



Multi-storied Commercial cum Residential Complex in Chittagong

Final Feasibility Report

July 2017



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List of Abbreviations

ADB	Asian Development Bank
ARR	Average Room Rate
BBS	Bangladesh Bureau of Statistics
BDT	Bangladeshi Taka (local currency)
BHBFC	Bangladesh House Building and Finance Corporation
BHK	Bedroom, Hall and Kitchen
BIFFL	Bangladesh Infrastructure Finance Fund Ltd.
BPDB	Bangladesh Power Development Board
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CBD	Central Business District
CCC	Chittagong City Corporation
CCCI	Chittagong Chamber of Commerce & Industry
CCEA	Cabinet Committee on Economic Affairs
CDA	Chittagong Development Authority
CPDL	CA Property Development Ltd
CUET	Chittagong University of Engineering and Technology
CWASA	Chittagong Water Supply and Sewerage Authority
DCS	Deputy Commissioner Settlement
DFI	Development Finance Institution
DOE	Department of Environment
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules
EIRR	Equity Internal Rate of Return
EMP	Environmental Management Plan
EPZ	Export Processing Zones
F&B	Food & Beverage
FAR	Floor Area Ratio
GDP	Gross Domestic Product
HSD	Housing and Settlement Direction
IDC	Interest During Construction
IDCOL	Infrastructure Development Company Ltd.
IEE	Initial Environmental Examination
IFB	Invitation for Bid
IFC	International Finance Corporation
IFIL	Islamic Finance and Investment Limited
IRR	Internal Rate of Return
LGED	Local Government Engineering Department
MGC	Maximum Ground Coverage
MoHPW	Ministry of Housing and Public Works
MSL	Mean Sea Level
NHP	National Housing Policy
NPV	Net Present Value
O&M	Operation and Maintenance
OPEX	Operational Expenditure
P&L	Profit and Loss

PIRR	Project Internal Rate of Return
PPP	Public Private Partnership
PSOD	Private Sector Operations Department
PWD	Public Works Department
REHAB	Real Estate & Housing Association of Bangladesh
RFP	Request for Proposal
RFQ	Request for Qualification
SEZ	Special Economic Zone
SWOC	Strengths, Weaknesses, Opportunities and Constraints
USD	United States Dollar (global currency)

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Executive Summary

This report pertains to the feasibility study for development of a Multi-storied Commercial and Residential Complex at GEC More in Nasirabad, Chittagong on a plot of land owned by National Housing Authority, Bangladesh.

Introduction – Background, Scope of Services and Approach & Methodology

The National Housing Authority (NHA) has been constituted under the NHA Act 2000 and functions under the Ministry of Housing and Public Works (MoHPW), Bangladesh. As part of its mandate (which includes ensuring housing for all with special emphasis on the disadvantaged, shelter-less, destitute, and low and middle-income group people and making available suitable land for housing at an affordable price), NHA continuously pursues the development and promotion of real estate activities to cater to the needs for commercial and residential facilities of the citizens of Bangladesh. Some initiatives have already been taken and implemented by the NHA in various areas of Chittagong mostly through public sector financing.

At GEC more in Nasirabad, Chittagong, the National Housing Authority plans to develop around 8.5 acres of its land through PPP. On the basis of in-principle approval obtained from the Cabinet Committee on Economic Affairs (CCEA) Bangladesh on 4th November 2015, NHA intends to construct a multi-storied commercial cum residential apartment complex with modern amenities. NHA plans to build a mix of commercial and residential apartment complex along with an office building and residential accommodation for NHA Chittagong on a PPP basis.

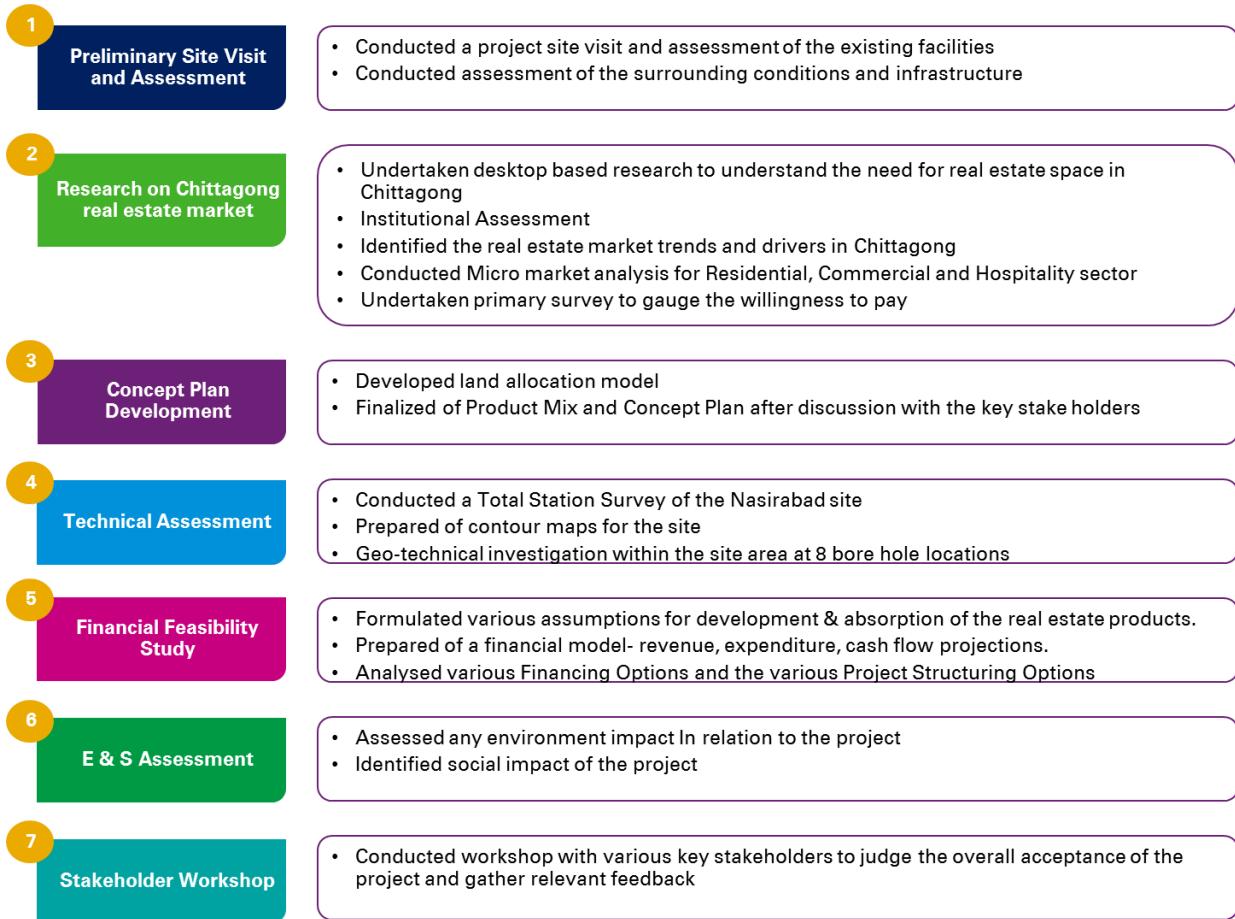
In order to manage the entire transaction process including carrying out techno-commercial feasibility assessment, project structuring and preparation of bid documents, NHA wanted to engage a transaction advisor and requested support from PPP Authority, Bangladesh. The PPP Authority conducted a competitive bidding process and based on technical and financial criteria, KPMG Advisory Services Private Limited was selected as the transaction advisors for providing Transaction Advisory Services for Construction of Multi-storied Commercial cum Residential Apartment Complex with Modern Amenities at Nasirabad, Chittagong.

The Scope of Services for the transaction advisory is divided into two phases as follows:

- **Phase 1: Detailed Feasibility Study and Project Development**
- **Phase 2: PPP Procurement Process Development and Implementation**

The Approach for this assignment and the methodologies that have been followed are structured in line with the Scope of Services envisaged by PPP Authority, Bangladesh and National Housing Authority (NHA). The project team has followed a participatory approach and has worked in unison with the representatives from National Housing Authority so as to incorporate their suggestions and inputs at various stages of this assignment.

The specific steps undertaken as part of Feasibility Study are shown below.



Needs Analysis

The need for Real Estate in Chittagong is derived from two main factors. One is the importance of Chittagong as the economic hub of Bangladesh. The region generates a significant portion of the country's industrial output, 60% of the governmental revenue and around 80% of its international trade. Further, the city of Chittagong also has a crucial role for the economic development of major regions of landlocked South Asia such as Bhutan, Nepal, Northeast India and some parts of Myanmar and South China. Therefore, development of Chittagong is vital.

Chittagong is also the second largest city of Bangladesh after Dhaka. In Bangladesh, the growth rate of urban population is 3.5% (the highest in South Asia). In Chittagong, even though the city area has remained constant at 157 sq. km, the population has almost trebled within the urban area in the last three decades. Hence, urban residents are experiencing problems associated with overpopulation and lack of housing facilities. Majority of households have 1-2 rooms. Additionally, studies show that over the last decade, the growth rate of the Real Estate sector has been lagging behind the GDP growth rate in Bangladesh. This has created a serious shortage of real estate space in Chittagong. Hence, both prices and rents are high across Bangladesh with Chittagong ranking second highest among urban locations in the country in terms of prices and rents.

To develop more industry and sustain more people, there has to be a sustained effort and facilitation from the Government to upgrade and develop the infrastructure within the region. Since the scope of

Government Funding is limited, the new Real Estate spaces have to be created utilizing the Public Private Partnership (PPP) route.

Institutional Assessment

Apart from improvement in connectivity and accessibility of the site and provision of basic utility and waste management services, one key linked project which can aid in the success of the project is the **Review of zoning practices around the site**. This will ensure adherence to development regulations related to encroachments and height restrictions along the site periphery and increase the attractiveness of the site from a Real Estate development perspective. Chittagong Development Authority (CDA) is the institution/organization responsible for undertaking this task.

Site and Location Analysis

The subject site is located at GEC More, Nasirabad and has a total area of 8.498 acres. The ownership of the site lies with National Housing Authority (NHA), Bangladesh. The coordinates of the site and elevation are as follows:

- Latitude: 22° 21' 35.73"N
- Longitude: 91° 49' 14.80"E
- Elevation: 14.215 m (above MSL)



The topography of the site is undulating with mounds/ elevations and it has a number of levels. The site has a large water body of approximately 31,000 sq. ft. and a number of fruit bearing and non-fruit bearing

trees and bushes. The existing infrastructure on the site includes the divisional and sub-divisional offices of National Housing Authority, bungalows and other residential accommodation for officers and staff, club, garages and a mosque. Additionally, there exists supporting infrastructure like internal roads, power networks and water supply and sewerage connections.

The location of the subject site is at GEC More in Nasirabad – the commercial heart of the Panchlaish ward in the city of Chittagong. The region is well surrounded by other prominent metropolitan wards of Chandgaon, Khulshi, Pahartali and Double Mooring and a large part of the new development activity in the past decade has accrued to this region. The site also enjoys good connectivity to key transit hubs and has substantial real estate activity in its vicinity comprising residential and commercial real estate developments. The main commercial area in the region is CDA Avenue and this entire stretch of 3-4 km is marked by presence of multiple small to large shopping plazas and commercial towers like Sanmar Ocean City and Yunusco Hallmark, among others.

The combination of factors such as good connectivity and linkages, easy access to educational institutes, medical facilities, shopping complexes and commercial offices lends a strategic location advantage to the site from a developer attractiveness perspective.

Overview of Real Estate Market in Chittagong

The Real Estate Market in Chittagong has been analysed in detail based on data from both market interactions and secondary research. The overall Real Estate market in Bangladesh and Chittagong has been analysed tracing its history and the current trends and drivers have also been outlined. Further, the Real Estate has been broken into three components – Residential, Commercial (Office and Retail) and Hospitality. Within each component, the prominent micro-markets have been identified and analysed along both demand-supply situation and pricing.

The summary of the analysis of the Real Estate market in Chittagong is encapsulated below:

RESIDENTIAL SEGMENT	COMMERCIAL OFFICE SEGMENT	RETAIL SHOPPING SEGMENT	HOTELS SEGMENT
<ul style="list-style-type: none"> Site surrounded by posh residential localities of Khulshi, O.R. Nizam Road, and Panchlaish, accruing premium pricing Good concentration of mid and high income buyer segment, healthy market for good quality housing units built by private developers 3 BHK (1,500 – 1,800 sq.ft) and 4 BHK (1,800 – 2,000) are most preferred type, with average sale price per sq. ft. rate ranging between BDT 6,000 to BDT 8,000 per sq. ft. i.e. ticket sizes ranging between BDT 90 lacs to BDT 1.85 crores Large land area allows for a large inventory, strong potential for developing premium priced residential real estate 	<ul style="list-style-type: none"> New office space demand moving away from Agrabad High concentration of quality office real estate across existing & upcoming projects due to good residential catchment & recreational avenues (CDA) Currently slow demand levels due to oversupply situation, substantial vacancy in new and upcoming projects Yet sale prices range between BDT 35,000 – BDT 25,000 sq. ft. for quality spaces GEC more in Nasirabad to be the next central business district of Chittagong 	<ul style="list-style-type: none"> Chittagong devoid of any large format multi-segment organized mall ~ only organized shopping complex located in Nasirabad - Sanmar Ocean Plaza Pure standalone organized sector retail/shopping quality spaces earn premium on price, most market comprises mixed use formats Average retail space sale rate in the range of BDT 35,000 – 45,000 per sq. ft. Nasirabad commands a marginal premium over other competing commercial retail micro markets due to mid-high income segment catchment population and location advantage 	<ul style="list-style-type: none"> Agrabad & Station road continue to be established markets but offer limited good quality hotel options Nasirabad shows good occupancy levels (50%-60%) and healthy tariffs due to corporate travelers Competing hospitality projects coming up, major chains acquiring land GEC more considered a preferred hospitality location due to connectivity, captive corporate led demand, infrastructure, and heart of the city location Site is attractive for developing branded 4 star category hotel or serviced apartment

Willingness to Pay Analysis

To estimate the demand for residential and commercial (office and shop) real estate among the consumers of Chittagong and their ability and willingness to pay for these assets, a "Willingness to Pay" survey was conducted. Out of the total 101 respondents, 50 respondents were residential apartment owners and 51 respondents were commercial (office and shop) owners.

The survey showed that large residential development with 3 BHK format flats of size of 1,000 – 1,500 sq. ft. is expected to witness good response from potential buyers. GEC More is the preferred location for renting/buying by majority of the respondents. Respondents would be willing to pay a rent of BDT 20,000-25,000 pm in GEC More and in case of purchase, be willing to pay a price between BDT 60-80 Lacs for an accommodation in GEC More.

Further, in the above survey, it was found that more than 75% of the respondents were open to consider purchase of new commercial space and GEC more was rated as one of the most sought after locations for a shop or office space. As per the survey, the current pricing for commercial shop space is less than BDT 30,000 sq. ft. but majority expressed willingness to pay above this price to acquire a new shop in GEC more location.

Concept Plan

The concept plan has been prepared based on detailed discussions with the Ministry of Housing and Public Works, National Housing Authority and PPP Authority held during 14-22 March 2017 and with the Chairman, National Housing Authority on 08 May 2017.

It has been agreed that the entire site is to be developed as a high-rise – a multi-storied commercial cum residential complex with modern amenities. The development is proposed to be undertaken through PPP (Public-Private Partnership). The envisaged PPP involves development of residential buildings and office for NHA by the private partner in area allocated to NHA as well as development of residential apartments

and commercial space (office, retail and/ or hotel) in the area allocated to the private partner, which will be retained and sold by the private partner. The private partner shall be responsible for development of the subject site and NHA shall be responsible for providing the land for the proposed development.

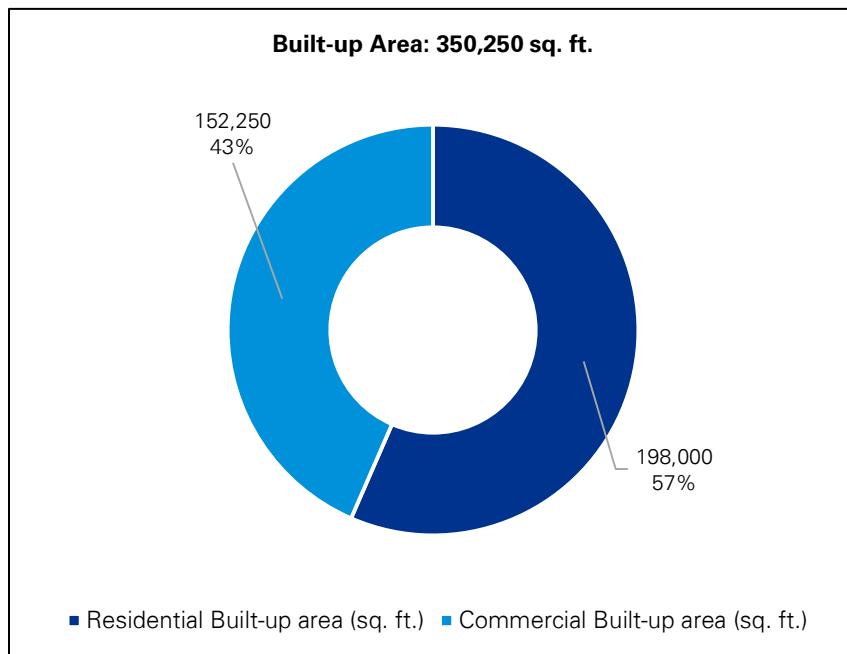
The Land Allocation Mix is shown below:

Particulars	Area Split (Acres)	% Area Split
Total Site Land Area	8.50	100%
Area for NHA	1.07	12%
Area for Private Developer	7.20	85%
Area for existing Mosque	0.23	3%

NHA Portion

NHA's portion of the plot, which is approximately 1.07 acres in area will comprise the NHA's office and residential accommodation for its officers and staff. The final product mix in NHA's portion has been finalized by NHA in discussion with the Ministry of Housing and Public Works (MoHPW). It has been envisaged that the development will consist of three buildings/ towers of at least 15 floors each, out of which, one tower near the entrance will be developed for commercial purpose (including office space for NHA) and the other two towers will be developed for residential purpose. The total available FAR in the NHA's portion will be utilized for this development.

The area break-up of NHA portion for the purpose of the feasibility study is shown below:



Developer Portion

An area of around 7.20 acres will be allocated to the private developer for development of multi-storied commercial and residential complex for sale. This area allocated to the private developer will have frontage towards the south of the site (on Zakir Hossain Road). NHA will grant development rights to the private

developer to develop 7.20 acres in the form of long term lease of 99 years. In the 7.20 acres, a strip of 20 feet width along the front boundary (towards south of the plot) will be used for beautification and landscaping at the private developer's cost, which will be a no-development zone. The developer's product mix in the 7.20 acres will be left to the discretion of the developer without any stipulations from the Ministry of Housing and Public Works (MoHPW) or NHA. However, commercial tower/s shall ideally comprise at least 20 floors, whereas residential towers shall comprise at least 25 floors.

For the purpose of feasibility study, a mix of residential, commercial and hospitality components has been assumed based on our understanding of the real estate market of Chittagong and the demand supply dynamics of various asset classes in the subject site and competing micro-markets. This translates around 4.2 acres being utilised as a residential zone and around 3 acres being utilized as a commercial zone comprising retail spaces, office spaces and a hotel. This is shown below:

The area statements for Residential and Commercial built-up area in developer portion are shown below:

Residential Product Mix for Private Developer					
Component	Area per Unit (sq. ft.)	Number of Units	Built-up area (sq. ft.)	Parking units	Saleable area¹ (sq. ft.)
Type A	2,000	96	192,000	64	212,000
Type B	1,500	384	576,000	100	636,000
Type C	1,250	480	600,000	210	662,000
Type D/ Condominiums	2,000	96	192,000	70	208,000
Total		1,056	1,560,000	444	1,718,000

Commercial Product for Private Developer					
Component	Area Per Floor (sq. ft.)	Number of Floors (excl. Ground Floor)	Built-up area (sq. ft.)	Parking units	Saleable area² (sq. ft.)
Commercial Product comprising office, retail and hotel	49,138	22	1,081,036	600	1,228,450
Total	49,138	22	1,081,036	600	1,228,450

¹ Area inclusive of ground floor, basement and common area

² Area inclusive of ground floor and two levels of basement

Technical Assessment

A survey of the site was conducted using an electronic Total Station. The findings of survey showed that the total area was 8.498 acres, which was more than the NHA indicated 8.39 acres.

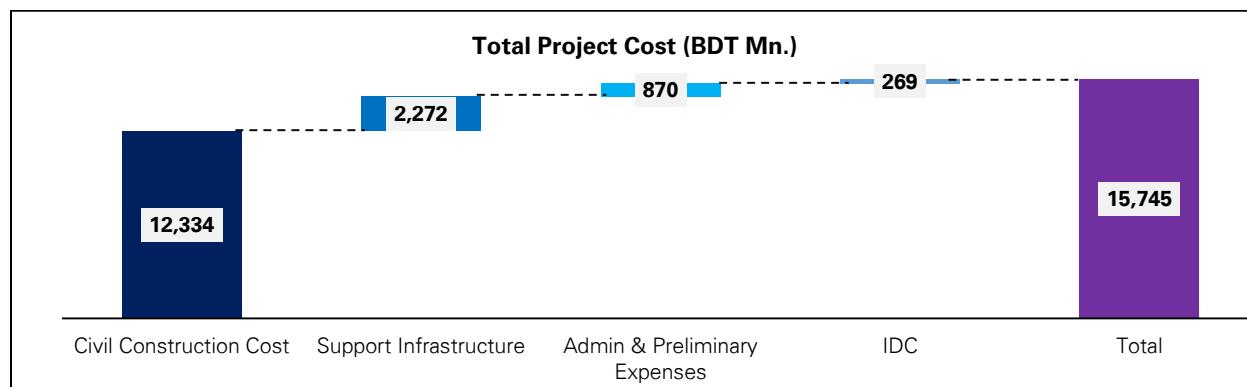
Further, a geo-technical investigation was conducted in 8 borehole locations within the site to ascertain the soil quality and determine the suitability of the envisaged project at the site. The SPT, cohesion, angle of internal friction, unit weight of soil indicated that the soil layers have very good load bearing capacity and are suitable for multi-storied building.

