Soils Report

Report Prepared for

Gulf Power Ltd.

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1 Introduction

1.1 Objective

This report is part of an Environmental Impact Assessment (EIA) report being prepared for the proposed Diesel Power Plant site in Athi River area. Its main objective is to present the soil conditions that pertain to the site. The vulnerability to pollution as a consequence of the proposed plant and mitigation measures necessary has also been considered.

1.2 Terms of Reference

The Consultant was commissioned by the Client to carry out a soil survey of the project area and subsequently present a report under the following terms:

(i) Undertake a desk study of soil information available of the project area.
(ii) Carry out fieldwork involving observation of the topography and drainage pattern of the project area; carry out sampling of soil at the project site.
(iii) Analyze the soil samples and data obtained from laboratory analyses of the samples especially in regards to surface water and groundwater pollution in the area and also to the nearby Stony Athi River.
(iv) Compile and submit to the Client a report which shall include all the details of the above investigations and the Consultants recommendations.

2 Soils

2.1 Introduction

The project area lies in an area of predominantly dark grey black cotton soil. The thickness of these soils varies and on the project plot it is between 0.6 and 1.2 metres in depth. Below this is an orange-brown lateritic soil. This is a weathering product of the Kapiti Phonolite that underlies it.

2.2 Black Cotton Soil

The black cotton soil or vertisol has a high content of expansive clay (60%) known as montmorillonite that forms deep cracks in drier seasons or years. Alternate shrinking and swelling causes self-mulching, where the soil material consistently mixes itself, causing vertisols to have an extremely deep A horizon and no B horizon. In our case it was 60 to 120cms thick. Vertisols typically form from highly basic rocks such as basalt and phonolites in climates that are seasonally humid or subject to erratic droughts and floods, or to impeded drainage. Depending on the parent material and the climate, they can range from grey or red to the more familiar deep black. The natural vegetation of vertisols is grassland, savanna, or grassy woodland. The heavy texture and unstable behaviour of the soil makes it difficult for many tree species to grow, and forest is uncommon.

The shrinking and swelling of vertisols can damage buildings and roads, leading to extensive subsidence.

2.3 Laterite Soil

This is a reddish soil developed from weathering which is also known as latosol. They are soils of humid tropical or equatorial zones characterized by a deep weathered layer from which silica has been leached, a lack of humus, and an accumulation or layer of aluminium and iron sesquioxides. The reddish brown colour of these soils is imparted by the iron compounds. It is derived from a wide variety of rocks weathering under strongly oxidizing and leaching conditions. It forms in tropical and subtropical regions where the climate is humid. Lateritic soils may contain clay minerals; but they tend to be silica-poor, for silica is leached out by waters passing through the soil. Typical laterite is porous and claylike. It contains the iron oxide minerals goethite, lepidocrocite, and hematite. It also contains titanium oxides and hydrated oxides of aluminum, the most common and abundant of which is gibbsite.

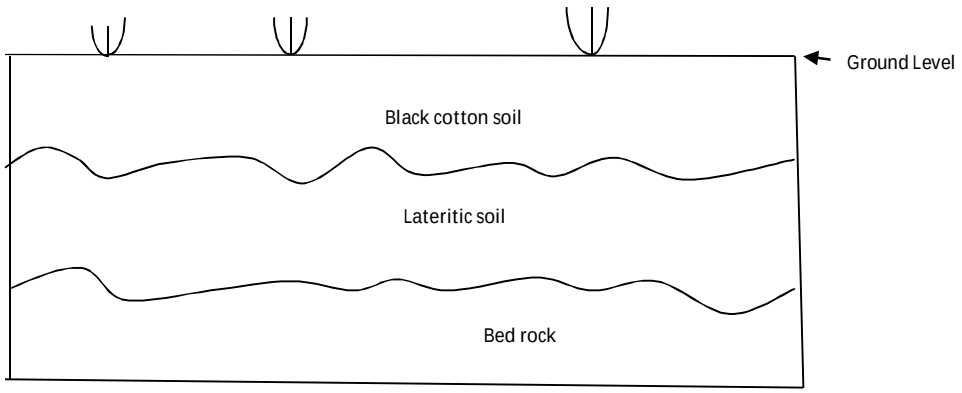


Figure 1: Section of Soil Profile

Source: E. K. Wamwangi (2010)

3 Soil and groundwater contamination

3.1 Introduction

The project area is mainly composed of unconsolidated black cotton soil termed as vertisols, which varies in thickness from 0.5 to 3m. They are poorly drained, have low infiltration rate and low permeability and are capable of significantly upholding any released contaminants to the groundwater.

