

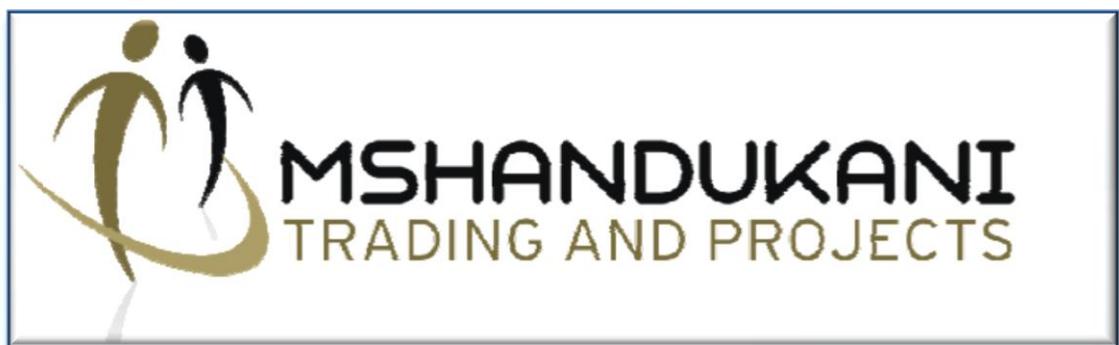
**CONSTRUCTION ENGINEERING GEOTECHNICAL
REPORT FOR IMPACT MINISTRY BUILDING
INFRASTRUCTURES IN JOHANNESBURG, SOUTH
AFRICA.**

Client: IMPACT MINISTRY

Report No.: 103-01-11 July 2011

Revision: 0

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1. SUMMARY

Impact ministry building project in Gauteng falls in the area with the following NHBRC¹ geotechnical zone: Class R,S1

The project entails building of bathroom, showers, toilets and the dome which will be built in compliance with NHBRC standards.

The foundation design to be implemented for this site should be kept under 50 kpa on the area demarcated for bathroom and 150 kpa where the dome will be built to avoid major settlement or collapse settlement and cracks on foundation and building.

Some aesthetic finishes and/or construction joints should be provided for on internal and external walls to accommodate differential settlement.

Investigation was done during rainy season (summer season) seepage of ground and surface water has been encountered during excavation of test pits. It is recommended that a **geohydrological study** be commissioned as soon as possible so as to determine among others the groundwater yield rate mainly where the bathroom structure is going to be erected. Such information is necessary for the design of subsurface drainage system adequate for this structure. Such drainage design should take into account the topographical and geotechnical character of this site of which Mshandukani Trading and Projects are already familiar with as per this study.

¹ NHBRC – National Home Builders Registration Council

2. INTRODUCTION

2.1. GENERAL

This report addresses the finding of a scientific study as requested by Constance Netshifhefhe of Impact Ministry. This study is meant solely for the specified engineering applications as stipulated under Report Provisions below.

2.2. TERMS OF REFERENCE

Mshandukani trading and projects (Pty) Ltd was approached and appointed by the client to undertake an engineering geological (geotechnical) investigation for development of building infrastructures foundation design.

The investigation was carried out at Johannesburg RSA. The site investigation took place on the 02 July 2011.

2.3. OBJECTIVES

The objectives of the investigation were to:

- Assess the exposure and vulnerability of the site with respect to Geo-hazards.

- Characterize the suitability of the area for residential development.

- Recommend the suitable foundation design for the houses.

- Highlight any discrepancies noted on site.

- Asses the overall structural integrity of existing units.

By default, the following form part of geotechnical investigations:

- Specific geology of the site.

- Potential geotechnical restraining factors.

- Excavation conditions.

- Presence and proximity of groundwater.

- Classification of the site according to the NHBRC's classification system.

- Identification of construction materials, where possible.

2.4. REPORT PROVISIONS

This report is specifically suitable for the use on design purposes for single storey masonry residential units imposing pressures of or less than 50 kPa on the area where bathrooms will be erected and 150 kPa on the dome structure. It is meant solely for use on the above mentioned residential unit.

Other infrastructure and service developments on this site such as cemeteries, schools, landfills, high rise buildings, commercial buildings, roads, bridges, underground works etc. falls outside the scope of this report.

Any form of development, whatsoever, outside the boundaries the investigated area as per the attached site layout plan is not covered by this report.

2.5. SCOPE

The scope of the work involved:

Project planning and desktop analysis of the area and available information;

Field investigations;

- Excavation and profiling of test pits;
- Sampling on key horizons;
- Field testing;

Interpretation of site information; and

Report writing

2.6. APPROACH

A systematic approach was followed consisting of:

Area identification and collection of existing information for the site;

Preliminary field visiting;

Excavation and profiling of test pits;

Sampling;

Field testing

Mapping

2.7. SOURCES OF INFORMATION

The following were studied prior to the investigation taking place

A 1:250 000 geological map as published by the Council for Geosciences.

Available literature (see Reference Section)

Probabilistic Seismic Hazard Identification Map as published by the Council for Geosciences

1:50 000 topographic sheets

Satellite images

3. SITE LOCATION AND DESCRIPTION

3.1. GEOGRAPHIC DESCRIPTION

As mentioned earlier, Impact ministry building project is situated in Gauteng province along the N14 from centurion to Randfontein.

3.2. COORDINATES AND ELEVATION

The site coordinates are 25°56'59.4"S and 27°57'36.8"E with an elevation of approximately 1320 m above mean sea level.

3.3. BOUNDARY CONDITIONS

The area is surrounded by farms and Diepsloot township .

3.4. VEGETATION

Vegetation on site was composed of short well established grass and weeds. (see plate 1)



Plate 1: Vegetation on site where the Dome will be built.

3.5. CLIMATE

The area falls at De Martonne's aridity index of between 10 and 20.

According to the Thornthwaite's moisture index, the area falls in the region of -20 to 0. This interprets to sub-humid condition.

The Weinert's N value for this site is between 2 and 3. This simply means chemical weathering processes heavily predominates over mechanical weathering.

3.6. DRAINAGE PATTERNS

Existing Drainage basins has been identified on site.

3.6.1. 1:50 and 1:100 Year Flood Lines

A 1:50 year flood line implies that an area below that line has a high probability of being flooded at least once in every fifty year period. Similar contextual definition applies for the 1:100 year flood line.

By law, residential developments below the 1:50 year flood lines areas are prohibited. This is due to the risk of flooding leading to property damage health and life hazards, inconveniences etc. If in existence within the township establishment limits, these areas could, however, be used for recreational purposes or for other similar low risk facilities.

It is the author's view that flood line lies outside boundaries of this township. This view is based on the absence of flood deposits on site and topographic setting. Proper flood line should be available from the Johannesburg Municipality Town Planning Department or the developer.

3.7. RELIEF AND TOPOGRAPHY

Topographically, the site has a low relief and a very shallow gradient inclined to the southwest. The gradient is approximately 15 degrees on site.

3.7.1. Slope Stability

Based on the topographic relief, the site is considered to be naturally stable as far as slope instability is concerned. Besides, signs of past instabilities were not observed.

3.8. PAST LAND USE

This land was previously used for residential purpose and farming till date.

3.9. CURRENT LAND USE

The land is currently used for residential development purposes. Most of the stands in the vicinity are occupied with housing units. Township electricity, water and sewer are already installed.

Some of Roads were paved.

This site then translates into a brown-fields development as opposed to a green-fields development

3.9.1. Mining activities

There were no existing quarries, open cast or open pit mining activities within the boundaries of this site. Also, there were no signs of past mining activities on site.

