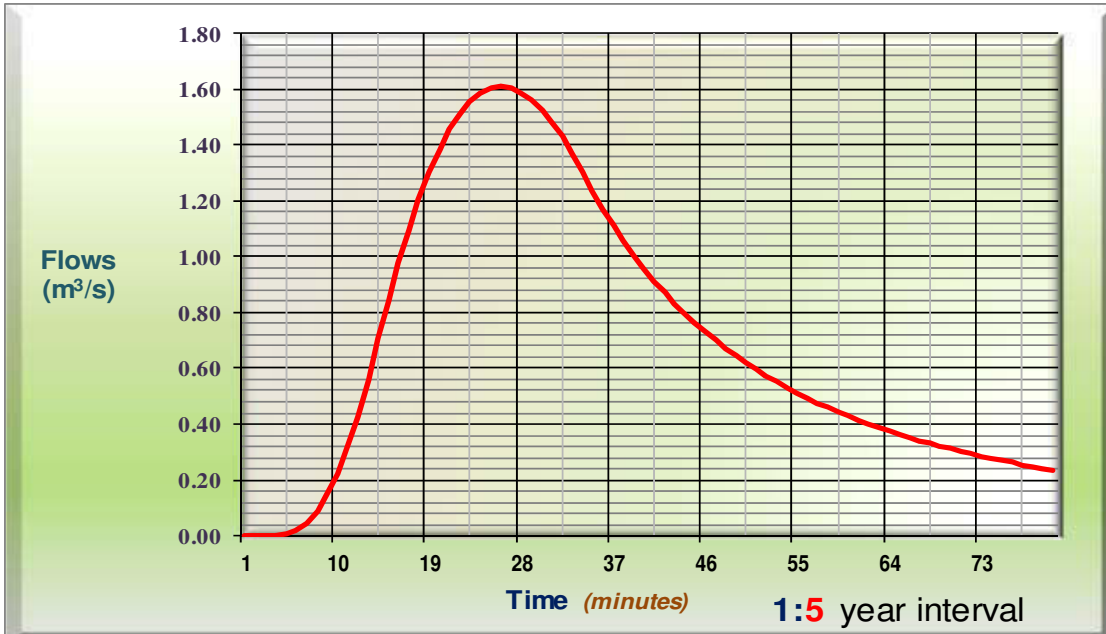


Figure 10 (Hydrograph Pre development 1:5 year)