Financial Feasibility Assessment and PPP Project Structuring

The financial feasibility assessment was undertaken by making various assumptions of the capex and opex and other parameters associated with the project.

The capex was estimated on the basis of the finalized concept plan and utilizing the Bangladesh PWD Schedule of Rates 2014. The opex and other costs like development costs and financing costs and parameters like construction phasing are based on market understanding. The Transaction Advisor fees have been taken at actuals.

The total cost of the project comes to **BDT 15,745 million**. The break-up is provided below:



The Revenue assumptions were based on market understanding, which were further escalated by 10% based on the inputs received from National Housing Authority.

Using the cost and revenue assumptions, the returns for the Base Case were calculated using an MS Excel based Financial Model. In the Base Case of the project, there is no payment from the private developer to National Housing Authority – in the form of Upfront Premium or Revenue Share or Built-up area. The returns for the Base Case are provided below:

Returns Summary: Without Upfront Premium and Share of Revenues to NHA	
Component	Assumption
Land Sharing Ratio (NHA : Private Developer)	1.07 : 7.20 (in acre)
Equity-Debt Ratio	30 : 70
Total Project Cost	BDT 15,745 million

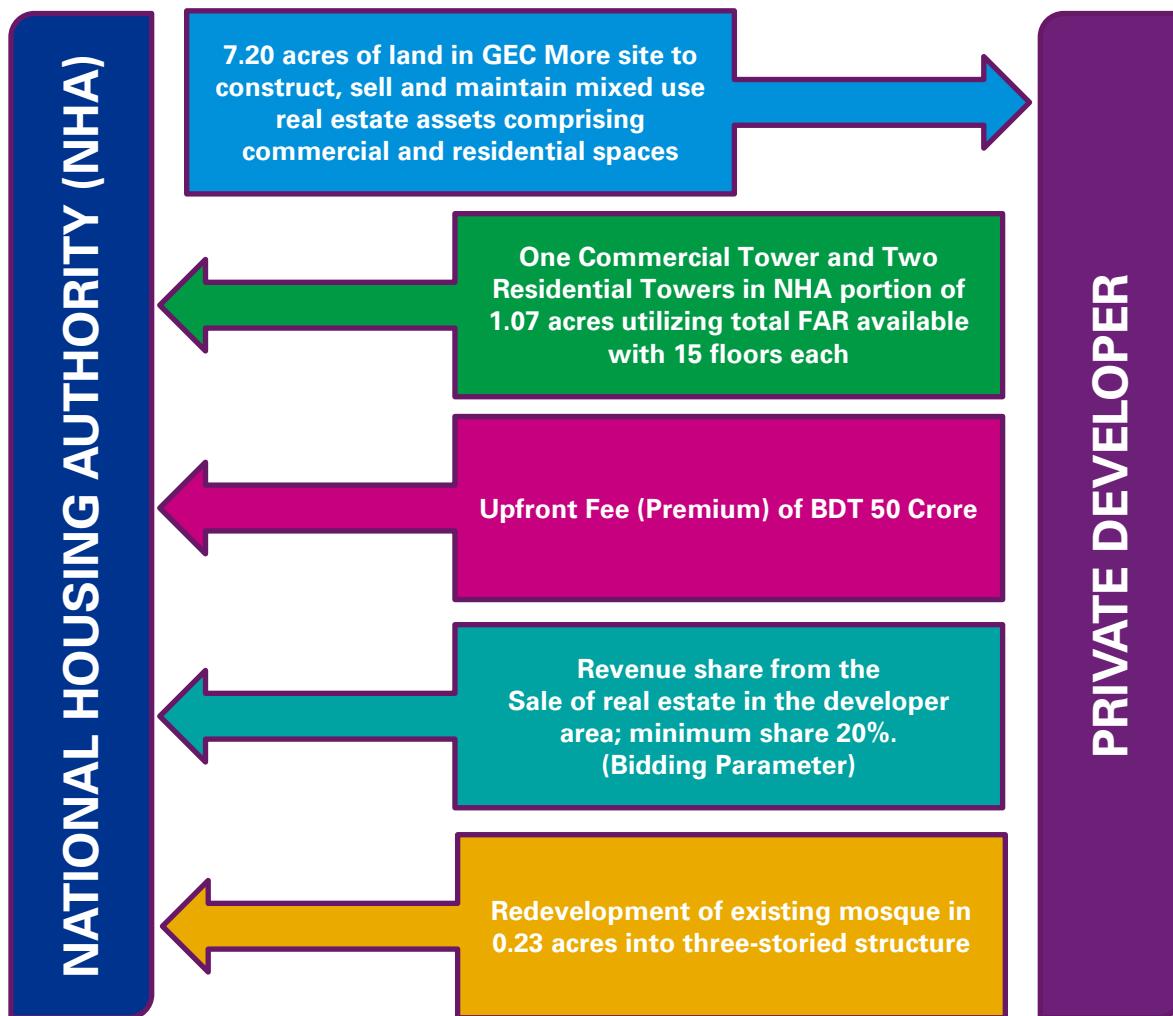
Equity Financing	BDT 4,724 million
Debt Financing	BDT 11,022 million
Project IRR	32%
Equity IRR	50%

The calculated returns for the Base Case were more than the returns expected by the market.

Further, to ensure that the risk-return allocation is optimum both for NHA and the private partner and to ensure that NHA at least is able to secure at least the approximate value (BDT 450 Cr.) of the 7.20 acres land, for which it will offer development rights to the developer, three project structuring options were evaluated as follows:

- **Option 1: Fixed upfront premium or annuity to NHA**
- **Option 2: Additional housing units to NHA**
- **Option 3: Revenue share to NHA**

Option 3: Revenue Share to NHA was recommended by KPMG as it was found to be positive across most evaluation criteria like Ease of Bid Evaluation, Benefit to NHA from Project upside and Impact to Bidder due to market downside, among others compared to the other two options. The final PPP structure was conceptualized in discussion with National Housing Authority and is shown below:



On the basis of revenue and cost assumptions and the PPP structure finalized the returns were calculated. This is shown below:

Returns Summary: With Upfront Premium of BDT 500 Million and 20% Share of Revenues	
Component	Assumption
Land Sharing Ratio (NHA : Private Developer)	1.07 : 7.20 (in acre)
Equity-Debt Ratio	30 : 70
Total Project Cost	BDT 16,330 million
Equity Financing	BDT 4,899 million
Debt Financing	BDT 11,431 million

Project IRR	16%
Equity IRR	23%

The calculated returns for the finalized project structure were in line with the returns expected by the market.

Further, an analysis was undertaken of organizations funding infrastructure projects in Bangladesh. A few among these agencies are as follows:

- Infrastructure Development Company Limited (IDCOL)
- Bangladesh Infrastructure Finance Fund Limited (BIFFL)
- International Finance Corporation (IFC)
- CDC Group
- European Investment Bank
- Proparco
- Asian Development Bank
- Islamic Finance and Investment Limited

Assessment of Environmental and Social Impact

As part of the Feasibility Study, an Assessment of Environmental and Social Impact of the project was conducted by the project team. As a first step, a screening assessment was undertaken as a precursor to a more detailed exercise. After the screening, an Initial Environmental Examination (IEE) was undertaken by the Environmental Expert.

The initial screening indicated minor environmental effects like cutting of trees within the site, impact on fauna within the site, waste generation and minor air and noise pollution.

The summary of the Initial Environmental Examination (IEE) are mentioned below:

- As per ECR 1997, the project can be categorized under Orange B (Category #8 – hotels, multi-storied commercial and apartment buildings)
- Rule 7 of ECR 1997 states that the proponent of such projects must obtain a Location Clearance Certificate and an Environmental Clearance Certificate (ECC) from the Department of Environment (DOE)
- Initial Environment Examination (IEE) has to be conducted to fulfil the requirements of the Department of Environment
- The project is expected to have little potential for environmental impacts
- The few environmental impacts that have been identified can be mitigated by the measures mentioned in the IEE and EMP
- **IEE document will be sufficient and acceptable to DoE as part of the ECC application and further study for impact assessment will not be necessary**

The project does not involve any land acquisition and consequently no rehabilitation and resettlement issue is envisaged. Further, there are no indigenous people or ethnic minority groups present in the project location. Therefore, no social impact is envisaged except relocation of families of employees staying within the project site.

Developer Workshop in Chittagong

A Developer workshop was conducted by KPMG on behalf of National Housing Authority, Bangladesh in Chittagong to create awareness about the GEC More PPP Project among the prominent developers of Bangladesh. The developer workshop was held on 25 May 2017 in The Peninsula, Chittagong. Most of the prominent developers of Chittagong participated in the workshop. The National Housing Authority was represented by Mr. Kawser Morshed, Executive Engineer, NHA and Mr. Choton Chowdhury, Sub-divisional Engineer, NHA.

The KPMG team presented to the participants the following aspects of the Project:

- Project Background
- Site and Location Overview
- Concept Plan
- PPP Project Structure
- Key Project Features
- Timelines

The project concept, the project structure and key project features were explained to the participants in detail. The queries of the participants on the project were answered and comments and suggestions of the developers were collated so as to incorporate them suitably during the Phase 2 of the project involving PPP Procurement Process Development and Implementation.

Way Forward

The submission of the Final Feasibility Study Report marks the end of Phase 1: Detailed Feasibility Study and Project Development for Multi-storied Commercial cum Residential Complex project at Chittagong.

Subsequent to this, the Phase 2: PPP Procurement Process Development and Implementation will commence. The main objective of the Phase 2 is to help National Housing Authority, the primary implementing agency to on-board a private partner/ developer to develop the project in line with the Project Structure finalized during Phase 1.

It has been already decided that the procurement shall be single stage. The major deliverables in Phase 2 shall be as follows:

- **Project Information Memorandum**
- **Invitation for Bid (IFB) document with Technical and Financial Eligibility and Evaluation Criteria**
- **Contract Document with terms and conditions for successful execution of the project**

Other assistance will be provided to NHA as per the scope of services.

1 Introduction

1.1 Background of the assignment

National Housing Authority was constituted under the Ministry of Housing and Public Works (MoHPW), Bangladesh by merging two organizations, viz. Housing and Settlement Directorate (HSD) and Deputy Commissioner Settlement (DCS), as per the National Housing Authority (NHA) Act 2000. This was implemented with effect from 15th July, 2001 by a government notification. The organization has the following mandates³:

- Ensuring housing for all with special emphasis on the disadvantaged, shelter-less, destitute, and low and middle-income group people
- Making available suitable land for housing at an affordable price
- Developing mechanisms to discharge formation of slums and squatter settlements, unauthorized constructions and encroachments
- Mobilization of resources for housing through personal savings and financial institutions
- Developing the institutional and legal framework to facilitate housing
- Providing encouragement to universities, research institutions and research centres for research on housing oriented

To achieve the above mandates, the Government of Bangladesh has set forth a Housing Strategy under the National Housing Policy (NHP). Some of the salient features of the Housing Strategy include:-

- Housing will be given due priority in the national development plans
- The role of the government in housing will be to supply serviced land at reasonable price and to help create and promote housing financing institution
- Efforts will be made to increase affordability of the disadvantaged and the low income groups through providing credit for income generation
- Improvement and rehabilitation of the existing housing stock will be given priority by the government alongside new housing
- Encroachment on public land and unauthorized constructions will be discouraged
- Facilitate incremental house building and ensure wider application of resources
- Conservation of the natural environment and preservation of cultural heritage in new housing projects

As a part of its mandates, NHA continuously pursues the development and promotion of real estate activities to cater to the needs for commercial and residential facilities of the citizens. Some initiatives have already been taken and implemented by the NHA in various areas of Chittagong mostly through public sector financing.

At GEC more, Nasirabad in Chittagong, the National Housing Authority has planned to develop around 8.39 acres of its land through PPP. On the basis of in-principle approval obtained from the Cabinet Committee

³ Website of National Housing Authority, Bangladesh - <http://www.nha.gov.bd/charter.html>

on Economic Affairs (CCEA) Bangladesh on 4th November 2015, NHA has intended to construct a multi-storied commercial cum residential apartment complex with modern amenities. NHA has planned to build a mix of commercial and residential apartment complex along with an office building for NHA Chittagong on a PPP basis.

NHA intended to appoint a transaction advisor for provision of technical, commercial, financial, transaction, environmental and social advisory services to support the process for appointment of a PPP developer for this project.

In line with the above requirement, the National Housing Authority (NHA) requested support from PPP Authority, Bangladesh which supports the line ministries and other government organizations in identifying, developing, tendering and financing of PPP projects. The PPP Authority, Bangladesh issued an RFP for selection of a consultant for provision of Technical Advisory Services for the above project.

On the basis of its submission for this RFP, KPMG Advisory Services Private Limited has been appointed by the PPP Authority, Bangladesh for providing Transaction Advisory Services for Construction of Multi-storied Commercial cum Residential Apartment Complex with Modern Amenities at Nasirabad, Chittagong.

1.2 Scope of Services

KPMG has been appointed by PPP Authority, Bangladesh to carry out Transaction Advisory for a Multi-storied Commercial cum Residential Complex in Chittagong to be implemented on PPP basis, taking into account issues relating to technical, financial, commercial, social, economic, environmental and other relevant aspects including local and national issues, applicable laws, regulations, standards, specifications, etc. Under the scope, KPMG is going to carry out the feasibility study and also manage the Bid Process for on-boarding a private developer. The detailed activities to be undertaken by KPMG are listed below:

Phase 1: Detailed Feasibility Study and Project Development

1. Needs Analysis

- The strategic objectives of the Ministry of Public Works and the NHA.
- Assessment of the need for provision of service and analysis of demand for various commercial facilities in the area.
- Carrying out socio-economic, commercial and technical assessment of the Project.
- Outline of the scope of the project including identification and mix of commercial vs residential facilities.
- Outlining the key performance Indicators that the service will be measured against.

2. Institutional Assessment

- Conduct an institutional analysis to determine the roles and responsibilities of NHA and other relevant government agencies that will have responsibilities (if any) for implementing of associated or linked projects (if any).
- Determine the budget requirement for implementing linked projects (if applicable)

3. Technical Assessment, Preliminary Engineering and Survey Analysis

- Scoping and detailed assessment of the technical suitability of the area selected for the project.
- Conduct a technical due diligence including identifying requirements for the project including the amount of land, critical inputs, utility services and access arrangements that will need to be secured, topography, soil condition analysis etc.
- Develop an initial project design
- Prepare a broad master plan for the project
- Prepare estimates of capital and operating costs for the project
- The detailed tasks that are expected to be carried out as part of the Technical Assessment, Preliminary Engineering and Survey Analysis are provided below:

I. Studies, data collection and surveys

As part of the feasibility studies, the advisors may need to collect data (both primary and secondary as required), conduct surveys and studies to:

- a. Establish a base-map as part of a graphic information system covering the project site.
- b. Study the availability and level of service of physical Infrastructure in the neighbourhood of the site. These would include the water supply, sewerage, power, drainage, telecom etc.
- c. Review previous studies and map planned and on-going projects surrounding the project site including communications networks, other civil infrastructure projects, utility upgradation etc.
- d. Advice an overall development plan linking the project including township and local market development
- e. Study of real estate trends: This analysis can be subdivided into the following segments:
 - The developer's perspective: A perception analysis study for the major developers to identify preferences on product mix (residential vs. commercial), price, amenities, positioning, etc. from the perspective of potential developer.
 - Commercial Survey: An opinion survey of commercial in primary, secondary and tertiary catchment areas shall be carried out to assess the potential of the subject site for such a kind of development.
 - The occupier/ retailers perspective: A primary survey shall be carried out to assess demand and analyse the positioning of the property with respect to the

different product mix (residential vs. commercial, different size of apartments, segregation of commercial facilities)

II. Determine land costs and recommend cost-based and market-based rates

A survey of upcoming real estate activities in the surrounding areas is need to be assessed for understanding the future supply of competing developments. It would provide information on the following aspects:

- Nature of new developments coming up around the site and in its neighbourhood.
- The prices at which the properties are sold or rented currently.
- Unique feature that such developments are offering.
- The quantum of additional supply under various categories.
- The absorption period of these developments.

III. Conduct Competitive Benchmarking and Pricing

Competitive benchmarking to be conducted to study and benchmark the competing developments in the site area as well as in the city. The benchmarking will focus on profile of builder, developer, type of products, absorption rate, prevailing prices and amenities/ facilities provided by the developer.

A price band also needs to be determined that realistically captures the value proposition and optimizes the net returns from the project. Pricing (sale price/ lease rentals or as structured) to be determined.

IV. Broad Technical Assessment

As part of the scope of services the advisors need to conduct broad technical assessment of the project. The scope will include but may not limit to the following assessment:

- Site location and connectivity infrastructure
- Site land profile and access to the land
- Broad Engineering design of the site including number of buildings, number of floors in each building, broad floor design etc.
- Appropriate zoning to accommodate various project components & to ensure compatibility
- Identification of facilities and amenities in the project facility (e.g. utility management including power, water, gas etc.)
- Requirement and use of open space
- Requirement and details of other facilities (e.g. shops, parking, playground etc.)
- Saleable land/ built up area after accounting for Infrastructure to be made available
- Commercial profiling of the area
- Topography and preliminary estimates of land development Issues
- Soil type (General soli profile and sub-soil characteristics) and hydrology details

- Cyclone, earthquake, flooding considerations
- Infrastructure availability road connection, drain, power distribution network, Substation, etc.

V. Detailed Engineering Study

After the broad technical assessment, the advisors need to detail out the engineering studies with reasonable depth as required for a PPP project of this nature. These details may be required primarily for site assessment, site lay-out design and master planning as provided below:

1. Layout Design and Master Planning: Specific scope may include but may not limit to the following:

- a. Prepare layout Plan for the Sites
- b. Develop a Master Plan

The following considerations shall be made for master planning:

- Land use and zoning
- Drawing and mapping of land use mix – Accommodation Buildings, Commercial Retail, Infrastructure, Common Facilities, Road, Green Space, etc.
- Building and construction guidelines
- c. Prepare Project Implementation schedules

4. Project Scope

- Prepare broad output specification and define key performance indicators (KPIs) for the private developer
- Options Assessment of the scope of services to be provided.
- Description of services that is to be delivered by the private partner.
- Description of services to be delivered by the contracting authority, assessment of the extent to which these represent delivery of new or existing functions.

5. Environment and Social Impact Assessment

- Assessment of any environment impact in relation to the project (Initial Environment Examination and Environmental Impact Assessment).
- Recommendations report for safeguarding environment impacts (Environmental Management Plan).
- In carrying out the assessment and setting out the recommendations, compliance with relevant Bangladesh environmental and social laws, regulations, policies, procedures and guidelines and Equator Principles should be addressed.
- The detailed tasks that are expected to be carried out as part of the environment and social impact assessment are provided below:
 - I. Environment/ Baseline studies, Data Collection and Interpretation

- II. Review of the Environmental Characteristics of the Project
- III. Environmental Screening covering:
 - Assessment of:
 - Physical Environment (geology, topography, and soils);
 - Natural Drainage (surface drainage and flood risk);
- IV. Mitigation Measures
 - Detail a set of mitigation and management measures to be taken during implementation of the project to avoid, reduce, mitigate, or compensate for adverse social and environmental impacts, in order of priority, and their timelines;
 - Recommend mitigation measures to address predicted adverse impacts including through design/conceptualization for both during construction works;
 - Quantify and assign financial and economic values to mitigating methods; Quantify associated costs;
 - Prepare a monitoring plan which should ensure that the mitigation plans are respected;
 - Delineate the desired outcomes as measurable parameters to the extent possible, such as performance indicators, targets or acceptance criteria that can be tracked over defines time periods.

6. Market Studies

- Conduct a market analysis to identify the sector structure, expected growth and level of competition, assess the extent to which there is a supply gap, and prepare a pricing analysis based on a market survey to identify willingness and ability to pay, Identify critical market risks, and possible mitigation strategies;
- Assessment of local and international market capability (including developer, contractors, sub-contractors and financiers} to deliver this project.
- Consultation with potential bidders to assess market Interest in project.
- Taking into account market feedback in relation to the project scope and preliminary design of the concession contract with the private sector.
- Recommendations in relation to potential market interest and how to engage with the market to maximise competition.

7. PPP Transaction Structure

- Options assessment for structuring the project to be delivered as a PPP conforming value for money and affordability to the NHA
- Recommendations on the proposed structuring option for delivering the project as a PPP.
- Detailing the capital and operational costs of delivering the project, including direct and indirect costs, that will be incurred over the whole of the project.
- Detailing the revenue stream that will be delivered from operating the project.
- Development of various possible alternatives for revenue maximization and preparation of revenue model for the project.
- Development of a Financial Model (including all assumptions made) with functionality to carry out sensitivity analysis on variables such as lease rent/sell rate, provision of viability gap funding etc.

