Appendix 1

Drawings for Power Plant Layout

(This appendix has been removed because of confidential information.)

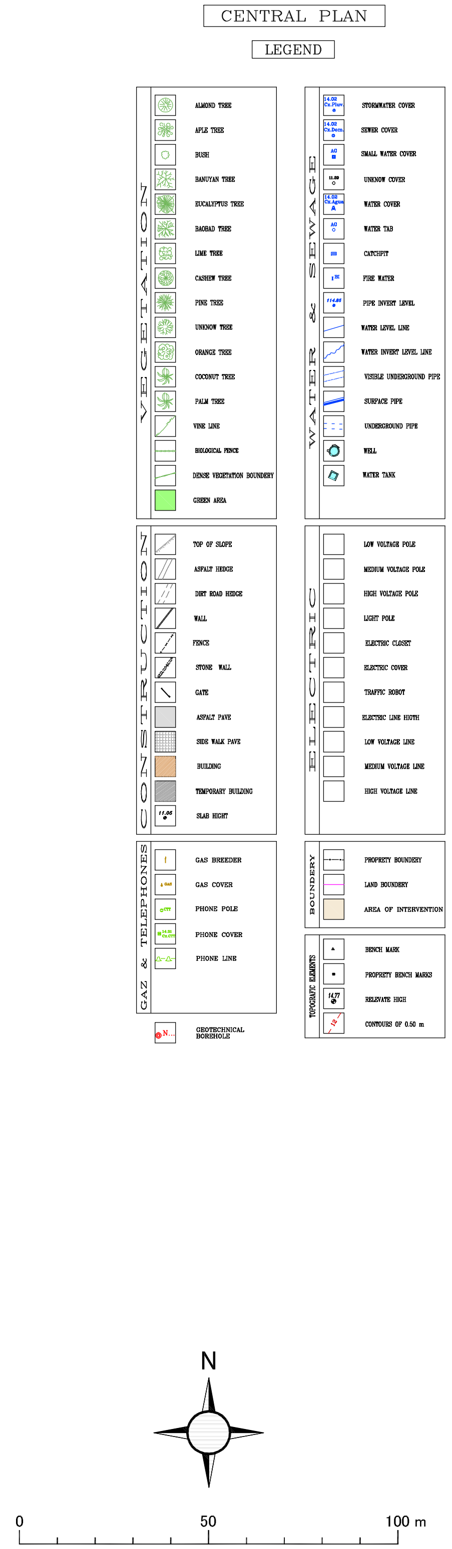
Appendix 2

Terms of Reference (TOR) of Engineering Consultancy Services

(This appendix has been removed because of confidential information.)

Appendix 3

Site Survey



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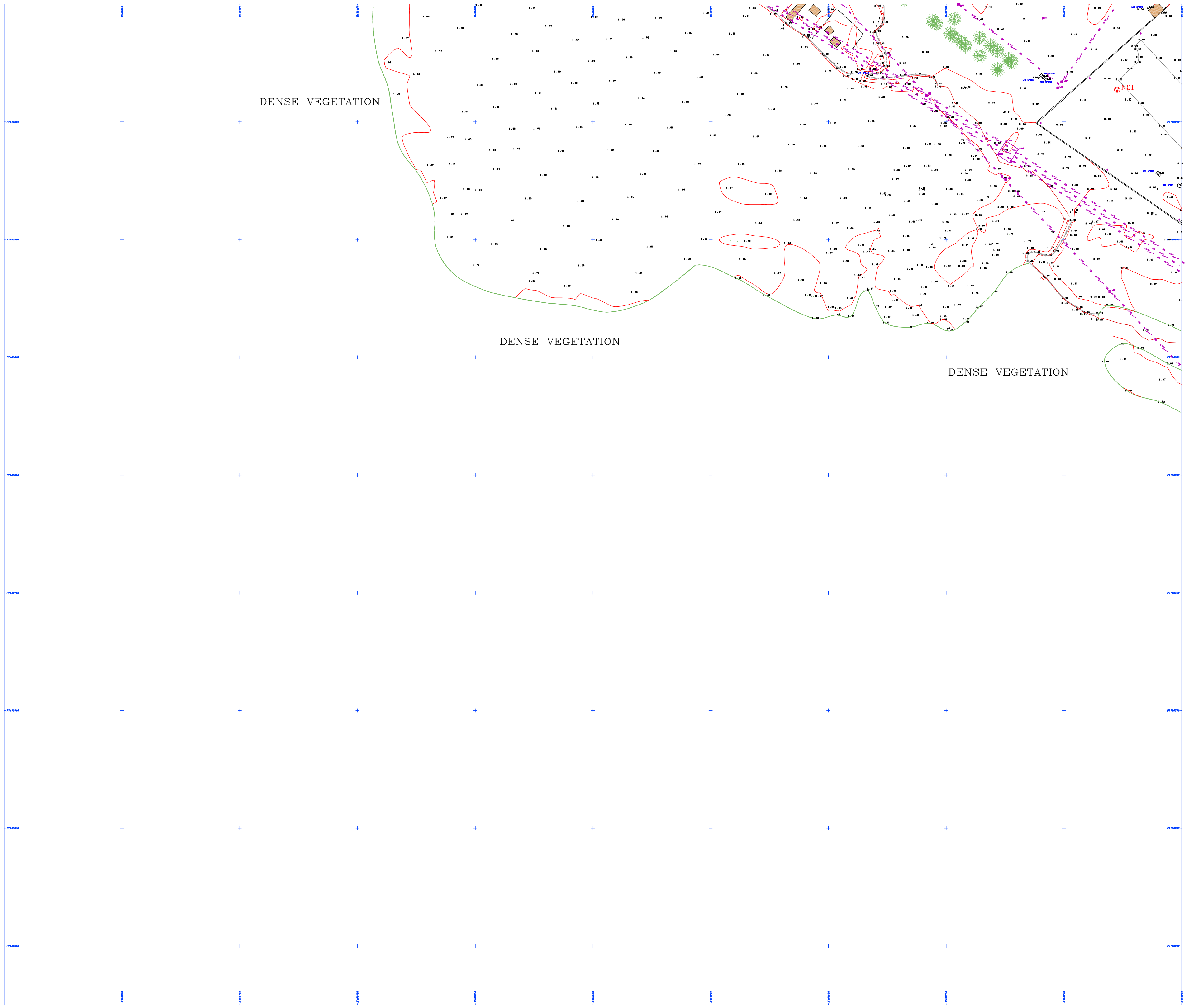
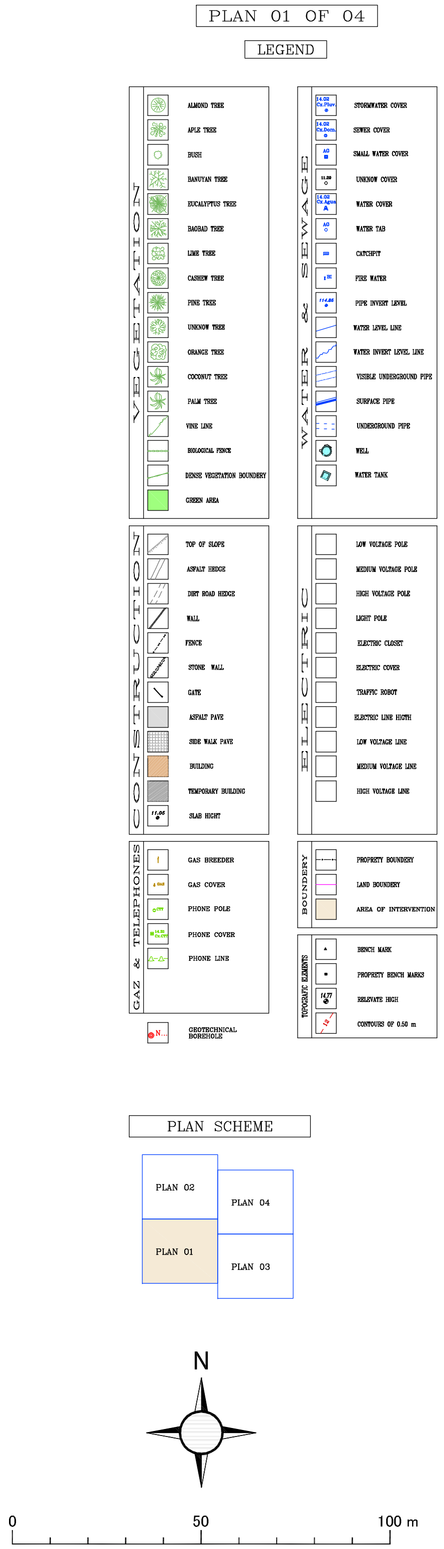
NO.	REV.	DESCRIPTIONS			DRAWING NO. —

APP3-1





NO.	REV.	DESCRIPTIONS

PROJECT: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

REVISION: 0

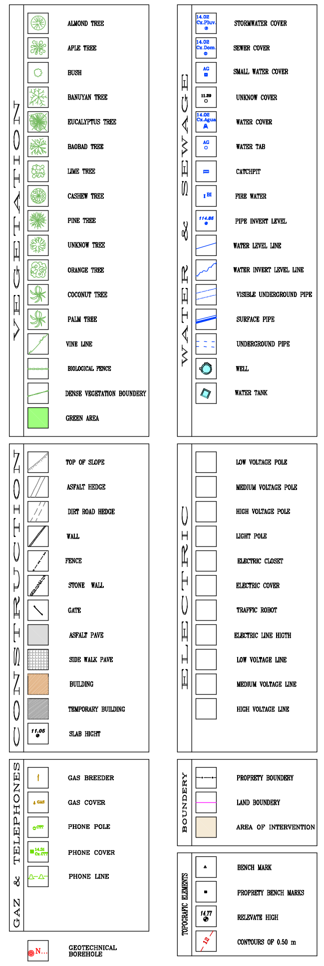
DRAWING TITLE: CTM TOPOSURVEY PLAN – 1

SCALE: 1/1000

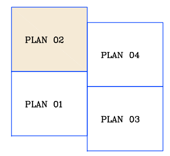
DRAWING NO. —

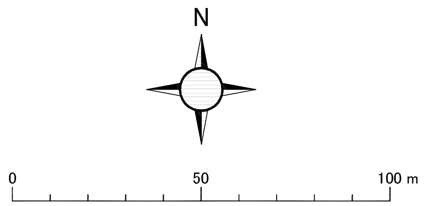
PLAN 02 OF 04

LEGEND



PLAN SCHEME





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			DRAWING TITLE: CTM TOPOSURVEY PLAN – 2	SCALE: 1/1000	DRAWING NO.: —

PLAN 03 OF 04

LEGEND

VEGETATION
- ALMOND TREE
- APLE TREE
- BUSH
- BANUYAN TREE
- EUCALYPTUS TREE
- BAOBAD TREE
- LIME TREE
- CASHEW TREE
- PINE TREE
- UNKNOW TREE
- ORANGE TREE
- COCONUT TREE
- PALM TREE
- VINE LINE
- BIOLOGICAL FENCE
- DENSE VEGETATION BOUNDERY
- GREEN AREA

WATER & SEWAGE
- 14.02 Cx.Pluv. — STORMWATER COVER
- 14.02 Cx.Dom. — SEWER COVER
- AG — SMALL WATER COVER
- 11.29 — UNKNOW COVER
- 14.02 Cx.Agua A — WATER COVER
- AG — WATER TAB
- CATCHPIT
- BI — FIRE WATER
- 114.85 — PIPE INVERT LEVEL
- WATER LEVEL LINE
- WATER INVERT LEVEL LINE
- VISIBLE UNDERGROUND PIPE
- SURFACE PIPE
- UNDERGROUND PIPE
- WELL
- WATER TANK

CONSTRUCTION
- TOP OF SLOPE
- ASFALT HEDGE
- DIRT ROAD HEDGE
- WALL
- FENCE
- STONE WALL
- GATE
- ASFALT PAVE
- SIDE WALK PAVE
- BUILDING
- TEMPORARY BUILDING
- 11.05 — SLAB HIGHT

ELECTRIC
- LOW VOLTAGE POLE
- MEDIUM VOLTAGE POLE
- HIGH VOLTAGE POLE
- LIGHT POLE
- ELECTRIC CLOSET
- ELECTRIC COVER
- TRAFFIC ROBOT
- ELECTRIC LINE HIGTH
- LOW VOLTAGE LINE
- MEDIUM VOLTAGE LINE
- HIGH VOLTAGE LINE

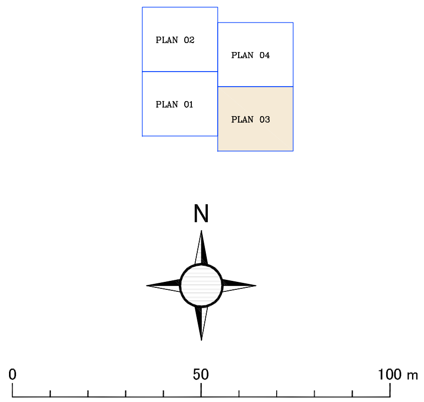
GAZ & TELEPHONES
- GAS BREEDER
- GAS — GAS COVER
- CTT — PHONE POLE
- 14.31 Cx.CTT — PHONE COVER
- PHONE LINE

- N... — GEOTECHNICAL BOREHOLE

BOUNDERY
- PROPRETY BOUNDERY
- LAND BOUNDERY
- AREA OF INTERVENTION

TOPOGRAFIC ELEMENTS
- BENCH MARK
- PROPRETY BENCH MARKS
- 14.77 — RELEVATE HIGH
- 12 — CONTOURS OF 0.50 m

PLAN SCHEME



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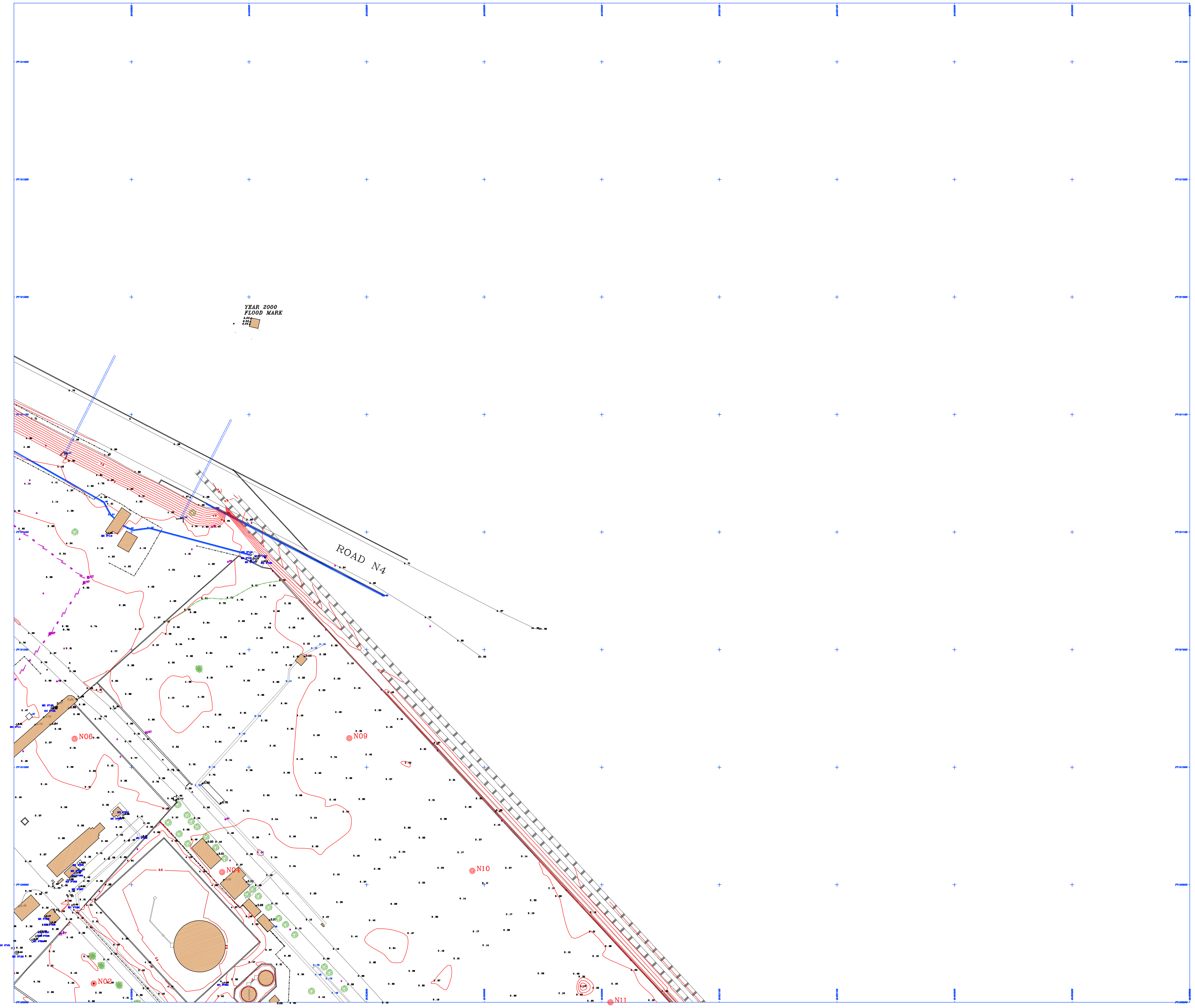

