ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR

NEW MULTISPECIALITY AND TEACHING HOSPITAL AT FLACQ

30.11.2020

GOVERNMENT OF MAURITIUS

Tel: 213 2743 Fax: 211 9903

MY REF: ENV/CLR/RQS/FLAQ

YOUR REF:MHC/FH/PJ/EIA

Date: 26 October 2020

From : Permanent Secretary, Ministry of Environment, Solid Waste Management and Climate Change

To : Senior Chief Executive, Ministry of Health and Wellness

SUBJECT: Construction of the New Flacq Teaching Hospital

Please refer to your letter dated 05 October 2020 regarding the above mentioned subject.

2. This is to inform you that the proposed construction of the New Flacq Teaching Hospital has been declared as "exempt undertaking" in accordance with Section 28 (1) of the Environment Protection Act 2002.

3. EIA Report should be submitted on the National Electronic Licensing System (NELS) Portal, accessible on the following URL: https://business.edbmauritius.org/. Furthermore, as a pre-requisite you will also be requested to submit 3 printed copies and one soft copy of your EIA report, after the preliminary EIA report verification stage.

Yours faithfully,

J. Seewoobaduth
Ag. Director of Environment

MINISTRY OF HEALTH AND WELLNESS
26 OCT 2020
OPEN REGISTRY

NEW MULTISPECIALITY AND TEACHING HOSPITAL AT FLACQ

CONTENTS:

NON-TECHNICAL SUMMARY

1. CHAPTER 1 - PROJECT PARTICULARS

2. CHAPTER 2 - POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

3. CHAPTER 3 - SITE ENVIRONMENT CHARACTERISTICS

4. CHAPTER 4 - ARCHITECTURAL AND FUNCTIONING PLANNING

5. CHAPTER 5 - PLANNING AND COMPLIANCE

6. CHAPTER 6 - SERVICES

7. CHAPTER 7 - PREDICTION AND MITIGATION OF ENVIRONMENTAL IMPACTS

8. CHAPTER 8 - MONITORING PLAN

NEW MULTISPECIALITY & TEACHING HOSPITAL AT FLACQ

NON TECHNICAL SUMMARY:

The Proponent

Project Site

Project Scope

Project Justification

Site Characteristics

Geotechnical Brief of the Site

Neighbourhood

Hospital Operation

Project Team

Statutory Compliances

Site Services

Site Access

Opportunities and Constraints

Legal Aspects

Socio Economic Impact

Prediction and Mitigation

NEW MULTISPECIALITY & TEACHING HOSPITAL AT FLACQ

NON TECHNICAL SUMMARY

The Proponent

The proponent for this project is the Ministry of Health & Wellness of the Government of the Republic of Mauritius. This Ministry is responsible for public health and manages several hospitals, mediclinics, area health centers and primary health centers all over the island.

In line with the policy of providing world-class health facilities to its citizen, the Ministry is desirous of proceeding with the Construction of a new hospital in the vicinity of Flacq which shall cater mainly for the population in the eastern zone of the island as well as serve as a Teaching Hospital for prospective medical doctors.

Project Site

The trapezoidal shaped site of an area of 105,521.8 m^2, has been vested to the Ministry for this project. It abuts the B23 road linking St Julien village to Central Flacq. On the right side of the site, there exists a feeder canal at around 4m away from the boundary. The rear side of the site is abutted by Rivière du Poste de Flacq all over its length. The site is relatively secured from any risks of flooding since it is approximately 8m higher than the river edge. There exists an escarpment on site and it is intended not to use it for any purpose. This shall allow to have a proper site preservation in terms of landscaping.

Project Scope

The hospital project comprises of a main Y-shaped block in a Basement, GF + 6 floors configuration, which shall house at the major services that are required for a hospital of that nature. There shall be 520 beds allocated on different floors of the building based on the criticality and severity of the cases.

Project Justification

It is part of the government strategy to provide world class health care to its citizen and in so doing, there is a constant need to improve existing facilities. The existing Flacq hospital has already served its purpose for the last 100 years while being upgraded at regular intervals. However, the site facilities have stayed the same while there has been an increase in the population in that region which is not commensurate with the hospital capacity. It is therefore required that a new facility with latest technologies and state of the art equipment be provided in order to continue providing quality health care facility to the population. This new hospital is aimed at alleviating the load on other regional hospitals, namely Dr A.G Jeetoo & SSRN Hospitals, as well while enhancing the overall quality of healthcare services in Region 3.

Site Characteristics

The site currently sits of vacant land which was formerly under sugarcane plantation. There exists currently an old unused building that shall be demolished later on and a litchi tree grove. No endemic trees are found on the site and it is generally covered with shrubs and wild trees since it has been abandoned for a few years. The site gently slopes towards the south, which is the rear face of it, along which there is a river. There exists an escarpment of width varying between 10 to 30m that it covered with dense wild foliage. It is envisaged that this portion of the site will remain untouched by construction and selective pruning will be carried out to create a healthy atmosphere.

Geotechnical Brief of the Site

A full geotechnical survey has been carried out on the site in order to determine the suitability of the soil and any remedial measures that may be necessary to be carried out in order to successfully implement the project.
Based on the survey, the following can be taken as the main summary of important points mentioned:
The site is located partly on fresh basalt and partly on tuffs and pyroclasts of the late lavas. They tend to be porous and vesicular in nature. The soil type is low humic latosols and have good internal drainage potential with low organic content.
The site is located on Aquifer IV region. The seasonal variation of the water level tends on the higher sides ranging between 10m to 20m.
It is to be noted that the river abutting the site on its rear South Eastern side is accessed by an escarpment having depth between 8m to 10m.
Further details on the geotechnical investigations are found in the section dedicated to site environmental characteristics.

Neighbourhood

The site is situated away from any settlement. It is along the B23 road that links St Julien to Flacq. There is a club house at around 1km from the site and a poultry farm at around 500m from the site. By virtue of the trade wind direction, there are very minimal chances of the smell from the poultry blowing towards the hospital site. It is expected to have a fourth motorway in the vicinity of the site and thus the hospital will be easily and directly connected to the airport and to the Northern plains.

Hospital Operation

The hospital shall be open on a 24/7 basis. As it is the case for all public hospitals in Mauritius, the peak hours of operation shall be between 9 am to 4 pm on weekdays. Inpatients visiting hours shall be between 3 pm to 5 pm on weekdays and in early afternoon hours during weekends. The hospital shall provide for the whole range of medical treatment that are usually provided in regional hospitals of the island. These include amongst others; Accident & Emergency facilities, Radiology & Interpretation, Outpatient Consultation, Operation theatres & Intensive Care Units, Labour & Maternity wards, Surgical, Medical & Orthopaedic wards as well as administrative facilities. The hospital shall be fully equipped with laboratories, laundry facilities, kitchen CSSD department and general stores.

Project Team

The project has been conceptualized by HSCC (India) Ltd. HSCC (Hospital Services Consultancy Corporation) is a parastatal body of the Government of India who are specialized Project Management Consultants for Hospital Projects. The project has been tailored to be built on a design and build basis. Larsen & Toubro Construction has been awarded the contract which is scheduled to be completed within a timeframe of 22 months. The project is currently being detailed out and all necessary approvals and permits are being sought prior to actual construction starting on site. All the construction activities shall be supervised by HSCC who shall be responsible for the completion and handing over of the proposed facility to the proponent.

Statutory Compliances

The project shall be designed in order to comply with the provisions of all legal framework namely amongst others;

Planning Policy Guidelines as issued by Ministry of Housing and Lands and its subsequent revisions.

Building Control Act.

Building and Land Use permit.

In the absence of any PPG or other such guidelines for healthcare, we shall be counter checking the hospital design against the IUSS data sheets and the HBN data sheets wherever applicable.

Site Services

i) Water
The site can be readily connected to the water distribution network of the Central Water Authority (CWA). The estimated consumption capacity as well as the other relevant data for water supply is found in the later chapters of the report.

ii) Wastewater
Wastewater will be treated through the Sewerage treatment plant that shall treat the wastewater and dispose same in an irrigation tank provided on site for daily plant watering. The treated effluent will be up to irrigation standards. All the technical details of the Sewer treatment plant are found in the later chapters of the report.

iii) Electricity
The site can be readily connected to the Electrical distribution network of the Central Electricity Board (CEB). Necessary load calculations and estimates have been submitted to the CEB in order to kick-start the process.

iv) Solid Waste
All solid waste shall be segregated prior to collection by the District Council waste collection system. Medical waste shall be kept separately under controlled environment and shall be securely transported to other sites under the management of the Ministry of Health and Wellness for incineration prior to disposal to the satisfaction of the Solid Waste Division.

Site Access

The site abuts the Main Road, which is a classified road, B23 and it is proposed that the access is branched off directly for same. We intend to have 2 accesses onto that road, one being the main access and the second one being the service access. Sufficient visibility splays shall be provided for road safety and necessary request for traffic lights or road widening may be envisaged depending on the traffic flow in this area.

Opportunities and Constraints

The project will provide for direct employment during construction stage as well as major indirect work during that stage. Upon operation, it will provide with direct employment to the existing staff of the Flacq hospital as well as new employment opportunities by virtue of its size and capacity and the technologies that are being incorporated in the facility.

Legal Aspects

The report has been prepared in order to fully comply in all aspects with the provision of Part IV, Section 15 of the Environment Protection Act 2002 and the relevant issues are further addressed in this report.

Socio Economic Impact

The implementation of a hospital project on a green field site away from settlement zone comes with certain impacts which can be both positive and negative. The measures taken to minimize the negative impacts while making the best of the positive ones are detailed in the later chapters and the report. In brief, the following points are deemed to be taken in top priority of positive impact.

1. Latest medical treatment to be provided to the public at lay and free of cost.
2. Modern equipment and facilities to prevent or cure severe medical conditions.
3. Reduced waiting times for treatment by providing a greater number of treatment and consultation rooms as well as more inpatient beds.
4. Providing better facilities for communicating treatment methods and preventive measures to limit the spread of non-communicable diseases as well as epidemics or other communicable diseases.

Prediction and Mitigation

Based on experience and precedent cases, a list of potential environmental impacts have been identified/predicted. The corresponding Mitigative measures have been enumerated in the most plausible manner.

ENVIRONMENTAL PARAMETER	PREDICTION OF IMPACTS	MITIGATION MEASURES
Fire	Destruction of inpatient/outpatient as well as sensitive information	A firefighting system shall be provided as part of the building works. The system shall be designed to meet the local fire codes and international codes where applicable. Regular testing and commissioning shall ensure its functionality at all times.
	Safety hazard to patients, staffs and visitors	A designated safe passage as well as clear egress plans shall be provided and regular training shall ensure the personnel are fully aware of the measures to be taken in case of fire outbreak.
Health & Safety	Hazards that can cause injury or impairment to personnel	The construction period shall be regulated with clauses for safe working conditions and regular follow-up by a dedicated health & safety officer. Appropriate signages and warning devices shall be installed on site and regularly checked for.
	Mishandling of medical products of and medical waste	All medical products including any chemicals that may be generally used in a hospital shall be kept under strict supervision with second access. All medical waste and bio hazards shall be collected, securely stored in a centralized location under controlled conditions prior to being disposed off in the most convenient manner.
	Contamination of air within enclosed areas/closed areas/mechanically ventilated areas	The mechanical ventilation system of the hospital shall be duly segregated such that the air from clinical areas do not mix with those of general areas. HEPA filters shall be provided on those lines serving critical & sensitive areas.

Hydrology	Spillage of foul water to the ground or into the river	The structures which are being designed to handle waste water and other foul drainage water shall comply with the relevant codes to prevent leakages and regular monitoring shall be carried out to ensure water tightness.
Noise	During construction	There are no any residential areas within a 1km radius from the site. It is thus not foreseen that the development will cause disturbance to the neighbourhood in terms of noise pollution. Nevertheless, protective equipment shall be supplied to workers handling or working near noise producing machines/equipment.
	At operation	Necessary protective equipment shall be provided to workers going to or producing noise producing equipment.
Climate	Impact of driving rain and wind on external façade	The external envelope shall be designed to be simple and easy for maintenance with materials that have hard wearing surfaces and resistance to fungi and the likes. The statutory requirement of designing to resist gusts of 300 km/h shall be complied in all aspects.
Domestic water supply	Risk of pipe bursts and flooding to internal areas	All site piping networks shall be buried and cast in concrete as the case may be. HDPE piping of the appropriate rating shall be used in areas with the necessary fittings properly tightened. To prevent shortage of water, water supply tanks catering to at least 2 days of consumption capacity shall be allowed for on site.
Electricity supply	Risk of electrocution Potential fire hazards	All electrical network shall be appropriately grounded. All connections shall be checked at commissioning to minimize loose ends that can result in fire. Circuit breakers shall be provided within particular zones of the hospital to minimize spread of fire.
Waste water disposal	General health hazards and risk of contamination when left untreated	A waste water treatment plant shall be provided on site which shall treat the water to tertiary level prior to being used for irrigation purposes.
Storm water drainage	Risk of flooding to the building	The building shall be raised from the finished ground level by at least 1m and any slope on site shall be away from the building. A storm water drainage network designed to divert the water towards adequately sized absorption pits..
Flora and Fauna	Insignificant due to absence of any indigenous plants or habitats	No specific measure required
Geology	Insignificant	No specific measure required

Solid Waste	Risk of contamination from medical waste	All waste shall be disposed off as per local guidelines. Medical waste shall be segregated and securely contained prior to being disposed off offsite.
	Risk of air pollution	There will not be any incinerator on the site to combust medical or other residues.

Conclusion

Taking into account the different points raised in this EIA report and the supporting documents provided in the annexures, it can be concluded that the project is environmentally responsive and aims at providing multi fold benefits to the population at large, especially for those in the Region 3 of the Ministry of Health map. It is thus recommended for approval by the Ministry of Environment, Solid Waste Management and Climate change.

CHAPTER 1

PROJECT PARTICULARS

1.1 PROJECT LOCATION

1.2 PROJECT DESCRIPTION

1.3 PROJECT SITE

1.4 PROJECT JUSTIFICATION

1.5 IMPLEMENTATION TEAM

1.6 ALTERNATIVE TO THE PROJECT

1.7 IMPLEMENTATION SCHEDULE

CHAPTER 1

PROJECT PARTICULARS

1.1 PROJECT LOCATION

The site designated for the project is located along the B23 road that connects St Julien village to Central Flacq. The geolocation can be taken as 20.19S and 57.70E. Please refer to **Annex 1** at the end of this section for the exact description of the site.

1.2 PROJECT DESCRIPTION

The hospital project comprises of a main Y-shaped block in a Basement, GF + 6 floors configuration, which shall house all the major services that are required for a hospital of that nature. There shall be 520 beds allocated on different floors of the building based on the criticality and severity of the cases. The broad floor wise allocation is given below:

- At Basement Level: MEP services, Kitchen, Laboratory, Laundry, CSSD, Medical gas room, General Stores on a built up area of 8750 sqm
- At Ground Floor: Accident & Emergency Ward, Blood Bank, Radiology OPD, General OPDs, Registry, Pharmacy, Registration & Waiting on a built up area of 8665 sqm
- At First Floor: Maternity Ward, Neonatal ward, General OPDs, Public Waiting, Day Care Ward on a built up area of 8425 sqm
- At Second Floor: Operation Theatres and Suites, Doctor's facilities, Hospital Admin, ICU wards 8665 sqm
- At Third Floor: Wards, Mechanical Plantroom for Operation Theatres on a built up area of 6370 sqm
- At Fourth Floor: Wards, Waiting Area on a built area of 5260 sqm
- At Fifth Floor: Wards, Admin Offices, Waiting Area on a built area of 5260 sqm
- At Sixth Floor: Wards, Admin Offices, Waiting Area on a built area of 5260 sqm
- At Roof Level: Building Services such as water tanks, chillers, solar water heaters and the likes. All are exposed to sky.

Since the project site has an area of 105,521.8 sqm, the planning has been done in such a way that the future phases of the project as envisaged by the Ministry can be easily implemented as well as there is sufficient parking spaces to cater for the outpatients as well as inpatient's visitors. Being next to a river, appropriate measures shall be taken to have an environmentally sensitive landscaping and an appealing landscape shall be provided around the hospital to give a more soothing environment.

The hospital is being designed so that it can be easily accessed and it shall be equipped with the latest state of the art facilities to provide the best healthcare facilities to the patients.

1.3 PROJECT SITE

The project is being implemented on a site having an area of 105,521.8 sqm and has for boundaries, the Rivière du Poste de Flacq on the Southern side, the Classified road B23 on the Northern side over a length of approximately 406m, a strip of land of around 4m wide following which there exists a canal on the Western side on over a length of approximately 231m and sugarcane plantation on

the eastern side over a length of approximately 295m. Refer to the **Annex 2** at the end of this section for more details.

The site has been acquired from the Constance La Gaiete Company Limited by the Ministry of Housing and Lands and has thereafter been vested to the proponent for the purpose of construction a new hospital.

Refer to **Annex 3** at the end of this section for more details.

By virtue of its boundary with the river, a 16m setback shall be observed from the river edge. The site conditions are such that the land is relatively higher than the river and the latter can be accessed through an escarpment. Owing to the sensitive nature of the river edge and the excessive amount of costly engineering works involved in constructing within this area, the project is planned such that no portion of the building or its annexes and service roads steer clear from this escarpment. This will leave the existing fauna undisturbed.

1.4 PROJECT JUSTIFICATION

The existing Flacq hospital has already served its purpose for the last 100 years while being upgraded at regular intervals. However, the site facilities have stayed the same while there has been an increase in the population in that region which is not commensurate with the hospital capacity. It is to be noted that the Flacq hospital in its current stat serves for patients in the Districts of Flacq, which is the largest district in Mauritius, as well as parts of the District of Moka.

Statistics also demonstrate that patients from neighbouring areas such as Plaine des Roches, Roches Noires and even Rivière du Rempart also seek medical treatment in this hospital owing to its proximity to them instead of the regional hospital of SSRN which is allocated for them.

The hospital has also seen an increase of around 45% in terms of surgeries being carried out over there. This implies that there is a need for more beds to be provided for this hospital. More wards are also required in order to reduce the waiting time for non-urgent medical interventions as well as to deal with the ever increasing number of roads with the increase in population. The bed occupancy is currently above 80% and the population to bed ratio has already reached a ratio of 500:1.

Moreover, it has been noted that there has been an increase of about 66% in the number of outpatients being treated at the existing Flacq Hospital.

The current Flacq hospital has been developed from a colonial building onto which various alterations and extensions that have been added over time. Some of the buildings are currently in a deplorable state and cannot be further upgraded.

Moreover, the existing site has limited scope for expansion since it is located in the middle of residential developments with already saturated plot coverage.

Furthermore, a number of vital wards such as Female Orthopaedic, Female Psychiatric are not available and there exists a very limited number of beds in the Obstetric ward combining both pre and ante natal facilities, thereby falling short of the accepted international norms for a hospital of this magnitude.

Based on the aforementioned points, it is thus recommended that a new hospital block laid on a fresh site that can cater for future expansion plans as well be proposed as part of the strategy of the Ministry to provide for quality health care to the population.

1.5 IMPLEMENTATION TEAM

The project shall be carried out by a team of Professionals which have specific experience in healthcare institutions. The project shall be carried out on a design and build basis.

Promoter:	Ministry of Health and Wellness
Project Concept Designers:	HSCC (India) Ltd
Project Supervising Consultants:	HSCC (India) Ltd
EPC Contractor:	Larsen & Toubro Construction Ltd

HSCC is a multi-disciplinary consultancy firm having long standing experience in the design of hospitals in India as well as overseas. They shall be deputing a team of Engineers, Project Managers and Quality Controllers for this project. Some of the major projects recently completed by HSCC are: AIIMS Hospitals in Nagpur, Guntur, Kalyani, CNCI Kolkata, NCI Jhajjar, NRHM Jaunpur & NEIAH Shillong. All of the above mentioned projects are similar or bigger in nature to the proposed Flacq hospital

Larsen & Toubro is a worldwide known Contractor that has successfully delivered many landmark projects all over the world within sanctioned time and budget. Amongst the hospital projects delivered by Larsen & Toubro are: Govt. Medical College & Hospital Madhepura, AIIMS Gorakhpur, Safdarjung Hospital Delhi, Regional Cancer Tripura, Apollo Proton Therapy Chennai, JIPMER Pondicherry & Prasanth Hospital Chennai.

1.6 ALTERNATIVE TO THE PROJECT

Based on its location, the site can be deemed to be a strategic one which is duly located along B23 road. There is a project to provide a new Motorway from the SSR Airport to Grand Baie in the North and the current site is strategically located at less than 1km from this proposed development. Furthermore, the site offers wide possibilities for expansion and future developments which can be carried out in phases as per the government convenience.

The reasons mentioned earlier in this section provide a very accurate outline on the urgent need to carry out this project.

Since the surroundings of the site is still undeveloped, it can be inferred that there could be many possibilities happening. However, by locating the hospital in this region in the first place itself, it allows opportunities to develop in the paramedical fields nearby.

There is always the standard “Do Nothing” option that leaves the site in status quo. However, based on the scarcity of land on the island, the various plans to have smart developments and the crucial need for better healthcare facility in the region, leaving the site as is would only mean that:

- A major development opportunity is missed out by the Government to set yet another benchmark in terms of public health.
- A major opportunity for future employment is killed at embryo stage

- A major opportunity to further establish the position of Mauritius as a reliable medical hub in the region is missed
- The opportunities to allow for only short term development is increased thereby creating further problems down the line
- There shall be major recurrent expenses by the Ministry of Health & Wellness to ensure that the sanitation and hygiene levels of the existing Flacq hospital are duly maintained

1.7 TENTATIVE IMPLEMENTATION SCHEDULE

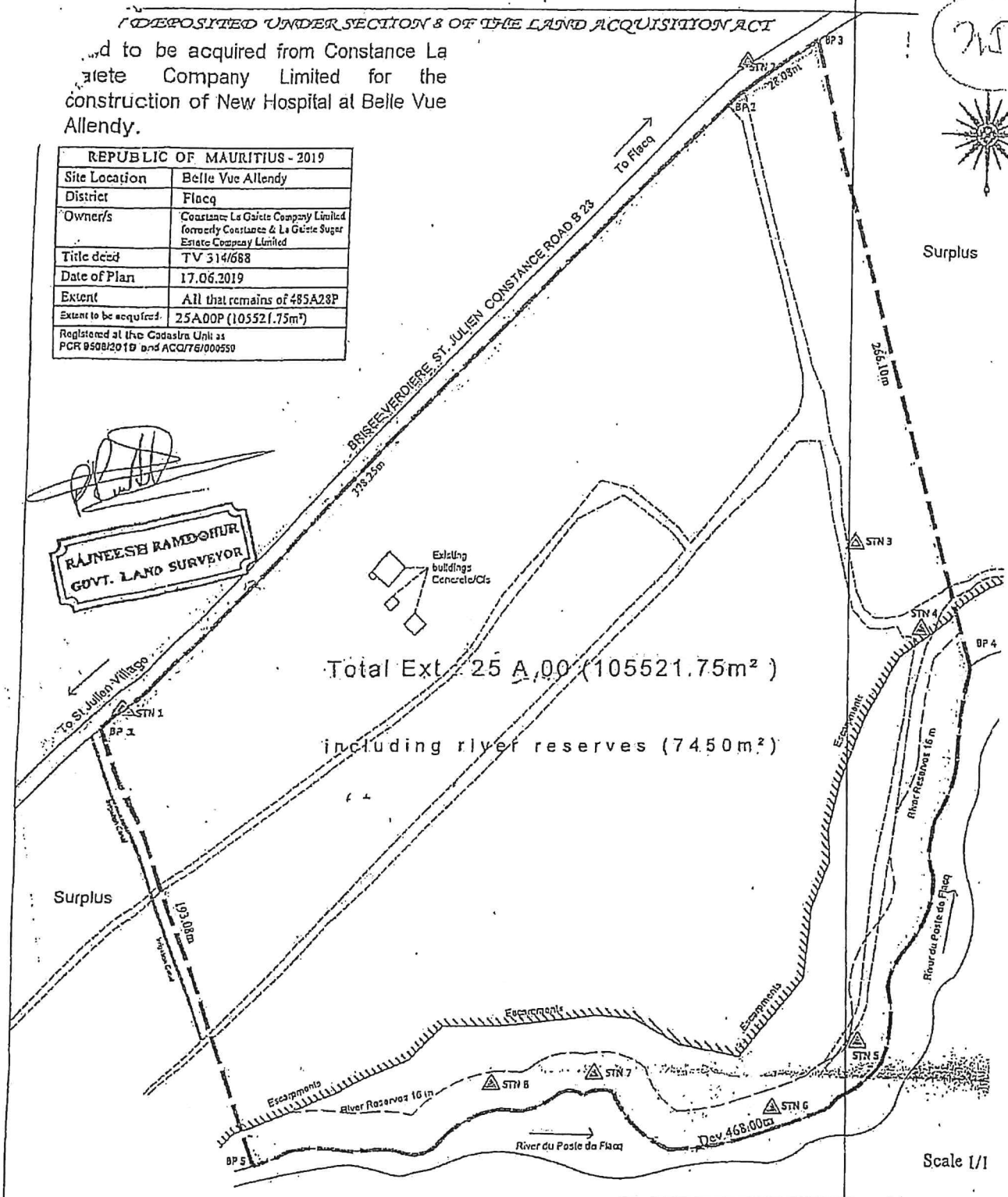
TEACHING HOSPITAL PROJECT, FLACQ MILESTONE ACTIVITIES			
ACTIVITY	**DURATION**	**START**	**END**
Land Handing over	1	1-Sep-20	2-Sep-20
Pre Construction Statutory approval	28	2-Sep-20	30-Sep-20
Completion of Initial Mobilisation	30	2-Sep-20	2-Oct-20
Completion of Excavation	94	6-Nov-20	8-Feb-21
Completion of Foundation	73	15-Dec-20	26-Feb-21
Completion of RCC upto Plinth Level	76	29-Jan-21	15-Apr-21
Completion of RCC upto RCC upto 3rd Floor Lev	147	22-Feb-21	19-Jul-21
Completion of RCC upto RCC upto Terrace Slab Level	85	21-Jun-21	14-Sep-21
Completion of Finishing & MEP works upto Ground Floor Lev	115	6-Jun-21	29-Sep-21
Completion of Blockwork	212	12-Jun-21	10-Jan-22
Completion of Finishing & MEP works upto 2nd Floor Level	206	14-Jul-21	5-Feb-22
Completion of Finishing & MEP works upto 6th Floor Level	236	27-Sep-21	21-May-22
Post-Construction Statutory Approval by Contractor as per aggrement	30	1-Jun-22	1-Jul-22
Project Completion	1	30-Jun-22	1-Jul-22

DEPOSITED UNDER SECTION 8 OF THE LAND ACQUISITION ACT

...d to be acquired from Constance La ...aiete Company Limited for the construction of New Hospital at Belle Vue Allendy.

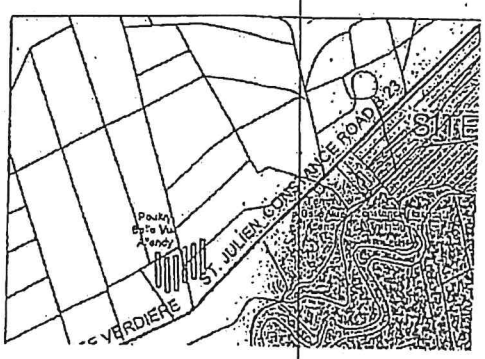
REPUBLIC OF MAURITIUS - 2019	
Site Location	Belle Vue Allendy
District	Flacq
Owner/s	Constance La Gaiete Company Limited formerly Constance & La Gaiete Sugar Estate Company Limited
Title deed	TV 314/688
Date of Plan	17.06.2019
Extent	All that remains of 485A28P
Extent to be acquired	25A00P (105521.75m²)
Registered at the Cadastre Unit as PCR 9508/2019 and ACQ/76/000550	

RAJNEESH RAMDOHUR
GOVT. LAND SURVEYOR



Traverse Stations Coordinates on LGM 2012			
Stn No.	Eastings(m)	Northings(m)	Description
Stn 1	264015.864	358827.837	Iron peg on ground
Stn 2	264269.393	359093.945	Iron peg on ground
Stn 3	264320.855	358897.169	Iron peg on ground
Stn 4	264349.273	358862.308	Iron peg on ground
Stn 5	264325.458	358690.183	Iron peg on ground
Stn 6	264239.669	358661.604	Iron peg on ground
Stn 7	264214.857	358676.220	Iron peg on ground
Stn 8	264172.167	358671.945	Iron peg on ground

Boundary Coordinates on LGM 2012			
BP No.	Eastings(m)	Northings(m)	Description
BP 1	264088.137	358819.965	Iron peg on ground
BP 2	264275.422	359087.602	Iron peg on ground
BP 3	264299.002	359102.862	Iron peg on ground
BP 4	264370.198	358846.458	Iron peg on ground
BP 5	264073.038	358638.122	Iron peg on ground




Ex Constance Sugar Estate
1.5 km from residential settlements
SITE
Flacq Hospital
0.6 km from Poultry
Constance Hospitality School
Riviere du Post de Flacq
Poultry
Constance Road B23
B23
B25
A7
B28
Central Flacq
Rue Ste Anne
H
N
1 km
Google Earth
© 2020 Google
Image © 2020 Maxar Technologies

PJ - 23

GOVERNMENT OF MAURITIUS

MY REF: SAPPL/400/H01/1 V. 4/
1125/5/N/F/14 V. 4
YOUR REF: MHC/FH/PJ V. 6

12 November 2019

From: Senior Chief Executive, Ministry of Housing and Lands
To: Senior Chief Executive, Ministry of Health and Quality of Life

Acquisition/Vesting of Land for the Construction of the New Flacq Hospital

Please refer to this Ministry's letter dated 19 June 2019 regarding the above subject matter.

2. I am directed to inform you that the plot of State land which has been acquired from Constance La Gaiete Company Limited, situated at Belle Vue Allendy, of the extent of 105,521.75m² or (25A00P), as shown edged orange on attached plan, is hereby being vested in your Ministry for the construction of the New Flacq Hospital.

3. For any query, you may wish to contact Mr. M. Ramjug, Principal Surveyor on 401 6808.

Y. R. Kheedhoo
for Senior Chief Executive

CHAPTER 2

POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 PROPONENT

2.2 PROJECT OPERATOR

2.3 SITE OWNERSHIP

2.4 LEGAL REQUIREMENTS & EIA LICENSE REQUIREMENT

2.5 BUILDING AND LAND USE PERMIT

2.6 PLANNING POLICIES, ZONING AND OUTLINE PLANNING SCHEMES

PLANNING POLICY GUIDELINES

2.7 PLANNING POLICIES, ZONING AND OUTLINE PLANNING SCHEMES

2.8 KEY POLICY: SD-4 DEVELOPMENT ON LAND OUTSIDE SETTLEMENT BOUNDARIES

2.9 KEY POLICY: SD-6 GROWTH ZONES AND ACTION AREA PLANS (AAPS)

2.10 EIA CONSULTANT

2.11 COMPLIANCE TO EPA 2002

2.12 STAKEHOLDERS CONSULTATIONS

CHAPTER 2

POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 PROPONENT

The proponent is the Ministry of Health & Wellness of the Government of the Republic of Mauritius. The project shall be overseen by the Project Implementation Unit of this same Ministry.

2.2 PROJECT OPERATOR

The hospital shall be operated by the personnel of the Ministry of Health & Wellness. The Ministry of Health is responsible for all public health care facilities in Mauritius. The Flacq hospital is categorized as a regional hospital. This implies that the institution should be able to operate on a 24/7 basis with adequate staff and all essential and emergency facilities on duty.

2.3 SITE OWNERSHIP

The site has been vested to the Ministry of Health & Wellness. Please refer to **Annex 3** at the end of Chapter 1 for more details regarding same.

2.4 LEGAL REQUIREMENTS & EIA LICENSE REQUIREMENT

Good practice for design of any construction project requires perusal of the Environment Protection Act 2002 (as subsequently amended) in order to determine the need for preparing an EIA report for the project for approval by the Directorate of Environment.

Undertakings requiring an EIA license are listed in Part B of the Environment Protection (Amendment of Schedule) Regulations 2006. Upon perusal of this Part B of the Act, it is noted that the Construction of a New Hospital warrants an EIA application to be made and clearance be sought for an EIA license.

The proponent is thus proceeding for the application of an EIA license to the Ministry of Environment, Solid Waste Management and Climate Change.

2.5 BUILDING AND LAND USE PERMIT

Since it is a Government project, it is exempted from the BLUP process. However, copies of the Architectural and Structural drawings have been submitted to the District Council of Flacq for compliance and observations. The District Council of Flacq does not have any adverse comments to the development.

2.6 PLANNING POLICIES, ZONING AND OUTLINE PLANNING SCHEMES

PLANNING POLICY GUIDELINES

The Planning Policy Guidelines, commonly referred to as PPG, is a set of guidelines for the built environment that was prepared and legislated in order to predict and harmonize the infrastructure development on the island while being sustainable.

There is no specific PPG document that deals with Hospitals since the latter is a specialized in itself for which international norms are usually referred to. However, since the project consists of different components and is of National importance, it has been verified for compliance.

Generally, the guidelines and technical sheets required for Commercial & Tall buildings, Industrial and Commercial roads, Access for People with disabilities, Drainage, On site sewer disposal amongst others have been referred to and generally complied to while developing the design based on the requirements of the Proponent.

2.7 PLANNING POLICIES, ZONING AND OUTLINE PLANNING SCHEMES

The site for the proposed New Multispecialty & Teaching Hospital is located in Constance in the District of Flacq. Thus, the Outline Planning Scheme for Moka Flacq District Council area has been referred to for compliance and corresponding guidelines.

According to this document, this project is outside of the growth zone sanctioned for the district of Flacq. Refer to **Annex 4** at the end of this section for more information on same. However, owing to the reasons mentioned hereinafter, it is evident that the hospital could not be located at a different site other than the one being proposed.

- The site of the existing hospital in Central Flacq is already congested and poorly planned and does not allow for major alteration works to proceed while keeping the hospital functional.
- The site of the existing hospital can be accessed only through congested roads, which is not the ideal situation for Accidents and Emergencies.
- The existing site does not allow for sufficient parking spaces.
- The existing site does not have the necessary scope for growth projected for the next 50 years.
- The existing site is located in a mixed urban grain area.
- The existing site caters mostly for the people of Central Flacq and not for Flacq District as a whole in terms of accessibility.

Based on the above mentioned important points, a new site has been identified which can accommodate for the future expansion of the hospital as well as provide necessary facilities for being a teaching hospital and does not suffer from connectivity issues. The proposed site will provide for sufficient parking to the hospital and since it will be located on a Tabula rasa site, it shall be the precursor for the development around the region. It has the potential for becoming a regional medical hub that can be easily accessed from different parts of the island with the proposed new motorway connecting the North to the East.

Notwithstanding the above, it is important to note that inspite of being outside of the settlement boundaries and owing to the national importance of the project; it still complies with the Key Policies SD4 & SD6 of the document.

2.8 KEY POLICY: SD-4 DEVELOPMENT ON LAND OUTSIDE SETTLEMENT BOUNDARIES

There should be a general presumption against proposals for development outside settlement boundaries unless the proposal:

- *Has been shown to have followed the sequential approach to the release of sites identified in SD 1, SD 2 and SD 3 and there are no suitable sites within or on the edge of settlement boundaries; and*
- *Is for the essential purposes of agriculture, forestry or other uses appropriate to a rural area; or*
- *Is for the re-use or refurbishment of existing buildings set in their own grounds; or*
- *Is considered a bad neighbour development as defined in Policy ID 4; or*

- *In cases of national interest when having regard to material considerations, locational preferences linked to employment creating uses and socio-economic policies of Government, development may have to be outside settlement boundaries and is acceptable on planning, traffic impact and environmental impact grounds; and is capable of ready connection to existing utility supplies and transport networks or can be connected without unacceptable public expense;*

Or where;

- *The proposal is from a small owner seeking residential property for themselves and their close kin and can be considered as a hardship case, provided that in the opinion of the relevant authorities such release would not encourage large scale removal of land from agriculture;*

Or;

- *There has been a formal commitment given by the Ministry responsible for Public Utilities, Local Authority, the Town and Country Planning Board, the Ministry responsible for housing and Lands or other Government-approved scheme prior to the approval of this Outline Planning Scheme, provided such a commitment is duly supported by bona fide evidence i.e. original and authentic documents;*

And the proposal:

- *Is not located in an environmentally sensitive area nor in an area of landscape significance as notified by the Ministry responsible for Environment and National Development Unit; or*
- *Is not occupying a site of long term suitability for agriculture, forestry or an irrigation zone as notified by the Ministry responsible for Agro-Industry and Fisheries;*
- *Broadly follows the design principles contained in Design Guidance outlined in SD 5.*

Justification: At the District level there is sufficient land available, committed or vacant within settlement boundaries for residential development and through approved Morcellement, VRS and other land conversion schemes to accommodate future residential needs for the next 15-20 years. To conserve remaining land in the District, especially land required for long term agriculture, or land that has an ecological or landscape significance, a sequential approach to new development should be followed which first considers sites within or on the edge of built-up areas in existing settlements before greenfield sites outside settlement boundaries are selected. This presumption reinforces key NDS objectives for clustered growth and more efficient provision of transport and utility facilities and social and community services.

It is recognised however that not all development can or should be accommodated within settlement boundaries and under well-defined circumstances some developments may be more appropriately located outside settlement clusters and the main built-up areas. The definition of hardship case, small owner and close kin is as defined in SD 3.

Based on the above extract, it can be considered that:

- The project is of National Importance and has manifold impacts on different aspects such as economic, social and technological and will be at the benefit of the public at large.
- Does not have major traffic impact that will require unreasonable expenses to be incurred

- Does not have major environmental impacts that are of irreversible nature
- Can be easily connected to existing services such as water network and electricity network without causing major interference to same
- Has been located on a site vested to the Proponent specifically acquired for this project
- The site is not located in an environmentally sensitive area nor does it have effect on sustainable agricultural production

It is thus inferred that the project site and the project itself is not to be deemed as being out of context.

2.9 KEY POLICY: SD-6 GROWTH ZONES AND ACTION AREA PLANS (AAPS)

Where sites for major new developments are required or are being considered within the District, public and private sector stakeholders should be first directed towards settlements capable of forming the basis for sustainable long term growth. Such growth zones have been defined and designated as Urban Renaissance Zones, Rural Regeneration Zones, Tourism Zones or Special Use Zones according to criteria established within the National Development Strategy. Rural Regeneration Zones focus on Moka/ St Pierre, Highlands, Quartier Militaire, Centre de Flacq, Bon Accueil and Bel Air/Rivière Sèche and the Tourism Zone comprising the Eastern Tourism Zone from Plaines des Roches to Grand Rivière Sud Est including Trou D'Eau Douce.

Where sites for major development can be found in designated growth zones and in other suitable areas of significance for environmental, social or economic planning and acceptable on planning grounds, scheme promoters and private sector developers as well as public sector agencies should be encouraged to bring forward Action Area Plans in accordance with the Design Guidance in policy SD5 and other relevant policies contained in this Outline Planning Scheme.

Justification: Growth zones have been identified within the NDS as development opportunity areas on the basis of good or potential strategic road network links, thresholds of population and jobs and proximity to social networks, retail and community services and facilities. Other criteria for selecting growth zones can include the need to attract inward investment (both private and public) to trigger regeneration due in part to loss of employment in the sugar industry, where key development areas have already been identified Development on Land Outside Settlement Boundaries.

In line with the provision of this key policy, it is to be noted that the proposed hospital is going to provide latest medical healthcare services to the population, which is not yet available in the region. The hospital will improve the daily activities of the Proponent, will reduce the burden on other regional hospitals and facilitate a more health conscious lifestyle. It will also act as a precursor for future development in the region and shall as well benefit to a greater segment of the population by virtue of its new location.

2.10 EIA CONSULTANT

Since this is a design and build project, the EIA consultant for this project is Larsen & Toubro Construction which is an EPC Contractor having successfully delivered projects is Mauritius in the recent past years. Refer to **Annex 5** at the end of this chapter for letter of Authorization

2.11 COMPLIANCE TO EPA 2002

The table shown below gives the necessary information on all the vital elements that are to be considered for the compliance of an EIA report to Section 18.2 of the EPA 2002.