- Listing of all assumptions made in relation to assessing the cost and revenue of the project, Including inflation rate, discount rate, depreciation, forecast demand etc.
- Assessing the commercial viability of the project if structured with or without any direct additional government support.
- Propose alternative options for a payment mechanism if required
- Advising on any Fiscal or Special Incentives that can be considered for the project and assessing the financial Implications of these Incentives on the project.
- Assessing what additional options exist to make the commercial viability of the project more attractive while taking into account the additional financial impact and burden that may fall to the public sector.
- Recommendation on the optimum structuring approach for delivering this project as PPP.
- Advising on tax -related issues arising out of the project structuring.

8. Legal Review and Stakeholder Consultation

- Conduct a legal review to confirm that the private sector can provide the proposed outputs, and use the associated assets, identify potential regulatory restrictions, identify permits and licensing requirements, determine the status of land ownership and any potential encumbrances that may restrict usage by the private sector, Identify costs and time required to resolve these issues, and prepare an implementation plan;
- Consult with key stakeholders to confirm the findings of the market and technical analyses and identify critical risks;

9. Project Risk Assessment

- Development of risk matrix to identify and assess scale of potential projects development and implementation risk and allocation of risk against stakeholders.
- Propose mitigation measures to address risk.
- Preparation of a consolidated list of approvals/consents/clearances required from government Instrumentalities

10. Heads of Terms for Concession Agreement

- Set out the key commercial terms and conditions that will need to be reflected in the concession agreement.
- Set out a proposed payment mechanism and any alternatives.
- Set out the proposed key performance Indicators and service credits that will be Included

11. Procurement Plan

- Developing a detailed plan for developing and executing the procurement process of the project.
- Setting out a detailed timeline for project delivery.
- Propose the project team structure required to deliver the project, clarifying the type of support that will be required from the Implementing Authority.
- Detail the roles and responsibilities of the consultant in relation to each stage of procurement.

- Proposing a governance arrangement for ensuring project oversight and delivery.
- Development of an outline structure for the Project Information Memorandum, RFQ and RFP document.
- Develop Proposals of how transfer of knowledge can be embedded through tour and training under Phase 2.

Phase 2: PPP Procurement Process Development and Implementation

1. Production of Phase 2 Inception Report

The Transaction Advisor shall prepare and submit an inception report for agreement by the Implementing Agency. The inception report shall be a further elaboration of the consultant's submission towards carrying out all the activities and deliverables under Phase 2. It will set out the methodology to be followed, the proposed work plan, the key interim and final delivery milestones, the schedule of timing for the deliverables and the frequency of the reports that are to be produced.

2. Preparation of Procurement Documents:

- Prepare a Project Information Memorandum for potential tenderers to give them more detailed information about the project.
- Prepare the advertisements and notices required for the launch of a procurement process.
- Prepare Request for Qualification (RFQ) document to communicate the scope of the project to the potential tenderers and pre-qualify a competitive number of competent tenderers to participate in the bid.
- Prepare Request for Proposals (RFP) document to communicate the details of the scope of services that are required from tenderers, to guide tenderers in relation to their submission of proposal and to select a tenderer to initiate negotiations for the awarding of the contract to deliver the project.
- Prepare a Heads of Terms of the key commercial terms and conditions.
- Provide input into the draft concession contract in accordance with applicable Bangladeshi laws, taking into account the PPP policies, guidelines and the draft PPP model concession agreements.
- Prepare a strategy paper on the proposed payment mechanism and the calibration of the performance deduction regime that embeds the risk allocation proposal set out in the Detailed
- Feasibility Studies and demonstrates the impact of different risk scenarios including the impact of performance deductions.
- Prepare a tender evaluation strategy paper that sets out the bid evaluation system and criteria, designs a suitable bid process that maximizes competition, addresses how variant bids (if any) will be addressed.
- Prepare a Service Requirements document that sets out the output specifications incorporating the key performance indicators and the thresholds that apply to each.
- Liasise and co-ordinate with other advisors, such as the legal advisor, appointed by the Implementing Agency/PPP Authority to support the implementation of the project.
- Prepare the environmental and social elements of the Information Memorandum, answer questions related to environmental and social issue raised by investors during their due diligence.

3. Engagement with Market

Support the Implementing Agency to:

- Market the project among reputed private investors/operators including assistance in shaping advertisements for local, regional and international media, organizing meetings, visits and presentations to reputed international operators to enable a sufficient level of interest in bidding for the project.
- Support the launch of the RFQ process by arranging and conducting Bidders' Conferences to discuss the RFQ requirements and set out the project context.
- Respond to requests for clarification from bidders on the RFQ, RFP and other documents including addendum if any required.
- Carry out detailed consultations and meetings with potential tenderers at the RFQ and the RFP stages to discuss the project, bidding documents and other relevant issues in addition to regular bidder conferences.

4. Project Management and Governance Arrangements

- Support the Implementing Agency in putting together proposals for a governance structure to monitor and implement the project.
- Provide project management and administrative support to the Implementing Agency for delivering the project.
- Provision of support to the Implementing Agency in the preparation of presentations and documents to report on project progress and issues.
- Working together with other advisors and managing other advisory inputs to support the Authority in developing a consolidated view in delivering the project.
- Monitoring and providing advice on performance of bidder against any conditions precedent to financial close.

5. Procurement Support

To assist the Implementing Agency in carrying out the following activities:

- Prepare a virtual data room containing key documents and information, including the draft concession contract and RFP, to assist pre-qualified bidders in preparing bids.
- Prepare a virtual data room to enable members of the Implementing Agency's project team and key stakeholders to securely access, share and store project documents.
- Developing mechanisms to evaluate responses to the RFQ, drafting an evaluation report and recommending the list of pre-qualified bidders for the concession contract.
- Respond to requests for clarification from pre-qualified tenderers on the draft concession Contract, RFP and other documents and information included in the virtual data room.
- Arrange and conducting one or more tenderers Conferences to discuss the draft concession contract and RFP with the pre-qualified tenderers.
- Provision of commercial, financial and technical input in drafting the concession agreement and schedules, drawing upon the deliverables of Phase 1 of the Project and including all specific requirements of the project to be provided by the prospective concessionaire.
- Finalize the concession contract and RFP to take into account comments and requests for clarification received from the pre-qualified tenderers.
- Issuance of the concession contract and RFP to the pre-qualified tenderers.

- Receipt and developing mechanisms to evaluate responses to the RFP from the pre-qualified tenderers in accordance with the process set out in the final RFP.
- Drafting of evaluation report setting out the conclusions of the evaluation process.
- Recommendation of the selected tenderer for the concession contract.
- Award the concession contract bid to the selected tenderer.
- Finalize the concession contract with the selected tenderer to enable signing of the concession contract.

6. Commercial and Financial Support

To assist the Line Ministry/Implementing Authority in the development and implementation of the project and the Concession Agreement by providing the following support:

- Assess and advise on optimizing financing and funding strategies and identifying flexibility, opportunities and risks.
- Update the Project Financial Model developed as part of the Detailed Feasibility Study and review and scrutinize financial models submitted by tenderers. This will include:
 - Review and refinement of the key financial inputs, project capital cost, operation and maintenance costs, and other costs that were identified in the Detailed Feasibility Study;
 - identification of the potential sources and cost of capital and terms and conditions of loans to determine the debt payment schedule;
 - Determination of the revenue projection, income statement projection, balance sheets, and cash flow statements over the life of the project;
 - Prepare projections of working capital requirement;
 - Calculation of various metrics used for assessment of feasibility, including NPV, IRR, debt service coverage ratio, cash and discounted break-even, financial ratios etc.;
 - Conduct sensitivity analysis on the major parameters including capital cost, O&M cost, inflation rate revenue to explore its sustainability under different scenario.
- Financial assessment of the
 - need for any additional support (e.g. Viability Gap Financing) that may be required to make the project commercially viable;
 - the commercial implications of the linked projects;
 - the fiscal Incentives and waivers as may be required for the project.
- Development of a Project Risk Report to identify the risks in relation to the project, advise on the balance of risk transfer and evaluate the commercial and financial implications of the risks allocation.
- Provide expert commercial and financial advice and input in the development of the procurement documents and during the procurement process.

7. Early Operations Support

Support the Line Ministry/Implementing Authority to:

- Develop an operations governance plan detailing the governance, monitoring and reporting arrangements that will apply from the financial close and launch of operations.
- Prepare a presentation to identify the roles and responsibilities of the public sector project representatives in managing the operations concessionaire.
- Prepare a presentation to highlight the key commercial issues and risk that need to be managed during the period of operations of the contract.

8. Training and Transfer of Knowledge

- The Transaction Advisor shall arrange a short offshore Study Tour for up to 1 week for 3 (three) government officials (from line Ministry/ Implementing Agency/ PPP Authority) to showcase similar projects that have been delivered in other countries or regions.
- Throughout the period of the assignment the Transaction Advisor shall on request deliver periodic seminars/training sessions (2 or 3 sessions in any one calendar year) on the delivery of PPP projects to relevant stakeholders from the Implementing Agency, Line Ministry and linked public sector authorities.

1.3 Approach & Methodology

The Approach for this assignment and the methodologies that have been followed are structured in line with the Scope of Services envisaged by PPP Authority, Bangladesh and National Housing Authority (NHA). We have also been guided by our understanding of the entire process of providing Feasibility Study and Transaction Advisory services gained through numerous similar assignments across sectors. In addition, since we believe that National Housing Authority has in-depth knowledge about the real estate industry in Bangladesh, we have adopted a participatory approach and have worked in unison with the representatives from National Housing Authority so as to incorporate their suggestions and inputs at various stages of this assignment.

The methodology adopted by KPMG for undertaking the Feasibility Study is shown below:

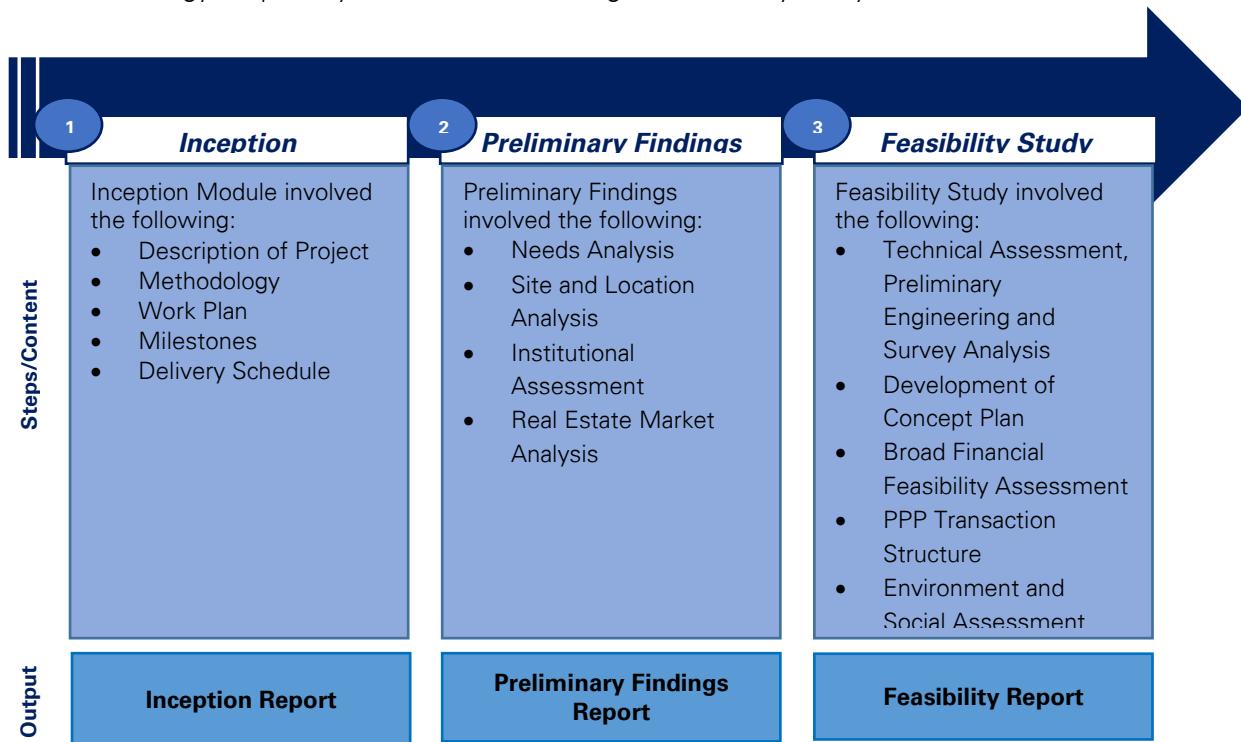


Figure 1: Our modular methodology for Phase 1 of the assignment

This Report pertains to the part – **Feasibility Study** and incorporates all the findings from the previous reports and the specific steps undertaken as part of Feasibility Study are shown below. These steps cover all the major requirements of the feasibility study as per the Scope of Services.

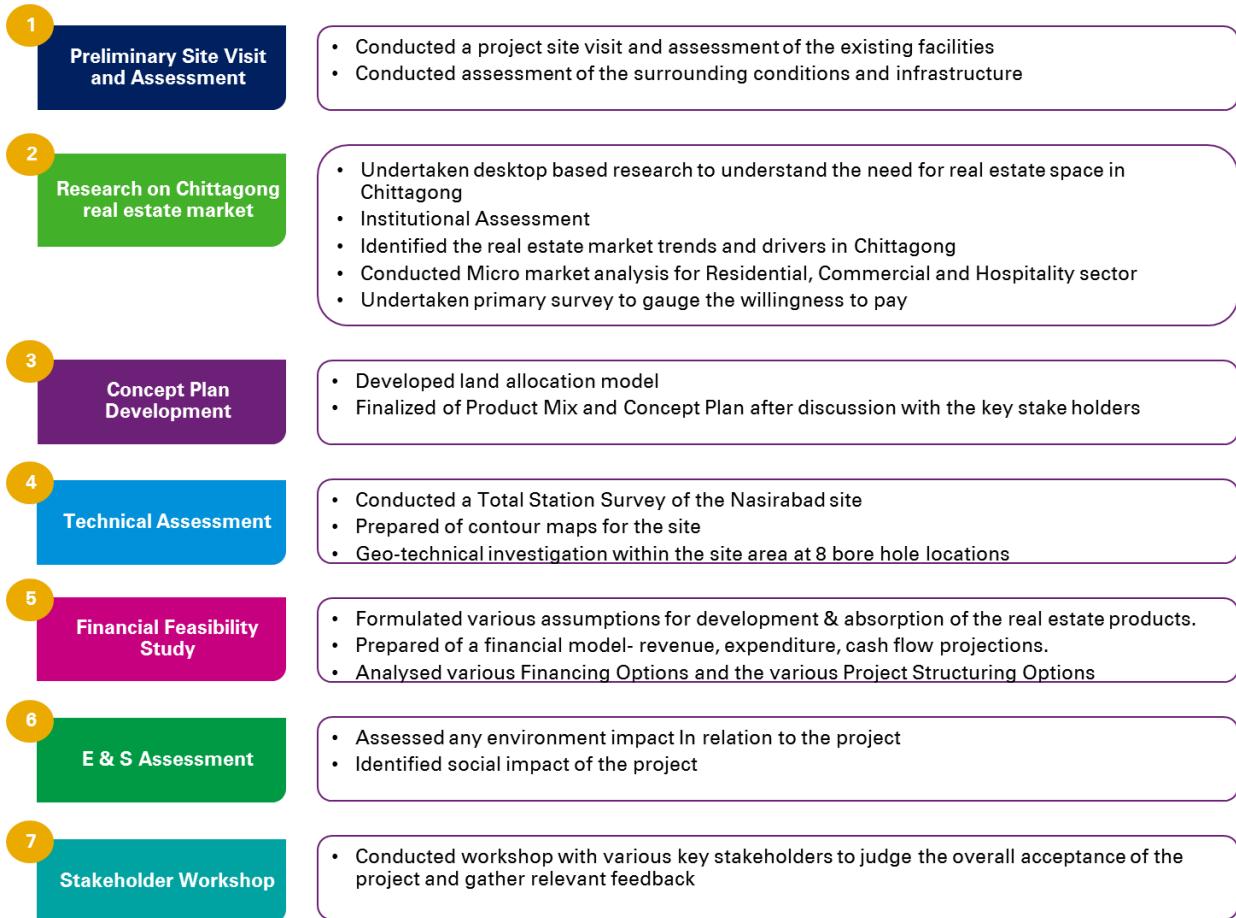


Figure 2: Step undertaken for conduct of Feasibility Study

1.3.1 Preliminary Site Visit and Assessment

The first step of the Feasibility Study was Preliminary Site Visit and Assessment, which acted as a precursor to subsequent steps. The project team from KPMG visited the site identified by NHA for the project from 27 to 28 September 2016. Initially, the team assessed the site for the proposed development including the site layout, its existing infrastructure and facilities, its approach road, its terrain and its surroundings. Additionally, the team also visited the surroundings of the site to gather a sense of the associated infrastructure requirements.

The preliminary site visit was undertaken jointly in presence of representatives from National Housing Authority, Bangladesh.

1.3.2 Research on Chittagong real estate market

The KPMG team conducted both secondary and primary research to identify the need of a Multi-storied Commercial cum Residential Complex in Chittagong. The specific activities have been mentioned below.

1.3.2.1 Needs Analysis

The Needs Analysis aimed to identify the strategic objectives of the Ministry of Housing and Public Works (MOHPW) and the National Housing Authority (NHA). It also traced the importance of Chittagong as an Economic Hub of Bangladesh and hence its need for real estate space.

The project team carried out the activities under this sub-module through the following means:

- Discussion with NHA personnel and other key stakeholders
- Extensive secondary research included review of previous studies, research papers and policy documents of the government

1.3.2.2 Institutional Assessment

The KPMG team also conducted an institutional analysis to determine the roles and responsibilities of NHA and other government agencies that will have responsibilities for implementation of associated or linked projects (which will impact the development of this project).

1.3.2.3 Review of Key Drivers for Real Estate Market

The KPMG team reviewed the relative advantages and challenges faced by the real estate industry in Chittagong from multiple secondary data sources. A review of existing policies and objectives of the Government and authorities in Chittagong was done in order to highlight the key drivers for real estate in Chittagong.

1.3.2.4 Analysis of Real Estate Industry Trends

With the objective of establishing the market potential, a brief analysis of trends in the real estate industry in Bangladesh over the past few years was undertaken. Data obtained from the administration and secondary sources were analysed to indicate the situation prevalent in the real estate industry of Chittagong.

1.3.2.5 Real Estate Market Studies

To establish the true potential for the identified site, the demand for envisaged real estate products and the proposed project, a detailed analysis of the Chittagong real estate market was undertaken. The KPMG team conducted extensive primary and secondary research to analyse the various micro markets in the Chittagong area and identify the demand supply scenario and pricing of the Residential, Commercial and Hospitality components of the real estate market.

The KPMG team interacted with more than 20 prominent real estate developers as well as with Local property brokers, architects and banking institutions. The team also conducted extensive discussions with other key stakeholders such as the Real Estate & Housing Association of Bangladesh (REHAB), Chittagong Development Authority (CDA), District Commissioner's Sub Registrar Office and Local Government Engineering Department (LGED).

A number of interactions were conducted with these stakeholders in form of general discussions, interviews, surveys and their feedback was collected on demand of residential apartments, commercial complex in Chittagong, profile of amenities provided by developers, aspects of land pricing, hospitality sector demand, etc.

1.3.2.6 Willingness to Pay Survey

A "Willingness to Pay" survey was conducted to gauge the willingness and ability of customers belonging to both residential and commercial segments, to pay for a particular real estate product or service. It provided a rough estimate of price that can be charged for such real estate product or service and this input was consequently factored in during revenue estimation. As per the scope, the project team carried out a "Willingness to Pay" survey of 101 respondents, out of which 50 respondents were residential apartment owners and 51 respondents were commercial (office and shop) owners.

1.3.3 Technical Assessment

Technical Assessment mainly dealt with the broad assessment of the project from engineering/ technical angle. Detailed Engineering for the project shall be covered by the developer of the project before actual construction and was therefore, not performed as part of Technical Assessment. The Technical Assessment aided in finalizing the capital cost of the project. The activities, which formed part of the Technical Assessment are as follows:

1.3.3.1 Total Station Survey of the site

A survey of the entire area of the site was organized by the Eptisa India, a sub-contractor of KPMG in this project. The survey work was carried out using an Electronic Total Station by M/s. Suchana Engineers, a reputable civil engineering firm based in Dhaka in line with the Survey Brief furnished by Eptisa India. This Survey Brief is provided in Annexure – 13.1. On the basis of the data collected during the Total Station Survey, a topographic survey map of the site was prepared by the survey team using the design and drafting software AutoCAD. Contours with 0.25m for flat land and 0.50m for slopes and hills were superimposed on this topographic map for better understanding of the relief of the site.

1.3.3.2 Geo-technical investigation at 8 borehole locations within the site area

Geo-technical investigation was also conducted for the project. The investigation was conducted at 8 borehole locations within the site for the project. M/s Suchana Engineers, Dhaka carried out the Geo-technical investigation using a brief prepared by Eptisa India. The Brief for geo-technical investigation is provided in **Annexure – 13.2**.

1.3.4 Development of Concept Plan

After assessment of the real estate market in Chittagong, the KPMG team developed a land allocation framework for the project. The product mix for the project was formulated on the basis of the market assessment and inputs from the Technical Assessment. This product mix was finalized post discussions with NHA and the PPP Authority. The basic concept plan provided details of the total area of the proposed commercial and residential complex and the area break up for NHA and Private Developer real estate components.