3.10. CONDITION OF EXISTING STRUCTURES

Most of the existing houses observed on this site showed signs of structural distress that might be linked to foundational failure

4. GEOHAZARDS

4.1. SEISMIC HAZARD / ACTIVITIES

Seismic-hazard can be described as being the physical effects of an earthquake or earth tremor. Examples of such phenomenon include surface faulting, ground shaking and liquefaction (Kijko A *et al*, 2004).

According to the published (Council for Geosciences) Seismic Hazard Identification Maps of South Africa, Ladysmith falls under an area with a 10 % probability of 0.18g (peak ground acceleration) being exceeded in a 50 year period. The risk and consequences of such magnitude quake / seismic activities are presented in Appendix V.

The peak ground acceleration is the maximum acceleration of the ground shaking during an earthquake.

For single and double storey masonry housing units, a 4 to 5 Hz Spectral Acceleration is assumed. This natural frequency of the building can give an indication of the spectral part of the earthquake motion time history that has the capacity to introduce energy into the building. Spectral Acceleration (ARS – acceleration-response spectra) is the movement experienced by the structure during an earthquake / seismic event.

This phenomenon is known as resonance. Resonance is where the frequency of the applied harmonic force is consistent with the natural frequency of a vibrating body. At resonance, the vibrating body will exhibit the maximum amplitude of response displacement leading to extremely high structural distress similar to popular example of the Tacoma Narrows Bridge that was situated in Washington State, near Puget Sound. Therefore, frequencies far away - either lower or higher - from the natural frequency of the structure have little capability of damaging the structure.

For a 4 to 5 Hz Spectral Acceleration, a 0.26 to 0.34 g with a 10 % probability of being exceeded in a 50 year period is inferred for this region.

4.2. GROUND SUBSIDENCE

Subsidence occurs in areas with large underground cavities typically resulting from large scale shallow to very shallow mining and also from dolomite/limestone dissolution. It can also appear where high thickness of unconsolidated material exists.

This site showed no signs of previous subsidence occurrences. Furthermore, there is no evidence or record of active mining in the immediate vicinities that might cause drop in the ground water level thus triggering ground subsidence. The site is a no dolomitic land, so it cannot be subject to doline formation.

4.3. SINKHOLE FORMATION

Similar to subsidence, sinkhole formation happens in areas with very large to extremely large underground cavities resulting from mining poorly designed shallow underground activities. Coal Mines in Mpumalanga Province and Gold Mines in Gauteng Province are typical examples of such. Dissolution of dolomites or limestones over millions of years also lead to cavity formations that might later manifest into sinkhole formation as evidenced very much so in Gauteng and Limpopo Provinces.

According to the research done, there are no records of wide shallow underground mining activities directly below this site.

There is no dolomite or limestone underlying the site so the chances of dolomite related sinkhole formation are remote.

4.4. LANDSLIDES AND MUDSLIDES

The probability of landslides and mudslides occurring at this area are remote. This is primarily due to the low relief and relatively flat gradient of the area.

4.5. ROCK FALLS AND ROCK SLIDES

As per above reasoning, the probability of occurrences of rock falls and rock slides is very low. Such geo-hazards could similarly be excluded.

4.6. VOLCANIC ACTIVITIES

South Africa has seen its last volcanic activity approximately 65 million years ago during the massive historical eruption of the Drakensberg Lava forming the Basaltic Drakensberg Mountain Ranges that we see today. Recent studies showed no signs for the possibility of volcanic eruption in the foreseeable future.

4.7. AVALANCHES

The climatic conditions for this site do not allow continuous freezing temperatures that might lead to formation of thick ice sheets. The probability of avalanches occurring can therefore, confidently, be excluded.

5. HYDROGEOLOGY

5.1. GENERAL

Aeolian and alluvial sands are relatively fairly porous making it easier for infiltration to occur. Contact zones of different geological units, fractures, joints, faults are also preferred groundwater pathways. Other pathways include *in situ* features such as permeable pores and cavities within the strata.

Groundwater occurrence in the project area is geologically and geographically controlled.

5.2. HYDROGEOLOGY OF SITE

The topographical setting of the site in conjunction with anthropological activities encourages stagnation of water, following precipitation, giving rise to highly saturated ground especially at Test pit 01 which is more closer to the river.

Perched water table resulting from the contact between various geologic zones occurs during rainy seasons in some of the areas.

This investigation was carried out in a rainy season. By the time of investigation, excavations were moist to wet, with some saturated due to high water table.

6. GEOLOGY

6.1. REGIONAL GEOLOGY

The area is manifested by relatively complex geology both lithologically and structurally.

Lithologically, on a regional scale, the area is underlain by sedimentary and metamorphic rocks of the West Rand and Central Rand Groups, Witwatersrand Supergroup. This formation dates back to the Randian Age. Overlying these are rocks are Ventersdorp and Transvaal Supergroup of the Randian to Vaalian Age.

6.2. LOCAL GEOLOGY

Bedrock

Locally, the site is underlain by red medium grained quartzite of the Government Formation, west Rand Group, Witwatersrand Supergroup. This formation dates back to the Randian Period.

Residual soils

Residual soils are composed of very moist, whitish brown orange speckled, very dense, intact, silty sandy GRAVEL with ferricrete nodules, residual whitish brown QUARTZITIC SANDSTONE. These soils are the weathering product of the underlying whitish brown, moderately weathered, medium jointing, medium to hard rock QUARTZITE.

Transported soils

Overlying the residual soils is the moist, light brown, dense, intact, sandy GRAVEL, Colluvial, tree roots which are in turn overlain by moist, light brown, dense, intact, silty fine SAND, Colluvial, roots.

6.3. GEOLOGICAL FEATURES

As could be seen on the geological map and satellite image, series prominent geological features such as faults and lineaments dominate the area (Syenite and Diabase intrusions). Two prominent NE-SW trending faults, namely the Witpoortjie and the Roodepoort Fault cuts in the outskirts of the area.

6.4. SOIL PROFILES

6.4.1. General

As critical part of the geotechnical investigations, soil profiling was carried out to identify and to characterise soil horizons at selected sites. For areas devoid of rock outcrops on site, test pitting was the most appropriate investigative technique. The pits depths were variable, depending on the depth to bedrock and material type.

The pit's surface dimensions were approximately 0.5m x 1.5m. In addition to test pitting, existing borrow pits / foundation excavations were profiled. An opportunity was taken to profile existing foundation trench excavations where available.

6.4.2. Soil Profiling and Sampling

Soil horizons in each of the pits were identified and described comprehensively applying the MCCSSO technique as advocated by Jennings *et al* (1973). The acronym – MCCSSO – stands for Moisture, Colour, Consistency, Structure, Soil Texture and Soil Origin. The photographs of the pits and trenches together with the soil/rock profiles are attached in Appendix II.

Disturbed soil samples were collected from the excavated test pits and trenches in the project area for identification and analysis. The test results are attached in Appendix III.

6.4.3. Profile Results

The area is composed of approximately:

- 30 cm of moist, light brown, dense, intact, silty fine SAND, Colluvial, roots.
- 50 cm of moist, light brown, dense, intact, sandy GRAVEL, Colluvial, tree roots.
- *80 cm of very moist, whitish brown, very dense, intact, silty sandy GRAVEL with ferricrete nodules, residual QUARTZITIC SANDSTONE*
- *Underlying the soils is whitish brown, moderately weathered, medium jointing, medium to hard rock iron-rich QUARTZITE.*

7. CONDITIONS NOTED ON SITE

During the site visit, it was noted that the site is a Brown-Fields project area. As can be seen from the figures, the site is already developed. It was also noted that all services were already installed.

