GROUNDWATER RESOURCE INFORMATION PROJECT
EASTERN CAPE PROVINCE

GROUNDWATER INFORMATION SOURCE REFERENCE SHEET

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A: SOURCE DESCRIPTION

District Municipality:	Amatole		Chris Hani	X	O.R Tambo	
	Ukhahlamba		Cacadu		Alfred Nzo	
Local Municipality:	INTSIKA YETHU					
Institution where Information is held:	SRK CONSULTING					
Branch of Institution:	East London					
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B: TYPE OF INFORMATION

Information format:	Hard copy	x	Data Summary		Electronic Report	
	Specify Other:					
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Report Nr:	313166/1		Date:	Nov-03		
Author Details:	JU DU PLOOY					
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Captured by: Karen Aylward Date: 08/06/2009 Signed: KA

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	Specify Other:					

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Hydrocensus Data		x		
Pump Testing Data	x			x
Chemical Water Analysis Data	x		x	
Geohydrological Data	x			
Spring Data				
Remote Sensing Data				
Map Data	x			

Comments:

Reviewed by: Date: Signed:

SR042

CHRIS HANI DISTRICT MUNICIPALITY

INTSIKA YETHU FEASIBILITY STUDY

Report No. 313166/1

November 2003

CHRIS HANI DISTRICT MUNICIPALITY

INTSIKA YETHU FEASIBILITY STUDY

By:

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Report No. 313166/1

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SECTION 1
INTRODUCTION AND PROJECT OBJECTIVES

1.1 INTRODUCTION

On behalf of Chris Hani District Municipality (CHDM), Camdekon Engineers appointed SRK Consulting on 27 November 2002 to conduct a hydrogeological investigation as part of the Intsika Yethu Water Supply Programme. Camdekon and the CHDM wish to obtain sufficient information on the potential of the groundwater resources of the study area to determine the most suitable and cost effective measures for water supply.

- This technical report covers **Stage 1** of the study and focus on existing information, as well as various scientific techniques such as Landsat Lineament Mapping, recharge calculations and Digital Terrain Modeling (DTM) to determine the groundwater potential and **Stage 2** exploratory drilling & testing

1.2 PROJECT OBJECTIVES

The main objectives of **stage 1** of the hydrogeological investigation were as follows:

- Determine the groundwater potential of the Intsika Yethu area. This would include the collection and evaluation of available groundwater information ;
- Compile an interim report, with accompanying GIS-based maps, outlining optimal areas for groundwater exploration;

Stage 1 represented a theoretical analysis that has been tested and refined during stage 2.

The main objectives of stage 2 of the hydrogeological investigation were as follows:

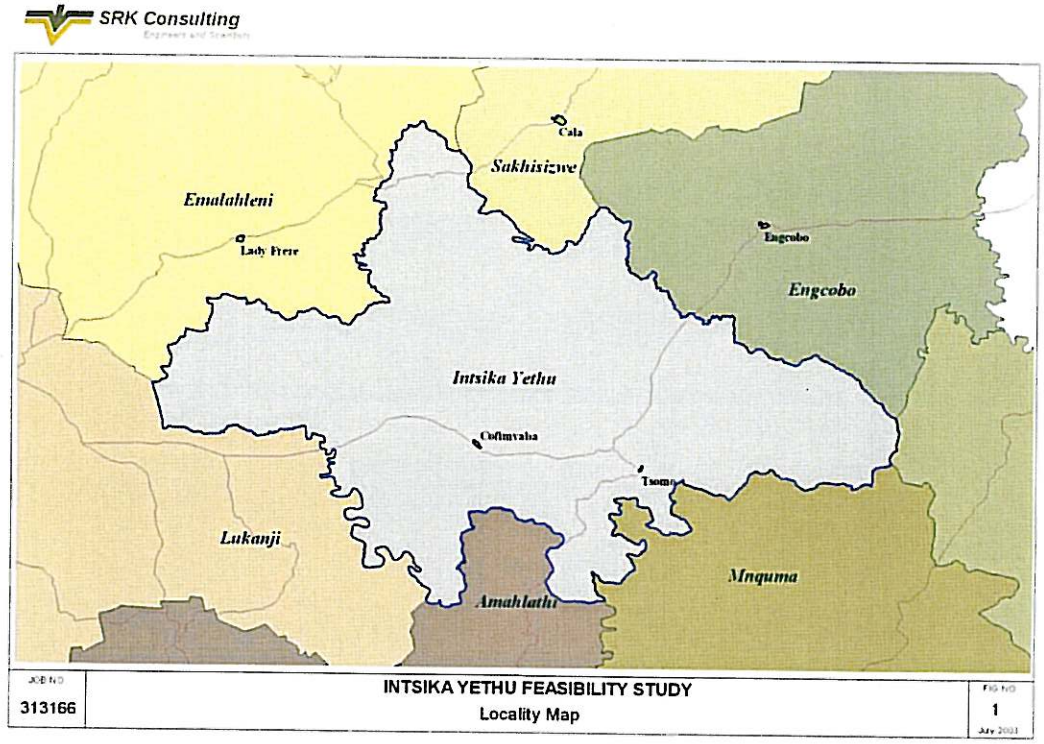
- Identification of drilling targets based on the groundwater development potential areas as defined during stage 1 of the investigation;
- Geophysical siting of exploration boreholes using recognised geophysical techniques;
- Drilling of exploration boreholes in the identified areas and;
- Yied testing of 10 selected existing boreholes as well as the successful exploration boreholes;

This report will highlight the following:

- Feasible areas for the development of groundwater sources i.e areas with a good potential for the development of a groundwater source;
- Typical water bearing features that can be targeted for the development of a groundwater source;
- Estimated development cost to establish a groundwater source in each village within the Intsika Yethu Local Municipal Area

SECTION 2
SITE LOCALITY, PHYSICAL ENVIRONMENT GEOLOGY AND HYDROGEOLOGY

Figure 1: Locality of the Intsika Yethu study area



2.1 LOCATION OF THE STUDY AREA

The study area comprises the entire Intsika Yethu Local Municipal Area and is situated in the Chris Hani District Municipality, southeast of Queenstown (See Figure 1). The study area is bordered by the Emalahleni, Sakhisizwe and Engcobo Local Municipalities in the north and the Lukhanji, Amahlathi (ADM) and Mnquma (ADM[1]) Local Municipalities in the south.

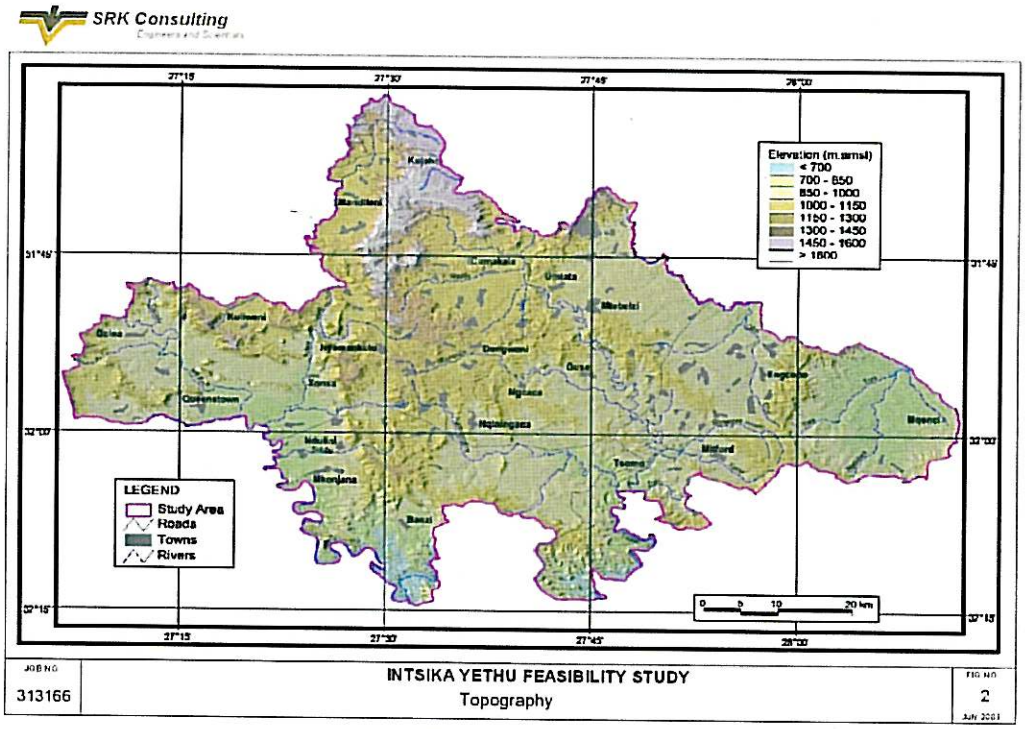
2.2 PHYSICAL ENVIRONMENT

2.2.1 Topography

The Intsika Yethu Local Municipal area is characterised by vast flat lying areas separated by Dolerite hills / mountains caused by the intrusion of dolerite ring structures. The general drainage direction in the study area is towards the south east.

[1] ADM – Amatola District Municipality

Figure 2: Topography and drainage



2.2.2 Climate

The Intsika Yethu Local Municipal Area falls in a moderate precipitation region. The Mean Annual Precipitation (MAP) in the study area varies between 400 to 800 mm per annum. The range given above is for the general study area, but localised areas of high precipitation are also present in the study area.

The mean annual surface temperature in the study area varies between 17.5°C and 20°C
(MC Smart 1998)

2.3 REGIONAL GEOLOGY AND HYDROGEOLOGY

In the Karoo rocks, groundwater occurs naturally in fractures, fissures, structures and weathered zones within rocks. The interaction of these rocks with groundwater forms the key in defining the groundwater potential. The criteria that were therefore used to define the groundwater potential of Intsika Yethu were:

- Geology & geological structures
- Drainage
- Topography
- Recharge

All the lithological units in the study area belong to the Karoo Super group. The following lithological units are present in the study area:

Molteno Formation: The Molteno formation consists of pale "glittering" fine- to coarse-grained sandstone, alternating with pale olive fine-grained mudstone lithosomes. The mudstone often grades into a dark shale. Occasional conglomerate and coal layers are also present in the Molteno formation.

Burgersdorp Formation: The Burgersdorp formation forms part of the Tarkastad sub-group and consist of alternating greenish grey to light grey, fine grained litho-feldspathic sandstone and greyish-red massive mudstone. The average thickness of the sandstone is 2 to 3 m (Sandstone zones can be up to 20 m in thickness). The thickness of the mudstone ranges from a few meters up to tens of meters

Katberg Formation: The Katberg formation forms part of the Tarkastad sub-group and consists of thick (>= 20 m) light brownish grey, greenish grey and light grey fine grained, well sorted sandstone zones with irregular layers and lenses of mudstone. Alternating with the sandstone are thinner greyish red and greenish grey massive mudstone zones interbedded with sandstone and siltstone.

Balfour Formation: The Balfour formation forms part of the Adelaide sub-group and consists of massive greenish to bluish-grey and greyish-red mudstone with sub-ordinate fine grained litho-feldspathic sandstone. The sandstone is usually grey in colour and is generally a few meters in thickness.

Quaternary Alluvium: The quaternary alluvial deposits are represented by two types of deposits. Alluvial slope deposits or sheet wash that ranges from very thin layers up to a thickness of approximately 2 meters and alluvial valley deposits or channel transported that are usually a few meters thick.

Jurassic Dolerite Intrusions: Three types of doleritic intrusions are distinguished in the Intsika Yethu area, namely:

- Ring Dykes
- Dolerite Sills (sheets)
- Linear dolerite dykes

Ring dykes form prominent, ring-shaped features and comprise positively weathered dolerite structures with the form of a cup.

Sills are sheet like forms of dolerite intrusion that tend to follow the bedding planes of the sedimentary formations concordantly.

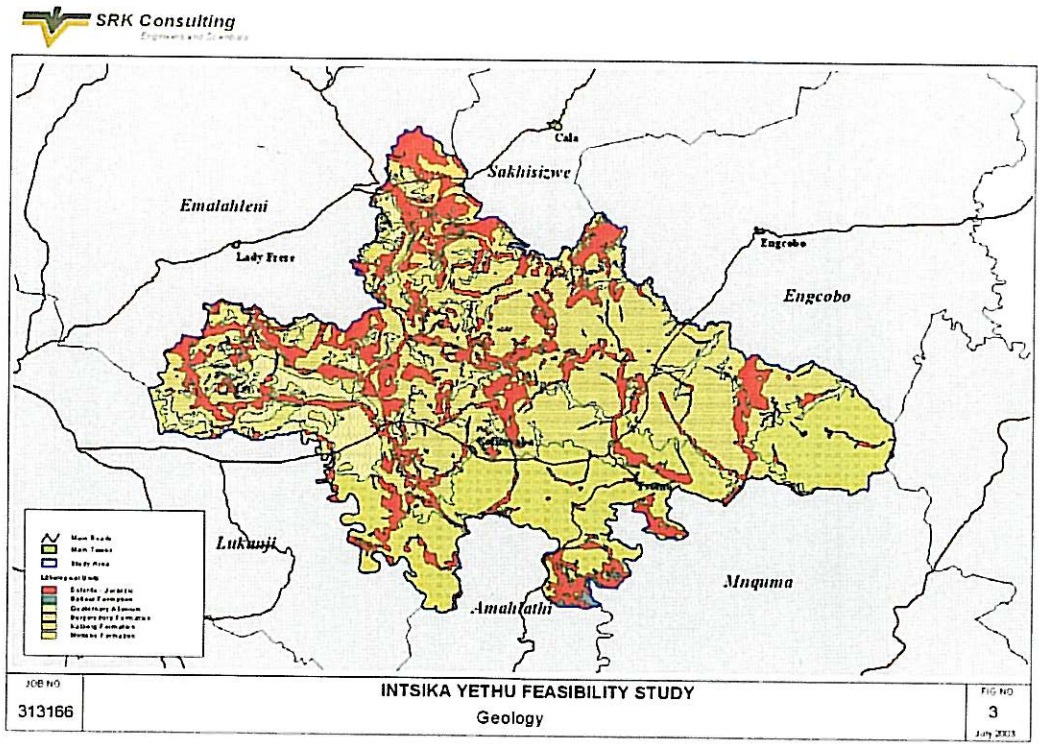
Linear dykes are considered younger than ring-dykes and sills (they are often seen cutting through the sills and ring-dykes). They are also usually thinner than the other two and seem to be confined to the Ecca and Beaufort Groups. Linear dolerite dykes have always been regarded as the major sources of groundwater in the Karoo Supergroup, partly because they are relatively easy to detect using geophysical techniques. The density of fractures within sedimentary strata is also usually higher near linear dykes than in the undisturbed sedimentary rocks.

Occurrences within the study area:

Dykes are found widespread in the Intsika Yethu Local Municipal area, with a high concentration of dykes in the northern, southern and south-eastern parts of the study area. Regional dykes, i.e. dykes that stretch over kilometres, occur in the centre of the area. Ring dykes are distinguished in the lower northern and eastern parts of Intsika Yethu. Dolerite sheets are found throughout the area and do not follow any specific pattern.

(See Figure 3)

Figure 3: Geology



SECTION 3
GROUNDWATER DEVELOPMENT POTENTIAL

3.1 INTRODUCTION

The development of a groundwater development potential model of any area requires the following input:

- Existing data, i.e. borehole information;
- Geological information (including structural information, Landsat, etc.) to identify the most suitable geological structures (for groundwater development);
- Rainfall information to determine recharge and evaporation;
- Digital Terrain Models to generate groundwater catchment areas;

The lineament mapping, DTM modelling and structural analysis are used to generate a theoretical model on the area. Existing information is then overlaid on this model to confirm and redefine the classification. Where existing information seems incorrect (eg. co-ordinates) it needs to be verified in the field and where information is absent, exploration boreholes must be drilled.