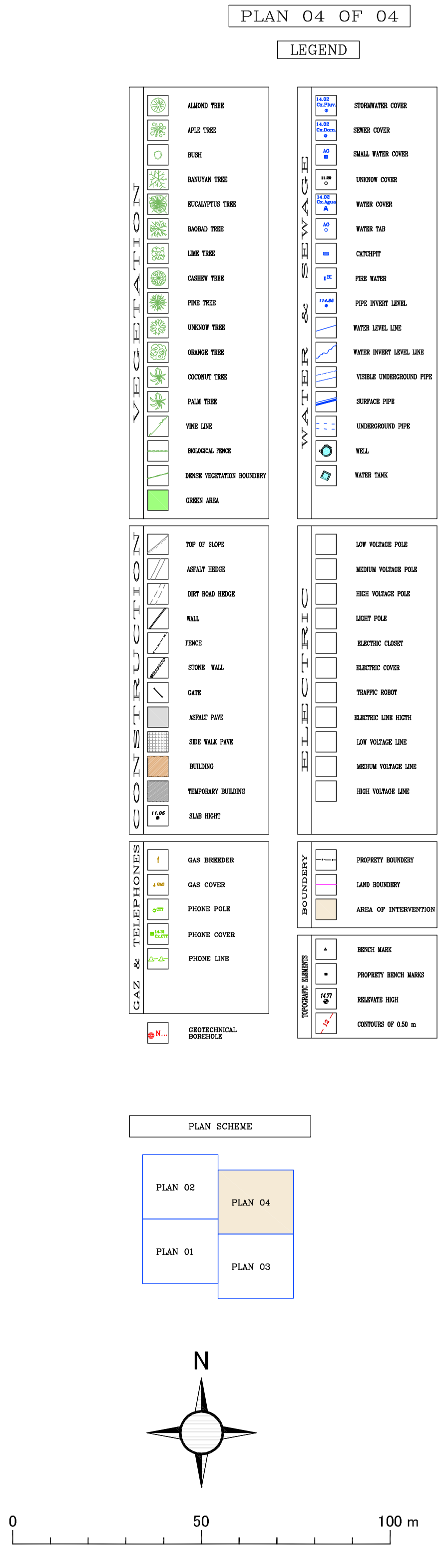

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NO.	REV.	DESCRIPTIONS				

Appendix 4

Geological & Geotechnical Survey

GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

GEOLOGICAL & GEOTECHNICAL REPORT

Dec.2012

Document Profile

Client	**ORIENTAL CONSULTANTS CO. LTD.** **Shibuya-ku, Tokyo, 151-0071, Japan**
Design	**GAS FIRED POWER PLANT DEVELOPMENT** **IN SOUTHERN MOZAMBIQUE**
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Project Manager	F. Gomes Pinto
Geological & Geotechnical Manager	Luis Lopes
Date	December, 2012

Revised	Eurico Teixeira / Luis Lopes
Verified	Luis Lopes
Approved	Fernando Ferreira

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FIGURE INDEX

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1 Introduction

At the request of **ORIENTAL CONSULTANTS CO. Ltd**, Shibuya-ku, Tokyo, 151-0071, Japan and with the scope of determining the geological and geotechnical model of the **Gas Fired Power Plant Development in Southern Mozambique** site, Ingérop Moçambique, with the collaboration of Geoarea supervised the ground investigation works and developed the geological and geotechnical design of the referred area.

Ground investigations were carried out between the 24th of October and the 8th of November and were undertaken by Tecnasol, consisting of rotary drill holes with core recovering.

Soil samples recovered from executed boreholes were laboratory tested including index and classification tests, specific gravity, moisture content, shear strength tests (unconfined compression test and direct shear test) and consolidation tests. Laboratory activity took place between the 28th of October and the 5th of December.

The current report is structured in 4 main chapters, including this one. A brief description is given bellow.

- **Introduction**
- **Site conditions**, where the geomorphology and geological setting is described including local hydrogeology and structural geology conditions.
- **Ground investigation works**, where a summary of executed ground investigation works is presented
- **Geotechnical interpretation**, presenting a discussion of various geotechnical aspects such as soil properties, terrain excavation ability and required foundation.

It is also presented, as an appendix to this report, the ensuing documents, bound as a separate volume.

- Ground investigation location plan
- Interpreted geotechnical cross-sections.
- Ground investigation data records and laboratory testing results

2 Site Conditions

2.1 General

The Study area is located at Maputo's Electricity of Mozambique old thermal power plant area, lying to the west of the city between the national road EN4 and the shoreline of Maputo Bay.

Figure 1 presents site location highlighted on a detailed aerial view framed up on a general aerial perspective of Maputo city.

Figure 1 – Location of studied area

Present site conditions include industrial ruins from the old thermal power plant and other accessory infrastructures.

2.2 Geomorphology

On geomorphologic unit terms, the studied location integrates the vast quaternary sedimentary deposits that dominate most of Mozambican south region and overlie the Sedimentary Mozambican Basin resulted after Gondwana dispersal

This area is situated downstream the confluence of Infulene River with Maputo Bay shoreline, where delta margins are dominated by flood plains that have been progressively intervened with earthworks throughout recent times.

The entire zone is integrated on a relatively flat area with elevation ranging from 3 to 5 meters, outlining a terrain morphology that was man modulated using landfill materials to raise the original levels.

Although preserved from the flood plains that characterize shorelines, all of the area might be periodically submitted to flood episodes due to heavy rains when combined with high sea waters or spring tides. In fairness, such scenario has not been reported happening since present site conditions were concluded for the previous thermal power plant.

Figure 3 presents a perspective of local terrain morphology and conditions.

Figure 2 – General view of site conditions

2.3 Geological Settings

2.3.1 Lithostratigraphy

Stratigraphic sequence occurring at the site location consists on Holocene superficial deposits that overlie Pleistocene (Congolote and Machava formation) and Pliocene (Ponta Vermelha formation) geological units described on the following paragraphs.

Holocene deposits compose all of the surface soils of the studied area, comprising landfill materials used to modulate terrain morphology at previous interventions. These materials are mainly constituted by silty-sandy soils with coal fragments and vegetal residues.

By this description one assume that most of it is of alluvium nature which might also occur in depth beneath the landfill deposits. Given these circumstances, it will be extremely difficult to differentiate one from the other and should all be treated as one unit.

Pleistocene unit known as Congolote formation (Qco) is mainly described as a coarse to fine grained sandy soil, poorly consolidated, of white, yellow or orange colouration. It represents aeolian materials of continental dunes, constituting a sandy stratum that overlies succeeding geological units.

Underlying the Congolote formation is the Machava formation (Qmc), mainly described as an interbedded sedimentary deposit of clayey sands with carbonated, salty and ferruginous formations and with a basal conglomerate.

Although its lateral limits are generally well defined, this geological unit may not be represented throughout all of the lower Pleistocene, enabling Congolote formation to settle directly on the Pliocene unit Ponta Vermelha through a stratigraphic unconformity.

Ponta Vermelha formation (TPv) comprises sand, siltstones and sandstones of reddish to yellowish colouration, occasionally with a ferruginous hard cover.

The Mozambican National Department of Geology published a geological map of Maputo on a scale of 1:50 000 (map 2532D3) of which an extract it is presented on the next figure with the approximate location of the new thermal power plant.

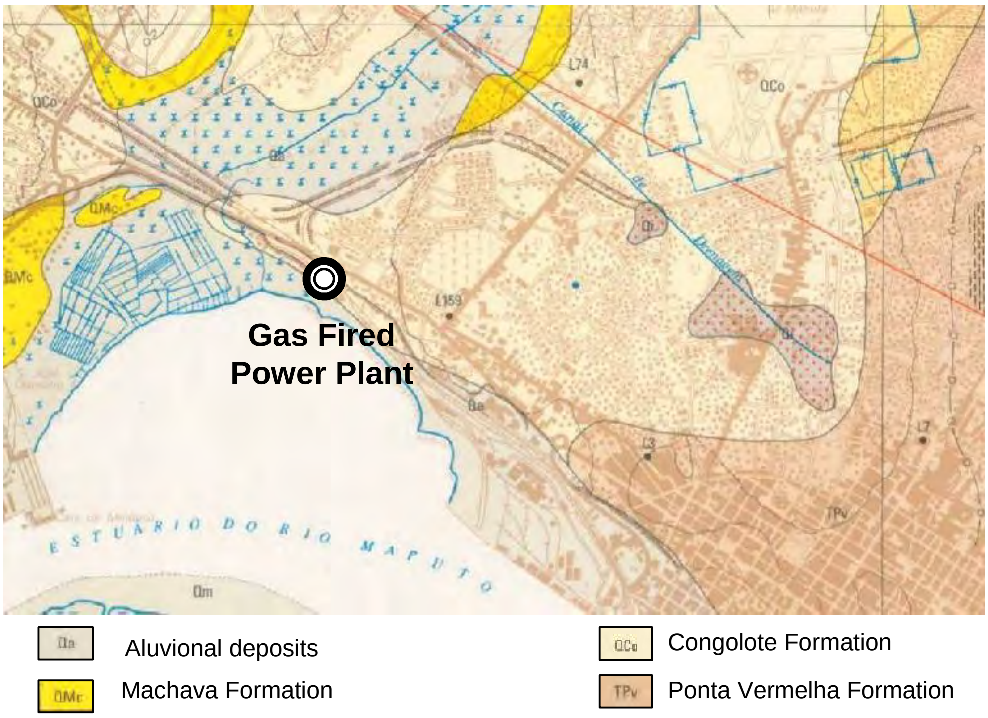

Figure 3 – Extract of Maputo geological map, 1:50 000 (published scale)

A few samples recovered from executed boreholes illustrate the described geology.

Figure 4 – Samples recovered from borehole S1 (above) and S2 (below)

Given the presented geological conditions there are no structural evidences of tectonic nature on the referred geomorphologic unit, as the deposited sediments overlie any bedrock that may exhibit any type of fragmentation.

For this reason there are no geological structural constraints at the purposed site.

2.3.2 Hydrogeology

Hydrogeological aptitude of a sedimentary deposit with the described features suggest the existence of a multi-layered aquifer system with alternating pervious to impervious stratum, depending on its grading characteristics.

Therefore, on a general approach, it may be assumed that this is a complex system where possibly confined and unconfined aquifers coexist and the existence of aquitards and aquifuges plays an essential role on the confinement of hydrogeological units and their own drainage.

Although, very little hydrogeological information in known regarding this area, soils are expected to be saturated a couple of meters below ground level as groundwater was identified on all boreholes at very superficial depths ranging from 0 to 2 meters.

3 Ground Investigation Works

3.1 General

Works started with a site visit to the future location of the new Maputo Thermal Power Plant on the 18th of October. At the time, a Client's representative was present (Mr Mitsuro Miyashita) as well as the general coordinator for the present study (Mr F. Gomes Pinto) and the geology and geotechnics consultant (Mr Luis Lopes). A topographical field team was also made available so that ground investigation locations would be promptly marked.

Ground investigation fieldworks comprised on 11 rotary drill holes. Final location was later adjusted by the geology and geotechnics consultant so that ground investigation data could be optimized for the design purpose. After fieldworks were completed these locations were surveyed by the topographic team.

The following image shows the final borehole locations.

Figure 5 – Borehole locations

3.2 Rotary Boring

Using standard rotary coring methods, 11 boreholes of 86mm internal diameter were drilled with Delta Base 520 equipment. In order to prevent soil to collapse, boreholes were lined with casing, particularly when sandy soil was intersected.

In situ field testing such as SPTs were carried out along the drilling process, between 1.0m intervals constituting, in fact, the main criterion for drilling stoppage, occurring when N_{SPT} hits a minimum of 50 blows on 5 consecutive times (N_{SPT} >50).

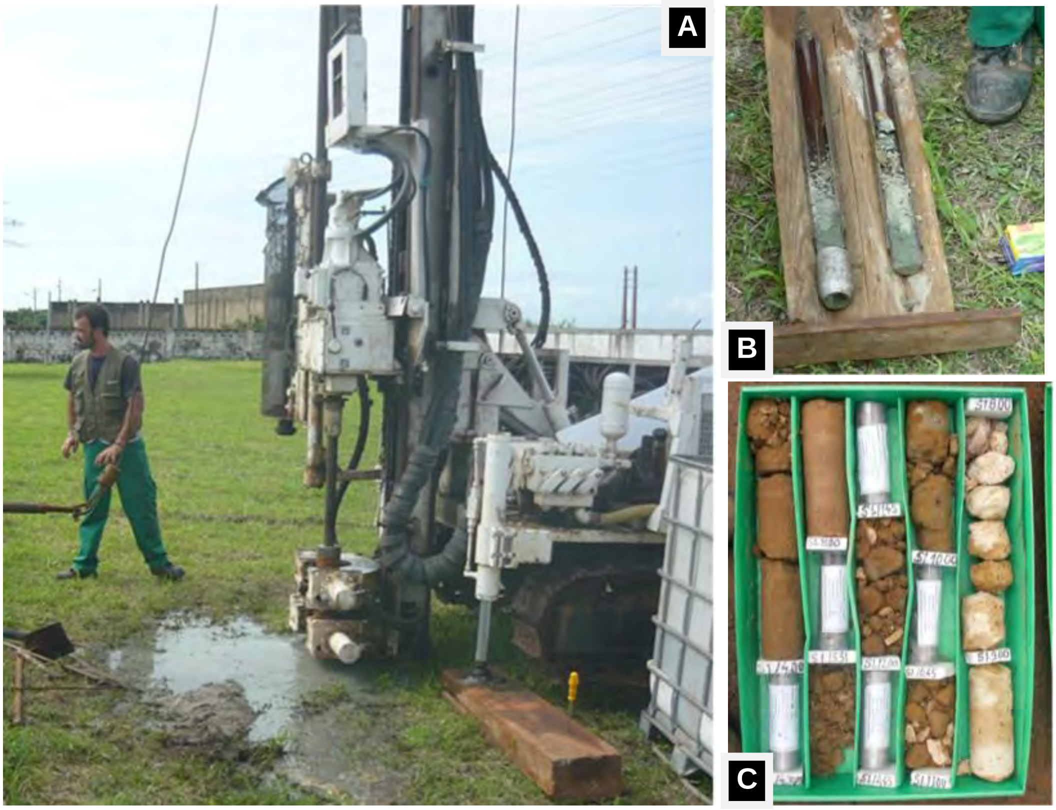

Figure 6 – A - Rotary drilling at S1. B - Terzaghi's sample for the SPT. C – Recovered sample on drilling

The following table summarizes the geographic features of executed boreholes through their respective x, y and z coordinates considering UTM format and WGS84 datum.

Table 1– Geographic features of ground investigation works

Reference		Coordinates X	Coordinates Y	Coordinates Z	Remarks
rotary drill hole	S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4 - 5.2m (depth)
	S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4 - 5.2m (depth)
	S3	7130849.02	452891.05	3.20	Laboratory test sample collected between 4 - 4.5m (depth)
	S4	7130955.90	452888.10	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
	S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4 - 4.6m (depth)
	S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4 - 4.6m and 8.5 - 9.0 m (depth)
	S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 – 5.5 m(depth)
	S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
	S9	7131012.36	452943.24	3.40	Laboratory test sample collected between 4,5 - 5.1m (depth)
	S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
	S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)

The main geological and geotechnical features of all boreholes are summarized in the following table.