7.1. CONSTRUCTION PRACTICES

There was no construction activity by the time of investigations



Plate 2: Test pit excavation on the area where Dome structure will be built.

8. GEOTECHNICAL RESULTS

8.1. GENERAL

Disturbed soil and rock samples were collected for analysis. The site soils were predominantly composed of sand and gravel fractions in terms of particle size distribution

8.2. RESULTS INTERPRETATION

8.2.1. Site Classification and Development Potential

The aim of this geotechnical site investigation report is to determine the different engineering geological properties of the surface and subsurface soils in accordance with the GFSH-2 guidelines and NHBRC soil classification. The intention is to be able to recommend for the foundation designs of structures imposing pressures of less than 50 kPa (Bathroom and toilets) and 150kpa in the area where the dome will.

The following is the explanation of the geotechnical properties evaluated during the investigation.

8.2.2. Activity, Expansiveness or Swelling of Soils

Damage to structures erected on potentially active soils occurs where the expansiveness has not been determined and necessary remedial measures not employed. The potential expansiveness of a soil depends upon its clay content, the type of clay mineral present, its chemical composition and mechanical character. A material is potentially expansive if it exhibits the following properties:

Clay content of more than 12%.

Plasticity index of more than 12%.

Liquid limit of more than 30%.

Linear shrinkage of more than 8%.

The method of van der Merwe (1964) was used to determine the potential heave of soil samples. In addition to van der Merwe's method, the plasticity index and linear shrinkage of soil samples were used to indicate the soils potential expansiveness.

Where development is anticipated on areas with potential expansiveness, the following modified construction methods proposed by Williams *et al.* (1985) may need to be employed:

Pre-wetting of expansive soil horizons

Removal of the active layer

Construction of moisture barriers and paving around the structures

Stiffened raft foundations, sandwich raft foundations (two overlying raft foundations with a mattress of gravel or sand between the rafts)

Split construction.

From the visual observations coupled with lab testing, the *potential expansiveness of the soils on the site is Low*. This is due soil texture and low percentage of clay content which result in low plasticity index and liquid limit. The possibility of structural distress resulting from cyclic drying shrinkage in dry seasons and swell after wetting is therefore minimum.

8.2.3. Settlement and Collapse Potential

Collapsible soils are soils that can withstand relatively large imposed stresses with small settlements at low in situ moisture content but will decrease in volume causing relatively larger settlements when wetting occurs under a load. This volume change is associated with a change in the structure of the soil and can occur in any open textured clayey silty sandy soils with a high void ratio. Colluvial soils situated on straight slopes, plains and residual soils on well-drained hill-slopes derived from weathered granite generally exhibit a collapsible fabric.

Site soils are not *prone to collapse potential* due to their thickness, presence of coarse material and absence of some notable voids. The site soils are consolidated to unconsolidated and immature.

Soil settlement is due to consolidation of soils resulting from imposed loads. These loads mobilises the soil particles into tight form by particle orientation rearrangement and closing of voids.

The compact nature and the limited thickness in the residual soils (Appendix III) manifest into low to medium settlement ratio.

The foundation designs should, however, be such that it takes settlement, especially differential settlement into account. This is due to variations in the site soils resulting from geology, geohydrology, reworked material by farming and construction activities, waste disposal pits, closed pit latrines, presence of pedogenic material etc. The site falls under **R,S1 (up to 20 mm movement) soil classification**

8.2.4. Dispersivity

A dispersive soil is prone to desegregation or separation of clay particles from the soil mass on contact with water. These soils can be identified in the field by the presence of erosion gullies, piping and areas of stunted growth. The Emmerson Crumb Test is used to identify the dispersivity of soil samples by determining the tendency of soil particles to deflocculate and go into suspension. This test was not undertaken for this site due to the type of cohesive clay and the absence of dispersivity indicator features. The site soils can therefore be classified as non-dispersive soils.

8.2.5. Inundation and flooding

Areas that are susceptible to flooding are not suitable for housing development. Recreational facility development for flood zone should have been a better solution.

Inundation on site may be realised cyclically following precipitation. A damp proof membrane (DPM) to be installed below foundations and damp proof course (DPC) to be provided on walls to inhibit the migration of moisture up the foundation and walls (Mainly on the area where the bathroom and toilets going to be erected).

Present land structure exacerbated by excavations and raised surface soil levels encourages stagnation and ponding post precipitation. The site should be landscaped as to channel the accumulation of rain water away from the foundations of houses into a properly designed storm water drainage system. Ground water in the area has a neutral pH value, it can be corrosive towards still but non corrosive towards concrete.

8.2.6. Soil Aggressiveness

The pH and conductivity tests were not taken due to the type of service pipes (HDPE Type) installed on site.

Steel pipes are not used on site so the possibility of service pipe corrosion is remote. Should it however, be decided at a later stage to install any form of corrosive material underground, such component must be galvanised or properly coated with an efficient protective surface compound.

The aggressivity degree in this case can be determined by conducting some pH and conductivity tests.

8.2.7. Erodability

The existence of well developed vegetation, shallow slopes (approximately 0-5 degrees), shallow bedrock controls the erodability of the site soils by reducing the runoff speed.

The site soils are not rapidly erodible taking into account the slopes, bedrock proximity and the degree of compaction.

8.2.8. Excavatability

The depth to bedrock for this site is shallow to moderate.

Most of the area is excavatable to 1.5 m (Appendix I). Drill and blasting will be a suitable excavation method for most of the area where excavator reaches refusal.

8.2.9. Potential Sources of Construction Materials

The site soils and rocks are variable. For this reason it is recommended that construction material be identified and sourced from a suitable remote site. These soils are however suitable for use as fill material.

9. GENERAL

The excavation sidewalls appeared stable. Shoring might however be required when working in deeper than 1,5 m pits and excavations.

10. CONCLUSION AND RECOMMENDATIONS

The geotechnical investigation was carried out for the Impact ministry building project situated at Johannesburg near Diepsloot RSA.

It should be noted that all test pits were lightly backfilled and any structural construction over such areas might lead to some degree of settlement if not properly designed for. It is recommended that such areas be identified and re-compacted with suitable fill material in thicknesses not greater than 150mm compacted to 98 Mod AASHTO at +/-2% optimum moisture content or as per design engineer's specifications.

It should be borne in mind that the geotechnical boundaries are inferred. So, some variations to the reported conditions should be expected.

The site predominantly falls within NHBRC Site Soil Class R, S1 (up to 20mm estimated total settlement) (Appendix I & IV). It is recommended that reinforced strip footing foundation solution be used for this site. Details on foundation preparations are outlined in Appendix IV.

Proper compaction of the classified fill material must take place for all foundation types.

Foundations should be laid at depths not less than 0.5 m.

Site drainage should be such that water is channeled from site into a suitable storm water drainage system.

Damp proof membrane / course should be able to inhibit the ingress of moisture.

No major settlement or differential settlement cracks are foreseen provided the pressures are kept under 50 kPa at the area where bathroom (TP 02 represent soil profile of area where bathroom will be built) and toilets are going to be erected and 150kpa where the Dome will be built (TP06 and TP07 represent soil profile of where dome will be built).

Some aesthetic finishes and/or construction joints should be provided for on both the internal and the external walls.

Conditions prevailing at the site suggest that no problems are foreseen for the development of single and double storey masonry structures, provided the recommendations outlined in the report are adhered to.

10.1. SUGGESTED FOLLOW UP WORK

Proper drainage system should be implemented which will allow runoff of water from foundations of houses into the main existing drainage basin.

Persistent moisture will deposit salts, cause corrosion of steel reinforcement leading to concrete deterioration, it will encourage algal growth and moulding if house contents. However laboratory results of water samples indicates that underground water can be corrosive to still and non-corrosive to concrete.