Section 18 of EPA Act	Statutory Requirement	EIA Report
2(a)	The name and address of proponent	Ministry of Health & Wellness, 5th Floor, Emmanuel Anquetil Building, SSR St, Port Louis
2(b)	The ownership of the undertaking and of the land on which it is being conducted	Ministry of Health & Wellness, 5th Floor, Emmanuel Anquetil Building, SSR St, Port Louis
2(c)	The name, address and qualifications of the consultant who prepared the EIA	Larsen & Toubro Construction Ltd, 5th Floor, Medine Mews, 4, La Chaussee, Port Louis
2(d)	The precise location and surroundings of the undertaking, the zoning of the site and the number of similar undertakings in the area	Belle Vue Allendy, Along B23, St Julien – Flacq road, Frontage of site along road of approximately 406m Located outside of Growth Zone for Flacq District No similar undertakings in the said area
2(e)	The principle, concept and purpose of the undertaking	Refer to Sub chapters 1.2 & 1.4 of the previous chapter of the report
2(f)	The direct or indirect effects that the undertaking is likely to have on the environment	Refer to Chapter 7 regarding the Predictions and Mitigations of Impacts of the project
2(g)	An assessment of the social, economic and cultural effects which the undertaking is likely to have on the people and society	Refer to Chapter 7 regarding the Opportunities and Benefits of the project
2(h)	Any actions or measures which the proponent proposes to take to avoid, prevent, change, mitigate or remedy, as far as possible, the likely effects of the undertaking on the environment	Refer to Chapter 7 regarding the Predictions and Mitigations of the Impacts of the project
2 (i)	An assessment of the inevitable adverse environmental effects that the undertaking is likely to have on the environment, people and society, where it is implemented in the manner proposed by the proponent	Refer to Chapter 7 regarding the Predictions and Mitigations of the Impacts of the project
2 (j)	An accurate assessment of the irreversible and irretrievable commitment of resources which will be involved in the undertaking, where it is implemented in the manner proposed by the proponent	Refer to Chapter 8 regarding the Environmental Monitoring Plan to be implemented at the time of construction/implementation of the project
2 (k)	Any alternative manner or process in the undertaking may be carried out so as to cause less harm to the environment	Refer to Chapter 7 & 8 regarding the mitigating measures and the opportunities from the project

2(l)	An environmental monitoring plan	Refer to Chapter 8 for details on same
2(m)	Information pertaining to the decommissioning of the project at the end of its life cycle and associated impacts, proposed measures to return the site as far as possible to its former state or rehabilitation measures	Refer to Chapter 7 regarding the decommissioning of the project once it has gone beyond its intended life cycle
2 (n)	In the case of a new infrastructure proposal, an environmental management to be implemented during the construction phase	Refer to Chapter 8 for details on same

2.12 STAKEHOLDERS CONSULTATIONS

Preliminary consultations have been made to different departments and ministries with a view to secure early clearances. Drawings have been sent for approval, vetting and comments and as necessary and required, these have been implemented into the finalized design. A full coordination shall be carried out with all concerned parties prior to major works related to their discipline are undertaken.

Special attention has been given to the Fire Safety of the building as well as Waste water treatment, Medical Waste Disposal and the Road safety within the site vicinity.

Ministry of Health and
Wellness
Mauritius

REPUBLIC OF MAURITIUS

MHC/FH/PJ/EIA

27 November 2020

The Director
Ministry of Environment,
Solid Waste Management and Climate Change
Department of Environment
2nd Floor, Ken Lee Tower
Barracks Street
Port Louis

Dear Sir,

EIA for proposed construction of the New Flacq Teaching Hospital

This is to inform you that the firm Larsen and Toubro has been entrusted the assignment of preparing the Environmental Impact Assessment (EIA) report for the above project. We have duly authorized the firm to:

i. Deposit the EIA to the Department of Environment (DOE) in the required number of copies (18 hard copies and 2 CDs);

ii. Apply for the EIA License on behalf of the Promoter;

iii. Exchange correspondence with the DOE regarding the follow – up of the project dossier.

Yours faithfully,

D. Allagapen
Ag Senior Chief Executive

Ex Constance Sugar Estate

1.5 km from residential settlements

Mountain view

View towards Belle Mare Beach

SITE Flacq Hospital

CHTC

View towards Ile aux cerfs

View towards Moka

0.6 km from Poultry

Poultry

Wind Direction

Constance Road B23

Central Flacq

Rue Ste Anne

B23

B28

B25

A7

A7

Google Earth

1 km

CHAPTER 3

SITE ENVIRONMENTAL CHARACTERISTICS

3.1 Site Description & Characteristics

3.2 Features of Interest

3.3 Satellite View

3.4 Land Type Description

3.5 Micro Climate

3.6 Settlement Zones

3.7 General Environment Characteristics

CHAPTER 3

SITE ENVIRONMENTAL CHARACTERISTICS

3.1 Site Description & Characteristics

The project is being implemented on a site having an area of 105,521.8 sqm and has for boundaries, the Rivière du Poste de Flacq on the Southern side, the Classified road B23 on the Northern side over a length of approximately 406m, a strip of land of around 4m wide following which there exists a canal on the Western side on over a length of approximately 231m and sugarcane plantation on the eastern side over a length of approximately 295m. Refer to the **Annex 2** at the end of Chapter 1 for more details.

The site currently sits of vacant land which was formerly under sugarcane plantation. There exists currently an old unused building that shall be demolished later on and a litchi tree grove. No endemic trees are found on the site and it is generally covered with shrubs and wild trees since it has been abandoned for a few years. The site gently slopes towards the south, which is the rear face of it, along which there is a river. There exists an escarpment of width varying between 10 to 30m that it covered with dense wild foliage. It is envisaged that this portion of the site will remain untouched by construction and selective pruning will be carried out to create a healthy atmosphere.

3.2 Features of Interest

While at ground level, it is not apparent, the site actually boasts of many scenic views. There is a river at the rear side and the site overlooks the West Peak Mountain found along its southern side. Towards the east, there is an unmatched view on the Coast and the eastern lagoon. Towards the northern side, there are opportunities to view the Moka range of mountains.

3.3 Satellite View

A satellite view is enclosed at **Annex 6** at the end of this chapter to give a better understanding of the site. The site boundaries are indicated as well as the river to its backside, existing buildings in the surroundings and opportunities for views and connection to road network.

3.4 Land Type Description

Please refer to the extract from the geotechnical report that has already been carried out for more details regarding the above mentioned sub chapter. Extract forms part of **Annex 7** of this chapter.

3.5 Micro Climate

In order to correctly design the infrastructure, meteorological data pertaining to temperature, humidity, wind and rainfall has been sought from the Mauritius Meteorological Department. Please refer to **Annex 8** of this section for further details.

3.6 Settlement Zones

The site is found at around 1.5 km away from any existing settlement zones. It is being developed on a tabula rasa situation wherein future development opportunities may be dictated by the presence of the hospital institution.

3.7 General Environment Characteristics

The site was previously under sugarcane plantation prior to acquisition by the Ministry. Thereafter, it is noted that there is a litchi plantation on site. The remainder of the site is covered with wild trees and shrubs which do not have any important endemic relevance. Any mature trees that do not hinder the new hospital footprint shall be left untouched. Prior to the felling of any trees on site, the clearance from the Forestry Department, Ministry of Agro-Industry shall be sought. As at date, such clearance has already been applied for and a part clearance has been issued as well.

Legend

Key Policy Number

Administrative Boundary	
Settlement Boundary	SD1-4
Indicative Built up Area	
A Road	TP3
B Road	TP3
Proposed East Coast Trunk Road	TP9
Proposed Bon Accueil By-pass	TP9
Proposed Bel Air R. S./Tr. D'eau Douce By-pass	TP10
Former Railway Track	TP11
Proposed Airport Safeguarding Area	NA1
Growth Zone	SD6, CDT1
Lake/Reservoir/Dam	EC1,EC2
Lagoon	EC1, EC4
Public Beach	CDT6
Mineral Resource	MR1
Privately Owned Mountain Reserve	EP1
State Forest Land	EC1
Habitat for Flora and Fauna	EC1
Mountain Slope	EC1, EC5
Range Peak	EC1, EC5
Scenic Landscape Area	LS1
Wetland (Surveyed)	EC1,EC3
W Wetland (unsurveyed)	EC1,EC3
M Mangrove	EC1
Main Electrical Power Line	E2
Electrical Substation	GI2
Sugar Factory/Bagasse Power Plant (Operational)	ID3
Industrial Site	ID1
Stone Crushing Plant / Buffer Zone	ID4

FLACQ
Development Management Map
Moka/Flacq Outline Planning Scheme

APPROVED VERSION
Sept 2006

Sheet No.
1 of 2

Scale:1/25 000

Airport Operational Area
Airport Noise Contraints Zone
Poste Lafayette Fishing Reserve Ext. 280ha
Bras d' Eau
Mare Sarcelle
Poste Lafayette
Airport Noise Contraints Zone
Poste de Flacq
Pont Blanc
Constance
Centre de Flacq
St. Remy
Laventure
Petite Retraite
Grand Retraite
Mare d' Australia
Brisée Verdière
Bon Accueil
Lalmatie
St. Julien Village
Union Flacq
Rich Fund
Camp BonneMère
Bonne Mère
Queen Victoria
St. Julien d' Hotman
Unité
Bramsthan
Isidore Rose (Pavé)
Isodore Rose
Mare La Chaux
Quatre Cocos
Belle Mare
Camp Marcelin
Camp Ithier
Palmar
Ecroignard

1. Introduction

On the 23rd August 2020, Larsen & Toubro Ltd (the Client) awarded Water Research Co. Ltd a contract to carry out geotechnical investigation on a site at Flacq where a hospital comprising basement, ground plus 6No. storeys shall be implemented. The site is roughly trapezoidal shaped with approximate length of 406m and sides 231m and 295m. The aim of the contract is to define the soil or rock profile and identify the groundwater level to support the assessment of foundation solutions and geotechnical aspects and risks that may be present. The geotechnical investigations were required to:

- define the ground profile and properties
- identify groundwater level
- define the bearing capacity of the ground and settlement under the expected loading
- identify and assess any geotechnical aspect of the proposed site in relation to the development.

The site boundary showing the location of the proposed building and parking is presented in Figure 1.1 (provided by Client). The site boundary in Google Earth is presented in Figure 1.2.

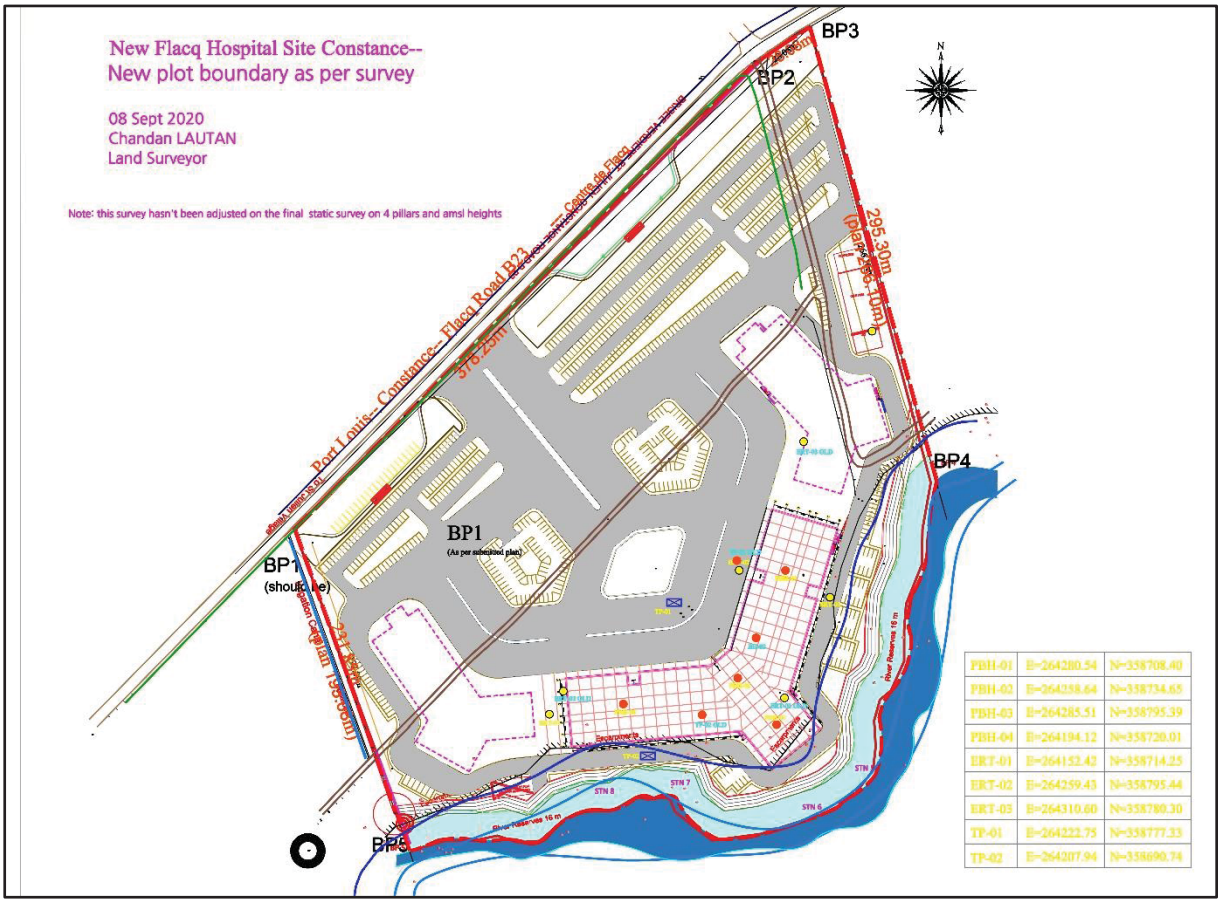


Figure 1. 1: Site boundary

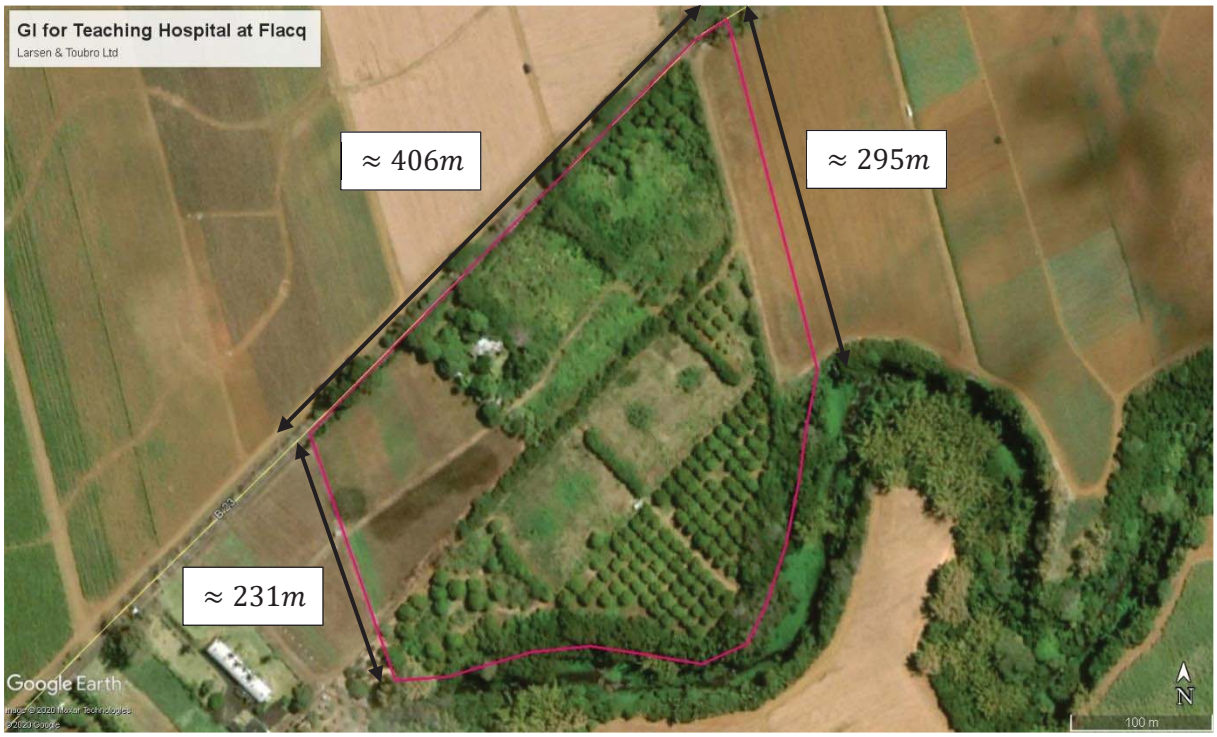


Figure 1. 2: Site Boundary (Google Earth)

Water Research's brief comprised:

- Excavate, log and photograph trial pits
- Core recovery drilling
- Disturbed sampling from trial pits and undisturbed sampling from coreholes
- In situ electrical resistivity tests and standard penetration tests
- Laboratory testing
- Geotechnical assessment and preparing of interpretative report.

This Report describes the activities carried out on the site and presents the outcome of the investigations in the following format:

- Desk study information: including geological maps and plans.
- Factual information: comprising description of fieldwork; trial pits and coreholes photographs and logs and in situ and laboratory test results.
- Geotechnical assessment: comprising profile definition; assessment of strata geotechnical properties, recommendations for selection of foundation solutions, estimates of bearing capacity and settlement of required foundation.

2. Desk Study Information

2.1 Site location and Topography

The site is located at Constance, Flacq in the district of Flacq (Figure 2.1 and Figure 2.2). It can be accessed via Brisée Verdière - Saint Julien - Constance Road (B23). The site is roughly trapezoidal shaped with approximate length of 406m and sides 231m and 295m and occupies an approximate area of 95,000 m^2 (according to Google Earth). It is bounded to the north by B23 Road, to the south by Riviere Poste de Flacq, and to the east and west by agricultural lands. There is one residential building of roughly 10m square near the north boundary. The Constance Hospitality Training Centre is approximately 100m to the west boundary of the site. Elevations of exploratory holes varied between +109.987m and +113.785m amsl as per survey carried out by Water Research Co Ltd.

Figure 2. 1: General location of the site

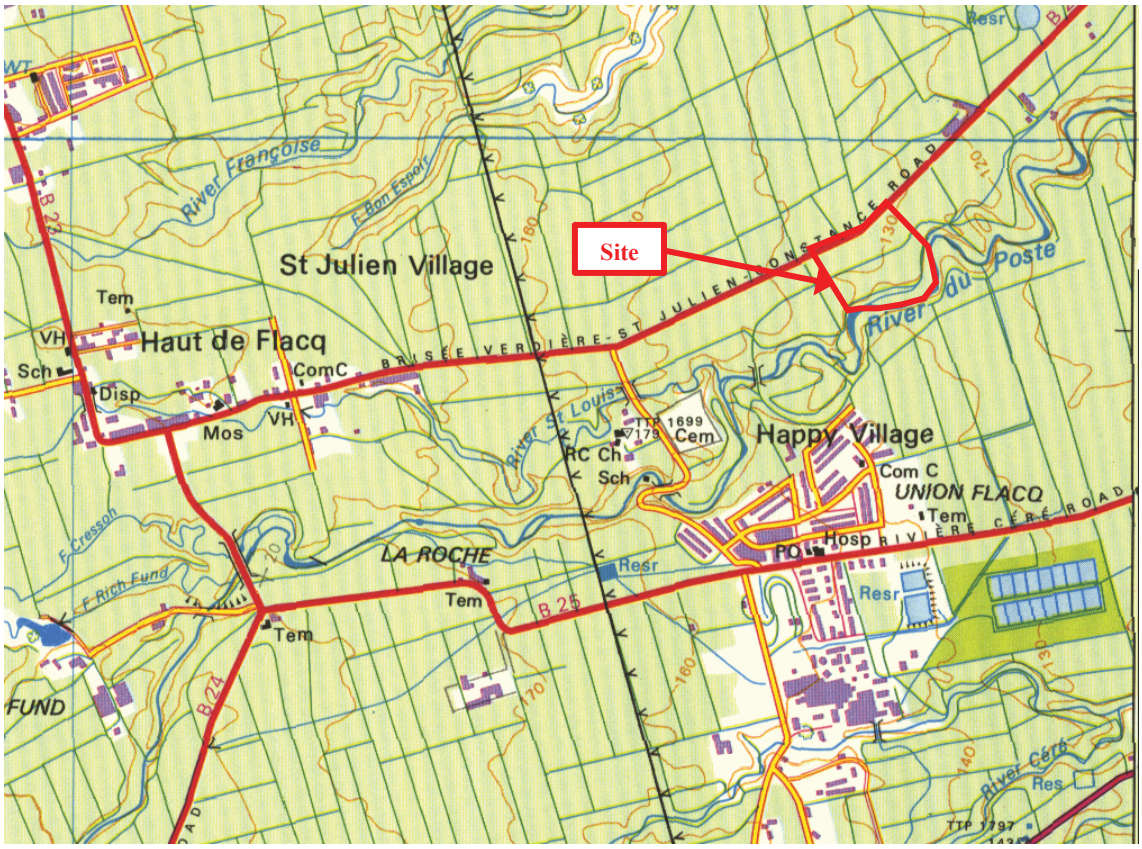


Figure 2. 2: Site location (Digital Map)

At the time of the investigation, the north, east and central regions of the site were covered with wild vegetations. The west and south regions were used for agricultural purposes such as lychee tree plantation (Figure 2.3).

Figure 2. 3: Lychee tree plantation

2.2 Site History

Figure 2.4 shows the historical development (from year 2005 to 2020) of the surroundings of the site using Google Earth images. The images show that the plot and its surroundings were used mainly for agriculture purposes. St Remy area which is around 1km east to the site was not yet developed in 2005 and undergone most development between 2015 to 2020.

Figure 2. 4: Site History (Google Earth)

2.3 Geology

According to Ile Maurice Carte Geologique et Hydrogeologique (1996), presented in Figure 2.5, the site is located on partly on fresh basalt and partly on tuffs and pyroclasts of the Younger Volcanic Series (Late Lavas). According to Proag (1995) these lavas are light greyish in colour and show many phenocrysts (large crystal surrounded by a finer-grained matrix in an igneous rock) of olivine scattered in the doleritic network of feldspars and pyroxenes (silicate minerals). They are often porous and vesicular and show many cracks and fissures, but they are also sometimes compact. Scoriaceous textures are common, mainly at the upper and lower parts of the flows. Weathering is in general not important and is very often in concentric beds production onion-type alteration structures. The pyroclasts are rare in the late series. They are represented by some pozzolanic tuffs or by a cone of very coarse scoria mixed with bombs of the breadcrust type.

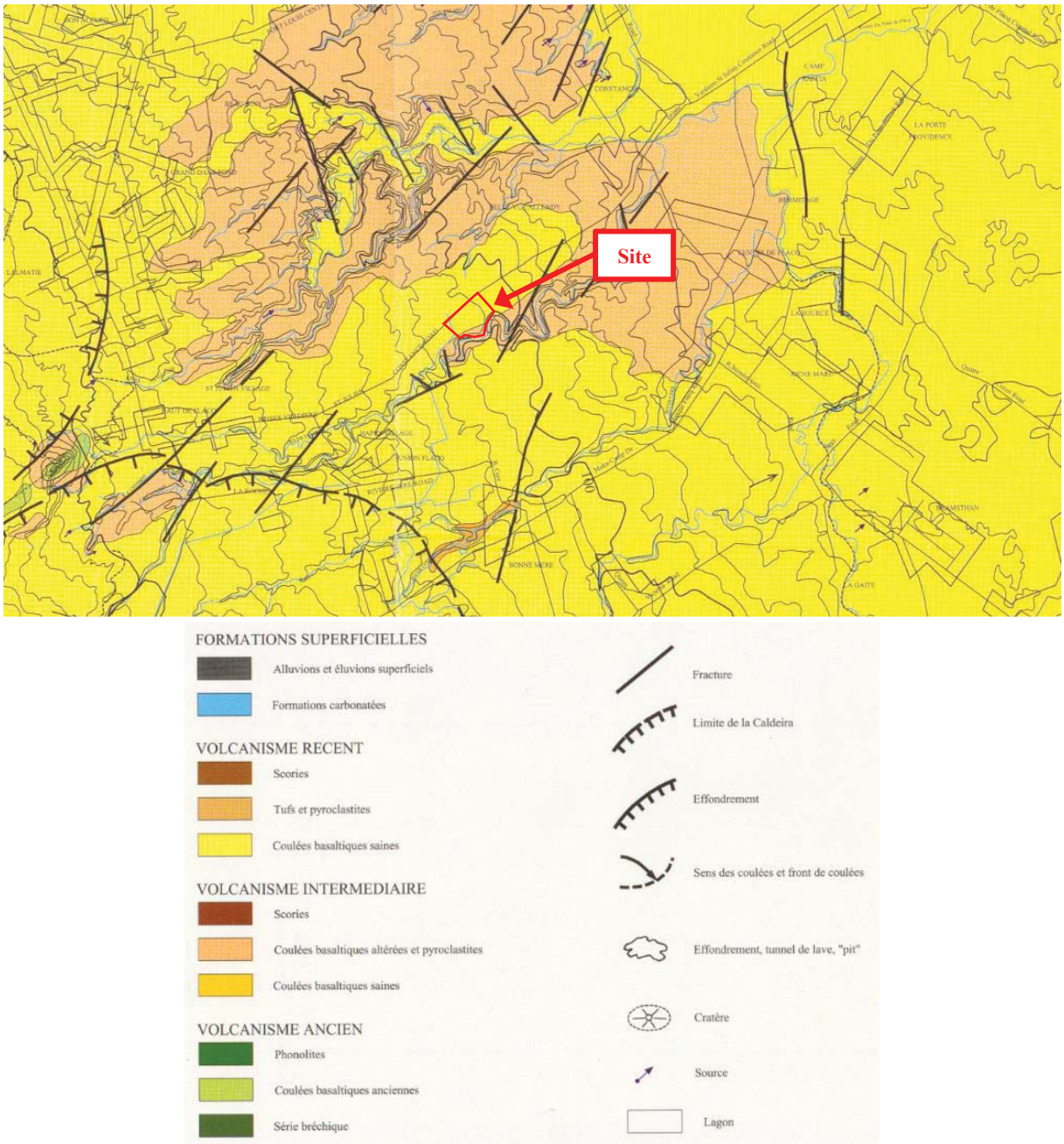


Figure 2. 5: Map of basaltic units

2.4 Soil type

According to the Soil Map of Mauritius (Figure 2.6), by the Directorate of overseas surveys UK (1962), the natural strata on the site area are low humic latosols. Proag (1995) mentioned that low humic latosols occur in sub-humid and lower rainfall zones and in areas with a distinct dry season. Their depths range from 60cm to over 100cm, have good internal drainage potential, base saturation between 30% - 90%, and their organic content is low. Their A horizon is weak to moderately strong structured with colour varying from red to brown whereas the B horizon varies from red to reddish brown in colour. The texture of the A horizon is silty clay to clay, with kaolinite being the dominant clay mineral.

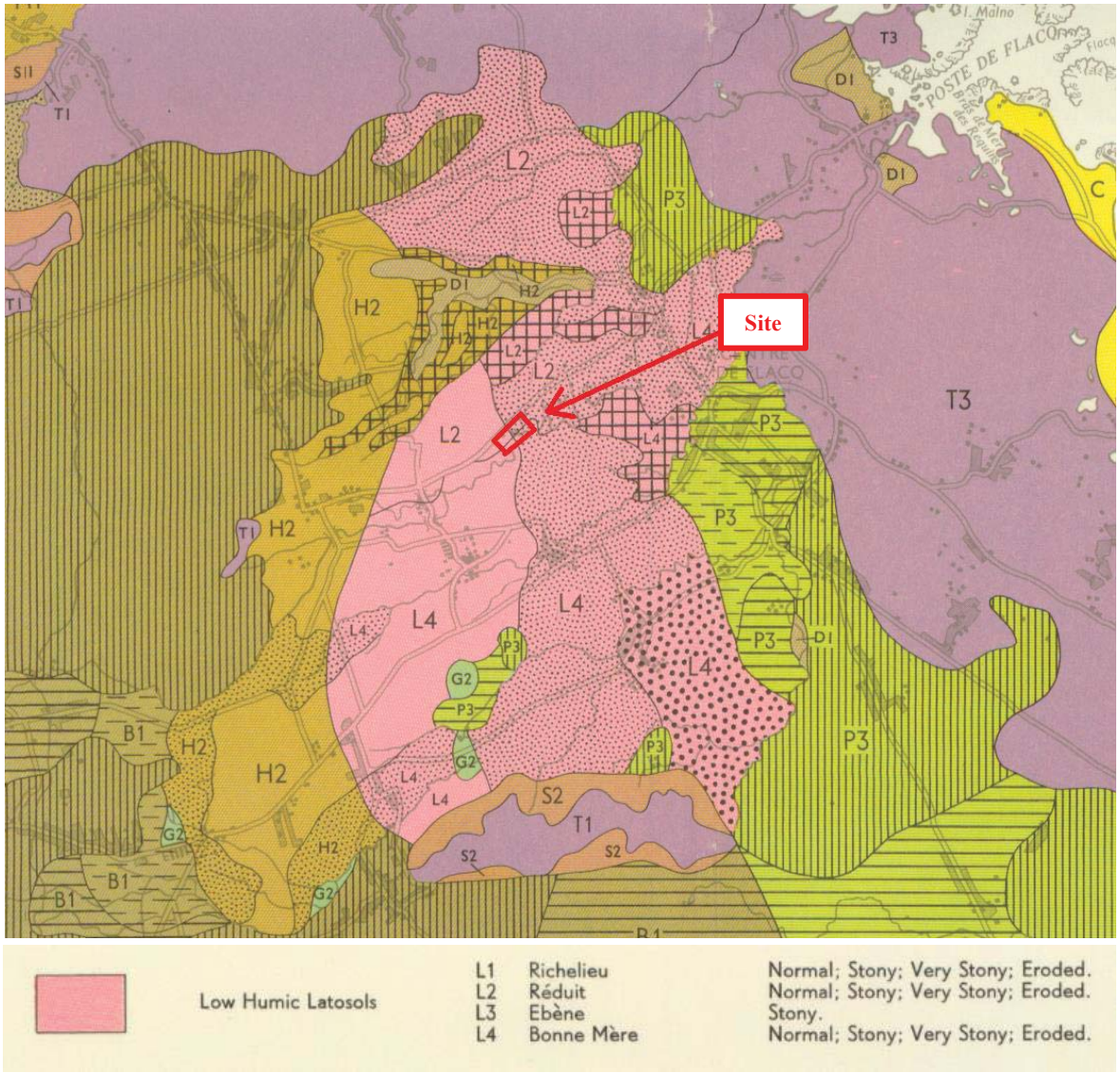


Figure 2. 6: Soil map of the site

2.5 Hydrology

The Aquifer Map (Figure 2.7) shows that the area is located on Aquifer IV – Aquifer of Nouvelle Decouverte – Plaines des Roches / Midlands – Trou d'Eau Douce. This site is affected by the median reservoir of Melrose – Bel Etang and is limited to the north by the ridge of Motte a Therese – St. Julien d'Hotman and to the south by buttresses of the Montagne Bambous. The downstream part of this reservoir is subdivided in to three zones by Montagne Fayence and Montagne Blanche mountains. Seasonal variations of the water level are high, between 10 metres (Melrose – Belle Mare) and 20 metres (west of Pont Bon Dieu near Lalmatie) (Giorgi, et al., 1999).

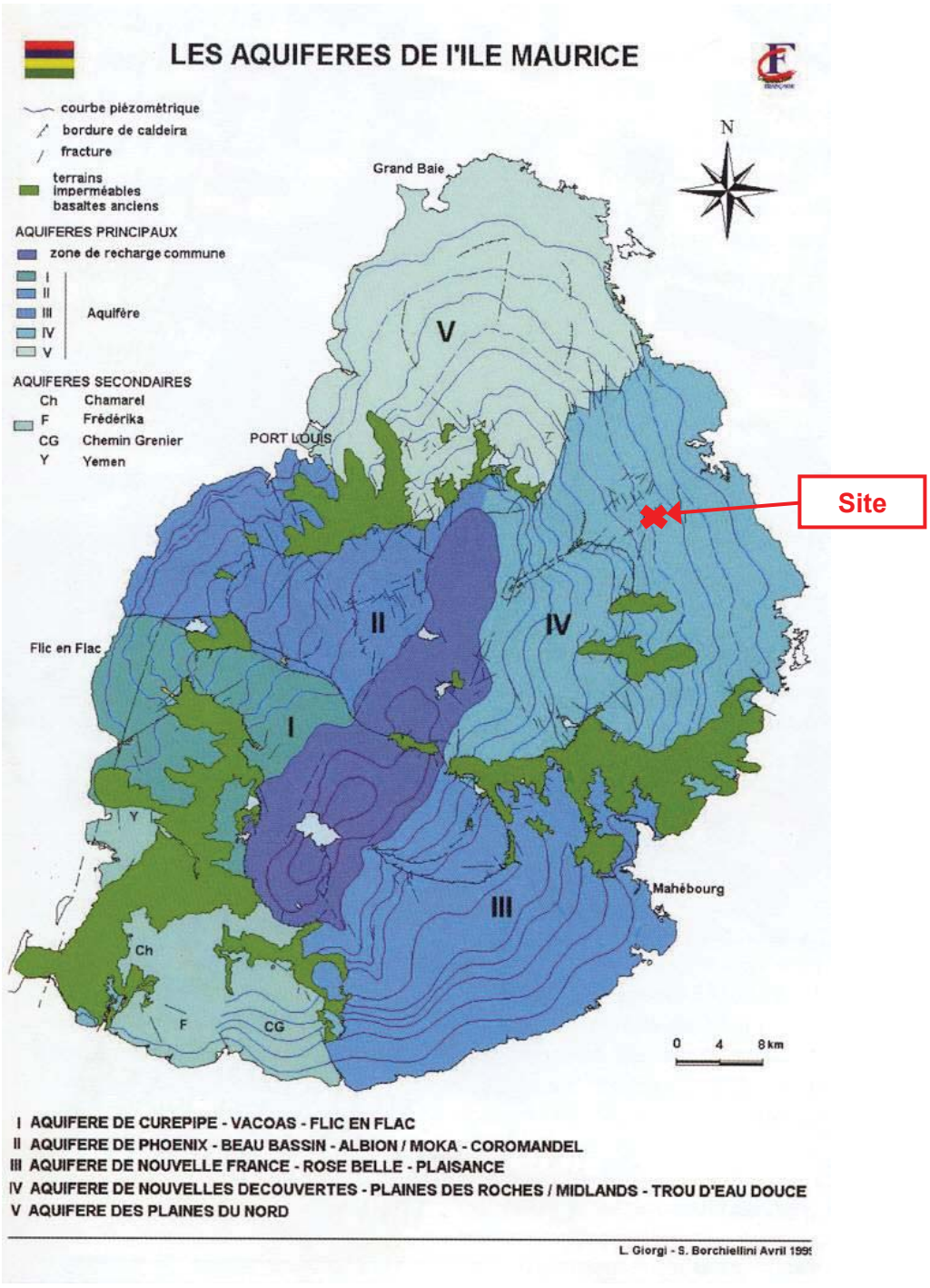


Figure 2. 7: Aquifers of Mauritius

3. Field and Laboratory works

3.1 Geotechnical Investigation Works

The scope of works, including the number and depth of trial pits and coreholes, were according to specifications from the client and were undertaken in general accordance with BS 5930 (2015). The scope of works included:

- Excavation, inspection, logging and photographing of 3No. trial pits
- Collection of disturbed samples from trial pits
- 4No. rotary drilled coreholes of total depth of 160m with core recovery
- Collection of undisturbed samples from coreholes
- Standard penetration tests (SPT)
- Installation of standpipes in coreholes for groundwater monitoring
- Laboratory testing.

The trial pit investigation works were carried out on 7th September 2020 for TP 1 and TP 2 and on 24th September 2020 for TP 3. Coreholes drilling were carried out from 8th to 22nd September 2020. Figure 3.1 presents the location of the trial pits and coreholes on Google Earth.

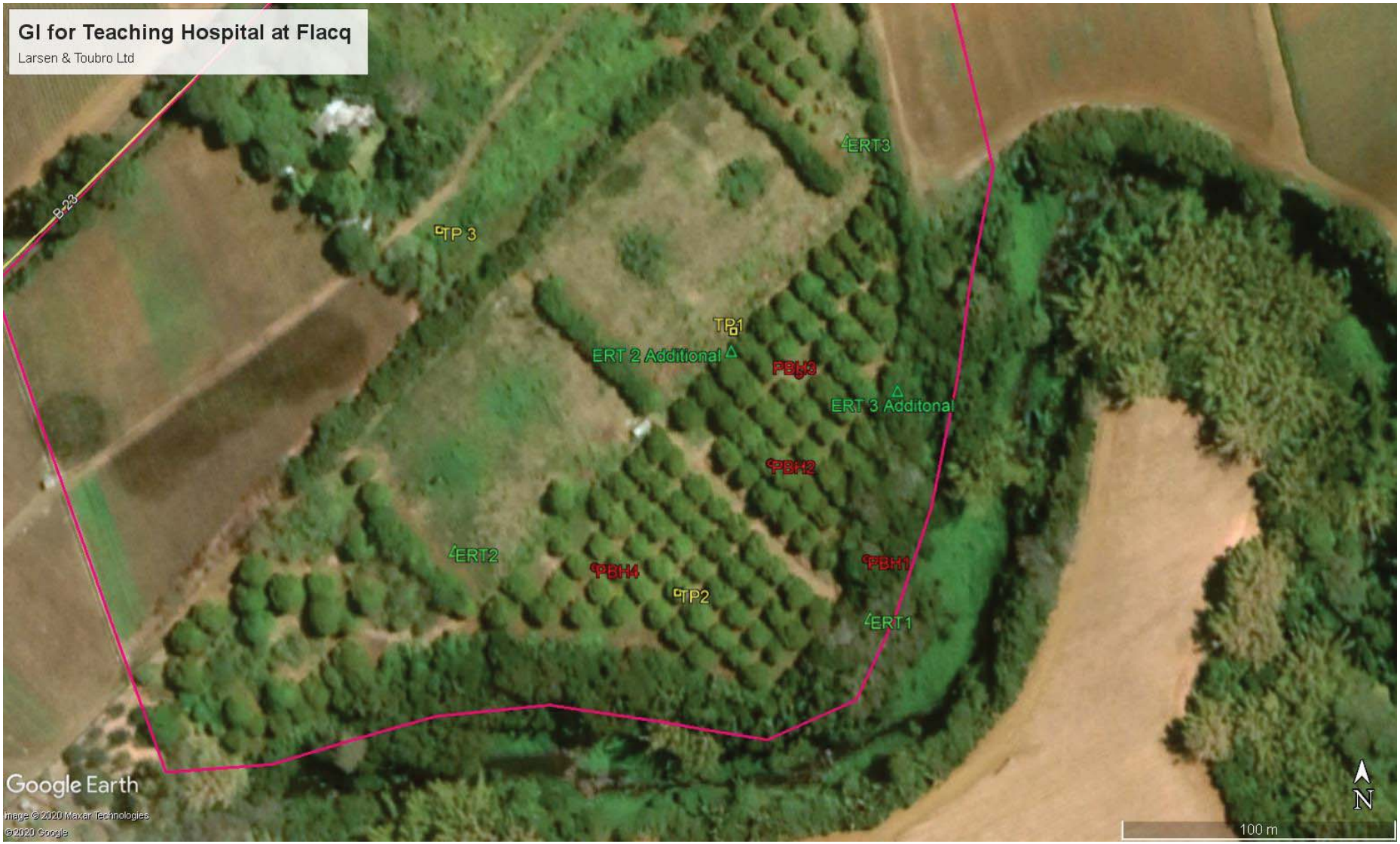


Figure 3. 1: Location of the trial pits and coreholes on Google Earth

3.2 Trial Pits

3No. Trial Pits were excavated to assess the shallow soil profile and properties for shallow foundations and earthworks; the depth, coordinates and elevations of the trial pits are presented in Table 3.1. The coordinates and elevations are according to a survey carried out using a S660N GNSS Network RTK Receiver Instrument. The trial pits were excavated using a mechanical backhoe excavator and logged from the surface immediately after excavation. The photos and logs of the trial pits are presented in Appendices A and B, respectively. Photos during trial pit investigations are presented in Figure 3.2.

Table 3. 1: Summary of Trial Pits

TP No.	Depth (m bgl)	Easting	Northing	Elevation (m amsl)
TP 1	2.20	264258.639	358800.683	111.260
TP 2	2.90	264239.045	358713.639	112.175
TP 3	1.50	264158.343	358839.673	113.785

Figure 3. 2: Trial pit investigations

Large bulk disturbed samples were recovered for geotechnical testing at depths as indicated in Table 3.2.

Table 3. 2: Disturbed samples collected from Trial Pits

TP No.	Depth Interval (m)	Disturbed sample
TP 1	0.40 –1.00	4 LB + 2 SB
	1.00 – 1.50	
TP 2	0.50 – 2.00	
	2.00 – 2.90	
TP 3	0.20 – 0.70	
	0.70 – 1.50	

3.3 Rotary Core Drilling

4No. Coreholes were drilled through rotary drilling techniques using NMLC core barrel (hole diameter of 76mm and core diameter of 52mm). The depths, coordinates and elevations (according to survey by Water Research Co. Ltd) of coreholes are presented in Table 3.3 and the locations are shown in Figure 3.1. The total drilled depth of all coreholes was 120.28m. Water was used as flushing medium; circulation of water was stopped to achieve the maximum recovery when coring of soft and weak materials with the term “dry coring” used in such cases. Dry cored soft samples are generally 76mm in diameter. Figure 3.3 presents drilling works at location PBH 2.

Table 3. 3: Summary of coreholes

CH No.	Depth (m bgl)	Easting (m)	Northing (m)	Elevation (m amsl)
PBH 1	40.00	264281.26	358708.48	109.80
PBH 2	40.00	264269.50	358757.08	110.65
PBH 3	40.11	264285.51	358795.35	110.00
PBH 4	40.17	264194.10	358719.93	111.65

Figure 3. 3: Drilling work at PBH 2

The core samples recovered from coreholes were photographed and described by an Engineer according to BS5930:2015 (BS 5930, 2015). Details of the strata encountered are given in the corehole logs along with the assessment of Total Core Recovery (TCR), Solid Core Recovery (SCR), Rock Quality Designation (RQD), each expressed as a percentage of the individual core runs, and the Fracture Index (FI). The corehole photos and logs are presented in Appendix C and Appendix D, respectively.

9No. U3 (dia 75mm) and 10No. U2 (dia 50mm) undisturbed sample tubes were collected from coreholes. The details are presented in Table 3.4.