Table 2 – Summarize features of boreholes

Ref.	GW level (m)	Depth (m)	Geology Depth (m)	Geology Lithology	Total core recovery (%) ≤ 50	Total core recovery (%) 50 - 75	Total core recovery (%) ≥ 75
S1	1.8	20.0	0.0 – 2.45	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.0 5.2 - 14 15 - 16	14 - 15 18 – 20	4,0 - 5.2 16 - 18
			2.45 - 3	Medium grained, clean sand, poorly graded			
			3 – 6.45	Fine to coarse grained clayey sand, on a loose density state, occasionally with gravel			
			6.45 – 8.0	Medium to coarse grained clayey sand with thin marly and calcarenite interbeds			
			8.0 – 10.0	Medium to fine grained sandstone			
			10.0 – 20.0	Fine to medium grained clayey sand, generally on a very dense state			
S2	1.3	15.0	0.0 – 2.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4,0 5,2 - 8,0 12 - 13	8,0 - 11,0 14,0 -15,0	4,0 - 5,2 11,0 - 12,0 13,0 - 14,0
			2.0 – 3.0	Fine grained clean sand, poorly graded.			
			3.0 – 4.0	Fine grained clayey sand with calcarenite gravel			

Ref.	GW level (m)	Depth (m)	Geology		Total core recovery (%)		
			Depth (m)	Lithology	≤ 50	50 - 75	≥ 75
			4.0 – 55	Gravel of variable dimension with sandy silt matrix			
			5.5 – 6.45	Fine to medium clayey sand, on a loose density state.			
			6.45 – 9.0	Coarse grained calcarenite with fossiles			
			9.0 -11.0	Fine to medium grained clayey sand with interbedded sandstone gravel, on a loose density state.			
			11.0 – 12.0	Fine to medium grained sandstone			
			12.0 – 15.0	Fine to medium grained clayey sand with sandstone gravel, on a very dense state.			
S3	1.05	12.0	0.0 – 3.45	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 1.0 2.0 - 4.0 4.6 - 6,0 7.0 - 11	1.0 - 2.0 6.0 - 7.0 11 - 12	4.0 - 4.6
			3.45 – 4.0	Medium grained clean sand, poorly graded.			
			4.0 – 12	Fine to medium grained clayey sand with gravel, on a dense to very dense state, with highly weathered sandstone interbeds (5-7.5m)			
S4	1.0	10.0	0.0 – 2.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 3.5 4.7 - 8.0	8.0 - 10.0	3.5 - 4.7
			2.0 – 3.0	Medium grained clean sand, poorly graded.			
			3.0 – 5.45	Fine grained clayey sand, with gravel, on a loose density sate			
			5.45 – 10.0	Fine to medium grained clayey sand, on a very dense state, with interbeds of highly weathered sandstone (5.45 – 7.0)			
S5	1.0	9.0	0.0 – 2.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.0 5.0 - 7.0	7.0 - 9.0	4.0 - 5.0
			2.0 – 3.45	Medium grained clean sand, poorly graded.			
			3.45 – 7.0	Weathered sandstone with occasionally highly weathered interbeds recovered as a clayey sand with gravel.			
			7.0 – 9.0	Fine to medium grained clayey sand, on a very dense state.			
S6	1.0	15.0	0 - 1.45	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.0 4.6 - 8.5 9.0 - 11 10 - 11 12 - 13	11.0 - 12.0 11 - 12 13 - 15	4.0 - 4.6 8.5 - 9.0
			1.45 – 4.0	Medium grained clean sand, poorly graded.			
			4.0 – 7.0	Fine to medium grained clayey sand, with gravel			
			7.0 – 8.0	Coarse grained calcarenite, weathered			
			8.0 – 12.0	Fine grained clayey sand, on a dense to very dense state			
			12.0 – 14.0	Medium grained weathered sandstone, with a fresh interbed between 13.6 and 14.0			
			14.0 – 15.0	Fine grained clayey sand, on a dense to very dense state			
S7	-	10.0	0.0 – 3.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.0 4.4 - 4.9	5.5 - 7.0 8.0 - 9.0	4.0 - 4.4 4.9 – 5.5

Ref.	GW level (m)	Depth (m)	Geology		Total core recovery (%)		
			Depth (m)	Lithology	≤ 50	50 - 75	≥ 75
			3.0 – 4.0	Medium grained clean sand, poorly graded.	7.0 - 8.0		9.0 - 10.0
			4.0 – 4.4	Coarse gravel with clayey to sandy matrix, poorly graded			
			4.4 – 5.45	Fine grained clayey sand, with gravel.			
			5.45 – 7.2	Medium grained sandstone with occasionally interbeded calcarenite			
			7.2 – 10.0	Fine to medium grained clayey sand, on a very dense state.			
S8	1.0	11.1	0.0 – 2.45	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 5.0 5.6 - 6.0	6.0 - 9.0	5.0 - 5.6 9.0 - 11.0
			2.45 – 3.0	Medium grained clean sand, poorly graded.			
			3.0 – 9.35	Fine grained clayey sand, with gravel, on a medium to very dense state.			
			9.35 – 11	Medium grained weathered sandstone with interbedded marls			
			11 – 11.1	Fine grained clayey sand, on a very dense state.			
S9	0.5	14.0	0.0 – 2.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.5 5.1 - 12	-	4.5 - 5.1 12.0 - 14.0
			2.0 – 4.0	Medium grained clean sand, poorly graded.			
			4.0 – 5.1	Fine to medium grained clayey sand, with gravel on a very loose density state			
			5.1 – 7.0	Medium grained weathered sandstone.			
			7.0 – 9.45	Fine grained clayey sand, with gravel, on a medium density state			
			9.45 – 10.4	Fine grained weathered sandstone.			
			10.4 – 14.0	Fine grained clayey sand, on a very dense state.			
S10	0.0	14.0	0.0 – 3.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 5.0 6.2 – 9.0 11 - 13	9.0 - 11 13 - 14	5.0 - 6.2
			3.0 – 4.0	Fine grained weathered sandstone			
			4.0 – 5.0	Sandy clay, of hard consistency			
			5.0 – 6.2	Clayey sand with gravel			
			6.2 – 7.4	Coarse grained weathered sandstone with interbedded marls			
			7.4 – 14	Fine grained clayey sand, with gravel, on a very dense state, with interbedded weathered sandstone between 13-13.38m.			
S11	1.0	19.0	0.0 – 3.0	Landfill deposits. Silty sand with coal fragments and vegetal residues	0.0 - 4.0 5.1 - 8.0 10 - 11 16 - 17	8.0 - 10.0 11.0 - 16.0 17.0 - 18.0	4.0 - 5.1 18.0 - 19.0
			3.0 – 10.3	Fine to medium grained clayey sand, with gravel, on a medium to very dense state			
			10.3 – 11	Sandy clay, of hard consistency			
			11 - 18	Fine to medium grained clayey sand, with gravel, on a very dense state			

Standard Penetration Test (SPT)

This dynamic penetration test was undertaken at the bottom of the boreholes along with the drilling process at intervals of 1 m, allowing for the estimation of strength and deformation properties of intersected soils as well as obtainment of disturbed samples for identification purposes.

Its procedure consisted on driving a split spoon sampler of standard dimensions into the bottom of the borehole, at a given depth, by an automatic trip hammer that allowed a weight of 63,5 kg to fall on to a drive head from a height of 0,76m.

SPT field results are summarized in the following table and chart.

Table 3 – Summarize of SPT field result values

Depth / Ref.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
S1	14	15	-	-	11	8	8	60	-	30	22	60	60	60	31	60	60	60	60	60
S2	-	-	-	-	60	10	54	60	10	16	60	60	60	60	60	-	-	-	-	-
S3	3	4	6	-	35[(1)]	30	39	50	60	60	60	60	-	-	-	-	-	-	-	-
S4	14	13	15	-	22	60	60	60	60	60	-	-	-	-	-	-	-	-	-	-
S5	7	8	2	-	60	60	60	60	60	-	-	-	-	-	-	-	-	-	-	-
S6	7	5	10	-	10[(1)]	40	44	28	38	60	60	60	60	60	60	-	-	-	-	-
S7	2	3	3	6 [(1)]	60[(2)]	60	60	60	60	60	-	-	-	-	-	-	-	-	-	-
S8	10	13	11	15	-	11[(2)]	60	60	60	60	60	-	-	-	-	-	-	-	-	-
S9	16	19	3	2	-	58	32	25	11	60	60	60	60	60	-	-	-	-	-	-
S10	18	17	60	45	-	60	60	41	31	60	60	60	60	60	-	-	-	-	-	-
S11	3	8	19	-	19	22	25	47	60	60	60	39	48	42	60	60	60	60	60	-

(1) – True SPT depth is 4.5m

(2) - True SPT depth is 5.5m

SPT refusal

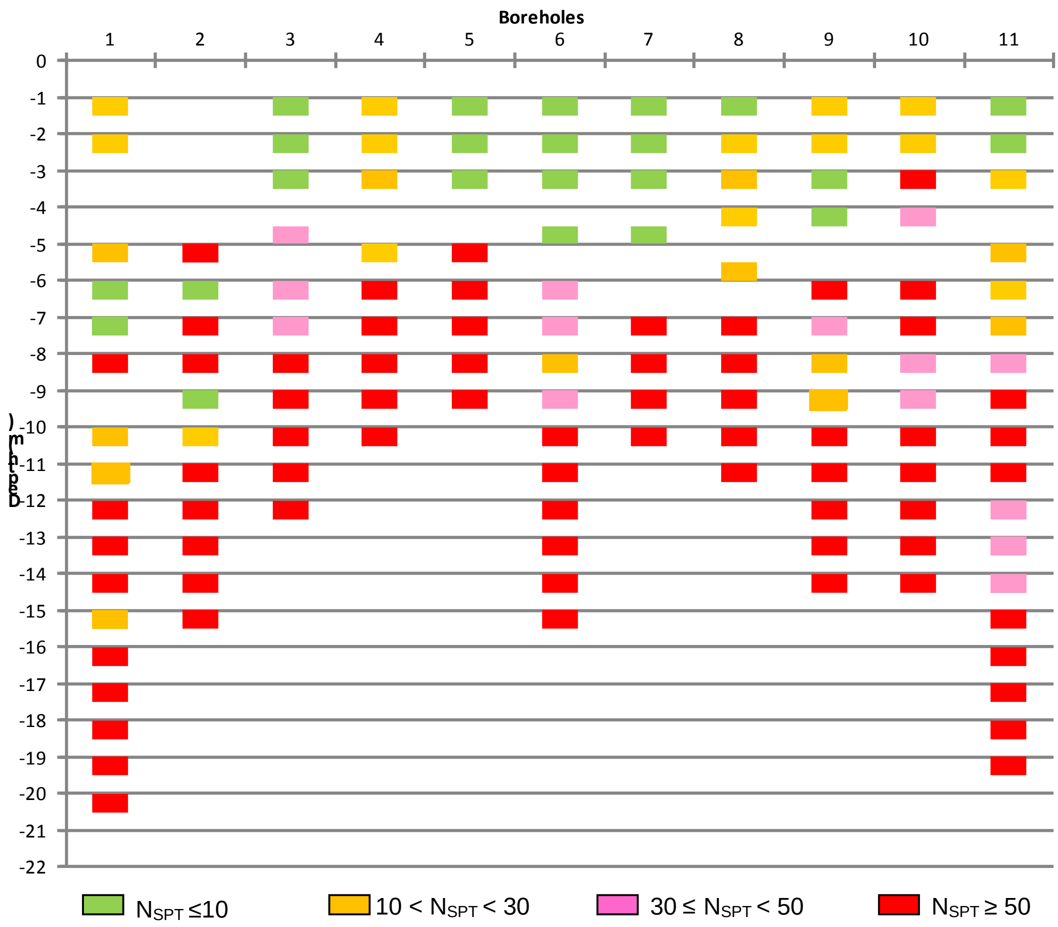

Figure 7 – Graphical view of SPT results

In order to obtain more reliable SPT results, the application of the appropriate correction factors was considered, in particular, energy delivered to the drive rods and energy loss due to the length of rods. Taking into account the moderated cohesive nature of the soils the effect of overburden pressure was not regarded.

Energy delivered to the drive rods was standardized to N_{60} so that $N_{60} = N.(ER_r/60)$, where N are the SPT field results and ER_r is the energy ratio of the test equipment (60%). That being said, this correction factor assumes a proportion of 1 on this particular case.

Correction for energy losses due to the length of rods considers the following correction factors.

Table 4 – Correction factors for rod length

Rod length below the anvil (m)	Correction factor
> 10	1,0
6 – 10	0,95
4 – 6	0,85
3 - 4	0,75

SPT corrected results are summarized in the following table.

Table 5 – Summarize of SPT corrected result values ($NSPT_C$)

Depth / Ref.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
S1	11	11	-	-	9	7	8	57	-	29	22	60	60	60	31	60	60	60	60	60
S2	-	-	-	-	51	9	51	57	10	15	60	60	60	60	60	-	-	-	-	-
S3	2	3	5	-	30(1)	26	37	57	57	57	60	60	-	-	-	-	-	-	-	-
S4	11	10	11	-	19	51	57	57	57	57	-	-	-	-	-	-	-	-	-	-
S5	5	6	2	-	51	51	57	57	57	-	-	-	-	-	-	-	-	-	-	-
S6	5	4	8	-	9(1)	34	42	27	36	57	60	60	60	60	60	-	-	-	-	-
S7	2	2	2	5 (1)	51(2)	51	57	57	57	57	-	-	-	-	-	-	-	-	-	-
S8	8	10	8	13	-	9(2)	57	57	57	57	60	-	-	-	-	-	-	-	-	-
S9	12	14	2	2	-	49	30	24	10	57	60	60	60	60	-	-	-	-	-	-
S10	14	13	45	34	-	51	57	39	29	57	60	60	60	60	-	-	-	-	-	-
S11	2	6	14	-	16	19	24	45	57	57	60	39	48	42	60	60	60	60	60	-

(1) - True SPT depth is 4.5m

(2) - True SPT depth is 5.5m

The following points highlight the obtained results.

- The geological model is generally represented by superficial landfill deposits on a loose density state, with a generalized thickness of 2-3m that overlies Pleistocene sandy soils with occasionally interbedded weathered sandstone and calcarenite.
- Core recovery is mostly below 50% - 60%, with the occasionally 75-100% recovery particularly when the special sampler was used for the laboratory tests samples.
- On general terms soil resistance estimated by the SPT increases with depth, with the occasional breaks, particularly when intersected clayey interbeds.
- All boreholes feature a minimum of 4 consecutive SPT refusals, starting at depths ranging between 5m and 15m
- Groundwater level was identified in every borehole with the exception of S7. Water level depths range between 0 and 1.8m which, in terms of elevation, translates on 1.5 to 4.8m. These water level values should be carefully analysed as most likely these readings do not match with stabilized groundwater levels.

3.3 Laboratory testing

Laboratory testing was carried out using available undisturbed and disturbed soil samples recovered throughout rotary drilling, although one must admit that in geotechnical work there is no such thing as undisturbed soil sample. In reality undisturbed means a sample where care has been taken to minimize damage.

Undisturbed samples were collected using the Moran sampler when a geotechnical stratum of $N_{SPT}<15$ was intersected, as in these conditions a scenario of cohesive soils was expected; and also, when partially consolidated stratums were cut across by the T2 sampler.

Disturbed samples were obtained throughout drilling using either the T2 sampler or the Terzaghi sampler of the SPT surveys.

Figure 8 – Moran sampler used for undisturbed sampling

The following table resumes all sample locations and submitted laboratory testing.

Table 6 – Executed laboratory tests

Drill hole ref.	Sample ref. / Type of sample	Sample depth (m)	Soil laboratory tests						
			Grain size analysis	Atterberg limits	Moisture content	Specific gravity	Unconf. Compres. Strength	Direct Shear Strength (C.U.)	Consolid. test
S1	56727 / DS	2.4-3.0	✓	✓	✓	✓	-	-	-
	56724 / US	4.0-4.6	✓	✓	✓	✓	-	✓	-
	56725 / US	4.6-5.2	✓	✓	✓	✓	-	-	-
	56728 / DS	14.0-15.0	✓	✓	✓	✓	-	-	-
	56726 / ST2	17.6-18.0	✓	✓	✓	✓	-	✓	-
S2	56736 / US	4.0-5.2	✓	✓	✓	✓	-	-	-
	56740 / DS	9.4-10.0	✓	✓	✓	✓	-	-	-
	56737 / ST2	14.4-15.0	✓	✓	✓	✓	-	✓	-
S3	56741 / DS	1.4-2.0	✓	✓	✓	✓	-	-	-
	56738 / US	4.0-4.6	✓	✓	✓	✓	-	-	✓
	56742 / DS	6.7-7.0	✓	✓	✓	✓	-	-	-
	56739 / ST2	9.4-10.0	✓	✓	✓	✓	-	✓	-
S4	56764 / DS	2.4-3.0	✓	✓	✓	✓	-	-	-
	56753 / US	3.5-4.7	✓	✓	✓	✓	-	✓	-
	56754 / ST2	8.4-9.0	✓	✓	✓	✓	✓	✓	-
S5	56765 / DS	3.6-4.0	✓	✓	✓	✓	-	-	-
	56755 / US	4.0-4.2	✓	✓	✓	✓	-	-	-
	56756 / ST2	7.0-8.0	✓	✓	✓	✓	-	✓	-
S6	56730 / US	4.0-4.6	✓	✓	✓	✓	-	✓	✓
	56732 / DS	5..0-6.0	✓	✓	✓	✓	-	-	-
	56731 / ST2	8.4-9.0	✓	✓	✓	✓	✓	✓	-
	56733 / DS	11.5-12.0	✓	✓	✓	✓	-	-	-
S7	56757 / US	4.0-4.2	✓	✓	✓	✓	-	-	-
	56758 / US	4.8-5.4	✓	✓	✓	✓	-	✓	✓
	56766 / DS	7.7-8.0	✓	✓	✓	✓	-	-	-
	56759 / ST2	9.5-10.0	✓	✓	✓	✓	-	✓	-
S8	56767 / DS	3.6-3.9	✓	✓	✓	✓	-	-	-
	56760 / US	5.0-5.6	✓	✓	✓	✓	✓	-	✓
	56761 / ST2	8.4-9.0	✓	✓	✓	✓	-	✓	-
S9	56777 / US	4.5-5.1	✓	✓	✓	✓	-	-	✓
	56778 / ST2	7.5-8.5	✓	✓	✓	✓	-	✓	-
	56781 / DS	13.5-14.0	✓	✓	✓	✓	-	-	-
S10	56779 / US	5.0-6.2	✓	✓	✓	✓	✓	-	-
	56780 / ST2	8.5-9.0	✓	✓	✓	✓	-	✓	-
	56782 / DS	11.5-12.0	✓	✓	✓	✓	-	-	-
S11	56762 / US	4.0-5.1	✓	✓	✓	✓	-	✓	-
	56768 / DS	3.5-4.0	✓	✓	✓	✓	-	-	-
	56763 / ST2	9.5-10.0	✓	✓	✓	✓	✓	✓	-
	56769 / DS	17.4-17.8	✓	✓	✓	✓	-	-	-

Soil laboratory testing results are summarized in the following table. The complete laboratory data records are available in the appendix volume attached to this report.