It is recommended that a **geohydrological study and detailed Flood line survey** to be commissioned as soon as possible so as determine among others the groundwater yield rate mainly in position of house **of the bathroom structure.**

Such information is necessary for the design of subsurface drainage system adequate for this structure. Such drainage design should take into account the topographical and geotechnical character of this site of which Mshandukani Trading and Projects has studied as per the request.

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For Mshandukani Projects (Pty) Ltd

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APPENDIX I:

FIGURES

Figure 1: Locality Map

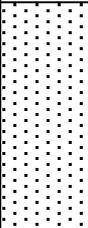
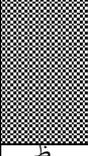
Figure 1: Site layout with test pit position of Impact village site



APPENDIX II:

Soil Profiles

PROJECT: Impact village	TEST PIT: TP 01	DATE: 2011 July
SITE: Impact ministry site (JHB)	LOGGED BY: Mashudu shandukani	
CLIENT: Impact ministry	COORDINATES: 25°56'59.29"S 27°57'36.68"E 1317m	
	MACHINE: TLB CAT	

Depth (cm)	Legend	Sample
10	 Moist to wet, light brown, loose, silty sand, Colluvium, roots.	
20		
30		
40		
50		
60		
70		
80		
90		
100		
110	 Wet, Whitish brown, dense, intact, sandy GRAVEL, Residual Quartzite.	
120		
130	 White, moderately weathered, medium jointing, medium grained, medium hard rock. Quartzitic sandstone.	
140		
150		
160		
170		
180		
190		
200		
210	 <p style="text-align: center;">Notes: Test pit collapsing from the side due to water seepage estimated at 4.5l/min. Area not suitable for building as it falls within flood line. Water sample taken for analysis.</p> <p style="text-align: center;">Test Pit Picture</p>	
220		
230		
240		
250		
260		
270		
280		
290		
300		
310		
320		

Legend		Excavation	
≠	Weak seepage	Type:	Test pit
¥	Strong seepage	Date Excavated:	July 2011
ط	Refusal	Method:	Machine Pit/Trench Excavation
◎	Compaction Tests	Hole Diameter:	0.6 - 1.5 m
---	Approximate material change	Geohydrology	
Ω 1	Disturbed sample / sample number		
■	Undisturbed sample	Seepage level:	Yes
▨	Perble marker	Water rest level:	0.4m
▶	Indicator tests	No picture taken of collapsing test pit	
EOH	End Of Hole		

PROJECT: Impact village	TEST PIT: TP2 (Bathroom)	DATE: 2011 July
SITE: Impact ministry site (JHB)	LOGGED BY: Mashudu shandukani	
CLIENT: Impact ministry	COORDINATES: 25°56'58.71"S 27°57'38.59"E 1322m	
	MACHINE: TLB CAT	

Depth (cm)	Legend	SOIL PROFILE	Sample		
10		Slightly Moist to moist, light brown , loose to medium dense, sandy silty clay. Colluvium	Ω Sample TP 2 (bulk)		
20					
30					
40					
50					
60		Moist, dark brown, Dense, Clayey sandy gravel. Pebble marker.	Ω Sample TP 2-1		
70		Slightly moist to moist, Orange brown, dense, intact, sandy GRAVEL, Residual Quartzitic sandstone.			
80					
90					
100					
110					
120					
130					
140					
150					
160		Witish brown, highly to moderately weathered, medium jointing, medium grained, medium hard rock.Sandstone.			
170					
180					
190					
200					
210					
220					
230					
240					
250					
260					
270					
280					
290					
300					
310					
320					
330					
Notes: Machine refusal at 2.9 m, disturbed sample taken, No water seepage observed					

Legend	Excavation	Test Pit Picture
# Weak seepage	Type: Test pit	
¥ Strong seepage	Date Excavated: July 2011	
ط Refusal	Method: Machine Pit/Trench Excavation	
© Compaction Tests	Hole Diameter: 0.6 - 1.5 m	
--- Approximate material change		
Ω Disturbed sample	Geohydrology	
Undisturbed sample	Seepage level: None	
Pebble marker	Water rest level: None	
Indicator tests		
EOH End Of Hole		

PROJECT: Impact village	TEST PIT: TP3	DATE: 2011 July
SITE: Impact ministry site (JHB)	LOGGED BY: Mashudu Shandukani	
CLIENT: Impact ministry	COORDINATES: 25°56'58.7"S 27°57'41.45"E 1328m	
	MACHINE: TLB CAT	

Depth (cm)	Legend	SOIL PROFILE	Sample
10	[Dotted pattern]	Moist to wet, black, soft to firm, intact, silty Clay with Ferricrete nodules of Quartzite, Colluvial.	
20			
30			
40			
50	[Cross-hatch pattern]	Moist to wet, whitish brown orange speckled, dense, intact, sandy gravel. Residual quartzite.	
60			
70			
80			
90			
100			
110			
120			
130			
140			
150			
160	[Dotted pattern]	Witish, moderately to slightly weathered, medium jointing, fine to medium grained, hard rock. Quartzite	
170			
180	[Refusal symbol]	Machine refusal at 1.9 m. No Undisturbed sample collected. No water seepage observed.	
190			
200			
210			
220			
230			
240			
250			
260			
270			
280			
290			
300			
310			
320			
330			

Test Pit Picture

Legend		Excavation	
#	Weak seepage	Type:	Test pit
¥	Strong seepage	Date Excavated:	July 2011
⊔	Refusal	Method:	Machine Pit/Trench Excavation
⊙	Compaction Tests	Hole Diameter:	0.6 - 1.5 m
---	Approximate material change	Geohydrology	
Ω	Disturbed sample		
■	Undisturbed sample	Seepage level:	None
▣	Perble marker	Water rest level:	None
▶	Indicator tests		
EOH	End Of Hole		



PROJECT: Impact village	TEST PIT: TP4	DATE: 2011 July
SITE: Impact ministry site (JHB)	LOGGED BY: Mashudu Shandukani	
CLIENT: Impact ministry	COORDINATES: 24°56'57.32"S 27°57'45.4"E 1337m	
	MACHINE: TLB CAT	

Depth (cm)	Legend	SOIL PROFILE	Sample
10	[Dotted pattern]	Moist to wet, black, soft to firm, intact, silty Clay with Ferricrete nodules of Quartzite, Colluvial.	
20			
30			
40			
50			
60			
70			
80			
90			
100			
110			
120			
130			
140			
150			
160			
170			
180			
190			
200			
210	[Dotted pattern]	Whitish, moderately to slightly weathered, medium jointing, medium grained, hard rock. Quartzite	
220			
230			
240			
250			
260			
270			
280			
290			
300	[Symbol: ط]		
310			
320			
330			
		Notes: Machine refusal at 2.7m. No water seepage observed.	