3.2 EXISTING INFORMATION

The results from boreholes already drilled vary. There seems to be no direct link between the high-yielding boreholes and the regional structures (i.e. long dykes & lineaments). Some of the highest yielding boreholes (yields > 10 l/s) were drilled on localised, relative small lineaments where yields of < 1.0 l/s would be expected.

If the correctness of the borehole coordinates is taken as correct within 400 m of the point plotted, the majority of the successful boreholes were however drilled on or near the mapped lineaments and dolerite dykes, which corresponds with the fact that dolerite dykes constitutes the main targets for groundwater development.

The fact that the water quality ranges from Good to Poor could be contributed to localised problematic areas. The Chris Hani area is not known to have problematic groundwater under natural conditions. External factors that can contribute to a poor water quality include:

- Unhygienic drilling and pump testing equipment
- Delays in the delivery of the water sample to the laboratory in time
- Cattle / other livestock (eg. Nitrate)
- Influences from nearby rivers or streams (Turbidity)
- Testing during a rainy period (Turbidity)

Where the water quality is found to be poor and no natural causes can be found (eg. geological conditions), it is suggested that these boreholes be re-tested with a dedicated borehole sampler and that the sampling protocol (as per CSIR specs) be adhered to.

3.3 GEOGRAPHICAL ASSESSMENT

The processes followed during the geographical assessment included:

- Structural mapping, including Landsat imagery (TM-5), aerial photography and geological analysis;
- Digital Terrain Model (DTM)
- Division of the area into separate groundwater catchments (units);
- Groundwater recharge calculations (based on rainfall and topography);
- Description of the groundwater development potential of each catchment.

3.3.1 Remote sensing and lineament mapping

Remote sensing and lineament mapping are used to identify suitable targets for groundwater development. These targets could include:

- Dolerite dykes;
- Dolerite sheets (weathered basins);
- Dolerite Ring Structures;
- Faults;
- Geological contact zones;
- Other linear structures that cannot easily be identified from aerial photographs and geological maps.

Once target areas have been identified, the sustainability of these targets in terms of groundwater development needs to be determined. This is done by evaluating topography, rainfall and recharge.

Figure 4a: Satellite Image of the Intsika Yethu Local Municipal area

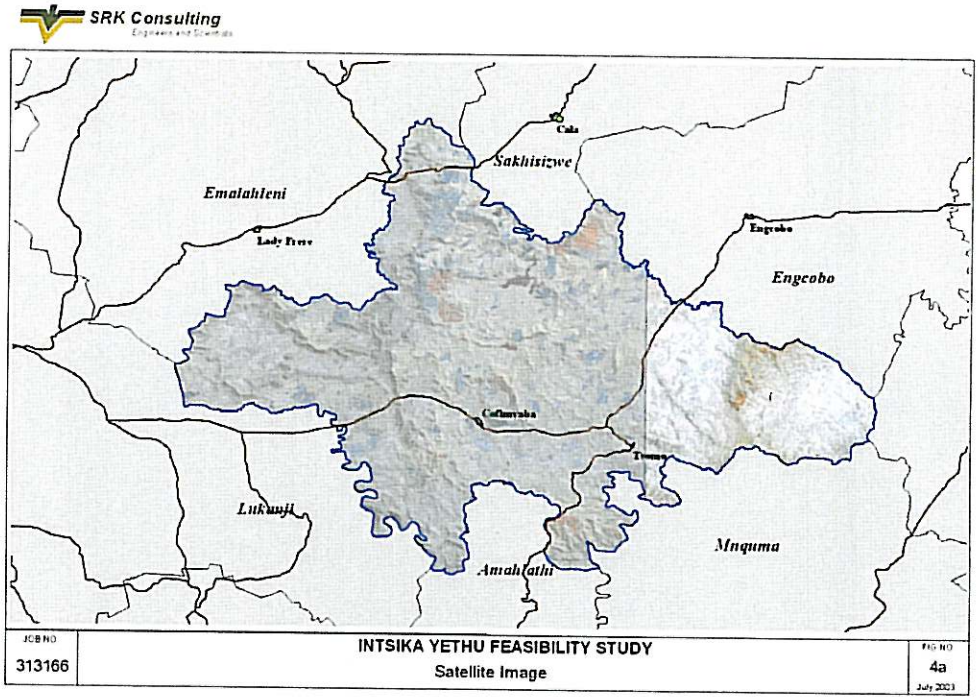
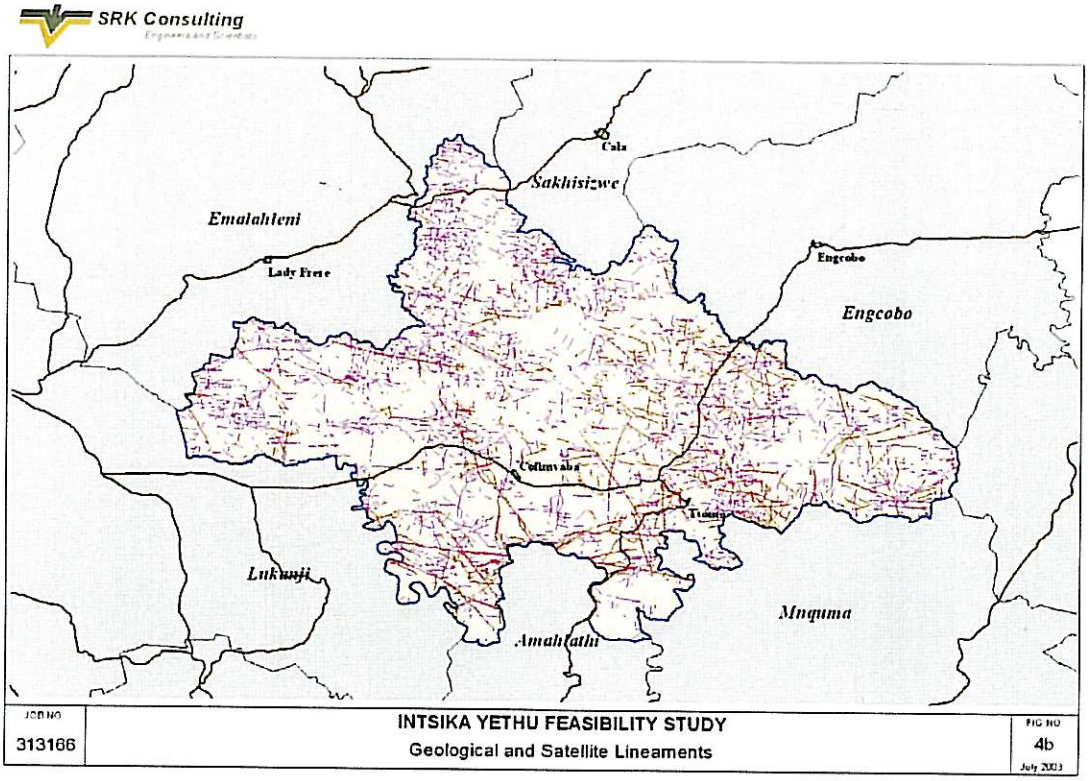


Figure 4b: Distribution of Geological and Satellite Lineaments in the Intsika Yethu Local Municipal area



3.3.2 Aquifer Recharge

Aquifer recharge refers to the amount of rainwater that infiltrates the area between the ground surface and the water table (vadose zone). The percentage of infiltration depends on the following physical factors:

- Slope (topographical setting);
- Vegetation;
- Geology (density of the sediments);
- Rainfall intensity, evaporation and;
- Water table elevation

In mountainous areas, characterised by steep slopes, the recharge from rainfall is expected to be low as the rainwater does not get the opportunity to settle and penetrate the vadose zone. Surface run-off is transported via the valleys towards the coast. In areas where the mountains fan out into fluvial floodplains, the recharge is considered to be higher. Vegetation also plays a major role in the potential for rainwater to penetrate. Figure 5 provides and indication of the recharge patterns for the study area.

Rainwater is being "soaked up" by root systems or large trees. The other extreme is where no vegetation exists and gradients are steep. The water will then just run off towards rivers and eventually into the sea.

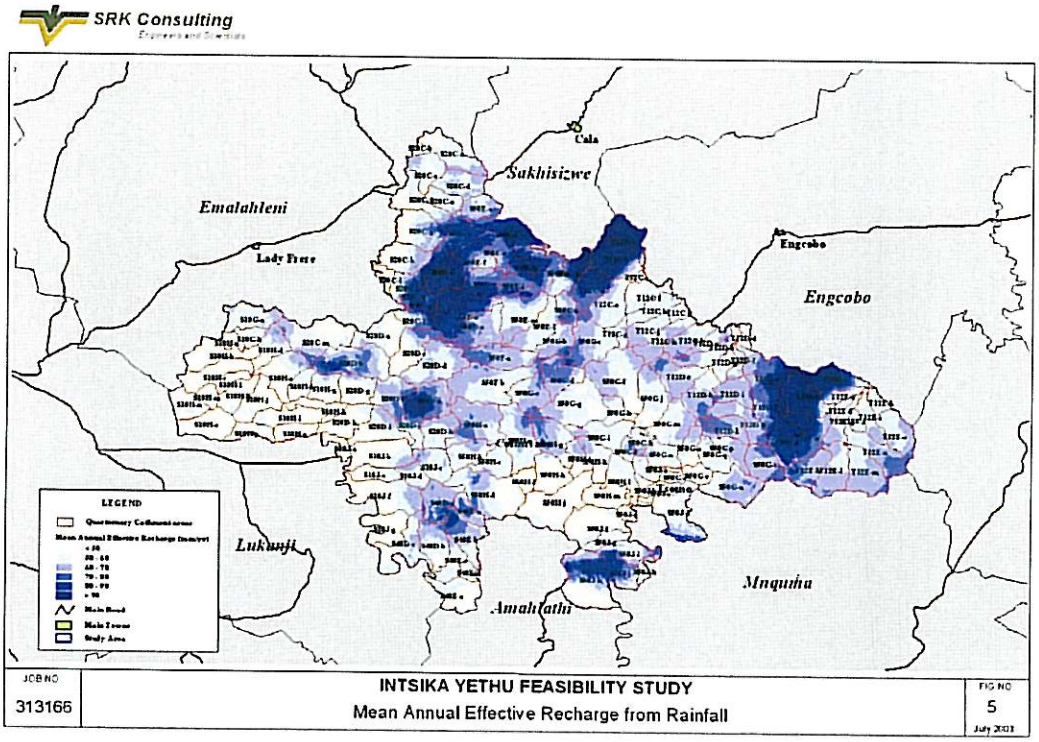
The porosity of geological units (density) also controls the rate at which the rainwater infiltrates. Generally speaking, the denser the sediments, the less recharge can be expected. The transportation of the rainwater from the surface to the water table also depends on the number of fractures in the sediments and the degree to which they are inter-linked.

For the recharge calculation the following method were used:

The mean annual effective recharge from rainfall was estimated using the MAP, Coefficient of Variance (CV) of MAP and % slope grids. The slope grid was constructed from a 25x25 grid-cell digital elevation model, which was compiled using the vector 1/50 000 scale contours of the study area.

The annual volumes of rainwater recharge within each groundwater unit was estimated using 25m x 25m cell-size grids of mean annual precipitation or MAP, Coefficient of Variance (CV) of MAP and %-slope. ArcView Spatial Analyst was used to compute the %-slope from the DTM. Table 1 in Appendix B provides a summary of the recharge calculated for each separate groundwater unit / catchment area.

Figure 5: Aquifer Recharge



3.4 GROUNDWATER DEVELOPMENT POTENTIAL

The groundwater development potential of the study area (**Figure 6**) provides a qualitative indication (i.e. low, moderate, high and very high) of the potential for siting and drilling of successful boreholes. Also, the higher the rating of an area the higher the anticipated yield of the borehole.

The groundwater development potential of the study area was qualitatively estimated using a grid-based ranking and modelling process within the GIS, where the following parameters were considered:

- Lithology: the physical and chemical character (permeability, grain size, mineralogy etc.) of the aquifer material both directly and indirectly controls the regional and local occurrence of groundwater, as well as the groundwater quality. Woodford et al (1999) studied the effects of lithology on borehole productivity in the T60 drainage basin and surrounding areas. Borehole yields in the Beaufort rocks were found to be marginally higher than those drilled in other lithological units and groups such as the Ecca and Dwyka Groups;

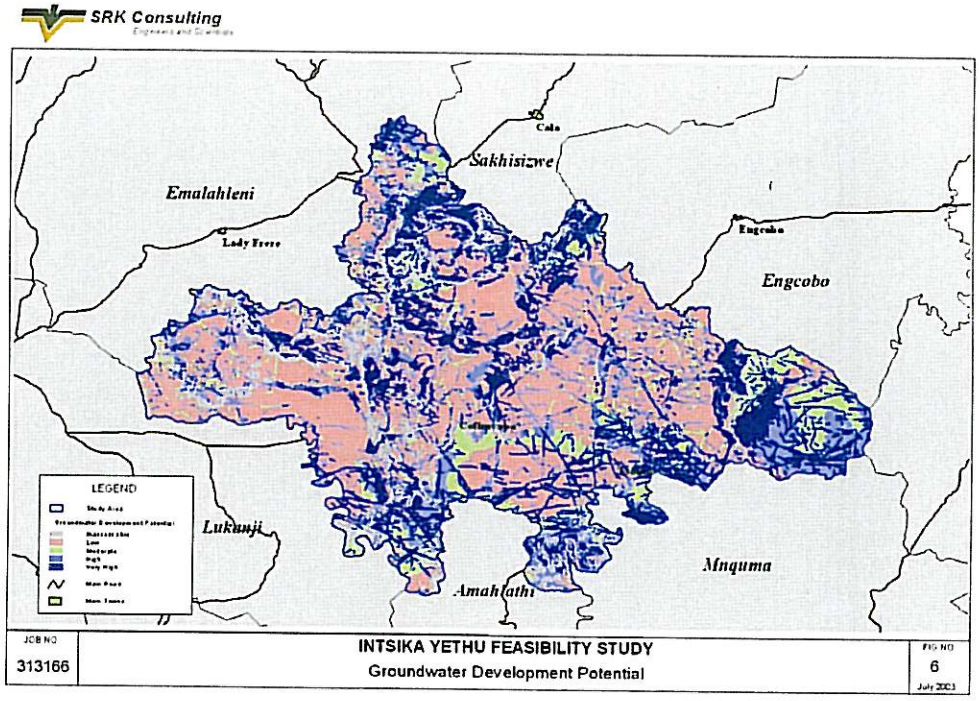
- Geological Lineaments: Numerous detailed studies have shown that boreholes drilled in the vicinity of geological lineaments (<250m) are higher-yielding than those drilled away from such structures. The mapped dolerite dykes and faults, as well as the aerial-photograph and satellite lineaments, were subdivided into four categories in terms of anticipated borehole productivity:
  - Very High: All dolerite dyke and faults and lineaments that may have been subjected to extension under both palaeo- and neo- stress regimes.
  - High: All lineaments that may have been subjected to extension with recent times.
  - Moderate: All lineaments that may have been subjected to extension under palaeo stress regimes (i.e. older than 60 Ma).
  - Low: All unclassified aerial-photograph and satellite lineaments.

In the GIS modelling process, the geological lineaments were 'buffered' by 150m in order to take into account the anticipated 'zone of influence' of these structures.

- Dolerite Sills and Ring-Structures: The positive influence of dolerite sills and especially ring-structures on borehole productivity has been studied in detail by Chevallier et al (2000). All areas underlain by dolerite sills or their associated ring-structures were considered to represent zones of moderate to high potential for the drilling of successful boreholes.

- Slope: The percentage slope of the terrain was derived from the DTM and any areas with a percentage slope in excess of 15% were regarded as inaccessible to drilling-rigs and therefore excluded from the analysis process regardless of their borehole productivity ranking.

Figure 6 – Groundwater Development potential



SECTION 4
EXPLORATION DRILLING AND YIELD TESTING

4.3 INTRODUCTION

Following the determining the different groundwater development potential areas in the Intsika Yethu Local Municipal area (Stage 1), an intensive exploration drilling and yield testing exercise was undertaken to verify and confirm the results obtained in Stage 1 of investigation. Steyns Drilling Trust and AB Pumps were appointed by the Chris Hani District Municipality to conduct the drilling and yield testing of the exploration boreholes.