Table 7 – Summarized results of laboratory testing

Sample reference / investigation point	Particle size distribution (% passing)			Atterberg limits		Classification		W_{nat} (%)	Gs (g/cm³)	Shear Strength parameters		qu (kPa)		Consolidation			
	0.074 mm	0.42 mm	2.0 mm	WL (%)	PI (%)	ASTM	AASHTO			c (kPa)	Φ (º)	qu (kPa)	E (kPa)	Cc	e_0	Cv (cm²/s)	K (cm/s)
56727 / S1	3	80	100	NP	NP	SP	A-3 (0)	22.8	2.67	-	-	-	-	-	-	-	-
56724 / S1	21	71	83	35	17	SC	A-2-6 (0)	24.0	2.74	42	22	-	-	-	-	-	-
56725 / S1	23	50	77	35	19	SC	A-2-6 (1)	20.0	2.75	-	-	-	-	-	-	-	-
56728 / S1	21	95	97	54	32	SC	A-2-7 (1)	23.4	2.72	-	-	-	-	-	-	-	-
56726 / S1	25	97	100	37	13	SC	A-2-6 (0)	26.6	2.75	52	37	-	-	-	-	-	-
56736 / S2	10	25	38	26	11	GP-GC	A-2-6 (0)	12.5	2.70	-	-	-	-	-	-	-	-
56740 / S2	26	83	92	44	19	SC	A-2-1 (1)	20.9	2.70	-	-	-	-	-	-	-	-
56737 / S2	16	96	100	41	18	SC	A-2-6 (0)	23.0	2.72	65	23	-	-	-	-	-	-
56741 / S3	28	44	63	NP	NP	SM	A-2-4 (0)	33.6	2.42	-	-	-	-	-	-	-	-
56738 / S3	21	79	86	27	12	SC	A-2-6 (0)	25.3	2.72	-	-	-	-	0.16	0.81	1.8E-3	5.9E-8
56742 / S3	26	44	58	26	13	SM	A-2-6 (0)	11.6	2.74	-	-	-	-	-	-	-	-
56739 / S3	22	90	96	42	18	SC	A-2-7 (1)	25.7	2.75	34	30	-	-	-	-	-	-
56764 / S4	1	72	98	NP	NP	SP	A-3 (0)	19.3	2.65	-	-	-	-	-	-	-	-
56753 / S4	22	56	65	35	14	SC	A-2-6 (0)	20.1	2.76	0	41	-	-	-	-	-	-
56754 / S4	21	93	97	39	17	SC	A-2-6 (0)	17.7	2.75	32	26	156	10968	-	-	-	-
56765 / S5	36	80	88	43	22	SC	A-7-6 (3)	26.1	2.72	-	-	-	-	-	-	-	-
56755 / S5	15	30	36	37	19	GC	A-2-6 (0)	14.0	2.73	-	-	-	-	-	-	-	-
56756 / S5	16	92	97	44	23	SC	A-2-7 (0)	25.2	2.76	13	33	-	-	-	-	-	-
56730 / S6	31	84	89	40	21	SC	A-2-6 (2)	27.0	2.74	20	35	-	-	0.17	0.9	7.8E-3	2.1E-7
56732 / S6	17	53	68	34	20	SC	A-2-6 (0)	23.4	2.73	-	-	-	-	-	-	-	-
56731 / S6	16	86	94	48	25	SC	A-2-7 (0)	24.3	2.75	37	22	51	9167	-	-	-	-
56733 / S6	19	96	99	38	16	SC	A-2-6 (0)	22.3	2.75	-	-	-	-	-	-	-	-
56757 / S7	12	28	37	37	18	GP-GC	A-2-6 (0)	14.4	2.72	-	-	-	-	-	-	-	-
56758 / S7	34	66	72	42	25	SC	A-2-7 (3)	24.0	2.74	17	36	-	-	0.15	0.77	8.5E-3	2.0E-7
56766 / S7	18	95	99	41	18	SC	A-2-7 (0)	20.8	2.72	-	-	-	-	-	-	-	-

56759 / S7	21	95	98	39	18	SC	A-2-6 (0)	24.7	2.71	23	36	- -	- -	- -
56767 / S8	29	65	74	28	12	SC	A-2-6 (0)	18.3	2.72	-	-	- -	- -	- -
56760 / S8	29	69	80	46	27	SC	A-2-7 (2)	23.5	2.74	-	-	45 7692	0.14 0.79	4.4E-3 8.2E-8
56761 / S8	19	96	100	40	20	SC	A-2-6 (0)	21.2	2.72	24	34	- -	- -	- -
56777 / S9	21	53	67	49	26	SC	A-2-7 (1)	21.2	2.70	-	-	- -	0.19 0.90	4.1E-3 1.9E-7
56778 / S9	18	97	98	44	21	SC	A-2-7 (0)	23.3	2.70	40	28	- -	- -	- -
56781 / S9	24	90	98	42	21	SC	A-2-7 (1)	25.0	2.72	-	-	- -	- -	- -
56779 / S10	20	40	60	46	26	SC	A-2-7 (1)	15.1	2.72	-	-	22 2667	- -	- -
56780 / S10	17	56	82	44	25	SC	A-2-7 (0)	15.5	2.71	38	34	- -	- -	- -
56782 / S10	21	94	98	48	22	SC	A-2-7 (1)	23.2	2.72	-	-	- -	- -	- -
56762 / S11	21	78	94	44	25	SC	A-2-7 (1)	29.0	2.73	15	34	- -	- -	- -
56768 / S11	31	68	83	45	25	SC	A-2-7 (2)	18.3	2.74	-	-	- -	- -	- -
56763 / S11	19	87	99	36	17	SC	A-2-6 (0)	18.4	2.70	25	34	120 13684	- -	- -
56769 / S11	25	95	97	43	19	SC	A-2-7 (1)	23.8	2.71	-	-	- -	- -	- -

The next figures present the grading curves of particle size distribution and the plasticity chart for the fine fraction of soils.

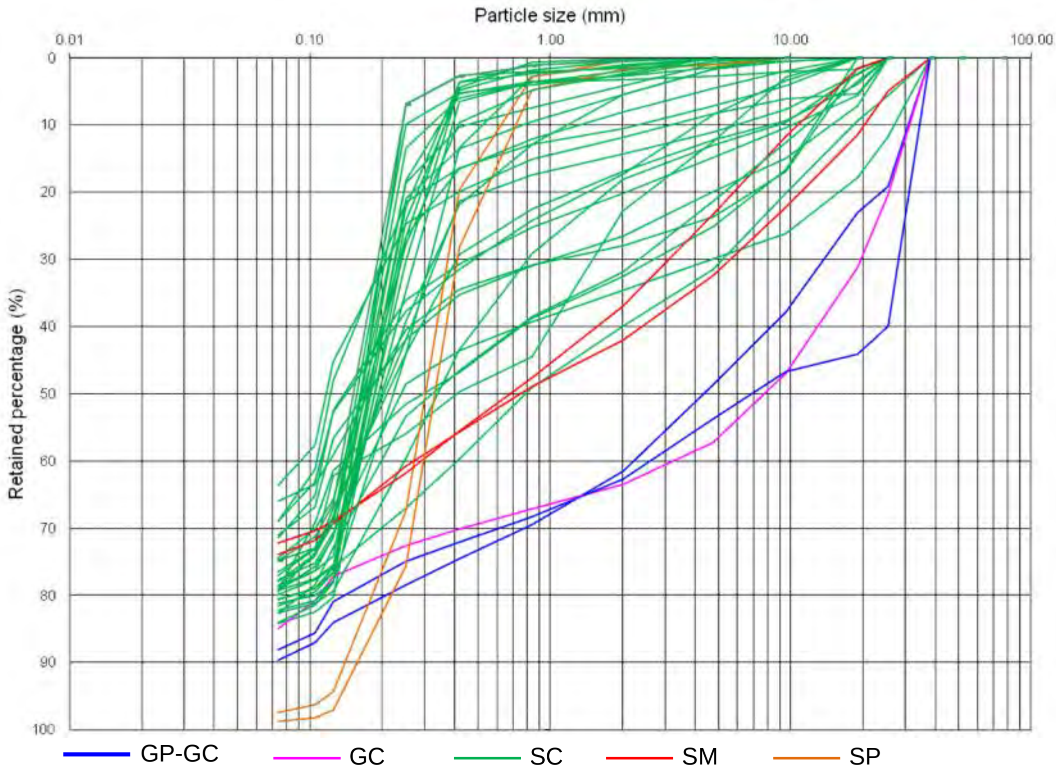

Figure 9 – Grading curves of particle size distribution

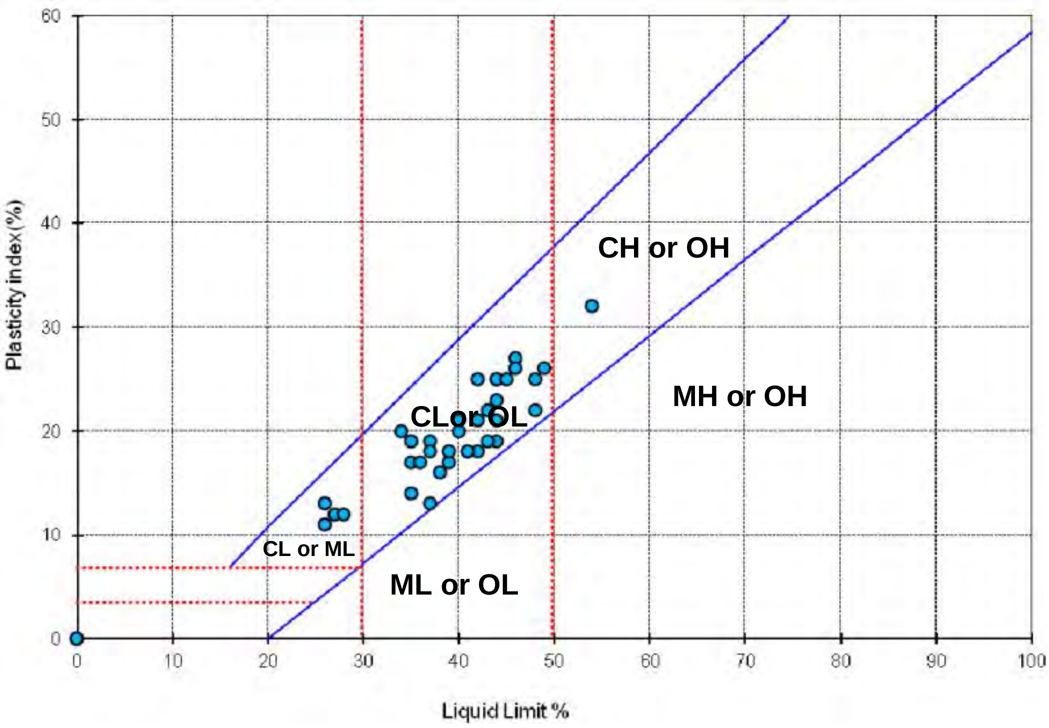

Figure 10 – Plasticity chart

Following figure exhibits the distribution of natural moisture content (in blue colour) within the computed Atterberg limits: liquid limit on the upper extreme and plastic limit on the lower extreme

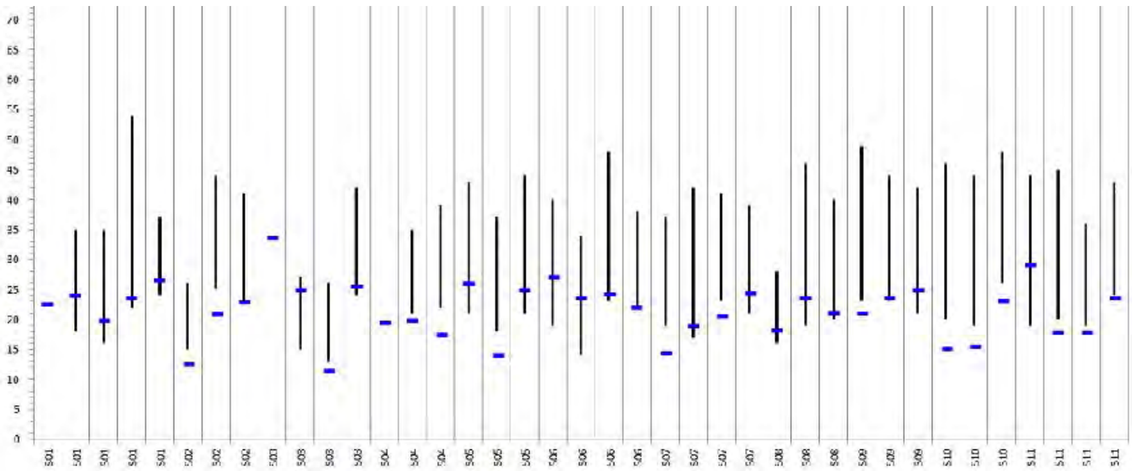

Figure 11 – Moisture content within Atterberg limits

4 Geotechnical Interpretation

4.1 General

The geotechnical deliberations set out in the following sub-chapters are based on the obtained data from the ground investigation works and laboratory testing specifically planned for this design.

It was also taken into consideration previous experience on similar geological settings by the geological team.

4.2 Geotechnical Zones

Local geotechnical conditions dictated a model comprising 5 geotechnical zones (GZ) outlined by its geology features and SPT results.

Table 8 exhibits the applied criterion when establishing these geotechnical zones.

Table 8 – Geotechnical zoning criterion

Geotechnical zone	Geology	N_{SPT}	N_{SPTc}
GZ5	Topsoil, landfill and organic soils	0 – 16	0 – 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 – 14
GZ 3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 – 25 [30]	[2] 5 – 24 [29]
GZ 2		30 – 48	26 – 48
GZ 1		54 - 60	49 - 60

[...] registered only once

These geotechnical zones are outlined in cross-sections A-A' to H-H' which can be consulted on the appended drawings referenced 02412.D01 and 02412.D02.

On a general note it's evident that the transition between geotechnical zones is not sequential, reflecting a high heterogeneity of geological materials and thus implying a wide range of soil shear strength parameters.

Geotechnical zone GZ5 represents the superficial soft soil horizon and includes materials such as topsoil and organic soil layers, landfill and earthwork debris. It was clearly identified in all of the surveyed area at depths that range from 1.5 to 3.5 m.

Geotechnical zone GZ4 represents a medium grained sandy soil that occurs on a loose to medium density state below GZ5, being identified throughout all of the surveyed area with the exception of the north-eastern sector, which comprises boreholes S10 and S11. Thickness varies between 0.5 and 2.5m and soil samples collected at matching depths mainly identified poorly graded sands (SP, on the Unified Soil Classification System (USC system))

Geotechnical zones GZ1 to GZ3 are mainly differentiated through SPT results as the sedimentary deposits exhibit an alternating sequence that tends to be repetitive in depth. It’s expected that soil resistance improves from GZ3 to GZ1.

Soil identification on these geotechnical zones mainly comprise clayey sands (SC, on the USC system) with occasional gravel resulted out of the disaggregation of consolidated or partially consolidated sedimentary formations such as sandstones and calcarenites resulting in GP-GC and GC soils (USC system).

Geotechnical zone GZ1 constitutes the most capable geotechnical horizon and occurs at depths ranging from 5 to 15 metres, coinciding with the final surveyed segment. On occasion GZ1 was identified on upper levels of the geotechnical model, usually associated with interbeds of sandstones and calcarenites or very dense sandy stratums, with limited lateral continuity.

4.3 Geotechnical Design Parameters

To the greatest extent possible, geotechnical design parameters resulted of the analysis of N_{SPTc} corrected values, laboratory tests and published analytical procedures.