Legend	Excavation	Test Pit Picture
# Weak seepage	Type: Test pit	
¥ Strong seepage	Date Excavated: July 2011	
ط Refusal	Method: Machine Pit/Trench Excavation	
© Compaction Tests	Hole Diameter: 0.6 - 1.5 m	
--- Approximate material change		
Ω Disturbed sample		
[Symbol: Undisturbed sample]	Geohydrology	
[Symbol: Perble marker]	Seepage level: None	
[Symbol: Indicator tests]	Water rest level: None	
EOH End Of Hole		

PROJECT: Impact village	TEST PIT: TP5	DATE: 2011 July
SITE: Impact ministry site (JHB)	LOGGED BY: Mashudu shandukani	
CLIENT: Impact ministry	COORDINATES: 25°56'53.74"S 27°57'48.23"E 1344m	
	MACHINE: TLB CAT	

Depth (cm)	Legend	SOIL PROFILE	Sample
10		Slightly moist, dark brown, loose, silty sandy Gravel. Colluvium	Q Sample TP 5
20			
30		Slightly moist to moist, whitish brown, dense, intact, sandy GRAVEL, Residual Quartzitic sandstone	
40			
50			
60		Whitish, moderately to slightly weathered, medium jointing, medium grained, hard rock. Quartzite	
70			
80			
90			
100			
110			
120			
130			
140			
150			
160			
170			
180			
190			
200			
210			
220			
230			
240			
250			
260			
270			
280			
290			
300			
310			
320			
330			

Notes:
Machine refusal at 1.2 m. No water seepage observed.

Test Pit Picture

Legend	Excavation	Geohydrology
	Type: Test pit	
	Date Excavated: July 2011	
	Method: Machine Pit/Trench Excavation	
	Hole Diameter: 0.6 - 1.5 m	
	Seepage level: None	
	Water rest level: None	

PROJECT: Impact village	TEST PIT: TP6 Dome	DATE: 2011 July
SITE: Impact ministry site (JHB)	LOGGED BY: Mashudu Shandukani	
CLIENT: Impact ministry	COORDINATES: 25°56'48.30"S 27°57'48.32"E 1352m	
	MACHINE: TLB CAT	

Depth (cm)	Legend	SOIL PROFILE	Sample
10		Dry to moist, brown, medium dense to dense, sandy silty Clay with Ferricrete nodules quartzite, Colluvial.	Ω Sample TP 6
20			
30			
40		Slightly moist to moist, whitish brown, dense, intact, sandy GRAVEL, Residual Quartzitic sandstone	
50			
60		Whitish, moderately to slightly weathered, medium jointing, medium grained, hard rock. Quartzite	
70			
80			
90			
100			
110			
120			
130			
140			
150			
160			
170			
180			
190			
200			
210			
220			
230			
240			
250			
260			
270			
280			
290			
300			
310			
320			
330			

Notes:
Shallow refusal at 0.8m

Test Pit Picture

Legend		Excavation		
	Weak seepage	Type: Test Pit		
	Strong seepage	Date Excavated: July 2011		
	Refusal	Method: Machine Pit/Trench Excavation		
	Compaction Tests	Hole Diameter: 0.6 - 1.5 m		
	Approximate material change			
	Disturbed sample	Geohydrology		
	Undisturbed sample	Seepage level: None		
	Perble marker	Water rest level: None		
	Indicator tests			
	End Of Hole			

PROJECT: Impact village	TEST PIT: TP7 Dome	DATE: 2011 July
SITE: Impact ministry site (JHB)	LOGGED BY: Mashudu shandukani	
CLIENT: Impact ministry	COORDINATES: 25°56'51.1"S 27°57'50.96"E 1352m	
	MACHINE: TLB CAT	

Depth (cm)	Legend	SOIL PROFILE	Sample
10	•••••	Dry, Brown, dense, silty Fine sand.colluvium.	
20			
30	▣		
40	▣	Slightly moist to moist, whitish brown, dense, intact, sandy GRAVEL, Residual Quartzitic sandstone	
50	▣		
60	▣	Whitish, moderately to slightly weathered, medium jointing, medium grained, hard rock. Quartzite	
70	▣		
80	ط		
90			
100			
110			
120			
130			
140			
150			
160			
170			
180			
190			
200			
210			
220			
230			
240			
250			
260			
270			
280			
290			
300			
310			
320			
330			
340			
350			

Notes:
Machine refusal at 0.7m. No water seepage observed.

Test Pit Picture

Legend		Excavation	
≡	Weak seepage	Type:	Test pit
¥	Strong seepage	Date Excavated:	July 2011
ط	Refusal	Method:	Machine Pit/Trench Excavation
◎	Compaction Tests	Hole Diameter:	0.6 - 1.5 m
---	Approximate material change		
Ω 1	Disturbed sample / sample number	Geohydrology	
■	Undisturbed sample	Seepage level:	None
▣	Perble marker	Water rest level:	None
▶	Indicator tests		
EOH	End Of Hole		



APPENDIX III

Laboratory Test

Sheets Field Test

Sheets



RONEY HOFFMANN CONSULTANTS CC
 WATER AND WASTE WATER PROCESS CONSULTANTS

141 Cresswell Road Silverton P.O. Box 11864 Queenswood 0121 Tel: (012) 804 8363 Fax: (012) 804 2212 Cell: 082 557 9860 E-mail: roney@fiscali.co.za

DETERMINATION OF CORROSIVITY OF WATER SAMPLES

REF : PM 2011-8/17a

AGGRESSIVENESS TOWARDS CONCRETE : AGGRESSIVENESS INDEX
 (PORTLAND CEMENT INSTITUTE - J.J. BASSON PUBLICATION)

CLIENT	CIVILAB, CENTURION
SAMPLE IDENTIFICATION :	MSHANDUKANI - IMPACT VILLAGE

DETERMINAND	TP 01 WATER SAMPLE	VALUE	CONSTANT	INDEX
pH		8.1	200	280
Calcium Carbonate Saturated pH		8.5	-2000	800
Calcium Hardness as CaCO ₃		80	2.2	924
Total Ammonium as NH ₄		3	10	30
Magnesium as Mg		17	0.6	10
Sulphates as SO ₄		130	0.3	39
Chlorides as Cl		80	0.2	16
Total Dissolved Solids		429		
Leaching - corrosion sub-index , LCSi				668
Spalling - corrosion sub-index , SCSi				26
Final aggressiveness index at 25 Degr. C, corrected for stagnant conditions, Nc				360

GUIDELINES FOR ASSESSING FINAL INDEX

FINAL INDEX	AGGRESSIVENESS	RECOMMENDATION
Under 350	Non to mildly aggressive	Use concrete class as required for structural design
350 - 750	Mildly to fairly aggressive	Good concrete design and construction essential
750 - 1000	Highly aggressive	Identify dominant corrosion sub-index Follow recommendations
Over 1000	Very highly corrosive	Do not use in contact with unprotected concrete



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DETERMINATION OF CORROSIVITY OF WATER SAMPLES

LANGELIER SATURATION AND RYZNAR STABILITY INDICES , AGGRESSIVENESS INDEX AND CHLORIDE + SULPHATE TO ALKALINITY CORROSIVITY RATIO

CLIENT	CIVILAB, CENTURION
ORDER NO	HP 7689
SAMPLE IDENTIFICATION :	MSHANDUKANI - IMPACT VILLAGE

RHC REF.	PM 2011-8/17a
DATE RECEIVED	17 AUGUST 2011

1.1 CHEMICAL ANALYSIS		1.2. CORROSIVITY INDICES	
Results are in mg/l unless otherwise stated.			
DETERMINAND	TP 01 - WATER SAMPLE	INDEX	VALUE
pH	8.1	Stability pH (pHs) at 20°C	8.2
Conductivity (mS/m)	66	Langelier Index at 20°C	-0.1
Total dissolved solids (Calculated)	429	Ryznar Stability Index at 20°C	8.3
Total Hardness as CaCO ₃	150	Aggressiveness Index	10.2
Calcium Hardness as CaCO ₃	80	Cl and SO ₄ Corrosivity Index (Corrosivity Ratio)	4.4
Calcium as Ca	32		
Magnesium as Mg	17		
Total Alkalinity as CaCO ₃	56		
Chloride as Cl	80		
Sulphate as SO ₄	130		