Table 3. 4: Undisturbed samples collected from coreholes

CH No.	Depth Interval (m)	Undisturbed sample	Recovery (cm)
PBH1	5.50 –6.00	U3	40
	9.00 – 9.50		35
	13.00 – 13.50	U2	35
	17.00 – 17.50		32
	27.50 – 28.00		31

CH No.	Depth Interval (m)	Undisturbed sample	Recovery (cm)
PBH2	4.00 – 4.50	U3	32
	6.50 – 7.00		45
	9.00 – 9.50		35
	14.00 – 14.50	U2	32
	18.50 – 19.00		50
PBH3	4.50 – 5.00	U3	35
	8.00 – 8.50		45
	14.50 – 15.00	U2	45
	16.50 – 17.00		35
	18.50 – 19.00		37
	21.00 – 21.50		37
PBH4	7.50 – 8.00	U3	45
	10.50 – 11.00		30
	19.00 – 19.50	U2	44

3.4 In Situ Testing

3.4.1 Electrical Resistivity Tests

5No. Electrical Resistivity Traverse Survey were carried out up to a depth of 6m bgl using an ABEM geo-electrical imaging system at location as shown in Figure 3.1. The Electrical Resistivity Traverse survey is a geophysical survey that measures the electrical resistivity of subsurface materials by driving electrical currents from a 12V battery though the ground using electrodes placed at equal intervals and simultaneously measuring voltage differences between electrodes. The coordinates, elevations and depth of the test are presented in Table 3.5. Photos of the test at location ERT 3 are shown in Figure 3.4. The ERT Reports are attached as Appendix E.

Table 3. 5: Summary of ERT

CH No.	Depth (m bgl)	Easting (m)	Northing (m)	Elevation (m amsl)
ERT 1	6.00	264284.968	358723.451	111.176
ERT 2		264259.430	358795.440	-
ERT 3		264295.773	358868.078	109.987
ERT 2 Additional		264257.035	358801.632	111.351
ERT 3 Additional		264314.601	358801.816	110.895

Figure 3. 4: ERT 3

3.4.2 Standard Penetration Tests

Standard Penetration Tests (SPT) were carried out in all coreholes in accordance to BS1377: Part 9 (2015) (BS5930, 2015)). The test consisted of driving a 50mm split spoon sampler by means of a 63.5kg hammer falling at a height of 760mm. The SPT blow count N is the number of blows required to drive the spoon by 300mm after initially seating the spoon by 150mm. Tests for which the full penetration could not be achieved after 50 blows are termed as “Refusals”.

3.5 Groundwater Monitoring

3No. 63mm diameter standpipes were installed up to the bottom of coreholes PBH 1, PHB 3 and PBH 4 for the monitoring of groundwater. Groundwater monitoring was carried out using a Water Level Indicator.

3.6 Laboratory Testing

The scope of geotechnical laboratory testing aimed at determining site parameters concerning the classification, compaction, chemical, consolidation and strength properties of the strata to enable the geotechnical design. Table 3.6 presents the number of tests and the standards utilised. The laboratory tests were carried out at Geotechnical Services Ltd (GETS Ltd), Université Des Mascareignes (UDM) and Labolink Ltd.

Table 3. 6: Summary of tests carried out

Item No. in BOQ	Tests	Quantity	Standard
3.1	Natural Moisture Content	19	BS 1377-2:1990 Section 3
3.2	Specific Gravity	35	BS 1377-2:1990 Section 8
3.3a	Particle Size Distribution (Hydrometer)	20	BS 1377-2:1990 Section 9.5
3.3b	Grain Size Analysis (Wet Sieving)	23	BS 1377-2:1990 Section 9.2
3.4	Atterberg Limits	23	BS1377-2:1990 Section 4 & 5
3.5	Bulk Density	5	BS 1377-2:1990 Section 7
3.6	Modified Proctor Compaction	16	BS 1377-4:1990 Section 3.5 & 3.6
3.7	Unconsolidated Undrained Triaxial Test	7	BS1377-7:1990
3.8	Direct Shear Test	5	BS1377-7:1990
3.9	Soil Total Sulphate Content	4	BS 1377-3:1990 Section 5.2
	Soil Chloride Content	4	BS 1377-3:1990 Section 7
	pH on soil	4	BS ISO 10390:2005
3.11	Free Swell Index Test	16	IS 2720-40:1977
	Swelling Pressure		BS 1377-5: Section 3
3.12	1D Consolidation (Oedometer) 8 Loadings	14	BS 1377-5: Section 3
3.13	CBR (Soaked)	6	BS 1377-4:1990 Section 7
4.1	Water Absorption of Rock	6	IS 1124
	Specific Gravity test of Rock		IS 1122
4.2	Density of Rock	6	BS 1377-2:1990 Section 7
	Porosity of Rock		IS 13030
4.3	Unconfined Compression test on Rock – soaked condition	4	IS 1121
4.2	Point load test on Rock – soaked condition	4	IS 8764

4. Results and Ground Conditions

This Chapter summarises the factual information obtained during the investigation works. The descriptions of the soils and rocks are based on BS 5930:2015 (Code of Practice for Ground Investigation) which, when discussing the description of soils and rocks, refers to BS EN ISO 14689-1:2003, Part 1: Identification and description. Based on Mclean and Gribble (1979), the following terms are used in the report:

- Slightly Weathered Basalt (SWB) - Discoloration indicates weathering of rock material and discontinuity surfaces. Distinctly weathered through much of the rock fabric with slight limonite staining. Strength approaches that of the fresh rock. Requires explosive for excavation. Highly permeable open joints.

- Moderately Weathered Basalt (MWB) - Less than half of the rock material is decomposed or disintegrated. Fresh or discoloured rock is present either as a continuous framework or as core stones. Considerably weathered throughout. Possessing some strength – large pieces cannot be broken by hand, reasonable core recovery. Often limonite stained. Difficult to rip.

- Highly Weathered Basalt (HWB) - More than half of the rock material is decomposed or disintegrated. Fresh or discoloured rock is present either as a discontinuous framework or as core stones. Rock so weakened by weathering that fairly large pieces can be broken and crumbled in the hands. Sometimes recovered as core in careful rotary drilling.

- Completely Weathered Basalt (CWB) - All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact. Rock completely decomposed by weathering in place but texture still recognisable. Can be excavated by hand.

The following Sections present the description of strata encountered and the results of the in-situ and laboratory testing.

4.1 Identified soil profile

The detailed depth of the various strata as interpreted in trial pits and coreholes are summarised in Table 4.1. Figure 4.1 presents location of the cross-section lines with respective cross sections presented from Figure 4.2 to Figure 4.4.

Table 4. 1: Summary of strata encountered in Trial Pits and Coreholes

Hole No.	Topsoil		Clayey Weathered Basalt (CWB and HWB)		Rock Weathered Basalt (MWB and SWB)	
	Depth Interval (m)	Thickness (m)	Depth Interval (m)	Thickness (m)	Depth Interval (m)	Thickness (m)
TP 1	0.00 – 0.40	0.40	0.40 – 1.50	1.10	1.50 – 2.20 (MWB) Refusal on SWB	0.70
TP 2	0.00 – 0.50	0.50	0.50 – 2.00 (H to MWB) 2.00 – 2.90	1.50 0.90		
TP 3	0.00 – 0.20	0.20	0.20 – 1.50	1.30	Refusal on Rock at 1.50m bgl.	
PBH 1	0.00 – 0.24	0.24	0.24 – 0.83 (HWB) 0.83 – 25.25 (CWB) 25.25 – 30.70 (HWB) 30.70 – 40.00 (CWB)	0.59 24.42 5.45 9.30		
PBH 2	0.00 – 0.50	0.50	0.50 – 1.05 (CWB) 3.50 – 23.78 (CWB) 27.93 – 40.00 (CWB)	0.55 20.28 12.07	1.05 – 3.50 (M to HWB) 23.78 – 25.17 (SWB) 25.17 – 26.50 (MWB) 26.50 – 27.93 (SWB)	2.45 1.39 1.33 1.43
PBH 3	0.00 – 0.38	0.38	4.44 – 28.92 (CWB) 28.92 – 32.54 (C to HWB) 32.54 – 33.44 (HWB) 35.86 – 37.25 (H to MWB)	24.49 3.62 0.90 1.39	0.38 – 4.44 (MWB) 33.44 – 35.86 (SWB) 37.25 – 38.55 (SWB) 39.13 – 40.11 (SWB)	4.06 2.42 1.30 0.98

Hole No.	Topsoil		Clayey Weathered Basalt (CWB and HWB)		Rock Weathered Basalt (MWB and SWB)	
	Depth Interval (m)	Thickness (m)	Depth Interval (m)	Thickness (m)	Depth Interval (m)	Thickness (m)
			38.55 – 39.13 (H to MWB)	0.80		
PBH 4	0.00 – 0.40	0.40	0.40 – 1.50 (CWB) 1.50 – 5.10 (H to MWB) 5.10 – 7.00 (CWB) 7.00 – 14.50 (C to HWB) 18.68 – 35.38 (HWB) 35.38 – 40.17 (H to CWB)	1.10 3.60 1.90 7.50 16.70 4.79	14.50 – 18.68 (SWB)	4.18

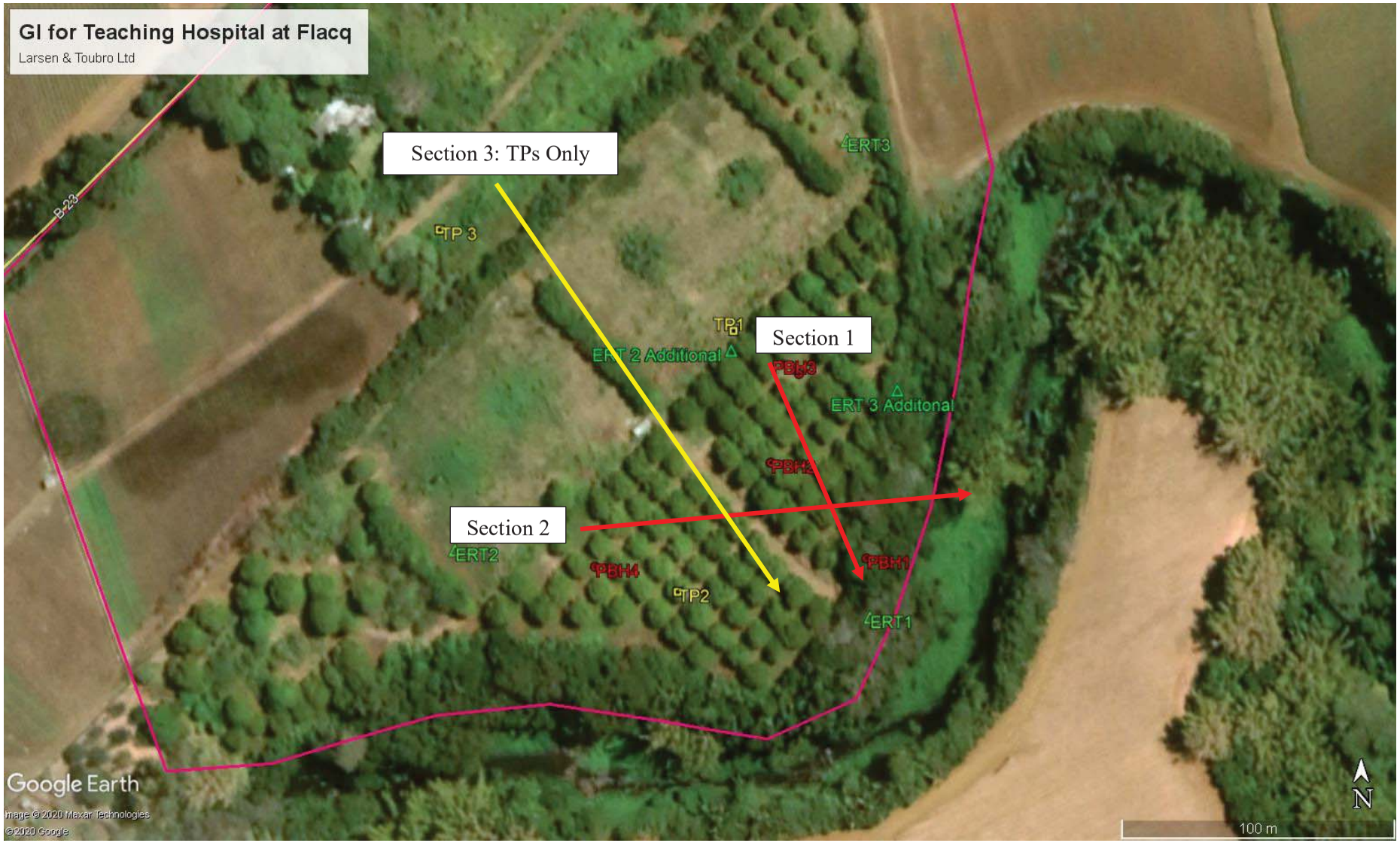


Figure 4. 1: Location of the trial pits and coreholes with cross section lines

Project Id: OPG 20087 LAR	Title: Section line 1
Project Title: Geotechnical Investigation for Teaching Hospital	Vertical Scale: 1:322
Location: Flacq	Horizontal Scale: 1:784
Client: Larsen Tubro	Engineer: SS

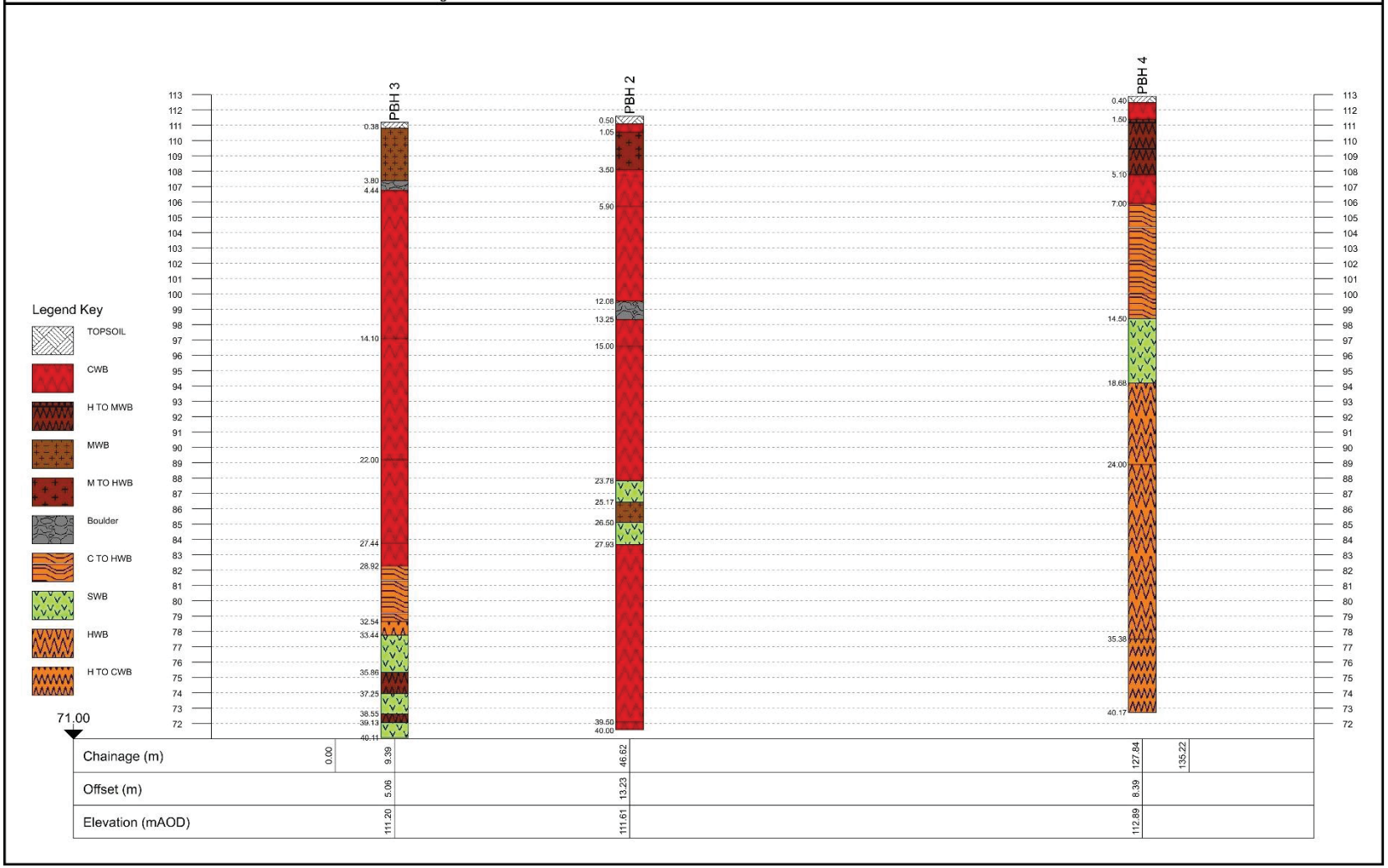


Figure 4. 2: Section 1

Project Id: OPG 20087 LAR	Title: Section line 2
Project Title: Geotechnical Investigation for Teaching Hospital	Vertical Scale: 1:314
Location: Flacq	Horizontal Scale: 1:624
Client: Larsen Tubro	Engineer: SS

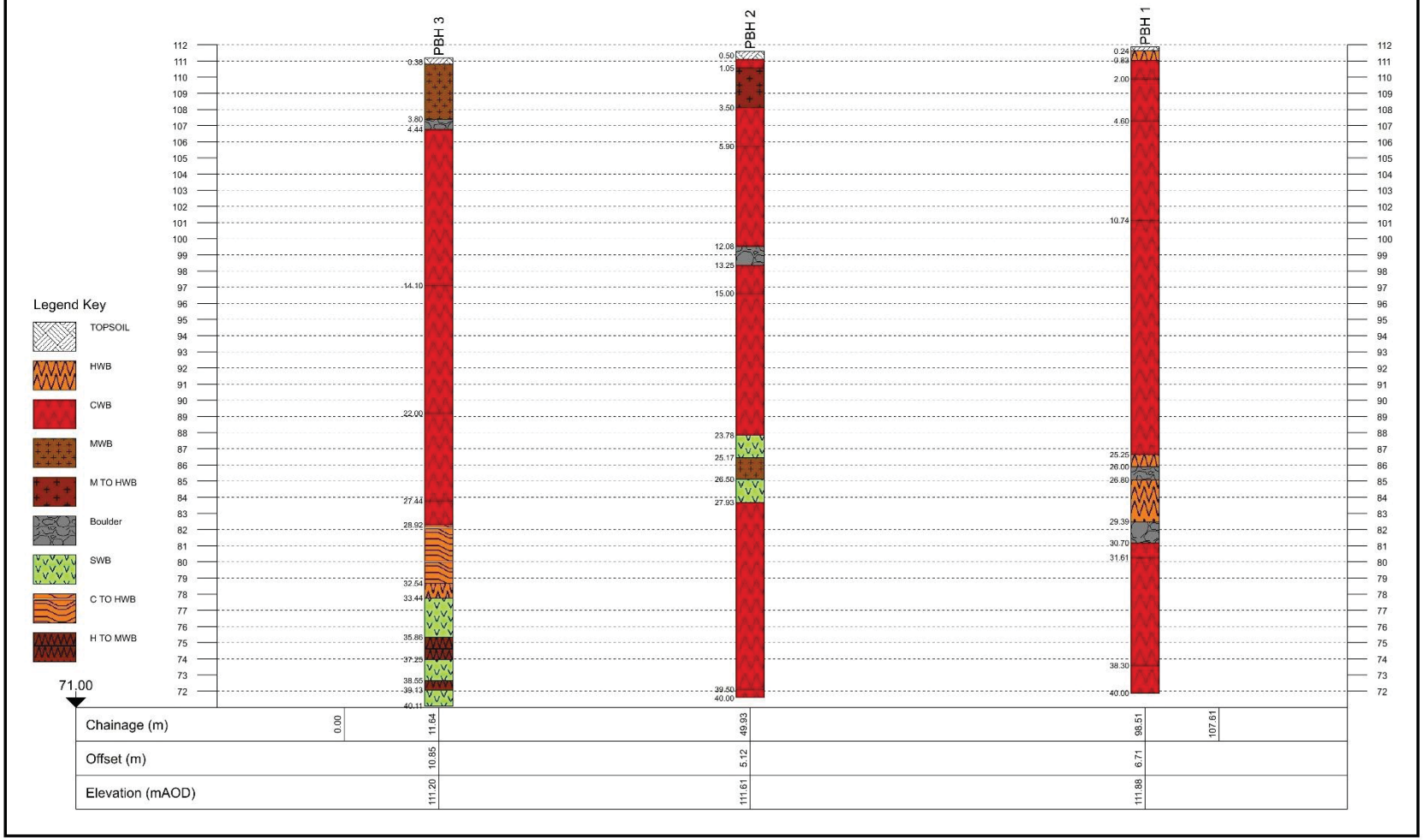


Figure 4. 3: Section 2

Project Id: OPG 20087 LAR	Title: Section line 3
Project Title: Geotechnical Investigation for Teaching Hospital	Vertical Scale: 1:39
Location: Flacq	Horizontal Scale: 1:971
Client: Larsen Tubro	Engineer: SS

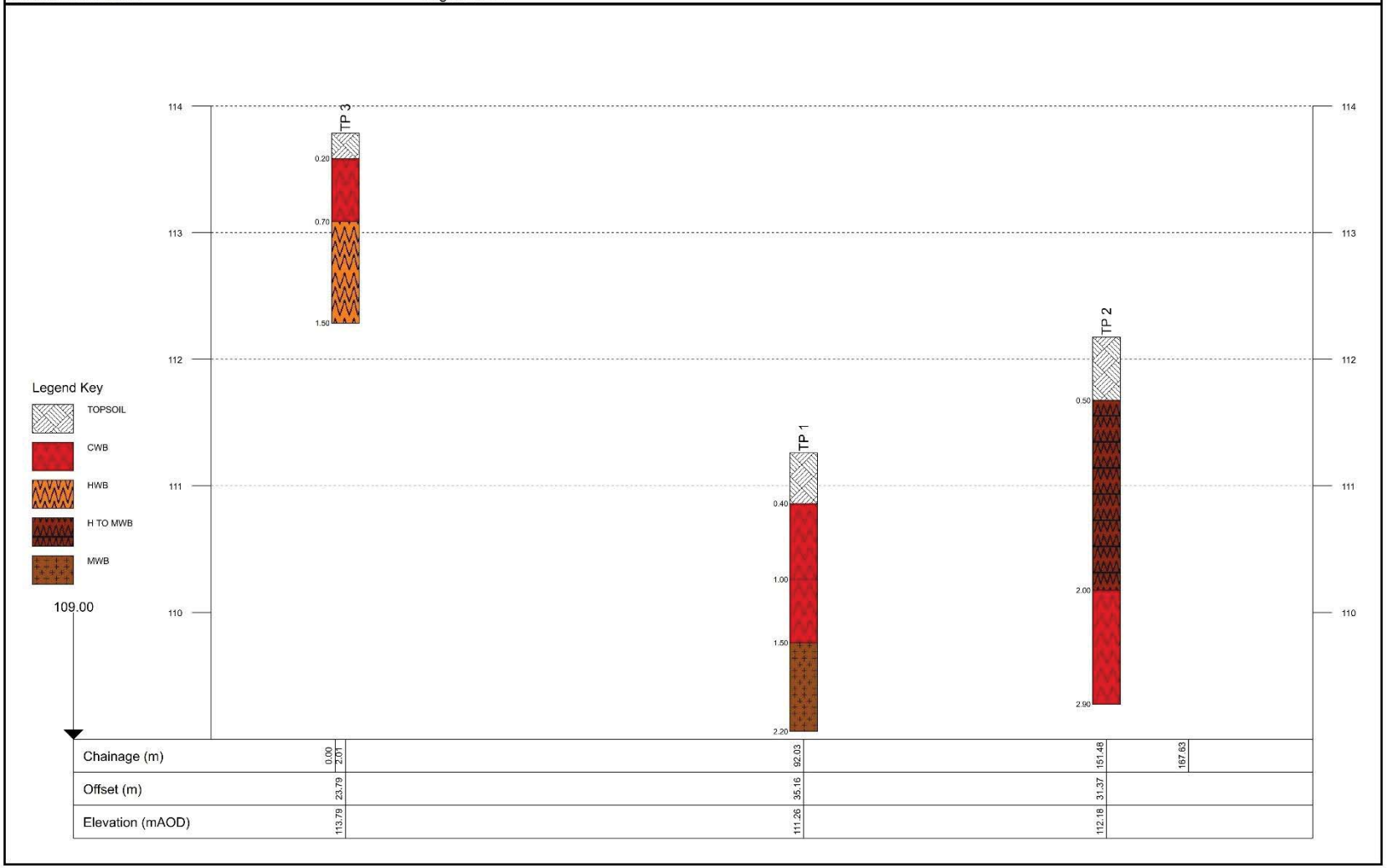


Figure 4. 4: Section 3

4.2 Topsoil

Topsoil was encountered in all exploratory holes with thicknesses varying from of 0.20m to 0.50m. The stratum was generally described as brown slightly gravelly to gravelly high plasticity silty Clay or clayey Silt with frequent rootlets.

4.3 Clayey Weathered Basalt

Clayey Weathered Basalt is termed as Completely Weathered Basalt or Highly Weathered Basalt. The stratum was encountered in all exploratory holes. In PBH 1, the stratum extended up to the end of the corehole with thickness of 39.76m and consisted mostly of CWB with HWB and boulders at depth from 25.25m to 30.70m bgl.

In PBH 2, PBH 3 and PBH 4, the first 3.50m to 5.10m bgl consisted of generally less weathered basalt which was observed as H to MWB, M to HWB or MWB. This layer was then followed by Clayey material mostly of CWB or C to HWB with thicknesses varying from 9.40m (PBH 4) to 29.00m (PBH 3) until a layer of Rock Weathered Basalt was encountered. The latter was encountered at 14.50m to 18.68m bgl in PBH 4, 23.78m to 27.93m bgl in PBH 2 and deeper in PBH 3 at 33.44m to 40.11m bgl. In PBH 2 and PBH 4, the Rock Weathered Basalt was followed by Clayey Weathered Basalt up to the end of corehole at 40.00m bgl and 40.17m bgl, respectively. Clayey Weathered Basalt was mostly described as stiff to very stiff brown or reddish brown gravelly high plasticity Clay with cobbles.

4.3.1 Standard Penetration Tests (SPT)

53No. SPT were carried out in Clayey Weathered Basalt in all coreholes. The N values were corrected according to the rig hammer efficiency ratio which is 72.3%. Refusals in Clayey Weathered Basalt was considered as SPT N value 51. The average corrected SPT N value for depth 0m to 20m bgl is 25 and for depth 20m to 40m bgl is 34. Table 4.2 presents the summary of SPT and Figure 4.5 presents the graph of Depth (m bgl) vs Corrected N values.

Table 4. 2: Summary of SPT in Clayey Weathered Basalt

Location	Depth (from)	Depth (to)	Average depth bgl (m)	SPT - N	SPT N-Corrected	Strata
PBH 1	1.50	2.00	1.75	19	23	CWB
	3.50	4.00	3.75	20	24	CWB
	5.50	6.00	5.75	7	8	CWB
	9.50	10.00	9.75	R	51	CWB
	11.50	12.00	11.75	26	31	CWB
	20.00	20.50	20.25	31	37	CWB
	22.00	22.50	22.25	33	40	CWB
	24.00	24.50	24.25	43	51	HWB
	28.00	28.50	28.25	35	42	HWB
	31.00	31.50	31.25	32	39	CWB
	33.00	33.50	33.25	17	20	CWB
	35.00	35.50	35.25	19	23	CWB

Location	Depth (from)	Depth (to)	Average depth bgl (m)	SPT - N	SPT N-Corrected	Strata
	37.00	37.50	37.25	24	29	CWB
PBH 2	4.50	5.00	4.75	22	27	CWB
	7.00	7.50	7.25	19	23	CWB
	9.50	10.00	9.75	11	13	CWB
	11.50	12.00	11.75	20	24	CWB
	14.50	15.00	14.75	25	30	CWB
	16.50	17.00	16.75	33	40	CWB
	19.50	20.00	19.75	22	27	CWB
	21.00	21.50	21.25	31	37	CWB
	23.00	23.50	23.25	31	37	CWB
	28.00	28.50	28.25	35	42	CWB
	30.80	31.30	31.05	18	22	CWB
	33.00	33.50	33.25	20	24	CWB
	35.00	35.50	35.25	18	22	CWB
PBH 3	5.00	5.50	5.25	8	10	CWB
	7.00	7.50	7.25	12	14	CWB
	8.50	9.00	8.75	13	16	CWB
	11.11	11.61	11.36	15	18	CWB
	13.50	14.00	13.75	23	28	CWB
	17.00	17.50	17.25	19	23	CWB
	19.00	19.50	19.25	21	25	CWB
	21.50	22.00	21.75	26	31	CWB
	27.50	28.00	27.75	26	31	CWB
	29.50	30.00	29.75	19	23	C to HWB
	31.50	32.00	31.75	18	22	C to HWB
	36.00	36.50	36.25	14	17	H to MWB
PBH 4	1.50	2.00	1.75	21	25	H to MWB
	3.50	4.00	3.75	61	51	H to MWB
	5.50	6.00	5.75	24	29	CWB
	8.00	8.50	8.25	28	34	C to HWB
	11.00	11.50	11.25	25	30	C to HWB
	13.00	13.50	13.25	18	22	C to HWB
	19.50	20.00	19.75	21	25	HWB
	23.00	23.50	23.25	39	47	HWB
	25.00	25.50	25.25	41	49	HWB
	27.50	28.00	27.75	35	42	HWB
	30.00	30.50	30.25	26	31	HWB
	32.00	32.50	32.25	19	23	HWB
	34.00	34.50	34.25	28	34	HWB
	36.00	36.50	36.25	31	37	H to CWB
	38.00	38.50	38.25	55	51	H to CWB

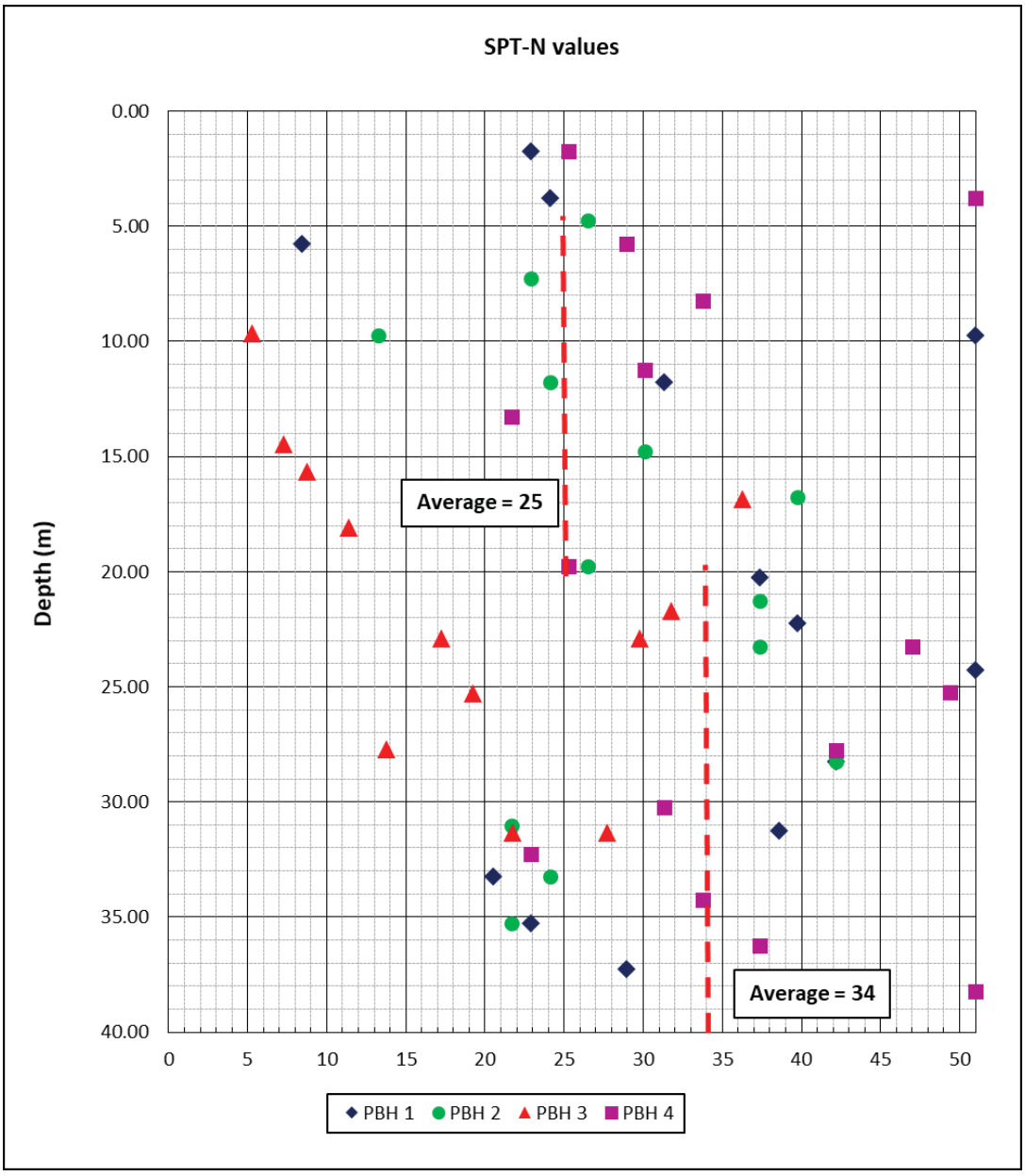


Figure 4. 5: Depth (m bgl) vs Corrected N value

4.3.2 Laboratory Results (Clayey Weathered Basalt)

The following sub Sections present the laboratory results on Clayey Weathered Basalt which have been completed by the time of this report. All the available laboratory reports are attached in Appendix F.

Soil Classification Tests

23No. determination of moisture content tests were carried out on disturbed samples from trial pits and undisturbed samples from coreholes. The results are presented in Table 4.3.

Table 4. 3: Summary of moisture content test (Clayey Weathered Basalt)

Hole No.	Sample Type	Sample Depth (m)	Moisture Content (%)
TP 1	Disturbed – Trial Pit	0.40 – 1.00	41
		1.00 – 1.50	46
TP 2		0.50 – 2.00	40
		2.00 – 2.90	41
TP 3		0.20 – 0.70	31
		0.70 – 1.50	28
PBH 1	Undisturbed U2 or U3	5.00 – 5.50	26
		9.00 – 9.50	25
		13.00 – 13.50	43
PBH 2	Disturbed – Trial Pit	0.50 – 1.05	45
	Undisturbed U2 or U3	4.00 – 4.50	45
		6.50 – 7.00	28
		9.00 – 9.50	49
		14.00 – 14.50	37
		18.50 – 19.00	49
PBH 3	Undisturbed U2 or U3	4.50 – 5.00	48
		8.00 – 8.50	51
		14.46 – 15.00	80
		16.50 – 17.00	60
		18.50 – 19.00	61
PBH 4	Undisturbed U2 or U3	7.50 – 8.00	45
		10.50 – 11.00	28
		14.00 – 14.50	37

34No. specific gravity tests were carried out on trial pit and core box samples at depth as shown in Table 4.4.

Table 4. 4: Summary of specific gravity test results (Clayey Weathered Basalt)

Hole No.	Sample Type	Sample Depth (m)	Specific Gravity
TP 1	Disturbed – Trial Pit	0.40 – 1.00	2.95
		1.00 – 1.50	2.95
TP 2		0.50 – 2.00	2.91
		2.00 – 2.90	2.95
TP 3		0.20 – 0.70	2.79
		0.70 – 1.50	2.77
PBH 1	Disturbed – Corebox	4.60 – 10.74	2.91
		10.74 – 25.25	2.83

Hole No.	Sample Type	Sample Depth (m)	Specific Gravity
		25.25 – 30.70	2.81
		31.61 – 40.00	2.84
	Undisturbed U2 or U3	5.00 – 5.50	2.83
		9.00 – 9.50	2.82
		13.00 – 13.50	2.86
PBH 2	Disturbed – Trial Pit	0.50 – 1.05	2.89
	Disturbed – Corebox	3.50 – 12.08	2.89
		15.00 – 23.78	2.81
		27.93 – 40.00	2.83
	Undisturbed U2 or U3	6.50 – 7.00	2.70
		14.00 – 14.50	2.70
PBH 3	Disturbed – Corebox	0.38 – 3.80	2.85
		4.44 – 14.10	2.90
		14.10 – 27.44	2.85
		28.92 – 32.54	2.86
	Undisturbed U2 or U3	4.50 – 5.00	2.86
		8.00 – 8.50	2.80
		14.46 – 15.00	2.89
		16.50 – 17.00	2.68
		18.50 – 19.00	2.75
PBH 4	Disturbed – Corebox	3.50 – 12.08	2.94
		7.00 – 14.50	2.78
		18.68 – 35.38	2.80
	Undisturbed U2 or U3	7.50 – 8.00	2.86
		10.50 – 11.00	2.70
		14.00 – 14.50	2.70

20No. Particle Size Distribution with hydrometer tests were carried out at depth shown in Table 4.5. Note that for particle distribution tests, cobbles and boulders are not taken with the bulk samples from trial pits.

Table 4. 5: Summary of PSD test results (Clayey Weathered Basalt)

Hole No.	Sample Depth (m)	Particle Size Distribution				Soil Type
		Gravel (%)	Sand (%)	Silt (%)	Clay (%)	
TP 1	0.40 – 1.00	32	33	35	0	Slightly Gravelly Sandy SILT
	1.00 – 1.50	22	51	27	0	Slightly Gravelly Silty SAND
TP 2	0.50 – 2.00	37	17	46	0	Gravelly Sandy SILT

Hole No.	Sample Depth (m)	Particle Size Distribution				Soil Type
		Gravel (%)	Sand (%)	Silt (%)	Clay (%)	
	2.00 – 2.90	19	41	40	0	Slightly Gravelly Silty SAND
TP 3	0.20 – 0.70	37	27	28	8	Gravelly Sandy SILT
	0.70 – 1.50	33	34	27	6	Slightly Gravelly Silty SAND
PBH 1	4.60 – 10.74	11	43	39	7	Slightly Gravelly Silty SAND
	10.74 – 25.25	14	38	41	6	Slightly Gravelly Sandy SILT
	25.25 – 30.70	43	21	31	4	Gravelly Sandy SILT
	31.61 – 40.00	10	42	40	8	Slightly Gravelly Silty SAND
PBH 2	0.50 – 1.05	26	26	38	11	Slightly Gravelly Sandy SILT
	3.50 – 12.08	23	29	45	4	Slightly Gravelly Sandy SILT
	15.00 – 23.78	24	32	40	4	Slightly Gravelly Sandy SILT
	27.93 – 40.00	12	38	47	4	Slightly Gravelly Sandy SILT
PBH 3	4.44 – 14.10	1	35	49	15	Clayey Sandy SILT
	14.10 – 27.44	25	33	39	3	Slightly Gravelly Sandy SILT
	28.92 – 32.54	4	38	54	4	Sandy SILT
PBH 4	3.50 – 12.08	20	21	46	14	Slightly Gravelly Sandy SILT
	7.00 – 14.50	3	16	75	6	Sandy SILT
	18.68 – 35.38	7	35	54	4	Sandy SILT

21No. Atterberg limits tests were carried out on trial pit and core box samples. A summary of the tests is presented in Table 4.6.

Table 4. 6: Summary of Atterberg limits (Clayey Weathered Basalt)

Hole No.	Sample Depth (m bgl)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)
TP 1	0.40 – 1.00	51	75	24
	1.00 – 1.50	58	80	22
TP 2	0.50 – 2.00	43	66	23
	2.00 – 2.90	46	68	22
TP 3	0.20 – 0.70	42	71	29

Hole No.	Sample Depth (m bgl)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)
	0.70 – 1.50	42	68	26
PBH 1	4.60 – 10.74	47	62	15
	10.74 – 25.25	37	60	23
	25.25 – 30.70	28	56	28
	31.61 – 40.00	35	51	16
PBH 2	0.50 – 1.05	50	66	16
	3.50 – 12.08	40	60	20
	15.00 – 23.78	38	71	33
	27.93 – 40.00	36	47	11
PBH 3	0.38 – 3.80	29	49	20
	4.44 – 14.10	43	67	24
	14.10 – 27.44	42	62	20
	28.92 – 32.54	33	48	16
PBH 4	3.50 – 12.08	34	55	21
	7.00 – 14.50	38	51	14
	18.68 – 35.38	33	53	20

8No. bulk and dry density tests were carried out on undisturbed samples from coreholes. A summary of the tests is presented in Table 4.7.

Table 4. 7: Summary of Bulk and Dry Density tests (Clayey Weathered Basalt)

Hole No.	Sample Depth (m bgl)	Bulk Density Mg/m^3	Dry Density Mg/m^3
PBH 1	5.00 – 5.50	2.22	1.12
	9.00 – 9.50	1.83	1.30
	13.00 – 13.50	2.18	1.89
PBH 2	4.00 – 4.50	1.83	1.26
	6.50 – 7.00	2.22	1.21
	9.00 – 9.50	1.85	1.24
	14.00 – 14.50	1.83	1.29
	18.50 – 19.00	1.91	1.29

Soil Compaction Tests

14No. modified proctor dry density/moisture content relationship tests were carried out on trial pit and corehole samples. Summary of the results is presented in Table 4.8.