The geological and geotechnical design team also incurred on previous design experienced acquired on identical terrain conditions.

Table 9 presents the design values for the most relevant geotechnical parameters.

Table 9 – Geotechnical design parameters

GZ	γ_{wet} (kN/m^3)	Shear Strengh parameters *Mohr-Coulomb*			Stress-strain modulus E_s (kPa)	Ultimate static tip capacity - P_{pu} (kN)	
		Dominantly granular soils		Dominantly cohesive soils		Based on an analytical approach =	Based on N_{SPTc} results =
		c (KPa)	¤ (º)	c_u (kPa)			
GZ5	14-18	0	26 – 30	-	2000 – 6000	Not considered	
GZ4			26 – 32	-			
GZ3	17 – 19	0 – 20	22 – 34	11 – 22	2600 – 7700		
GZ2	19 – 20	20 – 40		40 – 175	9100 – 15000	520 - 1540	1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 -17500	850 - 2600	2100 - 2500

Wet unit weight was estimated through relative density evaluated from N_{SPTc} results and represents the soil in situ unit weight.

Shear strength parameters are presented for either drained and undrained conditions because geological survey data indicates a wide variety of lithological materials with an extensive range of fine percentages. This means that for Geotechnical Zone GZ3, 2 and 1 both conditions should be taken into account, depending on the intersected geology.

For dominantly granular soils these parameters were evaluated out of the laboratory test results. For cohesive soils, laboratory test results were considered as well as the correlation purposed by Bowles of $Cu=5.74.N_{SPTc}$.

For the assessment of the stress-strain modulus the relationship for saturated sands purposed by Bowles of $Es= 250(N_{SPTc}+15)$ was used for GZ1 and GZ2. Other geotechnical horizons required laboratory test results (GZ3) and normalized correlations for superficial soils (GZ4 and 5) for the estimation of such property.

Ultimate static point capacity (P_{pu}) was computed through 2 different approaches. One based on the Mohr-Coulomb failure stress parameters and using Hansen's bearing capacity factors incurs on the following equation:

$$P_{pu} = A_p.(c.N_c.d_c + q.N_q.d_q+0.5.\gamma.B_p.N_\gamma)$$

Where:

A_p – is the area of pile tip effective in bearing

N_c, N_q and N_γ – are bearing capacity factors

d_c and d_q – are depth factors
B_p – is the width of pile tip
q – is the vertical effective pressure at pile toe

When making this point resistance computations it was assumed the following conditions:

- Groundwater level was 2 metres below ground surface
- Considered pile depth was 10 metres
- Considered pile width was 0.6 metres
- Considered pile shape was with a round cross-section.

The other approach considers N_{SPTC} values and uses the following equation (JICA Study team):

$$P_{pu} = 150.N_{SPTc}.A_p$$

Where:
N_{SPTc} – are the corrected SPT values for a given geotechnical zone
A_p – is the area of pile point effective in bearing

Pile skin resistance capacity (kPa) may be estimated using N_{SPTc} results through Meyerhof's suggestion for sandy soils:

$$f_s = X_m N_{55}$$

Where
X_m – a factor of 2.0 for piles with large-volume displacement; and 1.0 for small volume piles
N_{55} – statistical average of the blow count in the upper stratums, corrected for 55% SPT energy efficiency

Considering this a pile skin resistance of 20 to 30 kPa should be accounted for depths of 10 metres.

4.4 Foundations

Given the geological and geotechnical design model it is recommended that deep foundations are taken into consideration in order to guarantee the ultimate support for any considered structure, although subjected to the following conditions:

- Geotechnical zones GZ5, GZ4 and GZ3 are not suitable as a foundation soil and do not provide a suitable loading support.
- Geotechnical zones GZ2 or GZ1 are required to be intersected by the pile toe by at least 3 to 5 times the pile diameter.
- Minimum pile diameter shall be of 0.6m

The allowable pile capacity (P_a) may be estimated using the following equation:

$$P_a = 1/3.P_{pu}+1/3.P_s$$

On the presented geotechnical and geological scenario the following allowable pile capacity may be considered.

- Geotechnical zone ZG2: 650 – 1800 kPa
- Geotechnical zone ZG1: 1000 – 3000 kPa

Awareness of Mozambique equipment availability suggests that the most indicated pile type is the cast in place concrete pile. Nevertheless a few cautions should be taken into consideration involving site location, namely expected high groundwater levels.

4.5 Excavations

Obtaining the recommended foundation depths will require terrain excavation. Considering the known geological model, excavations are expected to be done through direct mechanical digging using an excavator with a blade or a bucket.

Cut slopes are to assume minimum geometries of 1V:1.5H and provisions should be made to minimize rainwater and surface water flows. Vertical faces of excavations will unconditionally require support solutions.

Excavations should be kept dry during the construction period. If by chance groundwater level rises up to the bottom of the footing or surface water inflows into the excavation, dewatering must be assured either by impervious water barriers, drainage wells such as sump pits or any other efficient methods.

4.6 Reuse of soils

In case a reuse of excavated soils is intended, Table 10 presents an engineering use chart for compacted soils in relation with the Unified Soil Classification (ASTM), adapted from Lambe & Whitman, 1979.

Table 10 - Engineering use chart for compacted soil

Engineering Properties of Compacted Soil					
Soil group name	**Group symbol**	**Permeability**	**Shear strength (saturated)**	**Compressibility (saturated)**	**Workability as a construction material**
Well-graded gravel	GW	Pervious	Excellent	Negligible	Excellent
Poorly graded gravel	GP	Pervious	Good	Negligible	Good
Silty gravel	GM	Semipervious to impervious	Good	Negligible	Good
Clayey gravel	GC	Impervious	Good to fair	Very low	Good
Well-graded sands	SW	Pervious	Excellent	Negligible	Excellent
Poorly graded sands	SP	Pervious	Good	Very low	Fair
Silty sands	SM	Semipervious to impervious	Good	Low	Fair
Clayey sands	SC	Impervious	Good to fair	Low to medium	Good
Silt	ML	Semipervious to impervious	Fair	Medium	Fair
Lean clay	CL	Impervious	Fair	Medium	Good to fair
Organic silt and organic clay	OL	Semipervious to impervious	Poor	Medium to high	Fair
Elastic silt	MH	Semipervious to impervious	Fair to poor	High	Poor
Fat clay	CH	Impervious	Poor	High	Poor
Organic silt and organic clay	OH	Impervious	Poor	High	Poor
Peat and other highly organic soils	PT	-	-	-	-

Granular soils comprising well graded gravels (GW) down to clayey sands (SC) should be given priority when soil reuse is considered on embankments, even though soils such as ML and CL will still provide acceptable geotechnical properties, depending on its particular use.

High plastic and organic soils should be regarded as unsuitable for any construction work as they settle unduly even under their own weight and not be considered reusable.

Maputo, December, 2012

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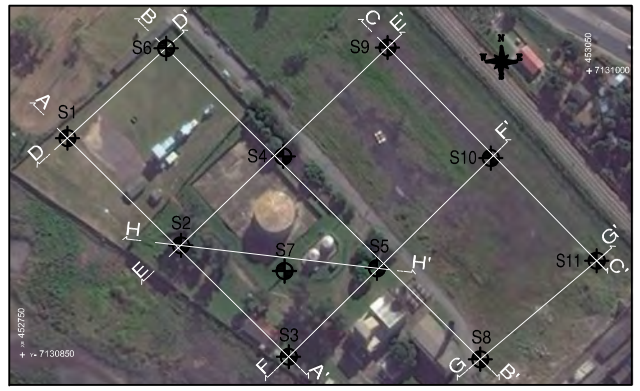
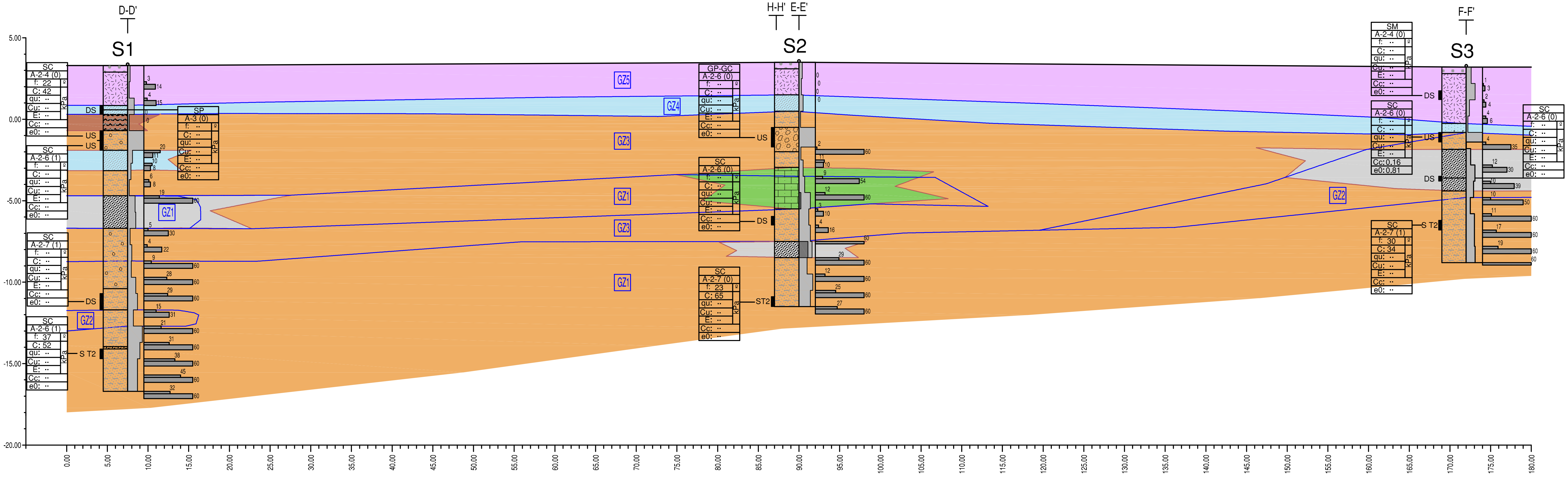
Geographic Features of Ground Investigation Works

Reference		Coordinates X	Coordinates Y	Coordinates Z	Remarks
rotary drillhole	S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4 - 5.2m (depth)
	S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4 - 5.2m (depth)
	S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4 - 4.5m (depth)
	S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
	S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4 - 4.6m (depth)
	S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4 - 4.6m and 8.5 - 9.0 m (depth)
	S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 – 5.5 m(depth)
	S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
	S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4,5 - 5.1m (depth)
	S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
	S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



CROSS-SECTION A-A'



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N_{SPT}	N_{SPTc}
GZ5	Topsoil, landfill and organic soils	0 – 16	0 – 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 – 14
GZ 3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 – 25 [30]	[2] 5 – 24 [29]
GZ 2		30 – 48	26 – 48
GZ 1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ_{wet} (kN/m³)	Shear Strengh parameters *Mohr-Coulomb*: Dominantly granular soils: c (KPa)	Dominantly granular soils: ϕ (º)	Dominantly cohesive soils: c_u (kPa)	Stress-strain modulus E_s (kPa)	Ultimate static tip capacity - P_{pu} (kN): Based on an analytical approach	Based on N_{SPTc} results
GZ5	14-18	0	26 – 30	-	2000 – 6000	Not considered	
GZ4			26 – 32	-			
GZ3	17 – 19	0 – 20	22 – 34	11 – 22	2600 – 7700		
GZ2	19 – 20	20 – 40		40 – 175	9100 – 15000	520 - 1540	1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 -17500	850 - 2600	2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

NO.	REV.	DESCRIPTIONS

PROJECT
GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

REVISION
0

DRAWING TITLE
INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTION A-A'

SCALE
H=1:250
V=1:125
1:2000

DRAWING NO.
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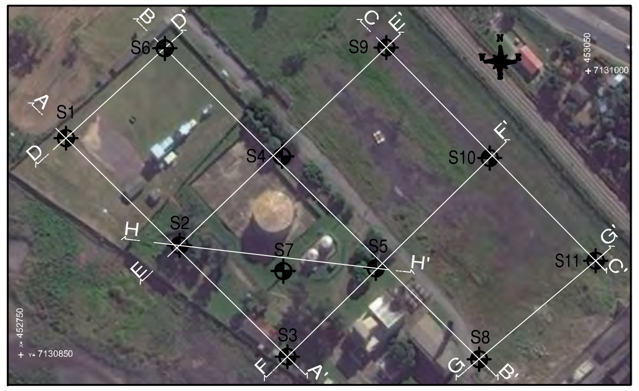
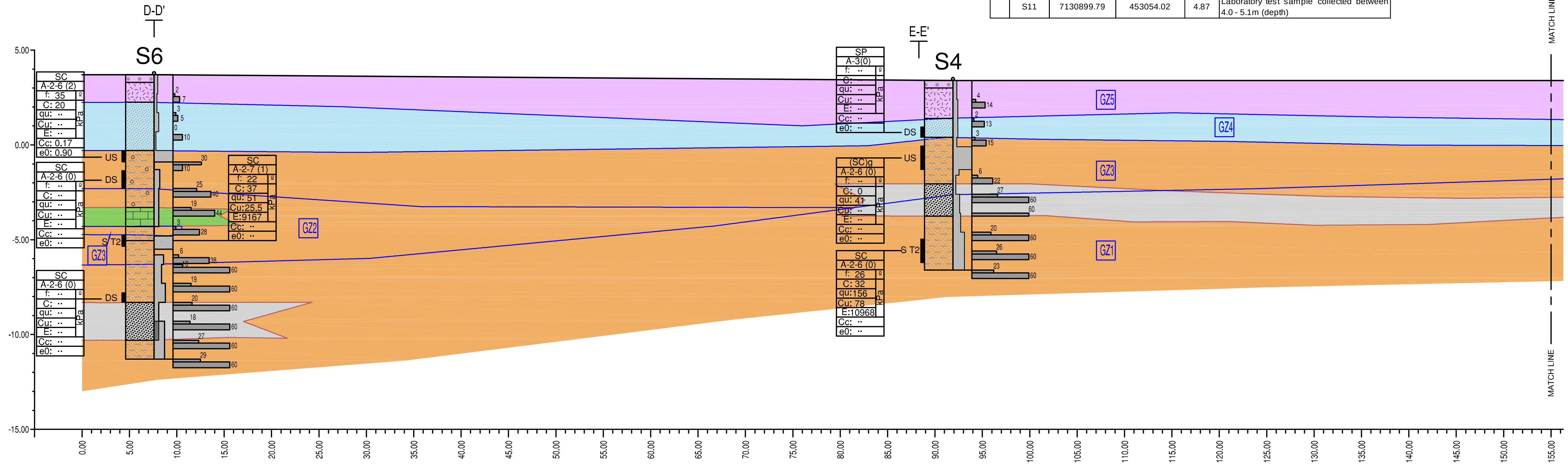
APP4-30

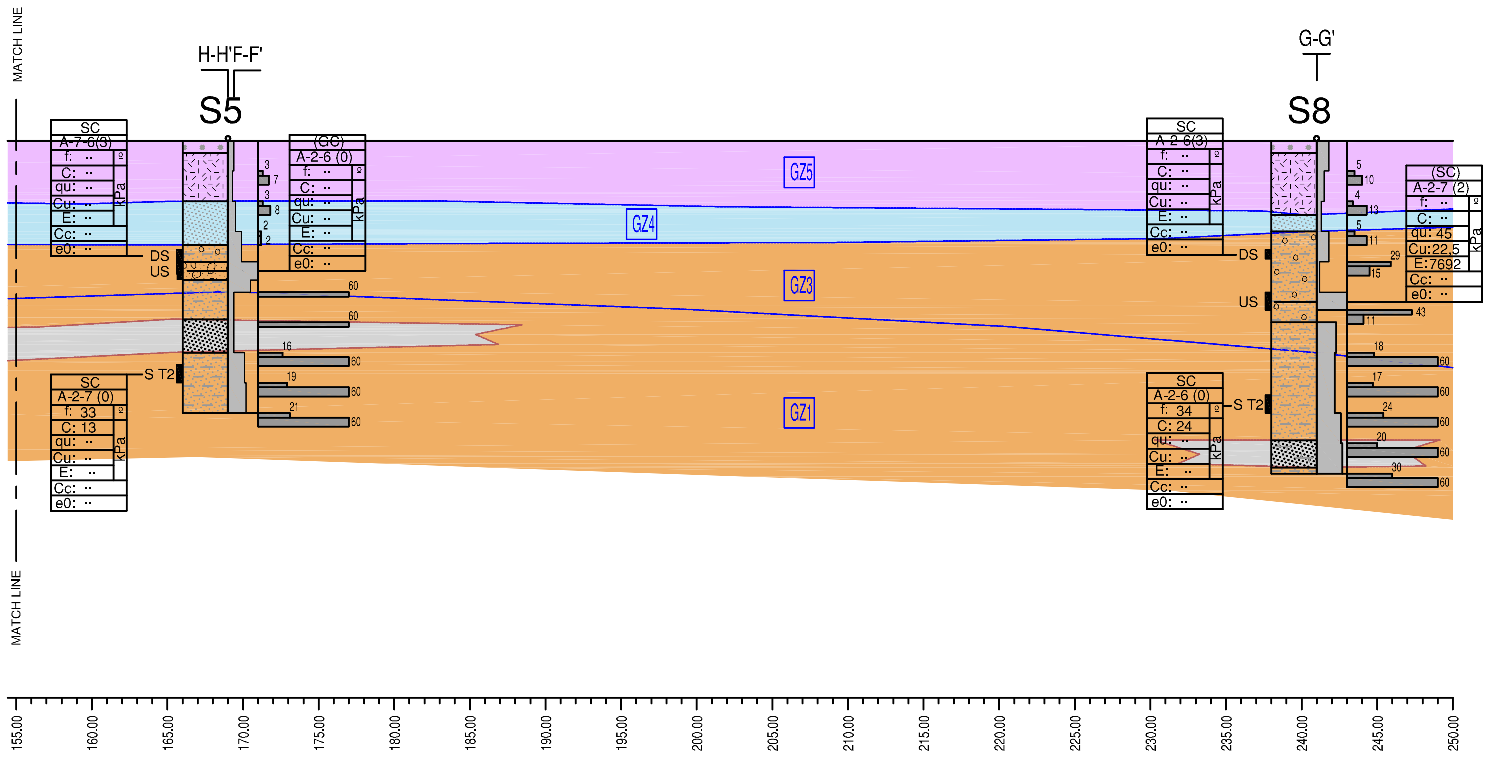
Geographic Features of Ground Investigation Works