2. INTERPRETATION OF CORROSIVITY INDICES

2.1 AGGRESSIVENESS TOWARDS CONCRETE AND FIBRE CEMENT PIPES

INDEX	AGGRESSIVE	NEUTRAL	NON-AGGRESSIVE	COMMENTS
a) STABILITY pH, pHs	< pH	= pH	>pH	According to the corrosivity indices, the water is not corrosive towards concrete but it is highly corrosive towards metals. According to the Basson Index, the water is mildly corrosive towards concrete.
b) LANGELIER INDEX	NEG. VALUE	ZERO	POS. VALUE	
c) RYZNAR INDEX	> 7,5	6 - 7	< 6	
d) AGGRESSIVENESS INDEX, AI	< 10	10 - 12	> 12	

2.2 CORROSIVENESS TOWARDS METALS

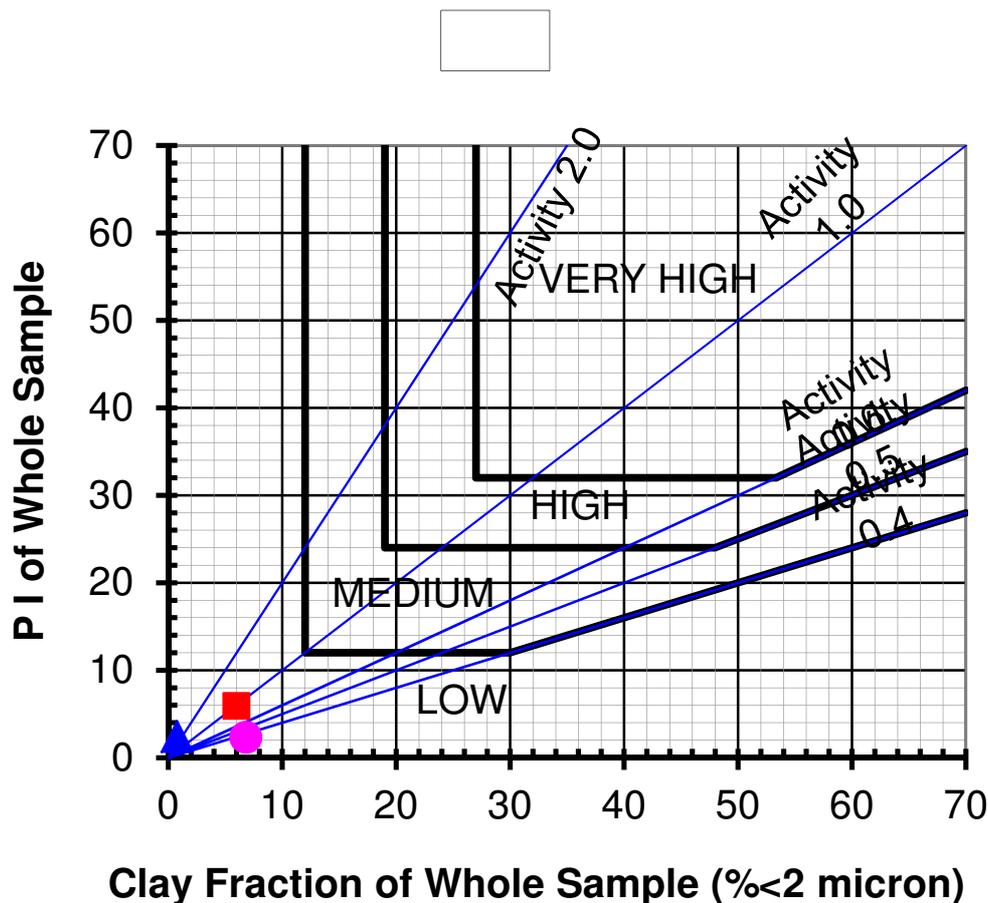
CORROSIVITY RATIO	CORROSIVE
	> 0,2

JRH Hoffmann

18 AUGUST 2011

JRH HOFFMANN

Activity Diagram After D H van der Merwe



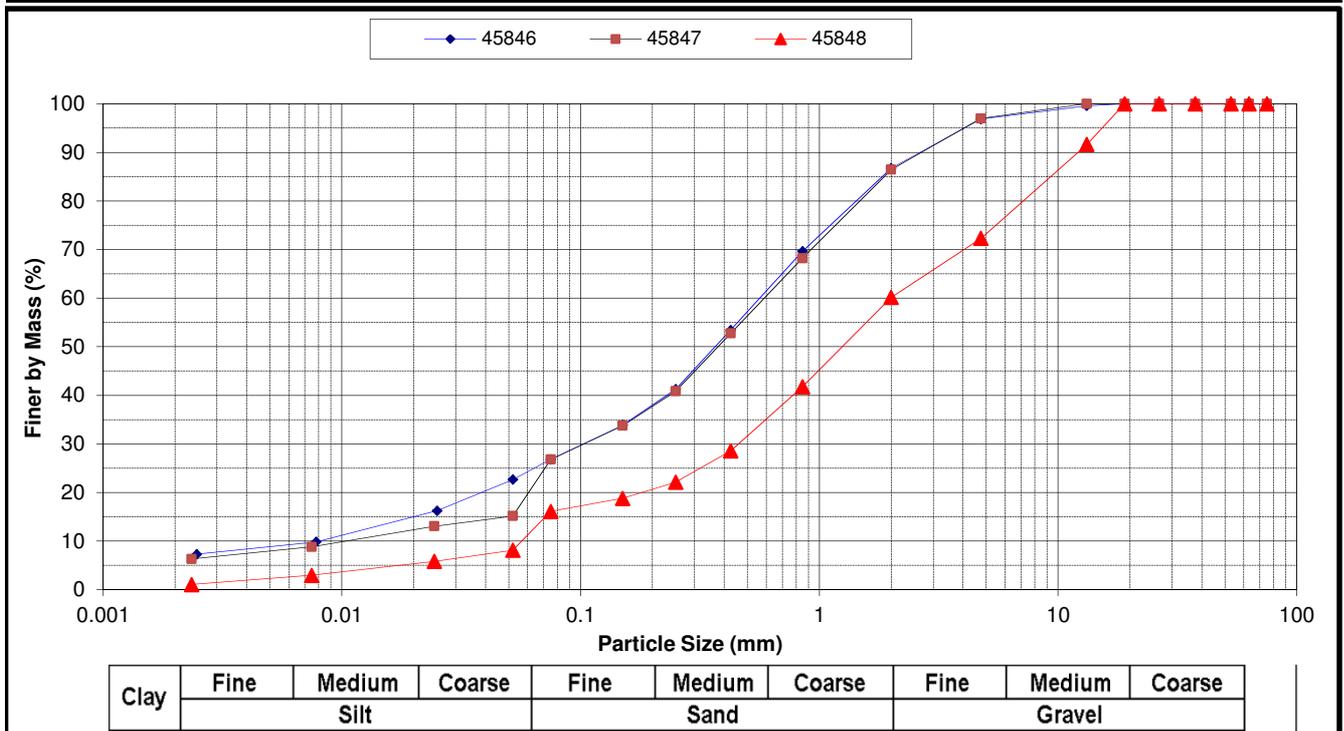
Plotted Values:

Sample	Clay Frac	PI
45846	6.8	2.3
45847	6.0	6.0
45848	0.8	2.4

Foundation Indicator Test Data

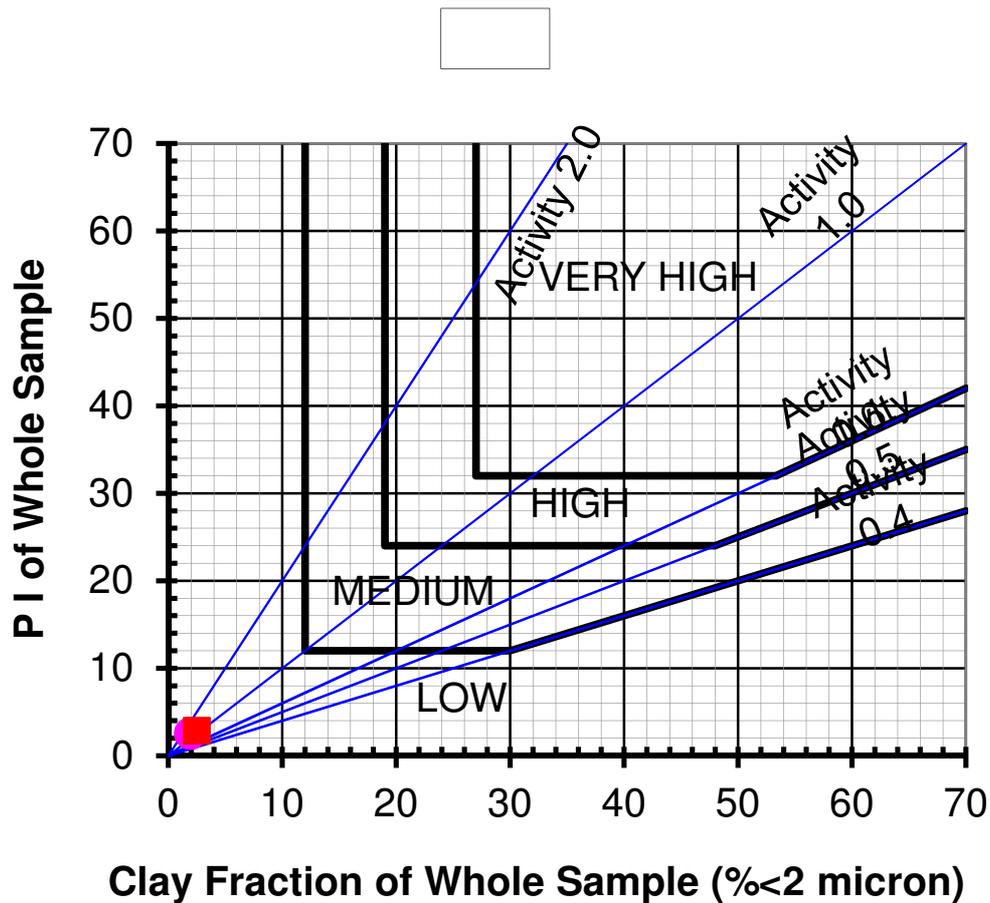
Project	Mshandukani - Impact Village		
Project No.	HP/B 302-22	Date	14 September 2011

Sample No.	45846	45847	45848	Sample No.	45846	45847	45848
Field Ref. No.	TP 2	TP 2	TP 4	%Gravel	13	14	40
Depth	0.0-2.9m	0.5-1.8m	0.1-2.9m	%Sand	62	67	49
Sieve size	%Passing	% Passing	% Passing	%Silt	17	14	10
75.00	100	100	100	%Clay	7	6	1
63.00	100	100	100	NMC %	Not Tested	Not Tested	Not Tested
53.00	100	100	100	Liquid Limit	19	28	25
37.50	100	100	100	Plasticity Index	4	11	9
26.50	100	100	100	Linear Shrink.	2.5	5.	3.5
19.00	100	100	100	Overall P.I.	2	6	2
13.20	100	100	92	Grading Modulus	1.33	1.34	1.95
4.75	97	97	72	H.R.B.	A-2-4 (0)	A-2-6 (0)	A-2-4 (0)
2.00	87	86	60	Unified	SC-SM	SC	SC
0.85	70	68	42	Weston swell (%) at 1 kPa			
0.425	53	53	29	Analysis as per method D422 of ASTM of 1985 The results reported relate only to the samples tested. Documents may only be reproduced or published in their full context.			
0.25	41	41	22				
0.15	34	34	19				
0.075	27	27	16				
0.04	20	14	7				
0.02	14	12	5				
0.006	8	8	2				
0.002	7	6	1				



Remarks:

Activity Diagram After D H van der Merwe



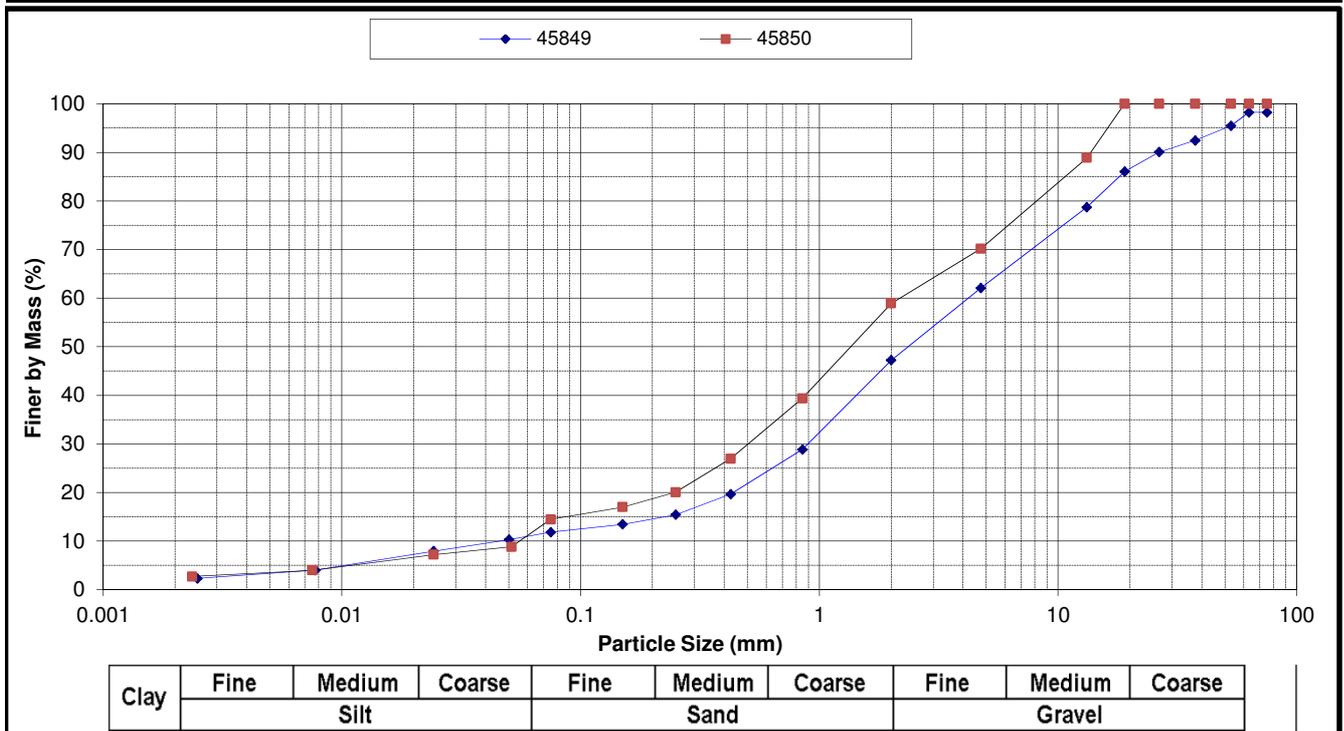
Plotted Values:

Sample	Clay Frac	PI
45849	2.0	2.5
45850	2.5	2.9

Foundation Indicator Test Data

Project	Mshandukani - Impact Village		
Project No.	HP/B 302-22	Date	14 September 2011