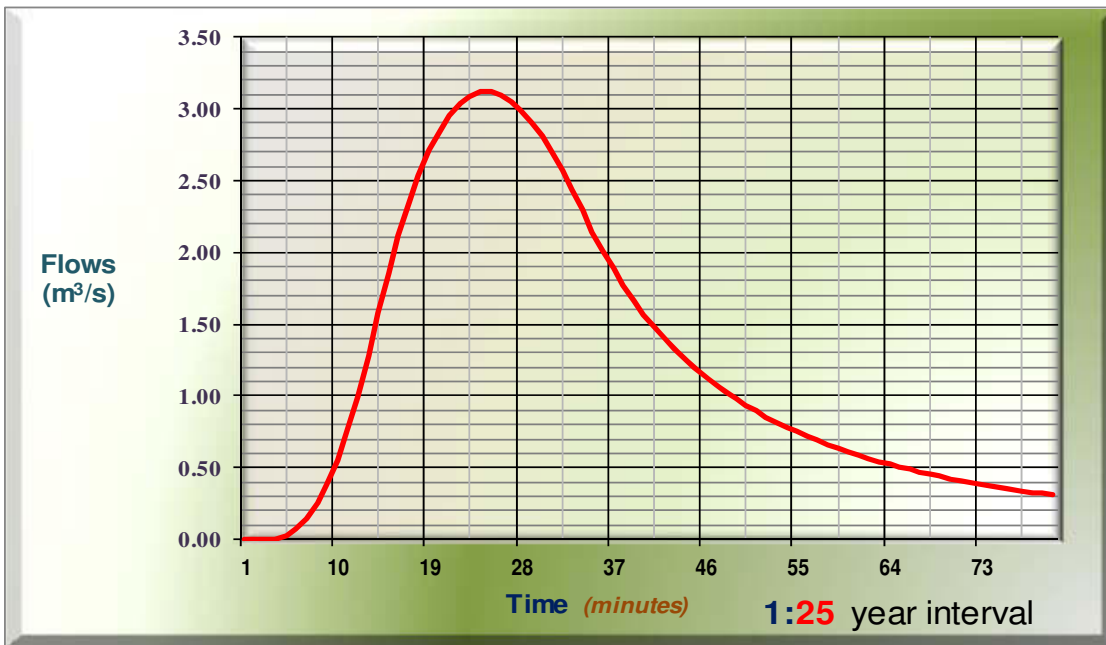


Figure 11 (Hydrograph Pre development 1:25 year)

(* please note that the pre development is for the total catchment area of extension 128

- a. (Post development)
- a. (Regional Catchment)

Region Spillway

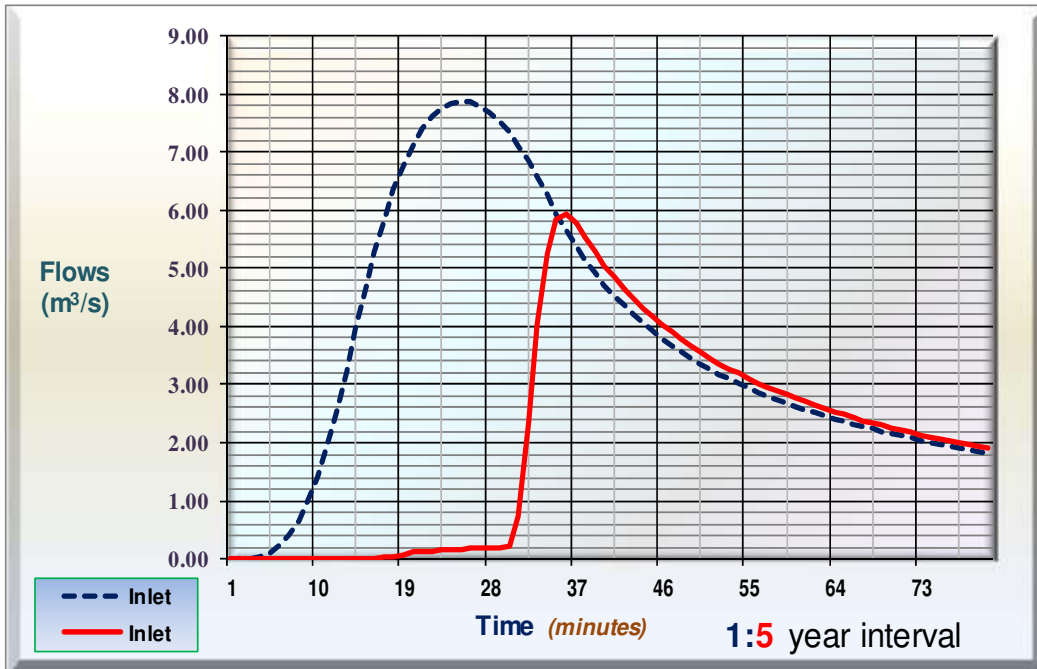


Figure 12 (Hydrograph Post development Res 1 1:5 year)