Based on the concept plan proposed and the envisaged product mix, an indicative layout diagram of the Multi-storied Commercial cum Residential Complex was prepared in AutoCAD.

1.3.5 Financial Feasibility Study

The financial feasibility analysis was done by means of a spreadsheet based financial model, which had inputs from the previous steps as well as some additional financial assumptions. Additionally, being a PPP with the involvement of a public authority – NHA and a private developer, the structuring options had to be properly evaluated including the risk and reward sharing mechanism and its financial impact on the project. The following activities were undertaken for the financial feasibility study:

1.3.5.1 Formulation of various assumptions for development of the project

A financial model has multiple assumptions regarding both construction and operation. The various assumptions necessary were finalized on the basis of discussions with various stakeholders and secondary research (web-resources). The assumptions on the following aspects were finalized:

- Development Phasing
- Demand and Absorption Phasing
- Capital Expenditure – using Bangladesh PWD Schedule of Rates 2014
- Development Cost
- Interest Rate on Capex Loan
- Operating Cost
- Revenue

1.3.5.2 Preparation of a financial model - revenue, expenditure, cash flow projections and calculation of financial returns

Using the assumptions, an MS Excel based financial model was prepared. The model was prepared with the following assumptions:

- Lease Period – 99 years
- Construction Period – 6 years

The major parts of the financial model were as follows:

- Assumptions
- P&L Statement
- Balance Sheet
- Cash Flow Statement

As output from the model, the Project IRR and Equity IRR were calculated. Using the finalised structuring options, a sensitivity analysis was undertaken for ascertaining the rates of returns for various values of upfront payment made and revenue shared by the private developer to/ with National Housing Authority.

1.3.5.3 Analysis of various Project Structuring Options

To ensure the success of this project - Multi-storied Commercial cum Residential Complex in Chittagong, analysis of the structuring options was a prerequisite. The project team carried out secondary research (from web-based resources) and also interacted with various stakeholders – developers, Government Authorities and consultants to identify the structures usually followed in Bangladesh and suitable to this type of real estate project. The term of involvement of the private party, the share of revenue/ profit, upfront payment, sharing of housing units, etc. were decided based on this analysis. The suitable PPP structure was finalised post discussions with NHA and PPP Authority.

1.3.5.4 Analysis of various Financing Options for the project – Banks, Financial Institutions, etc.

Infrastructure projects especially PPP projects are funded by a wide variety of organizations worldwide like commercial banks, infrastructure funding agencies and multilateral institutions. Both debt and equity funding is provided by some multilateral institutions.

Analysis of various financing options for similar projects in Bangladesh is required to understand whether such projects can be funded at competitive rates of interest. This increases the viability of the project. It also provides an indication of the financing avenues available to the private developer of this project. The project team was therefore, involved in the analysis of various financing options for PPP projects in Bangladesh and identifying case studies where loan funding had been provided.

1.3.6 Environmental & Social Assessment

The Environmental and Social Assessment of the project was carried out as part of the scope. Initially, an environmental and social screening was conducted by the project team. Further, the Environmental Expert prepared an Initial Environmental Examination Report.

1.3.7 Workshop for stakeholder consultation

Post finalization of the concept plan and PPP structure of the project, a consultation workshop was conducted on 25 May 2017 in Chittagong, which included prominent developers of commercial and residential properties.

The workshop was used to gauge the interest of these stakeholders in the project as well as to receive their feedback and comments on the various envisaged aspects of the project. The stakeholder consultation for the commercial cum residential complex was conducted in a workshop mode (involving extensive interaction) and all the comments regarding scope of work, project structure and commercial terms and conditions were collated.

2 Needs Analysis

2.1 Chittagong as an Economic Hub

Chittagong, situated on the shores of the Bay of Bengal, is a major coastal seaport city in the south-eastern part of Bangladesh. The second largest city of the country is also the capital of the Chittagong Division and Chittagong District. It is located on the banks of the Karnaphuli River between the Bay of Bengal and the Chittagong Hill tracts.

Historically, the natural harbour of Chittagong had always been a gateway to Bengal for centuries. It was a prominent trading centre operated by the Portuguese in the 16th and 17th centuries and later ceded to the British East India Company. Chittagong Port was the terminus for the Grand Trunk Road and the Assam Bengal Railway. The city, being the site of Bangladesh's Declaration of Independence in 1971 is also historically significant.

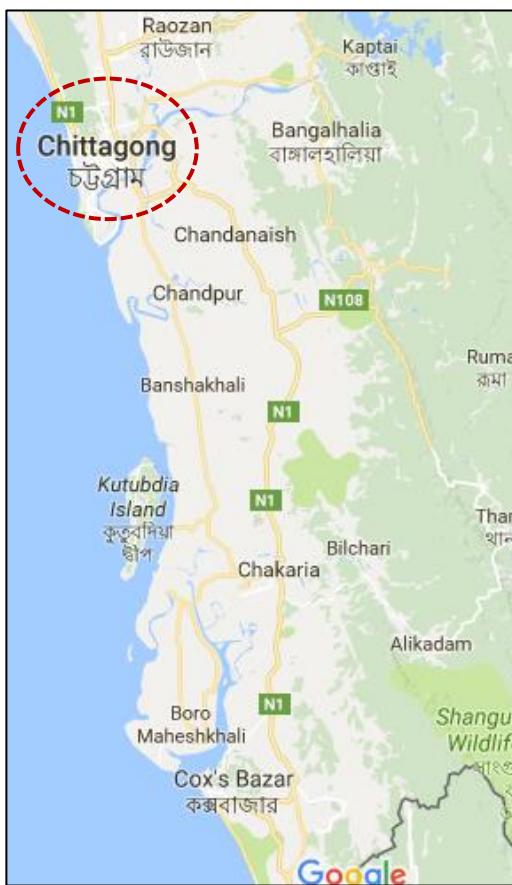


Figure 3: Location of Chittagong City

Chittagong (both the city and the region) is a major financial centre and hub for industry and trade in Bangladesh. The city is also referred to as the commercial capital of Bangladesh. Proximity to North East India, Nepal, Bhutan, Myanmar and South West China has increased the potential to develop Chittagong as a regional transshipment hub. Further, with the Port of Chittagong being developed and expanded, the Dhaka-Chittagong highway being upgraded to a 4-lane highway and the Shah Amanat International Airport

being modernized, there has been an influx of people into the city which is now being developed as a regional hub.

Chittagong has significant economic importance primarily due to the following reasons:

- The region generates a significant portion of the country's industrial output, 60% of the governmental revenue and around 80% of its international trade⁴
- The port of Chittagong is the largest international sea port of Bangladesh on the Bay of Bengal. It is the 3rd largest sea-port in South Asia after Mumbai and Colombo. The port handled a trade volume of USD 60 bn in 2011⁵
- The city houses some of the country's largest business enablers such as the Chittagong Stock Exchange, Chittagong Tea Auction and the eastern division of the Bangladesh Railway. The Chittagong Stock Exchange lists around 300 entities and has a market capitalization of USD 33 bn as of September 2016⁶. The Chittagong Tea Auction sets the price of tea in Bangladesh
- Agrabad is the major central business district of Chittagong and houses many industrial conglomerates such as BSRM, the PHP Group, the Habib Group and state owned firms such as Bangladesh Shipping Corporation, Padma Oil Company, Pragati Industries, among others
- The Chittagong Export Processing Zone is ranked as one of the leading SEZs in the world
- The city acts as the base for many key industrial sectors such as steel, shipbuilding, petroleum, textiles, chemicals, leather goods, pharmaceuticals, glass manufacturing, jute and motor vehicles among others
- The Eastern Refinery, Bangladesh's largest oil refinery is situated in Chittagong
- Many international banks such as Standard Chartered, HSBC and Citibank have operations in Chittagong
- It is the regional headquarters of many multinationals like GlaxoSmithKline, Reckitt Benckiser, Berger and Unilever
- It is the second largest city in Bangladesh in terms of total persons engaged after the capital Dhaka
- Cox's bazar, one of the two beaches in Chittagong is the largest sea beach in the world with significant tourism potential
- The largest base of the Bangladesh Navy is in the Chittagong Naval Area

Chittagong is also the export hub of Bangladesh. It also contributes 80% to the nation's total imports and 75% to total exports⁷.

⁴ The Chittagong Chamber of Commerce and Industry Website- <http://www.chittagongchamber.com/elc.php#>

⁵ https://www.files.ethz.ch/isn/162596/ISAS_Brief_271_-Chittagong_Port_%E2%80%93_Prosp...

⁶ Chittagong Stock Exchange - <http://www.cse.com.bd/>

⁷ The Chittagong Chamber of Commerce and Industry Website- <http://www.chittagongchamber.com/elc.php#>

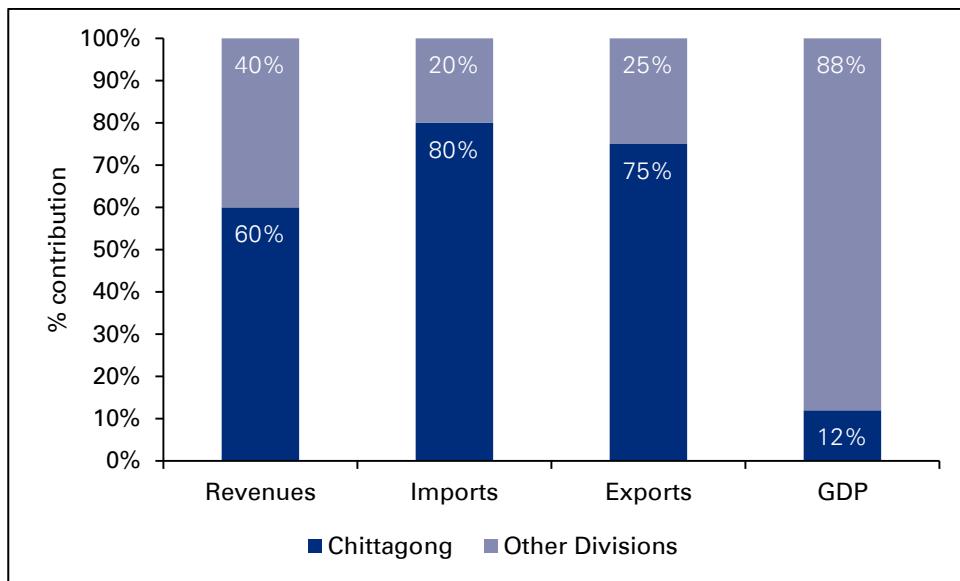


Figure 4: Chittagong's Contribution to Bangladesh's Economy

Being a major contributor to the country's economic and industrial growth, Chittagong has emerged as a major economic hub of Bangladesh. The city of Chittagong also has a crucial role for the economic development of major regions of landlocked South Asia such as Bhutan, Nepal, Northeast India and some parts of Myanmar and South China.

2.2 Need for Real Estate Space in Chittagong

Chittagong is one of the fastest growing cities worldwide in terms of growing urban per capita GDP in South Asia. In 2011, the Chittagong City Corporation had more than 1500 industries comprising offices, factories and mills⁸. With growing industrialization in the region and an increase in the number of jobs, the city has been expanding in all directions necessitating the need for more commercial spaces. However, in the absence of proper planned development of smaller urban centres at the local and regional levels, Chittagong is facing tremendous pressures of urbanization and industrialization since the last 15 years⁹.

With the metropolitan area having a population of over 10 million and the city having a population of more than 2.5 million, Chittagong is the second largest city of Bangladesh after Dhaka. In Bangladesh, the growth rate in urban population is 3.5%¹⁰ (the highest in South Asia). In Chittagong, even though the city area has remained constant at 157 sq. km, the population has almost trebled within the urban area in the last three decades. Hence, urban residents are experiencing troubles with overpopulation and lack of housing facilities.

In 2011 alone, 31,882 people migrated to Chittagong and the density of migrants is 4,951 persons per sq. km¹¹. Due to livelihood opportunities, Chittagong also faces a significant influx of migrant population and percentage of migrant population is around 68%¹². In 2011, the population density of Chittagong district was 1,442 persons per sq. km¹³. Majority (almost 75%) of households have 1-2 rooms.

⁸ Bangladesh Bureau of Statistics Data for Chittagong -

<http://www.bbs.gov.bd/WebTestApplication/userfiles/Image/District%20Statistics/Chittagong.pdf>

⁹ Chittagong City Corporation Report on Urban Decentralization and Sustainable Development in Bangladesh -

http://www.ccc.org.bd/urban_decentralization_sustainable_development_bangladesh

¹⁰ Population Data based on World Bank Indicators-

<http://www.tradingeconomics.com/bangladesh/urban-population-growth-annual-percent-wb-data.html>

¹¹ Population Density and internal migration data published by Bangladesh Bureau of Statistics -

http://www.bbs.gov.bd/WebTestApplication/userfiles/Image/PopMonographs/Volume-6_PDIM.pdf

¹² Report on Urbanization in Bangladesh: Challenges and Priorities published in Bangladesh Economist' Forum dated June 2014 - http://www.pri-bd.org/upload/file/bef_paper/1414213688.pdf

¹³ Population Density data for 2011 published by Bangladesh Bureau of Statistics -

http://www.bbs.gov.bd/WebTestApplication/userfiles/Image/PopMonographs/Volume-7_PDV.pdf

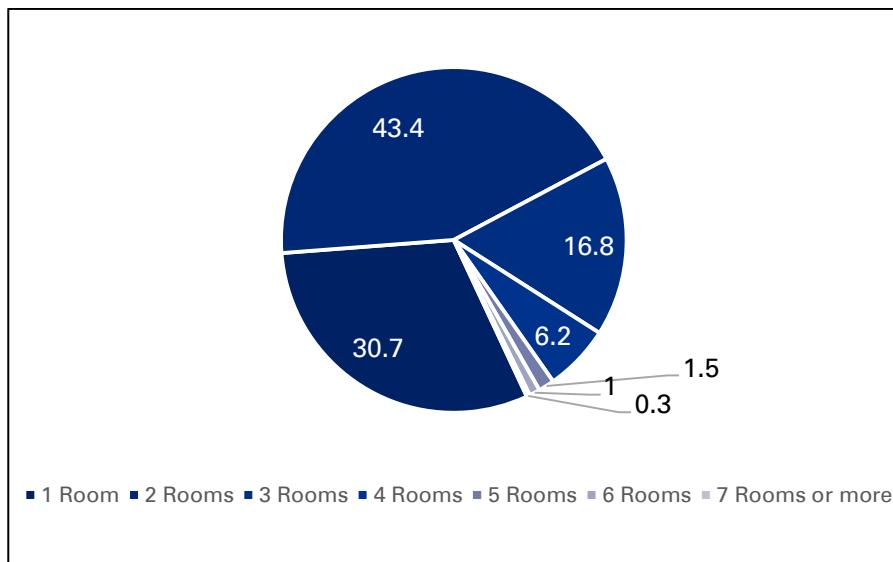


Figure 5: Distribution of Households by Sleeping Rooms in Chittagong District

The figures above clearly show that scarcity of residential area is a major issue in Chittagong which needs to be addressed. Additionally, studies show that over the last decade, the growth rate of the Real Estate sector has been lagging behind the GDP growth rate in Bangladesh. This has created a serious shortage of real estate space in Chittagong. Hence, both prices and rents are high across Bangladesh with Chittagong ranking second highest among urban locations in the country in terms of prices and rents.

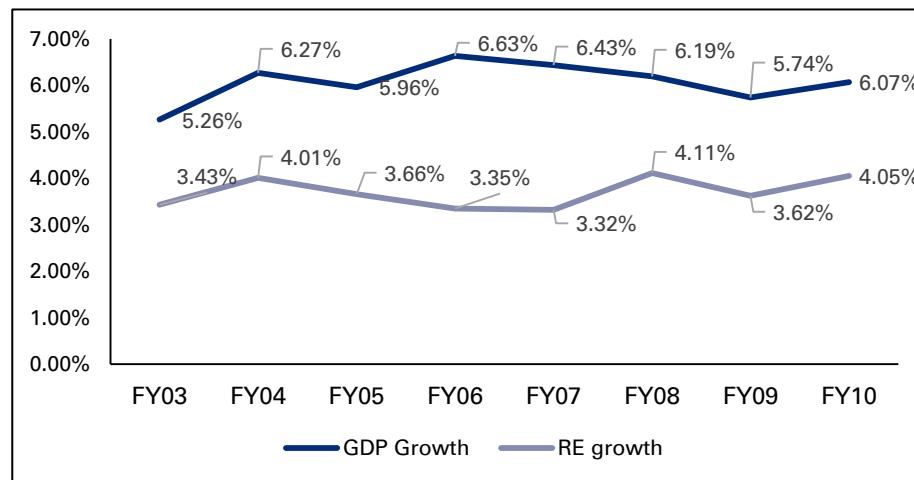


Figure 6: Comparison of GDP and Real Estate Growth Rates in Chittagong¹⁴

To develop more industry and sustain more people, there has to be a sustained effort and facilitation from the Government to upgrade and develop the infrastructure within the region. To obviate the need to

¹⁴ Comparison of growth rates of GDP and Real Estate in Bangladesh -

<http://www.lightcastlebd.com/blog/2015/07/market-insight-bangladesh-housing-sector-overview>

commit additional funding for such and similar infrastructure projects, Governments in many developing countries often undertake these projects through the Public-Private Partnership (PPP) mode. Apart from the private investment, the PPP model also has the ability to leverage private sector technical and management expertise in developing infrastructure as its unique advantage.

In light of the above, the initiative by the National Housing Authority (NHA) for *Construction of Multi-storied Commercial cum Residential Apartment Complex with Modern Amenities at Nasirabad, Chittagong* (on an 8.39 acre land) under PPP is therefore, an extremely vital step to cater to the need for residential and commercial real estate space in Chittagong and integrates seamlessly into NHA's broad vision to provide affordable housing and develop commercial and residential infrastructure.

3 Institutional Assessment

The success of a real estate project depends on multiple factors. Some of the important factors are:

- Connectivity – Road connecting to the site ensuring accessibility to the property
- Basic Utility services – Water supply, power and sewerage infrastructure existing at the site
- Accessibility – Traffic condition existing at the approach roads to the site
- Solid Waste Management – Provision of Municipal solid waste collection and safe disposal
- Zoning Norms – Developmental regulations taking care of height restrictions and deterring encroachment in close vicinity of the site

In line with that, for the proposed multi-storied commercial cum residential complex to achieve success, there are some critical linked projects, which need to be developed. These linked projects are outlined below:

- 1. Improvement of the road connectivity to the site** – The road leading to the property site is not in good condition. There is a need to undertake widening of the adjoining Zakir Hossain road connecting the site to CDA avenue road. Chittagong Development Authority (CDA) and Public Works Department (PWD) are the agencies responsible for undertaking this task.
- 2. Upgrade of basic utility services at the site** – The existing water supply, sewerage and electricity supply lines need to be augmented and expanded to support the proposed commercial and housing real estate development. Chittagong Water Supply and Sewerage Authority (CWASA) and Bangladesh Power Development Board (BPDB) are the nodal agencies responsible for undertaking these tasks.
- 3. Improvement of accessibility to the site** – The road leading to the site is congested due to heavy traffic. There is a need to improve and upgrade road linkages to GEC More for easing flow of traffic in and around the GEC More area. Chittagong Development Authority (CDA) and Public Works Department (PWD) are the agencies responsible for undertaking this task.
- 4. Provision of waste management services at the site** – Provision of municipal solid waste collection and segregation goes a long way in improving the acceptability of the property, once developed. Chittagong City Corporation (CCC) will be the nodal agency responsible for implementing this task.
- 5. Review of zoning practices around the site** – Chittagong Development Authority (CDA) should review zoning norms on CDA Avenue and ensure adherence to development regulations related to encroachments and height restrictions along the site periphery.

4 Site and Location Analysis

The site identified by NHA for the project constitutes approximately 8.498 acres and the proposed development on the site encompasses commercial and residential real estate. The site and location analysis discussed in this section broadly covers an assessment of site location w.r.t. surrounding real estate development, evaluation of existing infrastructure, applicable development regulations and the impact of such aspects on the development potential of the project site. The site and location analysis has been conducted through physical reconnaissance of the site and on-ground surveillance of regions surrounding the site for the purpose of identifying critical conditions such as access, connectivity, encroachments, relocation and rehabilitation requirements, etc. impacting the site's development potential.

An integral part of the location and site analysis is the preliminary examination of data available with NHA such as the existing site maps, technical drawings, and development plans, etc. Key aspects evaluated through visual inspection and site reconnaissance include the assessment of site conditions, availability of physical infrastructure and proximity to necessary amenities such as schools, health care facilities, commercial markets and employment hubs. Location analysis section broadly covers the macro analysis of the site, establishing its geographic significance and positioning, in relation to the spatial spread and presence of existing and upcoming areas for residential and commercial real estate activity. The site analysis takes a micro view of the site area and its immediate surroundings, highlighting the potential upsides and challenges for site development. Factoring in the location positioning of the subject site and the site conditions, the site's **SWOC** analysis has been presented highlighting the preliminary assessment of the site's development potential.

The findings of the location and site analysis have been reviewed along with the market study and technical survey findings to technically and commercially evaluate the site's development potential.