Sample No.	45849	45850		Sample No.	45849	45850	
Field Ref. No.	TP 5	TP 6		%Gravel	53	41	
Depth	0.3-1.2m	0.0-0.7m		%Sand	36	48	
Sieve size	%Passing	% Passing	% Passing	%Silt	9	9	
75.00	98	100		%Clay	2	3	
63.00	98	100		NMC %	Not Tested	Not Tested	
53.00	95	100		Liquid Limit	29	28	
37.50	92	100		Plasticity Index	13	11	
26.50	90	100		Linear Shrink.	6.5	5.	
19.00	86	100		Overall P.I.	3	3	
13.20	79	89		Grading Modulus	2.21	2.00	
4.75	62	70		H.R.B.	A-2-6 (0)	A-2-6 (0)	
2.00	47	59		Unified	GP-GC	SC	
0.85	29	39		Weston swell (%) at 1 kPa			
0.425	20	27		Analysis as per method D422 of ASTM of 1985 The results reported relate only to the samples tested. Documents may only be reproduced or published in their full context.			
0.25	15	20					
0.15	13	17					
0.075	12	14					
0.04	10	8					
0.02	7	7					
0.006	3	3					
0.002	2	3					



Remarks:

**APPENDIX
IV:**

Soil Movement and Foundation Design Tables

© NHBRC Home Building Manuals Part 1 and 2 (1999)

Residential site class designations

TYPICAL FOUNDING MATERIAL	CHARACTER OF FOUNDING MATERIAL	EXPECTED RANGE OF TOTAL SOIL MOVEMENTS (mm)	ASSUMED DIFFERENTIAL MOVEMENT (% OF TOTAL)	SITE CLASS
Rock (excluding mud rocks which may exhibit swelling to some depth)	STABLE	NEGLIGIBLE	-	R
Fine grained soils with moderate to very high plasticity (clays, silty clays, clayey silts and sandy clays)	EXPANSIVE SOILS	< 7,5	5	H
		7,5 – 15	0	H1
		15 – 30	%	H2
		> 30	5	H3
Silty sands, sands, sandy and gravelly soils	COMPRESSIBLE AND POTENTIALLY COLLAPSABLE	<5	7	C
		5-10	5	C1
		>10	%	C2
Fine grained soils (clayey silts and clayey sands of low plasticity), sands, sandy and gravelly soils	COMPRESSIBLE SOILS	<10	5	S S1
		10-20	0	S2
		>20	%	
Contaminated soils, Controlled fill, Dolomitic areas, Landslip, Landfill, Marshy areas Mine waste fill, mining subsidence Reclaimed areas, Uncontrolled fill, Very soft silts/silty clays	VARIABLE	VARIABLE		P

NOTE:

- 1) The classifications, C, H, R and S are not intended for dolomitic areas unless specific investigations are carried out to assess the stability (risk of sinkholes and doline formation) of the dolomites. Where the risk is found to be acceptable, the site shall be designated in accordance with the provisions of clause 2.8 of Part 1, Section 2.
- 2) Site classes are based on the assumption that differential movements, experienced by single-storey residential structures, expressed as a percentage of the total soil movements are approximately equal to 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 movement implied by the Table is equal to that which is expected in the field.
- 3) In some instances, it may be more appropriate to use a composite description to describe a site more fully 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/S1 may be described as a Class S2 site. Alternatively, a further site investigation may be necessary as the final design solution may depend on the location of the housing unit on a particular site.
- 4) 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.
- 5) 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 Class S1 or S2, as relevant and appropriate.
- 6) Sites containing contaminated soils include those associated with reclaimed mine land; land down slope of mine tailings and old land fills.
- 7) Where a site is classified as being P, full particulars relating to the founding conditions on the site must be provided.
- 8) 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 appropriate.
- 9) Certain fills may contain contaminants, which present a health risk. The nature of such fills should be evaluated and should be clearly demarcated as such

Foundation design, building procedures and precautionary measures for single storey residential structures founded on soil horizons subject to consolidation settlement.

SITE CLASS	ESTIMATED TOTAL SETTLEMENT (mm)	CONSTRUCTION TYPE	FOUNDATION DESIGN AND BUILDING PROCEDURES (Expected damage limited to Category 1)
S	< 10	Normal	Normal construction (strip footing or slab-on-the-ground) foundation. Foundation bearing pressure not to exceed 50 kPa Good site drainage
S1	10-20	Modified normal Compaction of insitu soils below individual footings Deep strip foundations Soil raft	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 insitu 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 lightly reinforced strip foundations and light reinforcement in masonry. Normal construction with drainage precautions. Founding on a competent horizon below the problem horizon. Remove insitu material to 1,0 m beyond perimeter of building to a depth 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 lightly reinforced strip footings and light reinforcement
S2	> 20	Stiffened strip footings, stiffened or cellular raft Deep strip foundations Compaction of insitu soils below individual footings Piled or pier foundations Soil raft	Stiffened strip footings or stiffened or cellular raft with lightly reinforced or articulated masonry. Bearing pressure not to exceed to 50 kPa. Mesh reinforcement in floor slabs. Site drainage and service/plumbing precautions. As for S1 but with mesh reinforcement in floor slabs. As for S1. Reinforced concrete ground beams or solid slabs on piled or pier foundations. Ground slabs with fabric reinforcement. Good site drainage. As for S1.

- NOTE:
- 1) Differential settlement equals 50% of total settlement.
 - 2) The relaxation of some of these requirements, e.g. the reduction or omission of reinforcement or articulation joints, may result in a Category 2 level of expected damage.
 - 3) Account must be taken of sloping sites where differential fill heights may lead to greater differential settlements.
 - 4) Settlements induced by loads imposed by deep filling beneath surface beds may necessitate the adoption of a construction type appropriate to a more severe site class.

**APPENDIX
V:**

Classification of Earthquakes in terms of Modified Mercalli

**Scale
Table**

© Council for
Geosciences

CLASSIFICATION OF EARTHQUAKES IN TERMS OF MODIFIED MERCALLI SCALE

SCALE	DESCRIPTION OF OUTCOMES OF QUAKE	APPROXIMATE PEAK GROUND ACCELERATIONS (g)
I	Not felt except by a very few under especially favorable circumstances.	0,001g
II	Felt only by a few persons at rest, especially on upper floors of buildings. Suspended objects may swing slightly.	0,001g - 0,002g
III	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing truck.	0,002g - 0,005g
IV	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, doors, disturbed, walls make creaking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.	0,005g - 0,01g
V	Felt by nearly everyone, many awakened. Some dishes, windows, etc. broken, a few instances of cracked plaster, unstable objects overturned. Disturbances of trees, poles and other tall objects sometimes noticed. Pendulum clocks may stop.	0,01g - 0,02g
VI	Felt by all, many are frightened and run outdoors. Some heavy furniture moved, a few instances of fallen plaster or damaged chimneys. Damage slight.	0,02g - 0,044g
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction, slight to moderate in well-built ordinary structures, considerable in poorly built or badly designed structures, some chimneys broken. Noticed by persons driving motor cars.	0,044g - 0,094g
VIII	Damage slight in specially designed structures, considerable in ordinary substantial buildings with partial collapse, great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, monuments and walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water, persons driving motor cars disturbed.	0,094g - 0,202g
IX	Damage considerable in specially designed structures, well designed frame structures thrown out of plumb, great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.	0,202g - 0,432g
X	Some well built wooden structures destroyed, most masonry and frame structures destroyed with foundations, ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water sloshed (slopped) over banks.	>0,432g
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.	
XII	Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.	