4.4 TARGET SELECTION

The following targets types were identified to be drilled in stage 2 of the programme:

Dolerite Ring Structures / Dykes:

Information obtained from similar studies done on dolerite ring structures revealed that very high yielding boreholes can be associated with these ring structures. Yields in excess of 30 l/s have been found on these structures. The dolerite ring structures consist of two sills (inner – and outer sill, as well as an inclined dyke/ faults that have displaced the sill positions. The exact geometry of these structures is still being investigated in several unpublished research projects.

There are three major areas that can be targeted in the drilling of boreholes on these ring structures and include the following:

- Outer Dolerite Sheet – Fracturing in the sedimentary host rock at the bottom contact of the sheet. The fracturing is normally associated with the intrusion and cooling effect of the sheet;
- Inner Dolerite Sheet – Fracturing in the contact zone between the feeder dyke and the inner sheet as well as fracturing in the sedimentary host rock also caused by the intrusion of and the cooling effect of the sheet;
- Inclined Feeder Dyke – This is a dyke that intruded into the sheet and displaced it into an inner and outer sheet. This is associated with the fracturing of both the dolerite sheets as well as the host sedimentary rocks

Linear Dolerite Dykes:

From previous experience in the study area as well as information obtained from existing data, linear dolerite dykes always serve as very good groundwater bearing targets. Yields ranging from 1 l/s to greater than 10 l/s can be expected on these linear dykes.

The areas targeted in the drilling of linear dolerite dykes are:

- Fracturing within the dolerite dyke and;
- Weathering and fracturing on the contact zone between the dolerite and the sedimentary host rock, associated with the intrusion of the dyke.

The two target areas discussed above was identified as the major targets during the exploratory drilling phase (stage 2) of the project. Other targets that can be included in the drilling of production boreholes include the following:

Dolerite Sheets / Sills: Dolerite sills are normally intrusions that intruded into the sedimentary rock on fractures between lithological units. The sheets vary in thickness from a few meters to greater than 100 meters. The target areas include:

- Weathering and fracturing on both the bottom and top contact zones with the sedimentary host rock. The weathering and fracturing are associated with the intrusion and cooling effect of the dolerite sheet / sill.
- Fracturing within the dolerite sheet;

Lineaments: These are linear features that have been identified from satellite images as well as aerial photographs. The lineaments have different characteristics and can consist of the following:

- Fractured zones in sedimentary rocks caused by tectonic movement such as faults, folding etc. of the rock units;

Although the above mentioned structures and features also serve as good potential groundwater bearing targets, the emphasis during stage 2 of the project was placed on the dolerite ring structures and linear dolerite dykes.

4.3 EXPLORATION DRILLING AND YIELD TESTING

Borehole Drilling:

A total number of 14 exploration boreholes were drilled as part of the hydrogeological feasibility investigation. Of the 14 boreholes drilled only one borehole was dry. This gives a success rate (boreholes with an airlift yield of > 0.1 l/s) of 92 %. The average airlift yield obtained during the drilling of boreholes was 3.8 l/s with the lowest airlift yield being 0.1 l/s and highest 14 l/s. The strike depths at which the water was found varied between 9 mbgl (meters below ground level) and 164 mbgl.

The following targets proved to be successful during the drilling phase of the project:

- ✓ Inner Dolerite sill of ring structure: All the four (4) boreholes drilled on the inner sill of the dolerite ring structures yielded good water. The smaller water strikes were found on the top contact zone of the dolerite sill, while the higher yielding water strikes were found on the bottom contact and fractured sedimentary rocks below the dolerite sill. Some smaller water strikes were also found within the dolerite sill. The average yield of the boreholes drilled on the inner dolerite sheet of the dolerite ring structures is 7 l/s. The highest yielding borehole on the project (14 l/s) was also drilled on the inner sill of a dolerite ring structure.
- ✓ Linear Dolerite dykes: All six (6) boreholes drilled on the linear dolerite dykes yielded water. The depth of the water strikes varied from 9 mbgl to 40 mbgl. The biggest water strikes occurred in the dolerite dyke and are associated with the fracturing caused by the cooling of the dolerite dyke. Some water strikes were also found in the weathered and fractured zone (contact zone) between the dolerite dyke and sedimentary host rock. The average airlift yield obtained in the linear dolerite dykes is 4.1 l/s. The highest yielding borehole drilled on a linear dolerite dyke had an airlift yield of 9 l/s.

The following targets did not prove to be successful during the drilling of the exploration boreholes:

- ❖ Outer Dolerite sill of ring structure: One borehole was drilled on the outer sill of the dolerite ring structure. The borehole was very low yielding and had very shallow water strikes. The depth of the water strikes varied between 9 mbgl and 24 mbgl. The water strikes were found on the top contact of the dolerite sill with the sedimentary host rock. The yield of the borehole drilled on the outer sill was 0.2 l/s.
- ❖ Feeder dyke: Three (3) boreholes were drilled on the feeder dyke of the dolerite ring structures. Two of the boreholes were very low yielding, while the third borehole was dry. The water strikes in the two low yielding boreholes were very shallow and varied between 12 and 21 mbgl.

Table 1 below provides a summary of the boreholes drilled on the project:

Manuals / Technologic office

Table 1: Exploration Boreholes

Borehole Number	Latitude	Longitude	Depth (mbgl)	Airlift Yield (l/s)	Target
EC/S10/068	31° 54' 45.4"	27° 10' 27.9"	119	0.20	Outer Sill – Dol Ring
EC/S10/069	31° 54' 43.6"	27° 10' 39.3"	200	0.10	Feeder dyke – Dol Ring
EC/S10/070	31° 53' 35.4"	27° 11' 58.4"	60	9.00	Linear Dolerite dyke
EC/S10/071A	31° 51' 30.7"	27° 14' 57.2"	48	0.80	Linear Dolerite dyke
EC/S10/071	31° 51' 30.8"	27° 14' 55.4"	61	3.41	Linear Dolerite dyke
EC/S10/72	31° 51' 30.3"	27° 14' 57.4"	150	Dry	Feeder dyke – Dol Ring
EC/S10/073	32° 00' 22.0"	27° 22' 30.1"	92	3.41	Linear Dolerite dyke
EC/S10/074	31° 56' 17.8"	27° 20' 13.3"	217	3.50	Inner sill – Dol Ring
EC/S50/003A	32° 01' 38.0"	27° 38' 26.4"	100	0.20	Feeder dyke – Dol Ring
EC/S50/003	32° 01' 37.6"	27° 38' 24.6"	194	7.20	Inner sill – Dol Ring
EC/S20/002	31° 47' 45.5"	27° 26' 27.3"	43	1.10	Linear Dolerite dyke
EC/S20/003	31° 47' 45.3"	27° 26' 26.8"	100	7.00	Linear Dolerite dyke
EC/S20/004	31° 45' 05.3"	27° 26' 39.3"	140	14.00	Inner sill – Dol Ring
EC/S10/081	31° 54' 42.5"	27° 10' 45.4"	126	3.40	Inner sill – Dol Ring

From this it is clear that the inner sill of a dolerite ring structure, as well as linear dolerite dykes, are very good groundwater bearing targets.

Borehole Yield Testing:

As part of the Hydrogeological feasibility study 7 existing boreholes were yield tested, as well as the 8 of the exploration boreholes. Table 2 provides a summary of the boreholes yield tested.

From the 8 newly drilled boreholes yield tested 6 boreholes had a recommended yield of greater than 1.0 l/s over a 24-hr duty cycle. From the 7 existing boreholes yield tested, five had a recommended yield of greater than 0.4 l/s over a 24 hr duty cycle.

A correlation can be seen between the two strongest (Recommended yield > 1.0 l/s, 24 hr duty cycle) yielding existing boreholes and with the higher yielding exploration boreholes. The two existing boreholes were drilled on a linear dolerite dyke and on the inner sill of a dolerite ring structure, which proved to be the best and most successful targets during the exploration drilling phase.

Table 2: Borehole Yield Testing

Borehole Number	Latitude	Longitude	Recommended Yield (l/s)		Recommended Pump Depth (mbgl)	Water Quality
			8-hr yield	24-hr yield		
New Exploration Boreholes						
EC/S10/070	31° 53' 35.4"	27° 11' 58.4"	3.56	6.16	52	Ideal
EC/S10/071	31° 51' 30.8"	27° 14' 55.4"	2.70	1.56	51	Ideal
EC/S10/073	32° 00' 22.0"	27° 22' 30.1"	3.06	1.77	51	Good - Ideal
EC/S10/074	31° 56' 17.8"	27° 20' 13.3"	2.00	1.58	51	Ideal
EC/S50/003	32° 01' 37.6"	27° 38' 24.6"	2.54	1.47	164	Good [1]
EC/S20/003	31° 47' 45.3"	27° 26' 26.8"	0.96	0.56	73	Good [2]
EC/S20/004	31° 45' 05.3"	27° 26' 39.3"	4.66	8.08	64	Ideal
EC/S10/081	31° 54' 42.5"	27° 10' 45.4"	0.35	0.20	104	Ideal
Existing Boreholes						
EC/S20/007	31° 52' 32.1"	27° 23' 13.0"	0.46	0.26	63	Ideal
EC/S20/008	31° 43' 01.8"	27° 25' 58.8"	3.06	1.77	63	Ideal
EC/T12/010	31° 44' 02.0"	27° 46' 27.8"	0.79	0.46	50	Good – Ideal
EC/S10/080	32° 03' 14.0"	27° 26' 01.9"	2.01	1.16	27	Good
EC/S20/005	31° 57' 47.0"	27° 25' 57.0"	0.1	< 0.1	51	No WQ [3]
EC/S20/006	31° 57' 43.7"	27° 26' 05.5"	0.94	0.54	75	Good – Ideal
EC/T12/011	31° 57' 24.5"	27° 56' 15.2"	0.73	0.42	51	Marginal - Poor

Notes:

1 – Good water quality, but marginal values for Fluoride

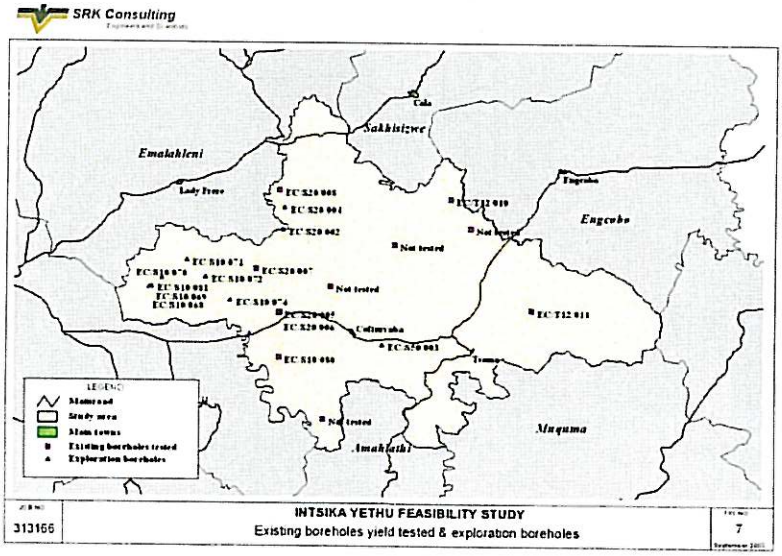
2 – Good water quality, bur marginal Bacteriological values

3 – No water sample could be taken from the borehole

Water Quality:

The general water quality obtained during the water quality analysis of the boreholes tested were Ideal to Good. The only exception was in borehole EC/T12/011 where the water quality was Marginal to Poor. A possible reason behind this can be due to poor borehole construction (absence of a sanitary seal) or on site activities (cattle grazing, informal sanitation etc.)

Figure 7 indicates the positions of the exploration boreholes drilled and yield tested as well as the existing boreholes yield tested



SECTION 5
CONCLUSIONS & RECOMMENDATIONS

5.1 CONCLUSIONS

On completion of the Intsika Yethu Hydrogeological Feasibility Study, the following conclusions can be made:

- The areas with the highest groundwater potential in the study area are concentrated in an around the areas with the highest structural intensity;
- The structures identified during the hydrogeological feasibility study with the highest potential for the development of a sustainable groundwater source, are linear dolerite dykes and the inner sill of a dolerite ring structure;
- A total number of 14 exploration boreholes were drilled as part of the project, with a 92% of the boreholes yielding higher than 0.1 l/s (airlift yield). Of these, 70% had airlift yields higher than 1.0 l/s. The highest yielding boreholes were drilled on linear dolerite dykes (average airlift yield of 4.1 l/s) and the inner sill of dolerite ring structures (average airlift yield of 7.0 l/s), thus confirming the good potential for the development of a groundwater source associated with these structures. Other targets (i.e. dolerite sills, outer dolerite sill of ring structure) also yielded successful boreholes, but their airlift yields were low;
- The water quality of the exploration boreholes drilled varied between Good and Ideal for human consumption. In one borehole slightly marginal values for fluoride and bacteria was found. None of these elements were present at a level that poses a health threat to consumers;
- From the results obtained during the feasibility study, the average development cost to deliver a sustainable yield of 1 l/s is as follows:
  - Good (High) Potential areas: R 47,000
  - Moderate Potential areas: R 80,000
  - Low Potential areas: R 120,000

5.2 RECOMMENDATIONS

The following are recommended:

- As additional funding becomes available, the targets that proved successful in the eastern and northern parts of the study area must be extended into an exploration drilling programme in the western parts of the Intsika Yethu Local Municipality.

- The aim of the exploration drilling programme was to identify structures that can produce high-yielding boreholes, but the drilling was not extended in specific areas to meet the current demand. Once groundwater projects have been identified (based on the exploration drilling results), the development of well-fields must be further investigated within the framework of the groundwater units and groundwater recharge potential of each unit.