Reference		Coordinates X	Coordinates Y	Coordinates Z	Remarks
rotary drillhole	S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4 - 5.2m (depth)
	S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4 - 5.2m (depth)
	S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4 - 4.5m (depth)
	S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
	S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4 - 4.6m (depth)
	S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4 - 4.6m and 8.5 - 9.0 m (depth)
	S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 – 5.5 m(depth)
	S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
	S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4,5 - 5.1m (depth)
	S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
	S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



CROSS-SECTION B-B'





Geotechnical Zoning Criterion

Geotechnical zone	Geology	N_{SPT}	N_{SPTc}
GZ5	Topsoil, landfill and organic soils	0 – 16	0 – 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 – 14
GZ 3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 – 25 [30]	[2] 5 – 24 [29]
GZ 2		30 – 48	26 – 48
GZ 1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ_{wet} (kN/m^3)	Shear Strengh parameters *Mohr-Coulomb*: Dominantly granular soils c (KPa)	Dominantly granular soils ϕ (º)	Dominantly cohesive soils c_u (kPa)	Stress-strain modulus E_s (kPa)	Ultimate static tip capacity - P_{pu} (kN): Based on an analytical approach	Based on N_{SPTc} results
GZ5	14-18	0	26 – 30	-	2000 – 6000	Not considered	
GZ4			26 – 32	-			
GZ3	17 – 19	0 – 20	22 – 34	11 – 22	2600 – 7700		
GZ2	19 – 20	20 – 40		40 – 175	9100 – 15000	520 - 1540	1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 -17500	850 - 2600	2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

NO.	REV.	DESCRIPTIONS

PROJECT
GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

REVISION
0

DRAWING TITLE
INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS B-B'

SCALE
H=1:250
V=1:125
1:2000

DRAWING NO.
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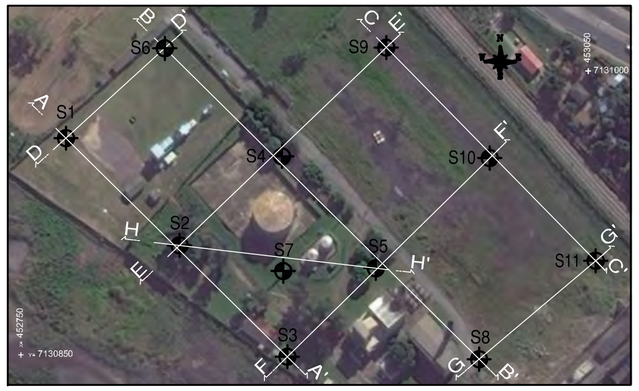
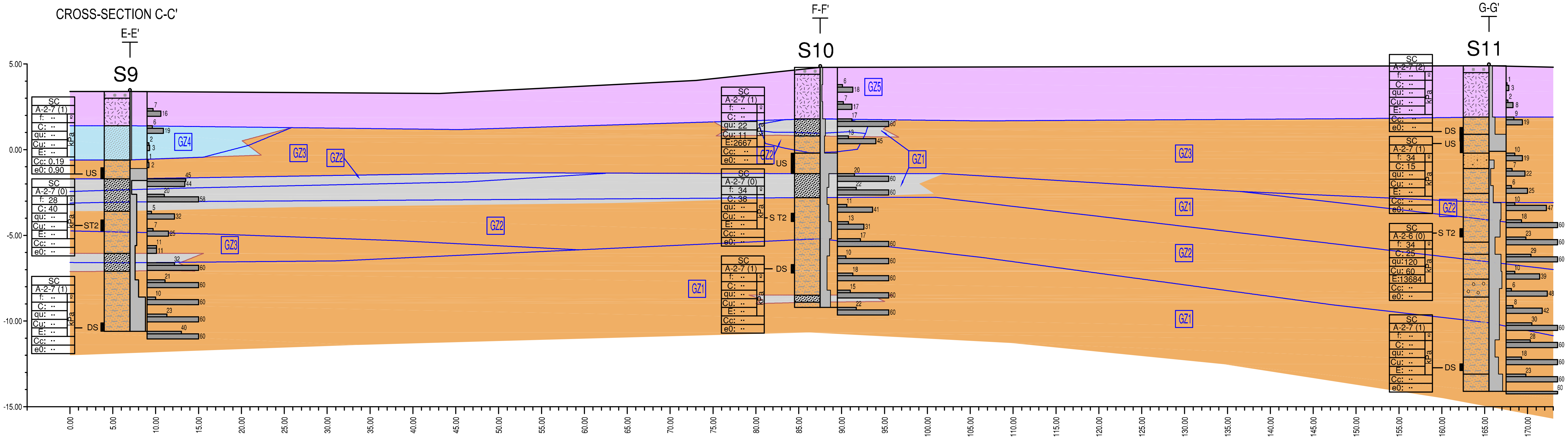
Geographic Features of Ground Investigation Works

Reference		Coordinates X	Coordinates Y	Coordinates Z	Remarks
rotary drillhole	S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4 - 5.2m (depth)
	S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4 - 5.2m (depth)
	S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4 - 4.5m (depth)
	S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
	S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4 - 4.6m (depth)
	S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4 - 4.6m and 8.5 - 9.0 m (depth)
	S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 – 5.5 m(depth)
	S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
	S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4,5 - 5.1m (depth)
	S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
	S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



CROSS-SECTION C-C'



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N_{SPT}	N_{SPTc}
GZ5	Topsoil, landfill and organic soils	0 – 16	0 – 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 – 14
GZ 3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 – 25 [30]	[2] 5 – 24 [29]
GZ 2		30 – 48	26 – 48
GZ 1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ_{wet} (kN/m^3)	Shear Strengh parameters *Mohr-Coulomb*: Dominantly granular soils c (KPa)	Dominantly granular soils ϕ (º)	Dominantly cohesive soils c_u (kPa)	Stress-strain modulus E_s (kPa)	Ultimate static tip capacity - P_{pu} (kN): Based on an analytical approach	Based on N_{SPTc} results
GZ5	14-18	0	26 – 30	-	2000 – 6000	Not considered	
GZ4			26 – 32	-			
GZ3	17 – 19	0 – 20	22 – 34	11 – 22	2600 – 7700		
GZ2	19 – 20	20 – 40		40 – 175	9100 – 15000	520 - 1540	1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 -17500	850 - 2600	2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

NO.	REV.	DESCRIPTIONS

PROJECT: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

REVISION: 0

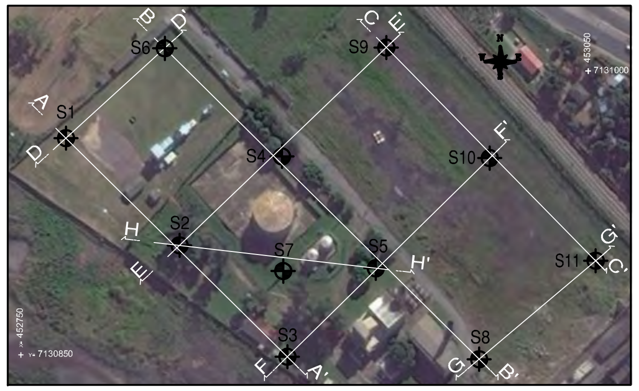
DRAWING TITLE: INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS C-C'

SCALE: H=1:250 V=1:125 1:2000

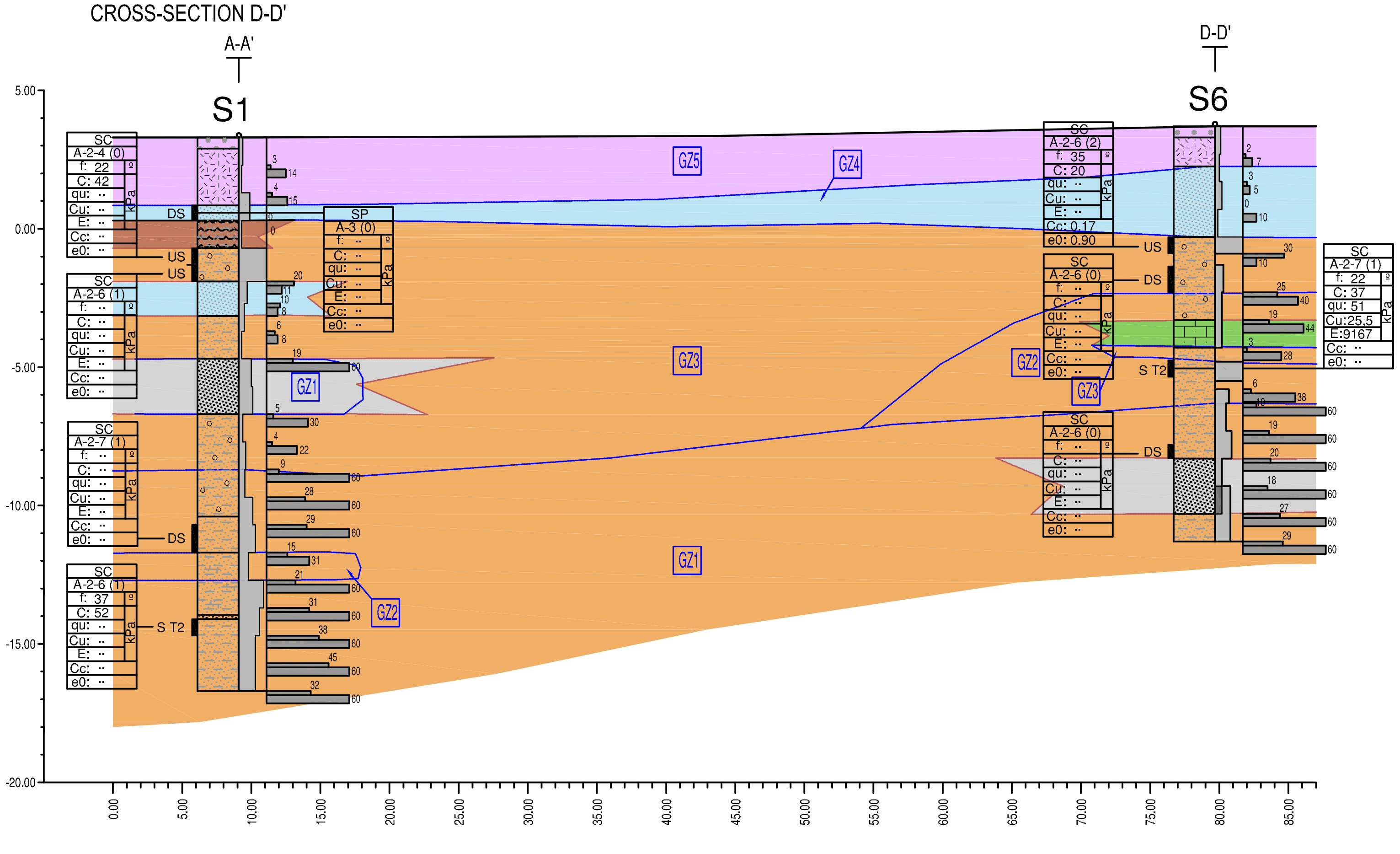
DRAWING NO. —

Geographic Features of Ground Investigation Works

Reference		Coordinates X	Coordinates Y	Coordinates Z	Remarks
rotary drillhole	S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4 - 5.2m (depth)
	S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4 - 5.2m (depth)
	S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4 - 4.5m (depth)
	S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
	S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4 - 4.6m (depth)
	S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4 - 4.6m and 8.5 - 9.0 m (depth)
	S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 – 5.5 m(depth)
	S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
	S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4,5 - 5.1m (depth)
	S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
	S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



CROSS-SECTION D-D'



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N_{SPT}	N_{SPTc}
GZ5	Topsoil, landfill and organic soils	0 – 16	0 – 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 – 14
GZ 3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 – 25 [30]	[2] 5 – 24 [29]
GZ 2		30 – 48	26 – 48
GZ 1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ_{wet} (kN/m^3)	Shear Strengh parameters *Mohr-Coulomb* – Dominantly granular soils: c (KPa)	Dominantly granular soils: ϕ (º)	Dominantly cohesive soils: c_u (kPa)	Stress-strain modulus E_s (kPa)	Ultimate static tip capacity - P_{pu} (kN): Based on an analytical approach	Based on N_{SPTc} results
GZ5	14-18	0	26 – 30	-	2000 – 6000	Not considered	
GZ4			26 – 32	-			
GZ3	17 – 19	0 – 20	22 – 34	11 – 22	2600 – 7700		
GZ2	19 – 20	20 – 40		40 – 175	9100 – 15000	520 - 1540	1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 -17500	850 - 2600	2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

NO.	REV.	DESCRIPTIONS

PROJECT: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

REVISION: 0

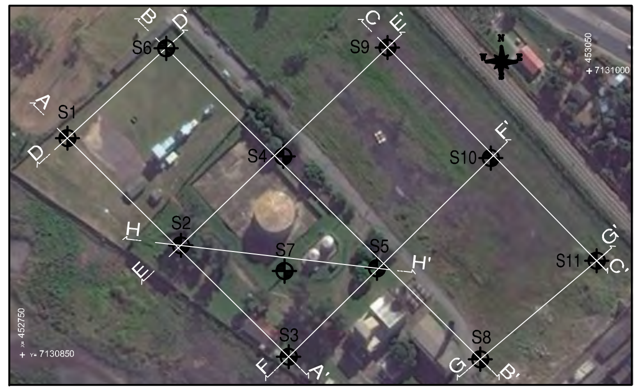
DRAWING TITLE: INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS D-D'

SCALE: H=1:250 V=1:125 1:2000

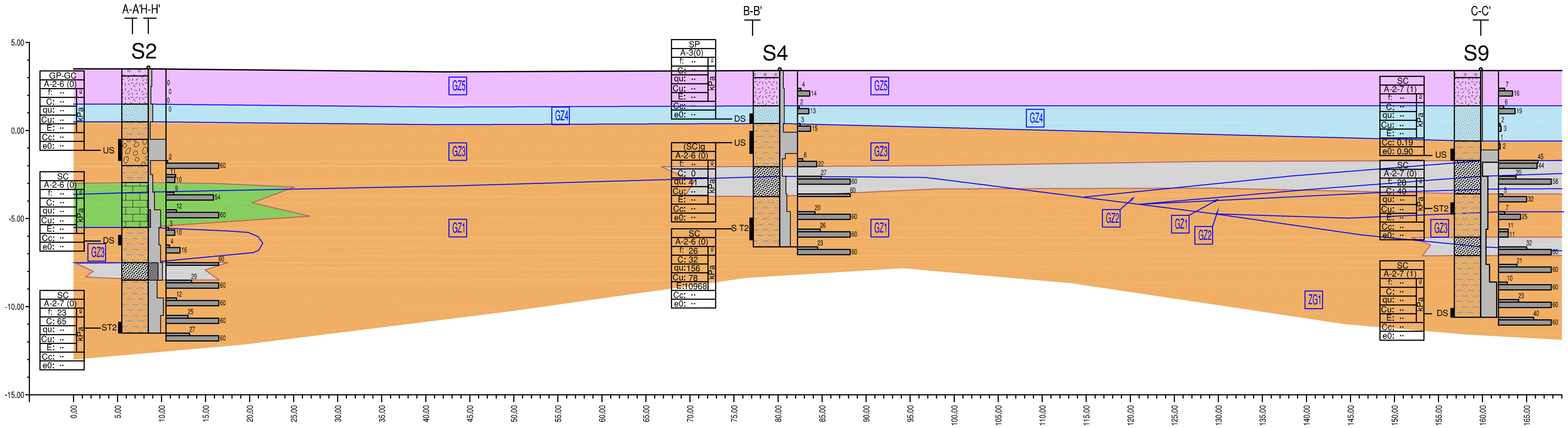
DRAWING NO. —

Geographic Features of Ground Investigation Works

Reference		Coordinates X	Coordinates Y	Coordinates Z	Remarks
rotary drillhole	S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4 - 5.2m (depth)
	S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4 - 5.2m (depth)
	S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4 - 4.5m (depth)
	S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
	S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4 - 4.6m (depth)
	S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4 - 4.6m and 8.5 - 9.0 m (depth)
	S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 – 5.5 m(depth)
	S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
	S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4,5 - 5.1m (depth)
	S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
	S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