Immediately below the soils, weathered phonolitic brownish deposits with rounded grains are found. A gradual transition from the weathered upper layer of the phonolite formation to a less weathered one occurs. It is noted that the shallow perched aquifer occur between 0.5 and 1.5 m. below ground surface. This basically will occur because of the interphase between the clay layer and the phonolitic rock. The other main aquifers are deep and occur from a depth of about 50m onwards.

3.2 Risk of Groundwater Contamination

The main aquifer in the area is mostly formed within the old land surfaces and weathered portions between the different volcanic flows; however above it are fresh compact phonolites highly impermeable that do not allow infiltration of the subsurface contaminants to reach the deeper aquifer. Studies conducted by Panafcon (2000), at the Kenya Shell Nairobi Terminal indicate that the rock is highly impermeable. However, care should be taken while handling hydrocarbon liquids.

It is should be noted that in the event of hydrocarbon spillage into the soils, the principle force behind volatile organic compound (VOC) vapour transport through soil is the diffusion of vapour in soil from a source material, in the event that the soil is impermeable such as Clay / black cotton soils subsurface VOC's will tend to be compressed and inhibit the movement, making the likely contamination of subsurface oil and groundwater fairly minimal and limited to the point source. The environmental advantage with this situation is that even if the impact is covering wider area the depth is shallow making bioremediation easier, cheap and affordable. In this case the bioremediation methodology may be simple excavation of contaminated soils and remediating using the oxygenation method or application of fertilizers to the contaminated soil.

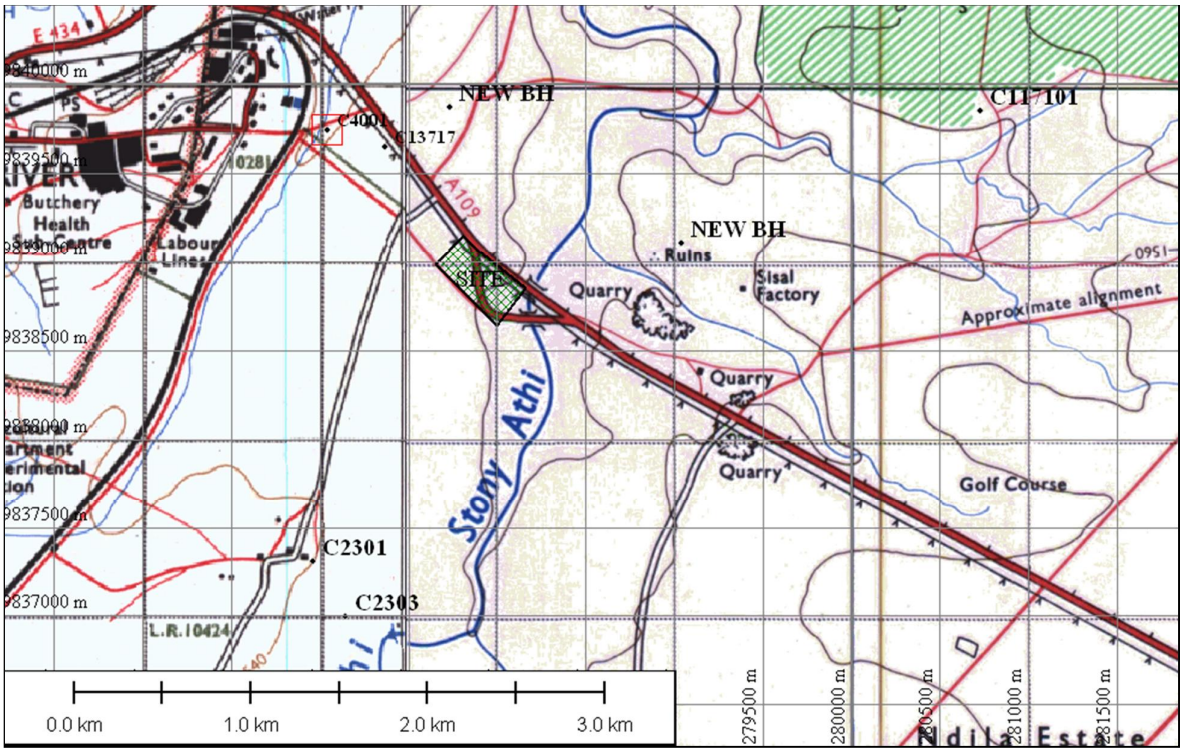
The proposed project is expected to be a diesel operated power plant. Generally, diesels have C12 to C24 carbon compounds that are generally heavy, and also contain sulphur traces (0.2%-0.3% by weight). The most soluble fraction makes up about five percent by volume. It contains Benzene, toluene, xylene, and Ethylbenzene. These are potentially dangerous compounds in very small traces. However, compared to petrol, jet fuel and naphtha, diesel is heavy and therefore its movement in soils is slower and added by highly impermeable clay in the project site, it is not easy for any released hydrocarbons to reach the main aquifer currently being exploited in the area.