4.1 Location Analysis

The region of Chittagong consists of 26 Upazilas/ Thana, 194 unions, 890 mauzas, 1,267 villages, 46 city wards, 237 city mahallas, 10 PSs, 90 wards and 199 mohallas¹⁵. The heart of Chittagong zila is the aggregation of Chittagong City Corporation (CCC) areas, comprised of 11 main thanas or wards as follows:- Bayejid Bostham Thana, Panchlaish Thana, Chandgaon Thana, Bakali Thana, Kotwali Thana, Khulshi Thana, Pahartoli Thana, Double Mooring Thana, Halishahar Thana, Chittagong Port and Patenga Thana.

¹⁵ Community Report of Chittagong Zila (June 2012), 2011 Population and Housing Census (Bangladesh Bureau of Statistics, Statistics and Informatics Division of Ministry of Planning)

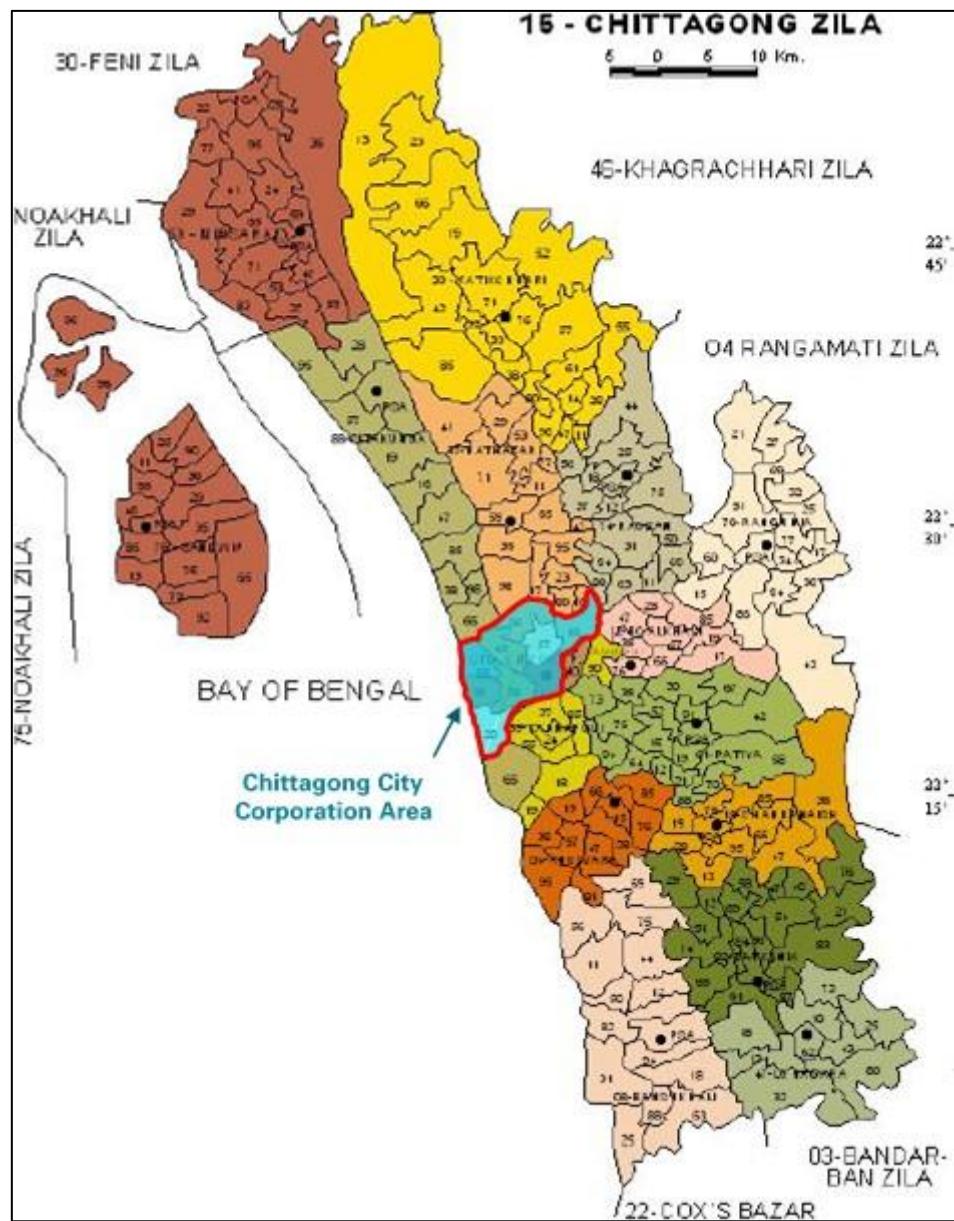


Figure 7: Map of Chittagong Divisions and Chittagong City Corporation

Within Chittagong, the compound annual population growth rate of Chittagong City Corporation has been the highest at 2.3%, much higher than the national level of 1.3%¹⁶, thus indicating the economic growth and increasing importance of the region. The subject site is part of the Panchlaish administrative ward, one of the key metropolitan areas that have emerged in the past decade as a hub for residential and commercial activities.

¹⁶ Community Report of Chittagong Zila (June 2012), 2011 Population and Housing Census (Bangladesh Bureau of Statistics, Statistics and Informatics Division of Ministry of Planning)

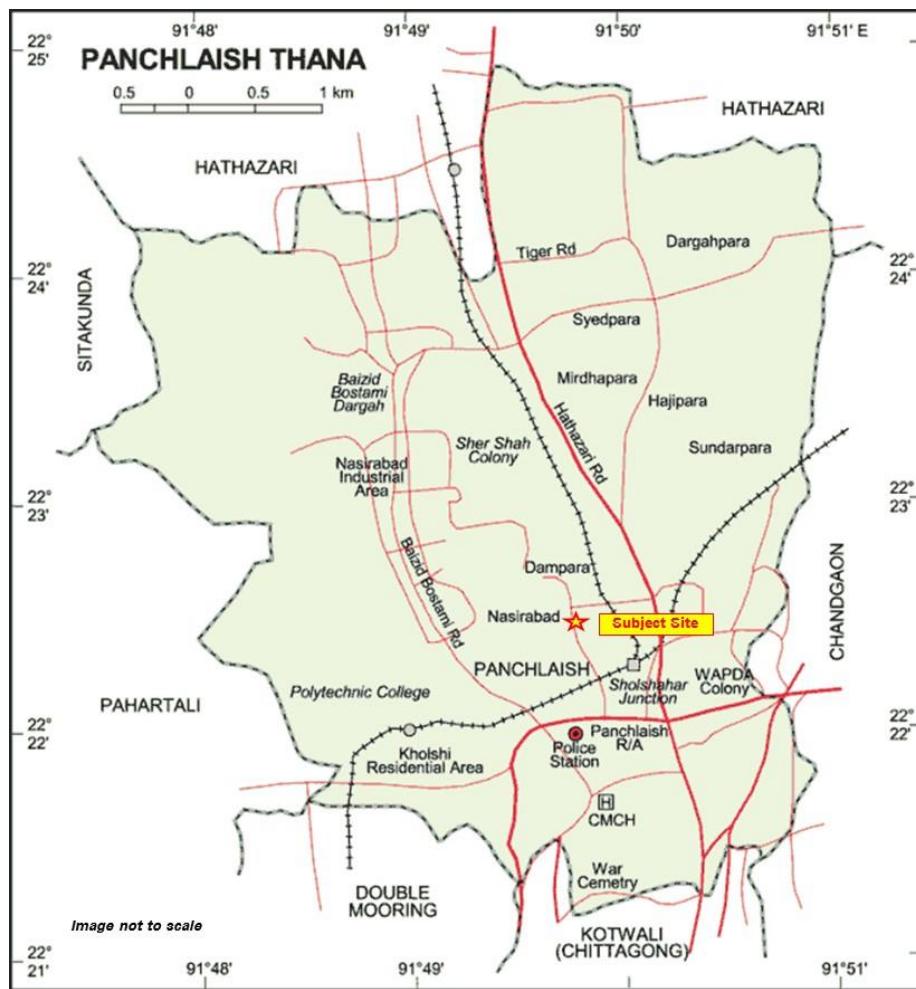


Figure 8: Location of Subject Site within Panchlaish Administrative Ward

Over the years, the city has witnessed outward growth from South to North and Panchlaish ward has undergone a major transformation over the past decade. Shifting north from Double Mooring ward housing the Central Business District (CBD) of Agrabad, development activity has led to Panchlaish becoming a major centre for commercial and residential real estate activity. In terms of presence of support infrastructure, the region houses a well-balanced mix of commercial complexes, private and government residential projects, educational institutions (school, colleges) and health care institutions (nursing homes, hospitals) while being well connected to neighboring wards having a similar mix commercial and social amenities.

The location of the subject site is at GEC More in Nasirabad – the commercial heart of the Panchlaish ward. The region is well surrounded by other prominent metropolitan wards of Chandgaon, Khulshi, Pahartali and Double Mooring and a large part of the new development activity in the past decade has accrued to this region. The image below provides a contextual perspective of the site location in Nasirabad as the city's residential, commercial and hospitality centres.

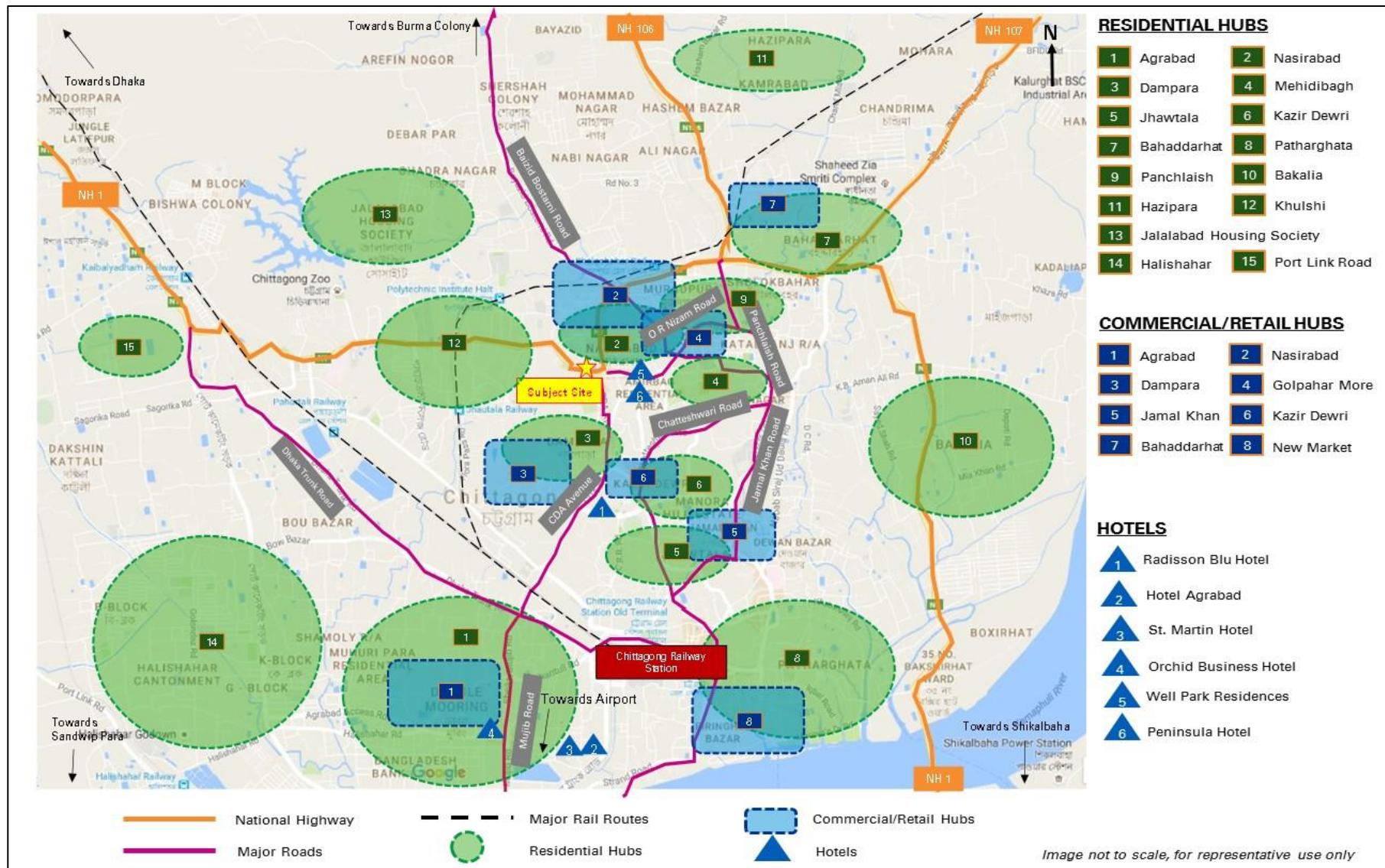


Figure 9: Location Map for Subject Site and Key Activity Hubs

From the location map, it is clear that the subject site is centrally located and is surrounded by major commercial and residential hubs of metropolitan Chittagong. GEC more in Nasirabad is also the congregation point and thus enjoys good connectivity via arterial routes such as NH -1 (*Dhaka Trunk Road*) and NH-106 (*CDA Avenue Road*), passing through the area. It is also well connected to major transport hubs such as Chittagong Railway Station and Chittagong International airport, located approximately 5 km and 20 km from the region. Since CBD locations such as Agrabad have become increasingly congested and are low on land availability for new development, majority of the real estate activity has moved to Nasirabad location, as indicated by the high concentration of residential and commercial projects by private developers already existing or coming up in the location. Connected with Khulshi (west), Sholoshahar (north), Panchlaish (east) and Dampara (south), in close proximity, the location has emerged as a prime hotspot for real estate activity in Chittagong City. Despite various peripheral areas being proposed for new real estate development such as Halishahar and Port Connecting Road, Nasirabad still remains the focal point for large format multi-segment real estate developments. In near future, Nasirabad is expected to serve as the new alternate CBD for Chittagong city, making this location currently the most attractive location for private developer initiated projects.

4.2 Site Analysis

National Housing Authority (NHA) has a total of 8.498 acres land at GEC More in Nasirabad, Chittagong, which is the proposed site ("subject site") for the development. The coordinates of the site and elevation are as follows:

- Latitude: 22° 21' 35.73"N
- Longitude: 91° 49' 14.80"E
- Elevation: 14.215 m (above MSL)

On the basis of the approval obtained from CCEA, NHA has planned development of a mixed use commercial cum residential complex through PPP route. The following sections detail out our understanding of the site dynamics from a location, connectivity, surrounding profile and development potential perspective.

4.2.1 Site Location and Surrounding Area Profile

The subject site is located at GEC More, which is essentially the cross section of Dhaka Trunk Road, CDA Avenue and O.R. Nizam Road. An aerial view of the project site and site surroundings is provided in the following sections. A description of the immediate site periphery is provided hereunder:

North: The northern periphery of the site comprises some apartment projects of local developers, unorganized residential developments in plotted format and Nasirabad Government High School. Based on visual inspection, it seemed that there was no access from North boundary of the site, despite presence of a 30 feet road except a small gate for a mosque. As per the information provided by NHA officials, this Mosque forms part of the subject site but is also utilized by outsiders.

South: The southern periphery of the site runs along the Dhaka Trunk Road, providing an approximate frontage of approximately 280 meters. The main site entry lies at the south west corner of the site. There is an unoccupied Government land parcel for institutional use opposite the site along Dhaka Trunk Road. The south east periphery of the site leads up on the intersection of CDA Avenue and Dhaka Trunk Road at GEC More. However there are some commercial establishments at the South East corner which limits direct access to GEC more.

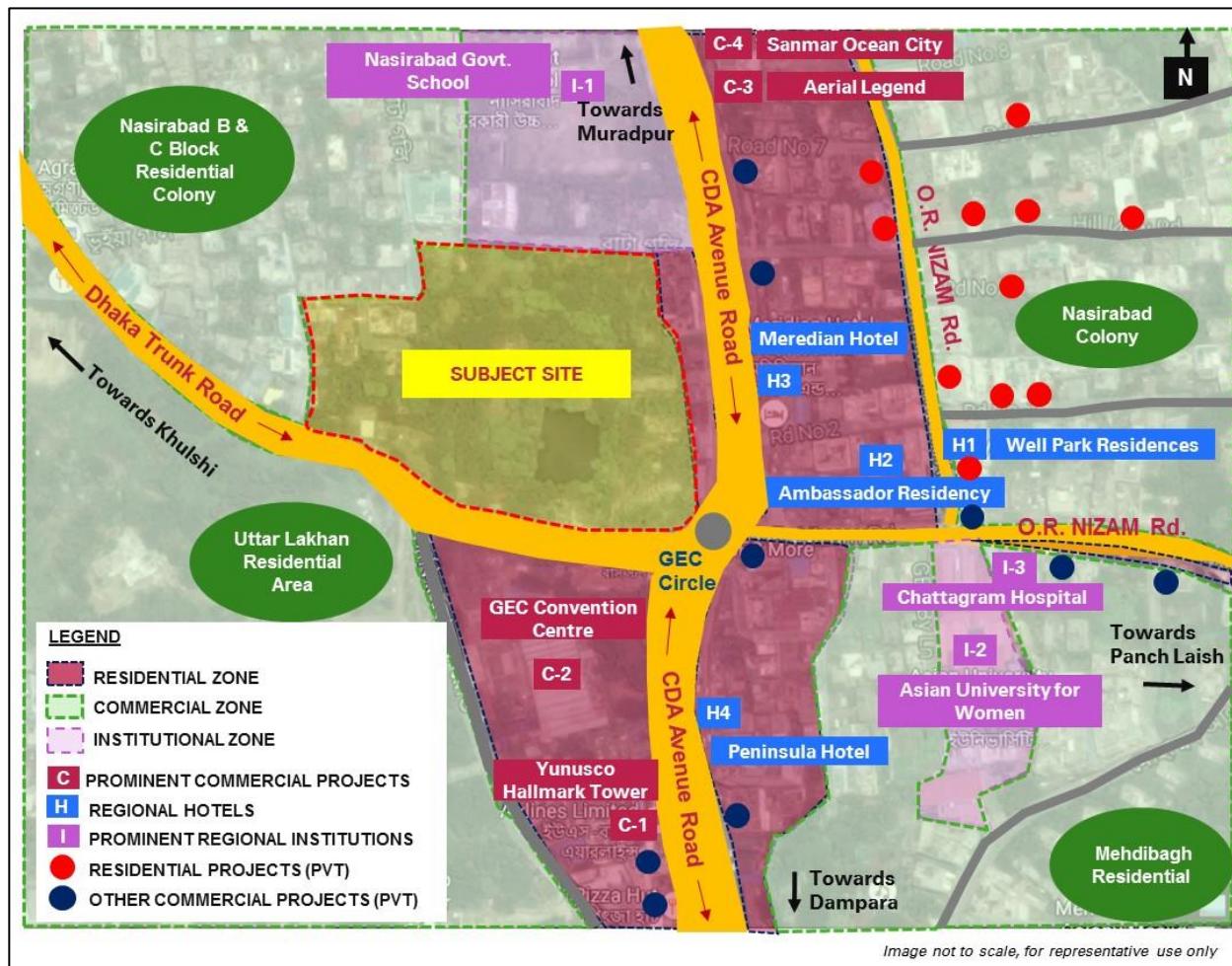


Figure 10: Aerial View of the Project Site Location and Surrounding Region

East: The eastern periphery of the site adjoins a commercial belt comprising business establishments such as Jamal Khan Hotel, a few small eateries and food joints, clothing item shops and mid-scale multi-storied mixed use commercial office and shopping centres. This commercial zone runs parallel to CDA Avenue from GEC more all the way up to the north-east corner of the site. Based on visual inspection and information shared by local NHA representatives, there is no direct access to the site from CDA Avenue. The opposite side of the commercial zone on CDA Avenue also features an unorganized mix of shops, commercial establishments and a small hotel (Meridian Hotel). This dense mix of small to medium sized commercial establishments adjoining east side boundary of the subject site may impact the site attractiveness, limiting access to the main commercial area of the CDA avenue. Construction of a new flyover between one of the ends of CDA Avenue and Muradpur is currently ongoing, creating vehicular congestion along CDA Avenue and also affecting accessibility of the site.