CROSS-SECTION E-E'



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N_{SPT}	N_{SPTc}
GZ5	Topsoil, landfill and organic soils	0 – 16	0 – 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 – 14
GZ 3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 – 25 [30]	[2] 5 – 24 [29]
GZ 2		30 – 48	26 – 48
GZ 1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ_{wet} (kN/m^3)	Shear Strengh parameters *Mohr-Coulomb* – Dominantly granular soils – c (KPa)	Shear Strengh parameters *Mohr-Coulomb* – Dominantly granular soils – ϕ (º)	Shear Strengh parameters *Mohr-Coulomb* – Dominantly cohesive soils – c_u (kPa)	Stress-strain modulus E_s (kPa)	Ultimate static tip capacity - P_{pu} (kN) – Based on an analytical approach	Ultimate static tip capacity - P_{pu} (kN) – Based on N_{SPTc} results
GZ5	14-18	0	26 – 30	-	2000 – 6000	Not considered	
GZ4			26 – 32	-			
GZ3	17 – 19	0 – 20	22 – 34	11 – 22	2600 – 7700		
GZ2	19 – 20	20 – 40		40 – 175	9100 – 15000	520 - 1540	1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 -17500	850 - 2600	2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

NO.	REV.	DESCRIPTIONS

PROJECT
GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

REVISION
0

DRAWING TITLE
INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS E-E'

SCALE
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DRAWING NO.
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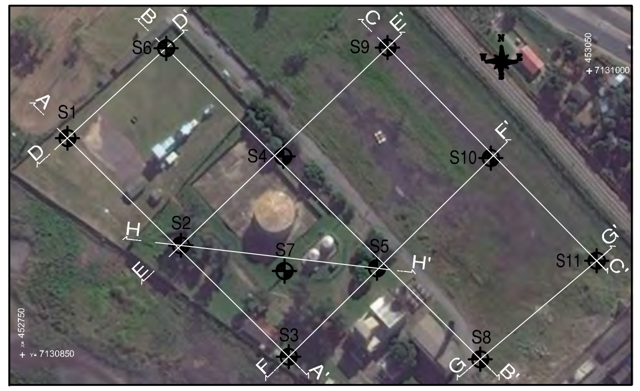

Geographic Features of Ground Investigation Works

Reference		Coordinates X	Coordinates Y	Coordinates Z	Remarks
rotary drillhole	S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4 - 5.2m (depth)
	S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4 - 5.2m (depth)
	S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4 - 4.5m (depth)
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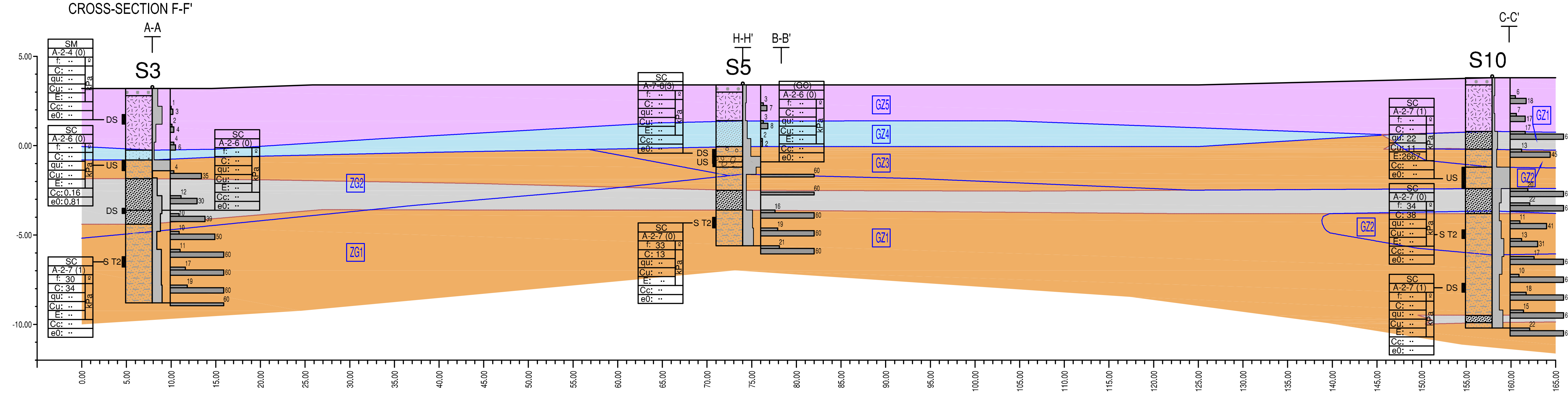
	S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)

CROSS-SECTION F-F'



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N_{SPT}	N_{SPTc}
GZ5	Topsoil, landfill and organic soils	0 – 16	0 – 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 – 14
GZ 3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 – 25 [30]	[2] 5 – 24 [29]
GZ 2		30 – 48	26 – 48
GZ 1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ_{wet} (kN/m^3)	Shear Strengh parameters *Mohr-Coulomb*: Dominantly granular soils, c (KPa)	Dominantly granular soils, ϕ (º)	Dominantly cohesive soils, c_u (kPa)	Stress-strain modulus E_s (kPa)	Ultimate static tip capacity - P_{pu} (kN): Based on an analytical approach	Based on N_{SPTc} results
GZ5	14-18	0	26 – 30	-	2000 – 6000	Not considered	
GZ4			26 – 32	-			
GZ3	17 – 19	0 – 20	22 – 34	11 – 22	2600 – 7700		
GZ2	19 – 20	20 – 40		40 – 175	9100 – 15000	520 - 1540	1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 -17500	850 - 2600	2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

NO.	REV.	DESCRIPTIONS	PROJECT	REVISION
			GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE	0
			DRAWING TITLE: INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS F-F' — SCALE H=1:250 V=1:125 1:2000	DRAWING NO. —

Geographic Features of Ground Investigation Works

Reference		Coordinates X	Coordinates Y	Coordinates Z	Remarks
rotary drillhole	S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4 - 5.2m (depth)
	S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4 - 5.2m (depth)
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	S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4 - 4.6m (depth)
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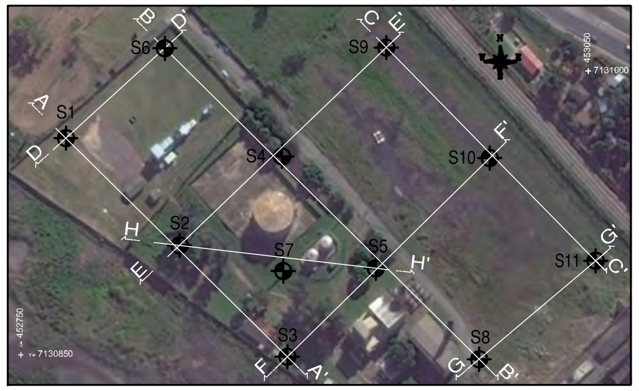
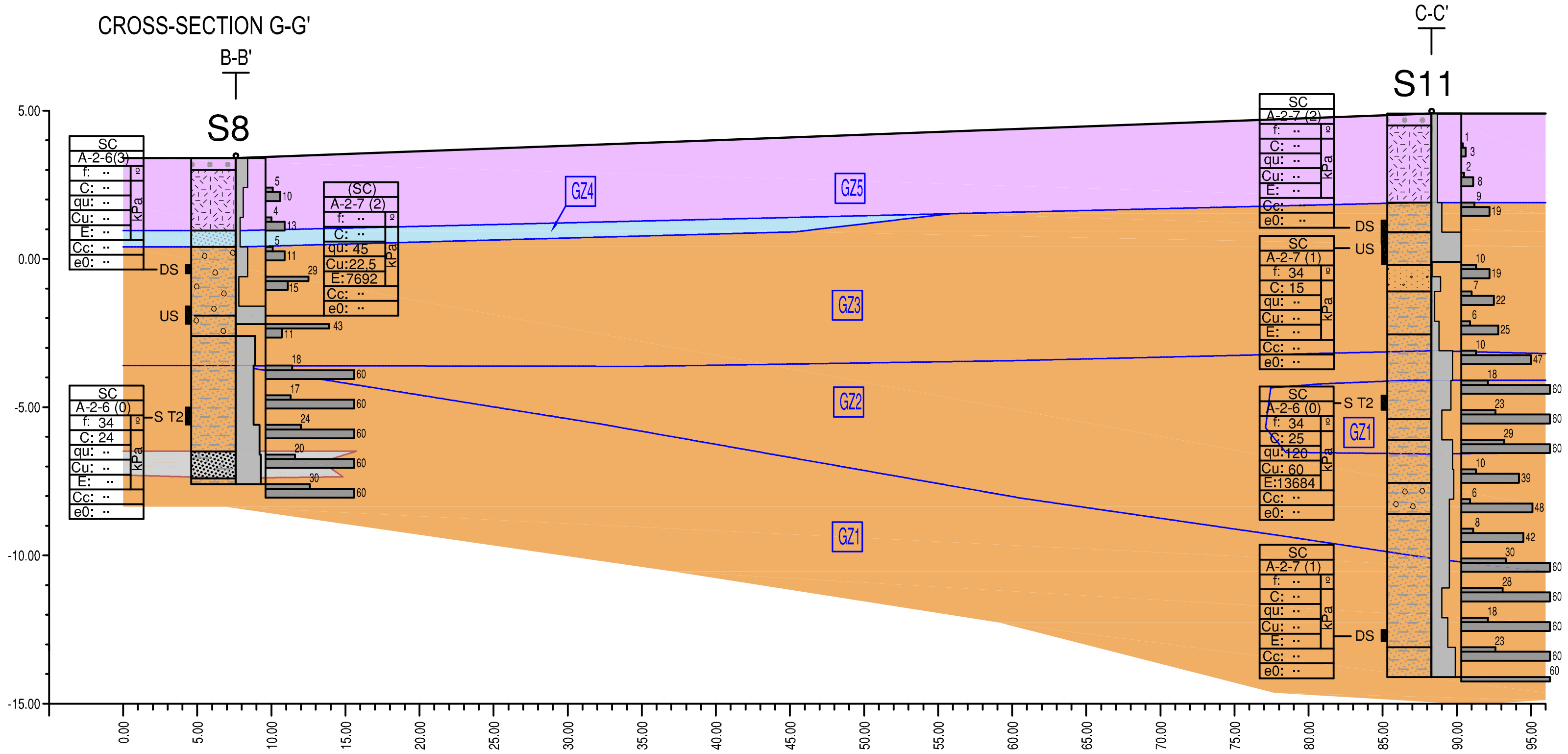
	S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



CROSS-SECTION G-G'



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N_{SPT}	N_{SPTc}
GZ5	Topsoil, landfill and organic soils	0 – 16	0 – 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 – 14
GZ 3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 – 25 [30]	[2] 5 – 24 [29]
GZ 2		30 – 48	26 – 48
GZ 1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ_{wet} (kN/m^3)	Shear Strengh parameters *Mohr-Coulomb*: Dominantly granular soils, c (KPa)	Dominantly granular soils, ϕ (º)	Dominantly cohesive soils, c_u (kPa)	Stress-strain modulus E_s (kPa)	Ultimate static tip capacity - P_{pu} (kN): Based on an analytical approach	Based on N_{SPTc} results
GZ5	14-18	0	26 – 30	-	2000 – 6000	Not considered	
GZ4			26 – 32	-			
GZ3	17 – 19	0 – 20	22 – 34	11 – 22	2600 – 7700		
GZ2	19 – 20	20 – 40		40 – 175	9100 – 15000	520 - 1540	1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 -17500	850 - 2600	2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

NO.	REV.	DESCRIPTIONS

PROJECT: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

REVISION: 0

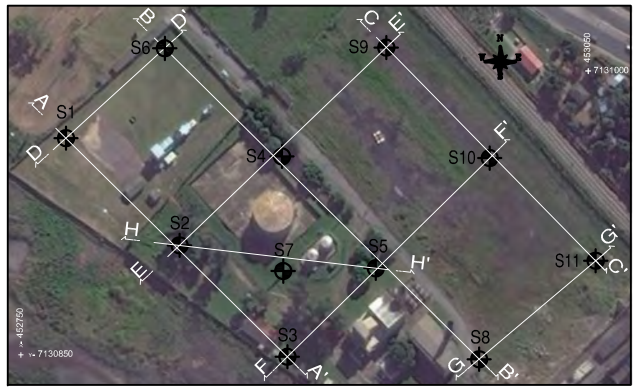
DRAWING TITLE: INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS G-G'

SCALE: H=1:250 V=1:125 1:2000

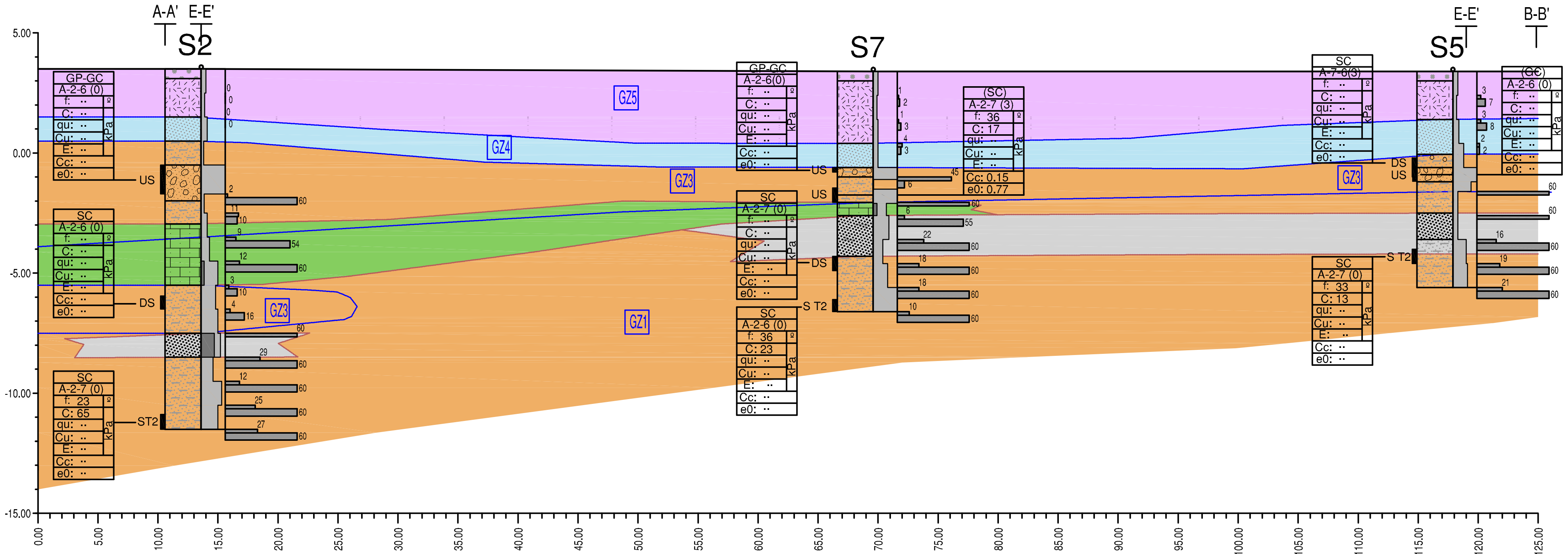
DRAWING NO. —

Geographic Features of Ground Investigation Works

Reference		Coordinates X	Coordinates Y	Coordinates Z	Remarks
rotary drillhole	S1	7130964.57	452773.81	3.32	Laboratory test sample collected between 4 - 5.2m (depth)
	S2	7130907.99	452833.93	3.55	Laboratory test sample collected between 4 - 5.2m (depth)
	S3	7130849.02	452891.05	3.2	Laboratory test sample collected between 4 - 4.5m (depth)
	S4	7130955.9	452888.1	3.35	Laboratory test sample collected between 3.5 - 4.7m (depth)
	S5	7130895.83	452937.72	3.42	Laboratory test sample collected between 4 - 4.6m (depth)
	S6	7131012.04	452826.08	3.68	Laboratory test sample collected between 4 - 4.6m and 8.5 - 9.0 m (depth)
	S7	7130894.29	452888.71	3.44	Laboratory test sample collected between 4 and 4.4m and 4.8 – 5.5 m(depth)
	S8	7130847.74	452992.31	3.35	Laboratory test sample collected between 5.0 - 5.5m (depth)
	S9	7131012.36	452943.24	3.4	Laboratory test sample collected between 4,5 - 5.1m (depth)
	S10	7130954.03	452997.92	4.81	Laboratory test sample collected between 5.0 - 6.2m (depth)
	S11	7130899.79	453054.02	4.87	Laboratory test sample collected between 4.0 - 5.1m (depth)