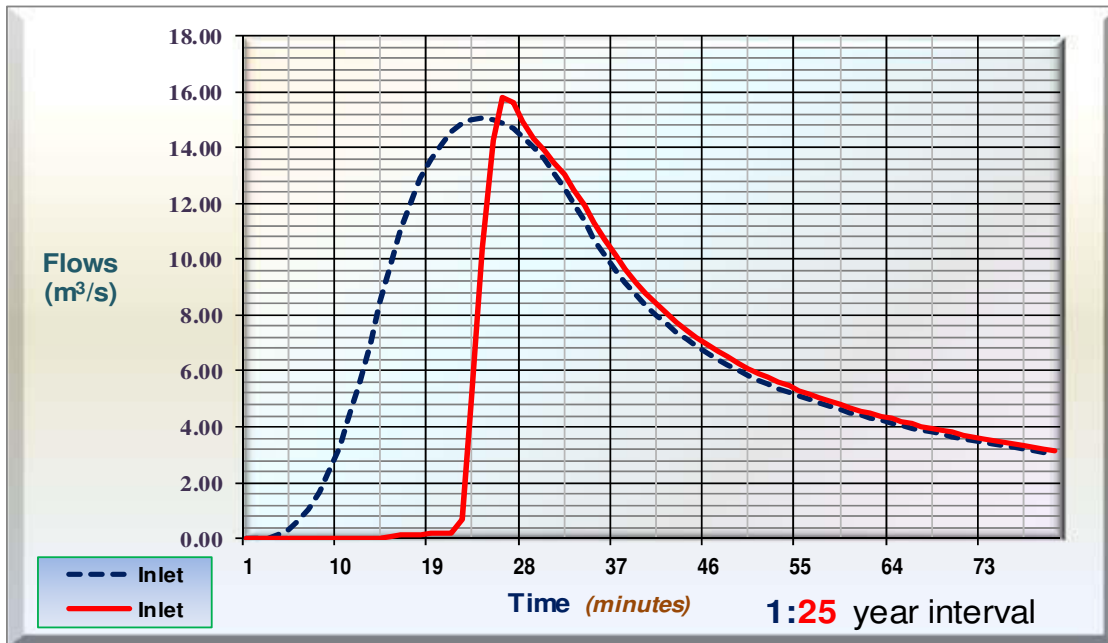


Figure 13 (Hydrograph Post development Res 1 1:25 year)

b. (Extension 128 Effective Catchment plus offset)

Ext. 128 / Spillway

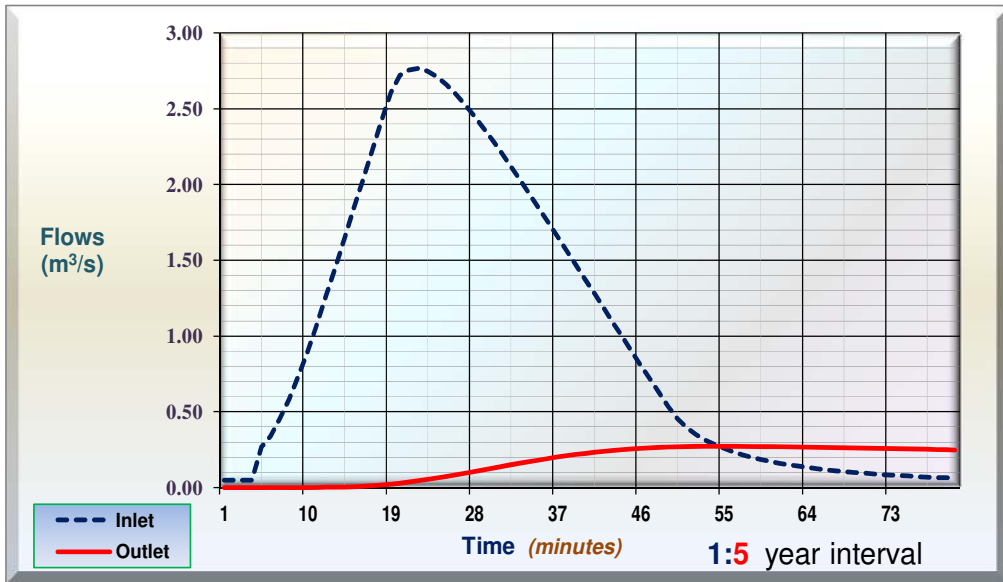


Figure 14 (Hydrograph Post development Res 1:5 year)