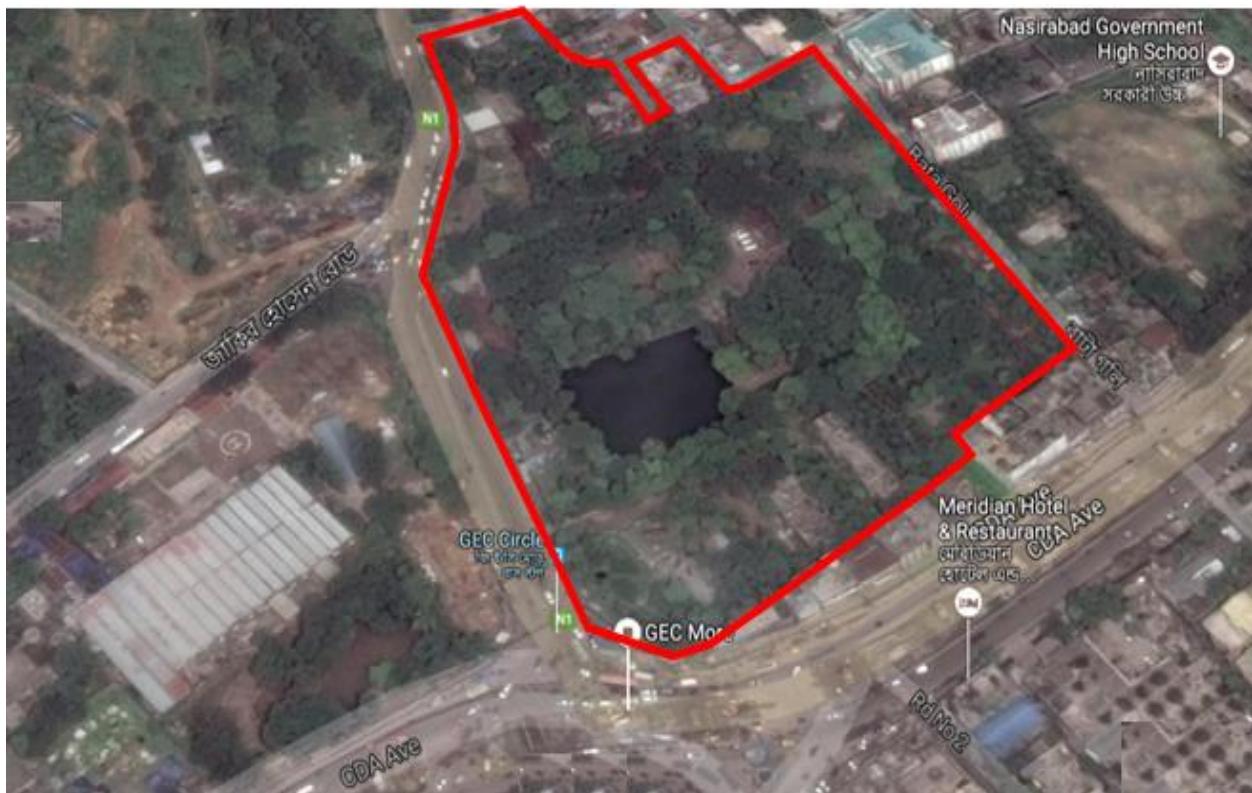


Figure 11: Perspective Aerial View of the Project Site

West: The western boundary periphery has some multi-storied apartment complexes by local developers and plotted housing developments. Further west, there are some commercial buildings (Agrani Bank) and local hotel projects (Hotel Top Inn), along the Dhaka Trunk Road leading up to Khulshi residential area.

The following images provide a visual perspective of the site linkages and access to and from key connecting roads around the site:

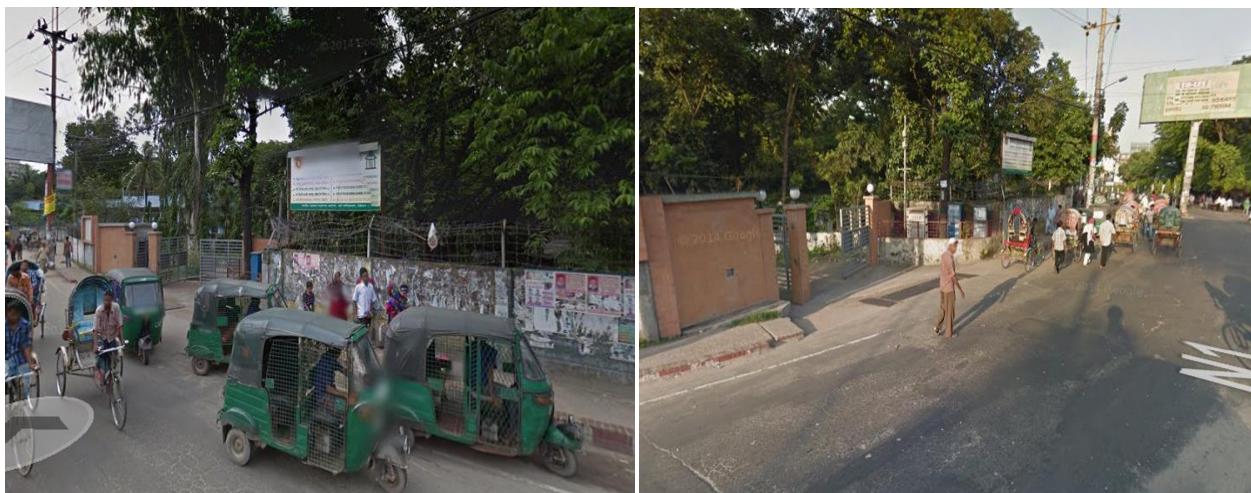


Figure 12: View of Site from Dhaka Trunk Road



Figure 13: View of Commercial Establishments along Site Boundary on CDA Avenue Road



Figure 14: View of Subject Site from GEC More



Figure 15: View of Under Construction Flyover on CDA Avenue



Figure 16: Commercial establishments on CDA Avenue around site

Site Connectivity and Linkages

The subject site is accessible from CDA Avenue which connects the site to Muradpur in north and Dampara in south. The main access to the site is currently from Zakir Hossain Road (part of Dhaka Trunk road); connecting to Khulshi region in the west. Based on physical verification, it is understood that the site has only one south side frontage since the site entry opens up on Dhaka trunk road. The site also enjoys good connectivity to key transit hubs such as GEC More bus stop, Chittagong Railway Station, and Chittagong International Airport. Chittagong Railway Station is located at a distance of around 5 km, the Chittagong Port is located at a distance of 8 km and the Shah Amanat International Airport is situated at a distance of approximately 20 km. Hence, the area boasts good connectivity by road, rail, sea and air¹⁷. In relation to the immediate surrounding areas, the site is strategically located at the heart of the emerging commercial centre of Nasirabad region. The Chittagong Stock Exchange is also located at close proximity to the subject site (around 4.5 km). The Chittagong Export processing Zone and Agrabad are located at a distance of 12 km and 4 km respectively from the subject site.

Surrounding Real Estate Profile

¹⁷ Note: Distances have been computed using google maps and are approximate

Substantial real estate activity comprising residential and commercial real estate developments can be seen around the site, as observed from the site map provided above. The main commercial area in the region is CDA Avenue and this entire stretch of 3-4 km is marked by presence of multiple small to large shopping plazas and commercial towers along the road.

Located slightly away from the site on the southeast is another key activity centre; O.R. Nizam road; which also comprises a large mix of residential apartment projects, offices and shopping spaces developed by private developers. Typical commercial projects constructed by private sector real estate developers in this region feature multi-storied (Ground + 4-7 floors), mixed use developments having retail/ shopping areas in the lower floors (Ground to 2nd floors) and commercial office spaces in the upper floors. While majority of the commercial spaces are characterized by their unorganized nature – comprising a mix of ad-hoc large and small commercial establishments – the new and upcoming projects are fairly larger and better organized in terms of real estate offerings. Some of the prominent completed and under construction commercial developments around the site include Yunusco Hallmark Plaza, Yunusco Trade Centre, GEC Convention Centre, Sanmar Tower – 1, Aerial Legend Tower all located on CDA Avenue Road and Equity Tower located on O.R. Nizam Road. The following images provide a perspective of the large commercial developments in the surrounding area of the site:

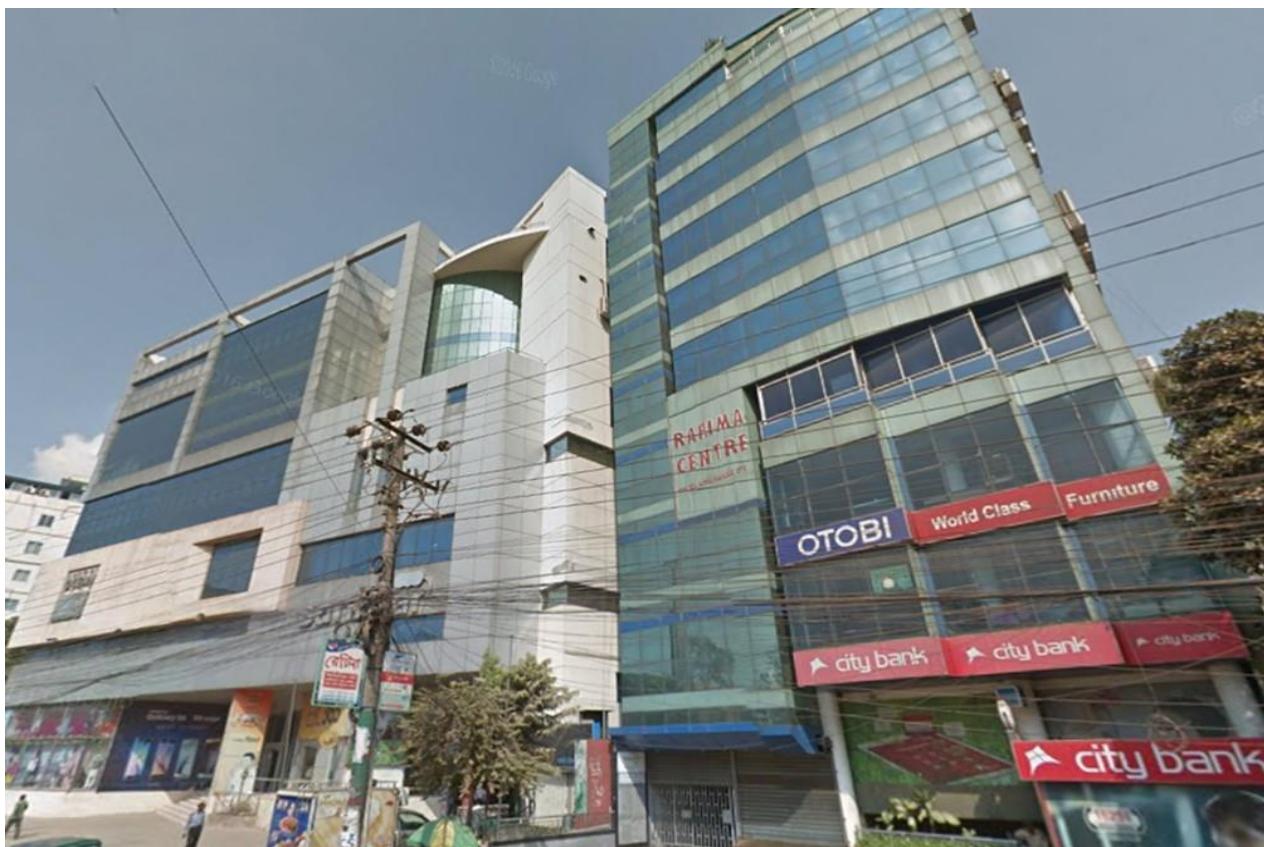


Figure 17: View of Sanmar Ocean City and Rahim Centre on CDA Avenue



Figure 18: View of Commercial Projects Ariel Heights and Yunusco Hallmark on CDA Avenue

Over the years, GEC More has emerged as one of the key shopping and recreational area within Chittagong city and houses a few large format organized retail establishments. Sanmar Ocean City is one such example, resembling a large format organized mall and is considered to be a regional landmark. Further north of the CDA avenue, another such large organized format development, the Finlay Square is currently under development. Apart from these two major developments, CDA Avenue and OR Nizam road is heavily marked by the presence of numerous smaller commercial stand-alone shops, small - medium scale shopping plazas and recreational establishments (such as Restaurants).

The site lies in proximity to some of the prominent hotels of Nasirabad such as Peninsula Hotel and Well Park Residences. From a perspective of Chittagong's hospitality market, these two hotels are much sought after, considering their comparatively superior hospitality offerings, and rated higher when compared to other nearby hotels such as Meridian and Ambassador Residency. From an institutional perspective, the site is located in close proximity to Chittagong Medical College and Hospital, Asian University for Women, Chittagong Government Women's College and other prominent private educational establishments. The region also features numerous health care facilities with two large hospitals and 3-4 diagnostic centres located in the site vicinity.

The site is situated between large residential colonies such as Nasirabad Housing Colony, Uttar Lakhan, and Mehdibagh. Presence of social and commercial infrastructure has also led to a growing presence of private developer driven projects in the area, especially the areas along O.R. Nizam Road and Mehdibagh. The residential housing in the region is a mix of private developer projects and self-constructed plotted houses/ bungalows. However, a large majority of the housing is still of unorganized nature and private developer apartment projects have been a recent phenomenon, thus constituting a smaller share of the overall housing units in the region. Residential apartments developed by prominent developers such as Equity Group, BTI and Sanmar Group are generally perceived to offer contemporary designs, good

construction quality and good support amenities such as parking, power back up and uninterrupted piped gas supply. Owing to the limited availability of projects and housing units and the relatively high occupancy levels, such projects command a premium in comparison to similar private developer projects in other regions.

The combination of factors such as good connectivity and linkages, easy access to educational institutes, medical facilities, shopping complexes and commercial offices lends a strategic location advantage to the site from a developer attractiveness perspective.

4.2.2 Site Layout and Associated Infrastructure Profile

A basic layout plan was provided by Chittagong office representatives of NHA, highlighting the site layout and profile of existing infrastructure on the site. Physical reconnaissance of the site and surrounding regions was conducted by way of on-ground visual inspection with the objective of verifying the existing site layout and the infrastructure present.

Further, a survey was conducted by a technical team engaged by KPMG using a total station to assess the exact area of the subject site and identify contours of the site. This helped in proper identification of the substantial level differences within the subject site, which was also apparent from visual inspection.

The layout plan of the subject site as furnished by NHA is provided in the image below and survey map as prepared by the technical team engaged by KPMG is provided subsequently.



Figure 19: Existing Site Layout Plan (Provided by NHA Nasirabad Office)

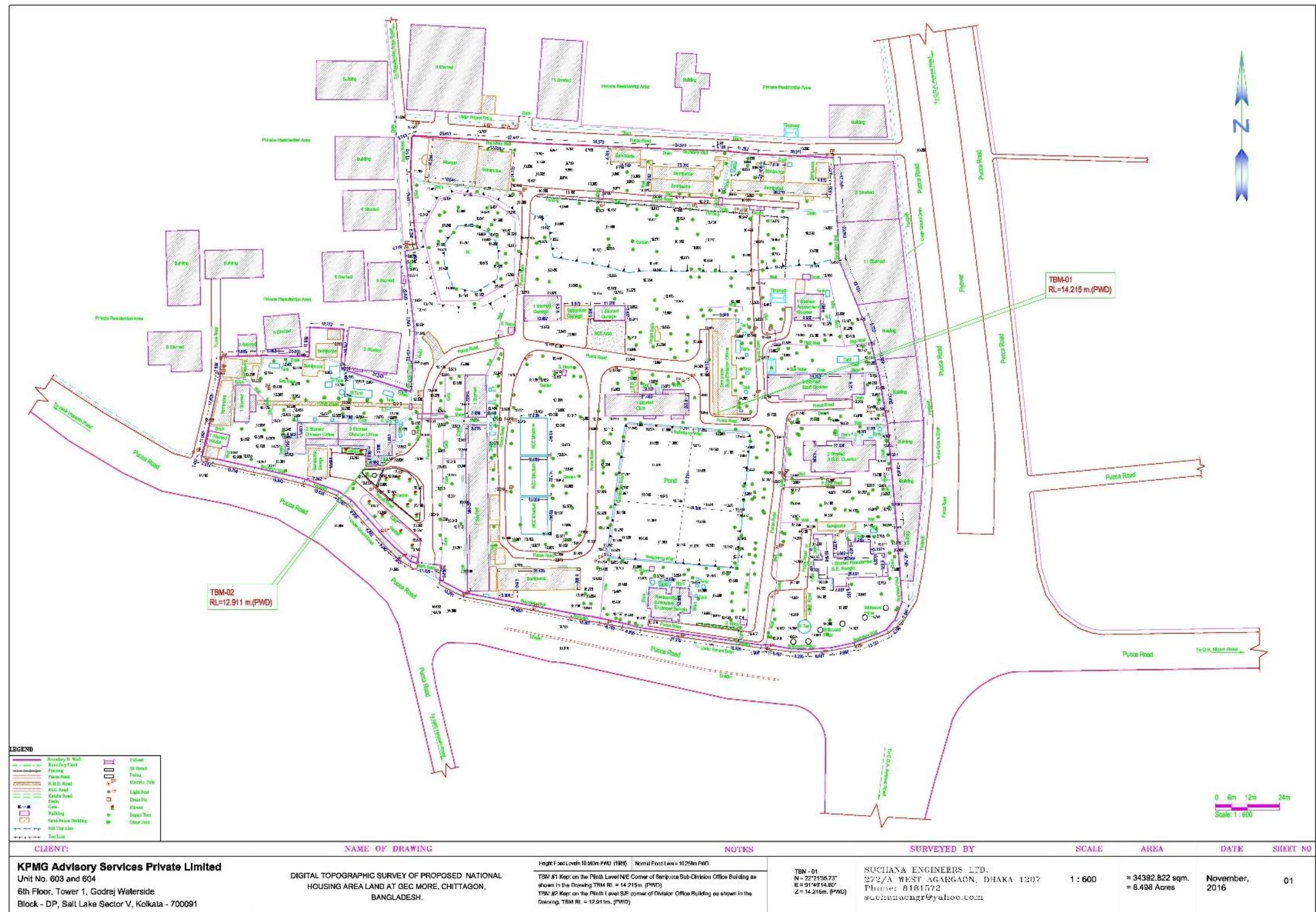


Figure 20: Survey Map of the Subject Site

The site land parcel has a fairly regular shape offering long stretches along two sides of the site periphery. There exists a large water tank in the south-east part of the site occupying a large land space. Considering Nasirabad is a slightly hilly area, land undulations are a natural feature common to most land parcels in the site vicinity. Based on visual inspection, it can be clearly established that the subject site land has some undulations comprising few elevated and trough sections. Only a portion of the site is constructed upon and there are a few large old trees and tracts of dense vegetation lying unused/ vacant at various locations within the site. The built-up structures present on the site include the following:

- a. One Office and Administrative Building of NHA
- b. 3-4 Shed type quarters for NHA staff
- c. Two blocks of multistoried (3 floors) buildings housing NHA Staff
- d. One Garage shed
- e. One Vehicle shed
- f. One large utilities shed
- g. 4 newly built shed type staff quarters – currently being constructed
- h. Two large bungalows for NHA staff
- i. One large water tank
- j. One Mosque structure and associated infrastructure

With regard to the presence of existing support infrastructure, the site can be labelled as a brownfield site and has support infrastructure already in place. As residential and administrative structures are already operational, support infrastructure such as power lines, water supply, sewerage system, etc. are already in place. The site is 'development ready' - well suited for immediate construction and requiring limited land development efforts.

Based on discussions with the NHA officials, the private developer will be required to demolish these structures before commencing construction on the site. The existing water tank occupies a reasonably large part of the site, however this may not be covered, or filled up or constructed upon. Other possible obstacle expected is the presence of old trees, which may require relocation or felling, depending upon environmental clearances received. Such limitations need to be factored and amalgamated in the overall conceptual design and development plan of the site. The presence of existing structures which require relocation or demolition may pose a challenge for site development. The requirement for relocation of existing tenants poses an additional challenge for undertaking construction on the site.

4.3 Review of Development Regulations

Development Control Regulations and Zoning plan of the site area were reviewed to assess the mandatory regulatory conditions influencing the project construction and requirement for change of land use, if any. Interviews were conducted with key personnel within the Local Government Engineering Department (LGED), Chittagong Development Authority (CDA) and Town Planning Department to assess the applicable building regulations and land zoning norms applicable to the site.

4.3.1 Land use plan

Land Use Zoning and Master Plan obtained from Town Planning Department of Chittagong Development Authority is represented below:

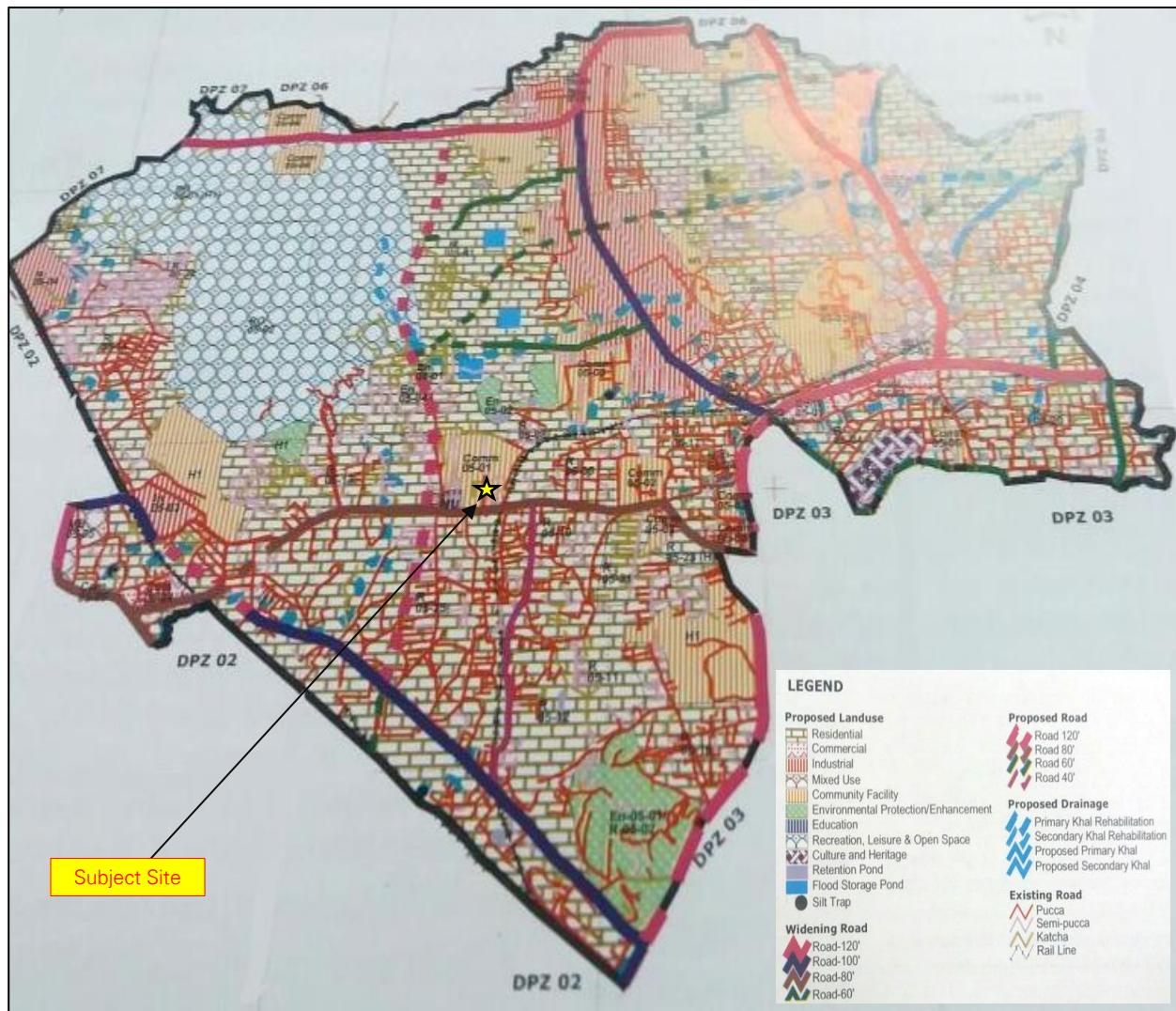


Figure 21: Land Use Plan for Chittagong and Subject Site

The land use currently defined for the NHA subject site is 'Community Facility' land. This land use is typically assigned to Government owned land parcels used by national level or local level governmental development agencies. It is to be noted that the current 'Community Facility' land use zoning can be changed through a formal request by the NHA for converting land use to commercial land use. Within commercial land use, real estate projects such as housing/ apartments, offices, shopping plazas, and hotels can be allowed¹⁸.