Table 4. 8: Summary of modified proctor test results (Clayey Weathered Basalt)

Hole No.	Sample Depth (m bgl)	Maximum dry Density (Mg/m3)	Optimum Moisture Content (%)
TP 1	0.40 – 1.00	1.39	25.2
	1.00 – 1.50	1.38	27.3
TP 2	0.50 – 2.00	N/A	
	2.00 – 2.90	1.44	32.6
TP 3	0.20 – 0.70	1.62	23.2
	0.70 – 1.50	1.62	24.0
PBH 1	4.60 – 10.74	1.47	29.1
	10.74 – 25.25	1.47	29.2
	31.61 – 40.00	1.37	32.0
PBH 2	0.50 – 1.05	1.52	30.0
	3.50 – 12.08	1.46	32.0
	15.00 – 23.78	1.35	36.0
	27.93 – 40.00	1.39	33.0
PBH 4	7.00 – 14.50	1.51	28.0
	18.68 – 35.38	1.35	36.0

6No. Soaked CBR tests at 2 different energy levels for each sample were carried out and the results are summarised in Table 4.9.

Table 4. 9: Summary of CBR (Soaked) results (Clayey Weathered Basalt)

Hole No.	Sample depth (m bgl)	No. of blows	Top Penetration		Bottom Penetration		Swelling (mm)
			CBR value for 2.5mm (%)	CBR value for 5.0mm (%)	CBR value for 2.5mm (%)	CBR value for 5.0mm (%)	
TP 1	0.40 – 1.00	31	12.5	13.0	11.0	8.4	0.00
		62	10.8	13.1	25.7	21.2	0.00
	1.00 – 1.50	31	1.8	1.8	7.9	6.9	0.00
		62	21.5	20.2	31.2	28.5	0.00
TP 2	2.00 – 2.90	31	12.5	13.0	11.0	8.4	0.00
		62	17.1	16.4	27.7	22.1	0.00
TP 3	0.20 – 0.70	31	11.3	18.2	28.3	22.0	0.00
		62	23.4	30.4	36.5	25.9	0.00
	0.70 – 1.50	31	3.6	4.0	9.4	11.3	0.00
		62	3.7	4.5	17.0	16.8	0.00
PBH 2	0.50 – 1.05	31	36.7	29.3	34.8	28.7	0.00

Hole No.	Sample depth (m bgl)	No. of blows	Top Penetration		Bottom Penetration		Swelling (mm)
			CBR value for 2.5mm (%)	CBR value for 5.0mm (%)	CBR value for 2.5mm (%)	CBR value for 5.0mm (%)	
		62	37.0	34.9	42.8	29.3	0.00

Soil Chemical Tests

4No. determination of pH value tests, chloride content tests and sulphate content tests were carried out on undisturbed samples from coreholes. The results are presented in Table 4.10.

Table 4. 10: Soil Chemical tests (Clayey Weathered Basalt)

Hole No.	Sample Depth (m bgl)	pH Value	Chloride Content, %	Sulphate Content, %
PBH 1	9.00 – 9.50	8.16	0.01	<0.01
PBH 2	6.50 – 7.00	7.86	0.014	<0.01
PBH 3	4.50 – 5.00	7.83	0.07	<0.01
PBH 4	7.50 – 8.00	7.66	0.014	<0.01

Soil Compression Tests

8No. Free Swell Index tests were carried out on undisturbed samples from coreholes. The results are summarised in Table 4.11.

Table 4. 11:Free Swell Index tests (Clayey Weathered Basalt)

Hole No.	Sample Depth (m bgl)	Free Swell Index (%)
PBH 1	17.00 – 17.50	0.2
	27.50 – 28.00	0.3
PBH 2	4.00 – 4.50	0.0
	9.00 – 9.50	0.0
	18.50 – 19.00	0.1
PBH 3	14.50 – 15.00	0.1
	18.50 – 19.00	0.0
	21.00 – 21.50	0.2

9No. oedometer test were carried out on undisturbed sample from PBH 2. The results are presented in Table 4.12 to Table 4.20.

Table 4. 12: Summary of oedometer consolidation test result for PBH 1 (17.00m – 17.50m)

Applied Pressure	Pressure Range	Time t_{90}	Coefficient of Consolidation C_v	Coefficient of Volume of Compressibility m_v	Void ratio
kN/m²	kN/m²	min	m²/year	m²/MN	e
0	0	-	-	-	0.970
50	0 – 50	13.690	3.214	0.182	0.943
100	50 – 100	16.240	2.659	0.190	0.925
200	100 – 200	9.610	4.400	0.115	0.902
400	200 – 400	17.640	2.339	0.064	0.878
200	400 – 200				0.880
100	200 – 100				0.883
50	100 – 50				0.886
0	50 – 0				0.887

Table 4. 13: Summary of oedometer consolidation test result for PBH 1 (27.50m – 28.00m)

Applied Pressure	Pressure Range	Time t_{90}	Coefficient of Consolidation C_v	Coefficient of Volume of Compressibility m_v	Void ratio
kN/m²	kN/m²	min	m²/year	m²/MN	e
0	0	-	-	-	1.130
50	0 – 50	7.840	5.586	0.274	1.096
100	50 – 100	30.250	1.411	0.241	1.071
200	100 – 200	9.000	4.599	0.183	1.033
400	200 – 400	8.410	4.679	0.159	0.969
200	400 – 200				0.970
100	200 – 100				0.973
50	100 – 50				0.976
0	50 – 0				0.985

Table 4. 14: Summary of oedometer consolidation test result for PBH 2 (4.00m – 4.50m)

Applied Pressure	Pressure Range	Time t_{90}	Coefficient of Consolidation C_v	Coefficient of Volume of Compressibility m_v	Void ratio
kN/m²	kN/m²	min	m²/year	m²/MN	e
0	0	-	-	-	1.150
25	0 – 25	16.000	2.756	0.272	1.136
50	25 – 50	86.490	0.503	0.272	1.121
100	50 – 100	36.00	1.181	0.317	1.088
200	100 – 200	42.250	0.948	0.431	0.998
400	200 – 400	30.250	1.196	0.285	0.884
200	400 – 200				0.886
100	200 – 100				0.891
50	100 – 50				0.895
25	50 - 25				0.898
0	25 – 0				0.902

Table 4. 15: Summary of oedometer consolidation test result for PBH 2 (6.50m - 7.00m)

Applied Pressure	Pressure Range	Time t_{90}	Coefficient of Consolidation C_v	Coefficient of Volume of Compressibility m_v	Void ratio
kN/m²	kN/m²	min	m²/year	m²/MN	e
0	0	-	-	-	-
25	0 – 25	6.25	6.383	0.524	0.663
100	50 – 100	17.64	2.168	0.383	0.615
200	100 – 200	3.61	9.985	0.297	0.567
400	200 – 400	14.44	2.369	0.109	0.533
200	400 – 200	7.84	4.279	0.013	0.537
100	200 – 100	5.76	5.854	0.026	0.541
50	100 – 50	4.00	8.462	0.025	0.542
0	50 – 0	4.00	8.505	0.078	0.548

Table 4. 16: Summary of oedometer consolidation test result for PBH 2 (9.00m – 9.50m)

Applied Pressure	Pressure Range	Time t_{90}	Coefficient of Consolidation C_v	Coefficient of Volume of Compressibility m_v	Void ratio
kN/m²	kN/m²	min	m²/year	m²/MN	e
0	0	-	-	-	1.110
25	0 – 25	33.640	1.255	1.988	1.011
50	25 – 50	36.000	1.094	0.771	0.975
100	50 – 100	15.210	2.483	0.480	0.928
200	100 – 200	20.250	1.771	0.267	0.877
400	200 – 400	10.240	3.285	0.184	0.807
200	400 – 200				0.809
100	200 – 100				0.813
50	100 – 50				0.817
25	50 - 25				0.821
0	25 – 0				0.832

Table 4. 17: Summary of oedometer consolidation test result for PBH 2 (18.50m – 19.00m)

Applied Pressure	Pressure Range	Time t_{90}	Coefficient of Consolidation C_v	Coefficient of Volume of Compressibility m_v	Void ratio
kN/m²	kN/m²	min	m²/year	m²/MN	e
0	0	-	-	-	1.050
25	0 – 25	46.240	0.927	1.384	0.978
50	25 – 50	23.010	1.568	0.580	0.950
100	50 – 100	17.640	2.232	0.406	0.910
200	100 – 200	49.000	0.759	0.356	0.842
400	200 – 400	38.440	0.890	0.234	0.756
200	400 – 200				0.758
100	200 – 100				0.763
50	100 – 50				0.767
25	50 - 25				0.771
0	25 – 0				0.782

Table 4. 18: Summary of oedometer consolidation test result for PBH 3 (21.00m – 21.50m)

Applied Pressure	Pressure Range	Time t_{90}	Coefficient of Consolidation C_v	Coefficient of Volume of Compressibility m_v	Void ratio
kN/m²	kN/m²	min	m²/year	m²/MN	e
0	0	-	-	-	1.330
50	0 – 50	6.250	7.082	0.062	1.318
100	50 – 100	56.250	0.783	0.030	1.315
200	100 – 200	15.210	2.870	0.077	1.297
400	200 – 400	16.000	2.641	0.123	1.241
200	400 – 200				1.244
100	200 – 100				1.248
50	100 – 50				1.252
0	50 – 0				1.265

Table 4. 19: Summary of oedometer consolidation test result for PBH 4 (7.50m – 8.00m)

Applied Pressure	Pressure Range	Time t_{90}	Coefficient of Consolidation C_v	Coefficient of Volume of Compressibility m_v	Void ratio
kN/m²	kN/m²	min	m²/year	m²/MN	e
0	0	-	-	-	-
50	0 – 50	5.29	7.962	0.133	1.013
100	50 – 100	4.00	10.286	0.243	0.988
200	100 – 200	6.25	6.404	0.152	0.958
400	200 – 400	2.56	15.074	0.105	0.917
200	400 – 200	5.76	6.576	0.014	0.922
100	200 – 100	3.24	11.761	0.031	0.928
50	100 – 50	4.84	7.915	0.047	0.933
0	50 – 0	2.56	15.088	0.116	0.944

Table 4. 20: Summary of oedometer consolidation test result for PBH 4 (10.50m - 11.00m)

Applied Pressure	Pressure Range	Time t_{90}	Coefficient of Consolidation C_v	Coefficient of Volume of Compressibility m_v	Void ratio
kN/m²	kN/m²	min	m²/year	m²/MN	e
0	0	-	-	-	-
50	0 – 50	6.76	5.899	0.097	1.445
100	50 – 100	2.56	15.281	0.286	1.410
200	100 – 200	4.84	7.843	0.156	1.372
400	200 – 400	1.96	18.362	0.186	1.284
200	400 – 200	2.89	12.039	0.022	1.294
100	200 – 100	1.44	24.357	0.037	1.303
50	100 – 50	1.21	29.177	0.056	1.309
0	50 – 0	10.89	3.276	0.157	1.327

Direct Shear Tests

5No. Direct Shear tests were carried out on undisturbed samples from coreholes. The results are presented in Table 4.21.

Table 4. 21: Direct Shear tests (Clayey Weathered Basalt)

Hole No.	Sample Depth (m bgl)	Cohesion (c), kPa	Angle of friction (Ø') °
PBH 1	5.00 – 5.50	29	19
PBH 2	6.50 – 7.00	25	18
PBH 3	4.50 – 5.00	23	16
	8.00 – 8.50	30	16
PBH 4	10.50 – 11.00	28	18

Triaxial Tests

4No. Unconsolidated Undrained Shear Strength tests were scheduled to be carried out in PBH 1 and PBH 2. However, since the material is of weathered basalt with less than 50% of fine particles as shown during PSD test in Table 4.5, there were difficulties in extruding the samples. Table 4.22 presents the remarks of each scheduled sample.

Table 4. 22: Triaxial Tests (UU) (Clayey Weathered Basalt)

Hole No.	Sample Depth (m bgl)	Shear Strength (Su), kPa	Remarks
PBH 1	4.00 – 4.50	-	Sample collapsed while extrusion. Contained coarse gravel.
	9.00 – 9.50	-	Test not performed as the sample was collapsing while manipulating and contained gravels making it difficult to trim.
PBH 2	14.00 – 14.50	4.55	Only one sample tested. The other broke upon extrusion.
	18.50 – 19.00	6.17	Only one sample tested. The other broke upon extrusion.

Note: It is not advisable to use the results for PBH 2 since only one sample was tested.

4.4 Rock Weathered Basalt

Slightly Weathered Basalt and Moderately Weathered Basalt are grouped as Rock Weathered Basalt. The stratum was encountered in TP 1, TP 3 and in all coreholes. In TP 1 and TP 3, the stratum was encountered as Refusal whereby excavation by backhoe mechanical excavator was not possible. The thicknesses of the stratum varied from 0.98m (PBH 3) to 4.18m (PBH4). In PBH 3, the stratum was encountered at depth from 33.44m to 40.11m bgl (end of corehole). Moderately Weathered Basalt was generally described as weak brownish grey with black discolorations Moderately Weathered Basalt with seams of reddish brown high plasticity Clay. Slightly Weathered Basalt was generally described as strong light grey with fine grained Slightly Weathered Basalt. Discontinuities were mostly closely to medium spaced undulating rough horizontal to sub horizontal.

4.4.1 Standard Penetration Tests (SPT)

10No. SPT were carried out on Rock Weathered Basalt. The uncorrected N values varied between 66 and Refusals. Table 4.23 presents the summary of SPT in Rock Weathered Basalt.

Table 4. 23: Summary of SPT in Rock

Location	Depth (from)	Depth (to)	Average depth bgl (m)	SPT - N	SPT N-Corrected	Strata
PBH 1	26.00	-	26.00	R	R	Boulder
PBH 2	1.05	1.55	1.30	66	80	M to HWB
	2.50	3.00	2.75	R	R	M to HWB
	25.50	26.00	25.75	42	51	MWB
PBH 3	1.50	2.00	1.75	67	81	MWB
	3.50	4.00	3.50	R	R	MWB
	23.80	-	23.80	R	R	Cobble

Location	Depth (from)	Depth (to)	Average depth bgl (m)	SPT - N	SPT N-Corrected	Strata
	26.00	-	26.00	R	R	Cobble
PBH 4	14.16	-	14.16	R	R	SWB
	21.50		21.50	R	R	Cobble
PBH 1	26.00	-	26.00	R	R	Boulder

4.4.2 Laboratory Results (Rock Weathered Basalt)

2No. specific gravity tests were carried out on core box samples at depths as shown in Table 4.24.

Table 4. 24: Summary of specific gravity test results (Rock Weathered Basalt)

Hole No.	Sample Type	Sample Depth (m)	Specific Gravity
PBH 2	Disturbed – Core box	1.05 – 3.50	2.96
PBH 4		1.50 – 5.10	2.93

3No. particle size distribution (wet sieving) were carried out in Rock Weathered Basalt at depth shown in Table 4.25. Note that for particle distribution tests, cobbles and boulders are not taken with the bulk samples.

Table 4. 25: Summary of PSD test results (Rock Weathered Basalt)

Hole No.	Sample Type	Sample Depth (m)	Particle Size Distribution			Soil Type
			Gravel (%)	Sand (%)	Silt+Clay (%)	
PBH 2	Disturbed – Core box	1.05 – 3.50	79	11	10	Silty Sandy GRAVELS
PBH 3		0.38 – 3.80	33	23	44	Sandy Gravelly SILT
PBH 4		1.50 – 5.10	66	15	19	Sandy Silty GRAVELS

2No. Atterberg limits tests were carried out in fine particles of MWB from core box samples. A summary of the tests is presented in Table 4.26.

Table 4. 26: Summary of Atterberg Limits (Rock Weathered Basalt)

Hole No.	Sample Depth (m bgl)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)
PBH 2	1.05 – 3.05	36	49	14
PBH 4	1.50 - 5.10	27	49	22

6No. Porosity tests were carried out rock weathered basalt samples from core box. A summary of the tests is presented in Table 4.27.

Table 4. 27: Summary of Porosity (Rock Weathered Basalt)

Hole No.	Sample Depth (m bgl)	Porosity (%)			
		Sample 1	Sample 2	Sample 3	Average
PBH 2	12.08 – 13.52	7.5	4.5	5.7	5.9
	23.78 – 25.17	3.6	2.4	1.6	2.5
	26.50 – 27.93	1.6	3.0	1.0	1.8
PBH 3	33.44 – 35.86	2.5	5.0	2.5	3.3
	37.25 – 38.55	9.2	4.5	7.4	7.0
PBH 4	14.50 – 18.68	6.0	5.1	6.4	5.8

4 No. Point load tests were carried out on rock weathered basalt samples from the core box. A summary of the tests is presented in Table 4.28.

Table 4. 28: Summary of Point Load Test (Rock Weathered Basalt)

Hole No.	Sample Depth (m bgl)	Is(50) MPa
PBH 2	23.78 – 25.17	5.63
PBH 3	33.44 – 35.58	4.47
	37.25 – 38.55	2.90
PBH 4	14.50 – 18.68	6.06

4 No. UCS tests were carried out on rock weathered basalt samples from the core box. A summary of the tests is presented in Table 4.29.

Table 4. 29: Summary of UCS Test (Rock Weathered Basalt)

Hole No.	Sample Depth (m bgl)	UCS MPa
PBH 2	23.78 – 25.17	108.54
PBH 3	32.44 – 35.58	58.83
PBH 4	14.50 – 18.68	88.12
	37.25 – 38.55	50.78

4.4.3 Rock Quality Designation (RQD)

The Rock Quality Designation (RQD) for Rock Weathered Basalt was mostly below 70%. The average RQD per corehole was 45%, 51% and 95% for PBH 2, PBH 3 and PBH 4. The overall average RQD was 64%. Table 4.30 summarises the Solid Core Recovery (SCR) and RQD. Figure 4.6 shows the RQD vs depth of rocks encountered in each corehole.

Table 4. 30: SCR and RQD

Location	From (m)	To (m)	Average depth (m)	SCR %	RQD %	Quality
PBH 2	24.00	25.50	24.75	71	43	Poor
	26.00	28.00	27.00	64	41	Poor
PBH 3	33.18	34.60	33.89	79	73	Fair
	34.60	36.00	35.30	78	53	Fair
	37.25	38.55	37.90	81	53	Fair
	39.13	40.11	39.62	62	24	Very Poor
PBH 4	14.50	16.00	15.25	99	97	Excellent
	16.00	17.37	16.69	99	99	Excellent
	17.37	18.68	18.03	94	89	Good

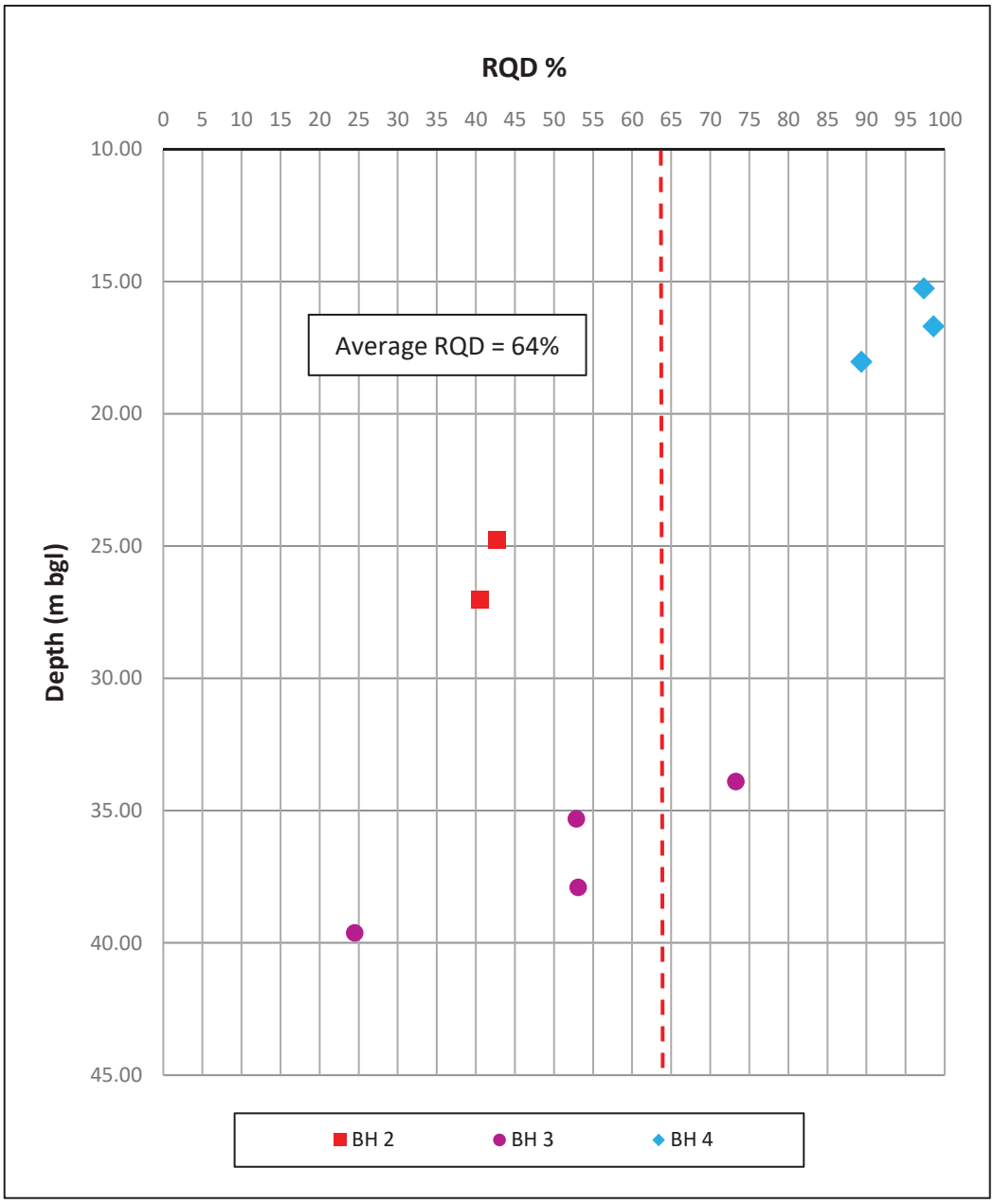


Figure 4. 6: Graph of Depth m bgl vs RQD

4.5 Groundwater

4.5.1 Monitoring

Groundwater levels were recorded in coreholes PBH 1, PBH 3 and PBH 4 on 29th September and 21st October 2020. The water depths are presented in Table 4.31.

Table 4. 31: Groundwater Depth

Location	Water Depth (bgl)	
	29th Sept 20	**21st Oct 20**
PBH 1	19.90	19.00
PBH 3	16.76	16.95
PBH 4	15.42	15.51

4.5.2 Chemical Tests

4 No. chemical tests were carried out on water samples collected from the standpipes and the river on 21st October 2020. A summary of the tests is presented in Table 4.32.

Table 4. 32: Summary of Chemical Tests on Water

Parameters	**Units**	**River water**	**PBH 1**	**PBH 3**	**PBH 4**
pH @ 25° C	-	7.05	6.43	6.49	6.84
Conductivity @ 25° C	uS/cm	150.2	205.5	236.2	257.7
Chloride	mg/L	26	30	32	36
Sulphate as SO_4^{2-}	mg/L	6.9	5.4	1.6	38.2
Calcium as Ca	mg/L	15.2	14.4	17.6	20.0
Magnesium as Mg	mg/L	7.9	12.2	14.1	14.5

5. Geotechnical Engineering Assessment

This Chapter presents the geotechnical interpretation of the factual data to define the ground profile and properties and identify foundation solutions and estimate of bearing capacities and settlements. The proposed development comprises basement, ground plus 6No. storeys.

5.1 Ground Profile

The general ground profile in vertical sequence are as follows:

- Topsoil with thicknesses varying from of 0.20m to 0.50m.
- Moderately Weathered Basalt or Highly Weathered Basalt up to 3.50m to 5.10m bgl.
- Clayey Weathered Basalt encountered at depth varying from 33.44m bgl (PBH 3) to end of corehole at 40m bgl (PBH 1, PBH 2 and PBH 4).
- Rock Weathered Basalt interspersed between Clayey Weathered Basalt in PBH 2 and PBH 4 at depths 23.78m to 27.93m bgl and 14.50m to 18.68m bgl, respectively and encountered deeper at 33.44m bgl in PBH 3.

Figure 5.2 presents the site map with location of coreholes and cross section lines and Figure 5.3 and Figure 5.4 show cross section of coreholes with the proposed foundation level.

5.2 Foundation Solution

Figure 5.1 presents the basement floor numeration drawing provided by the Client. From the drawing, the foundation level varies from 4.00m bgl to 5.00m bgl. The water depth was recorded between 15.42m bgl (PBH 4) to 19.90m bgl (PBH 1). Considering the corehole with lowest elevation which is PBH 1 at 109.8m amsl, the foundation level was taken at 106m amsl as shown in Figure 5.3 and 5.4.

The foundation stratum shall be infinite Clayey Weathered Basalt. The properties of the stratum are discussed in Section 5.3.

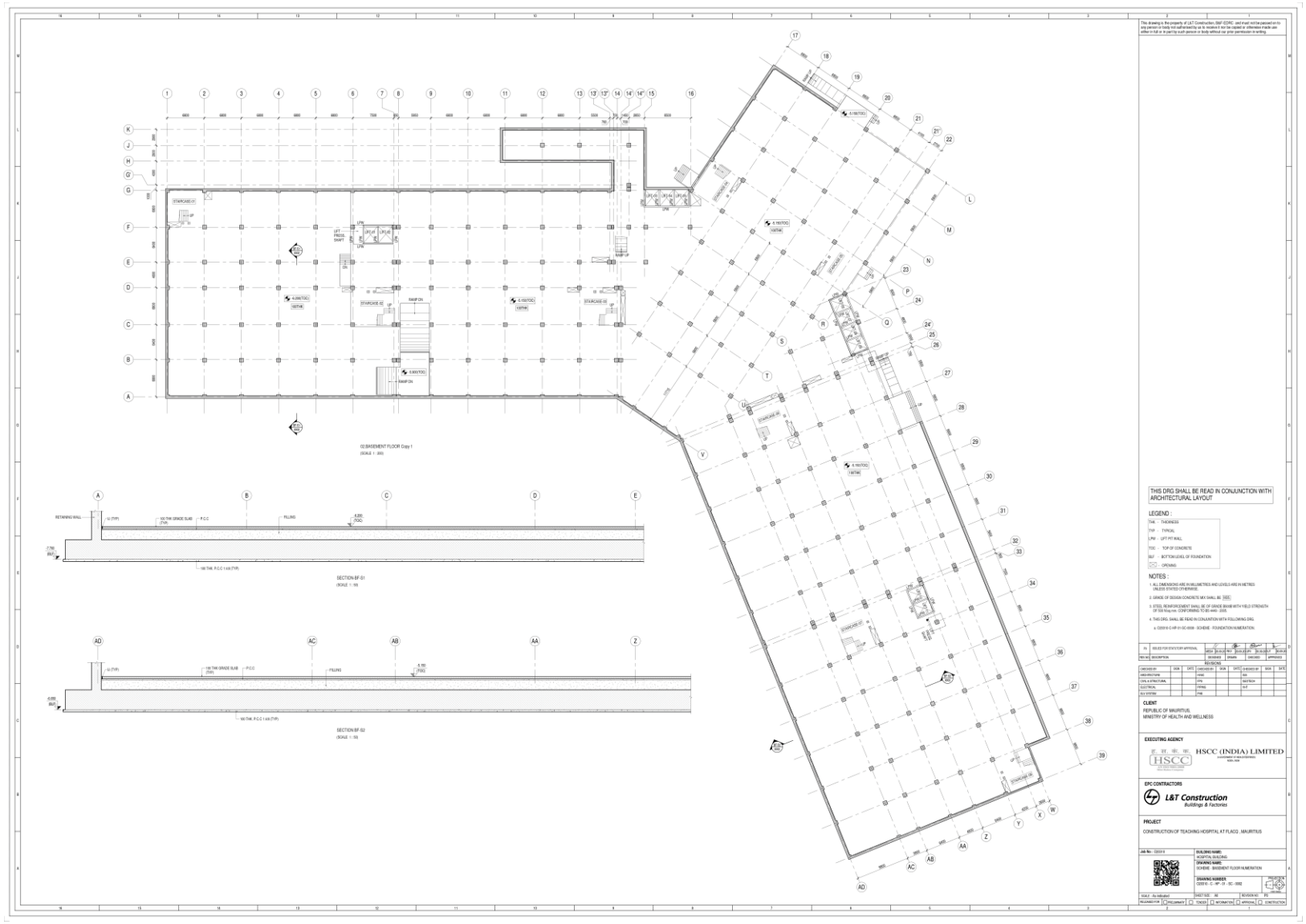


Figure 5. 1: Basement Floor Numeration

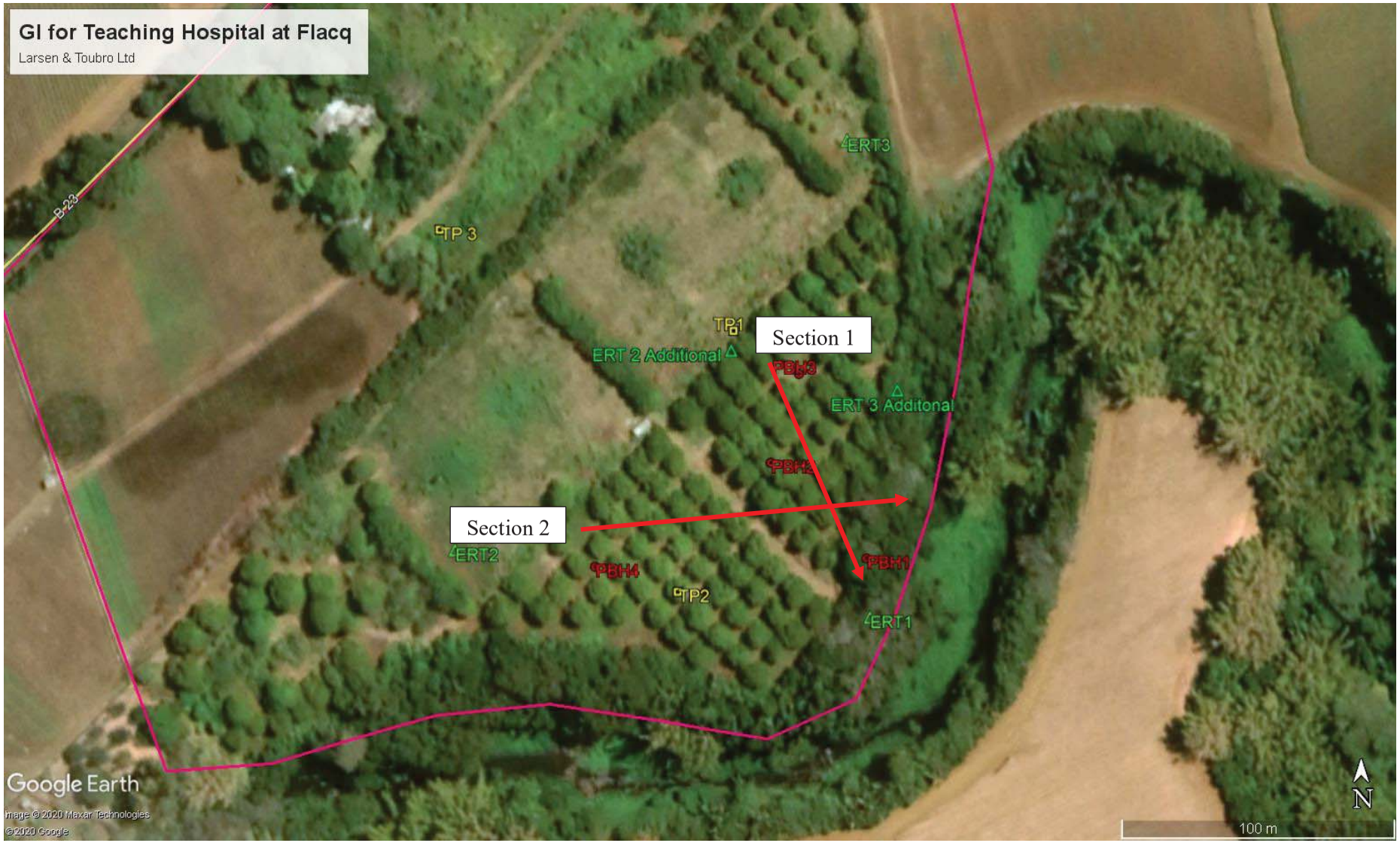


Figure 5. 2: Location of the trial pits and coreholes with cross section lines

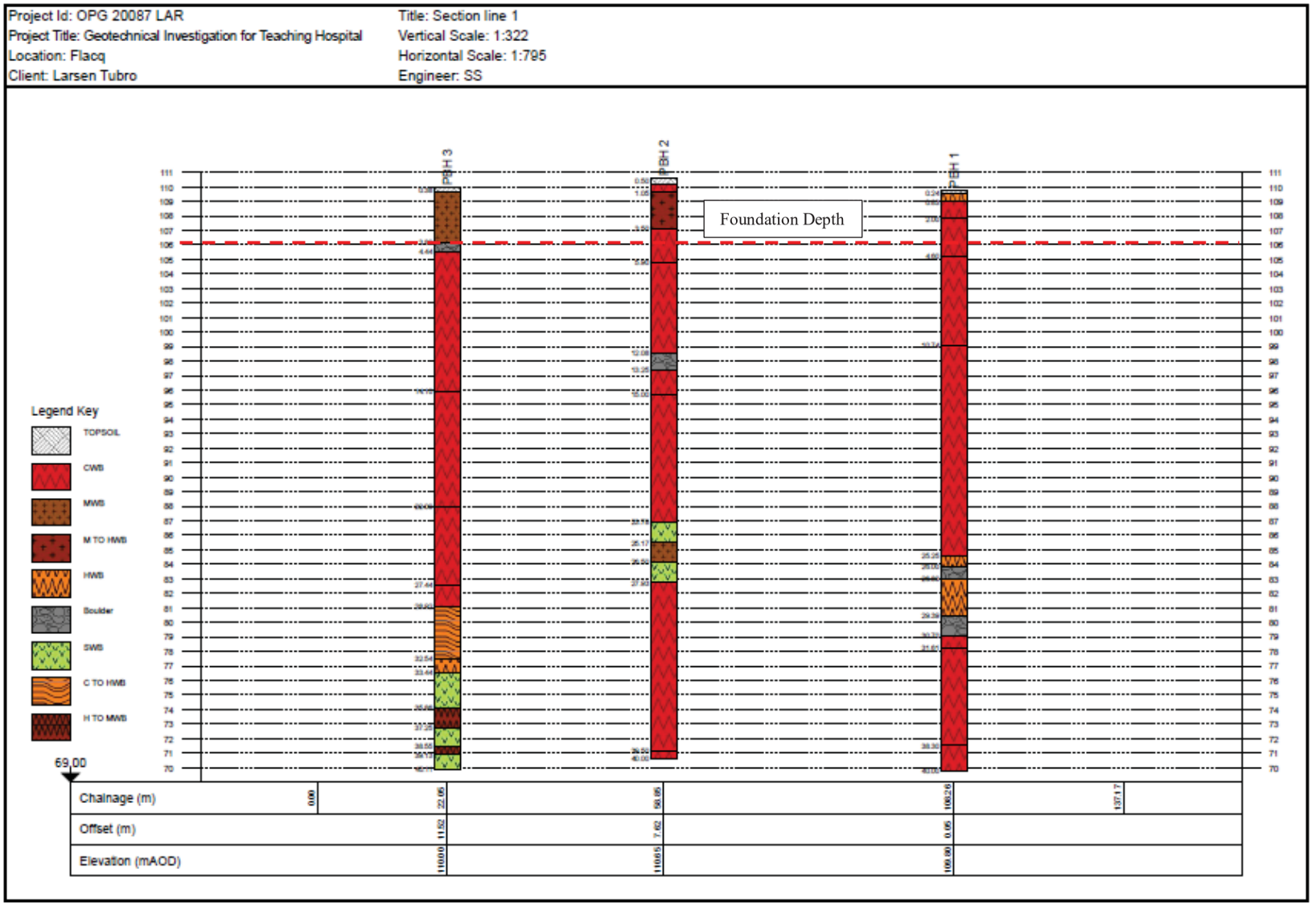


Figure 5. 3: Section 1 with foundation level

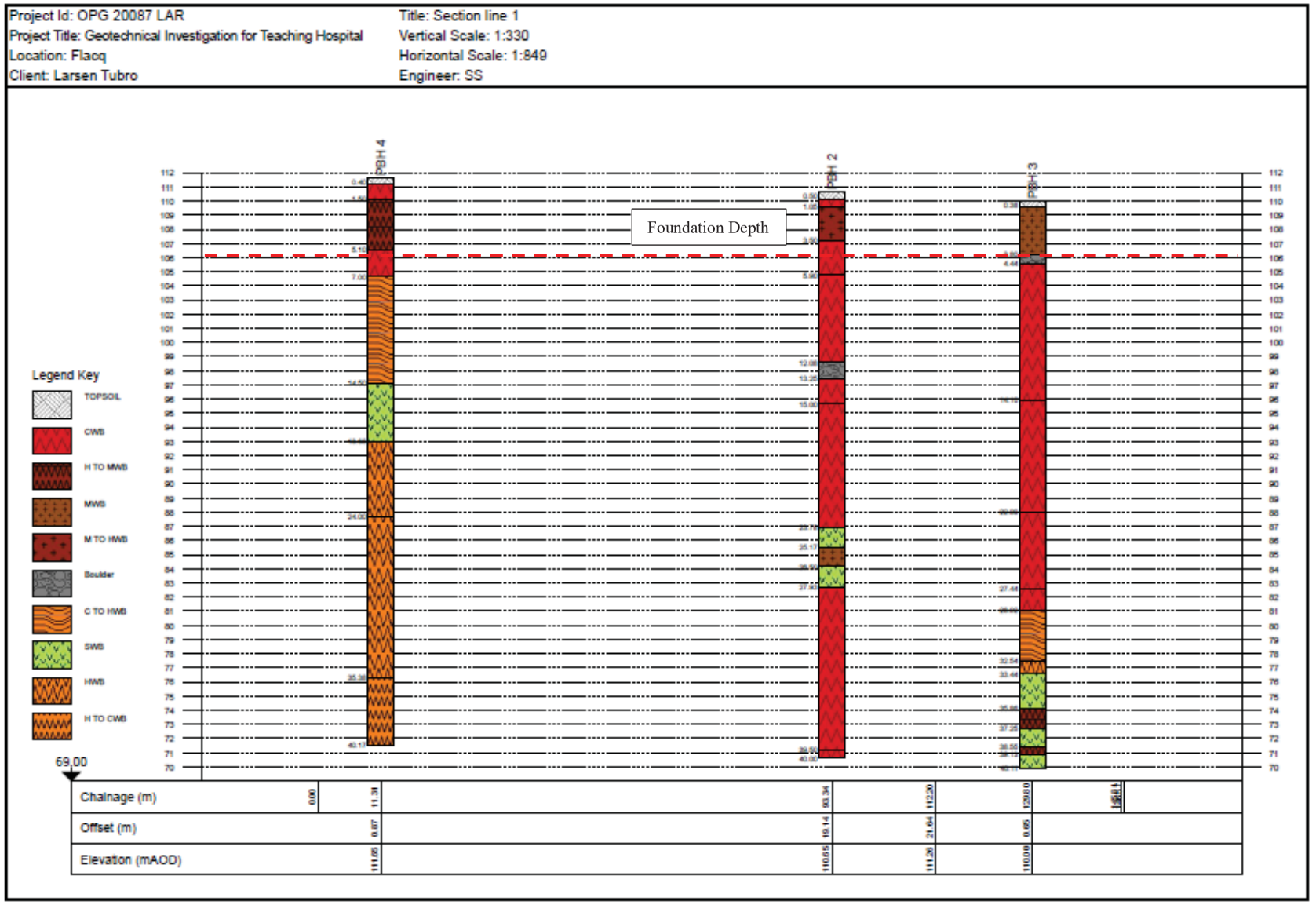


Figure 5. 4: Section 2 with foundation level

5.3 Clayey Weathered Basalt Properties

The following properties are suggested for geotechnical analysis based on the laboratory test results from databases and correlations.

Clayey Weathered Basalt was mostly described as slightly gravelly Sandy SILT as per particle size distribution tests. The average plasticity index was 21% with the higher bound being 33%. The average bulk unit weight obtained was 1.98 Mg/m^3 (19.4 kN/m^3). The average SPT from 0m to 20m bgl was 25 and from 20m to 40m bgl was 34. The coefficient of volume compressibility (m_v) for a pressure range of 200-400kPa varied from 0.18 m^2/MN to 0.29 m^2/MN based on oedometer test. Undrained Shear Strength (S_u) from triaxial tests were not considered for design.

The bulk unit weight was taken as 18kN/m^3. A conservative N value of 15 was considered for analysis. The undrained shear strength was calculated from the formula $S_u = f_1N$ where f_1 is taken as 5.0 based on plasticity index of 25%. The undrained shear strength S_u was computed as 75kPa. The coefficient of volume compressibility (m_v) was computed as 0.13 m^2/MN using formula $m_v = (1/f_2N)$, f_2 being 0.50. A conservative m_v of 0.20 m^2/MN was considered. The drained Young's modulus is calculated using the formula E' = 1/ m_v as 5,000kPa. Typical Young modulus values for medium clay are between 15 to 50MPa. Using correlation graph of E'/N vs. q_{net}/q_{ullt} (Stroud, 1989), E' was computed as 25,000 kPa. E' was taken as 25,000 kPa. As per Bowles (1997) guidance a Poisson ratio of 0.40 was considered. Table 5.1 presents the parameters of the Clayey Weathered Basalt layer.