JU du Plooy (Pr Sci Nat)
Hydrogeologist

GP Nel (Pr Sci Nat)
Principal Hydrogeologist

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Steffen, Robertson and Kirsten (South Africa) (Pty) Ltd

Report Distribution Record

Report No. : 310554/1

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M. Mbambisa	Chris Hani	3	May 2004	JU du Plooy
S. Wakeni	Intsika Yethu	4	May 2004	JU du Plooy
D. Clark	Arcus Gibb	5	May 2004	JU du Plooy
K. Maposa	DWAF	6	May 2004	JU du Plooy
HF Campbell	Camdekon	7	May 2004	JU du Plooy

Approval Signature :

APPENDIX A

- A3 Groundwater Development Potential Map (Fig 6)
- A3 Exploration boreholes drilled and yield tested (Fig 7)
- A3 Groundwater Development Areas
- A3 Borehole Yields

APPENDIX B

- Geological Borehole Logs

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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality**						
Project:	**Intsika Yethu**		Site:				
Borehole Number:	**EC/S10/068**		Logged By:	**Johan du Plooy**			
Date Commenced:	**14-04-2003**		Date Completed:	**14-04-2003**			
Longitude:	**S 31 54' 45.5"**		Latitude:	**E 27 10' 27.9"**			
Collar Height:	**200 mm**		Total Depth from surface (m):	**119**			
Diameter of Borehole			Water Strike:				
Size (mm)	From (m)	To (m)		Depth (m)	Yield (l/s)	Yield (l/h)	
305			1st	**8**			
254	**0**	**10.19**	2nd	**43**	**0.2**		
203/216			3rd				
165	**10.19**	**119**	4th				
Casing:			Water Level (m):				
Type	Size (mm)	Length (m)	Apparent quality of water:				
Steel	**177 x 4**	**10.19**	Development time (hr):				
			Standing Time (hr):				
B/hole Protection (no)			Concrete Collar (no)	**1**			
Sanitary Seal (m)			Borehole Disinfection (no)				
Borehole marking (no)	**1**		Interhole-move for >10km (km)	**102**			

State whether the borehole is:

	Successful	x	Casing left in borehole
x	Unsuccessful		Casing recovered

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Borehole Number: EC/S10/068

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	1	33		Highly Weathered Dolerite		Light Yellow Brown
2.	1	51				
3.	2	11				
4.	2	17				
5.	2	28				
6.	2	16				
7.	2	24				
8.	2	19		Medium Grained Very Hard Fractured Dolerite		Dark Grey
9.	2	39				
10.	2	43				
11.	2	40				
12.	2	44				
13.	2	58				
14.	2	51				
15.	2	59				
16.	3	04				
17.	3	17				
18.	3	34				
19.	3	29				
20.	3	24				
21.	3	18				
22.	3	21				
23.	3	17				
24.	3	20				
25.	3	27				
26.	3	31				
27.	3	44		Medium To Fine Grained Sandstone Fractured		Greyish White to Light Pink
28.	3	37				
29.	3	21				
30.	3	17				
31.	3	29				
32.	3	18				
33.	3	27				
34.	3	30				
35.	3	41				
36.	3	38				
37.	3	39				
38.	3	44				
39.	3	53				
40.	3	49				
41.	4	17		Very Fine Grained Shale very Prominent Features		Olive Green
42.	4	11				
43.	4	19				
44.	4	17		Medium Grained Fractured Dolerite Very Hard		Dark Grey
45.	4	06				
46.	4	11				
47.	4	02				
48.	3	59				
49.	3	55				
50.	3	40				
51.	3	44				
52.	3	38				
53.	3	30				
54.	3	34				
55.	3	28				
56.	3	33				
57.	3	17				
58.	3	20				
59.	3	28				
60.	3	14				

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
61	3	01				
62	3	04				
63	2	56				
64	2	51				
65	3	06				
66	3	12				
67	3	01				
68	3	54				
69	3	38				
70	4	02		Fractured, very hard dolerite coarse grained		Dark Grey
71	4	38				
72	5	02				
73	6	01				
74	6	33				
75	6	02				
76	5	41				
77	5	53				
78	6	04				
79	6	00				
80	5	48				
81	5	40				
82	5	31				
83	5	23				
84	4	00				
85	4	18				
86	4	12				
87	3	38				
88	3	57				
89	4	06				
90	3	44				
91	3	56				
92	3	09				
93	3	33				
94	3	55				
95	4	06				
96	4	14				
97	4	22				
98	4	34				
99	4	19				
100	4	12				
101	4	21				
102	4	18				
103	3	49				
104	3	51				
105	3	48				
106	3	56				
107	3	59				
108	4	06				
109	4	00				
110	3	49				
111	3	52				
112	4	11				
113	4	17				
114	4	19				
115	4	03				
116	4	11				
117	4	17				
118	4	14				
119	4	12				
120						

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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality**						
Project:	**Intsika Yethu**		Site:				
Borehole Number:	**EC/S10/070**		Logged By:	**Johan du Plooy**			
Date Commenced:	**26-04-2003**		Date Completed:	**26-04-2003**			
Longitude:	**S 31 53' 35.4"**		Latitude:	**E 27 11' 58.4"**			
Collar Height:	**200 mm**		Total Depth from surface (m):	**60**			
Diameter of Borehole			Water Strike:				
Size (mm)	From (m)	To (m)		Depth (m)	Yield (l/s)	Yield (l/h)	
305			1st	**18**	**2.55**		
254	**0**	**7.24**	2nd	**41**	**3.04**		
203/216			3rd				
165	**7.24**	**60**	4th				
Casing:			Water Level (m):				
Type	Size (mm)	Length (m)	Apparent quality of water:				
Steel	**177 x 4**	**7.24**	Development time (hr):	**1.5**			
			Standing Time (hr):				
B/hole Protection (no)	**1**		Concrete Collar (no)	**1**			
Sanitary Seal (m)	**5**		Borehole Disinfection (no)	**1**			
Borehole marking (no)	**1**		Interhole-move for >10km (km)				

State whether the borehole is:

x	Successful	x	Casing left in borehole
	Unsuccessful		Casing recovered

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Borehole Number: **EC/S10/070**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	1	01		Fine Grained highly weathered Dolerite		Light Brown
2.	1	12				
3.	1	16		Weathered and highly Fractured Dolerite		Light Brown to Grey
4.	1	48				
5.	1	59				
6.	2	09				
7.	2	44				
8.	2	47				
9.	2	36				
10.	2	31				
11.	2	39				
12.	2	44				
13.	2	51		Medium Grained Highly Fractured Dolerite		Dark Grey
14.	2	47				
15.	2	41				
16.	2	38				
17.	2	45				
18.	2	49	water			
19.	2	50				
20.	2	48				
21.	2	35				
22.	3	00				
23.	2	51				
24.	3	02				
25.	2	59		Medium Grained Fractured Dolerite		Dark Grey
26.	2	51				
27.	2	48				
28.	2	53				
29.	2	45				
30.	2	51				
31.	2	56				
32.	2	49				
33.	2	41				
34.	2	53				
35.	2	58				
36.	3	01				
37.	3	06				
38.	2	49				
39.	2	51				
40.	2	58				
41.	3	02				
42.	3	14				
43.	3	01				
44.	3	14				
45.	3	28				
46.	3	20				
47.	3	17				
48.	3	14				
49.	3	19				
50.	3	26				
51.	3	33				
52.	3	27				
53.	3	19				
54.	3	28				
55.	3	24				
56.	3	20				
57.	3	31				
58.	3	21				
59.	3	19				
60.	3	21				

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
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BOREHOLE LOG

Applicant:	Intsika Yethu District Municipality altitude 1680						
Project:	Intsika Yethu		Site:	Snow Hill 206			
Borehole Number:	EC/S10/071A		Logged By:	Johan du Plooy			
Date Commenced:	29-04-2003		Date Completed:	29-04-2003			
Longitude:	S 31 51' 30.7" 313045		Latitude:	E 27 14' 57.2" 270844			
Collar Height:	200 mm		Total Depth from surface (m):	48			
Diameter of Borehole			Water Strike:				
Size (mm)	From (m)	To (m)		Depth (m)	Yield (l/s)	Yield (l/h)	
305			1st	10			
254	0	9	2nd	0.81			
203/216			3rd				
165	9	48	4th				
Casing:			Water Level (m):				
Type	Size (mm)	Length (m)	Apparent quality of water:				
Steel	177 x 4	9	Development time (hr):				
			Standing Time (hr):				
B/hole Protection (no)			Concrete Collar (no)				
Sanitary Seal (m)			Borehole Disinfection (no)				
Borehole marking (no)			Interhole-move for >10km (km)				

State whether the borehole is:

	Successful		Casing left in borehole
x	Unsuccessful	x	Casing recovered

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Borehole Number: **EC/S10/071A**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	1	16		Fine Grained Highly Weathered Dolerite		Light Brown
2.	1	20				
3.	1	28				
4.	1	31		Medium Grained Fractured Dolerite		Dark Grey
5.	1	39				
6.	1	36				
7.	1	28				
8.	1	33				
9.	1	41				
10.	1	36	water			
11.	1	38				
12.	1	40				
13.	1	52				
14.	1	44				
15.	1	41				
16.	1	51		Fine Grained Fractured Shale		Dark Grey
17.	1	46				
18.	1	38				
19.	1	40				
20.	4	48				
21.	1	41				
22.	1	51		Fine Grained Fractured Sandstone		Light Grey
23.	1	59				
24.	1	56				
25.	2	13				
26.	2	17				
27.	2	06				
28.	1	47				
29.	1	52				
30.	1	38				
31.	1	49		Medium to Coarse Grained Fractured Dolerite		Dark Grey
32.	1	44				
33.	1	38				
34.	1	31				
35.	1	24				
36.	1	17		Fine Grained Sandstone		Light Grey
37.	1	28				
38.	1	16				
39.	1	20				
40.	1	24				
41.	1	19		Fine Grained Mudstone		Dump & Grey
42.	1	16		Fine grained Sandstone		Light Grey
43.	1	21				
44.	1	26				
45.	1	22				
46.	1	30				
47.	1	34				
48.	1	27				
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60.						

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality**						
Project:	**Intsika Yethu**		Site:				
Borehole Number:	**EC/S10/071B**		Logged By:	**Johan du Plooy**			
Date Commenced:	**1-05-2003**		Date Completed:	**1-05-2003**			
Longitude:	**S 31 51' 30.8"**		Latitude:	**E 27 14' 55.4"**			
Collar Height:	**200 mm**		Total Depth from surface (m):	**61**			
Diameter of Borehole			Water Strike:				
Size (mm)	From (m)	To (m)		Depth (m)	Yield (l/s)	Yield (l/h)	
305			1st	**10**			
254	**0**	**11**	2nd	**13**			
203/216			3rd	**19**	**2.55**		
165	**11**	**61**	4th	**43**	**3.41**		
Casing:			Water Level (m):				
Type	Size (mm)	Length (m)	Apparent quality of water:				
Steel	**177 x 4**	**11**	Development time (hr):	**1.5**			
			Standing Time (hr):				
B/hole Protection (no)	**1**		Concrete Collar (no)	**1**			
Sanitary Seal (m)	**5**		Borehole Disinfection (no)	**1**			
Borehole marking (no)	**1**		Interhole-move for >10km (km)	**17**			

State whether the borehole is:

x	Successful	x	Casing left in borehole
	Unsuccessful		Casing recovered

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Borehole Number: **EC/S10/071B**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	0	18		Soil Hill wash		Dark Brown
2.	0	20		Medium Grained Highly Fractured Dolerite		Dark Grey
3.	0	45				
4.	0	43				
5.	1	16				
6.	1	12				
7.	1	09		Fine Grained Highly Fractured Sandstone		Olive Green to Brown
8.	1	44				
9.	1	39				
10.	1	51	water	Medium Grained Slightly Fractured Dolerite		Dark Grey
11.	2	16				
12.	2	22	water			
13.	2	11		Fine Grained Slightly Fractured Sandstone		Dark Grey
14.	2	09				
15.	2	01				
16.	2	10				
17.	2	03				
18.	1	51		Medium to Fine Grained Dolerite widely Fractured		Dark Grey
19.	1	56	water	Fine Grained Sandstone		Dark Grey
20.	2	00				
21.	1	52				
22.	1	58				
23.	1	56				
24.	2	01				
25.	2	08				
26.	2	01				
27.	2	05				
28.	1	56				
29.	1	59		Medium to Fine Grained Dolerite		Dark Grey
30.	2	01				
31.	2	06		Fine Grained Slightly Fractured Sandstone		Dark to Light Grey
32.	2	11				
33.	2	16				
34.	2	03				
35.	1	56				
36.	2	01				
37.	2	06				
38.	1	51				
39.	1	58				
40.	2	06				
41.	2	14				
42.	2	19				
43.	2	09		Fine Grained Slightly Fractured Mudstone		Purple
44.	2	01				
45.	1	56				
46.	2	07				
47.	2	11				
48.	2	18				
49.	2	24				
50.	2	16				
51.	2	06				
52.	2	09				
53.	1	56				
54.	1	59				
55.	2	09				
56.	2	16		Fine Grained Sandstone		Light Grey
57.	2	22				
58.	2	07				
59.	2	12				
60.	1	51				

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
61	2	02		Fine Grained Sandstone		Light Grey
62						
63						
64						
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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality**		
Project:	**Intsika Yethu**	Site:	
Borehole Number:	**EC/S10/072**	Logged By:	**Johan du Plooy**
Date Commenced:	**02-05-2003**	Date Completed:	**02-05-2003**
Longitude:	**S 31 51' 30.3"**	Latitude:	**E 27 14' 57.4"**
Collar Height:	**200 mm**	Total Depth from surface (m):	**150**

Diameter of Borehole		
Size (mm)	From (m)	To (m)
305		
254	**0**	**10**
203/216		
165	**10**	**150**

Water Strike:			
	Depth (m)	Yield (l/s)	Yield (l/h)
1st			
2nd			
3rd			
4th			

Casing:		
Type	Size (mm)	Length (m)
Steel	**177 x 4**	**10**

Water Level (m):	
Apparent quality of water:	
Development time (hr):	
Standing Time (hr):	

B/hole Protection (no)		Concrete Collar (no)	**1**
Sanitary Seal (m)		Borehole Disinfection (no)	
Borehole marking (no)	**1**	Interhole-move for >10km (km)	**17**

State whether the borehole is:

	Successful	x	Casing left in borehole
x	Unsuccessful		Casing recovered

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Borehole Number: **EC/S10/072**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	2	29		**Clay**		**Dark Brown**
2.	2	46		**Fine Grained Weathered Dolerite**		**Yellowish**
3.	2	44				
4.	2	51				
5.	3	11				
6.	3	09				
7.	2	56				
8.	2	44				
9.	3	01		**Medium Grained Slightly Fractured Dolerite**		**Dark Grey**
10.	2	59				
11.	2	51				
12.	3	04				
13.	3	16				
14.	3	14				
15.	3	19				
16.	3	03				
17.	3	09				
18.	3	12				
19.	3	01				
20.	3	04				
21.	3	11				
22.	3	18				
23.	3	08				
24.	3	02				
25.	3	16				
26.	3	18				
27.	3	08				
28.	3	11				
29.	3	06				
30.	3	48				
31.	3	59				
32.	3	53				
33.	3	09				
34.	3	02				
35.	3	11				
36.	3	06				
37.	3	51				
38.	3	57				
39.	3	07				
40.	3	10				
41.	3	03				
42.	3	14				
43.	3	18				
44.	3	30				
45.	3	44				
46.	3	56				
47.	3	43				
48.	3	31				
49.	3	14				
50.	3	06				
51.	2	55				
52.	2	58				
53.	2	51				
54.	3	17				
55.	3	28				
56.	3	39				
57.	3	31				
58.	3	41				
59.	3	48				
60.	3	51				
61	3	48				
62	3	51				
63	3	04				
64	2	56				
65	2	48				
66	2	33				
67	2	43				
68	3	18				
69	2	40				
70	2	54				
71	2	44				
72	3	00				
73	3	14				
74	3	02				
75	3	05				
76	2	57				
77	3	16				
78	3	02				
79	3	09				
80	3	12				
81	2	48				
82	3	03				
83	3	09				
84	3	02				
85	3	05				
86	3	19				
87	3	14				
88	2	41				
89	2	36				
90	3	12		**Medium Grained Slightly Fractured Dolerite**		**Dark Grey**
91	3	06				
92	3	11				
93	3	18				
94	3	02				
95	3	56				
96	3	08				
97	3	04				
98	3	16				
99	3	24				
100	3	00				
101	2	48				
102	2	36				
103	2	39				
104	2	48				
105	3	06				
106	3	14				
107	3	02				
108	3	11				
109	2	51				
110	2	58				
111	3	04				
112	3	09				
113	2	56				
114	3	27				
115	3	20				
116	3	32				
117	3	10				
118	3	24				
119	3	18				
120	3	14				

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Borehole Number: **EC/S10/072**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
121.	3	20		**Medium Grained Slightly Fractured Dolerite**		**Dark Grey**
122.	3	26				
123.	3	14				
124.	3	10				
125.	3	17				
126.	3	21				
127.	3	20				
128.	3	48				
129.	3	35				
130.	3	31				
131.	3	30				
132.	3	26				
133.	3	22				
134.	3	33				
135.	3	31				
136.	3	26				
137.	3	30				
138.	3	20				
139.	3	12				
140.	3	19				
141.	3	26				
142.	3	17				
143.	3	22				
144.	3	19				
145.	3	23				
146.	3	18				
147.	3	21				
148.	3	20				
149.	3	28				
150.	3	33				