¹⁸ Town Planning Department, Chittagong Development Authority

4.3.2 Development Control Norms

The subject site is adjacent to Zakir Hossain Road (part of Dhaka Trunk Road) and the adjoining commercial zone along CDA Avenue. Since the site is adjacent to 120 feet roads on both sides and the size is approximately 8.5 acres, the following local development control norms and guidelines shall be applicable:

FAR: A total FAR of 6.5 shall be applicable to the entire site land parcel. Further, FAR for residential component is limited to 6.5 whereas for commercial real estate developments, there is no prescribed limit.

Maximum Ground Coverage (MGC): An MGC of 50% shall be applicable for the entire land parcel.

Height Limitations: The height limitations depend on a multitude of factors such as the prescribed FAR, MGC, soil load bearing capacity, seismic zoning, building structural design, building and fire safety guidelines, civil aviation guidelines, etc. The height limitations are usually decided at the stage of seeking approvals for proposed building plan from relevant authorities such as CDA. Currently, there are no general height limitations prescribed as per the building codes¹⁹. However, as observed in common practices across real estate developments, height for residential apartment buildings is generally capped at 10-12 stories, whereas commercial buildings may reach heights of up to 15-18 stories²⁰.

4.4 Site SWOC Analysis

Factoring in all the findings of location and site analysis, a Strengths, Weaknesses, Opportunities and Constraints (SWOC) analysis has been conducted for the subject site as showcased in the table below:

Strengths	Weaknesses
<ul style="list-style-type: none"> Strategically located Site: Situated in Nasirabad considered to be the emerging CBD for Chittagong after Agrabad. GEC More is positioned as the prime area in Chittagong being well connected and situated at the intersection of Dhaka Trunk Road, CDA Avenue and O.R. Nizam Road. 	<ul style="list-style-type: none"> Construction limitations and obstacles: <ul style="list-style-type: none"> Presence of large water tank on main frontage side, not allowed to be covered Topographical constraints due to hilly nature of site warrant higher construction efforts Expected obstruction to view from high rise buildings due to upcoming flyover

¹⁹ To be verified through technical survey assessment

²⁰ Town Planning Department, Chittagong Development Authority, KPMG Analysis

<ul style="list-style-type: none"> Favourable Site Layout and Size: Site is ideal for undertaking large integrated real estate development due to large plot size, fairly regular shape and good frontage along a major road Good on-site infrastructure presence: Limited site development efforts required since all the required basic infrastructure is already present on the site Highly Positive Site Perception: Almost all stakeholders and prominent developers interacted with consider the site to be highly attractive and expressed positive willingness to develop the project at the identified site. Encouraging potential catchment – Strong presence of residential, institutional and educational developments around the site, high possibility of catering to large potential customer base No land use related challenges: Site land use zoning for the site is "Community Facility", minimal efforts expected for land use change 	<ul style="list-style-type: none"> No frontage on CDA Avenue: Dense presence of commercial establishments along CDA avenue side site boundary may limit direct access to and from CDA Avenue
Opportunities	Constraints
<ul style="list-style-type: none"> Nasirabad heralded as the emerging CBD: Directional growth expected in the region owing to saturating supply and poor quality of real estate in competing locations of Agrabad, Jhoutala and Kazir Dewri Absence of Competing Land Parcels around site: No known availability of a new equally large sized land parcel for development in the site vicinity, premium can be expected for the site land Possibility to construct 'landmark' integrated development: Owing to shape and size of land, potential exists for creating a "landmark" mixed use real estate development comprising commercial, residential and recreational real estate Premium for location due to demand supply gap: All existing real estate developments command a relative premium, compared to other locations. There exists a demand-supply gap for quality real estate projects Absence of Star Quality Hospitality Options: good quality hospitality options can be provided in the site region Real Estate Market Recovering: gradual increase in development activity, especially residential housing due to stabilizing economic situation 	<ul style="list-style-type: none"> Relocation and Rehabilitation challenges: Relocating existing NHA tenants may have high cost and time overrun implications for private developer Environmental Approval related issues: Site has presence of dense vegetation comprising old trees, felling of which may become a problem Low and slow market appetite for commercial office space: Existing commercial projects have witnessed slow absorption and high vacancy levels, scope for supplying additional commercial space may be jeopardized Fluid market delineation may cause micro market over supply situation: Small geographical pockets with dense concentration of projects has diluted micro market boundaries effecting dedicated catchments, upcoming residential and commercial real estate developments in the larger site region of 5 – 10 km radius Competing hospitality projects coming up: Planning and land acquisition underway for development of new star rated hotels in the city may make provision of additional hotel property risky

<ul style="list-style-type: none">Critical Connectivity Node in future: Site expected to be part of a critical road alignment being planned, improving the connectivity between main Dhaka-Chittagong highway to peripheral regionsGrowing market for premium and organized real estate: gradual upward shift observed in pricing matched with buying, especially in residential marketAbsence of Recreational Amenities: significant potential for creation of recreational amenities such as club house etc.	
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Figure 22: Site SWOC Analysis

5 Overview of the Real Estate Market in Chittagong

Real Estate sector has emerged as one of the most attractive sectors for investment in Bangladesh over the past decade. According to the National Board of Revenue, the Real Estate Sector contributed approximately BDT 123,400 crore in the last fiscal year which is close to 7 per cent of the Gross Domestic Product. The sector's annual turnover is about BDT 20 billion. Not only does it generate around 25 lakh employment opportunities both directly and indirectly, but it also supports over 250 ancillary industries such as steel, cement, tiles and sanitary ware, cable and electric ware, paint, glass and aluminum, brick and other building materials. The table below summarizes the share of Real Estate as a Share of overall GDP²¹.

Table 1: Contribution of Real Estate Sector in GDP

Contribution of Real Estate Sector to GDP (at Current Prices) ²¹					
Year	Size of GDP (In Crore BDT)	Overall GDP Growth (%)	Real Estate, Renting and Business Services (% of GDP)	Real Estate, Renting and Business Services (In BDT Crore)	Real Estate, Renting and Business Services Growth (%)
2010-11	915,829	14.83	6.56	60,119	-
2011-12	1,055,204	15.22	6.51	68,715	14.30
2012-13	1,198,923	13.62	6.57	78,820	14.71
2013-14	1,343,674	12.07	6.79	91,229	15.74
2014-15	1,515,802	12.81	7.00	106,061	16.26
2015-16 (P)	1,729,567	14.10	7.13	123,392	16.34

The rate of urbanization is estimated to be 5-6% annually for Bangladesh. As per REHAB estimates, 50% of the population of Bangladesh is expected to reside in urban areas by 2025²². A large part of the growth of real estate is attributable to increased flow of investments in manufacturing sector, development of industrial and social infrastructure and overall improvements across citizens' income levels. After Dhaka, Chittagong has emerged as the fastest growing city in Bangladesh. Chittagong city has a population of 2.69 million according to the Community Report of Chittagong Zila, based on the Population and Housing Census of 2011. However, the actual population is expected to be around 5.5 million²³. Chittagong city is a major economic hub and thus witnessed a large influx of migrants from rural areas, who are attracted by the

²¹ Source: Bangladesh Bureau of Statistics

²² Source: REHAB Report 2004

²³ Source: LGED Report, 2014

prospect of easier lives and higher incomes in urban areas. It is one of the fastest growing cities in the world, is a commercial and industrial hub of the South Asia region with a GDP of USD 25 billion²⁴.

As the major commercial and industrial hub of the country, the city has seen a fair share of economic activity driven by the establishment of globally competitive economic processing zones (EPZ). A significant part of the heavy industries in Bangladesh are based in Chittagong. Some of the prominent industries in the region include oil refineries and oil-blending plants, cotton and jute-processing mills, tea and match factories, chemical and engineering works, an iron and steel mill, fruit canning, leather-processing and shipbuilding/breaking. Chittagong is regarded as a future regional transit hub due to the strategic Chittagong Port. Upgrade of existing infrastructure in the region has the ability to attract foreign investments. For instance, Dhaka Chittagong Highway has been upgraded into a four lane divided highway and Shah Amanat International Airport has undergone much improvement. The importance of Chittagong for the countries surrounding Bangladesh in the South Asian region, is well recognized.

The Real Estate industry started off in Bangladesh in 1970's with only five registered firms. However, the real estate boom in Bangladesh started around 2008 and showed the typical traits of an emerging market.

The sector witnessed very slow growth rate in the initial years – 1998 to 2005. The industry grew in a moderate pace till 2006 but between 2008 and 2010 the growth was exponential. At present, there are more than 1500 active developers in the real estate sector with 1200 members registered with REHAB. The nature of the industry is fairly unorganized and fragmented, comprising a varied mix of large to small scale contractor, builders and developers. While the top 20 companies hold close to 80 per cent of the organized market share making the market structure fairly consolidated, the overall market (organized plus unorganized) is highly segmented in respect of developer mix, micro market locations, prices, product mix w.r.t quality and scale of real estate development. Though the current mix of real estate players still remains varied, the real estate market has evolved into a more organized structure over the past 10 years. Local real estate developers in Chittagong have also followed the larger national developers and reorganized their business with the times with respect to project quality, amenities/ offerings, project marketing and internal departmental reorganization.

In respect of the overall real estate market segmentation, the organized sector is very small as compared to the larger unorganized segment consisting of small local developers, builders, contractors, engineering and architect firms, undertaking frequent real estate projects in Chittagong. As per interactions with REHAB, the projects undertaken by registered members of REHAB Chittagong constitute only 20% of the total real estate in the Chittagong region. **It is to be duly noted that the real estate market analysis covered in this report only encompasses the organized sector real estate projects, developed/ supplied by prominent real estate developers operating in the Chittagong region.**

Over the years, the nature of the market shifted from a supply driven market to a demand driven one. As a result, Chittagong has witnessed impressive participation in organized real estate activity from private sector developers. Foreign investment has also been on the rise from neighbouring countries, shaping the socio-economic character of the city and its real estate market. The fluctuations witnessed in the stock market in Bangladesh has been a major influencing factor impacting the growth of the real estate industry. Though the real estate industry of Dhaka was the major benefactor, Chittagong also underwent a phenomenal transformation during the past decade. With the growth in economic opportunities and the trickle-down effect from growth of Dhaka, Chittagong has also witnessed a migration of Dhaka residents to Chittagong. This has brought about a major change in the nature of the real estate industry in Chittagong. Chittagong real estate market has benefitted from the growth in education sector, creating parallel demand for recreational and commercial facilities. There are fully government funded universities such as Chittagong University, Chittagong Medical College and Chittagong University of Engineering and Technology (CUET). The Asian University for Women (AUW) is an established institution for higher education for women. In

²⁴ Source: REHAB Report 2004

addition to Govt. supported institutes, there has been an increasing presence of private educational institutions in the city. Private universities such as the BGC Trust University Bangladesh, International Islamic University of Chittagong, University of Science and Technology-USTC, Southern University of Bangladesh, Premier University (PU), and University of Information Technology & Sciences also witness a significant influx of students from neighbouring cities of Bangladesh, making Chittagong a vital educational hub. This in turn has led to demand for residential, commercial and recreational real estate in the region.

The master planning of the region has also guided the real estate market activity to a large extent. The initial city master plan prepared in 1961 focused on four strategies: (i) retaining the strategic importance of the port (ii) keeping central business areas intact; (iii) developing low-lying areas west of the Dhaka Trunk Road and southwards towards the Patenga Area and (iv) ensuring reasonable real estate supply for growing urban population. In line with this overall plan, the real estate market has also grown. Despite the fact that the urban population has grown at the rate of 2.25% or more, many peripheral areas proposed for development under the master plan still remain under developed. This has led to increasing population density within the existing urban area, thus leading to concentrated real estate activity in main city areas, with limited expansion in peripheral areas. This is evidenced by the lack of private developer driven real estate activities around the port region, high degree of real estate congestion in central business district of Agrabad and emerging real estate activities along port connecting road.

While Chittagong is still to catch up with the contemporary trends of Dhaka, the city features very competitive and high quality real estate product offerings from the local developers. The growing demand for quality real estate products has primarily been fuelled by the foreign remittances from Chittagong locals who have increasingly pumped funds into real estate market for investment and consumption purposes. With an inward migration from congested cities like Dhaka, Chittagong has also witnessed demand from Dhaka based residents who are actively investing in the real estate market in the city across asset classes such as residential, retail and commercial office spaces. User preferences for real estate products have gradually become more evolved and this is reflected in the real estate offerings of developers. Compared to a decade back, the real estate industry has become more mature with greater presence of Dhaka based developers and positive changes in local developer activity w.r.t size, scale, structure and offerings in real estate.

Despite the recent stock market crash and poor socio-political situation bringing about a recessive trend, the real estate market has shown some degree of resurgence. Various development initiatives have been set in motion by Government agencies to bring about positive transformation in the socio-economic and infrastructure situation in Chittagong. Major urban development works, such as the construction of CDA Avenue-Nasirabad- Muradpur flyover are being undertaken to improve the connectivity and linkages within the city. With increasing cross border investments flowing into Chittagong, especially from India and China, the overall economic scenario for Chittagong is improving. Rising income levels, globalized customer preferences and inherent need for better real estate offerings will drive the future real estate market in Chittagong. Looking at the current scenario, reasonable potential exists for growth of the Chittagong real estate market.

5.1.1 Real Estate Market Trends

Some of the key trends observed in the real estate industry in Chittagong are summarized below:

- **Dominance of Land Sharing Model:** Profit motives of the land owners has led to increased prevalence of the land sharing model of development²⁵. Land owners have become aggressively active in selling

²⁵ This Land Sharing Model involves sale of land parcels by land owners to large private developers in lieu of initial advance money and a share of constructed real estate asset. The asset handed over to the land owner are subsequently sold by themselves or through the developers for recovering the cost of land and a reasonable return.

their land parcels to developers and with constrained availability, developers have utilized the land and constructed projects. Developers are willing to develop residential apartments on such land parcels to meet the demand and unlock the returns in these purchased land banks. This model of development is expected to remain as the chosen mode for development in the future.

- **Increasing Preference for Quality Real Estate Options:** With rapid urbanization, the real estate preferences of home and office owners have changed who now prefer apartments to self-constructed houses, high rises to plotted developments, and shopping malls to shopping centres. The concept of apartment living has matured and the market has seen keen buyers across all ticket size offerings. Similar trend has been adopted by Chittagong, which has closely followed real estate trends in Dhaka.
- **Poor socio-political environment:** Despite no major incident of social unrest, and acts of violence/terrorism having taken place in the immediate past in the city, Chittagong has been affected by the general sense of social uncertainty in the country, leading to diminished investment appetite for real estate. In addition, the political instability has also led to low risk appetite of developers and consumers alike considering that political changes often lead to capital traps due to delayed projects. This has been a constant limitation effecting the real estate market growth and is expected to influence the real estate industry in Chittagong going forward.
- **Real Estate Sales Slowdown, Price Corrections and Lower Realizations:** the overall market has undergone a period of sluggish sales and this trend is expected to continue for one to two years as the economy recovers. Real estate market in Chittagong is undergoing a recessive cycle after going through the boom period between 2008 -2012. One major outcome of this has been the price corrections and discounts being offered by private developers on real estate assets. To ensure regularity of inward sales revenues, the market has been observed to adopt a discounting sales approach and this trend is expected to continue in the future 1-2 years.
- **Concept Selling and Changed Consumer Preferences:** Moving away from a direct sales strategy, developers are showcasing concept based residential and commercial real estate options to lure potential customers. Mock ups, 3rd models and sample flat designs are being created by the developers to visually share the project vision/ concept with potential customers who have in parallel been exposed to better real estate and related changes happening around the world and become more demanding. This trend is expected to continue in the coming years as well.

5.1.2 Real Estate Market Drivers

With reference to the industry trends discussed above, the following factors can be considered to be the 'key drivers' for growth of real estate sector in Chittagong:

- **Increasing inward foreign income remittances:** A large portion of skilled and unskilled working population hailing from Chittagong is working in foreign countries such as Middle East to improve upon their income levels. The income remitted by such working population is channelled into real estate sector, creating investment demand for residential and commercial real estate in the city.
- **Changing Consumer Preferences:** Apartments have gradually emerged as the format of choice for residential property buyers. Re-structuring of households to single family units has been a major factor, apart from the affinity towards amenities and facilities offered in new apartment complexes. Even within commercial formats, buyers are moving to organized format real estate projects like office tower complexes considering better quality of specifications, maintenance, better amenities and facilities provided in such projects. This has created replacement demand for real estate products in the city.
- **Inward Migration from Dhaka and Surrounding Cities:** As the city of Chittagong gains dominance as the 2nd largest metropolitan and economic-commercial hub, there is some degree of inward population migration from neighbouring cities and prominent cities as well and this has created incremental demand for real estate, especially housing.

- **New and Improving Infrastructure developments:** with the local government aggressively undertaking infrastructure development (*roads, flyovers, townships, industrial zones, etc.*), in and around, the city has gradually become an attractive location for Bangladeshi residents. This improved attractiveness has led to growing demand for residential and commercial real estate as more people look at Chittagong as a city to work and stay
- **Improving Economic Scenario:** The stock market has historically been a driver for real estate in the region. The market has gradually begun to recover leading to overall increasing investment levels in the economy. Cross border trade and cooperation has improved with neighbouring countries like China and India taking active interest in pushing investments in setting up trade infrastructure and industries. This in turn has generated avenues for increased income and spending by buyers and suppliers active in real estate market.
- **Growing Services Sector:** Being the alternate commercial centre to Dhaka, Chittagong has also witnessed a fair share of growth in the services sector. Increasing service sector presence in telecom, education, hospitality, healthcare have led to rapid urbanization of Chittagong. The city has also grown into a major educational hub. All these factors have inherently created demand for residential apartments, commercial office spaces and recreational (shopping) spaces in Chittagong.
- **Attractive lending rates:** Over the past year, the nation's banking institutions have made reasonable policy and institutional changes to provide impetus to the real estate industry in general. This regulation has brought down interest rates on home loan borrowings, made disbursements easier and thereby rekindled real estate buying.

Given the existing scenario, expected trends and key drivers for real estate industry, Chittagong is expected to evolve as a major hub for organized formats for residential commercial and retail real estate. The following section of the report provide a detailed analysis of the major segments of real estate segments in Chittagong.

5.2 Residential Real Estate Market

Considering the end objective of undertaking a PPP transaction for appointment of reputable developer to undertake the proposed project on subject site, the analysis of unorganized real estate sector has been excluded from the scope of the report. Further, we were informed that there is no real estate market data available with REHAB. Thus, the data presented as part of the analysis represents primary data collected through interactions with developers and supported through secondary research.

5.2.1 Overview of Residential Real Estate

The residential housing real estate market in Chittagong is witnessing a paradoxical state of affairs much similar to the real estate market in Bangladesh. On one side there is acute shortage of housing supply in all urban areas, whereas on the other hand there exists reasonable quantum of unsold inventory. Bangladesh's housing sector has been facing sluggishness for the past 3-4 years. The market conditions started deteriorating after the share market debacle in 2010 and the Destiny scam. The situation has become discouraging as realtors have been forced to reduce apartment prices by 15-30 per cent on average to reinvigorate the depressed residential market. As per REHAB, around 14,000 ready flats worth about BDT 120 billion have remained unsold in the country. The sale of apartments fell down by as much as 60 per cent in 2013 and the situation has not yet improved much. It is expected that the country's housing and real estate market is likely to remain relatively flat even in coming years owing to moderate economic growth and prevailing socio-political situation.