Table 5. 1: Parameters for Clayey Weathered Basalt

Stratum	SPT	γ (kN/m^3)	S_u (kPa)	m_v (m^2/MN)	E (kPa)	μ
Overburden Soil	15	18	75	0.20	25,000	0.40

5.4 Bearing capacity

Bearing capacities were computed using Brinch Hansen coefficients for condition of infinite Clayey Weathered Basalt. The foundation elevation was taken at 106.00m amsl. The groundwater depth was taken at 10m bgl. Isolated pad and strip footings and Raft foundation were considered for analysis. The dimensions of the footings were provided by the Client. Table 5.2 presents the net allowable bearing capacities, the gross bearing pressure and modulus of subgrade (k_s) of each footing. The gross bearing pressure was calculated by adding overburden pressure to the net allowable bearing pressure. The modulus of subgrade (k_s) was calculated by the formula $k_s = (40xFSx\ q_a)$ and the allowable bearing pressure (q_a) is calculated for a settlement 25mm.

Table 5. 2: Allowable Bearing Capacities(Net & Gross) and Modulus of subgrade

Footing Type	Footing Width (m)	Footing Length (m)	Allowable Bearing Capacity, kPa	Gross Bearing Pressure, kPa	k_s, kN/m^2/m
Strip	3	10	222	312	9,923
	3.5	10	220	310	9,046

Footing Type	Footing Width (m)	Footing Length (m)	Allowable Bearing Capacity, kPa	Gross Bearing Pressure, kPa	k_s, kN/m²/m
	4	12	216	306	7,892
	4.5	15	212	302	6,923
	5	15	222	312	6,508
Pad	4	4	263	353	11,954
	4.5	4.5	259	349	10,662
	5	5	270	360	9,738
Raft	40	180	171	171	1,980
	40	130	173	173	1,950

5.5 Settlement

Regarding allowable settlements, Tomlinson (2001) presents settlement values (by Skempton and MacDonald,1956) for foundations on clays. They prescribed a design limit for maximum differential settlement of 40mm, with design limits for total settlement of 65mm for isolated shallow foundations and 65mm to 100 mm for raft.

Design limits for total settlement 65mm for isolated and strip and 100mm for raft & two-way strip foundation were taken respectively for the computation of allowable bearing pressure.

The maximum settlement of each footing is shown in Table 5.3. Settlement calculation was carried out on Oasys Pdisp Software using Boussinesq method.

Table 5. 3: Net bearing capacities, max settlement and allowable bearing pressure

Footing Type	Footing Width (m)	Footing Length (m)	Allowable Bearing Capacity, kPa	Maximum Settlement, mm	Allowable Bearing Pressure based on design limit, kPa
Strip	3	10	222	50	275
	3.5	10	220	50	275
	4	12	216	50	260
	4.5	15	212	60	215
	5	15	222	60	230
Pad	4	4	263	40	300
	4.5	4.5	259	50	300
	5	5	270	50	260
Raft	40	180	171	150	100
	40	130	173	150	100

Footing Type	Footing Width (m)	Footing Length (m)	Allowable Bearing Capacity, kPa	Maximum Settlement, mm	Allowable Bearing Pressure based on design limit, kPa
Two-way strip	Wide 3.5m @ 6.8m c/c	41.2	211	125	200
Strip	4.3m	41.2	206	60	215
Strip	3.5	69.5	210	54	220

Based on the bearing capacity and settlement results in Table 5.2 and Table 5.3, allowable bearing pressures for Pad 260 to 300kPa, Strip 200 to 275kPa , Raft 100kPa and Two way Strip 200kPa were recommended respectively.

5.6 Foundation comments

Allowable bearing pressure on Clayey Weathered Basalt was estimated in the range of 200kPa to 275kPa for strip footing, 260kPa to 300kPa for pad footing, 100kPa for Raft foundation and 200kPa for Two-way Strip. All the settlements for isolated pad and strip footings and for raft foundation and Two-way Strip were to the design limit of 65mm and 100mm, respectively. Note that these estimates do not include the stiffness of the foundation or superstructure thus, the real settlements will be more uniform, with the maximum settlement reducing. Implementing the grid of strip foundations solution may carry stiffness lower but close to those associated to the raft, so the allowable total settlement may be considered as for raft foundations. It is recommended to compact the formation level of foundation.

5.7 Excavation

All excavations must be carried out in accordance with Occupational Health and Safety Act (OHSA). The soils that will be excavated across the site include Topsoil, Clayey Weathered Basalts and Rock Weathered Basalts. Excavations shall be kept free from water. Excavated materials which complies section 5.8.2 can be used as fill material and stockpiled separately without any contamination. Topsoil can be stockpiled and used for Landscape purpose.

Excavation in Weathered Basalts materials can be carried out with conventional methods and conventional excavating plant. Vertical excavations for foundations within the rock weathered basalt are likely to be possible using hydraulic hammer from a standard backhoe machine excavator. The choice of plant for bulk excavation is largely determined by the quantity and by the length of haul to the disposal point. Small boulders, if encountered, may be disposed of by the excavating plant. Excavations should be protected from rain and paving should be carried out as soon as practicable.

During construction, an inspection at founding level is recommended ensuring suitable quality and consistency. Hard and soft pockets such as pockets of clay and boulders might need to be removed and backfilled in with suitable fill and compacted. Softening at the founding level is possible, particularly during adverse weather conditions where excess surface water may increase the moisture content of clayey materials. To mitigate against this, ensure that the founding layer is not exposed excessively.

Temporary Excavations

Short term vertical excavations for structures within the Clayey Weathered Basalts are likely to be stable for 2 to 3m metre height unshored in the short term, provided no one is at risk below the excavation. A temporary slope angle of approximately 1V:1H should be sufficient to allow construction, which can then be backfilled. Groundwater was not encountered during excavation of trial pits.

5.8 Earthworks

The proposed project also includes earthworks with paved areas. Based on findings, it is recommended that the designer may consider the following requirements for the pavement design.

The materials for embankment construction were detailed in the following sections.

5.8.1 Removal of Topsoil/Unsuitable Material

Where embankments or subgrades will be constructed on natural ground, Topsoil of Depth 300mm shall be stripped after clearing and grubbing. The stripped area shall be compacted to minimum 90% BS Heavy Maximum Dry Density.

Where areas containing soft, humus or other deleterious materials harmful to the stability of road, the supervising Engineer may order for a greater depth up to 600mm instead of 300mm within the area designate and replace with rockfill compacted to refusal. Over the rockfill, it is recommended to fill with granular material (field stones – grabbeaux) to fill the voids.

5.8.2 Materials

The materials for construction of embankment, subgrade and backfill shall comply with the requirements as shown in Table 5.4:

Table 5. 4: Requirements for embankment, subgrade and backfill

Description	**Main Body of Embankment**	**Subgrade/Backfill**
Liquid Limit	<70%	<50%
Plasticity Index	<30%	<25%
Swelling (from CBR - 4 days soaking)	<3%	<1%
Maximum Size of aggregate (100mm)	Depends upon the layer thickness and Compaction Equipment	

5.9 Compaction of Earthworks

During the construction of road pavement, it is recommended earthworks up to top of embankment shall be compacted to a relative density >90% MDD and for subgrade layer >95% achieved with the BS

Heavy Compaction Test (4.5 kg rammer method) and moisture content should be within the range ± 2% of modified optimum.

Backfilling behind structures shall be carried out in layers of 150mm thick with appropriate compaction equipment to achieve a relative compaction >95% with OMC ± 2%, material properties shall comply as above.

5.10 Pavement Design

For designing a new road pavement and parking spaces, 'Overseas Road Note (ORN) 31 - A guide to the structural design of bitumen-surfaced roads in tropical and sub-tropical countries' shall be adopted. The strength of road subgrades is commonly assessed in terms of the CBR and this is dependent on the type of soil, its density, and its moisture content. The low-volume road design chart procedures for flexible pavements are basically same as highway pavement design. The designer needs to assume Subgrade strength class, Traffic Class and Design Life for designing the pavement structure.

Based on test results the CBR values >10% at 95% of BS Heavy Maximum Dry Density, the soil assumed to have a subgrade strength class of S4 (CBR 8-14). Since the development will be for a teaching hospital, it is expected there will be light vehicular traffic loading considered as traffic class T1. As per ORN 31, Chart 1 Granular Road base/Surface dressing (T1-S3) considered for the proposed development, the following road structure can be adopted:

- Surface Dressing/Wearing Course - 50mm (WC1)
- Granular Road Base - 150mm thick Crusher run 0/20
- Granular Sub-Base - 200mm thick Crusher run 0/50.

5.11 Slab-on-Grade

The existing native soil shall comply section 5.8.2 may consist of a layer of engineered fill to bring the slab to proper elevation. The existing native soil consists of gravels shall be compacted to 95% BS Heavy MDD, in many instances, is considered as sub-base. On top of the sub-base, the base course (i.e. CR 0/20) of 150mm thick is laid and compacted to 98% BS Heavy MDD. This provides additional bearing support and a generally flat surface. A thick polythene sheet shall be laid on top of base course prior to the slab cast, see Figure 5.5.

Soft areas can be excavated and or scarified and re-compacted with engineered fill. The more uniform the base and sub-base, the better the SOG construction.

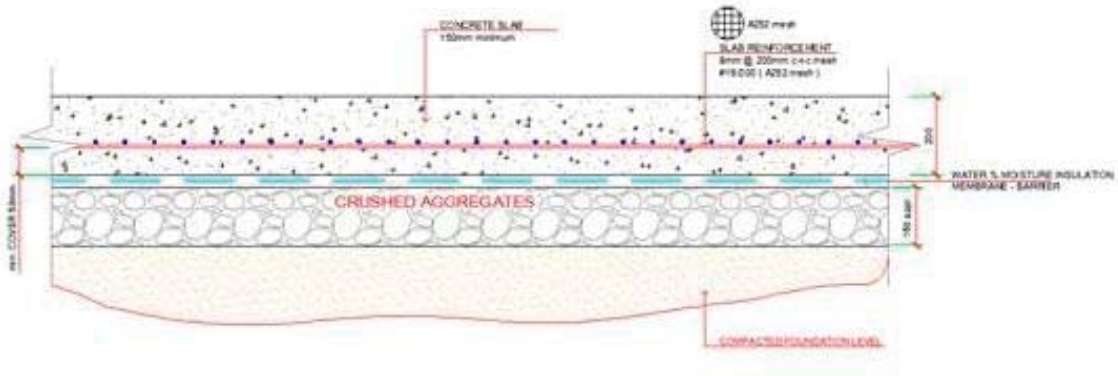


Figure 5. 5: Thick polythene prior to slab cast

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CHAPTER 4

ARCHITECTURAL AND FUNCTIONAL PLANNING

4.1 ARCHITECTURAL PROJECT LAYOUT

4.2 SITE ENTRANCE

4.2.1 SECURITY

4.2.2 BUILDING ENTRANCE

4.2.3 ACCIDENT AND EMERGENCY ENTRANCE

4.3 MAIN BUILDING

4.3.1 BASEMENT

4.3.2 GROUND FLOOR

4.3.3 FIRST FLOOR

4.3.4 SECOND FLOOR

4.3.5 THIRD FLOOR

4.3. 6 FOURTH TO SIXTH FLOOR

TYPICAL INPATIENT WARD

4.4 VERTICAL CIRCULATION

4.5 ELEVATION

4.6 FINISHES (INTERNAL)

4.7 WASHROOM FACILITIES

4.8 SERVICE AREAS

4.9 AESTHETIC AND ENVIRONMENT

CHAPTER 4

ARCHITECTURAL AND FUNCTIONAL PLANNING

4.1 ARCHITECTURAL PROJECT LAYOUT

The proposed hospital is to be sited on a parcel of land of 105,521.8 sqm that has been vested to the Minister of Health & Wellness. Owing to the presence of a river at the rear side, the border of the site is irregular in shape. The planning of the building has been devised in such a way that there is an efficient use of the land. As demonstrated in the site plan in **Annex 8** at the end of this section, the building form follows the site form and site levels. Taking advantage of the site levels, the entrance of the basement is planned to be accessed from the rear side. The building is such that there is a central circulation core from which radiates two wings of the building. This is a very effective way of planning for hospital institutions ensuring that there are sufficient breaks in corridors and sufficient vertical access points. The overall campus consists of 3 similar blocks strategically placed for ease of interconnectivity and access from the entrance and parking areas.

4.2 SITE ENTRANCE

The entrance driveway directly leads to a drop off area which gives access to a double height entrance lobby. The proposed drive way branches off from the existing St Julien-Flacq B23 Road and shall be divided into an ingress and egress access for vehicular and pedestrian traffic. The divider shall be a landscaped portion which shall as well contain necessary road signages.

The entrance driveway also links to the car parking area internal roads of sufficient size to allow easy manoeuver of vehicles. At term, the car parking has a capacity of 490 parking lots for visitors and provision has been made outside the site for 22 parking lots for taxis and a waiting area for buses. The parking areas will be asphalted and properly landscaped with different varieties of shading trees.

4.2.1 SECURITY

As Shown on the site plan layout enclosed at **Annex 8**, a security kiosk will be proposed at the entry/exit way for the control of the incoming and outgoing vehicles, as well as to provide shelter to the on duty security guard. The security kiosk shall be located such that there is sufficient queueing and control at entrance. Same shall be finalized with the TMRSU and the Proponent.

4.2.2 BUILDING ENTRANCE

The main building will welcome patients into a double height entrance lobby after transiting through an air lock. Once inside, they shall be channeled to the proper direction at the help desk. Based on the case, they shall either be proceeding to the registration counter prior to getting consulted at the OPD or shall be referred to the concerned department for check-in. Necessary waiting areas have been provided near the registration counters as well as in the OPD clinics wherein the patients shall be called upon based on the algorithms of a queue management system.

A public cafeteria has also been planned so as to serve as an internal meeting point or a waiting area for relatives of patients being examined.

4.2.3 ACCIDENT AND EMERGENCY ENTRANCE

The Accident & Emergency unit is directly accessed from the main driveway by an internal road that gives sufficient leeway to ambulances to manoeuver. It has a covered porch allowing patients to be safely dropped off at any point in time. This unit is fully autonomous and its access is always kept clear.

4.3 MAIN BUILDING

Taking into account the constraints of the site, the main building for the hospital facility has been planned as 2 wings connecting to a central core. This arrangement ensures quick and easy access to the various departments of the hospital while still complying with hospital planning guidelines and general building safety codes. Taking into account the various requirements of the Client, the building has been designed over eight levels, namely:- Basement, Ground Floor and First to Sixth Floors. The accommodation list for the hospital is listed in the subsections below:

4.3.1 BASEMENT

The basement of the building, with a total floor area of 8,756.80 m^2 will encompass the technical and service areas necessary for the good functioning of the hospital. Amongst others, the basement consists of:-

- A kitchen and storage area for preparation of meals for patients
- General storage areas
- Laundry and linen storage
- CSSD
- Medical gas plant and control room
- Laboratories
- Mortuary Unit
- Engineering staff room
- UPS room
- Battery room
- LV room
- MEP plant room

Refer to **Annex 9** for more details in terms of the floor layout.

4.3.2 GROUND FLOOR

The ground floor of the building, with a total floor area of 8,663.66 m^2, is designed to accommodate the public specs of the hospital. Different OPD clinics, Pharmacy & Dispensing units and Accident & Emergency Units form part of the core component of the Ground Floor. The different units of the Ground Floor are listed below with their major rooms listed immediately after:

Accident and Emergency Unit

- Emergency Sorting (Triage) Unit
- Emergency Minor Operation Theatre
- Treatment rooms
- Waiting Area
- Doctors and support staff units
- Duty doctor's restroom
- Services Rooms and stores
- Toilet blocks

Radiology Department

- Registration counter
- Waiting Area
- Examination/Imaging Rooms
- Services Rooms and stores
- Toilet blocks

Blood Bank

- Donor's room
- Blood storage bank
- Sorting Room
- Waiting Area

Pharmacy & Dispensing
Registration & Waiting
Cafeteria

OPD Clinics

- Consultation rooms
- Treatment rooms
- Storage area
- Dirty & Clean Utilities
- Services Rooms and Stores
- Toilet blocks
- Doctors rooms

Refer to **Annex 10** at the end of this section for the ground floor plan

4.3.3 FIRST FLOOR

The First Floor of the building has a total floor area of 8,421.60m^2. Taking into account the design of the floor plan, 1 wing is kept as a continuation of the ground floor wherein which the OPD clinics shall be arranged while the other wing is designed to house the Maternity Unit and Neonatal departments. The Central core shall be used for Daycare wards and waiting areas. The different units of the First Floor are listed below with the major rooms listed immediately after:

OPD Clinics

- Consultation rooms
- Treatment rooms
- Storage area
- Dirty & Clean Utilities
- Services Rooms and Stores
- Toilet blocks
- Doctors rooms
- Minor OT and support rooms

Daycare Ward

- 6 bed Wards
- Treatment rooms
- Support rooms
- Toilet blocks

Maternity & Neonatal Unit

- Operation theatre
- Labour room
- Pre & Post Labour wards
- Doctor's change
- Services rooms and stores
- Neonatal Intensive Care Unit (NICU)
- Nursery Department with Septic and Aseptic wards
- Baby Feeding room
- Examination room
- Nurse Station
- Services rooms and stores

Refer to **Annex 11** at the end of this section for the First Floor plan

4.3.4 SECOND FLOOR

The Second Floor of the building has a total floor area of 8 663.66 m^2. It can be considered to be the most critical floor of the hospital as it is designed mainly for operation theatre and intensive care units. The hospital has 8 operation theatres which help in reducing the waiting time for urgent surgical interventions as well as help diminish the waiting time on non-urgent cases. It is should be the case, the Operation theatres wing has pre & post-operative wards along with all necessary facilities such as scrubs, surgical stores, TSSU area, direct connection to the CSSD unit and change rooms. The central core being a transit space between the Operation theatres and the ICU wards houses the doctors' rest facilities and offices that are to be used mostly by staff that are directly involved in the day to day running of the units on this floor. All ICU wards are located on the opposite wing of the Operation theatres for quick intervention as the case may be. Each ICU ward is designed to be a self-sufficient unit with an examination room, duty doctor room and nurse station centrally located for easy overviewing of the patients.

The major rooms forming part of the different units on the Second Floor are listed below:

Operation Theatres Unit

- Operation theatres
- Pre & Post Operation wards
- Anesthesia department
- TSSU
- Waiting area
- Doctor's & Nurses lounges
- Offices
- ICU
- ICU beds fully serviced
- Examination room
- Nurse station
- Changing rooms
- Services rooms & stores
- Equipment rooms
- Clean and dirty utilities
- Toilets

Refer to **Annex 12** at the end of this section for the Second Floor

4.3.5 THIRD FLOOR

The Third Floor of the building, with a total floor area of 6 396.12 m^2 consists of a public waiting lobby at the central core. It is designed to accommodate mainly In-patient wards. Patients wards are distributed in units of 6 to 8 beds to provide better care to patients. Each ward also consists of examination rooms, nurse station duty doctor room and utilities rooms:

TYPICAL INPATIENT WARD

- Patient wards
- Demo room
- Doctors/ nurse/staff room
- Examination room
- Toilets and showers
- Services rooms and stores
- Public waiting lobby
- Services areas for Operation theatres
- Terraces

Refer to **Annex 13** at the end of this section for the Third Floor plan

4.3.6 FOURTH-SIXTH FLOOR

The Fourth to Sixth Floors are typical and have a total floor area of 5 259.87m^2 each. They are designed to accommodate mainly patient wards. Patients in units of 6 to 8 beds. Each ward consists of examination rooms, nurse station duty doctor room and utilities rooms. A portion of the floor is also dedicated for offices for the administration of the hospital:

TYPICAL INPATIENT WARD

- Patient wards
- Demo room
- Doctors/ nurse/staff room
- Examination room
- Toilets and showers
- Services rooms and stores
- Public waiting lobby
- Services areas for Operation theatres
- Terraces

Refer to **Annex 14** at the end of this section for the Fourth to Sixth Floor plan

4.4 VERTICAL CIRCULATION

The vertical circulation within the hospital has been designed in order to provide an excellent service level in terms of the number of lifts required. 2 of the lifts on either side are meant to be operated in the event of fire emergencies. The floors can also be accessed by staircases which have been designed to be of sufficient width in the event of emergencies. They are located such that easy evacuation is possible in the event of any emergencies. A ramp has also been provided for circulation of heavy equipment or bed ridden patients in the of lift failure or emergency evacuation

4.5 ELEVATION

The elevation is designed to provide a contemporary look and feel to the building while still being easy to maintain. There shall be a mix o f plastered surfaces painted with antifungus paint, aluminium glazed and polished stones such as granite and marbles. There shall be a good mixture of aluminium glazed openings to provide sufficient natural lighting without causing unnecessary heating. In that respect, the glass specifications call for low E value. All the services running in the building shall be concealed in accessible ducts that are strategically located all around the lobby.

Refer to **Annex 15** at the end of this section for the Elevations and Sections

4.6 FINISHES (INTERNAL)

Hygiene is of utmost importance in a hospital and great care has been exercised in specifying the correct finishes in the e different areas of the hospital. Generally the floors shall be covered with PVC sheeting that are welded and covered to prevent dirt accumulation. The walls shall be smooth and painted with washable paint or antibacterial paint depending on the location. All areas shall have false ceiling of high quality finish with access panels to allow for every maintenance of services. Where the traffic flow is more, guard and bumper rail shall be fixed to the walls.

4.7 WASHROOM FACILITIES

Washroom blocks have been provided for all common and public areas of the hospital, as well as in In-patient wards and doctor's quarters. They have been provided based on the provisions of Bs 6465:

4.8 SERVICE AREAS

Apart from the main building, some of the services have been located on the site based on the ease of accessibility for maintenance or the potential problem they may pose in the event of any mishappening. The services which are located on site in separate building from the main building are:-

- Gas manifold room
- Oxygen generation plant
- Water storage tank and pumps (Underground)
- Generators transformers, Diesel tank, sewer treatment plant, irrigation water tank.

A clear demarcation has been made to segregate the electrical services with net services to prevent any accidents. The sewer treatment plant has been located much beyond the statuary setbacks and does not pose a problem in the event of any breakdown.

4.9 AESTHETIC AND ENVIRONMENT

The beauty of the project will rely on the landscaping elements together with the routing of pathways and accesses which are required to structure the whole design.

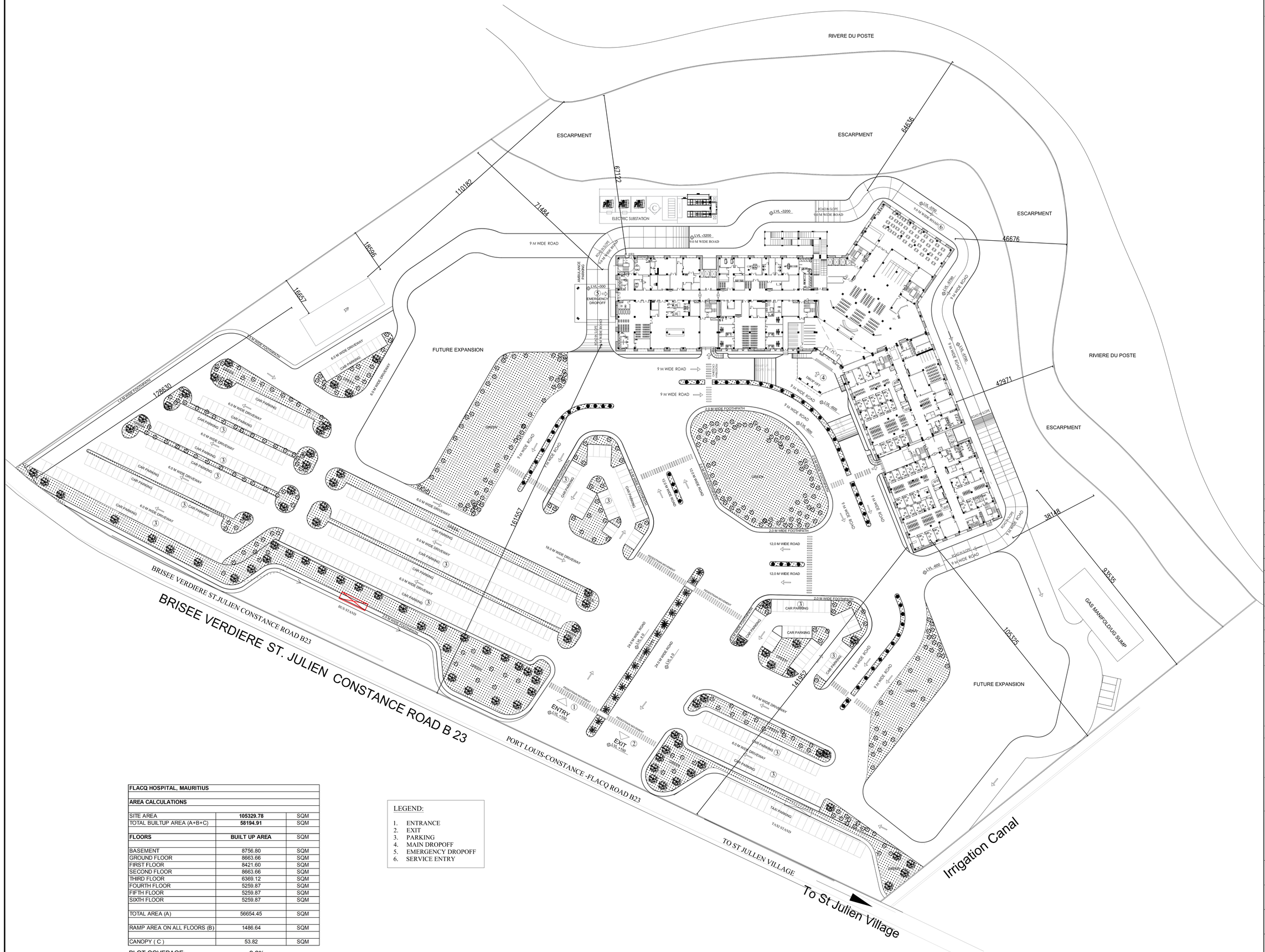
The main aim is to create a landscape which enhance the existing characters of the building, and add to the aesthetics of the development, but also be as sustainable as possible.

In this way, the choice of plants for the softscape will be geared towards mostly flowery and endemic plants. Fruity trees will be avoided as they may attract bugs and unwanted guest to the hospital vicinity.

Infrastructure will be designed and located to preserve existing trees on site.
Inspite of being a functional building where the accent is on efficiency and productivity, the site shall be duly landscaped in order to create a more harmonious and pleasing environment. We strongly believe that the landscape contributes a lot to the overall well being and acts as a booster for speedy recovery.

On that count, the plants selection shall be oriented mostly towards endemic species requiring low maintenance. Flowery variety of trees shall also be planted in order to create interest in the landscape and views from the hospital. It will be strictly prohibited to plant fruit bearing trees as these will attract bugs, pests and bats thereby posing major health hazard to the site. Fruit becoming trees will also attract thieves who would tend to take advantage of being on a public site.

Any one tree that is required to be fell for the purpose of the project shall be replaced with at least three trees thereby ensuring a better final environment.



FLACQ HOSPITAL, MAURITIUS		
AREA CALCULATIONS		
SITE AREA	**105329.78**	SQM
TOTAL BUILTUP AREA (A+B+C)	**58194.91**	SQM
FLOORS	**BUILT UP AREA**	SQM
BASEMENT	8756.80	SQM
GROUND FLOOR	8663.66	SQM
FIRST FLOOR	8421.60	SQM
SECOND FLOOR	8663.66	SQM
THIRD FLOOR	6369.12	SQM
FOURTH FLOOR	5259.87	SQM
FIFTH FLOOR	5259.87	SQM
SIXTH FLOOR	5259.87	SQM
TOTAL AREA (A)	56654.45	SQM
RAMP AREA ON ALL FLOORS (B)	1486.64	SQM
CANOPY (C)	53.82	SQM

PLOT COVERAGE: 9.8%

No OF PARKING: 490 CARS

LEGEND:

1. ENTRANCE
2. EXIT
3. PARKING
4. MAIN DROPOFF
5. EMERGENCY DROPOFF
6. SERVICE ENTRY

GENERAL NOTES

All dimensions and levels are to be checked and verified on site and any discrepancy is to be brought to the immediate notice of the architect prior to the starting of the work.

Dimensions are to be read and not scaled. All dimensions given are to the construction faces of the work prior to addition of finishes unless otherwise mentioned. For existing features it relates to existing finished faces. All dimensions are in metric scale, usually in millimetres, unless otherwise stated.

This drawing indicates design intent only. Drawings of other consultants would indicate the details relating to their discipline & must be read and checked accordingly.

The information on previous revisions of this drawing is superceded by the information on this drawing.

The contractor is to comply in all respects with the latest building regulations whether or not specifically mentioned. Proprietary products are to be installed as per manufacturer's specs.

No changes are to be made without notifying the architect.

CONSTRUCTION PERIOD

Rev	Date	Initial	DESCRIPTION

ARCHITECTURAL NOTES

DISTRIBUTION OF PRINTS

Revision					
Client					
Structural Engr					
M&E Engr					
Q. Surveyor					
Project Manager					
Landscape Arch					
Contractor					
Sub-Contractor					
S. Manufacturer					
Local Authority					

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PAC Reg No: 170

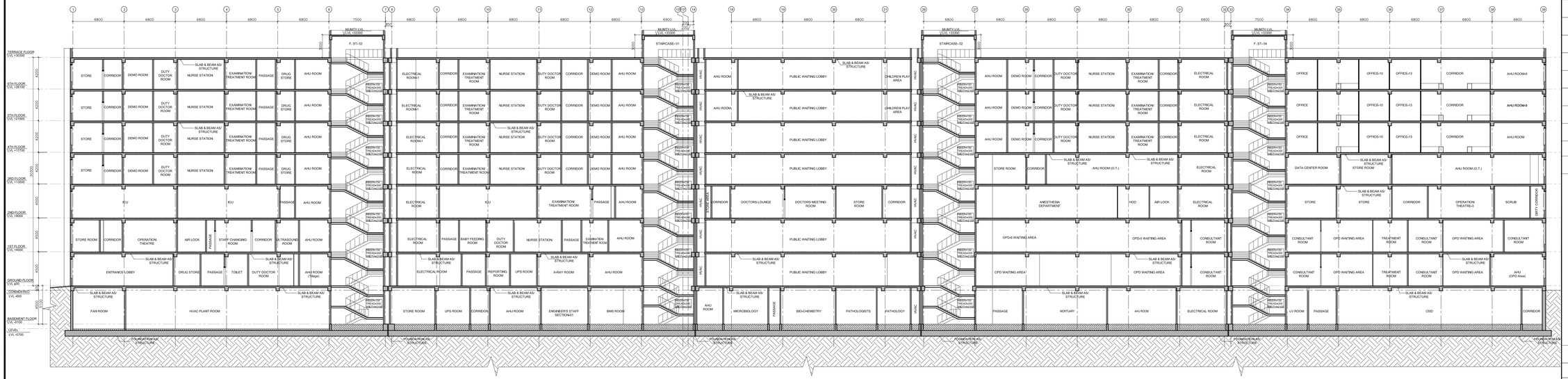
Client: MINISTRY OF HEALTH & WELLNESS

Project: NEW MULTISPECIALITY HOSPITAL
@ CONSTANCE B23 ROAD, FLACQ

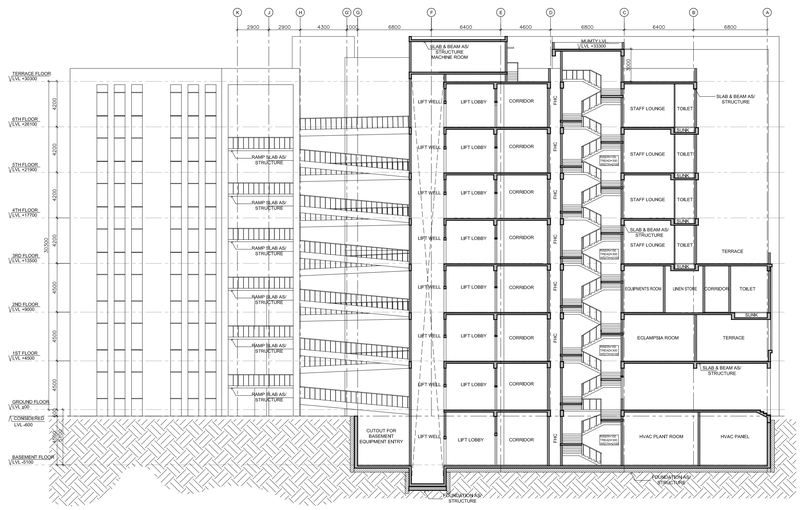
Drawing: SITE PLAN
SITE LAYOUT

FOR APPROVAL Date: 21-SEP-2020

Drawing no.:	Drawn:	Check:	Scale:	Rev
S-101	RG	KG	1:200 @ A0	P1



SECTION: A-A



SECTION: B-B

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Tel/Fax : (+230)59097117 Email: studiokarkz@gmail.com
PAC Reg No: 170

Client: MINISTRY OF HEALTH & WELLNESS

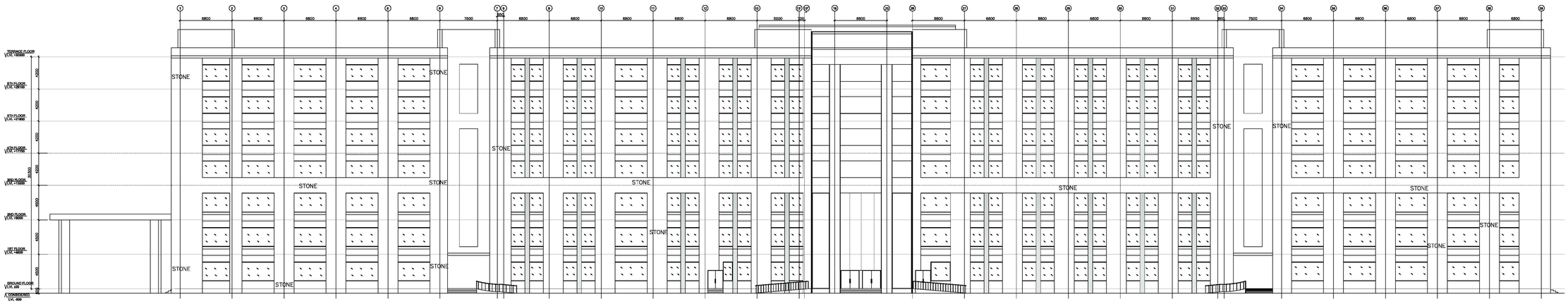
Project: NEW MULTISPECIALITY HOSPITAL
@ CONSTANCE B23 ROAD, FLACQ

Drawing: SECTIONS
SECTIONS A-A & B-B

FOR APPROVAL

Date:	
21-SEP-2020	

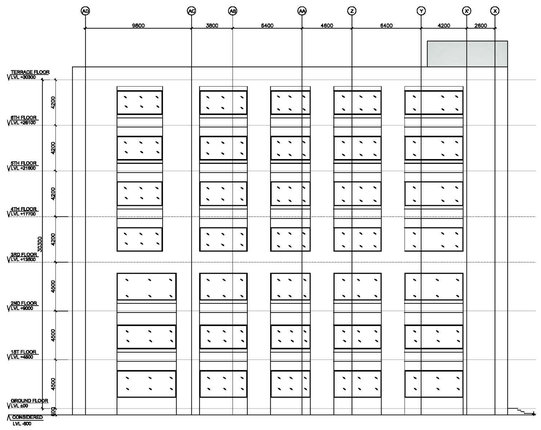
Drawing no.:	Drawn:	Check:	Scale:	Rev
A-220	RG	KG	1:200 @ A0	P1



ELEVATION: 1A

ELEVATION: 1B

ELEVATION: 1C



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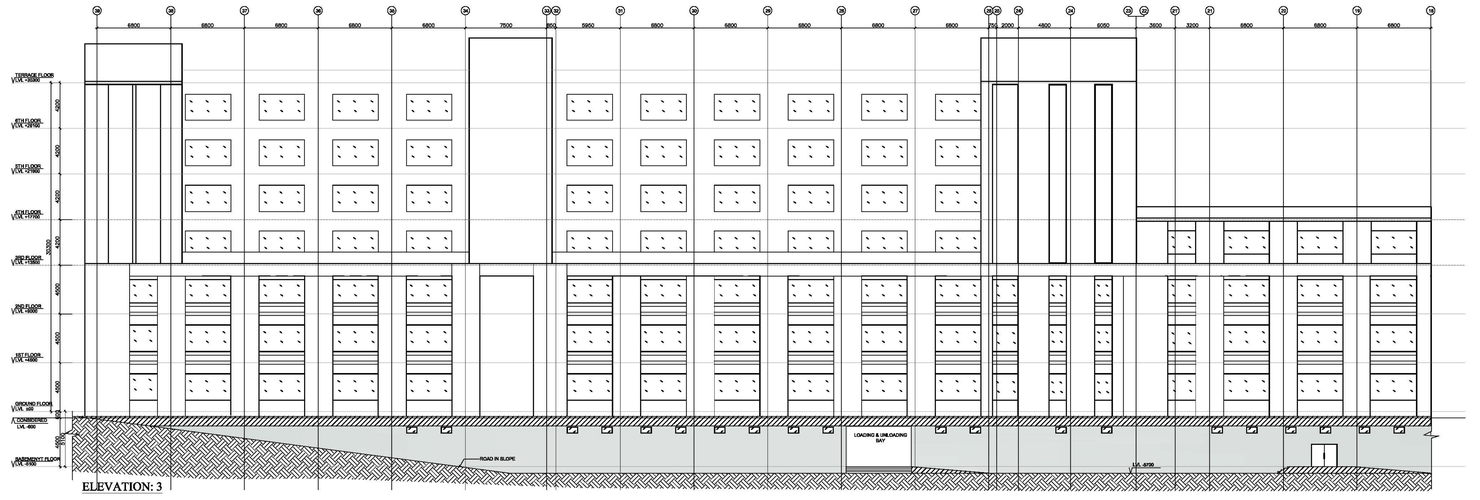

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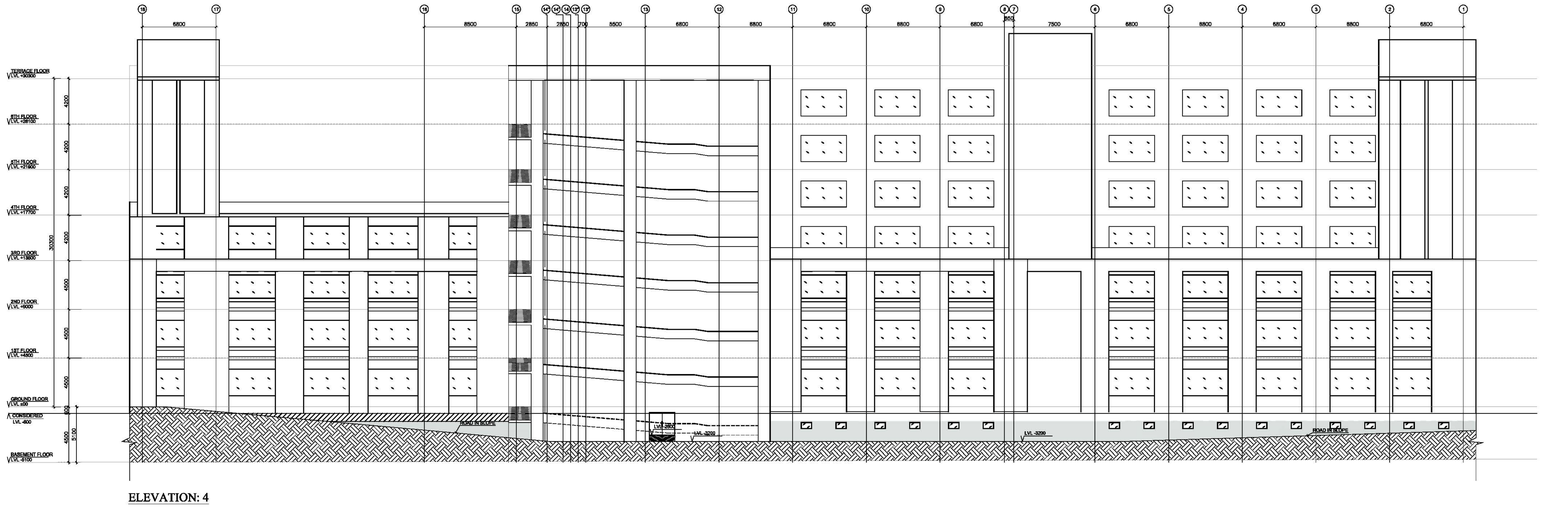
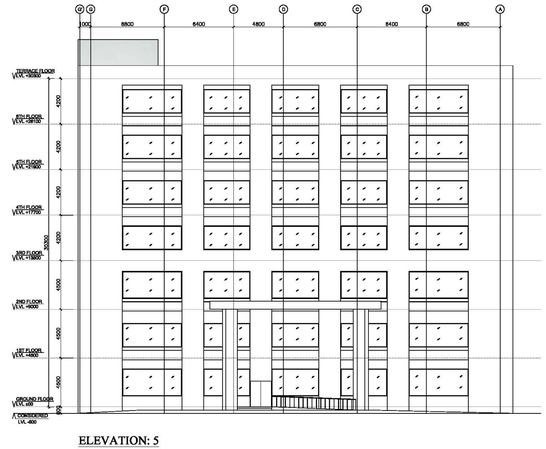