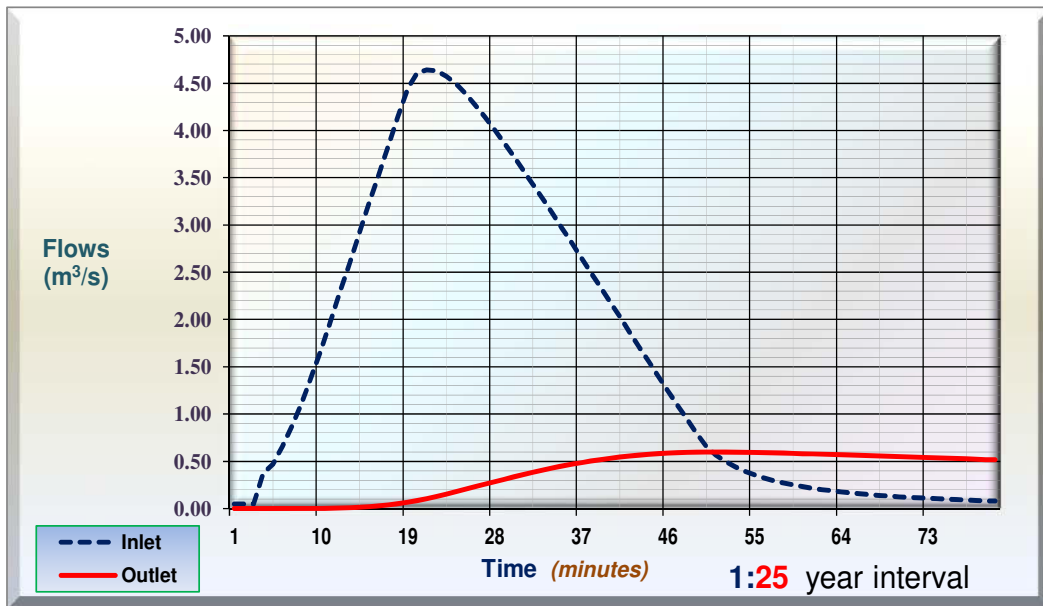


Figure 15 (Hydrograph Post development Res 1:25 year)

The hydrographs above indicate the runoff generated from Extension 128 (included of the offset area) flow inlet into the spillway dam area and the outlet flows. Based on these calculations, it can be clearly seen that the spillway dam area has sufficient capacity to accommodate the minor and major flows. The word "Res" as shown refers to the Spillway reservoir.

b. (Pre / Post development: Major region)

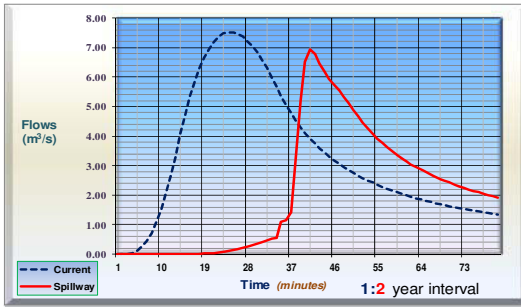


Figure 16

(Hydrograph Current / Spillway Major region 1:2 year)

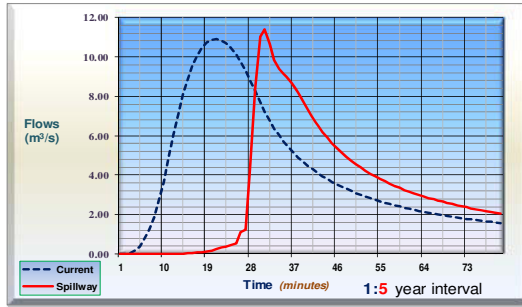


Figure 17

(Hydrograph Current / Spillway Major region 1:5 year)