APPENDIX

Topographical map extract [Mapsheet 148/4 & 149/3 - 1:50,000]

Laboratory Soil Test Reports

Figure 1: Topographical Map of the Project Site



Kenya Agricultural Research Institute

National Agricultural Research Laboratories

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SOIL TEST REPORT

Name	Eliud Wamwangi
Address	P. O. Box 667, 00517 Nairobi
Location of farm	Machakos
Crop(s) to be grown	N/A
Date sample received	01/04/10
Date sample reported	13/04/10
Reporting officer (through Director NARL)	A. Chek

	Soil Analytical Data							
Lab. No/2010	1424		1425					
Soil depth	top		sub					
Fertility results	value	class	value	class	value	class	value	class
Soil pH	7.69	medium alkaline	8.09	medium alkaline				
Total Nitrogen %	0.06	low	0.04	low				
Org. Carbon %	0.64	low	0.36	low				
Phosphorus ppm	4	low	2	low				
Potassium me%	0.75	adequate	0.35	adequate				
Calcium me%	16.4	high	21.2	high				
Magnesium me%	3.99	high	6.93	high				
Manganese me%	0.47	adequate	0.08	low				
Copper ppm	1.68	adequate	1.28	adequate				
Iron ppm	25.6	adequate	27.3	adequate				
Zinc ppm	0.91	low	0.95	low				
Sodium me%	1.75	adequate	2.77	high				
Elect. Cond. mS/cm	0.61	adequate	0.66	adequate				

Interpretation and Fertilizer Recommendation

The soil pH is very alkaline for crops' growth. The soil is inadequately supplied with nitrogen, phosphorus and zinc. The organic matter has to be improved. During the land preparation apply 4 tons/acre of well decomposed manure or compost. At planting time apply 150 kg/acre of diammonium phosphate (DAP).

NOTE: Test results are based on customer sampled sample(s).

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SOIL SURVEY TEST REPORT

Name	Eliud Wamwangi
Address	P. O. Box 667, 00517 Nairobi
Location of farm	Machakos
Date sample received	01/04/10
Date sample reported	22/04/10
Reporting officer (through Director NARL)	A. Chek

Lab. No. /2010	1424	1425				
Soil depth cm	top	sub				
Soil pH-H_2O (1:2.5)	7.79	8.39				
Elect. Cond. mS/cm	0.22	0.24				
Carbon %	0.6	0.4				
Sand %	26	24				
Silt %	14	36				
Clay %	60	40				
Texture Class	C	C				
Cat. Exch. Cap. me%	17.2	12.3				
Calcium me%	2.1	1.5				
Magnesium me%	2.9	2.2				
Potassium me%	1.6	1.6				
Sodium me%	2.8	3.8				
Sum me%	9.3	9.2				
Base %	54	75				

Key: C - Clay

NOTE: Test results are based on customer sampled sample(s).