ELEVATION: 4



ELEVATION: 5

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PAC Reg No: 170

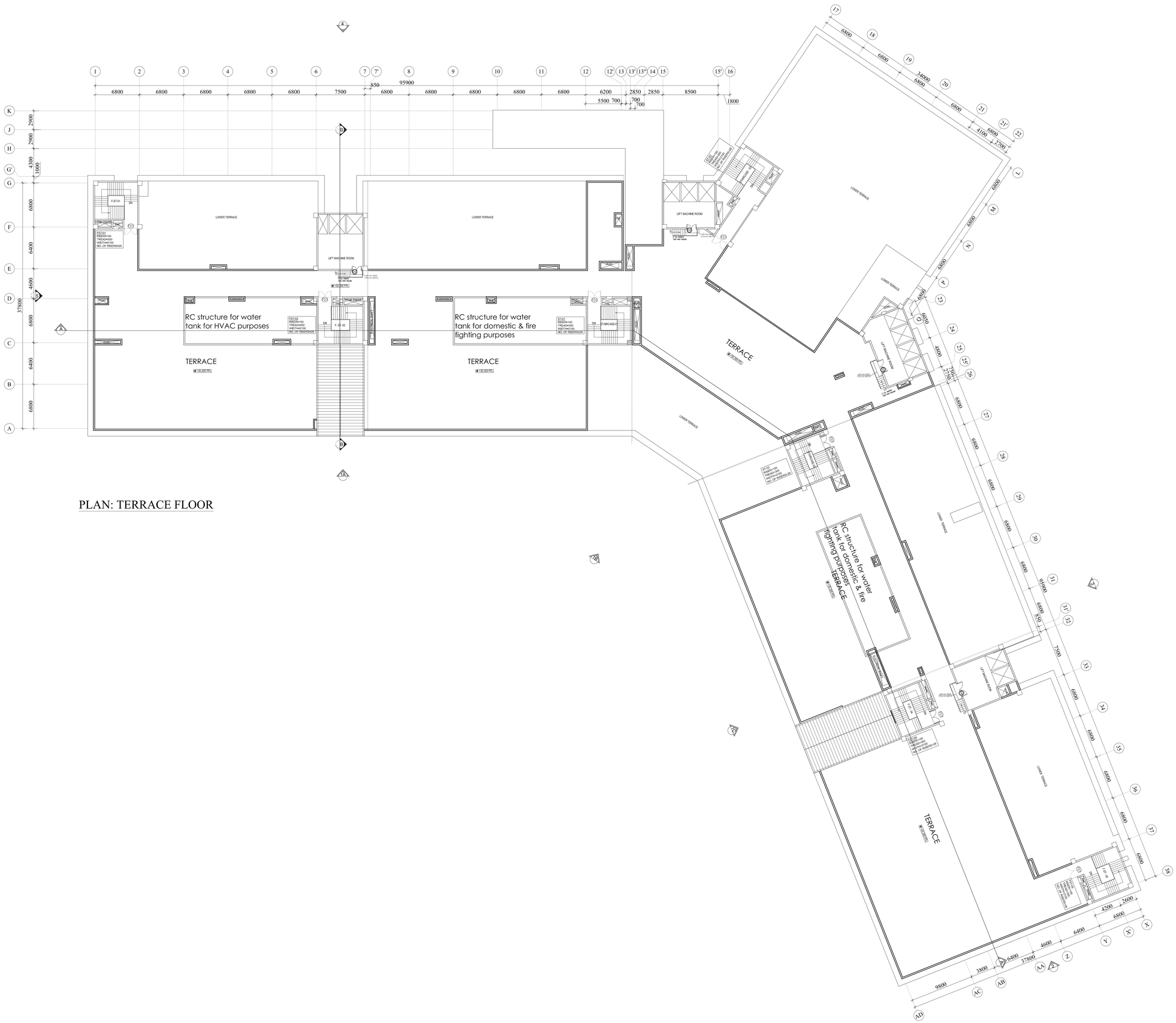
Client: MINISTRY OF HEALTH & WELLNESS

Project: NEW MULTISPECIALITY HOSPITAL
@ CONSTANCE B23 ROAD, FLACQ

Drawing: ELEVATIONS
ELEVATIONS 1,2,3,4 & 5

FOR APPROVAL Date: 21-SEP-2020

Drawing no.:	Drawn:	Check:	Scale:	Rev
A-201	RG	KG	1:200 @ A0	P1



PLAN: TERRACE FLOOR

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PAC Reg No: 170

Client: MINISTRY OF HEALTH & WELLNESS

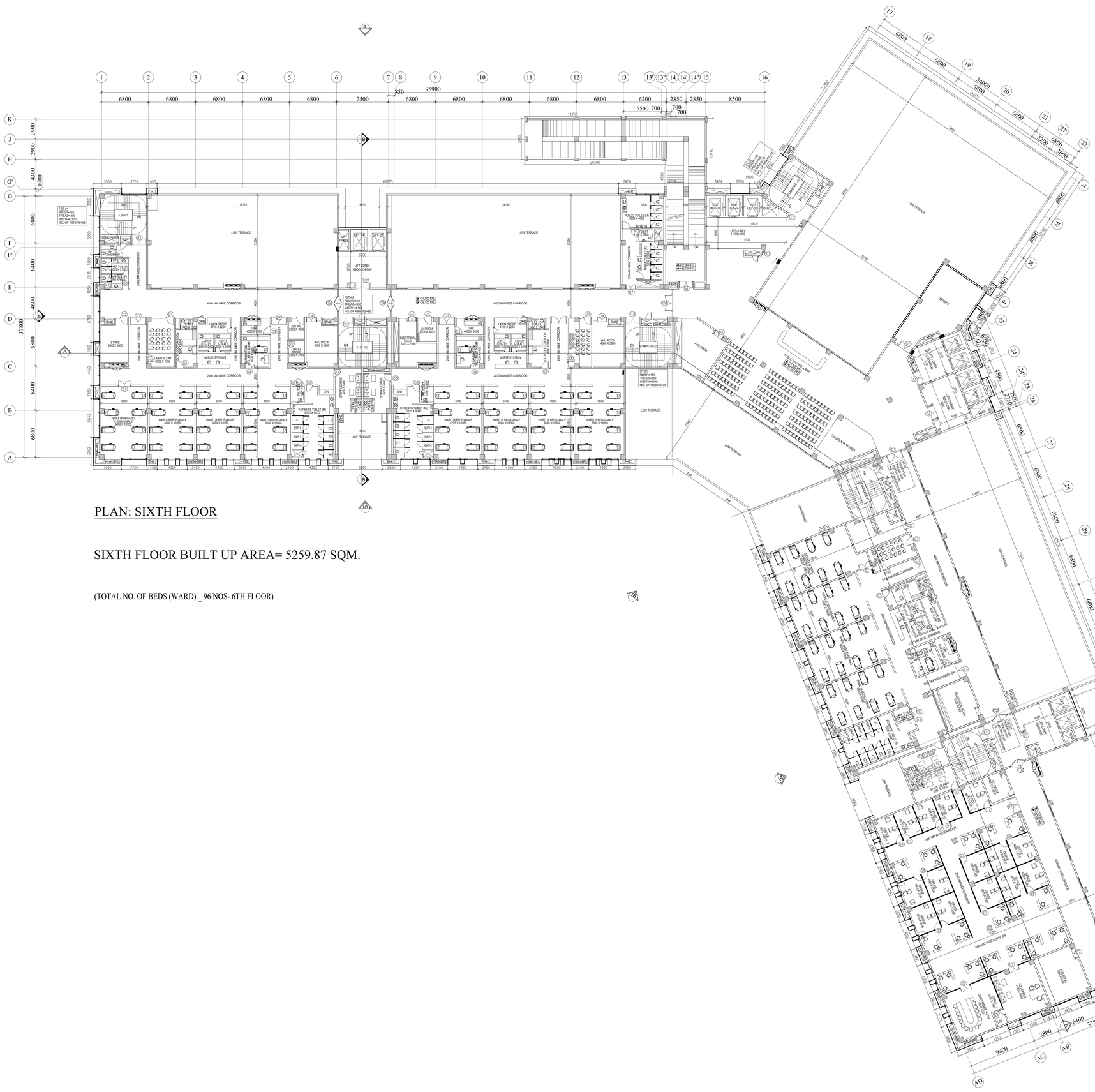
Project: NEW MULTISPECIALITY HOSPITAL
@ CONSTANCE B23 ROAD, FLACQ

Drawing: PLAN
ROOF PLAN

FOR APPROVAL

Date: 21-SEP-2020

Drawing no.:	Drawn:	Check:	Scale:	Rev
A-171	RG	KG	1:200 @ A0	P1



PLAN: SIXTH FLOOR

SIXTH FLOOR BUILT UP AREA= 5259.87 SQM.

(TOTAL NO. OF BEDS (WARD) _ 96 NOS- 6TH FLOOR)

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PAC Reg No: 170

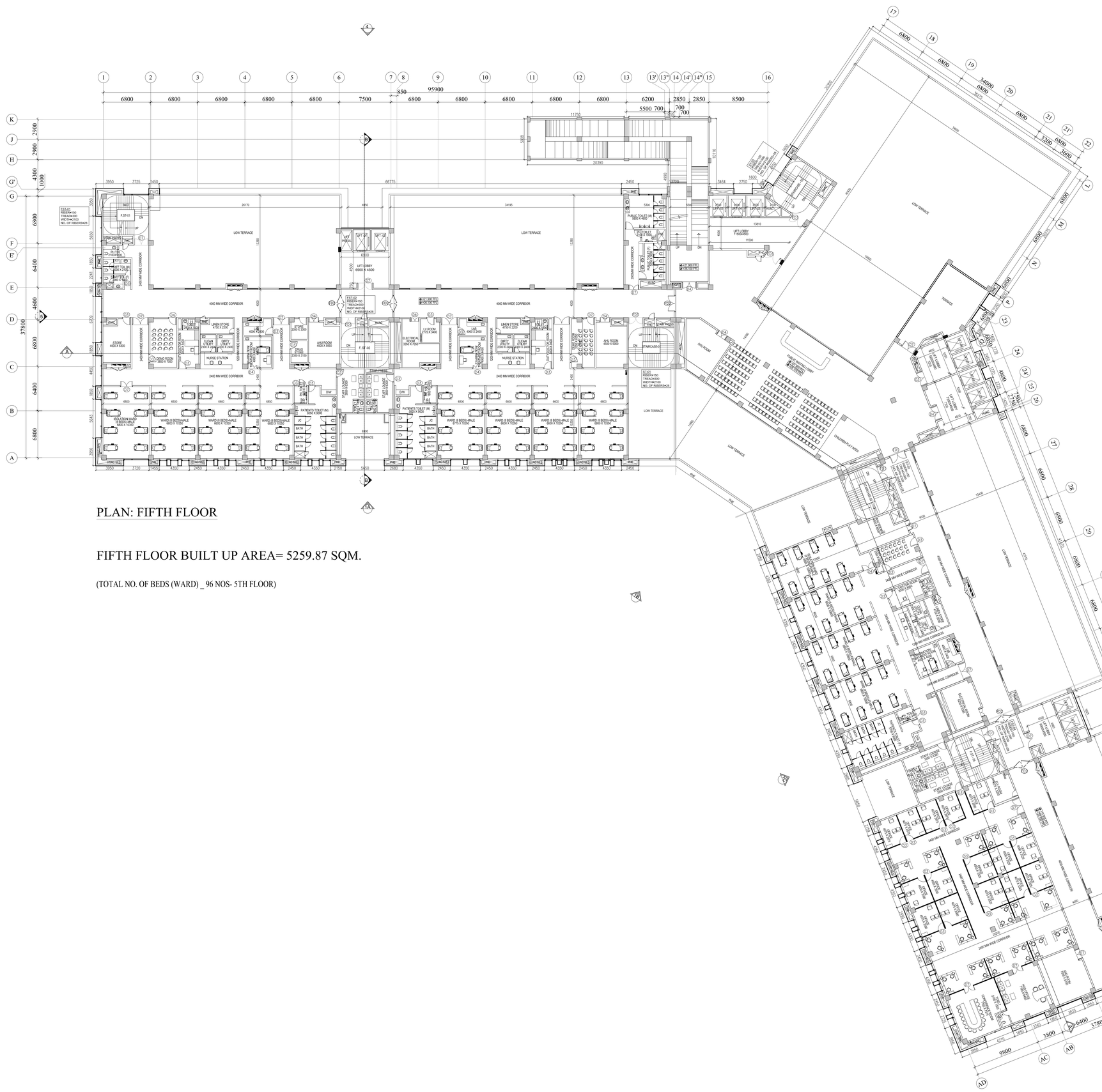
Client: MINISTRY OF HEALTH & WELLNESS

Project: NEW MULTISPECIALITY HOSPITAL
@ CONSTANCE B23 ROAD, FLACQ

Drawing: PLAN
SIXTH FLOOR PLAN

FOR APPROVAL | Date: 21-SEP-2020

Drawing no.:	Drawn:	Check:	Scale:	Rev
A-161	RG	KG	1:200 @ A0	P1



PLAN: FIFTH FLOOR

FIFTH FLOOR BUILT UP AREA= 5259.87 SQM.

(TOTAL NO. OF BEDS (WARD) _ 96 NOS- 5TH FLOOR)

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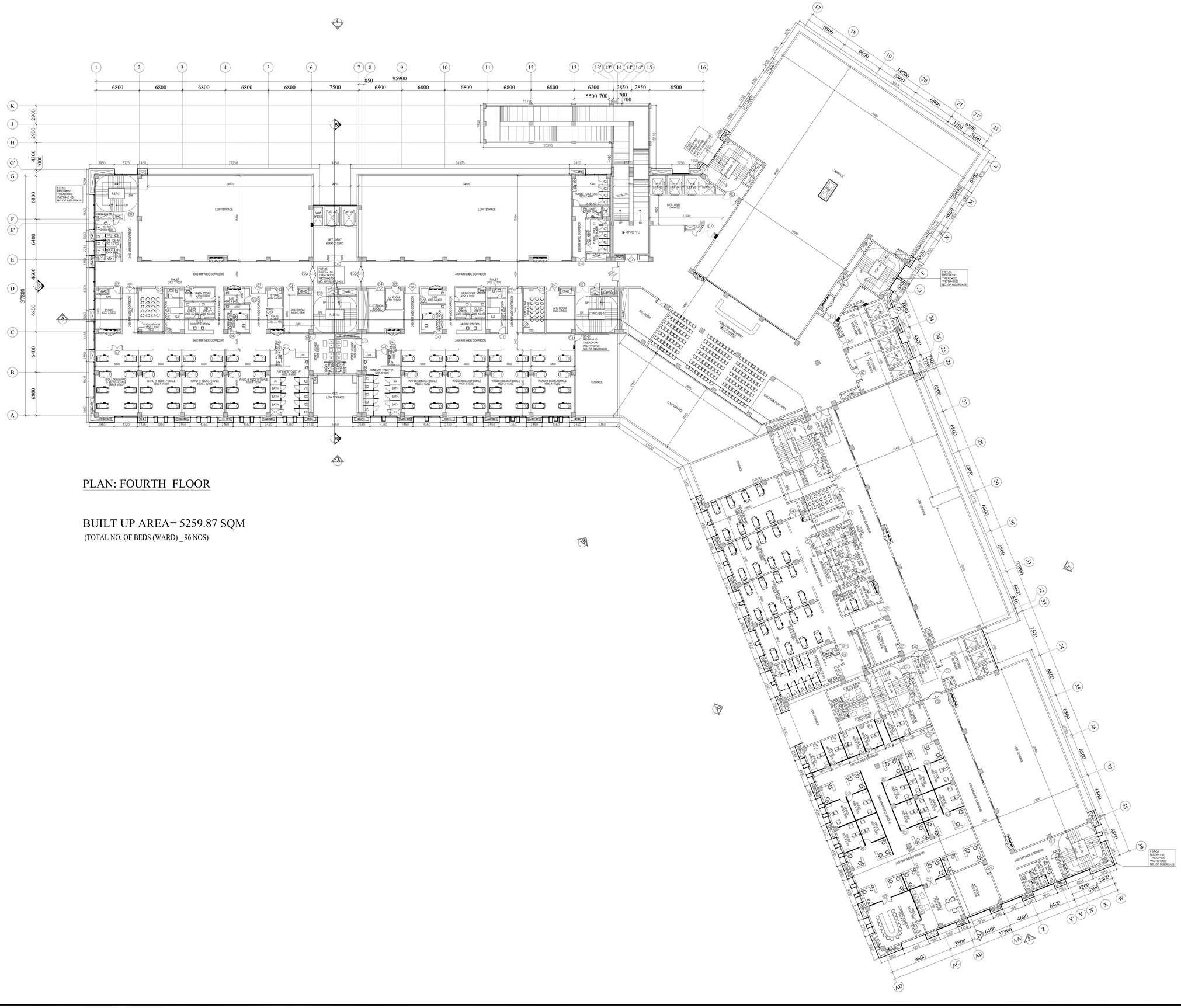
Client: MINISTRY OF HEALTH & WELLNESS

Project: NEW MULTISPECIALITY HOSPITAL
@ CONSTANCE B23 ROAD, FLACQ

Drawing: PLAN
FIFTH FLOOR PLAN

FOR APPROVAL Date: 21-SEP-2020

Drawing no.:	Drawn:	Check:	Scale:	Rev
A-151	RG	KG	1:200 @ A0	P1



PLAN: FOURTH FLOOR

BUILT UP AREA= 5259.87 SQM

(TOTAL NO. OF BEDS (WARD) _ 96 NOS)

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Tel/Fax : (+230)59097117 Email: studiokarkz@gmail.com
PAC Reg No: 170

Client:	MINISTRY OF HEALTH & WELLNESS
Project:	NEW MULTISPECIALITY HOSPITAL @ CONSTANCE B23 ROAD, FLACQ
Drawing:	PLAN FOURTH FLOOR PLAN

FOR APPROVAL	Date: 21-SEP-2020			
Drawing no.:	Drawn:	Check:	Scale:	Rev
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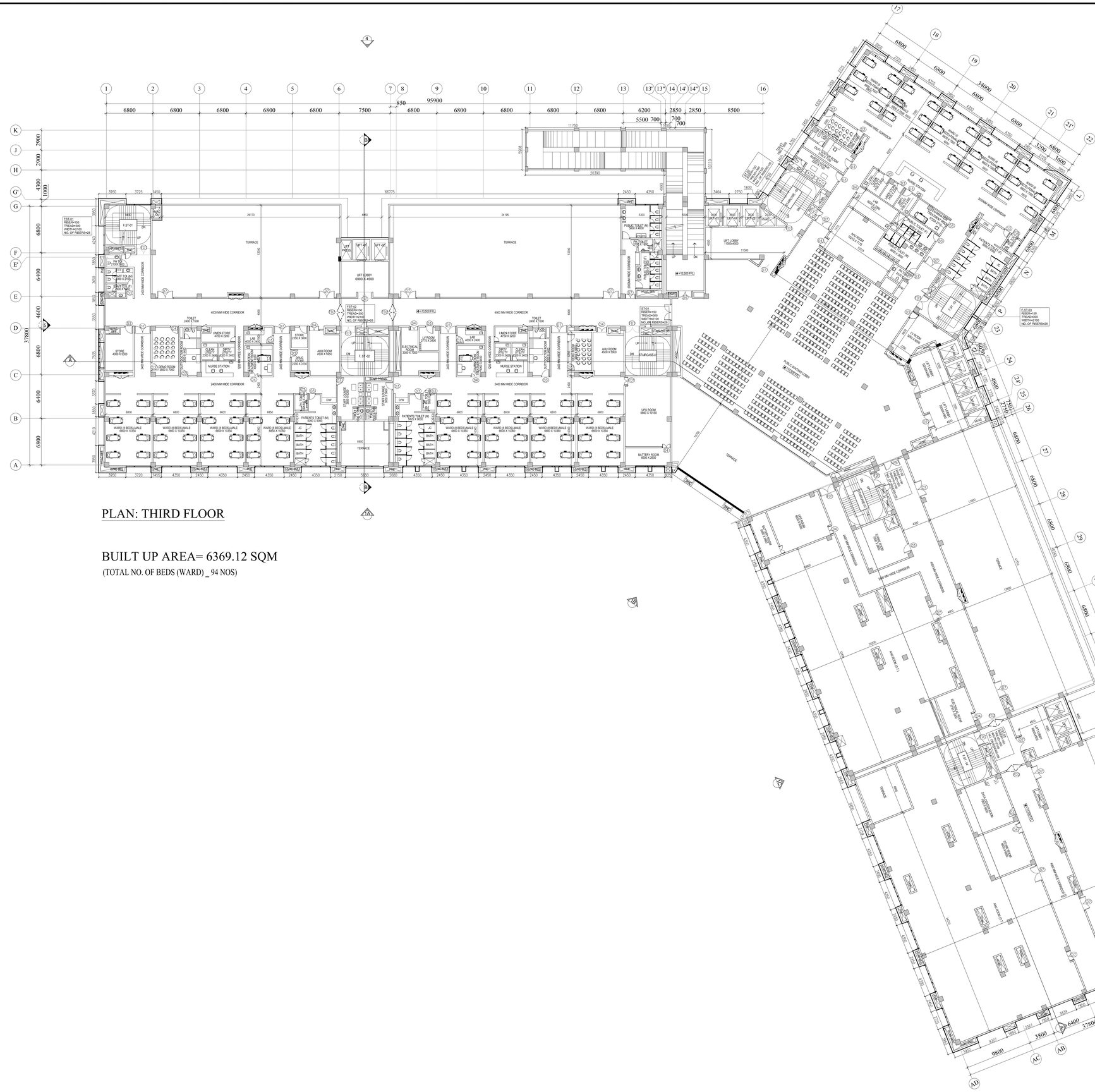

PLAN: THIRD FLOOR

BUILT UP AREA= 6369.12 SQM

(TOTAL NO. OF BEDS (WARD) _ 94 NOS)

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PAC Reg No: 170

Client: MINISTRY OF HEALTH & WELLNESS

Project: NEW MULTISPECIALITY HOSPITAL @ CONSTANCE B23 ROAD, FLACQ

Drawing: PLAN
THIRD FLOOR PLAN

FOR APPROVAL

Date: 21-SEP-2020

Drawing no.:	Drawn:	Check:	Scale:	Rev
A-131	RG	KG	1:200 @ A0	P1

PLAN: SECOND FLOOR

BUILT UP AREA= 8663.66 SQM

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PAC Reg No: 170

Client: MINISTRY OF HEALTH & WELLNESS

Project: NEW MULTISPECIALITY HOSPITAL @ CONSTANCE B23 ROAD, FLACQ

Drawing: PLAN SECOND FLOOR PLAN

FOR APPROVAL

Date: 21-SEP-2020

Drawing no.:	Drawn:	Check:	Scale:	Rev
A-121	RG	KG	1:200 @ A0	P0

PLAN: FIRST FLOOR

BUILT UP AREA= 8421.60 SQM

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Client: MINISTRY OF HEALTH & WELLNESS

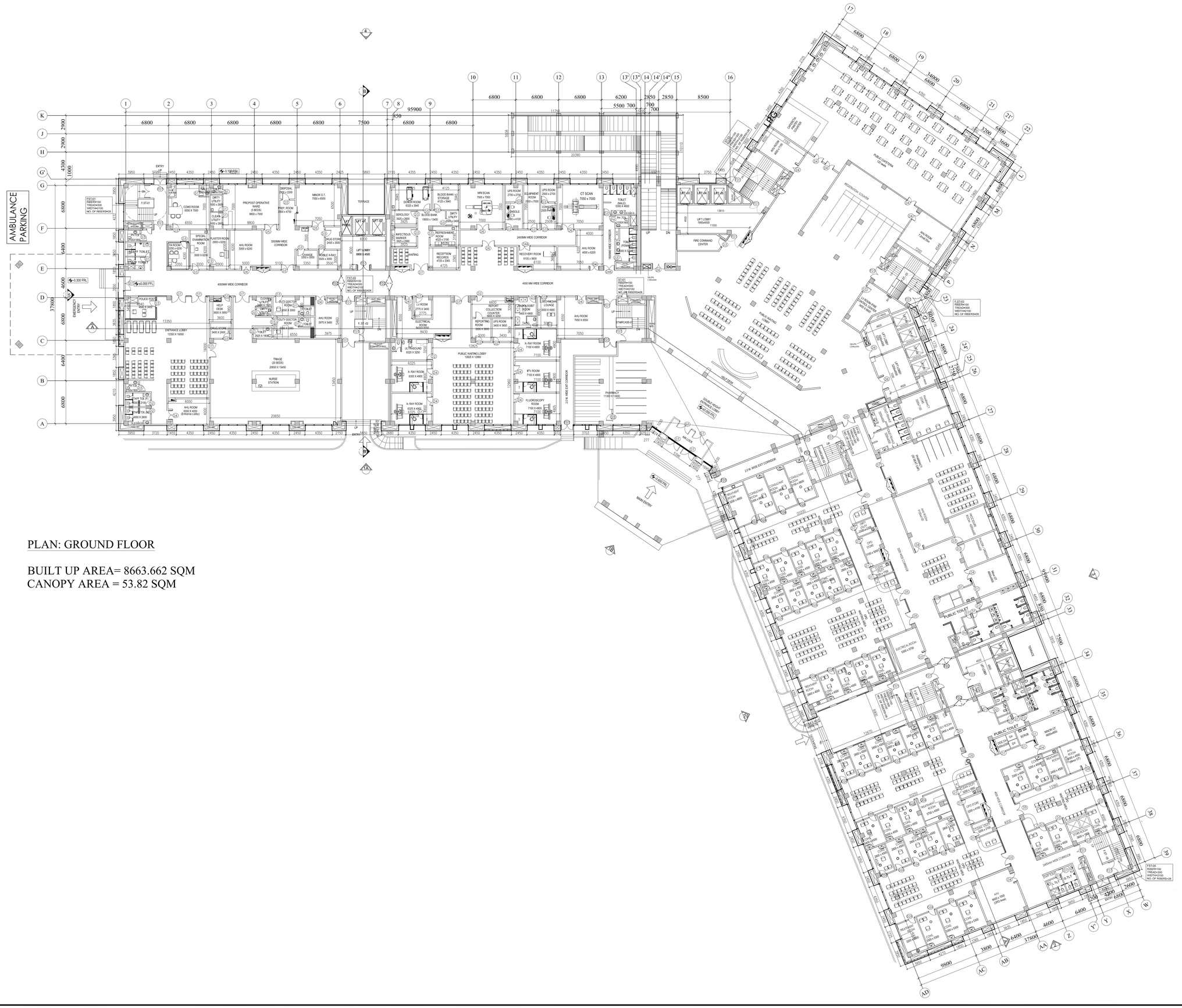
Project: NEW MULTISPECIALITY HOSPITAL @ CONSTANCE B23 ROAD, FLACQ

Drawing: PLAN
FIRST FLOOR PLAN

FOR APPROVAL

Date: 21-SEP-2020

Drawing no.:	Drawn:	Check:	Scale:	Rev
A-111	RG	KG	1:200 @ A0	P1



PLAN: GROUND FLOOR

BUILT UP AREA= 8663.662 SQM
CANOPY AREA = 53.82 SQM

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CONSTRUCTION PERIOD

Rev	Date	Initial	DESCRIPTION

ARCHITECTURAL NOTES

DISTRIBUTION OF PRINTS

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Client					
Structural Engr					
M&E Engr					
Q. Surveyor					
Project Manager					
Landscape Arch					
Contractor					
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S. Manufacturer					
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PAC Reg No: 170

Client: MINISTRY OF HEALTH & WELLNESS

Project: NEW MULTISPECIALITY HOSPITAL
@ CONSTANCE B23 ROAD, FLACQ

Drawing: PLAN
GROUND FLOOR PLAN

FOR APPROVAL

Date: 21-SEP-2020

Drawing no.:	Drawn:	Check:	Scale:	Rev
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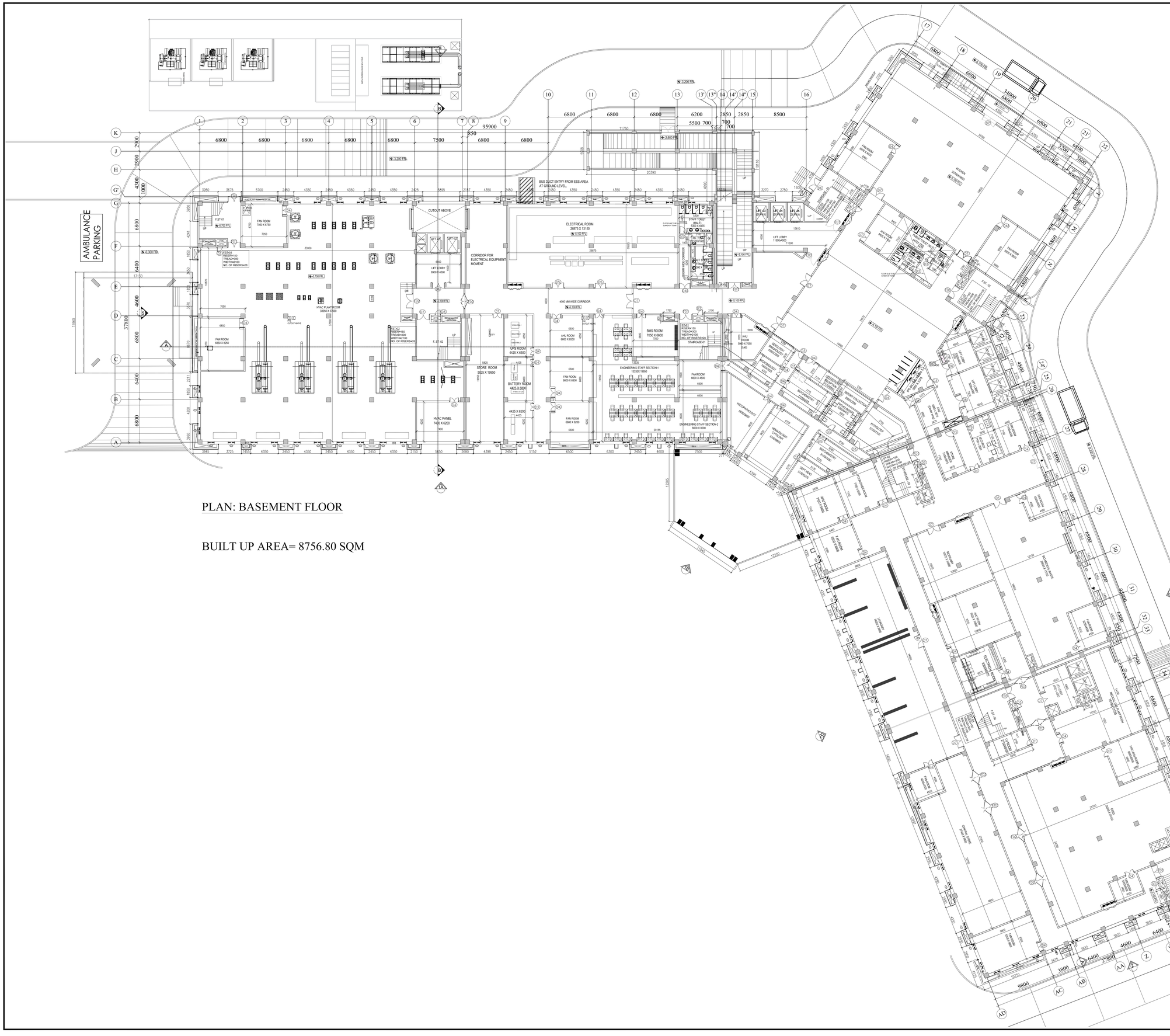

PLAN: BASEMENT FLOOR

BUILT UP AREA= 8756.80 SQM

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FOR APPROVAL — Date: 21-SEP-2020

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A-001	RG	KG	1:200 @ A0	P1

CHAPTER 5

PLANNING AND COMPLIANCE

5.1 INTRODUCTION

5.2 PLANNING CONSIDERATION

5.3 AS SHOWN ON DRAWINGS IN CHAPTER 4

5.4 SETBACKS

5.5 PLOT COVERAGE

5.6 DEVELOPMENT DENSITY

5.7 PARKING REQUIREMENTS

5.8 MATERIALS

5.9 WALLS AND FENCES

5.10 SANITATION

5.11 SITE RETICULATION

CHAPTER 5

PLANNING AND COMPLIANCE

5.1 INTRODUCTION

The planning policy guidelines, commonly referred to as PPG have been developed in order to harmonize the infrastructure development in Mauritius.
There is however no specific PPG document that deals specifically with hospital design and construction.
Taking the above into account and based on its importance, the guidelines and technical sheets prepared for commercial and tall buildings, industrial and commercial roads, access for people with disabilities, on site sewer disposal have been consulted and complied to in the design. Where there is no specific reference material, the guidelines for hospital design as per British Standard (Healthcare Design notes) and other similar building regulations have been looked into for compliance.

5.2 PLANNING CONSIDERATION

The previous subsection as well as the contents of the Chapter 4 gives a fair representation of the different considerations taken into account while developing the hospital design.
The main guiding factor has been to create a hospital campus that can cater for expansions and different scenarios over the next 50 years at the minimum. The form of the site has been used to advantage in order to shape the building as well as plan the expansion phases of the hospital.

5.3 AS SHOWN ON DRAWINGS IN CHAPTER 4

The height of the Building is 30.3m when measured from the finished ground level. There are 8 levels starting from a basement and seven floors above.
The height of the each floor validated as highlighted below:

- Basement = 5100m
- Ground - Second floor = 4500m each
- Third- Sixth floor = 4200m each

Several reasons and consideration, as herein after mentioned, have had to be taken while designing the project whereby which it has been required to have a building of that height.

1. There is limited land on the island and it is more advisable to go on a vertical development line in order to have sustainable land use.
2. The overall programme for the main hospital block calls for a minimum of 1000 beds. By simply going on a lower development height would mean more plot coverage.
3. It is better in terms of planning and construction, specially for hospital projects to go to the final height of the building at the initial stages in order to reap maximum benefits when additional phases are added as the services provision would have already been made.
4. The overall scheme for the project calls for a teaching institution as well as a super speciality block which are planned in the later phases of the project. At term, the overall plot average is expected to be around 35% thereby complying with general acceptable norms.
5. There is always an acute need for parking spaces in hospitals. Due to budget limitations, it is required to have the parking at ground level. The current disposition of going higher helps in achieving same.
6. The site is not far away from Central Flacq, approximately 1.5 km. The permissible height in Flacq is already 45m as per the PPG for commercial development.

7. There is an intention to have a helipad access to the building in its current form and thus a taller building will facilitate same.

5.4 SETBACKS

Based on the site's location, the following setbacks are applicable:

- From road side : 6m since it is along a classified road.
- From river side : 16m for building
  : 30m for sewer treatment plant
- From sides : 3m minimum

As denoted on the site plan in **Annex 8** of this report, all of these setbacks have been complied to in all respects.

5.5 PLOT COVERAGE

It is generally accepted as good practice not to exceed 40% of the plot area for coverage by the building. The plot coverage calculations, as indicated on the site plan as well, is given below:

- Total built up area : 58194.91 sqm
- Total site area : 105329.8 sqm
- Plot coverage : 9.8%

The project is thus viable for the future extensions as well where it is projected to have 2 more buildings, each of approximately 125% of the current footprint.

5.6 DEVELOPMENT DENSITY

Total site area : 105329.8 sqm
Total No. of beds at phase 1 : 520
Development density at phase 1 : 202 sqm

The current development density can be assumed to be on the high comfort side.
Total no. of beds at phase 2 & 3 : 1550

Development density at phase 2&3 : 67 sqm
The development density at term will thus be at par with the other regional hospitals in Mauritius such as Dr, Jeetoo hospital.

5.7 PARKING REQUIREMENTS

There is currently no specific local guidelines regarding the parking requirements for hospitals. However, taking the following into account:

a) The location of the site
b) The vehicle ownership ratio in Mauritius
c) The site connectivity by public transport
d) The presence of cultural shared taxi in the region
e) The future phases of the project
f) International norms for parking requirements in healthcare facilities it can be safely assumed that the parking requirement can be taken as 1 parking space per bed.

Based on this, 520 car parking spaces shall be required. The current site plan makes provision for 490 car parking and 22 taxis (car). A separate area shall be dedicated for around 50 motorcycles parking.
The parking lot will be designed in a clustered layout to ease circulation around the site and provide continuous flow and avoid congestion. The parking area will be split into 6No parking lot offering a large number of parking bay. Each parking lot will be 5.0 metres by 2.5 metres.

5.8 MATERIALS

The hospital building as well as peripheral buildings are designed as RC framed structure. The façade of the building shall be plastered prior to application of finishes. The hospital building shall be finished with a combination of anti-fungus paint and granite cladding. Decorative screens shall be strategically located on the façade to create interest and provide screening from direct sunlight. The openings shall be in powder coated aluminum and designed to an appropriate size that allows good natural lighting but prevents overheating.

5.9 WALLS AND FENCES

The compound shall be secured by a boundary wall built with a combination of RC blockwall and local basalt stones. Wherever required, fencing may be added for further security.

5.10 SANITATION

The waste water shall be treated and disposed off though a sewer treatment plant. The details of same are given in Chapter 6.

5.11 SITE RETICULATION

Circulation across the site shall happen by means of tarred road that interlink the entrance of the site to the important building entrances and the parking areas. As per the recommendations of authorities, a services access shall also be included. Roads shall have the necessary cambers to divert storm water into the stormwater drainage network. The stormwater drains shall be built in RC and shall carry the water into absorption /soak away pits that are sized to cater for worst case scenario of rainfall.

CHAPTER 6

SERVICES

6.1 WATER SUPPLY

6.1.1 WATER REQUIREMENTS

6.1.2 EXISTING WATER SUPPLY MAIN

6.1.3 PRELIMINARY DESIGN OF ON-SITE WATER SUPPLY SYSTEM

6.1.4 WATER TREATMENT PLANT

6.1.4.a INTERNAL WATER SUPPLY DISTRIBUTION

6.1.4.b HOT WATER SYSTEM

6.1.4.c RO WATER SYSTEM

6.1.4.d EXTERNAL WATER SUPPLY DISTRIBUTION

6.2 SEWERAGE SYSTEM

6.2.1 Sanitary fixtures and CP fittings

6.2.2 Internal sanitary system

6.2.3 External sewer system

6.2.4 Sewage treatment plant

6.2.5 Expected raw and treated sewage characteristics6.2.6 Proposed Treatment Scheme:

6.2.7 Setback for STP

6.3 EFFLUENT TREATMENT PLANT

6.3.1 PROPOSED EFFLUENT WASTE WATER TREATMENT (ETP) BREIF:

6.3.2 EXPECTED RAW AND REQUIRED TREATED EFFLUENT QUANTITY CHARACTERISTICS :

6.3.3 TREATMENT SCHEME

6.4 STORM WATER DRAINAGE SYSTEM

6.4.1 Roof Rainwater drainage system

6.4.2 External surface storm water drainage system

6.5 TYPICAL RECHARGE PIT DETAIL

TELECOMMUNICATIONS

CHAPTER 6

SERVICES

6.1 WATER SUPPLY

6.1.1 WATER REQUIREMENTS

For a hospital development, the per day water demand is normally calculated on the basis of 450 ltrs/person for inpatient as per NHS- "Scottish Health Technical Memorandum 04-02" clause 4.3

For the stature of the proposed Teaching hospital at Flacq, Mauritius based on a capacity of an equivalent of 515 beds and to cater to the requirement of OPD visitors, staff, kitchen, laundry & HVAC Makeup, the maximum estimated water requirement for the hospital would be in the order of approximately 385 m3/day. Taking into account bed occupancy ratio, the estimated consumption shall be 300 m3/day.

The water break-down requirements for the various components of the hospital: per day bed demand, OPD visitors, staff, laundry, cafeteria, HVAC makeup water validating the daily requirement of 385 m3/day is enclosed in the below snap.

Sl.No	BLOCK	Population	Water demand - lpcd as per NBC 2016	Total water demand Litres	Domestic water demand Litres	Flushing water Demand Litres	Remarks
1	HOSPITAL BLOCK	515	450	231750	154500	77250	As per NHS- "Scottish Health Technical Memorandum 04-02 " clause 4.3 : 450 ltrs/person for inpatient
2	OPD	2450	15	36750	24500	12250	OPD Visitors as per Arch data
3	Staff	824	45	37080	16480	20600	
4	LAUNDRY			64375	64375		515 bed x 5kg/linen as per normal practice x 25 ltrs/kg as per IS 15461
5	CAFETERIA	2000	7	14000	14000		7 litres per meal as per normal practice/Data from kitchen consultant
	Sub- Total			**383955**	**273855**	**110100**	

6.1.2 EXISTING WATER SUPPLY MAIN

Main Supply from CWA

The water to be used for domestic purposes in the hospital shall be supplied by the CWA from the Piton du Milieu reservoir. Clearance has already been sought for water supply to the CWA and there has not been any adverse comments received so far regarding this matter.