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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality** Farm 223						
Project:	**Intsika Yethu**		Site:	Altitude 980			
Borehole Number:	**EC/S10/073**		Logged By:	**Johan du Plooy**			
Date Commenced:	**12/04/2003**		Date Completed:	**12/04/2003**			
Longitude:	**S 32 00' 22.0"**		Latitude:	**E 27 22' 30.1"**			
Collar Height:	**200 mm**		Total Depth from surface (m):	**92**			
Diameter of Borehole			Water Strike:				
Size (mm)	From (m)	To (m)		Depth (m)	Yield (l/s)	Yield (l/h)	
305			1st	**12**			
254	**0**	**9.74**	2nd	**20**	**2.55**		
203/216			3rd	**33**	**0.9**		
165	**9.74**	**92**	4th				
Casing:			Water Level (m):				
Type	Size (mm)	Length (m)	Apparent quality of water:				
Steel	**177 x 4**	**9.74**	Development time (hr):	**1.5**			
			Standing Time (hr):				
B/hole Protection (no)	**1**		Concrete Collar (no)	**1**			
Sanitary Seal (m)	**5**		Borehole Disinfection (no)	**1**			
Borehole marking (no)	**1**		Interhole-move for >10km (km)	**60**			

State whether the borehole is:

x	Successful	x	Casing left in borehole
	Unsuccessful		Casing recovered

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Borehole Number: **EC/S10/073**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	1	31		Coarse Grained Dolerite Highly Fractured. Signs of Iron Oxidation		Dark Grey
2.	1	29				
3.	1	49				
4.	2	02				
5.	1	51				
6.	1	40				
7.	1	49				
8.	1	56				
9.	1	54				
10.	1	48		Medium to Coarse Grained Highly Fractured Dolerite. Fractures Show signs of Iron Oxidation, and Fractures are filled with Quartz		Dark Grey
11.	2	01				
12.	1	50	water			
13.	1	52				
14.	2	07				
15.	1	18				
16.	1	43				
17.	2	18				
18.	3	22				
19.	3	02				
20.	2	24	water			
21.	2	09				
22.	2	01				
23.	1	58				
24.	1	57				
25.	2	03				
26.	2	07				
27.	2	02				
28.	1	56				
29.	1	44				
30.	2	10				
31.	2	01				
32.	2	06				
33.	1	59				
34.	2	02				
35.	2	18				
36.	2	26				
37.	2	14				
38.	2	16				
39.	2	19				
40.	2	26				
41.	2	33				
42.	2	28				
43.	2	44				
44.	2	31				
45.	2	37				
46.	2	27				
47.	2	30				
48.	2	29				
49.	2	41				
50.	2	21				
51.	2	27				
52.	2	29				
53.	2	31				
54.	2	28				
55.	2	19				
56.	2	17				
57.	2	20				
58.	2	28				
59.	2	17				
60.	2	14				
61	2	19		Medium to Coarse Grained Highly Fractured Dolerite. Fractures Show signs of Iron Oxidation, and Fractures are filled with Quartz		Dark Grey
62	2	10				
63	2	16				
64	2	20				
65	2	28				
66	2	16				
67	2	10				
68	2	09				
69	2	16				
70	2	04				
71	2	08				
72	2	14				
73	2	01				
74	1	55				
75	1	48				
76	1	52				
77	1	56				
78	2	01				
79	2	04				
80	2	16				
81	2	24				
82	2	18				
83	2	26				
84	2	33				
85	2	18				
86	2	16				
87	2	25				
88	2	19				
89	2	14				
90	2	17				
91	2	28				
92	2	18				
93	2	20				
94	2	17				
95	2	22				
96	2	19				
97	2	16				
98	2	22				
99	2	19				
100	2	00				
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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality**						
Project:	**Intsika Yethu**		Site:				
Borehole Number:	**EC/S10/074**		Logged By:	**Johan du Plooy**			
Date Commenced:	**09-05-2003**		Date Completed:	**09-05-2003**			
Longitude:	**S 31 56' 17.8"**		Latitude:	**E 27 20' 13.3"**			
Collar Height:	**200 mm**		Total Depth from surface (m):	**200**			
Diameter of Borehole			Water Strike:				
Size (mm)	From (m)	To (m)		Depth (m)	Yield (l/s)	Yield (l/h)	
305			1st	**32**	**1.01**		
254	**0**	**7**	2nd	**35**	**2.5**		
203/216			3rd				
165	**7**	**200**	4th				
Casing:			Water Level (m):				
Type	Size (mm)	Length (m)	Apparent quality of water:				
Steel	**177 x 4**	**7**	Development time (hr):	**1.5**			
			Standing Time (hr):				
B/hole Protection (no)	**1**		Concrete Collar (no)	**1**			
Sanitary Seal (m)	**5**		Borehole Disinfection (no)	**1**			
Borehole marking (no)	**1**		Interhole-move for >10km (km)	**11**			

State whether the borehole is:

x	Successful	x	Casing left in borehole
	Unsuccessful		Casing recovered

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Borehole Number: **EC10/074**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	1	44		Hill wash		Brown
2.	1	20				
3.	1	51				
4.	1	55		Dolerite Medium Grained		Dark Grey
5.	2	00				
6.	2	17				
7.	2	44				
8.	2	40		Fine Grained Slightly Fractured Sandstone		Light Grey
9.	2	38				
10.	2	45				
11.	2	33				
12.	2	28				
13.	3	00				
14.	3	31				
15.	3	28				
16.	3	41				
17.	3	33				
18.	3	30				
19.	3	28				
20.	3	30				
21.	3	33				
22.	3	28				
23.	3	41				
24.	3	40				
25.	3	28				
26.	3	31		Fine Grained Sandstone Slightly Fractured		Dark Grey
27.	3	27				
28.	3	16				
29.	2	00				
30.	2	06				
31.	2	11				
32.	2	02				
33.	2	00	water			
34.	2	18				
35.	2	51				
36.	3	16				
37.	3	33	water	Medium to Coarse Grained Dolerite Slightly Fractured		Dark Grey
38.	3	38				
39.	3	27				
40.	3	20				
41.	3	14				
42.	3	44				
43.	3	30				
44.	3	41				
45.	3	28				
46.	3	44				
47.	3	59				
48.	4	00				
49.	4	02				
50.	3	51				
51.	3	48				
52.	3	31				
53.	3	28				
54.	3	30				
55.	3	47				
56.	3	41				
57.	3	40				
58.	3	45				
59.	3	48				
60.	4	00				

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
61.	4	12		Medium to Coarse Grained Dolerite Slightly Fractured		Dark Grey
62.	4	06				
63.	4	08				
64.	3	51				
65.	3	44				
66.	3	40				
67.	3	28				
68.	3	29				
69.	3	51				
70.	3	49				
71.	3	41				
72.	3	37				
73.	3	30				
74.	3	28				
75.	3	31				
76.	3	41				
77.	3	47				
78.	3	44				
79.	3	41				
80.	3	28				
81.	3	26				
82.	3	33				
83.	3	35				
84.	3	41				
85.	3	40				
86.	3	40				
87.	3	46				
88.	3	28				
89.	3	31				
90.	3	29				
91.	3	20				
92.	3	31				
93.	3	35				
94.	3	41				
95.	3	47				
96.	3	50				
97.	3	55				
98.	4	00				
99.	4	11				
100.	4	16				
101.	3	59				
102.	3	51				
103.	3	50				
104.	3	53				
105.	3	48				
106.	3	47				
107.	3	30				
108.	3	37				
109.	3	48				
110.	3	49				
111.	3	27				
112.	3	20				
113.	3	31				
114.	3	29				
115.	3	42				
116.	3	41				
117.	3	56				
118.	3	51				
119.	4	00				
120.	3	50				

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Borehole Number: **EC/S10/074**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
121.	4	07		Medium Coarse Grained Dolerite Slightly Fractured		Dark Grey
122.	4	11				
123.	4	08				
124.	4	06				
125.	4	09				
126.	4	02				
127.	4	00				
128.	3	58				
129.	3	56				
130.	3	51				
131.	3	54				
132.	4	01				
133.	4	00				
134.	3	41				
135.	3	52				
136.	3	49				
137.	3	47				
138.	4	00				
139.	4	11				
140.	3	51				
141.	3	58				
142.	3	57				
143.	3	41				
144.	3	59				
145.	4	01				
146.	4	10				
147.	4	07				
148.	4	08				
149.	4	11				
150.	4	01				
151.	3	52		Fine Grained Sandstone Slightly Fractured		Light Grey
152.	3	55				
153.	3	48				
154.	3	49				
155.	3	53				
156.	4	06				
157.	4	01				
158.	3	51				
159.	3	49				
160.	3	47				
161.	3	48				
162.	3	52				
163.	4	06				
164.	4	10				
165.	4	14				
166.	3	51				
167.	3	41				
168.	3	48				
169.	3	52		Fine Grained Mudstone		Purple
170.	3	56				
171.	3	58				
172.	4	00				
173.	4	09				
174.	3	44				
175.	3	41				
176.	3	48				
177.	3	52				
178.	3	56				
179.	4	07				
180.	4	04				

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
181.	4	06		Fine Grained Sandstone		Grey
182.	4	11				
183.	3	56				
184.	3	44				
185.	3	48				
186.	3	47				
187.	3	49		Fine Grained Slightly Fractured Mudstone		Purple and Grey
188.	3	57				
189.	3	52				
190.	4	02				
191.	4	11				
192.	4	09				
193.	3	56				
194.	3	57				
195.	4	01				
196.	4	06				
197.	3	44				
198.	3	49				
199.	3	52				
200.	3	55				
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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality**						
Project:	**Intsika Yethu**		Site:				
Borehole Number:	**EC/S10/081**		Logged By:	**Johan du Plooy**			
Date Commenced:	**27-05-2003**		Date Completed:	**27-05-2003**			
Longitude:	**S 31 54' 42.5"**		Latitude:	**E 27 10' 45.4"**			
Collar Height:	**200 mm**		Total Depth from surface (m):	**127**			
Diameter of Borehole			Water Strike:				
Size (mm)	From (m)	To (m)		Depth (m)	Yield (l/s)	Yield (l/h)	
305			1st	**73**	**1.5**		
254	**0**	**7**	2nd	**107**	**3.4**		
203/216			3rd				
165	**7**	**127**	4th				
Casing:			Water Level (m):				
Type	Size (mm)	Length (m)	Apparent quality of water:				
Steel	**177 x 4**	**7**	Development time (hr):	**1.5**			
			Standing Time (hr):				
B/hole Protection (no)	**1**		Concrete Collar (no)	**1**			
Sanitary Seal (m)	**5**		Borehole Disinfection (no)	**1**			
Borehole marking (no)	**1**		Interhole-move for >10km (km)	**62**			

State whether the borehole is:

x	Successful	x	Casing left in borehole
	Unsuccessful		Casing recovered

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Borehole Number: **EC/S10/081**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	0	46		Fine Grained Soil		Light Brown
2.	0	51		Fine Grained Slightly Fractured Sandstone		Light Grey
3.	1	09				
4.	1	14				
5.	1	26				
6.	1	22				
7.	1	20				
8.	1	18				
9.	1	24				
10.	1	21				
11.	1	17				
12.	1	24				
13.	1	20				
14.	1	26				
15.	1	23				
16.	1	22				
17.	1	24				
18.	1	25				
19.	1	21				
20.	1	28		Fine Grained Mudstone		Purple
21.	2	00				
22.	1	20				
23.	1	17				
24.	1	29				
25.	1	33				
26.	1	40				
27.	1	30				
28.	1	28				
29.	1	31				
30.	1	33				
31.	1	30				
32.	1	41				
33.	1	52		Fine Grained Slightly Fractured Sandstone		Greenish Grey
34.	2	06				
35.	2	02				
36.	2	00				
37.	2	05				
38.	1	56				
39.	1	50				
40.	1	54				
41.	1	55				
42.	1	50				
43.	1	52				
44.	1	56				
45.	2	01				
46.	2	00				
47.	1	59				
48.	1	57				
49.	2	00				
50.	1	45				
51.	1	51				
52.	1	56				
53.	2	01				
54.	1	58				
55.	1	51				
56.	1	48				
57.	1	50				
58.	1	50				
59.	1	46				
60.	1	48				
61	1	52		Fine Grained Slightly Fractured Sandstone		Greenish Grey
62	2	02				
63	2	00				
64	1	58				
65	1	59				
66	1	52				
67	1	55				
68	2	06				
69	2	00				
70	2	01				
71	2	00				
72	1	58		Medium Grained Fractured Dolerite		Dark Grey
73	1	59	water			
74	2	29				
75	3	18				
76	3	44				
77	3	27				
78	3	56				
79	4	00				
80	4	00				
81	3	58				
82	3	57				
83	4	00				
84	3	51				
85	3	49				
86	3	41				
87	3	57				
88	3	57				
89	3	50				
90	4	00				
91	4	11				
92	4	16				
93	4	12				
94	4	06				
95	4	09				
96	4	00				
97	3	51				
98	3	50				
99	3	56				
100	3	55				
101	4	00				
102	4	06				
103	4	01				
104	4	11				
105	4	10				
106	4	19				
107	4	01	water			
108	4	06		Fine Grained Slightly Fractured Shale		Greenish Grey
109	3	56				
110	3	55				
111	3	55		Fine Grained Slightly Fractured Sandstone		Light Grey
112	4	00				
113	4	00				
114	4	11				
115	4	09				
116	4	07				
117	4	01				
118	4	05				
119	4	16				
120	3	59				

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Borehole Number:												
Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour	Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
121.				**Fine Grained Slightly Fractured Sandstone**		**Light Grey**							
122.													
123.													
124.													
125.													
126.													
127.													
128.													
129.													
130.													

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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality**						
Project:	**Intsika Yethu**		Site:				
Borehole Number:	**EC/S20/002**		Logged By:	**Johan du Plooy**			
Date Commenced:	**21-05-2003**		Date Completed:	**21-05-2003**			
Longitude:	**S 31 47' 45.5"**		Latitude:	**E 27 26' 27.3"**			
Collar Height:	**200 mm**		Total Depth from surface (m):	**43**			
Diameter of Borehole			Water Strike:				
Size (mm)	From (m)	To (m)		Depth (m)	Yield (l/s)	Yield (l/h)	
305			1st	**29**	**1.1**		
254	**0**	**9**	2nd				
203/216			3rd				
165	**9**	**43**	4th				
Casing:			Water Level (m):				
Type	Size (mm)	Length (m)	Apparent quality of water:				
Steel	**177 x 4**	**9**	Development time (hr):				
			Standing Time (hr):				
B/hole Protection (no)			Concrete Collar (no)	**1**			
Sanitary Seal (m)			Borehole Disinfection (no)				
Borehole marking (no)	**1**		Interhole-move for >10km (km)	**46**			

State whether the borehole is:

	Successful	x	Casing left in borehole
x	Unsuccessful		Casing recovered

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Borehole Number: EC/S20/002

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	2	41		Highly Weathered Dolerite		Yellowish Brown
2.	2	48		Weathered and Fractured Dolerite		Brown to Grey
3.	3	35				
4.	3	49				
5.	3	58				
6.	3	43				
7.	3	56		Medium Grained Fractured Dolerite		Dark Grey
8.	4	01				
9.	3	56				
10.	3	51				
11.	3	48				
12.	3	45				
13.	3	51				
14.	3	50				
15.	3	58				
16.	4	66				
17.	4	00				
18.	3	51				
19.	3	56				
20.	3	48				
21.	3	51				
22.	3	51				
23.	3	47				
24.	3	52				
25.	3	46				
26.	3	40				
27.	3	45				
28.	4	00				
29.	4	00	water			
30.	3	51				
31.	3	56				
32.	3	40				
33.	3	38				
34.	3	40				
35.	3	29		Fine Grained Slightly Fractured Sandstone		Greenish Grey
36.	2	11				
37.	2	08		Fine Grained Mudstone		Purple
38.	1	44				
39.	1	40				
40.	1	38				
41.	1	41				
42.	1	43				
43.	1	30				
44.						
45.						
46.						
47.						
48.						
49.						
50.						
51.						
52.						
53.						
54.						
55.						
56.						
57.						
58.						
59.						
60.						