CROSS-SECTION H-H'



Geotechnical Zoning Criterion

Geotechnical zone	Geology	N_{SPT}	N_{SPTc}
GZ5	Topsoil, landfill and organic soils	0 – 16	0 – 12
GZ 4	Medium grained sand, poorly graded on a loose density state	0 - 19	0 – 14
GZ 3	Fine grained clayey sand with sandstone and calcarenite interbeds.	[2] 6 – 25 [30]	[2] 5 – 24 [29]
GZ 2		30 – 48	26 – 48
GZ 1		54 - 60	49 - 60

Geotechnical Design Parameters

GZ	γ_{wet} (kN/m^3)	Shear Strengh parameters *Mohr-Coulomb* – Dominantly granular soils: c (KPa)	Dominantly granular soils: ϕ (º)	Dominantly cohesive soils: c_u (kPa)	Stress-strain modulus E_s (kPa)	Ultimate static tip capacity - P_{pu} (kN): Based on an analytical approach	Based on N_{SPTc} results
GZ5	14-18	0	26 – 30	-	2000 – 6000	Not considered	
GZ4			26 – 32	-			
GZ3	17 – 19	0 – 20	22 – 34	11 – 22	2600 – 7700		
GZ2	19 – 20	20 – 40		40 – 175	9100 – 15000	520 - 1540	1100 - 2000
GZ1	20 - 22	13 - 65	23 - 37	60 - 360	12000 -17500	850 - 2600	2100 - 2500

GEO REFERENCE: WGS 84
PAPER SIZE: A1

NO.	REV.	DESCRIPTIONS

PROJECT: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE

REVISION: 0

DRAWING TITLE: INTERPRETED GEOLOGICAL AND GEOTECHNICAL CROSS-SECTIONS H-H'

SCALE: H=1:250 V=1:125 1:2000

DRAWING NO. —

Client: ORIENTAL CONSULTANTS CO. Ltd

Job: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE - GEOTECHNICAL SURVEY

Process: 25512

Sample Type : Undisturbed

Laboratory Test Results

Borehole (Nº)	Sample (Nº)	Depth (m)	Description	Lit.-str.	Classif. Unified RTR AASHTO	W Sr EA (%)	ρ ρ_d (g/cm³) Dens. Part. G	W_L I_P V_S (%)	VB (g/100g) MO (%) Ph	Particle size Characteristics <2.0 mm <0.42 mm (%)	<0.074 mm <0.002 mm (%)	dim. bigger part. Max. Min. (mm)	Comp. Wopt (%) γ_{dmax} (kN/m³) Light Heavy	CBR CR (%)	Desv. Wopt (%)	CBR	Expansibility (%)	CBR at 95% Penet.	Consolidation Cc eo	Cv (cm²/s) K (cm/s)	Shear Strength qu E (kPa)	σ_3 σ_1 (kPa)	C C' (kPa)	φ φ' (º)	Permeability Gradient I (kg/cm²) K (cm/s)
S 1 (CTM)	56724	4.00 4.60	Fine sand, silty-clay, with gravel, dark gray		(SC) A-2-6(0)	24.0	2.74	35 17		83 71	21	30 11											42 --	22 --	
S 1 (CTM)	56725	4.60 5.20	Variable grain size sand, silty-clay, with gravel, grayish yellow		(SC) A-2-6(1)	20.0	2.75	35 19		77 50	23	18 9													
S 1 (CTM)	56726	17.60 18.00	Sandy silt, greenish yellow			26.4	1.44 1.50																52 --	37 --	
S 2 (CTM)	56736	4.00 5.20	Variable gravel, with sandy-silty-clay, bluish gray		(GP-GC)s A-2-6(0)	12.5	2.70	26 11		38 25	10	54 13													
S 2 (CTM)	56737	14.38 15.00	Fine sand, silty-clay, brownish yellow		(SC) A-2-7(0)	23.0	2.72	41 18		100 96	16												65 --	23 --	
S 3 (CTM)	56738	4.00 4.60	Fine sand, silt-clay, with gravel, bluish gray		(SC) A-2-6(0)	25.3	2.72	27 12		86 79	21	29 14							0.16 0.81	1.8 EE-3 5.9 EE-8					
S 3 (CTM)	56739	9.40 10.00	Fine sand, silty-clay, greenish yellow		(SC) A-2-7(1)	25.7	2.75	42 18		96 90	22												34 --	30 --	
S 4 (CTM)	56753	3.50 4.70	Fine sand, silty-clayey, with variable gravel, bluish gray		(SC)g A-2-6(0)	20.1	2.76	35 14		65 56	22	41 10											0 --	41 --	
S 4 (CTM)	56754	8.40 9.00	Fine sand, silty-clayey, greenish yellow		(SC) A-2-6(0)	17.7	2.75	39 17		97 93	21	26 7									156 10968		32 --	26 --	
S 5 (CTM)	56755	4.00 4.20	Variable gravel, sandy-silty-clayey, grayish yellow		(GC)s A-2-6(0)	14.0	2.73	37 19		36 30	15	54 12													

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Client: ORIENTAL CONSULTANTS CO. Ltd

Job: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE - GEOTECHNICAL SURVEY

Process: 25512

Sample Type : **Undisturbed**

Laboratory Test Results

Borehole (N°)	Sample (N°)	Depth (m)	Description	Lit.-str.	Classif. Unified RTR AASHTO	W Sr EA (%)	ρ ρ_d (g/cm³) Dens. Part. G	W_L I_P V_S (%)	VB (g/100g) MO (%) Ph	Particle size Characteristics: <2.0 mm <0.42 mm (%)	Particle size Characteristics: <0.074 mm <0.002 mm (%)	Particle size Characteristics: dim. bigger part. Max. Min. (mm)	Comp. Wopt (%) γ dmax (kN/m³) Light Heavy	CBR: CR (%)	CBR: Desv. Wopt (%)	CBR: CBR	CBR: Expansibility (%)	CBR: CBR at 95% Penet.	Consolidation: Cc eo	Consolidation: Cv (cm²/s) K (cm/s)	Shear Strength: qu E (kPa)	Shear Strength: σ_3 σ_1 (kPa)	Shear Strength: C C' (kPa)	Shear Strength: ϕ ϕ' (º)	Permeability: Gradient I (kg/cm²) K (cm/s)
S 5 (CTM)	56756	7.40 8.00	Fine sand, silty-clayey, greenish yellow		(SC) A-2-7(0)	25.2	2.76	44 23		97 92	16	18 8											13 --	33 --	
S 6 (CTM)	56730	4.00 4.60	Fine sand, silty-clay, with dispersed gravel greenish gray		(SC) A-2-6(2)	27.0	2.74	40 21		89 84	31								0.17 0.90	7.8 EE-3 2.1 EE-7			20 --	35 --	
S 6 (CTM)	56731	8.45 9.05	Fine sand, silty-clay, greenish yellow		(SC) A-2-7(0)	24.3	2.75	48 25		94 86	16										51 9167		37 --	22 --	
S 7 (CTM)	56757	4.00 4.20	Coarse gravel, sandy silty-clayey, light gray		(GP-GC)s A-2-6(0)	14.4	2.72	37 18		37 28	12	48 11													
S 7 (CTM)	56758	4.80 5.45	Fine sand, silt-clayey, with gravel fine to medium greenish gray		(SC)g A-2-7(3)	24.0	2.74	42 25		72 66	34	40 5							0.15 0.77	8.1 EE-3 2.0 EE-7			17 --	36 --	
S 7 (CTM)	56759	9.50 10.00	Fine sand, silty-clayey, greenish yellow		(SC) A-2-6(0)	24.7	2.71	39 18		98 95	21												23 --	36 --	
S 8 (CTM)	56760	5.00 5.60	Fine sand, silt-clayey, with Fine to medium gravel, yellow		(SC)g A-2-7(2)	23.5	2.74	46 27		80 69	29	36 8							0.14 0.79	4.4 EE-3 8.2 EE-8	45 7692				
S 8 (CTM)	56761	8.40 9.00	Fine sand, silty-clayey, brownish yellow		(SC) A-2-6(0)	21.2	2.72	40 20		100 96	19												24 --	34 --	
S 9 (CTM)	56777	4.50 5.10	Variable grain size sand, silt-clayey, with fine to medium gravel, yellow		(SC)g A-2-7(1)	21.2	2.70	49 26		67 53	21	33 8							0.19 0.90	4.1 EE-3 1.9 EE-7					
S 9 (CTM)	56778	7.50 8.50	Fine sand, silty-clayey, greenish yellow		(SC) A-2-7(0)	23.3	2.70	44 21		98 97	18	18 7											40 --	28 --	

Mod.PL.02.6/3

Client: ORIENTAL CONSULTANTS CO. Ltd

Job: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE - GEOTECHNICAL SURVEY

Process: 25512

Sample Type : **Undisturbed**

Laboratory Test Results

Borehole (N°)	Sample (N°)	Depth (m)	Description	Lit.-str.	Classif.	W	ρ	W_L	VB (g/100g)	Particle size Characteristics			Comp.	CBR					Consolidation		Shear Strength				Permea-bility
					Unified RTR AASHTO	Sr EA (%)	ρ_d (g/cm³) Dens. Part. G	I_P V_S (%)	MO (%) Ph	<2.0 mm <0.42 mm (%)	<0.074 mm <0.002 mm (%)	dim. bigger part. Max. Min. (mm)	Wopt (%) γ dmax (kN/m³) Light Heavy	CR (%)	Desv. Wopt (%)	CBR	Expansibility (%)	CBR at 95% Penet.	Cc eo	Cv (cm²/s) K (cm/s)	qu E (kPa)	σ_3 σ_1 (kPa)	C C' (kPa)	φ φ' (º)	Gradient I (kg/cm²) K (cm/s)
S 10 (CTM)	56779	5.00 6.20	Variable grain size sand, silt-clayey, with fine to medium gravel, light yellow		(SC)g A-2-7(1)	15.1	2.72	46 26		60 40	20	43 12									22 2667				
S 10 (CTM)	56780	8.50 9.00	Fine to medium sand, clayey, with fine gravel, yellowish brown		(SC) A-2-7(0)	15.5	2.71	44 25		82 56	17	31 8											38 --	34 --	
S 11 (CTM)	56762	4.00 5.10	Fine to medium sand, silty-clayey, brownish yellow		(SC) A-2-7(1)	29.0	2.73	44 25		94 78	21	16 6											15 --	34 --	
S 11 (CTM)	56763	9.50 10.00	Fine sand, silty-clayey, greenish yellow		(SC) A-2-6(0)	18.4	2.70	36 17		99 87	19										120 13684		25 --	34 --	

Mod.PL.02.6/3

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Geocontrole

Client: ORIENTAL CONSULTANTS CO. Ltd

Job: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE - GEOTECHNICAL SURVEY

Process: 25512

Sample Type : **Remolded**

Laboratory Test Results

Borehole (N°)	Sample (N°)	Depth (m)	Description	Lit.-str.	Classif. Unified RTR AASHTO	W Sr EA (%)	ρ ρ_d (g/cm³) Dens. Part. G	W_L I_P V_S (%)	VB (g/100g) MO (%) Ph	Particle size Characteristics <2.0 mm <0.42 mm (%)	Particle size Characteristics <0.074 mm <0.002 mm (%)	Particle size Characteristics dim. bigger part. Max. Min. (mm)	Comp. Wopt (%) γ dmax (kN/m³) Light Heavy	CBR CR (%)	CBR Desv. Wopt (%)	CBR CBR	CBR Expansibility (%)	CBR CBR at 95% Penet.	Consolidation Cc eo	Consolidation Cv (cm²/s) K (cm/s)	Shear Strength qu E (kPa)	Shear Strength σ_3 σ_1 (kPa)	Shear Strength C C' (kPa)	Shear Strength ϕ ϕ' (°)	Permeability Gradient I (kg/cm²) K (cm/s)
S 1 (CTM)	56727	2.45 3.00	Fine to medium sand, light gray		(SP) A-3(0)	22.8	2.67	N/P		100 80	3														
S 1 (CTM)	56728	14.00 15.00	Fine sand, silty-clay, light yellow		(SC) A-2-7(1)	23.4	2.72	54 32		97 95	21														
S 1 (CTM)	56729	17.60 18.00	Fine sand, silty-clay, yellow		(SC) A-2-6(0)	26.6	2.75	37 13		100 97	25														
S 2 (CTM)	56740	9.45 10.00	Fine sand, silt-clay, with gravel scattered greyish yellow		(SC) A-2-7(1)	20.9	2.70	44 19		92 83	26	20 7													
S 3 (CTM)	56741	1.45 2.00	Variable grain size sand, silty, with thin to medium gravel, black		(SM)g A-2-4(0)	33.6	2.42	N/P		63 44	28	25 11													
S 3 (CTM)	56742	6.70 7.00	Variable grain size sand, silt-clay, with gravel medium to fine yellow		(SC)g A-2-6(0)	11.6	2.74	26 13		58 44	26	41 19													
S 4 (CTM)	56764	2.45 3.00	Fine to medium sand, light gray		(SP) A-3(0)	19.3	2.65	N/P		98 72	1														
S 5 (CTM)	56765	3.60 4.00	ay silty-sandy, with dispersed gravel, yellowish gray		(SC) A-7-6(3)	26.1	2.72	43 22		88 80	36	39 8													
S 6 (CTM)	56732	5.05 6.00	Variable grain size sand, silty-clay, with gravel and medium grayish yellow		(SC)g A-2-6(0)	23.4	2.73	34 20		68 53	17														
S 6 (CTM)	56733	11.50 12.00	Fine sand, silty-clay, greenish yellow		(SC) A-2-6(0)	22.3	2.75	38 16		99 96	19														

Client: ORIENTAL CONSULTANTS CO. Ltd

Job: GAS FIRED POWER PLANT DEVELOPMENT IN SOUTHERN MOZAMBIQUE - GEOTECHNICAL SURVEY

Process: 25512

Sample Type : **Remolded**

Laboratory Test Results

Borehole (Nº)	Sample (Nº)	Depth (m)	Description	Lit.-str.	Classif. Unified RTR / AASHTO	W / Sr / EA (%)	ρ / ρd (g/cm³) / Dens. Part. G	WL / Ip / Vs (%)	VB (g/100g) / MO (%) / Ph	Particle size Characteristics: <2.0 mm / <0.42 mm (%)	Particle size Characteristics: <0.074 mm / <0.002 mm (%)	Particle size Characteristics: dim. bigger part. Max. / Min. (mm)	Comp. Wopt (%) / γ dmax (kN/m³) Light / Heavy	CBR: CR (%)	CBR: Desv. Wopt (%)	CBR: CBR	CBR: Expansibility (%)	CBR: CBR at 95% Penet.	Consolidation: Cc / eo	Consolidation: Cv (cm²/s) / K (cm/s)	Shear Strength: qu / E (kPa)	Shear Strength: σ3 / σ1 (kPa)	Shear Strength: C / C' (kPa)	Shear Strength: ϕ / ϕ' (º)	Permeability: Gradient I (kg/cm²) / K (cm/s)
S 7 (CTM)	56766	7.70 8.00	Fine sand, clayey, greenish yellow		(SC) A-2-7(0)	20.8	2.72	41 18		99 95	18														
S 8 (CTM)	56767	3.60 3.90	Fine sand, silt-clayey, with fine to medium gravel, gray		(SC)g A-2-6(0)	18.3	2.72	28 12		74 65	29	27 6													
S 9 (CTM)	56781	13.50 14.00	Fine sand, silty-clay, dark yellow		(SC) A-2-7(1)	25.0	2.72	42 21		98 90	24														
S 10 (CTM)	56782	11.50 12.00	Fine sand, silty-clay, yellowish brown		(SC) A-2-7(1)	23.2	2.72	48 22		98 94	21														
S 11 (CTM)	56768	3.50 4.00	Variable grain size sand, silt-clayey, with fine gravel, yellowish green.		(SC) A-2-7(2)	18.3	2.74	45 25		83 68	31	26 7													
S 11 (CTM)	56769	17.40 17.80	Fine sand, silty-clayey, greenish yellow		(SC) A-2-7(1)	23.8	2.71	43 19		97 95	25														