6.1.3 PRELIMINARY DESIGN OF ON-SITE WATER SUPPLY SYSTEM

It is proposed to supply water from the CWA/boreholes to storage tanks in basement which will be sized according to the parameters enumerated hereunder:

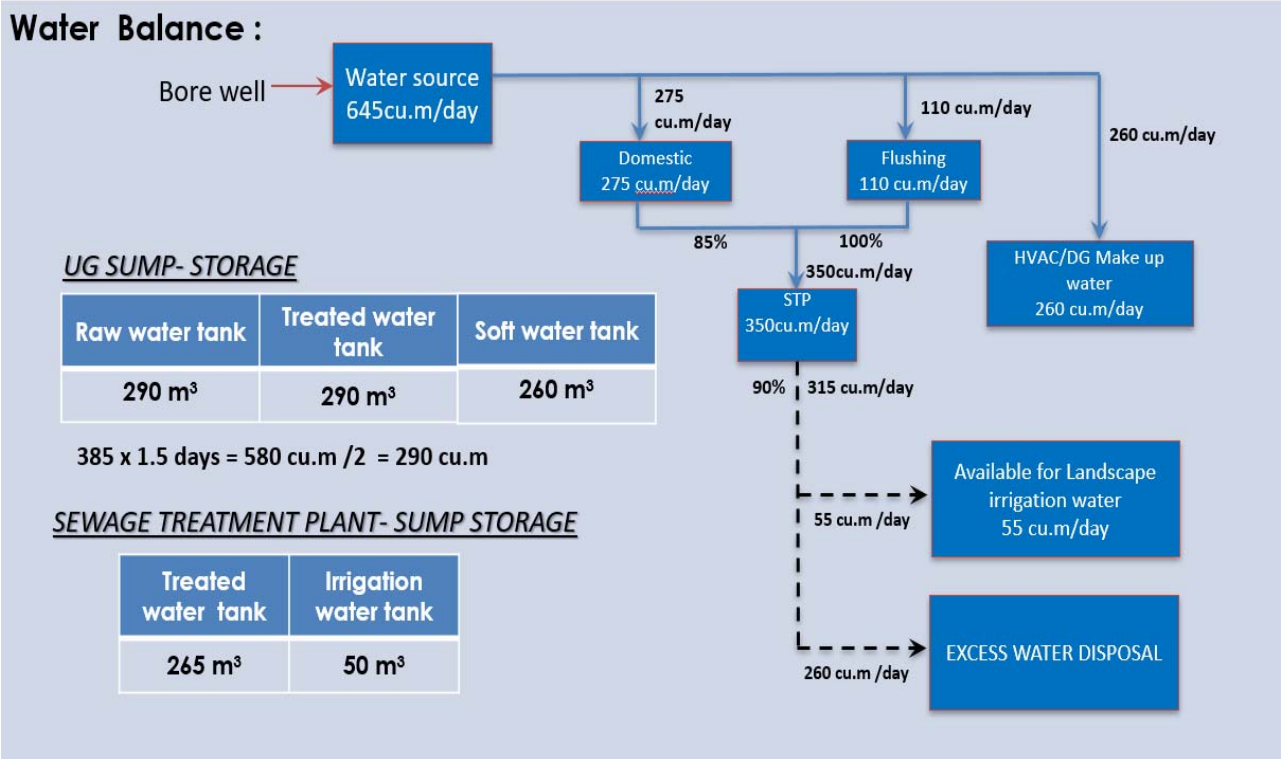
(a) Provision of 1.5 day's storage of 580m3, built as 600m3 underground tanks, based on 100% occupancy and to meet the demand of domestic & flushing water requirement (In underground compartments of Storage tanks).

(b) For HVAC Make up water -one day storage of 260 m3

(c) For firefighting, storage of 400 m3

Overhead tank water storage of approximately 200 m3 has been considered on the basis of half day water demand in the hospital block. The overall storage capacity for domestic water shall be of 800 m3.

The sump capacities are encapsulated below:



6.1.4 WATER TREATMENT PLANT

Raw water from CWA is already potable in nature as per the various byelaws applicable for water supply and distribution. However to ensure supplementary hygiene, the water shall be treated with filtration and disinfection process and used for domestic & flushing purposes in the proposed Flacq Hospital. Multigrade pressure sand filter and disinfection with UV water Sterilisers has been considered for water treatment. The proposed capacity of the Water Treatment Plant is 750 lpm to cater to the requirement.

Water for HVAC cooling shall be fed directly without any further on site treatment.

6.1.4.a INTERNAL WATER SUPPLY DISTRIBUTION

Domestic & flushing water supply distribution from Over Head Tanks at roof level shall be through gravity. The vertical down takes shall be dropped to each toilets/other wash areas etc., through shafts. Dual water supply system (i.e. separate domestic and flushing supply) is considered.

UPVC pipes of Schedule 80 conforming to ASTM D1785 has been considered for exposed water supply line & PE-RT (PN-10) Corrugated pipe conforming to ASTM F2769-18 has been considered for concealed water supply line in chase cut.

6.1.4.b HOT WATER SYSTEM

Solar water heating system, Thermosyphon type based on Flat plat collector system of capacity 5000 liters/day x 10Nos & Geysers is considered. The distribution shall be through gravity

6.1.4.c RO WATER SYSTEM

Centralized fully automatic RO plant of 600 litres capacity of 8 numbers has been considered in the terrace of hospital block for clinical water requirement, drinking water requirement and for kitchen usage.

6.1.4.d EXTERNAL WATER SUPPLY DISTRIBUTION

HDPE pipes of PE 100 conforming to ASTM D 3035 and BS-6437 are considered for external water supply distribution.

6.2 SEWERAGE SYSTEM

6.2.1 Sanitary fixtures and CP fittings

Wall hung water closet with concealed flushing cistern is considered for the proposed hospital. Wash basin with brass pressmatic type pillar tap, Urinal with flush valve is considered for toilets. SS-304 kitchen sink with drain board has been considered for the kitchen area. White vitreous china laboratory sink & compact floor mounted pedestal base surgical scrub sink are the clinical related fixtures considered.

6.2.2 Internal sanitary system

Soiled wastewater from water closets, toilets, consultation rooms, wash areas are conveyed to sanitary drainage system. Soil pipes are connected to manholes and waste pipes are connected to gully trap and then to manholes and to the STP.

Waste from laboratories, laundry, CSSD , mortuary and other hospital facilities shall be separately drained and connected to the gully trap & Manhole and then to the ETP. Waste water from the laundry shall be cooled in a retention tank prior to being discharge in the line connecting to ETP>

UPVC - PN10 pipes confirming to Relevant BS Heavy Class are proposed both in shaft and sunken slab/ ceiling for internal sanitary pipe for toilets, kitchen and all other wash areas. HDPE & SN-8 pipes confirming to BS 4622 has been considered for waste water from CSSD units and for basement ceiling and all underground service lines.

Kitchen waste shall transit through a sieve prior to being discharged in a grease trap that has been designed based on the number of meals expected to be produced in a day. The Grease trap shall be maintained regularly to prevent clogging or foul smell from emanating.

6.2.3 External sewer system

All building manholes are constructed in RC, interconnected with suitable diameter of sewer lines for final disposal to the proposed STP. Waste from laundry, laboratories, kitchen, CSSD, mortuary and other hospital facilities shall be disposed to propose ETP through a separate effluent network. All lines running underground on site shall be in UPVCC-SN8.

Manholes are provided wherever change in direction, slope and diameter of pipelines are encountered. Sizes and slopes are arrived for a peak flow factor 3.0 and minimum self-cleansing velocity of 0.6m/sec Min. diameter of sewer is kept as 160 mm.

6.2.4 Sewage treatment plant

Sewage treatment plant capacity of **370** m^3/day with **MBBR** (Moving Bed Bio Reactor) process (complete with Bar screen, Equalization tank with Raw sewage transfer pump, Aeration tank with Bio media, Rotary Air blower,Diffuser,Tube Settler, Oxylite system, Filter transfer pump, Multigrade filter, Activation carbon filter, Sludge transfer pump, Centrifuge & Filter press) is considered to treat the waste generated from the proposed hospital block. The treated water from wastewater treatment plant is stored in a separate sump and shall be used for landscaping irrigation. Capacity of irrigation tank shall be 100 Cum which is equivalent to the expected production for 2 days from the Sewage Treatment Plant.

S.No	Description	Population	Water demand - lpcd	Total water demand Litres	**Sewage Generation -90% of Water demand**
1	HOSPITAL - Inpatient	515	450	231750	**208575**
2	Out patient	2450	15	36750	**33075**
3	Staff	824	45	37080	**33372**
4	Laundry			64375	**57937**
5	Cafeteria	2000	7	14000	**12600**
	Sub- Total			383955	**345559**

6.2.5 Expected raw and treated sewage characteristics:

The expected raw sewage characteristics and required treated water characteristics are given in the table below:

LIST	PARAMETER (1)	UNIT	STANDARDS
A	Ph	-	5 – 9
	Colour	-	not objectionable
B	Biochemical Oxygen Demand (BOD5)	mg/1	40
	Chemical Oxygen Demand (COD)	mg/1	120
	Suspended Solids	mg/1	45
	Chloride	mg/1	250
	Sulphate	mg/1	500
	Nitrate N	mg/1	20
	Total Dissolved Solids	mg/1	2000
	Solid Absorption Ratio (SAR)	-	<6

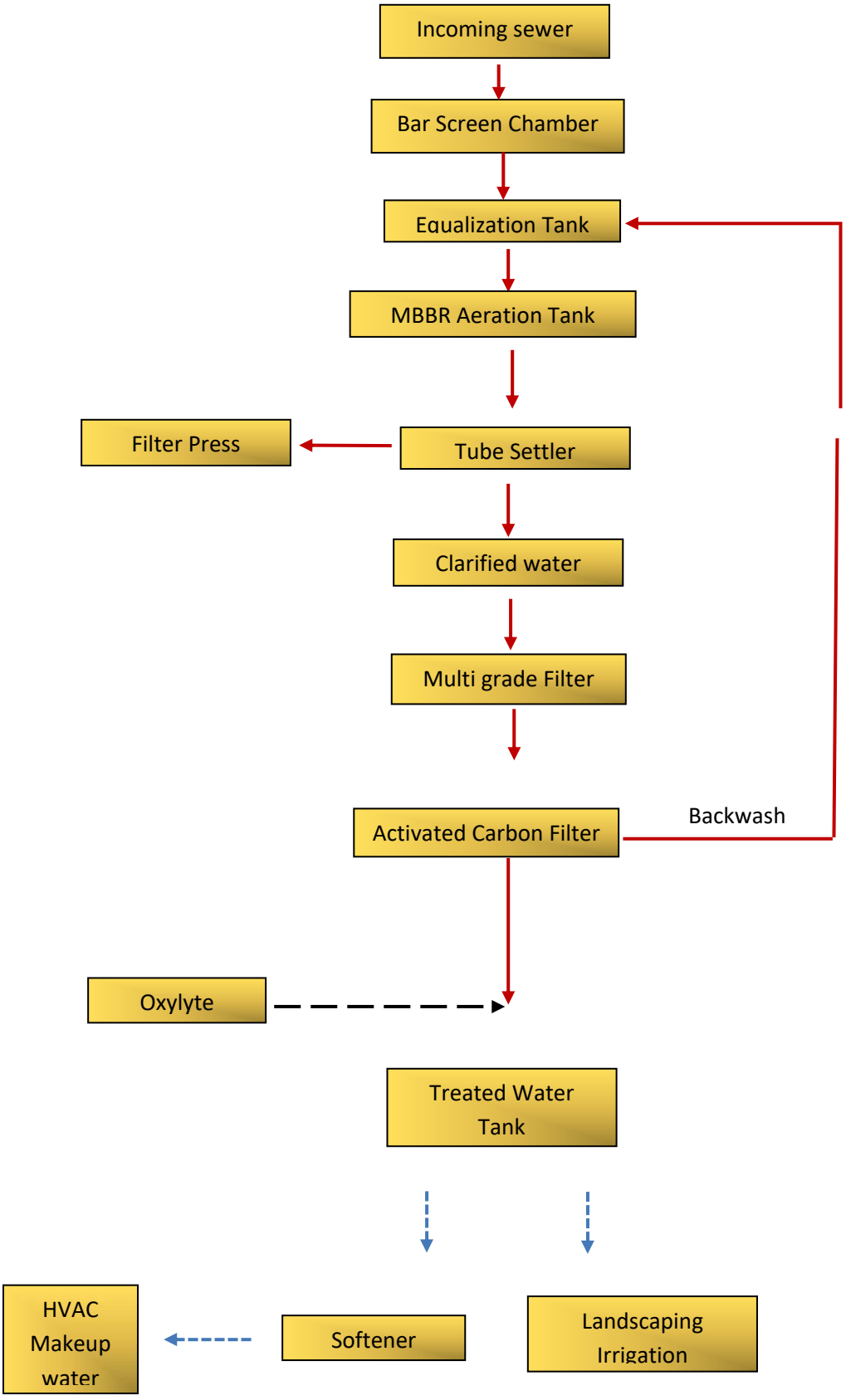
6.2.6 Proposed Treatment Scheme:

The proposed treatment process is Moving Bed Bio Reactor (MBBR) process followed by filtration using Multi grade Filter (MGF) & Activated carbon Filter (ACF). The filtered sewage will be disinfected with OxiLyte (Mixed Oxidant) Generation system. Separate softener is proposed for HVAC make up water treatment for reducing hardness. The treatment scheme is described below:

The sewage after passing through Bar screen chamber and further collected in the collection cum equalization tank. The equalisation tank is provided with 6 hours retention time to take care of peak flow and balancing the flow generation and treatment. The tank will be provided with coarse bubble diffused aeration for mixing (to avoid settling of suspended particles) and to prevent sewage getting septic. The sewage from the equalization tank will be pumped at uniform rate to MBBR tank. The sewage from MBBR tank flow by gravity to Moving Bed Bio Reactor tank. MBBR tank is provided with fine bubble aeration system and MBBR media. The sewage is then allowed to settle in settling tank and the overflow will be collected in clarified water tank. The clarified sewage shall be further filtered through Multi grade Filter and Activated carbon Filter. The treated sewage will be then disinfected with OxiLyte (Mixed

Oxidant) Generation System. Separate treatment for HVAC make up is proposed , i.e Softener for reducing hardness.

Treatment Scheme



6.2.7 Setback for STP

The STP has been located on the eastern side of the site after considering the natural slope on site and the minimum interference to be done to the soil. Refer to the attached Annexure for exact location. As demonstrated on the plan, the STP is at more than the statutory 2 m setback from the building and 15m from boundary. It is also more than 30 m from the road and river edges.

6.3 EFFLUENT TREATMENT PLANT

6.3.1 PROPOSED EFFLUENT WASTE WATER TREATMENT (ETP) BREIF:

The ETP is proposed to treat the Effluent of Lab, Laundry and Kitchen waste. The treatment process proposed is coagulating and settling.

Effluent will be collected to the grease trap / chemical reaction with suitable chemical dosing such as Fentons reagent or any other suitable for effluent/reaction tank SS316-3mm thick (required number & size)/mixer/settler/neutralisation chamber, dosing pump and agitator/Air Blower ,holding tank, including multi grade filter stand by motor pump, blower etc.

6.3.2 EXPECTED RAW AND REQUIRED TREATED EFFLUENT QUANTITY CHARACTERISTICS :

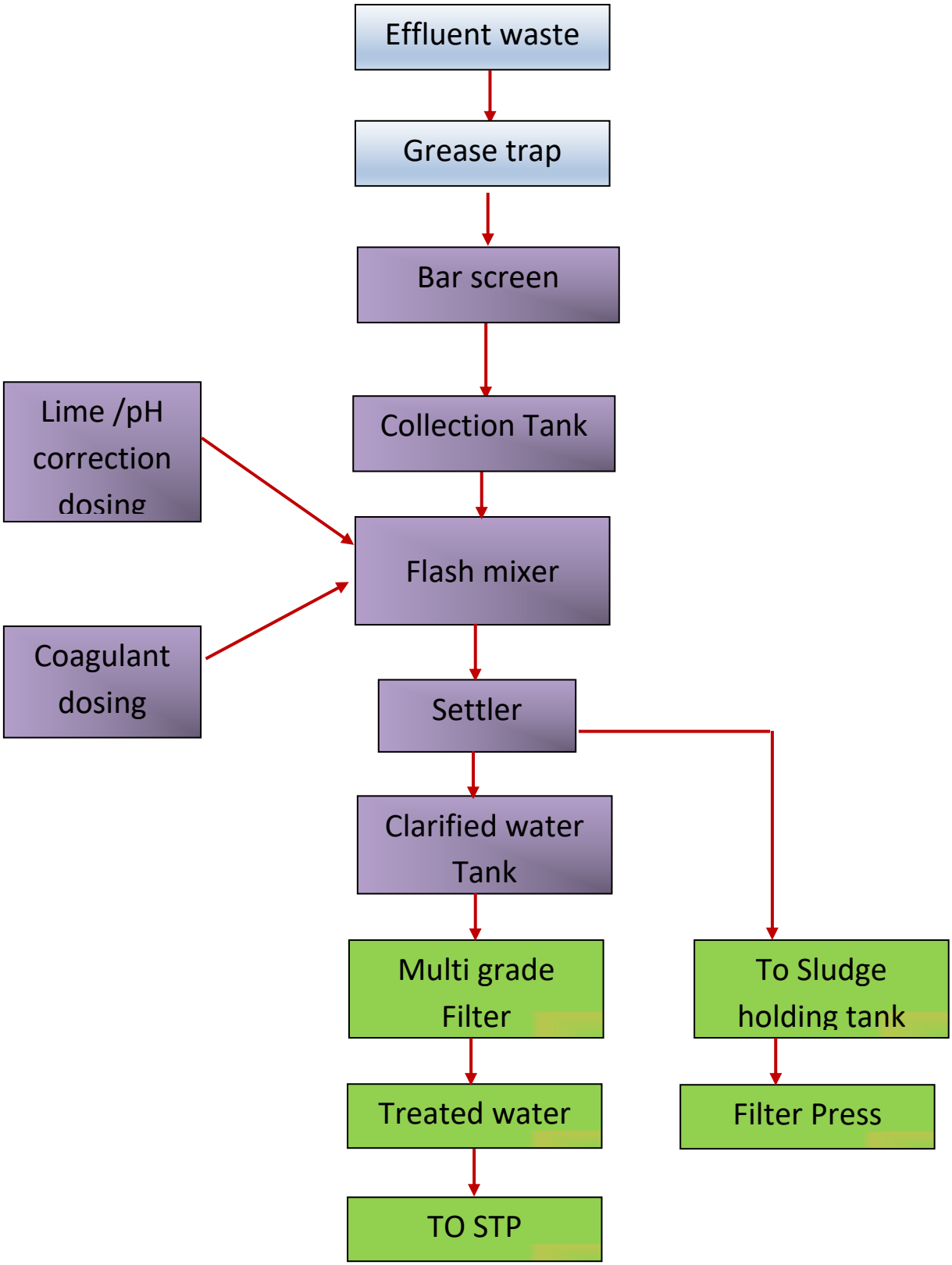
Quantity:

Considering Lab waste, Laundry waste, Kitchen waste and other Hospital facilities waste the total Effluent is 150,000 ltrs/day

6.3.3 TREATMENT SCHEME:

The wastewater shall pass through Grease separator and will be conveyed by gravity through a pipe network to the manual screen will be collected in collection tank. The equalisation tank is provided with 6 hrs retention period and balancing the flow generation and treatment. The effluent from the collection tank will pump at uniform rate based on cycles of operation to flash mixer cum Flocculator tank. Coagulants will be dosing to this tank. From this Tank, this effluent will flows to settler tanks where it is allowed to settle down all coagulated particles by gravity. Decanted clear water will overflow to Clarified Water tank. The clarified water shall pump to equalisation tank for further treatment. The sludge from settler tank shall pump to Sludge holding tank for further dewatering processes.

TREATMENT SCHEME



6.4 STORM WATER DRAINAGE SYSTEM

6.4.1 Roof Rainwater drainage system

Roof water drainage refers to the collection of rainwater runoff from the rooftops. Runoff from the roof area shall be collected through rainwater down take pipes. The rainwater down take pipe shall be connected to chamber and drains and further used to recharge the ground water with the help of recharge percolation pits/wells. Rainwater down take pipes have been designed for a rainfall intensity of 100 mm/hour.

UPVC pipes to BS-213- PN 10 of size 110 mm shall be considered for rainwater down take pipe.

6.4.2 External surface storm water drainage system

RC surface drains with factory made precast RCC perforated drain covers shall be considered for connection between rainwater chambers and this harvested rain water shall be used for recharging with recharge pits of size 3m dia x 4m deep – 12Nos with injection bore of 20m deep.

The rain water emanating from the building shall be collected in catch pits made of block wall and interconnected by a network of HDPE pipes of approximate diameter. This Storm water shall be discharged in RC drains that run across the site for the purpose of storm water evacuation.

The Storm water on site shall be evacuated using a network of underground precast drains that are covered with factory made perforated cover in either RC or metal. The final discharge points of the storm water drain is into absorption pits / soak pits which are sized as per the calculations of the Civil engineer.

A Typical detail of the absorption pit is enclosed as well as a preliminary storm water evacuation scheme is enclosed in **Annex 16** at the end of this chapter.

6.5 TELECOMMUNICATIONS:

It's estimated that a maximum of 20 lines will be required for the hospital taking into account the various main departments functioning on different floors of the hospital.

A PABX system will be set up in the server room which shall provide for the necessary bifurcation of lines towards the respective desks. As per statutory requirements there shall be one line that shall be kept free at all times in order to allow for use under emergency conditions.

The Telephone units shall be provided as per the requirements of the contract.

The Hospital shall also have an intelligent wifi system to allow easy communications at all times. The restrictions to be applied to the wifi network shall be decided upon by the proponent at the time of operation.

As it is the case for all government projects, the hospital shall be connected to the Mauritius Telecom network. In due course of the project, the engineer shall establish the liaison to ensure connectivity at handing over.

6.6 ELECTRICAL POWER REQUIREMENTS

The MEP Engineer has calculated the total power requirements for the hospital campus to be of a diversified load of the order of 4055kA. The table below shows the estimations breakdown calculated for the project.

Schedule of Electrical Load

S.No	Description	Connected Load	Unit
1	Hospital	3684	KW
2	Medical Services loads (CSSD, Medical Gas, Mortuary, Pneumatic Tube system)	360	KW
3	Utility Loads(kitchen, Laundry)	270	KW
4	MEP Plant loads(HVAC, ETP, WTP, STP & Fire Plant)	1853	KW
5	Total Connected Load	6167	KW
6	Total Connected Load in KVA	7708	KVA
7	Maximum Demand at 0.95 DF	4055	KVA

30% of the total load is actually required for equipments as per table below. These equipments are essential to the good functioning of the hospital.

It can be observed from the above table that the equipment load (item 3.0) consists of approximately 30% of the total load which can be accounted by high rating equipment comprising of:

S.No	Description	Connected Load	Unit
8	HVAC Chiller Plant	1511	KW
9	ETP	25	KW
10	STP & WTP	177	KW
11	Fire Plant	140	KW

The remaining electrical load will be required for Medical Equipment's, Medical system Medical Gas plant, Laundry, Kitchen, CSSD, Pneumatic Tube, ICU Bed sockets, OT etc., as well as for the external lighting.

The Schedule of Electrical Load includes all types of electrical loads such as Ward beds, OT, Medical Equipment's etc., it also includes external lighting.

The costs associated for the provision of power from the main lines upto the HT room on site shall be dealt with between the CEB and the proponent as per standard agreements for government projects. All connections and lines on site shall be underground in designated trenches constructed to the satisfaction of the electrical engineer.

6.6.1 STATUTORY REQUIREMENTS – ELECTRICITY SUPPLY

Preliminary consultations have already been established with the CEB for supplying power. Further to queries by the CEB, additional details were sent to them by the proponent on 31 August 2020.
The CEB will confirm in writing whether their existing infrastructure is capable of supporting the required electrical load. The works may comprise of the extension and reinforcement of the high-tension network and the displacement of the existing high-tension line passing near the site, to which CEB has already agreed. The electricity consumption will be metered on the high- tension side.

Based on the above, it is not foreseeable that there would be issues to connect to the CEB network. Since a hospital requires power supply at all times, there shall be stand by generators and UPS rooms to prevent any downtime.
The proposed substation within the site will accommodate HT panel, Transformer, Generators and diesel tank. HT Panel will be accommodated inside the building as per CEB guidelines and all the other equipments like transformer & DG set are located outside the buildings; the electrical schematics and distribution diagram have already been submitted to the CEB for processing.

The necessary H.T Switchgear and cables for the supply of a 4055 kVA demand on the Client's premises shall generally be provided by the CEB.

6.6.2 SITE ELECTRICITY INSTALLATION PROVISIONS

The CEB supply will be in 3-phase 22 KV HT cable. Thereafter the voltage shall be scaled down in the sub-station which will comprise of HV switchgear and oil cooled.
The 22kV switchgear panel will have the following parameters:

Primary voltage	: 22 kV
Output voltage	: 22 kV
Operating frequency	: 50 Hz

All connecting cables on site, whether HV or LV shall be underground in designated trenches constructed to the satisfaction of the electrical engineer.

Low voltage cables will have copper conductors and PVC insulation, and where installed directly in the ground, the cables will further be protected by steel wire armoring. All reticulation cables will include earth conductors, which will be earthed at source. Three-core cables will be used for single-phase power, and five-core / Single core cables with separate earth wire for three-phase power.

The main low voltage distribution board will be located inside the hospital building which is few meters away from transformer yard and will feed several sub-distribution boards installed in safe and convenient location inside the building & around the site. These sub-boards will in turn feed local distribution boards to ensure proper fault discrimination and convenience. All distribution boards will be mounted in a protected area.

6.6.3 TRANSFORMERS

The transformer will be rated at 3 x 2500KVA, 22 KV/415V, DYNII Vector Group, Oil Cooled Type, or equivalent

The MEP Engineer has envisaged providing a 3 X 2 5 00kVA, 22kV/415V, 50Hz, oil cooled core type double wound construction transformer to be situated within the electrical/technical yard, at the backside of the Hospital as shown on the Master Layout Plan.

Danger signs will be affixed on the outside of the transformer room as per CEB standards.

6.6.4 STAND-BY POWER SUPPLY

2 standby generators rated at 2 x 1250 KVA will provide back-up power to the Hospital in times of grid power failure. The stand-by generators shall be housed in weather proof enclosure. The Generator will be driven by diesel engine.

The change-over from main power to transformer power will be automatic whenever there is a main power failure so as provide continuous power to the below equipment:

- One no HVAC Chiller & associated pumps
- WTP
- Computer system
- Operation Theaters
- Intensive care unit

The generator will be capable of having a 10% overloading capacity at every 12 Hours.

6.6.5 LIGHTING

Adequate lighting and timer based control will be provided to on /off for parking area, as well as at the perimeter security fencing. A Street light on poles is proposed for functional as well as aesthetic purposes.

Lighting will be designed to be energy-efficient with PIR controls.

All electrical installations will be designed to comply with BS 7671.

6.6.6 SAFETY ASPECT OF CIRCUITRY

All low voltage circuits will be protected through appropriately-sized circuit breakers. All 230V socket outlets with earth terminals will be fed via residual current devices to protect users against electrocution due to earth faults.

Distribution boards will be provided with cover plates to prevent accidental contact with live switchgear or conductors. Specialist equipment which may pose security problems such as

H T Switchgear, Main Switchgear Panel will be installed in secured areas. Danger signs and notices will be provided where appropriate.

6.7 SOLID WASTE MANAGEMENT

Solid waste sources and types

The hospital will produce two types of wastes:

(a) Healthcare wastes (HCW) which all the wastes generated by medical activities. It embraces activities of diagnosis as well as preventive, curative and palliative treatments in the field of human medicine. In other words, are considered as healthcare waste all the wastes produced by the operating theatre, laboratories, patient rooms for ex syringes, blood wastes, serum, plasma, scalpel blades, cultures and contaminated laboratory wastes, surgical wastes, etc.

(b) Domestic wastes from kitchens, consultation room, patients' room for ex: paper, tissues, left over foods.

Collection and Disposal of Healthcare waste

The healthcare waste (HCW) that is generated will follow an appropriate and well-identified stream from its point of generation until its final disposal/treatment.

A colour coding system will be put in place and same will aim at ensuring an immediate and non-equivocal identification of the hazards associated with the type of HCW that is handled or treated.

Type of waste	Colour of Container and Markings	Type of Container
Highly infectious waste	Yellow, marked 'highly infectious'	Strong, leak-proof plastic bag or container
Other infectious waste, pathological and anatomical waste	Yellow	leak-proof plastic bag or container
Sharps	Yellow, marked 'sharps'	Puncture proof container
Chemical and pharmaceutical waste	Brown	plastic bag or container
Radioactive waste	_	Lead box, labeled with the radioactive symbol
General health care waste	Black	Plastic bag

Yellow-bagged waste will then be disposed of by burning in incinerator. in case if an incinerator is not available, arrangements will be made for off-site transport of these wastes based upon a established system consisting of consignments from point of receipt to discharge for traceability purposes to other incinerators owned by the Ministry of Health & Wellness.

Estimation

It is estimated that 0,4kg of waste is produced per bed on a daily basis. Thus the estimate daily amount of waste amounts to 208 kg. The discharge bins shall be designed to cater for a volume of 1400 kg of waste assuming that at least once a week the waste shall be taken off from the hospital for dumping.

6.8 FIRE PROTECTION AND FIRE FIGHTING

A detailed fire fighting prevention and mitigation plan has been submitted for approval to the Mauritius Fire and Rescue Services. The following pages in **Annex 17** give the necessary strategies that are being implemented in order to safely evacuate patients in the event of fire as well as protect or quickly salvage the building in the event of fire outbreak.

FLACQ HOSPITAL, MAURITIUS		
AREA CALCULATIONS		
SITE AREA	105329.78	SQM
TOTAL BUILTUP AREA (A+B+C)	58194.91	SQM
FLOORS	**BUILT UP AREA**	
BASEMENT	8756.80	SQM
GROUND FLOOR	8663.66	SQM
FIRST FLOOR	8421.60	SQM
SECOND FLOOR	8663.66	SQM
THIRD FLOOR	6369.12	SQM
FOURTH FLOOR	5259.87	SQM
FIFTH FLOOR	5259.87	SQM
SIXTH FLOOR	5259.87	SQM
TOTAL AREA (A)	56654.45	SQM
RAMP AREA ON ALL FLOORS (B)	1486.64	SQM
CANOPY (C)	53.82	SQM
PLOT COVERAGE:	9.8%	
No OF PARKING:	490 CARS	

LEGEND:

1. ENTRANCE
2. EXIT
3. PARKING
4. MAIN DROPOFF
5. EMERGENCY DROPOFF
6. SERVICE ENTRY

GENERAL NOTES

All dimensions and levels are to be checked and verified on site and any discrepancy is to be brought to the immediate notice of the architect prior to the starting of the work.
Dimensions are to be read and not scaled. All dimensions given are to the construction faces of the work prior to addition of finishes unless otherwise mentioned. For existing features it relates to existing finished faces. All dimensions are in metric scale, usually in millimetres, unless otherwise stated.
This drawing indicates design intent only. Drawings of other consultants would indicate the details relating to their discipline & must be read and checked accordingly.
The information on previous revisions of this drawing is superceeded by the information on this drawing.
The contractor is to comply in all respects with the latest building regulations whether or not specifically mentioned. Proprietary products are to be installed as per manufacturer's specs.
No changes are to be made without notifying the architect.

CONSTRUCTION PERIOD

Rev	Date	Initial	DESCRIPTION

ARCHITECTURAL NOTES

DISTRIBUTION OF PRINTS

Revision					
Client					
Structural Engr					
M&E Engr					
Q. Surveyor					
Project Manager					
Landscape Arch					
Contractor					
Sub-Contractor					
S. Manufacturer					
Local Authority					

PMC AGENCY

HOSPITAL SERVICES CONSULTANCY
CORPORATION (INDIA) LIMITED
(A GOVERNMENT OF INDIA ENTERPRISES)

EPC CONTRACTOR

L&T Construction
Buildings & Factories

GIAN P. MATHUR AND ASSOCIATES (P) LTD.
C - 55, East Of Kailash, New Delhi-110065
T : 46599599 I F 46599512
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Morc Coop, Bonne Terre, Vacoas, Rep. of Mauritius
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PAC Reg No: 170

Client: MINISTRY OF HEALTH & WELLNESS

Project: NEW MULTISPECIALITY HOSPITAL @ CONSTANCE B23 ROAD, FLACQ

Drawing: SITE PLAN
SITE DRAINAGE INTENT

FOR APPROVAL — Date: 21-SEP-2020

Drawing no.:	Drawn:	Check:	Scale:	Rev
S-103	RG	KG	1:200 @ A0	P1

CONSULTING AGENCY: HSCC (AN ISO 9001:2008 Mini Ratna Company)

PREPARED BY: K J GUNNESS ARCHITECT

0.0 AIM

The aim of this report is to provide an analysis of the existing design as proposed by HSCC (India) and check it's compliance as well as provide the necessary modifications in order to abide by the Mauritius Fire Code.

For the purpose of this report the following guidelines are being considered: Mauritius Fire Code 2017 as issued by Mauritius Fire & Rescue Services. The analysis is carried out in the form of compliance tables as well as drawings that demonstrate the application of the relevant guidelines in the design

1.0 DESIGN BRIEF

1.1 The Proponent

The project proponent, Ministry of Health & Wellness, Governemnt of Mauritius, has commissioned HSCC (India) Ltd to provide the best conceptual design for a multi speciality and teaching hospital on a plot of land situated along B23 road at Constance, Flacq. The project has had several preliminary clearances from carious Ministries before being floated for tender. Larsen & Toubro has been awarded the construction of the project on a design and build basis. In order to ensure smooth construction and later on easy commissioning and sign off from various Authorities, L&T is now submitting to the Mauritius Fire & Rescue Services a compliance report with respect to Fire Safety for vetting and comments. Towards the handing over period of the project, L&T shall again assist the proponent in obtaining the Fire Certificate.

1.2 Project Site and characteristics

The trapezoidal shaped site of an area of 105,329.8m2, has been vested to the Ministry for this project. It abuts the B23 road linking St Julien village to Central Flacq. On the right side of the site, there exists a feeder canal at around 4m away from the boundary. The rear side of the site is abutted by Riviere du Poste de Flacq all over its length. The site is relatively secured from any risks of flooding since it is approximately 8m higher than the river edge. There exists an escarpment on site and it is intended not to use it for any purpose. This shall allow to have a proper site preservation in terms of landscaping. Currently application has been made to different Authorities in order to supply water, electricity and other services.

1.3 Project scope

The hospital project comprises of a main Y-shaped block in a Basement, GF + 6 floors configuration, which shall house at the major services that are required for a hospital of that nature. There shall be 520 beds allocated on different floors of the building based on the criticality and severity of the cases. The broad floorwise allocation is given below:

- At Basement Level: MEP services, Kitchen, Laboratory, Laundry, CSSD, Medical gas room, General Stores on a built up area of 8750 sqm
- At Ground Floor: Accident & Emergency Ward, Blood Bank, Radiology OPD, General OPDs, Registry, Pharmacy, Registration & Waiting on a built up area of 8665 sqm
- At First Floor: Maternity Ward, Neonatal ward, General OPDs, Public Waiting, Day Care Ward on a built up area of 8425 sqm
- At Second Floor: Operation Theatres and Suites, Doctor's facilities, Hospital Admin, ICU wards 8665 sqm
- At Third Floor: Wards, Mechanical Plantroom for Operation Theatres on a built up area of 6370 sqm
- At Fourth Floor: Wards, Waiting Area on a built area of 5260 sqm
- At Fifth Floor: Wards, Admin Offices, Waiting Area on a built area of 5260 sqm
- At Sixth Floor: Wards, Admin Offices, Waiting Area on a built area of 5260 sqm
- At Roof Level: Building Services such as water tanks, chillers, solar water heaters and the likes. All are exposed to sky.

1.4 Project compliance

The statutory obligations of the Planning Policy Guidance of November 2004 as well as the guidelines of the Building & Land Use Permit have been complied to while designing the project. Provisions regarding plot coverage, distance from the river etc have been duly respected.

1.5 No of Storeys & Building Heights

The project shall consist of a basement, a ground floor and sixth storeys above. It is thus construed as being on 8 levels.
The floor to floor height of the building have been designed as per the following:
Basement to Ground Floor: 4500mm
Ground Floor to First Floor: 4500mm
First Floor to Second Floor: 4500mm
Second Floor to Third Floor: 4500mm
Third Floor to Fourth Floor: 4200mm
Fourth Floor to Fifth Floor: 4200mm
Fifth Floor to Sixth Floor: 4200mm
Sixth Floor to Roof Level: 4200mm
Parapet Height: 3000mm
Finished Site level is 1200mm below the Ground Floor level
It can thus be inferred that the building height from the Finished Site Level is 34,500mm.
Since the site is sloping, the distance at the Basement also is to be considered as being 38,400mm.
The building has been designed in order to have 11 lifts of which 2 shall be reserved for Fireman's access and 8 sets of enclosed pressurised staircases to comply with the Fire Code.

1.6 Plot Coverage, Density, Parking, Setbacks and Walls

The project consists of various phases which shall be implemented over a course of time. The current phase is currently occupying 10% of the site.
Currently the overall built up area of the project is at 56655 sqm.
The development density is taken as 1 bed per 108 sqm. This is a comfortable value which shall ensure that the best of services are being provided to the patients.
A total of 490 parking spaces for cars is being provided in order to easily allow the visiting population commute to the site.There is also a proposal for a bus waiting area to be provided along the B23 road.

As per the PPG and various other guidelines and bylaws, the following setbacks are to be mandatorily respected

- From Main Road: 6m
- From River: 16m for building, 30m for Treatment plants
- From sides: 5m

By virtue of the building location all of these have been complied to and even exceeded.

Taking into account the requirements of the Fire Safety norms, the road network has been designed in such a manner as to provide as island wide access to the building.

The whole compound shall be fenced with a blockwall boundary upto a height of 1.5m and metal fencing above.

1.7 Electricity, Water Supply & Waste Water Treatment

Application has already been made to the CEB and CWA for the provision of Electricity for the project. These can be easily branched out from the existing network along the road abutting the site. A generator system has been set up on site and it shall be fed with Diesel through diesel tanks.
As regards to Waste water, a treatment plant shall be constructed on site in order to treat the water prior to it being used for irrigation purposes on the site.
It is to be noted that all major hazardous services rooms are located either away from the building or in certain cases in the basement level of the building with a direct access to the external environment.

2.0 COMPLIANCE TO CODE

Table 1.2A Occupancy Load Tables

Purpose Group	Descriptive Title	Purpose for which building or part of the building is used or intended to be used
I	Small residential	Private dwelling house such as bungalows, semi-detached houses and terrace houses
II	Other residential	Accommodation for residential purposes other than any premises comprised in Group I to include flats, maisonettes, apartments etc.
III	Institutional	Establishments used for treatment, care or maintenance of persons suffering from disabilities, or educational purposes and accommodations, including hospitals, clinics, polyclinics student hostels, dormitories, old folks homes, orphanages, children's homes, day-care centres, infant care, kindergartens, army camps, detention/ correction centres, schools, colleges, commercial schools, vocational institutions, polytechnics and universities.
IV	Office	Office or premises used for office purposes meaning the purposes of administration, clerical work (including book-keeping, accounting, drawing and editorial work etc) telephone and telegraph operating and banking or as premises occupied with an office for the purposes of the activities therein carried on.
V	Shop	Shop or shopping centre including departmental stores, shopping arcades, supermarkets, drugstores, showrooms for sale of goods, hairdressing and beauty salons, ticketing agencies, pawnshops, laundries and/or any other similar trades or businesses.
VI	Factory	A factory refers to any industrial premises with manufacturing, processing, servicing or testing activities
VII	Place of public resort	Premises used for social, recreational or business purposes to include hotels, holiday resorts, boarding houses, service apartments, convention centres, private clubs, community centres, museums, public art galleries, exhibition centres, theatres, cinemas, concert halls, public libraries, religious buildings, public sports complex, stadium, public swimming complex, recreational buildings, amusement centres, eating houses, restaurants, coffee shops, hawker centres, fast food outlets, bus terminals, train stations, airport and ferry terminals.
VIII	Storage	Place of storage (including godowns, warehouses, stores etc), deposit or parking of goods, materials and/or vehicles.