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
61						
62						
63						
64						
65						
66						
67						
68						
69						
70						
71						
72						
73						
74						
75						
76						
77						
78						
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120						

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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality**						
Project:	**Intsika Yethu**		Site:				
Borehole Number:	**EC/S20/003**		Logged By:	**Johan du Plooy**			
Date Commenced:	**22-05-2003**		Date Completed:	**14-04-2003**			
Longitude:	**S 31 47' 45.3"**		Latitude:	**E 27 26' 26.8"**			
Collar Height:	**200 mm**		Total Depth from surface (m):	**100**			
Diameter of Borehole			Water Strike:				
Size (mm)	From (m)	To (m)		Depth (m)	Yield (l/s)	Yield (l/h)	
305			1st	**41**	**1.5**		
254	**0**	**10**	2nd	**58**	**4.5**		
203/216			3rd	**68**	**7**		
165	**10.19**	**119**	4th				
Casing:			Water Level (m):				
Type	Size (mm)	Length (m)	Apparent quality of water:				
Steel	**177 x 4**	**10**	Development time (hr):	**1.5**			
			Standing Time (hr):				
B/hole Protection (no)	**1**		Concrete Collar (no)	**1**			
Sanitary Seal (m)	**5**		Borehole Disinfection (no)	**1**			
Borehole marking (no)	**1**		Interhole-move for >10km (km)	**102**			

State whether the borehole is:

x	Successful	x	Casing left in borehole
	Unsuccessful		Casing recovered

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Borehole Number: **EC/S20/003**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	3	06		Highly Weathered Dolerite		Yellowish Brown
2.	3	18		Medium Grained Weathered and Fractured Dolerite		Dark Grey
3.	3	18				
4.	3	28				
5.	3	41				
6.	3	36				
7.	3	51		Medium Grained Slightly Fractured Dolerite		Dark Grey
8.	3	47				
9.	3	28				
10.	3	36				
11.	3	30				
12.	3	41				
13.	3	45				
14.	3	31				
15.	3	38				
16.	3	29				
17.	3	36				
18.	3	41				
19.	3	56				
20.	3	49				
21.	3	44				
22.	3	41				
23.	3	40				
24.	3	40				
25.	3	28				
26.	3	37				
27.	3	40				
28.	3	28				
29.	3	30				
30.	3	31				
31.	3	29				
32.	3	41				
33.	3	40				
34.	3	36				
35.	3	28				
36.	3	31				
37.	3	28				
38.	3	20				
39.	3	28				
40.	3	41		Fine Grained Slightly Fractured Sandstone		Light Grey
41.	1	51	water			
42.	1	41				
43.	1	36				
44.	1	40				
45.	1	37				
46.	1	37		Fine Grained Mudstone		Purple
47.	1	41				
48.	1	40				
49.	1	38				
50.	1	36				
51.	1	38				
52.	1	30				
53.	1	30				
54.	1	31				
55.	1	46				
56.	1	51		Fine Grained Slightly Fractured Sandstone		Light Grey
57.	1	40				
58.	1	44	water			
59.	1	38				
60.	1	35				

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
61	1	28		Fine Grained Slightly Fractured Sandstone		Light Grey
62	1	31				
63	1	27				
64	1	30				
65	1	33		Fine Grained Mudstone		Purple
66	1	40				
67	1	26				
68	1	31	water			
69	1	33				
70	1	30				
71	1	29				
72	1	36				
73	1	28		Fine Grained Slightly Fractured Sandstone		Light Grey
74	1	38				
75	1	44				
76	1	40				
77	1	33		Fine Grained Mudstone		Purple
78	1	39				
79	1	39				
80	1	36				
81	1	28				
82	1	28				
83	1	30				
84	1	33				
85	1	32				
86	1	25		Fine Grained Slightly Fractured Sandstone		Light Grey
87	1	27				
88	1	30				
89	1	36				
90	1	33				
91	1	40				
92	1	38				
93	1	28				
94	1	33				
95	1	31				
96	1	25				
97	1	28				
98	1	35				
99	1	38				
100	1	31				
101						
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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality**		
Project:	**Intsika Yethu**	Site:	
Borehole Number:	**EC/S20/004**	Logged By:	**Johan du Plooy**
Date Commenced:	**24-05-2003**	Date Completed:	**24-05-2003**
Longitude:	**S 31 45' 05.3"**	Latitude:	**E 27 26' 39.3"**
Collar Height:	**200 mm**	Total Depth from surface (m):	**140**

Diameter of Borehole		
Size (mm)	From (m)	To (m)
305		
254	**0**	**6**
203/216		
165	**6**	**140**

Water Strike:			
	Depth (m)	Yield (l/s)	Yield (l/h)
1st	**30**	**5**	
2nd	**35**	**11**	
3rd	**60**	**14**	
4th			

Casing:		
Type	Size (mm)	Length (m)
Steel	**177 x 4**	**6**

Water Level (m):	
Apparent quality of water:	
Development time (hr):	**1.5**
Standing Time (hr):	

B/hole Protection (no)	**1**	Concrete Collar (no)	**1**
Sanitary Seal (m)	**5**	Borehole Disinfection (no)	**1**
Borehole marking (no)	**1**	Interhole-move for >10km (km)	

State whether the borehole is:

x	Successful	x	Casing left in borehole
	Unsuccessful		Casing recovered

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Borehole Number: **EC/S20/004**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	1	17		Clay		Dark Brown
2.	2	11		Fine Grained Slightly Fractured Sandstone		Light Grey
3.	2	24				
4.	2	31				
5.	2	28				
6.	2	27				
7.	2	31				
8.	3	00				
9.	2	51				
10.	2	59				
11.	3	01				
12.	2	41				
13.	2	40				
14.	2	45				
15.	2	49				
16.	2	50				
17.	2	51				
18.	2	48				
19.	2	48				
20.	3	00				
21.	3	01				
22.	3	16				
23.	3	09				
24.	3	11				
25.	3	16				
26.	3	02				
27.	3	02				
28.	3	10				
29.	3	16				
30.	2	49				
31.	2	51				
32.	2	46				
33.	2	41				
34.	2	49				
35.	2	40				
36.	2	51		Medium Grained Slightly Fractured Dolerite		Dark Grey
37.	3	06				
38.	3	02				
39.	3	01				
40.	3	16				
41.	3	12				
42.	3	18				
43.	3	17				
44.	3	12				
45.	3	01				
46.	3	00				
47.	2	59				
48.	2	51				
49.	2	55				
50.	2	51				
51.	2	58				
52.	3	00				
53.	3	00				
54.	3	06				
55.	3	16				
56.	2	58				
57.	2	06				
58.	2	41				
59.	2	49				
60.	3	00				
61	2	56		Medium Grained Slightly Fractured Dolerite		Dark Grey
62	2	49				
63	2	17				
64	2	40				
65	2	59				
66	2	55				
67	3	06				
68	3	00				
69	3	00				
70	3	02				
71	3	11				
72	3	16				
73	3	18				
74	3	12				
75	3	17				
76	3	19				
77	3	21				
78	3	16				
79	3	06				
80	2	51		Fine Grained Fractured Sandstone		Greenish Grey
81	2	50				
82	2	50				
83	2	50				
84	2	41				
85	2	48				
86	2	49				
87	2	56		Medium Grained Slightly Fractured Hard Dolerite		Dark Grey
88	2	41				
89	2	54				
90	2	56				
91	3	01				
92	3	06				
93	3	00				
94	3	00				
95	3	09				
96	3	04				
97	3	04				
98	3	11				
99	3	10				
100	3	10				
101	3	11				
102	3	02				
103	3	01				
104	2	57				
105	2	51				
106	2	58				
107	2	41				
108	2	51				
109	2	41				
110	2	41				
111	2	48				
112	2	48				
113	2	56				
114	3	00				
115	3	00				
116	3	00				
117	3	00				
118	3	06		Fine Grained Fractured Sandstone		Greenish Grey
119	3	02				
120	3	01				

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Borehole Number: **EC/S20/004**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour	Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
121.	2	51		**Fine Grained Fractured Sandstone**		**Greenish Grey**							
122.	2	50											
123.	2	50											
124.	3	06											
125.	3	16											
126.	3	10											
127.	3	10											
128.	3	11											
129.	3	09											
130.	3	16											
131.	3	16											
132.	3	12											
133.	3	10											
134.	3	07											
135.	3	05											
136.	3	16											
137.	3	12											
138.	3	16											
139.	3	16											
140.	3	21											

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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality**						
Project:	**Intsika Yethu**		Site:				
Borehole Number:	**EC/S50/003**		Logged By:	**Johan du Plooy**			
Date Commenced:	**14-05-2003**		Date Completed:	**14-05-2003**			
Longitude:	**S 31 01' 37.6"**		Latitude:	**E 27 38' 24.6"**			
Collar Height:	**200 mm**		Total Depth from surface (m):	**189**			
Diameter of Borehole			Water Strike:				
Size (mm)	From (m)	To (m)		Depth (m)	Yield (l/s)	Yield (l/h)	
305			1st	**20**	**0.2**		
254	**0**	**6**	2nd	**40**	**3.2**		
203/216			3rd	**164**	**7.2**		
165	**6**	**189**	4th				
Casing:			Water Level (m):				
Type	Size (mm)	Length (m)	Apparent quality of water:				
Steel	**177 x 4**	**6**	Development time (hr):	**1.5**			
			Standing Time (hr):				
B/hole Protection (no)	**1**		Concrete Collar (no)	**1**			
Sanitary Seal (m)	**5**		Borehole Disinfection (no)	**1**			
Borehole marking (no)	**1**		Interhole-move for >10km (km)	**45**			

State whether the borehole is:

x	Successful		Casing left in borehole
	Unsuccessful	x	Casing recovered

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Borehole Number: EC/S50/003

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	2	00		Soil Hill Wash		Dark to Reddish
2.	2	18		Highly Weathered Sandstone		Light Yellow
3.	3	17		Slightly Weathered & Fractured Sandstone		Light Beige
4.	3	19				
5.	3	28				
6.	3	36				
7.	3	28		Fine Grained Slightly Fractured Sandstone		Grey
8.	3	29				
9.	3	31				
10.	3	40				
11.	3	37				
12.	3	36				
13.	3	30				
14.	3	29				
15.	3	48				
16.	3	56				
17.	3	51				
18.	3	21				
19.	3	41		Medium to Coarse Grained Sandstone		Grey to Beige
20.	3	48	water			
21.	3	21		Fine Grained Slightly Fractured Sandstone		Grey
22.	3	14				
23.	3	19				
24.	3	17				
25.	3	28				
26.	3	38				
27.	3	41				
28.	3	21				
29.	4	29				
30.	3	48				
31.	3	51				
32.	4	07				
33.	4	01				
34.	4	10				
35.	4	06				
36.	3	48		Fine Grained Sandstone		Dark Grey
37.	3	37				
38.	3	40				
39.	3	46		Fine to Medium Grained Slightly Fractured Sandstone		Grey
40.	3	31	water			
41.	3	27				
42.	3	41				
43.	3	29				
44.	3	31				
45.	3	36				
46.	3	29				
47.	3	48				
48.	3	41				
49.	3	17				
50.	3	24		Dolerite		Blue
51.	3	17				
52.	3	30				
53.	3	26				
54.	3	38				
55.	3	41				
56.	3	40				
57.	3	31				
58.	3	37				
59.	3	30				
60.	3	26				

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
61	3	29		Dolerite		Blue
62	3	34		D		Bl
63	3	31		D		Bl
64	3	37		D		Bl
65	3	32		D		Bl
66	3	20		D		Bl
67	3	18		D		Bl
68	3	20		D		Bl
69	3	27		D		Bl
70	3	22		D		Bl
71	3	22		D		Bl
72	3	19		D		Bl
73	3	27		D		Bl
74	3	38		D		Bl
75	3	41		D		Bl
76	3	17		D		Bl
77	3	25		D		Bl
78	3	20		D		Bl
79	3	28		D		Bl
80	3	27		D		Bl
81	3	19		D		Bl
82	3	28		D		Bl
83	3	40		D		Bl
84	3	39		D		Bl
85	3	35		D		Bl
86	3	30		D		Bl
87	3	21		D		Bl
88	3	25		D		Bl
89	3	24		D		Bl
90	3	20		D		Bl
91	3	26		D		Bl
92	3	19		D		Bl
93	3	27		D		Bl
94	3	29		D		Bl
95	3	31		D		Bl
96	3	34		D		Bl
97	3	30		D		Bl
98	3	29		D		Bl
99	3	24		D		Bl
100	3	20		D		Bl
101	3	29		D		Bl
102	3	37		D		Bl
103	3	42		D		Bl
104	3	51		D		Bl
105	4	00		D		Bl
106	3	41		D		Bl
107	3	30		D		Bl
108	3	27		D		Bl
109	3	29		D		Bl
110	3	31		D		Bl
111	3	29		D		Bl
112	3	38		D		Bl
113	3	31		D		Bl
114	3	28		D		Bl
115	3	40		D		Bl
116	3	44		D		Bl
117	3	08		D		Bl
118	3	28		D		Bl
119	4	00		D		Bl
120	3	51		D		Bl

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Borehole Number: EC/S50/003

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour	Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
121.	4	00		Dolerite		Blue	181.	14	36		Sandstone		Green
122.	4	06		D		Bl	182.	14	11		Ss		G
123.	4	04		D		Bl	183.	15	09		Ss		G
124.	4	01		D		Bl	184.	14	22		Ss		G
125.	3	57		D		Bl	185.	15	12		Ss		G
126.	3	48		D		Bl	186.	14	06		Ss		G
127.	3	41		D		Bl	187.	14	09		Ss		G
128.	3	51		D		Bl	188.	15	03		Ss		G
129.	3	50		D		Bl	189.	14	48		Ss		G
130.	3	53		D		Bl	190.	14	51		Ss		G
131.	3	49		D		Bl	191.	13	12		Ss		G
132.	3	40		D		Bl	192.	15	27		Ss		G
133.	3	52		D		Bl	193.	21	40		Ss		G
134.	3	47		D		Bl	194.	20	18		Ss		G
135.	3	59		D		Bl	195.						
136.	4	06		D		Bl	196.						
137.	4	01		D		Bl	197.						
138.	4	10		D		Bl	198.						
139.	4	12		D		Bl	199.						
140.	4	14		D		Bl	200.						
141.	4	06		D		Bl							
142.	3	51		D		Bl							
143.	3	50		D		Bl							
144.	3	57		D		Bl							
145.	3	55		D		Bl							
146.	3	48		D		Bl							
147.	3	44		D		Bl							
148.	3	51		D		Bl							
149.	3	56		D		Bl							
150.	3	49		D		Bl							
151.	3	54		D		Bl							
152.	3	59		D		Bl							
153.	4	00		D		Bl							
154.	4	06		D		Bl							
155.	3	58		D		Bl							
156.	4	02		D		Bl							
157.	3	55		D		Bl							
158.	3	57		D		Bl							
159.	3	48		D		Bl							
160.	3	29		D		Bl							
161.	3	31		D		Bl							
162.	4	06		D		Bl							
163.	4	02		D		Bl							
164.	3	51		D		Bl							
165.	3	52		D		Bl							
166.	3	49		D		Bl							
167.	3	57		D		Bl							
168.	4	08		D		Bl							
169.	4	04		D		Bl							
170.	4	06		D		Bl							
171.	3	51		D		Bl							
172.	3	56		D		Bl							
173.	4	02		Sandstone		Green							
174.	14	38		Ss		G							
175.	15	25		Ss		G							
176.	8	24		Ss		G							
177.	12	46		Ss		G							
178.	14	12		Ss		G							
179.	13	11		Ss		G							
180.	15	02		Ss		G							