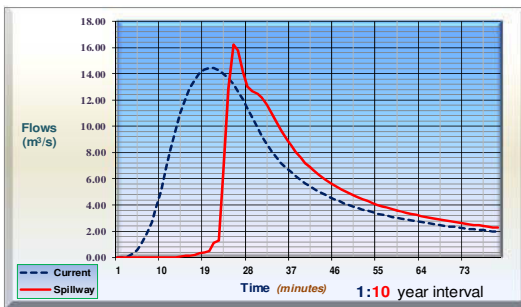


Figure 18

Hydrograph Current / Spillway Major region 1:10 year

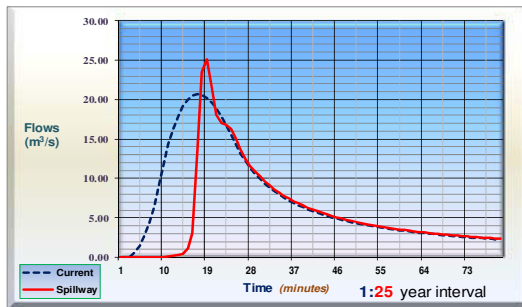


Figure 19

(Hydrograph Current / Spillway Major region 1:25 year)

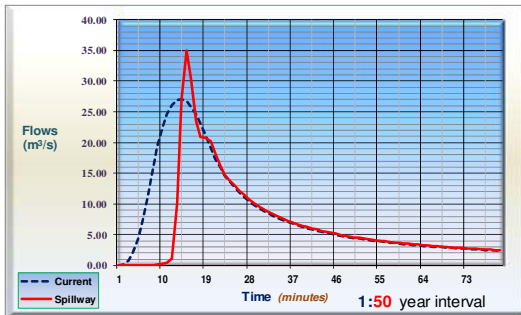


Figure 20

(Hydrograph Current / Spillway Major region 1:50 year)

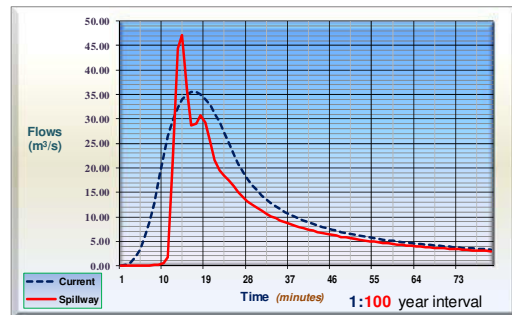


Figure 21

(Hydrograph Current / Spillway Major region 1:100 year)

The effective catchment region include the offset provided for from extension 128. As indicated, in the hydrographs above shows the effects the spillway has on the runoff.

It must be noted, that the spillway dam, is not intended to attenuate the upstream flows, as developed areas, have provided drainage attenuation to facilitate the Pre development runoffs.

The Spillway dam, is there to provide a feature for the area under study however this does provide adequate attenuation for extension 128 only. As can be seen in

Figures 16,17,18,19, 20 and 21, are the hydrographs that indicate the current flows without the spillway and the flows generated with the spillway.

It was found from the above analysis, that the major storms exceed the flows generated from current flows, this is due to the installation of the spillway, as the structure inhibits the flow direction, thus creating turbulent flows.