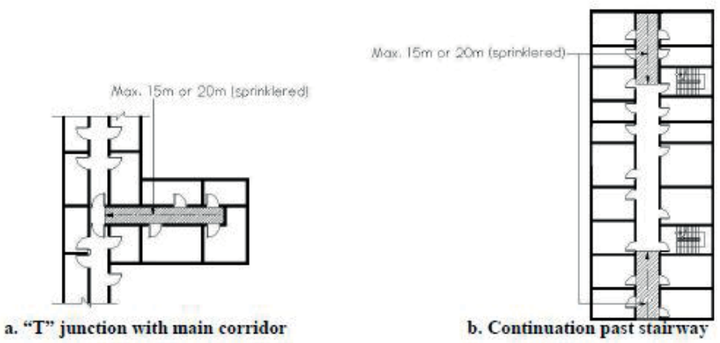
2.1 Building Categorisation and Occupancy Load

OCCUPANCY LOAD-
PURPOSE GROUP-III
BUILDING TYPES -

SCHEDULE 3.1
INSTITUTIONAL
HEALTH-CARE OCCUPANCY
(HOSPITAL, CLINIC & POLYCLINIC)

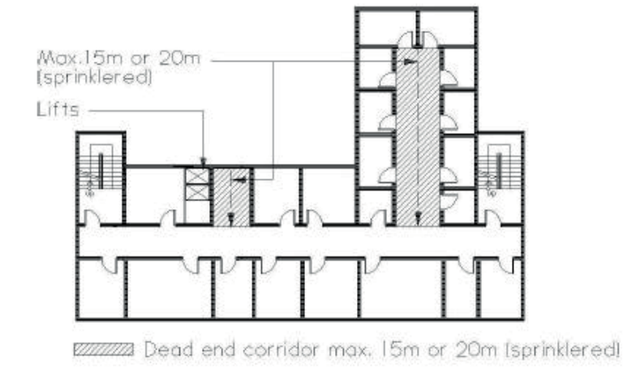
FUNCTIONAL SPACES	REMARKS	OCCUPANCY LOAD (m^2/person)
Reception Area		3.0
Lobby/Corridors	non-simultaneous	
Waiting Area/ Visitors Lounge		3.0
Out-patient Waiting Area		1.5
Admin Offices		10.0
Doctor's Offices		10.0
Nursing Station		10.0
Staff Lounge		3.0
Consultant/Treatment/ Examination Room		5.0
Therapy Centre		10.0
Operation Theatre		7.5
Surgical Viewing Gallery		3.0
Patient Accommodation	Intensive Care	20.0
	Room (max 2 beds)	10.0
	Ward	10.0
Laboratories		20.0
Pharmacy		20.0
Kitchen/Housekeeping		10.0
Laundry*(1)		10.0
Toilet/Locker/ Changing Room	non-simultaneous	
Storage		30.0
Canteen		1.5
Restaurant		1.5
Shop		5.0
Roof access for maintenance only		----
Roof garden/roof terrace accessible to staff or other members of public in the building		1.5 (except areas covered in Annex E)

DEAD-END CORRIDORS



a. "T" junction with main corridor

b. Continuation past stairway



c. Example of two common types of dead-end corridors. Both dead-end pockets serve as traps because travel into them does not lead to an exit; the egress path must be reversed to reach an exit staircase

2.2 Dead End Corridor Cases

Dead end corridor cases have been avoided all through the design. Same is shown on the plans at Annex 1

2.3 Travel distances, escape distances and escape widths

TABLE 2.2A DETERMINATION OF EXIT REQUIREMENT

(i) Type of Occupancy	(ii) Max Travel Distance (m) (One-way travel)		(iii) Max Travel Distance (m) (Two-way Escape)		(iv) Capacity No of persons per unit of width (x)				(v) Min Width (m)		(vi) Max Dead End (m)	
					Door opening (c), (d) & (e)		(f)	(d)			Corridors	
	Unsprinklered	Sprinklered	Unsprinklered	Sprinklered	To outdoors at ground level	Other exit & corridor doors	Staircases	Ramps Corridors Exits Passageways	Stairs	Corridors	Unsprinklered	Sprinklered
High hazard	10	20	20	35	50	40	30	50	1	1.2	15	20
Industrial buildings (factories, workshops, godown/warehouse)	15	25	30	60	100	80	60	100	1	1.2	15	20
Shops	15	25	45	60	100	80	60	100	1	1.2	15	20
Offices	15	30	45	75	100	80	60	100	1	1.2	15	20
Places of public resort & carparks	15	25	45	60	100	80	60	100	1(h)	1.2 (h)	15	20
Schools & educational buildings	15	25	45	60	100	80	60	100	1	1½(a)	15	20
Hospitals	15	25	30	45	30	30	15	30	1	2(b)	15	20
Hotels, Boarding Houses, Serviced Apartments, Hostels, Backpackers Hotel, Dormitories	15	20	30	60	60	50	45	50	1	1.2	15	20
Blocks of flats/maisonettes (k)	15(g) 20(j)	30(g) 40(j)	30 45(j)	75	50	40	30	50	1(i)	1.2	15	20
Detached, semi-detached & terrace house, including townhouses	NR	NR	NR	NR	NR	NR	NR	NR	0.9	0.9	NR	NR

NR = No requirements. Maximum direct distance = 2/3x Maximum travel distance ….see Cl.1.2.18.

(x) Unit of width = 0.5 metres.
(a) Applies to corridors serving classrooms. Other corridors shall have a minimum width of 1.2 metre.
(b) Applies to corridors serving patients. Other corridors shall have a minimum of 1.2 metre.
(c) See Cl.2.3.9.
(d) See Cl.2.3.8.
(e) Where a door opening is divided by mullions into two or more openings, each such opening shall be measured separately in computing the number of units of exit width.
(f) See Cl.2.2.15 regarding reduction of exit provision
(g) For travel distance in single staircase flats….see Cl.2.4
(h) Refer to Cl.2.8.2.
(i) Staircase within maisonette serving as an internal access to be at least 0.9m width.
(j) Applies to external corridor … see Cl.2.4.9.
(k) Measurement of travel distance is from the residential unit door to exit … see Cl.2.4.7

As denoted in the table above, the maximum travel distance for a 2 way escape route is 45m under sprinklered conditions. The building has been designed keeping same in mind as denoted on drawings in Annex 1.

Similarly, the staircases width and corridors width have been designed in order to meet or exceed these minimum criteria. The staircases are 2m wide with handrails on both sides and exit doors of similar size while the main corridors are 4m wide and minor corridors are 2.4m.

The staircases have also been designed in order to respect the guidelines given in the extract 1 on this page. All exits to the external portion of the building are through a safe passageway discharging directly outside as per the recommendations of Extract 2

(c) Discharge

(i) All exit staircases shall discharge at ground level directly into a safe exterior open space opened to sky. Open-sided external corridor which does not have any commercial activity and not more than 5m measured to the building eave line shall be considered as safe exterior space. In a sprinkler protected building, maximum 50% of the total number of exit staircase is allowed to be discharged directly to the ground level covered circulation space subject to the following:

(1) The discharge point of the exit staircase into the ground level circulation space shall be within sight of and with direct access to a safe exterior open space; and
(2) The maximum distance between the discharge point of an exit staircase and the exterior open space opened to the sky shall not exceed 10m; and
(3) Where there are commercial activities e.g. shops or kiosks/carts located along one side or both sides of the designated escape passageway leading to the safe exterior open space, a minimum separation distance of 10m shall be maintained between the commercial activities and the designated escape passageway. The circulation space shall also be installed with engineered smoke control system. Alternatively the commercial activities shall be fire compartmented with walls and doors of minimum one-hour fire resistance rating.
(4) The clear width of exit doors leading to the safe exterior open space shall be adequate to receive the occupant load in the 1st storey circulation space and the total number of people discharging from the internal exit staircases.

Extract 2

The capacity of exit doors to the industrial units, corridor, exit doors to staircases and exit staircases are measured in units of width of one half of a metre i.e.:

Clear width of exit door/corridor/staircase	*Number of unit widths*
1m	*2*
1.5m	*3*
2m	*4*

Where a fraction of 250mm or more are added to one or more full units, half of a unit of width shall be credited, for example:

Clear width of exit door/corridor/staircase	*Number of unit widths*
1000 to 1249	*2*
1250 to 1499	*2.5*
1500 to 1749	*3*
1750 to 1999	*3.5*
2000 (maximum)	*4 (maximum number per exit)*

The number of persons per unit of width shall be determined by the type of occupancy and type of exit as listed under Table 2.2A of the current Fire Code.

The provision of fire escape in buildings under Purpose Groups II to VIII comprises 3 distinct parts;

(a) The part within the functional room spaces to the exit staircase/area of refuge;
(b) The exit staircase; and
(c) The exit discharge.

(a) The part within the functional room spaces to the exit staircase/area of refuge.
It is critical that occupants from their respective areas of occupancy are able to get out within a prescribed distance, should a fire break out. The prescribed distances (given in Table 2.2A) shall be measured from the most remote point in that room space to its entrance (on first storey), or to the nearest exit staircase door, serving that storey or to door of area of refuge.
Occupants in room spaces, provided with two or more exit doors, should ensure that all these doors are readily opened for escape in emergency situations.

(b) The exit staircase
Once the occupants have entered the exit staircase, they shall be protected (from exposure to fire risk and obstacle) throughout their descent down the staircase to the final exit at ground level.

(c) The exit discharge
Occupants exiting from the exit staircases shall be able to discharge into the open external space at the ground level. From this point on they should no longer be in any danger from the fire or smoke in the building.

Where an exit opens or discharges into an internal courtyard, a safe passageway must be readily available to lead the occupants out from this internal courtyard to safety at the building exterior.

Examples on the detailed workings in deriving the total number of and widths of exit doorways and staircases, applying the above steps are furnished herewith as Attachment 1 which can be found at the end of the chapter.

Extract 1

2.4 Building Compartmentation

Table 6.4A - Compartmentation requirements for special purpose rooms in buildings

Usage (1)	Non-sprinkler protected building (2)		Sprinkler protected building (3)		
	Compartment (2a)	Door rating (2b)	Compartment (2a)	Door Rating (3b)	Sprinkler (3c)
Store room[1]	1 hr	1 hr	N	N	S
AHU room[3]	N	N	N	N	S
Kitchen[2]	1 hr	1/2 hr	1 hr	1/2 hr	S
Boiler room (oil fired)	2 hr	2 hr	1 hr	1 hr	S
Low voltage Switch room	B	B	B	B	Ex
High voltage Switch room	B	B	B	B	Ex
Transformer room (oil type)	B	B	B	B	Ex
Oil Tank room	2 hr	2 hr	1 hr	1 hr	S
Generator room	2 hr	2 hr	1 hr	1 hr	S
A/C Plant room	2 hr	2 hr	1 hr	1 hr	S
Electric Lift motor room	2 hr	2 hr	2 hr	2 hr	Ex
Hydraulic Lift motor room	2 hr	2 hr	1 hr	1 hr	S
Essential Fan room	2 hr	2 hr	1 hr	1 hr	S
Electrical room	2 hr	2 hr	2 hr	2 hr	Ex
Battery room	2 hr	2 hr	2 hr	2 hr	Ex
Sprinkler/Wet Riser Tank room	B	B	B	B	S
Fire Pump room	B	B	B	B	S
Fire Command centre	2 hr	2 hr	2 hr	2 hr	S
MDF room	N	N	B	B	Ex
			N	N	S
PABX room	N	N	B	B	Ex
			N	N	S

All doors to the different rooms and special rooms shall be designed to meet the minimum criteria set above. Moreover, the building shall have compartment walls that shall enclose a sizable portion of the plan such that it achieves a compartment rating equivalent to the table above.

Compartmentation and door rating in this table are specified in one of the following ways:

N = no specific requirement on compartmentation

B = compartmentation and door rating of the special purpose room shall not be less than the fire resistance of the elements of structure of the building where the room is located

The fire resistance rating stipulated in this table shall be the minimum.

Requirement for sprinkler in the special purpose rooms is specified in one of the following ways:

S = Sprinkler system has to be extended into such rooms

Ex = Sprinkler system is exempted from the corresponding area provided the area is fitted with an automatic fire alarm system installed according to BS5839-1

1. Requirements stated herein apply to store room which is required to be compartmentalized
2. Requirements stated herein apply to kitchens in hotel, restaurant, coffee house or other similar places where the preparation of food is required. However, special considerations will be given to the followings
   a. kitchens where 'open flame' cooking appliances are NOT used, or
   b. kitchens where all the cooking facilities are fitted with approved extinguishing systems.
3. Where AHU rooms are vertically stacked, each AHU room shall be separated by a compartment floor at every level. In the case of AHU serving more than one compartment, fire dampers shall be provided in air ducts at penetration through the compartment wall and floors, see C1.7.1.2.

2.5 Smoke stop lobby

2.2.13 Smoke free approach to exit staircase

Entry at every storey level (including 1st storey) to an exit staircase of any building or part of a building of more than four storeys above ground level shall be through:

(a) An external exit passageway or external corridor. The openings for natural lighting and ventilation to the corridor shall be so located that they face and open to:

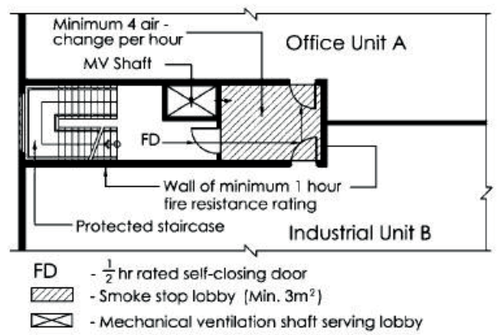
(i) The external space; or

(ii) A street, service road or other public space which is open to the sky; or

(iii) an air-well which opens vertically to the sky and having a min. width of 6m and a superficial plan area of not less than 93m², except that for residential occupancy, the external corridors for smoke free approach shall comply with the requirements of C1.2.4.8 and 2.4.9, and in the case of workers' dormitories and hotel bedrooms being served by external corridors, such corridors shall comply with C1.2.9.4 and C1.2.7.2 respectively;

For buildings under Purpose Group II, smoke free approach to exit staircase shall be provided with natural ventilation and lighting. In the case of Purpose Group III to VIII, smoke free approach to exit staircase, the need to provide mechanical ventilation would be considered if the lobby is internal where provision of natural lighting/ventilation is not possible.

Mechanically Ventilated Smoke Stop Lobby



(ii) The omission of smoke stop lobby to exit staircases shall not be allowed under the following situations : -

(1) where the building exceeds 4 storeys and belongs to Purpose Group III and VII;

(2) where the internal exit staircase, which is provided with pressurization, exceeds the habitable height of 24m;

(3) where the exit staircase is designated as fire-fighting staircase adjacent to a fire lift as required in Chapter 6.

Based on the information given in the extract above, smoke stop lobbies shall be provided at all emergency staircases as well as lift lobbies with fireman's access lift.

2.6 Basement Access

(d) Upper storey staircase continues into basement

Where upper storey staircase is allowed by the MFRS to be continuous with that serving the basement which is naturally ventilated, the following shall be complied with:

(i) Entry at basement

the entry into the basement staircase shall be through a protected lobby, or directly from the basement occupancy area provided the door to the basement staircase is minimum 1-hour fire rated;

(ii) Barrier

to prevent occupants exiting continuously from upper storeys into the basement storey during an emergency, a physical barrier in the form of a door or gate (self-closing type)could be provided across the staircase landing at ground level to separate the discharge route of upper storeys from the basement staircase;

(iii) Smoke-stop lobby

Smoke stop lobby shall be provided for entry into the staircase at all storeys, including basement if the staircase serves more than 4 storeys, including basement;

(iv) Signages

Appropriate signages shall be provided inside the staircase enclosure to direct occupants out of the building at ground level.

The design of the staircases have been made optimum such that it is in line with the above mentioned guidelines. Signages shall be provided both on doors and on wall in order clearly indicate the restrictions applicable.

2.8 Escape Bed Lift

(7) An escape bed-lift shall be provided with the following features :

- a duplicate power supply from an emergency generating plant;
- a switch labelled "Evacuation Bed-Lift" situated next to the lift landing door at the final exit storey, which enables an authorised person nominated by the building management to take control of the lift car during an emergency. Operation of the switch should isolate the lift landing call controls and return the lift immediately to the final exit storey, where upon the lift can only operate in response to the lift car control panel. Such a switch is not needed in 2-storey buildings; and
- a communications system (except in 2-storey building) should be installed to allow communication between occupants at each lift landing and the operator in the lift car.

(8) The installation of escape bed-lifts shall be in accordance with BS EN 81-20.

The escape bed lift shall be designed to meet the above mentioned requirements. Moreover, as an additional safety measure, an escape ramp has also been provided for manual evacuation of bed ridden patients.

2.7 General Provisions

2.5 HEALTH CARE OCCUPANCY

2.5.1 General

The provisions stated herein shall apply to Health Care Occupancies which may be identified under the following categories:

(a) Hospital
A building used for medical and surgical care and shall include general hospitals, hospitals for psychiatric care, children's hospitals, with 24 hours or in-patient service.

(i) Basement
Patient accommodation area containing beds shall not be located in the basement storey.

(ii) Number of exits per ward
Each patient accommodation ward area shall be provided with at least 2 exits, which shall be remotely located from each other, if the occupant load exceeds 50 persons.

(iii)Provision of area of refuge
Every upper storey used for the accommodation of patients shall be provided with at least an area of refuge for horizontal evacuation purposes. The size of the area of refuge and the routes leading to it shall comply with clauses 1.2.4 and 2.5.3.

(iv)Size and compartmentation of patient accommodation area

(1) Each patient accommodation ward shall not exceed a floor area of 750m² and an occupant load of 75 persons, calculated on the basis of gross floor area of 10m² per person.
(2) Each patient accommodation ward area shall be constructed as a compartment having fire resistance rating of at least 1-hour for walls/ceilings and ½-hour fire door for protection of door openings. The internal walls between wards shall be constructed to have min. 1-hour fire resistance rating and door opening shall be protected by ½ hour fire door. For walls and doors between ward and main exit access corridor (either internal or external corridor), the requirements given in sub clause 2.5.1(a)(vi) and 2.5.1(a)(vii) respectively shall be complied with. This requirement shall not be applicable to patient accommodation floor which is sprinkler protected.

2.9 Miscellaneous Provisions

2.5.1(a)(vi) Internal access corridor to wards

Patient accommodation ward with access through an internal access corridor shall comply with the requirements as follows:

(1) Each ward shall be separated from the internal access corridor by a wall having fire resistance of at least 1-hour; and

(2) Doors opening into internal access corridor shall have fire resistance of at least ½-hour and fitted with automatic self-closing device to comply with the requirements of cl.3.9.2; or held open by electromagnetic or electromechanical device; and

(3) Requirements on fire compartmentation under (vi)(a) and (vi)(b) will not be applicable if the patient accommodation floor is sprinkler protected; and

(4) Internal access corridors shall be naturally ventilated with fixed openings in an external wall, such ventilation openings being not less than 15 percent of the floor area of the internal access corridor; and

(5) The ventilation opening in the external walls shall not be less than 3.5m² and shall be unobstructed from parapet wall or balustrade level upwards and be positioned on opposite sides of the internal access corridor such that they provide effective cross-ventilation throughout the entire space of the corridor; and

(6) The ventilation openings in the external walls shall not be more than 12m from any part of the internal access corridor; and

(7) Internal access corridor may be provided with mechanical ventilation and pressurisation in lieu of natural ventilation; and

(8) Other non-patient accommodation areas or spaces which open into or form part of the internal access corridor and which may prejudice the means of escape provision shall be compartmentalised by min. 1-hour fire rated enclosures and min ½-hour fire doors.

2.5.1(a)(viii) Smoke free approach to exit staircase

(1) Entry into an exit staircase from any part of a building of more than 4 storey above ground level shall comply with cl.2.2.13 – requirements of smoke free approach to an exit staircase. Pressurisation of staircase in lieu of the provision of smoke-stop lobby is not permitted.

(2) Any exit staircase which serves a basement storey shall comply with C1.2.2.14 and C1.2.3.5.

(3) Where a smoke-stop lobby is provided to exit staircase to serve a patient accommodation floor, or any area where patients may need to be evacuated on mattresses or stretchers, the lobby shall have a minimum clear space (unobstructed by door swings) of 6m².

Where Area of Refuge serves as required exit, the calculation of area for refuge occupants shall be based on the following:

(i) Hospitals - 2.8 m²/person.
(ii) Nursing Homes - 2.8 m²/person.
(iii) Custodian Care Facility - 1.4 m²/person.
(iv) Supervisory Care Facility - 0.56 m²/person.
(v) Ambulatory Health Care Centre - 1.4 m²/person.

On storey of hospitals or nursing homes where patient accommodation is not provided, at least 0.56 m² per occupant shall be taken for the calculation of the area for refuge of occupants.

All of the above mentioned guidelines have been respected in the design.

3.0 MEP PROVISIONS FOR FIRE MITIGATION & FIRE FIGHTING

3.1 Provision for Fire Detection and Mitigation

The entire building has been designed in order to fully comply with the Mauritius Fire Code (Chapter 6 - Fire Fighting Systems). Various systems such as smoke detectors, heat dectectors, fire alarms, strobe lights, fire access panels and central fire control room have been provided for this building. Refer to Annex 2 for its layout and location in the building.

3.2 Provision for Fire Fighting

The entire building shall be protected with fire fighting systems such as fire hose reels, hydrants, sprinkler systems, gas suppression systems, extinguishers & safety signage.

3.3 Static Fire Water Tank

An underground water tank having a capacity of 200 Cu.M in 2 equal compartments shall be provided on site nearby the hospital block. This shall be supplemented with two static terrace tanks having a capacity of 10 Cu.M each.

3.4 Fire Water Pumping Station

Main Fire Water Pumping Station is located at UG Tank and Gas manifold Building. Details of fire pumps proposed are given in the table below.

Table: Fire Pump Details

Description	Pump Requirement	Nos
Electric Driven Main Fire Pumps	2280 LPM at 8.0 bar	2 (Hydrant & Sprinkler)
Electric Driven Jockey Pumps	180 LPM at 8.0 bar	2 (Hydrant & Sprinkler)
Diesel Engine Driven Standby Fire Pumps	2280 LPM at 8.0 bar	2 (Hydrant & Sprinkler)
Terrace Booster Fire Pumps	900 LPM at 3.5 bar	2 (Hydrant)

3.5 Fire Hydrants

The external of the building and fire brigade access way is protected with fire hydrants all around the hospital building, fed from a common ring main for internal and external hydrant systems, pressurized by hydrant pump set.

3.6 Hose Reel System & Portable Extinguishers

The hose reel system provides a means of first aid firefighting, to be operated by occupants without any special training, but is only effective for small fires or during the initial stages of a fire. The hose reels will be installed along escape routes and of sufficient numbers so that the nozzle can reach within 6 meters of all accessible space. To supplement the hose reels, portable fire extinguishers will be provided within the hospital premise, etc. These are the dry powder type with a capacity of 4.5 kg & 2.5 kg each and suitable for Class A, B and C fires involving combustible solids, liquids and electrical equipment. The extinguishers will be located beside hose reels and along escape routes or doors for ease of identification and accessibility. For the electrical and mechanical plant rooms, CO2 (4.5 & 2.5 kg) type of extinguishers will be installed since these are effective against electrical fires and are non-conducting in nature. Portable type extinguishers shall be provided throughout as necessary. The location of extinguishers shall be at easy assessable places and coverage area not more than 15 meters.

3.7 Wet Riser System

As per BS standard entire building shall be protected with Wet Riser System. From the fire tank, a suction pipe shall be connected to an electric-driven hydrant pump in the fire pump room to supply water to the wet riser cum fire hydrant pipe work system. Four-way and 2 way breeching inlets provided at fire appliance access level to enable the Fire Brigade to supply water to the storage tank and hydrant ring main. Wet Riser System shall be additionally supported by two terrace tanks of 10 KL each and two Terrace level booster pumps of 900 LPM capacity capable of pumping at 3.5 bar required pressure.

3.8 SPRINKLER SYSTEM

Water Sprinkler system has been provided to the whole facility as per the Norms provided in the Mauritius Fire Code (Chapter 6 –Fire Fighting Systems) and BS standards. The Sprinkler system is connected to the Fire Tank (200 cum) and the dedicated sprinkler pump set is triggered by the multi – detectors provided above and below the false ceiling.

4.0 Annex 1

Architectural Plans with escape routes and hose reel coverage and other Architectural features for Fire Fighting

Refer to Hard Copies submitted in A0 size paper

5.0 Annex 2

MEP drawings for:

a) Fire Detection
b) Fire Fighting System

CHAPTER 7

PREDICTION AND MITIGATION OF ENVIRONMENTAL IMPACTS

7.1 **TERRESTRIAL ENVIRONMENT**

7.1.1 Flora and Fauna

7.1.2 Rivière du Poste de Flacq

7.1.3 Mitigative Measures

7.1.4 Operation phase

7.2 **CLIMATOLOGY & ARCHITECTURE**

7.2.1 Predictions

7.3 **CYCLONE**

7.3.1 Impact

7.3.2 Mitigation

7.4 **SECURITY**

7.4.1 Impacts

7.4.2 Mitigations

7.5 **WATER SUPPLY**

7.5.1 Prediction

7.5.2 Mitigating Measures

7.6 **ELECTRICITY**

7.6.1 Impacts

7.6.2 Mitigations

7.7 **STANDBY GENERATOR**

7.7.1 Impacts

7.7.2 Mitigations

7.8 **FIRE HAZARD**

7.8.a Predicted Environmental Impacts

7.8.b Mitigative Measures

7.9 WASTE MANAGEMENT

7.10 LIQUID WASTE

7.11 DUMPING OF CONSTRUCTIONAL WASTES

7.12 SITE RUN-OFF DRAINAGE

7.12.1 Impacts

7.12.2 Mitigations

7.13 ACCESS TRAFFIC

7.13.1 Impacts during Operation Phase

7.13.2 Impacts during Construction Phase

7.13.3 Mitigating Measures

7.14 HEALTH AND SAFETY

7.15 DUST CONTROL

7.15.1 Impact

7.15.2 Mitigative Measures

7.16 HYDROLOGY

7.16.1 Prediction

7.16.2 Mitigating Measures

7.17 OPERATIONAL HYGIENE

7.17.1 Toilet

7.17.2 Rodents, Pests and Insect Control.

7.17.3 Refuse Bin

7.18 NOISE

7.18.1 Noise associated with the Operation of Hospital

7.18.2 Noise associated with Construction Works

7.18.3 Mitigative Measures

7.19 DECOMMISSIONING OF PROJECT

CHAPTER 7

PREDICTION AND MITIGATION OF ENVIRONMENTAL IMPACTS

7.1 TERRESTRIAL ENVIRONMENT

7.1.1 Flora and Fauna

As mentioned in chapter 3, there is no ecologically sensitive flora or any endemic fauna.

Currently on site, there are litchi trees and Yates trees as well as some other wild trees and bushes, none of these have been part of the Proponent's maintained landscape. The site can thus be categorized as having low ecological value.

7.1.2 Rivière du Poste de Flacq

The site is bordered on its southern side by the Rivière du Poste de Flacq. While the river is still going to remain unaffected by the hospital at operation stage, there are possibilities of ecological accidents happening during the construction stage.

7.1.3 Mitigative Measures

Mitigative measures shall be adapted for flora as stated below:

- Nature trees of ecological or visual interest falling outside of the building footprint shall be preserved.
- A comprehensive landscaping plan incorporating a maximum number of endemic trees that be prepared and caused to be executed.

7.1.4 Operation phase

Mitigative measures to be adopted for the river shall be as described below:

- The building shall be kept at least 40m from the high water mark
- The escarpment shall be kept untouched all the while
- The escarpment portion shall be fenced to prevent access to the river banks
- Any ablution facilities for the workers shall be kept far from the river and disposal in temporary tanks that shall be regularly services
- Excavated materials which have reuse value shall be kept as far possible from the escarpment line.

7.2 CLIMATOLOGY & ARCHITECTURE

7.2.1 Predictions

The campus shall consist of a set of buildings which do not have major impact on the ground coverage. It is also not industrial in nature and thus any change to the climate is unforeseen.

However, since the climate impacts the building, the Architectural design has taken same in consideration in order to have a more ecofriendly building. There will be careful selection of

7.3 CYCLONE

7.3.1 Impact

Mauritius being located in a tropical climatic zone is prone to cyclones. Based on past experiences, the designs of buildings in Mauritius have evolved to be more resistant to cyclone. The Mitigative measures are mentioned below:

7.3.2 Mitigation

The whole of the building and its peripheral components shall be designed to resist cyclonic conditions. They shall be designed to withstand gusts and wind pressure amounting to 300km/h.

On site electricity shall be underground and there shall be standby generators and UPS rooms to avoid down time, especially in critical care units.

Water storage capacity shall allow for a minimum of 2 days of consumption.

7.4 SECURITY

7.4.1 Impacts

Lack of safety measures may result in severe accidents especially at operational stage.

7.4.2 Mitigations

Double height spaces shall have parapets of appropriate heights to prevent falls.

Burglars proofing shall be provided to sensitive areas.

Security officers shall be posted at strategic locations.

CCTV camera shall be located at all the important points of the hospital.

Intercom and access control points shall be located at sensitive entrance points.

7.5 WATER SUPPLY

7.5.1 Prediction

Potential issues related to water supply are generally pipe bursts which can cause flooding and disruption to the good running of the hospital.

7.5.2 Mitigating Measures

- Generally pipes shall be buried at least 600mm below the finished ground level and vehicular traffic shall not be allowed over it.
- Whenever vehicular traffic has to occur, the pipes shall be encased in a concrete surround.

- All pipes shall be designed based on flow rate with a safety factor. Materials to be selected shall be durable and of proven experienced. Joints shall be kept to the strict minimum.

7.6 ELECTRICITY

7.6.1 Impacts

- The supply of electricity as well as its general distribution and safety aspects are mention in chapter 6.6 of this report.

7.6.2 Mitigations

- The distribution of electricity shall follow the principle of safe circuitry at all times.
- Overloading of a power point shall be prohibited under all circumstances.
- Generally all cables related to emergency lines shall be fireproofed.

All exposed conduits shall be heat and UV resistant, corrosion and moisture resistant. RCD and breakers shall be provided on all circuit and maintained regularly.

7.7 STANDBY GENERATOR

7.7.1 Impacts

Since it is of utmost importance to have zero or very minimal downtime in a hospital, 2 x 1250 KVA have been provided on standby mode. These generators are powdered with diesel. The storage of diesel comes with a risk of spills or leakages that will percolate and damage the environment. It can also cause slippery.

7.7.2 Mitigations

To minimize environmental risks, the following strategies shall be adopted:

- The tank shall be painted and regularly maintained and any apparent signs of posts or aperture will be treated pronto
- The normal procedure of having double enclosure to store the diesel shall be allowed to
- The tank shall be placed on an elevate surface which will allow for easy detection of leaks
- There shall be a sump in the concrete floor supporting the tank which allow easy pumping and disposal of any accidental spill.

7.8 FIRE HAZARD

7.8.a Predicted Environmental Impacts

As it is the case within a building, a hospital is always at risk of a fire outbreak especially with the presence of inflammable items in certain areas. It can be generally expected that unwarranted heat leading to dangerous flames, smoke and toxic are generated and exponentially increases.

Smoke also results in asphyxiation, reduced visibility and accidents. When exposed to flames for a long period of time, the structural integrity of the building is also affected. The Mitigative measures to be taken as described in the next subchapter. In parallel a full report regarding the fire fighting strategies has been sent for approval to the Mauritius Fire Rescue Services.

7.8.b Mitigative Measures

The Mitigative measures are in two aspects. Firstly detection and spread prevention and secondly safe evacuation.

a. Appropriate sensors and alarm systems shall be installed in all areas and connected to panels and BMS system.
b. Fire extinguishers, sprinklers and other similar fire fighting systems shall be strategically located in the building.
c. Regular checks and audits shall be carried out to ensure the system is fully functional.
d. All compartments are securely connected to the escape routes such as fire emergency staircase, ramp and firemen's lift.
e. All escape routes and procedures to be followed in the event of fire outbreak shall be conspicuously displayed.
f. Regular drills shall be carried out in order to familiarize the staff of the procedures and reduce panic reaction.
g. All fire safety signs and emergency lighting shall be provided and regularly maintained.
h. Fire clearances shall be sought prior to operation and renewed on a regular basis.

7.9 WASTE MANAGEMENT

It is expected to have two types of solid waste on this site:-

1. Domestic waste
2. Medical waste

The methods in which they shall be collected and disposal off are mention in Chapter 6.7 of this report

7.10 LIQUID WASTE

Liquid waste expected in this hospital is in the form of wastewater from laundry, CSSD, kitchen and foul water from ablution facilities. The details of these as well as their treatment are given in Chapter 6.3 of this report. Emphasis shall be on the reuse of the effluent water for irrigation purposes.

7.11 DUMPING OF CONSTRUCTIONAL WASTES

No dumping of any form of waste will be allowed within the surroundings. All wastes produced at construction stage shall be collected to a designated place on site and securely stacked until they are collected and disposed off to sites specifically designated for this purpose.

7.12 SITE RUN-OFF DRAINAGE

7.12.1 Impacts

The recent years has seen drastic changes in the way the island experiences the rainy season. Rainfall tends to be more intense over shorter period of time thereby resulting in flash flood situations. Rain water accumulates on impermeable surfaces of a site and causes situations of water ponding which over time can be a sanitation issue.

7.12.2 Mitigations

To prevent any issues due to storm water, the following measures shall be implemented:

- The roof of the hospital shall be properly screeded to fall towards rain water pipe outlets. Rainwater pipe
- Sufficient rain water pipes shall discharge in accessible catch pits which are interconnected in a sloped manner.
- In turn, this rain water shall discharge into storm water drains.
- All the impermeable ground surfaces such as tarmac for parking and driveways etc shall be designed to slope towards drain channels.
- The drain channels are interconnected over a network that finalty discharge into soak away.
- Regular maintenance and cleaning of the drains shall be effected to minimize clogging and ensure no storm water accumulation occurs within the drain.

7.13 ACCESS TRAFFIC

7.13.1 Impacts during Operation Phase

Generally, public hospitals see a reasonable flux of vehicular traffic at all times of the day and there is a peak that is noted in the morning around 8.00 to 9.30 and evening around .3.30 to 5.30. There is an estimated flow of about 5500 persons and taking into account vehicle ownership in Mauritius as well as transport connectivity, there shall be an estimated flow of 1250 vehicles over a period of 12 hours. This results in a traffic density of 100 vehicles per hour. Since the B23 road is a fairly high traffic road. It is not expected that the hospital building will have negative impacts over the traffic flow

7.13.2 Impacts during Construction Phase

There shall be additional traffic generated during construction. Since it is a major construction, it is estimated that approximately 30 to 40 lorries shall transit the site over the first three months of the construction and thereafter approximately 20 to 30 lorries shall transit the site over the estimated period of 18 months.

This gives rise to a density of 4 lorries per hour over a work period of 10 hours. This is a reasonable traffic flow that can be tolerated on the existing infrastructure.

Based on the hourly estimate of vehicle traffic and taking into account the expected surge during visiting hours, the increase in traffic at that particular segment of the road will not

cause undue disturbance to the traffic on the B23 road. However, currently the surroundings are mostly agricultural lands which do not generate further issues to the site.
Furthermore, the design of the hospital site allows for sufficient queuing at the site junction with the main road, thereby diminishing negative impact to the traffic flow.
Pedestrian crossing shall be provided to access the site and in this regards, consultations are being held with the TRSMU. Any road signage that needs to be incorporated shall also be finalized with them.

7.13.3 Mitigating Measures

During construction stage, owing to the presence of heavy vehicles on site, appropriate road signs will be placed at conspicuous location to warn vehicles. Vehicles exiting the site will be sprayed with water at the tyres and tyreguard areas to ensure that the road is not dirtied and pose a potential hazard.

7.14 HEALTH AND SAFETY

This comes at two levels. First at construction level and second at operation. For the construction stage, all the provisions given in the bylaws in relation to Occupation Health & Safety shall be complied to at all times. For the operation stage, the proponent has caused the facility to be designed by healthcare experts who have ensured that the design is fully compliant which all internationally recognized norms. Morever, the selection of materials and finishes shall be such that they are durable and safe in nature. The facility shall also be wholly disabled access friendly.

7.15 DUST CONTROL

7.15.1 Impact

Dust is expected to be generated all throughout the construction stage. The major dust particles expected are earthworks and aggregates residue, cement and concrete microchips, stone dust and saw dust.

7.15.2 Mitigative Measures

The generally accepted practice methods of mitigating dust propagation shall be adopted as stated below:

- The site shall be hoarded and charlon netting shall be used against the general wind direction to prevent spreading of dust.

- In order to avoid wind whipping on piled up materials such as excavated soil, water shall be regularly sprayed on them.

- All trucks carting material away from the shall be covered. Trucks delivering material to site shall be adequately prepared by the issuing factory to limit dust propagation.

- Any unloading of materials shall happen far from the escarpment to avoid spillage to the river. Any case of spillage shall be immediately attended to.

- Major materials such as concrete and aggregates shall preferably be sourced from nearby factories to limit dust propagation all the way.

- All waste shall be carted away from the site to designated dumping yards in covered trucks. Burning of waste on site shall not be allowed unless there is an absolute necessity.

- It will be ensured that all vehicles being associated with the project have proper fitness certificate and do not emit an unwarranted amount of air pollutants.

7.16 HYDROLOGY

7.16.1 Prediction

There are no rivers or drains crossing the site or within the site. The site is bounded the Rivière du Poste de Flacq at its southern side and there thus may be risks of sediments propagating to the river through erosion or run off from the surface. In the event of long standing diesel machines and vehicles, there is a risk of spill of diesel going to the ground water. Since water from this river is used by CWA in times of emergencies, it is important to provide Mitigative measures to avoid water pollution.

7.16.2 Mitigating Measures

As part of mitigative measures to protect the ground water, the points listed below shall be adopted:

- No refueling will be allowed on site. Nevertheless, a spill prevention and containment plan shall be developed and implemented.
- Excavated materials shall be kept away from the escarpment side. Moreover, other construction materials shall also be stored away from the escarpment side.
- Hoarding/fencing shall be placed towards the river side.
- The waste being treated at the STP, shall be disposed off in carriers. The residual water shall conform to the best practices and be used for irrigation.
- The building has been located much beyond the statutory 16m setback and away from the escarpment thereby avoiding the need for extensive reinforced structures.

7.17 OPERATIONAL HYGIENE

- A hospital is a highly hygienic area where no compromise is allowed on same. Apart from all the safety and hygienic consideration taken into account at design stage, the following minimum measures shall be implemented at the operational stage.

7.17.1 Toilet

- The toilets will be regularly cleaned and disinfected as per an established schedule.

7.17.2 Rodents, Pests and Insect Control.

- The proponent shall ensure that regular treatment is carried against pests and insects. The proponents shall cause to install a rodent control system which shall be scrupulously monitored.

7.17.3 Refuse Bin

- All refuse bins shall be of covered type and cleaned and disinfected every time they are emptied. All wastes shall be securely kept outside the site and serviced by the District Council.

7.18 NOISE

7.18.1 Noise associated with the Operation of Hospital

A hospital is generally associated with calmness and silence. As a matter of fact, it is a 'No horning zone'. It is absolutely very remote that noise will be generated by the facility.

The only areas where it may be expected to have noise are the machine rooms. However, the design calls for this spaces to be duly insulated and kept close at all times. It is thus not seen as being a negative impact to the environment. Any outlets from machine rooms shall be fitted with attenuators or silencers to minimize noise impact.

7.18.2 Noise associated with Construction Works

The following loud machinery shall be present at site during the construction stage:-

- Excavating machinery
- Mixers and vibrating machines
- General fit out machinery
- Drills and trench excavators
- Tarmac laying machinery

There are however no neighbours in the surroundings who would suffer from these activities.

7.18.3 Mitigative Measures

- Notwithstanding the fact that the site is located away from residential zone, the following Mitigative measures shall be taken to ensure pleasant environment.
- Construction will be generally restricted to day time as much as feasible and practicable, all Occupational Health & Safety regulations shall be implemented and a Health &Safety officer shall ensure due compliance.

7.19 DECOMMISSIONING OF PROJECT

- Since the hospital is a government undertaking, it is very unlikely that the project will be decommissioned. However, if such a case arises the shall be adopted:
- All MEP and equipment shall be transferred to other sites operated by the payment

- Any areas that are temporary in nature will be dismantled and converted into planters.
- Any demolition shall be supervised and carried out to minimize dust and noise or any other form of pollution.

ENVIRONMENTAL MONITORING PLAN

8.1 MONITORING AND MAINTENANCE

All sanitary and hygiene measures to be maintained throughout the construction phase. First aid room will be provided as well as adequate drinking water and sanitary facilities to all workers. Health condition of all workers should be taken into consideration before starting work on site. Necessary health checks are to be carried out whenever required. In order to duly monitor the impacts on the environment and as well as ensure that all the points before mentioned in the report are being respected, an environmental management plan shall be used. The different registers forming part of the management plan are detailed out in the table below.

TABLE 8.1 ENVIRONMENT MANAGEMENT PLAN

Actions/Plans	Purpose	Frequency	Cost implications	Responsibility
CONSTRUCTION PHASE:				
Training of all workers on health and safety best practices	To ensure that a safe work environment is maintained at the site and proper use of PPE is being made	Regular	• Resource persons • Training materials • Venue	Contractor responsible for the construction Management of the facility during operation phase
Monitoring of dust loading in the working environment and in the neighbourhood during construction	To ensure that the dust loading in the atmosphere is not above prescribed norms	Once a week or as often as required	• Dust level testing	Contractor responsible for the construction
Monitoring of noise generation by machinery during construction phase	To ensure that the noise levels on site and in the neighbourhood are within prescribed norms using a hand-held noise meter	Once a week	• Noise meter to measure the level of noise on site	Contractor responsible for the construction
Covering of all construction materials and wastes	To ensure that materials and wastes are not carried off by surface water runoff	Regularly	• Impermeable cover for materials and construction wastes	Site Manager
Waste movement log-book for construction waste	To ensure safe and regular disposal of solid waste generated during construction	…….	• Licensed carriers to transport waste to landfill	Site Manager and security guards

Actions/Plans	Purpose	Frequency	Cost implications	Responsibility
OPERATION PHASE:				
Medical waste movement logbook	For qualification of medical waste and to ensure its traceability	……	• None	Hospital waste management unit
Implementation of a "green" procurement policy	To reduce the amount of materials which release hazardous emissions when incinerated like mercury plastic and heavy metals	……..	• Some alternatives may cost more	Hospital procurement department
Implementation of a segregation programme	To ensure that materials containing hazardous substances such as mercury are not incinerated	…….	• Special containers for storage of different types of medical wastes • An appropriate labeling system	Hospital administration
Monitoring of emissions to air as per the requirements of EPA 2008	To ensure that air emissions are well within the EPA regulations for air standards	Once after commissioning and then on a yearly basis	• Air monitoring unit available at the University of Mauritius	Hospital administration
Monitoring of noise generation during operation	To ensure that the noise levels on site and in the neighbourhood are within prescribed norms using a hand-held noise meter	Once a week	• Noise meter to measure the level of noise on site	Hospital Administration
Inspection of the operational status of fire-fighting installations and conduct fire drills	To be prepared in the event of an accidental fire outbreak	Once every 6 months	Hiring of a fire fighting contractor	Hospital Maintenance Unit
Personal protective equipment for the persons handling medical waste	For the protection of workers handling hazardous wastes	Twice yearly	• Additional cost on PPE	Hospital procurement department

Developing an Emergency Response Plan	To prepare all personnel of the hospital on the procedures to follow in the occurrence of an emergency situation	……	• Fire fighting equipment	Hospital administration