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BOREHOLE LOG

Applicant:	**Intsika Yethu District Municipality**						
Project:	**Intsika Yethu**		Site:				
Borehole Number:	**EC/S50/003A**		Logged By:	**Johan du Plooy**			
Date Commenced:	**11-05-2003**		Date Completed:	**11-05-2003**			
Longitude:	**S 31 01' 38.0"**		Latitude:	**E 27 38' 26.4"**			
Collar Height:	**200 mm**		Total Depth from surface (m):	**100**			
Diameter of Borehole			Water Strike:				
Size (mm)	From (m)	To (m)		Depth (m)	Yield (l/s)	Yield (l/h)	
305			1st	**17**	**0.1**		
254	**0**	**10**	2nd	**92**	**0.1**		
203/216			3rd				
165	**10**	**100**	4th				
Casing:			Water Level (m):				
Type	Size (mm)	Length (m)	Apparent quality of water:				
Steel	**177 x 4**	**10**	Development time (hr):				
			Standing Time (hr):				
B/hole Protection (no)			Concrete Collar (no)	**1**			
Sanitary Seal (m)			Borehole Disinfection (no)				
Borehole marking (no)	**1**		Interhole-move for >10km (km)				

State whether the borehole is:

	Successful		Casing left in borehole
x	Unsuccessful	x	Casing recovered

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Borehole Number: **EC/S50/003A**

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
1.	2	57		Soil Hill Wash		Dark Brown
2.	2	44		Soil with Dolerite Bolders		Reddish Brown
3.	2	56				
4.	2	50				
5.	2	58		Medium Grained Slightly Fractured Dolerite		Dark Grey
6.	2	21				
7.	3	19				
8.	3	16				
9.	3	31				
10.	3	28				
11.	3	17				
12.	3	28				
13.	3	20		Medium to Coarse Grained Slightly Fractured Dolerite		Dark Grey
14.	3	34				
15.	3	06				
16.	2	56				
17.	2	38	water			
18.	2	40				
19.	2	55				
20.	3	23				
21.	3	28				
22.	3	10				
23.	3	14				
24.	2	08				
25.	2	58				
26.	3	03				
27.	2	54				
28.	2	50				
29.	2	56				
30.	2	44				
31.	1	59				
32.	1	48				
33.	2	08				
34.	2	08				
35.	1	35				
36.	2	01				
37.	1	53				
38.	1	59				
39.	3	36				
40.	3	53				
41.	3	48				
42.	3	26				
43.	3	30				
44.	3	27				
45.	3	48				
46.	3	50				
47.	4	14				
48.	4	00				
49.	3	57				
50.	3	48				
51.	4	12				
52.	4	02				
53.	4	00				
54.	3	49				
55.	3	51				
56.	3	43				
57.	3	49				
58.	4	02				
59.	4	16				
60.	4	22				

Depth (m)	Drill Rate min	Drill Rate sec	Water Strike	Lithology	Feature	Colour
61	4	09		Medium to Coarse Grained Slightly Fractured Dolerite		Dark Grey
62	4	12				
63	4	02				
64	3	49				
65	3	45				
66	3	51				
67	3	56				
68	3	58				
69	3	47				
70	3	59				
71	4	00				
72	4	10				
73	4	14				
74	4	06				
75	4	01				
76	4	00				
77	4	10				
78	4	18				
79	4	29		Medium to Fine Grained Slightly Fractured Sandstone		Greenish Grey
80	4	38				
81	4	55				
82	5	07				
83	5	09				
84	5	11				
85	5	19				
86	5	11				
87	5	14				
88	4	44				
89	4	41				
90	4	09				
91	3	16				
92	3	10	water			
93	2	58				
94	3	06				
95	3	01				
96	2	48				
97	2	41				
98	2	58				
99	3	06				
100	3	00				
101						
102						
103						
104						
105						
106						
107						
108						
109						
110						
111						
112						
113						
114						
115						
116						
117						
118						
119						
120						

APPENDIX C

- Borehole Management Recommendations
- Water Quality Results

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Borehole Management Recommendations

Project Name:	INTSIKA YETHU WATER SUPPLY
Project Number:	313166
Borehole Number:	EC/S10/070

Yield Recommendations

24-hour duty cycle:		**12-hour duty cycle:**	
3.56 l/s		5.03 l/s	
307.35 m3/d		217.37 m3/d	
14.79	Dynamic (mbs)	15.09	Dynamic (mbs)
28.07	Critical (mbs)	28.07	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
52

Borehole Depth
60

Water Quality Recommendations

Water Quality Class: Ideal

Chemical Parameters

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Borehole Management Recommendations

Project Name:	Intsika Yethu Feasibility Study
Project Number:	313166
Borehole Number:	EC/S10/071B

Yield Recommendations

24-hour duty cycle:		**8-hour duty cycle:**	
1.56 l/s		2.70 l/s	
134.68 m3/d		77.77 m3/d	
6.89	Dynamic (mbs)	8.44	Dynamic (mbs)
19.3	Critical (mbs)	19.3	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
50.82
Borehole Depth
60.84

Water Quality Recommendations

Water Quality Class: Ideal

Chemical Parameters

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Borehole Management Recommendations

Project Name:	Intsika Yethu Water Supply
Project Number:	313166
Borehole Number:	EC/S10/074

Yield Recommendations

24-hour duty cycle:		**14-hour duty cycle:**	
1.58 l/s		2.75 l/s	
136.92 m3/d		79.07 m3/d	
13.79	Dynamic (mbs)	19.80	Dynamic (mbs)
19.55	Critical (mbs)	19.55	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
50.8

Water Quality Recommendations

Water Quality Class: Ideal

Comments

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Borehole Management Recommendations

Project Name:	Intsika Yethu Water Supply
Project Number:	313166
Borehole Number:	EC/S10/080

Yield Recommendations

24-hour duty cycle:		**8-hour duty cycle:**	
1.16 l/s		2.01 l/s	
100.34 m3/d		57.94 m3/d	
6.91	Dynamic (mbs)	8.46	Dynamic (mbs)
14.43	Critical (mbs)	14.43	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
26.8
Borehole Depth
30.78

Water Quality Recommendations

Water Quality Class: Good

Chemical Parameters

Marginal Values for Hardness and Turbidity

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Borehole Management Recommendations

Project Name:	Intsika Yethu Water Supply
Project Number:	313166
Borehole Number:	EC/S10/081

Yield Recommendations

24-hour duty cycle:		**8-hour duty cycle:**	
0.20 l/s		0.35 l/s	
17.33 m3/d		10.00 m3/d	
61.68	Dynamic (mbs)	62.31	Dynamic (mbs)
85.77	Critical (mbs)	85.77	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
104.7
Borehole Depth
126.5

Water Quality Recommendations

Water Quality Class: Ideal

Chemical Parameters

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Borehole Management Recommendations

Project Name:	Intsika Yethu Water Supply
Project Number:	313166
Borehole Number:	EC/S20/003

Yield Recommendations

24-hour duty cycle:		**8-hour duty cycle:**	
0.56 l/s		0.96 l/s	
48.11 m3/d		27.78 m3/d	
32.25	Dynamic (mbs)	36.41	Dynamic (mbs)
61.07	Critical (mbs)	61.07	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
72.78
Borehole Depth
97.76

Water Quality Recommendations

Water Quality Class: Good (Marginal Bacteriological Values)

Chemical Parameters

Marginal values for Faecal and Total Coliforms. Water will have to be treated or re-sampled before it is utilised as water source to the community

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Borehole Management Recommendations

Project Name:	Intsika Yethu Feasibility Study
Project Number:	313166
Borehole Number:	EC/S20/004

Yield Recommendations

24-hour duty cycle:		**8-hour duty cycle:**	
4.66 l/s		8.08 l/s	
402.79 m3/d		232.60 m3/d	
19.58	Dynamic (mbs)	19.24	Dynamic (mbs)
42.23	Critical (mbs)	42.23	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
57.7
Borehole Depth
63.9

Water Quality Recommendations

Water Quality Class: Ideal

Chemical Parameters

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Borehole Management Recommendations

Project Name:	Intsika Yethu Water Supply
Project Number:	313166
Borehole Number:	EC/S20/006

Yield Recommendations

24-hour duty cycle:		**8-hour duty cycle:**	
0.54 l/s		0.94 l/s	
46.94 m3/d		27.11 m3/d	
17.03	Dynamic (mbs)	17.43	Dynamic (mbs)
24.1	Critical (mbs)	24.1	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
74.82
Borehole Depth
74.82

Water Quality Recommendations

Water Quality Class: Good to Ideal

Chemical Parameters

Slightly Marginally high values for Total Hardness

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Borehole Management Recommendations

Project Name:	Intsika Yethu Water Supply
Project Number:	313166
Borehole Number:	EC S20 007

Yield Recommendations

24-hour duty cycle:		**8-hour duty cycle:**	
0.26 l/s		0.46 l/s	
22.71 m3/d		13.12 m3/d	
31.03	Dynamic (mbs)	30.33	Dynamic (mbs)
28.56	Critical (mbs)	28.56	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
62.8
Borehole Depth
65.6

Water Quality Recommendations

Water Quality Class: ideal

Chemical Parameters

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Borehole Management Recommendations

Project Name:	Intsika Yethu Water Supply
Project Number:	313166
Borehole Number:	EC/S20/008

Yield Recommendations

24-hour duty cycle:		**8-hour duty cycle:**	
1.77 l/s		3.06 l/s	
152.52 m3/d		88.08 m3/d	
15.64	Dynamic (mbs)	16.48	Dynamic (mbs)
25.96	Critical (mbs)	25.96	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
62.5
Borehole Depth
79.8

Water Quality Recommendations

Water Quality Class: Ideal

Chemical Parameters

Ideal water quality with slightly marginal values for Turbidity

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Borehole Management Recommendations

Project Name:	Intsika Yethu Water Supply
Project Number:	313166
Borehole Number:	EC/S50/003

Yield Recommendations

24-hour duty cycle:		**8-hour duty cycle:**	
1.47 l/s		2.54 l/s	
126.74 m3/d		73.18 m3/d	
29.24	Dynamic (mbs)	34.18	Dynamic (mbs)
60.1	Critical (mbs)	60.1	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
168.3
Borehole Depth
189.82

Water Quality Recommendations

Water Quality Class: Good

Chemical Parameters

Borehole has Marginal Fluoride values

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Borehole Management Recommendations

Project Name:	Intsika Yethu Water Supply
Project Number:	313166
Borehole Number:	EC/T12/010

Yield Recommendations

24-hour duty cycle:		**8-hour duty cycle:**	
0.46 l/s		0.79 l/s	
39.39 m3/d		22.75 m3/d	
12.68	Dynamic (mbs)	14.46	Dynamic (mbs)
21.02	Critical (mbs)	21.02	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
50.16
Borehole Depth
50.64

Water Quality Recommendations

Water Quality Class: Good to Ideal

Chemical Parameters

Marginal Turbidity Values

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Borehole Management Recommendations

Project Name:	Intsika Yethu Water Supply
Project Number:	313166
Borehole Number:	EC/T12/011

Yield Recommendations

24-hour duty cycle:		**8-hour duty cycle:**	
0.42 l/s		0.73 l/s	
36.45 m3/d		21.05 m3/d	
19.22	Dynamic (mbs)	26.64	Dynamic (mbs)
19.04	Critical (mbs)	19.04	Critical (mbs)

*Note: The specified yields is given as the maximum abstarction rate for each duty cycle, but water can be abstracted at rates lower than the specified rate for each duty cycle

Recommended Pump Depth
50.5
Borehole Depth
55.27

Water Quality Recommendations

Water Quality Class: Marginal to poor

Chemical Parameters

Marginal values for Conductivity (EC), Nitrate (N) and Sodium (Na). Poor value for Total Hardness. Water will require treatment before used as water source.

DATE	24/09/03
PROJECT	INTSIKA YETHU WATER SUPPLY
PROJECT NUMBER	313166
SAMPLE ID	**EC/S10/070**

Alternative ID:

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Element	*Unit*	Value	*Ideal (B)*	*Good Class 1 (G)*	*Marginal Class 2 (Y)*	*Poor Class 3 (R)*	*Un- acceptable Class 4 (P)*	Result
pH (lower range)	Units	**7.07**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**63**	< 70	70 - 150	150 - 370	370 - 520	> 520	Ideal
Turbidity	NTU	**0.2**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Good
Ammonia (as N)	mg/l			< 2	2 - 10	> 10		
Nitrate (as N)	mg/l	**10**	< 6	6 - 10	10 - 20	20 - 40	> 40	Good
Chloride (as Cl)	mg/l	**23**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Ideal
Sulphate (as SO4)	mg/l	**11**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**39**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Ideal
Calcium (as Ca)	mg/l	**48**	0 - 80	80 - 150	150 - 300	> 300		Ideal
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**236**	< 200	200 - 300	300 - 600	> 600		Good
Potassium (as K)	mg/l	**0.72**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**0.29**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Ideal
Iron (as Fe)	mg/l	**0.001**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**2**	0	0 - 10	10 - 100	100 - 1000	> 1000	Ideal
Faecal Coliforms	No/100 ml	**0**	0	0 - 1	1 - 10	10 - 100	> 100	Ideal
						Recommended Class		Ideal

NOTES

Above analysis is based on "Quality of Domestic Water Supplies - Volume 1: Assessment Guide, second edition 1998" published jointly by:

* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission

DATE	06/06/03
PROJECT	Intsika Yethu Feasibility Study
PROJECT NUMBER	313166
SAMPLE ID	**EC/S10/071B**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**7.56**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**44**	< 70	70 - 150	150 - 370	370 - 520	> 520	Ideal
Turbidity	NTU	**1**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Good
Ammonia (as N)	mg/l	**0.06**		< 2	2 - 10	> 10		Good
Nitrate (as N)	mg/l	**1**	< 6	6 - 10	10 - 20	20 - 40	> 40	Ideal
Chloride (as Cl)	mg/l	**13**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Ideal
Sulphate (as SO4)	mg/l	**13**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**26**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Ideal
Calcium (as Ca)	mg/l	**33**	0 - 80	80 - 150	150 - 300	> 300		Ideal
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**19**	< 70	70 - 100	100 - 200	200 - 400	> 400	Ideal
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**160**	< 200	200 - 300	300 - 600	> 600		Ideal
Potassium (as K)	mg/l	**0.91**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**0.56**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Ideal
Iron (as Fe)	mg/l	**0.288**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**0**	0	0 - 10	10 - 100	100 - 1000	> 1000	Ideal
Faecal Coliforms	No/100 ml	**0**	0	0 - 1	1 - 10	10 - 100	> 100	Ideal
						Recommended Class		Ideal

NOTES

Above analysis is based on "Quality of Domestic Water Supplies - Volume 1: Assessment Guide, second edition 1998" published jointly by:

* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission

DATE	04/06/03
PROJECT	Intsika Yethu Water Supply
PROJECT NUMBER	313166
SAMPLE ID	**EC/S10/074**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**7.6**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**57**	< 70	70 - 150	150 - 370	370 - 520	> 520	Ideal
Turbidity	NTU	**0.56**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Good
Ammonia (as N)	mg/l	**0.11**		< 2	2 - 10	> 10		Good
Nitrate (as N)	mg/l	**0.37**	< 6	6 - 10	10 - 20	20 - 40	> 40	Ideal
Chloride (as Cl)	mg/l	**49**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Ideal
Sulphate (as SO4)	mg/l	**4.7**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**61**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Ideal
Calcium (as Ca)	mg/l	**28**	0 - 80	80 - 150	150 - 300	> 300		Ideal
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**22**	< 70	70 - 100	100 - 200	200 - 400	> 400	Ideal
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**161**	< 200	200 - 300	300 - 600	> 600		Ideal
Potassium (as K)	mg/l	**0.96**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**0.45**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Ideal
Iron (as Fe)	mg/l	**0.146**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**0**	0	0 - 10	10 - 100	100 - 1000	> 1000	Ideal
Faecal Coliforms	No/100 ml	**0**	0	0 - 1	1 - 10	10 - 100	> 100	Ideal
						Recommended Class		Ideal

NOTES

Above analysis is based on "Quality of Domestic Water Supplies - Volume 1: Assessment Guide, second edition 1998" published jointly by:

- The Department of Water Affairs and Forestry
- The Department of Health
- Water Research Commission