However from the 1:5 year runoffs generated, the flows subside.

c. (Pre / Post development: Extension 128)

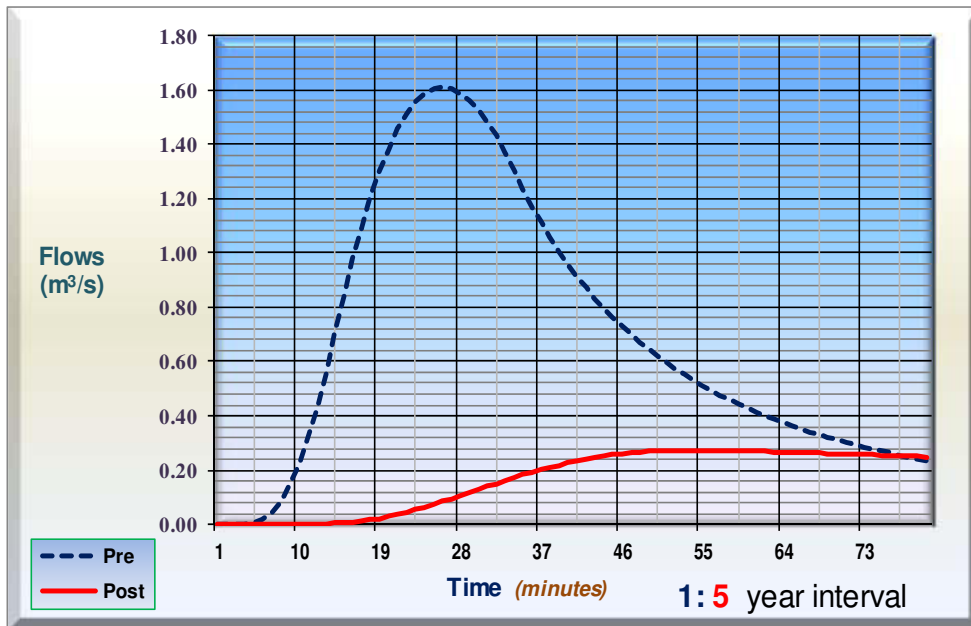


Figure 22 (Hydrograph Pre / Post development Pre / Spillway 1:5 year)

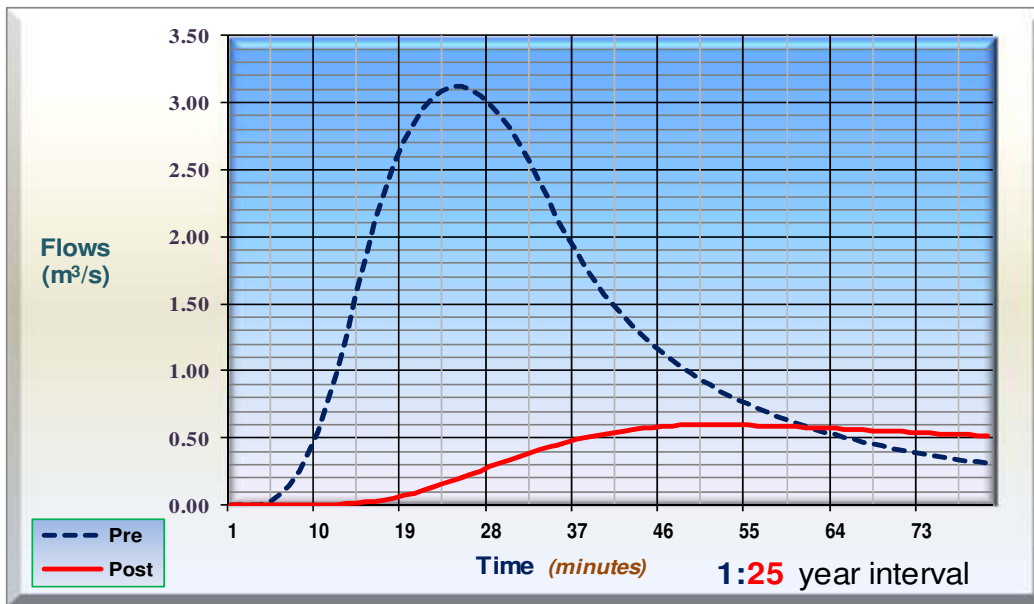


Figure 23 (Hydrograph Pre / Post development Pre / spillway 1:25 year)

The hydrographs indicate the Pre and Post flows generated from Extension 128 only.