DATE	06/06/03
PROJECT	Intsika Yethu Water Supply
PROJECT NUMBER	313166
SAMPLE ID	**EC/S10/080**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**7.44**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**122**	< 70	70 - 150	150 - 370	370 - 520	> 520	Good
Turbidity	NTU	**2.2**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Marginal
Ammonia (as N)	mg/l	**0.1**		< 2	2 - 10	> 10		Ideal
Nitrate (as N)	mg/l	**8.2**	< 6	6 - 10	10 - 20	20 - 40	> 40	Good
Chloride (as Cl)	mg/l	**145**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Good
Sulphate (as SO4)	mg/l	**44**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**128**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Good
Calcium (as Ca)	mg/l	**58**	0 - 80	80 - 150	150 - 300	> 300		
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**51**	< 70	70 - 100	100 - 200	200 - 400	> 400	Good
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**355**	< 200	200 - 300	300 - 600	> 600		Marginal
Potassium (as K)	mg/l	**5.7**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**0.81**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Good
Iron (as Fe)	mg/l	**<0.1**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**0**	0	0 - 10	10 - 100	100 - 1000	> 1000	Ideal
Faecal Coliforms	No/100 ml	**0**	0	0 - 1	1 - 10	10 - 100	> 100	Ideal
						Recommended Class		Good

NOTES

Above analysis is based on "Quality of Domestic Water Supplies - Volume 1: Assessment Guide, second edition 1998" published jointly by:

* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission

DATE	13/06/03
PROJECT	Intsika Yethu Water Supply
PROJECT NUMBER	313166
SAMPLE ID	**EC/S10/081**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**7.01**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**74**	< 70	70 - 150	150 - 370	370 - 520	> 520	Good
Turbidity	NTU	**0.88**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Good
Ammonia (as N)	mg/l	**0.02**		< 2	2 - 10	> 10		Ideal
Nitrate (as N)	mg/l	**0.07**	< 6	6 - 10	10 - 20	20 - 40	> 40	Ideal
Chloride (as Cl)	mg/l	**201**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Good
Sulphate (as SO4)	mg/l	**27**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**89**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Ideal
Calcium (as Ca)	mg/l	**37**	0 - 80	80 - 150	150 - 300	> 300		Ideal
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**4.3**	< 70	70 - 100	100 - 200	200 - 400	> 400	Ideal
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**110**	< 200	200 - 300	300 - 600	> 600		Ideal
Potassium (as K)	mg/l	**0.51**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**<0.04**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Ideal
Iron (as Fe)	mg/l	**0.266**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**0**	0	0 - 10	10 - 100	100 - 1000	> 1000	Ideal
Faecal Coliforms	No/100 ml	**0**	0	0 - 1	1 - 10	10 - 100	> 100	Ideal
							Recommended Class	Ideal

NOTES

Above analysis is based on "Quality of Domestic Water Supplies - Volume 1: Assessment Guide, second edition 1998" published jointly by:

* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission

DATE	08/06/03
PROJECT	Intsika Yethu Water Supply
PROJECT NUMBER	313166
SAMPLE ID	**EC/S20/003**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**7.61**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**43**	< 70	70 - 150	150 - 370	370 - 520	> 520	Ideal
Turbidity	NTU	**0.31**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Good
Ammonia (as N)	mg/l	**0.05**		< 2	2 - 10	> 10		Ideal
Nitrate (as N)	mg/l	**1.2**	< 6	6 - 10	10 - 20	20 - 40	> 40	Ideal
Chloride (as Cl)	mg/l	**13**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Ideal
Sulphate (as SO4)	mg/l	**9.6**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**26**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Ideal
Calcium (as Ca)	mg/l	**36**	0 - 80	80 - 150	150 - 300	> 300		Ideal
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**17**	< 70	70 - 100	100 - 200	200 - 400	> 400	Ideal
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**160**	< 200	200 - 300	300 - 600	> 600		Ideal
Potassium (as K)	mg/l	**1.3**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**0.39**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Ideal
Iron (as Fe)	mg/l	**0.116**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**66**	0	0 - 10	10 - 100	100 - 1000	> 1000	Marginal
Faecal Coliforms	No/100 ml	**13**	0	0 - 1	1 - 10	10 - 100	> 100	Marginal
						Recommended Class		Good (Marginal Bacteriological Values)

NOTES

Above analysis is based on "Quality of Domestic Water Supplies - Volume 1: Assessment Guide, second edition 1998" published jointly by:

* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission

DATE	June 2003
PROJECT	Intsika Yethu Feasibility Study
PROJECT NUMBER	313166
SAMPLE ID	**EC/S20/004**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**7.55**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**50**	< 70	70 - 150	150 - 370	370 - 520	> 520	Ideal
Turbidity	NTU	**0.72**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Good
Ammonia (as N)	mg/l	**0.1**		< 2	2 - 10	> 10		Good
Nitrate (as N)	mg/l	**0.28**	< 6	6 - 10	10 - 20	20 - 40	> 40	Ideal
Chloride (as Cl)	mg/l	**14**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Ideal
Sulphate (as SO4)	mg/l	**3**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**39**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Ideal
Calcium (as Ca)	mg/l	**35**	0 - 80	80 - 150	150 - 300	> 300		Ideal
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**18**	< 70	70 - 100	100 - 200	200 - 400	> 400	Ideal
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**151**	< 200	200 - 300	300 - 600	> 600		Ideal
Potassium (as K)	mg/l	**0.71**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**0.65**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Ideal
Iron (as Fe)	mg/l	**0.269**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**1**	0	0 - 10	10 - 100	100 - 1000	> 1000	Good
Faecal Coliforms	No/100 ml	**1**	0	0 - 1	1 - 10	10 - 100	> 100	Good
						Recommended Class		Ideal

NOTES

Above analysis is based on "Quality of Domestic Water Supplies - Volume 1: Assessment Guide, second edition 1998" published jointly by:

* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission

DATE	31/05/03
PROJECT	Intsika Yethu Water Supply
PROJECT NUMBER	313166
SAMPLE ID	**EC/S20/006**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**7.24**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**87**	< 70	70 - 150	150 - 370	370 - 520	> 520	Good
Turbidity	NTU	**0.45**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Good
Ammonia (as N)	mg/l	**0.11**		< 2	2 - 10	> 10		Good
Nitrate (as N)	mg/l	**6.1**	< 6	6 - 10	10 - 20	20 - 40	> 40	Good
Chloride (as Cl)	mg/l	**80**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Ideal
Sulphate (as SO4)	mg/l	**32**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**62**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Ideal
Calcium (as Ca)	mg/l	**67**	0 - 80	80 - 150	150 - 300	> 300		Ideal
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**38**	< 70	70 - 100	100 - 200	200 - 400	> 400	Ideal
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**323**	< 200	200 - 300	300 - 600	> 600		Marginal
Potassium (as K)	mg/l	**0.87**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**0.68**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Ideal
Iron (as Fe)	mg/l	**0.154**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**5**	0	0 - 10	10 - 100	100 - 1000	> 1000	Good
Faecal Coliforms	No/100 ml	**0**	0	0 - 1	1 - 10	10 - 100	> 100	Ideal
						Recommended Class		Good to Ideal

NOTES

Above analysis is based on "Quality of Domestic Water Supplies - Volume 1: Assessment Guide, second edition 1998" published jointly by:

* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission

DATE	08/06/03
PROJECT	Intsika Yethu Water Supply
PROJECT NUMBER	313166
SAMPLE ID	**EC S20 007**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**7.26**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**36**	< 70	70 - 150	150 - 370	370 - 520	> 520	Ideal
Turbidity	NTU	**0.46**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Good
Ammonia (as N)	mg/l	**0.05**		< 2	2 - 10	> 10		Ideal
Nitrate (as N)	mg/l	**0.61**	< 6	6 - 10	10 - 20	20 - 40	> 40	Ideal
Chloride (as Cl)	mg/l	**18**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Ideal
Sulphate (as SO4)	mg/l	**12**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**30**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Ideal
Calcium (as Ca)	mg/l	**27**	0 - 80	80 - 150	150 - 300	> 300		Ideal
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**12**	< 70	70 - 100	100 - 200	200 - 400	> 400	Ideal
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**116**	< 200	200 - 300	300 - 600	> 600		Ideal
Potassium (as K)	mg/l	**0.36**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**0.4**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Ideal
Iron (as Fe)	mg/l	**0.178**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**0**	0	0 - 10	10 - 100	100 - 1000	> 1000	Ideal
Faecal Coliforms	No/100 ml	**0**	0	0 - 1	1 - 10	10 - 100	> 100	Ideal
						Recommended Class		ideal

NOTES

Above analysis is based on "Quality of Domestic Water Supplies - Volume 1: Assessment Guide, second edition 1998" published jointly by:

* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission

DATE	10/06/03
PROJECT	Intsika Yethu Water Supply
PROJECT NUMBER	313166
SAMPLE ID	**EC/S20/008**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**7.3**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**58**	< 70	70 - 150	150 - 370	370 - 520	> 520	Ideal
Turbidity	NTU	**2.4**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Marginal
Ammonia (as N)	mg/l	**0.11**		< 2	2 - 10	> 10		Ideal
Nitrate (as N)	mg/l	**2.6**	< 6	6 - 10	10 - 20	20 - 40	> 40	Ideal
Chloride (as Cl)	mg/l	**28**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Ideal
Sulphate (as SO4)	mg/l	**35**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**39**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Ideal
Calcium (as Ca)	mg/l	**49**	0 - 80	80 - 150	150 - 300	> 300		Ideal
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**24**	< 70	70 - 100	100 - 200	200 - 400	> 400	Ideal
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**221**	< 200	200 - 300	300 - 600	> 600		Good
Potassium (as K)	mg/l	**0.93**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**0.36**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Ideal
Iron (as Fe)	mg/l	**0.161**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**0**	0	0 - 10	10 - 100	100 - 1000	> 1000	Ideal
Faecal Coliforms	No/100 ml	**0**	0	0 - 1	1 - 10	10 - 100	> 100	Ideal
						Recommended Class		Ideal

NOTES

Above analysis is based on "Quality of Domestic Water Supplies - Volume 1: Assessment Guide, second edition 1998" published jointly by:

* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission

DATE	18/06/03
PROJECT	Intsika Yethu Water Supply
PROJECT NUMBER	313166
SAMPLE ID	**EC/S50/003**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**7.79**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**44.4**	< 70	70 - 150	150 - 370	370 - 520	> 520	Ideal
Turbidity	NTU	**0.5**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Good
Ammonia (as N)	mg/l			< 2	2 - 10	> 10		
Nitrate (as N)	mg/l	**0.3**	< 6	6 - 10	10 - 20	20 - 40	> 40	Ideal
Chloride (as Cl)	mg/l	**73**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Ideal
Sulphate (as SO4)	mg/l	**2.4**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**71**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Ideal
Calcium (as Ca)	mg/l	**18**	0 - 80	80 - 150	150 - 300	> 300		Ideal
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**6.2**	< 70	70 - 100	100 - 200	200 - 400	> 400	Ideal
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**70**	< 200	200 - 300	300 - 600	> 600		Ideal
Potassium (as K)	mg/l	**0.25**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**1.43**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Marginal
Iron (as Fe)	mg/l	**0.11**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml	**800**						
Total Coliforms	No/100 ml	**0**	0	0 - 10	10 - 100	100 - 1000	> 1000	Ideal
Faecal Coliforms	No/100 ml	**0**	0	0 - 1	1 - 10	10 - 100	> 100	Ideal
						Recommended Class		Good

NOTES

Above analysis is based on "Quality of Domestic Water Supplies - Volume 1: Assessment Guide, second edition 1998" published jointly by:

* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission

DATE	14/06/03
PROJECT	Intsika Yethu Water Supply
PROJECT NUMBER	313166
SAMPLE ID	**EC/T12/010**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**7.4**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**20**	< 70	70 - 150	150 - 370	370 - 520	> 520	Ideal
Turbidity	NTU	**2.4**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Marginal
Ammonia (as N)	mg/l	**0.03**		< 2	2 - 10	> 10		Good
Nitrate (as N)	mg/l	**1.7**	< 6	6 - 10	10 - 20	20 - 40	> 40	Ideal
Chloride (as Cl)	mg/l	**12**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Ideal
Sulphate (as SO4)	mg/l	**27**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**23**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Ideal
Calcium (as Ca)	mg/l	**15**	0 - 80	80 - 150	150 - 300	> 300		Ideal
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**4.7**	< 70	70 - 100	100 - 200	200 - 400	> 400	Ideal
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**56**	< 200	200 - 300	300 - 600	> 600		Ideal
Potassium (as K)	mg/l	**0.6**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**0.3**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Ideal
Iron (as Fe)	mg/l	**<0.1**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**0**	0	0 - 10	10 - 100	100 - 1000	> 1000	Ideal
Faecal Coliforms	No/100 ml	**0**	0	0 - 1	1 - 10	10 - 100	> 100	Ideal
						Recommended Class		Good to Ideal

NOTES

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* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission

DATE	15/06/03
PROJECT	Intsika Yethu Water Supply
PROJECT NUMBER	313166
SAMPLE ID	**EC/T12/011**

Alternative ID:

SRK Consulting
Engineers and Scientists

Element	Unit	Value	Ideal (B)	Good Class 1 (G)	Marginal Class 2 (Y)	Poor Class 3 (R)	Un- acceptable Class 4 (P)	Result
pH (lower range)	Units	**6.94**	5 - 9.5	4.5 - 5	4 - 4.5	3 - 4	< 3	Ideal
				9.5 - 10	10 - 10.5	10.5 - 11	> 11	
Conductivity	mS/m	**273**	< 70	70 - 150	150 - 370	370 - 520	> 520	Marginal
Turbidity	NTU	**0.43**	< 0.1	0.1 - 1	1 - 20	20 - 50	> 50	Good
Ammonia (as N)	mg/l	**0.11**		< 2	2 - 10	> 10		Good
Nitrate (as N)	mg/l	**13**	< 6	6 - 10	10 - 20	20 - 40	> 40	Marginal
Chloride (as Cl)	mg/l	**194**	< 100	100 - 200	200 - 600	600 - 1200	> 1200	Good
Sulphate (as SO4)	mg/l	**31**	< 200	200 - 400	400 - 600	600 - 1000	> 1000	Ideal
Sodium (as Na)	mg/l	**328**	< 100	100 - 200	200 - 400	400 - 1000	> 1000	Marginal
Calcium (as Ca)	mg/l	**141**	0 - 80	80 - 150	150 - 300	> 300		Good
Calsium (as CaCO3)	mg/l							
Magnesium (as Mg)	mg/l	**72**	< 70	70 - 100	100 - 200	200 - 400	> 400	Good
Magnesium (as CaCO3)	mg/l		< 70	70 - 100	100 - 200	200 - 400	> 400	
Manganese (Mn)	mg/l		< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10	
Total Hardness	mg/l	**648**	< 200	200 - 300	300 - 600	> 600		Poor
Potassium (as K)	mg/l	**12**	< 25	25 - 50	50 - 100	100 - 500	> 500	Ideal
Fluoride (as F)	mg/l	**0.7**	< 0.7	0.7 - 1.0	1.0 - 1.5	1.5 - 3.5	> 3.5	Ideal
Iron (as Fe)	mg/l	**0.14**	< 0.5	0.5 - 1.0	1 - 5	5 - 10	> 10	Ideal
Arsenic (as As)	mg/l		< 0.010	0.01 - 0.05	0.05 - 0.2	0.2 - 2	> 2	
Cadmium (Cd)	mg/l		< 0.003	0.003 - 0.005	0.005 - 0.02	0.02 - 0.05	> 0.05	
Total Count	No/100 ml							
Total Coliforms	No/100 ml	**0**	0	0 - 10	10 - 100	100 - 1000	> 1000	Ideal
Faecal Coliforms	No/100 ml	**0**	0	0 - 1	1 - 10	10 - 100	> 100	Ideal
						Recommended Class		Marginal to poor

NOTES

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* The Department of Water Affairs and Forestry
* The Department of Health
* Water Research Commission