Housing finance sector has been struggling and high interest on bank loans has plagued the sector of late, negatively impacting the housing real estate. Banking sector has increasingly witnessed many buyers who having purchased flats on instalments have defaulted on their loan payments since their income was directly linked to the share market where prices have collapsed. According to the central bank statistics, the total amount of outstanding bank loans made to the housing sector stood at BDT 369 billion till June 2015. The banking sector has restructured loans worth over BDT 100 billion in the real estate sector over the last couple of year. The resultant effect is the private developers being deprived of any new loan. The central bank also instructed other banks to squeeze the home loan post 2012 with a view to tackle the huge liquidity crisis during the period. Inflationary pressure forced the central bank to decrease the ceiling of the consumer financing including home loan, further aggravating the situation.

During the pre-recession period, projects were launched at high prices and the developers were unwilling to bring down the prices after the recession set in. As a consequence, buyers are either waiting for further fall in prices or are buying at a very sluggish pace. Restrictions imposed by Government in providing new gas and electricity supply connections have also affected the demand for residential properties. With reasonably large unsold inventory, developers are struggling to recover capital investments, which is further limiting fresh investments. The bank loans taken by realtors have been piling up and REHAB estimates this capital loaned to be close to BDT 150 billion. Slowly, however, developers have started offering discounts to boost sales and recover some of the tied up capital.

The political scenario in Bangladesh is known to significantly impact government policy, which in turn affects the real estate markets. Political events in 2013 and 2015 had reportedly impacted the sector negatively. Further, lack of adequate policy support in the past for streamlining the housing sector has hindered housing development. The sector has reportedly been suffering from the challenges arising out of inadequate urban planning, deficient land administration, inadequate sources of finance, shortage of skilled and qualified manpower, non-availability of utility connections, high prices of land, rising manpower and material costs, approvals and procedural difficulties.

Another key reason for the slow growth in the past decade is that the average values of land have increased more than 10 times. Land sharing model is the most prevalent way in the country for developers to procure land and offer housing and commercial real estate. Since the land owners take a share of the housing units created by the developer and the prices of land have risen in parallel, the developer have found it difficult to correctly price their offering, which has directly impacted their profitability. Due to a disproportionate rise in land and construction material prices, developers have also faced difficulties in providing housing and apartments within favourable budgetary limits.

Despite the challenges, the real estate industry in Chittagong is gradually coming out of the recession. As per REHAB consumer survey report, it has been found that consumers are now more interested in buying flats than building their own houses. People who already own a house or flat are still very willing to buy another property and the younger consumer segments are willing to purchase flats rather than building their own houses. Apartment prices have also corrected by a quarter from their original launch rates four years back. Buyers are slowly coming forth to book flats and plots of their choice in large numbers. The number of unsold ready flats has come down across the country in past three years. The banking sector is also cooperating with the real estate consumers, offering home loans at reasonable rates. To improve the housing finance situation, the Finance Ministry had taken an initiative to constitute Bangladesh House Building and Finance Corporation (BHBFC), a specialised bank, in 2015-16. Through this medium, the Government intended to provide impetus to the housing sector. The Government is also planning to provide funds of at least BDT 5 billion to the home loan providers over three instalments. Bangladesh Bank has finally decided to increase loan flow to the housing sector to help it overcome the current crisis. The central bank instructed the commercial banks in January 2016 to consider lending to the housing sector alongside retail loans. Banks have also increased the credit ceiling for home loan because of price hike in construction materials used in housing. The private sector has also tried to bring some resurgence through self-driven initiatives. REHAB recently demanded the formation of a fund of BDT 30 billion for housing loan offering 7% - 8% interest rates to bring in investment in the housing sector.

Residential real estate remains the dominant segment within the industry and with the increasing demand for apartments and overall economic resurgence, the residential real estate in the city is expected to undergo a major positive change. The following sections describe the key residential micro markets within Chittagong.

5.2.2 Key Residential Micro Markets in Chittagong

Chittagong Master Plan has been the blue print guiding the spread/ concentration of residential activity in the city. The Chittagong Development Authority (CDA) and National Housing Authority (NHA) are the key implementation agencies in Chittagong engaged with provision of housing to city residents. Due to the hilly topography of the city, CDA and LGED traditionally had to create land parcels for accommodating mass housing projects. New areas constructed by cutting hills include Nasirabad as well as the southwest areas between Police Lines and Khulshi Road. Many other initiatives were also implemented for facilitating planned development including the construction of an intermediate ring road (CDA Avenue), the coastal bund, the development of the Agrabad Commercial area, industrial areas at Fouzderhat, Nasirabad, Hathazari and Kalurghat, and residential areas at Agrabad and Halishahar. Within these, CDA has been a major proponent developing some of the largest residential housing schemes in Chittagong. Some of the major residential areas developed by CDA are highlighted in the table below:

Table 2: Major Residential Project Schemes of CDA

Chittagong Development Authority (CDA) Past Schemes				
Residential Area Development				
S. No.	Scheme	Area (in acre)	No. of Plots	Land Development
1	Katalganj	6	51	1960-61
2	Agrabad	33	774	1962-63
3	Chandgaon	41	606	1962-63 / 1973-74
4	Chandgaon (2 nd Phase)	5.79	83	1978-80
5	Fouzderhat	13.62	164	1062-63 / 1980-81
6	Chandrima	11.97	183	1999-2000
7	Halishahar	14.80	22	1963-64
8	Sholashahar	10.25	98	1060-61
9	Silimpur	98.93	1029	1985-90
10	Karnaphuli	51.69	516	1991-96
11	Kalpalok (Phase-1)	40.00	1700	2005-06
	Kalpalok (Phase-2)	89.42		
12	Annayana	62	1521	2007

These larger residential schemes launched by the CDA constitute the major housing hubs within the city. While these represent the planned schemes of the Government to provide residential housing infrastructure, private developer activity in the city has been dispersed across concentrated pockets within the city. Considering limited geographic spread of the city of Chittagong and private developer activity being driven by availability of land under land sharing model, the combined effect has been the creation of regionally widely dispersed yet locationally concentrated apartment development activity across various parts of the city. Considering this micro market perspective, private developer led residential activity has been broadly classified by major micro markets such as Agrabad, Khulshi, Nasirabad, Panchlaish, Jhoutola Kazir Dewri, and Halishahar.

Considering the high concentration of projects in each small locality, the regions have been redefined, grouping the smaller areas in the immediate vicinity of 5-10 km under these hubs. For instance, the micro market of Nasirabad includes areas such as Mehdibagh, O.R. Nizam Road, Bayajit Bostami Road, Mirzapur road, Amirabagh, East Nasirabad, Shugandha, Zakir Hossain Road, CDA Avenue, GEC Circle, Gool Pahar More, Probandak More, Shugandha, and Muradpur.

The graph below provides a diagrammatic summary of the organized housing market, segmented by each key micro - market region within Chittagong:

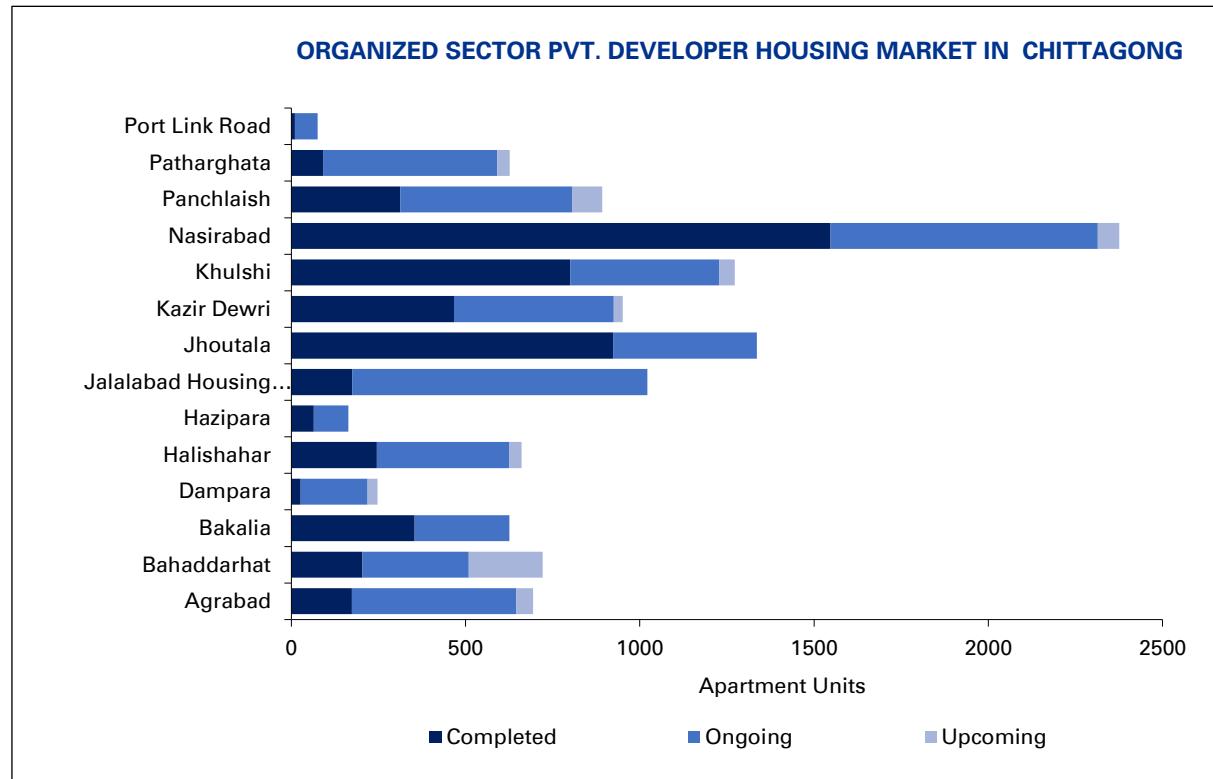


Figure 23: Organized Sector Private Developer Residential Market in Chittagong²⁶

Nasirabad currently represents one of the largest micro markets for organized apartment real estate in Chittagong city in terms of total apartment units, followed by Jhoutala, Khulshi (North and South), Jalalabad Housing Society and Kazir Dewri. Owing to the emergence of the Nasirabad region as the new city centre, the region also accounts for a substantially large share of ongoing housing projects in the region. Majority of the upcoming projects are in the nature of townships and mass housing projects (above 100 units), whereas completed projects typically comprise mid scaled (30-60 units) multi-storied apartment buildings.

The mix of ongoing projects is also atypical wherein:

- projects being constructed in land deficient regions such as Khulshi and Mehdibagh comprise small yet premium priced apartment projects whereas
- projects being constructed in Bakalia and Halishahar comprise mid-sized to large scale averagely priced apartments.

Apart from these areas having majority share of the completed and ongoing projects, regions such as Bahaddarhat, Halishahar, Jalalabad Housing Society have emerged as the future vectors for housing activity owing to outward growth of city and availability of competitively priced land for development. The micro markets are covered in detail below, highlighting the key characteristics of each of them:

²⁶ Source: KPMG Analysis

5.2.2.1 Nasirabad and Panchlaish Residential Market

The subject site is located in Nasirabad region, an emerging hub for premium residential and commercial projects. The region has witnessed growth in the past decade and has seen a healthy share of private developer led residential activity. Located adjacent to Nasirabad is the area of Panchlaish, a prime location featuring premium apartment projects from prestigious local and Dhaka based developers. For the purpose of this study, neighbouring areas to Nasirabad and Panchlaish were grouped together which include Mehdibagh Housing Society, Amirabagh, East Nasirabad, Shugandha, Zakir Hossain Road, CDA Avenue, GEC Circle, Gol Pahar More and Probandak More. The pictorial below provides a visual perspective of the residential and commercial profile of the region.

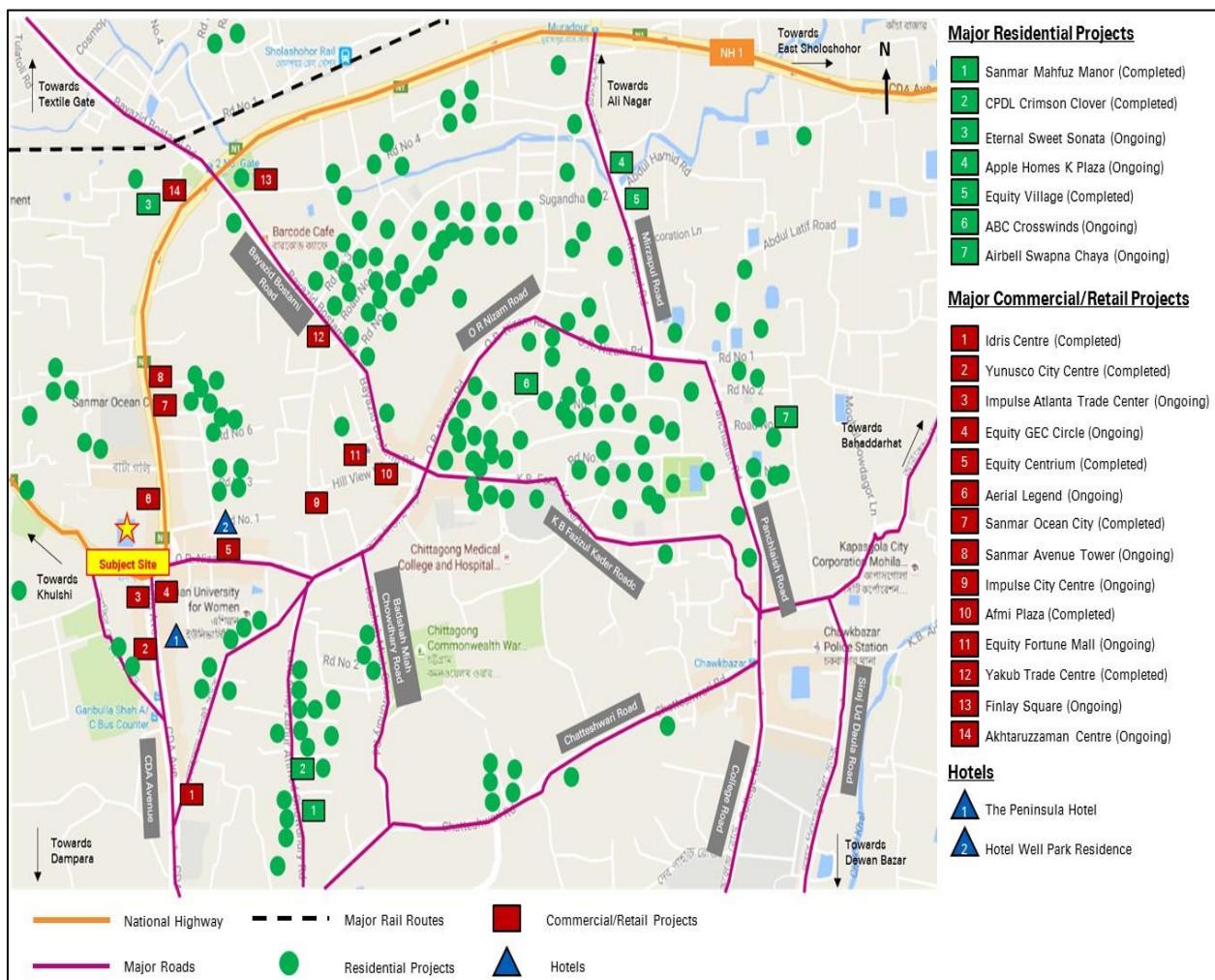


Figure 24: Map of Residential, Commercial & Hotel Projects in Nasirabad & Panchlaish

As seen from the image above, the Nasirabad - Panchlaish region features a large concentration of residential projects by private developers. Located centrally within the Chittagong City Corporation area, the region enjoys good connectivity and linkages with other prominent real estate hubs within the city. All major roads such as Dhaka Trunk road, CDA Avenue ring road, OR Nizam Road, Panchlaish road and Chatteshwari road connect and pass through the area adding to the connectivity and locational advantage of the region from an overall attractiveness perspective. The Chittagong railway station is also located in close proximity, making the region a major inter-city transit hub. The region is also the institutional hub for Chittagong,

housing prominent educational institutes such as Asian University for Women, Chittagong Medical College and prominent private universities such as Premier University.

The region of Nasirabad has come up as a major commercial alternative to the Agrabad CBD area and as a result features substantial commercial projects within a 5-10 km vicinity. This has been a key driver for the establishment of residential activity in the region. Traditionally, the region has witnessed sporadic residential apartment activity in the past 10 years owing to the ample availability of land, and most projects were constructed through the land sharing model. The concentration of residential apartment activity is the maximum around the O.R. Nizam Road, Bayazad Bistami Road (Muradpur) and Panchlaish Road, which are lined by multi-storied apartment projects constructed by private developers. The region features a mix of projects from prominent Dhaka based developers such as ANZ, PHP, BTI as well prominent local developers such as Sanmar, Equity Group and CPDL. In this area, the initial apartment projects were undertaken by prominent Dhaka based developers and a few large local developers.

Based on primary market survey information and interactions with local developers and industry stakeholders, the organized residential apartments market in Nasirabad - Panchlaish is estimated to comprise 3,800 – 4,000 apartment units. At an overall level, Nasirabad - Panchlaish market has a 28% - 30% market share of overall organized segment supply. Apartment projects of prominent developers constitute close to 3200 – 3400 units²⁷ out of the total units in this micro market. Provided below is a visual analysis of residential apartments market in Nasirabad and Panchlaish based on information collated from primary surveys:

²⁷ Source: KPMG Analysis

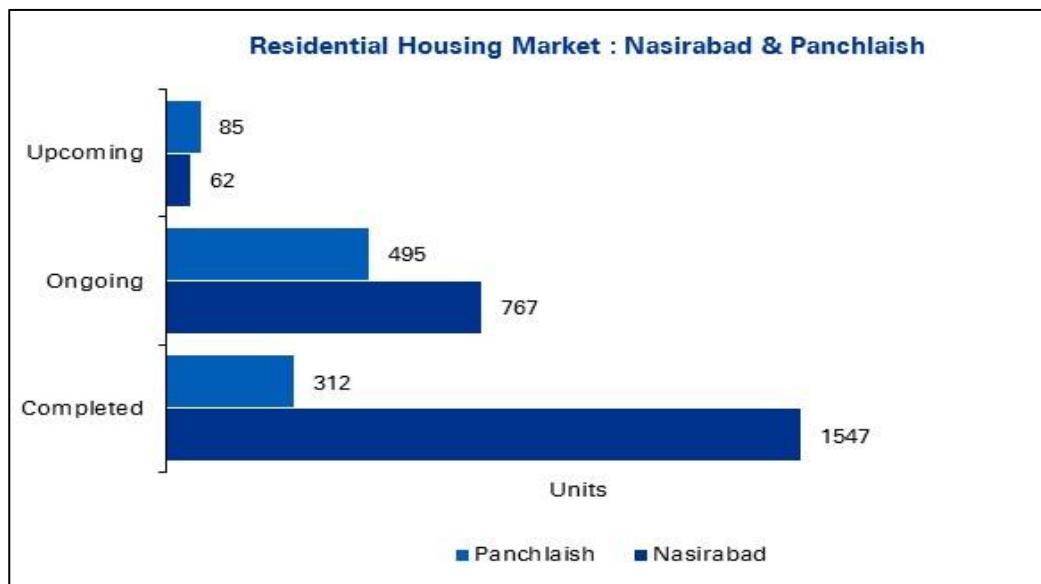


Figure 25: Status of Residential Projects in Nasirabad and Panchlaish

From a supply perspective, housing projects started coming up from 2009 while the larger part of the supply came into the market between years 2012 to 2016, comprising a mix of delivered, ready to deliver, as well as ongoing projects. The figure below provides the supply trend for residential apartments in Nasirabad and Panchlaish micro market:

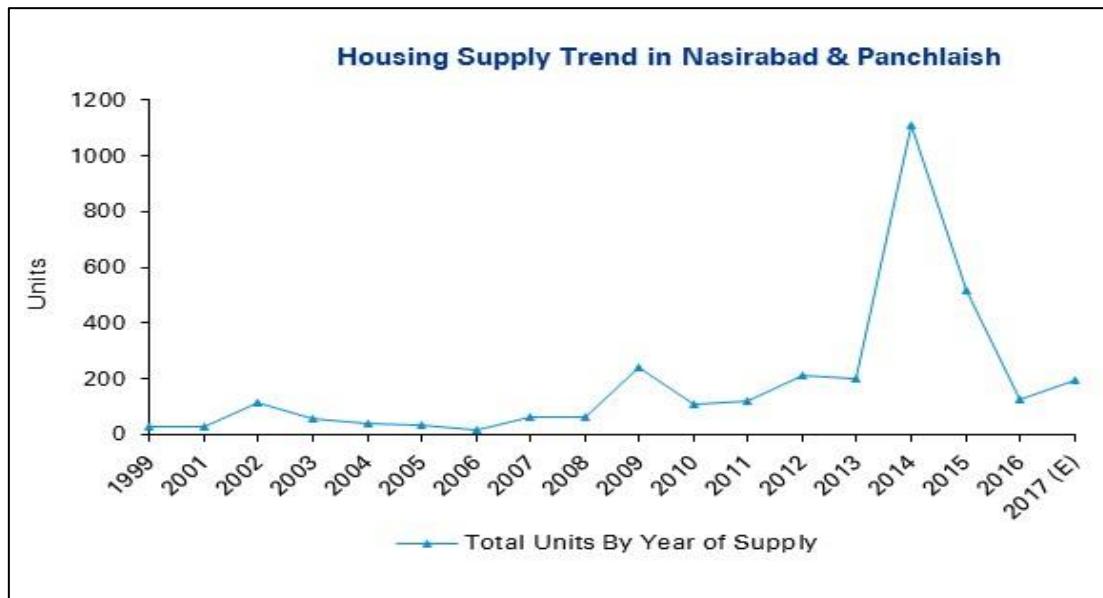


Figure 26: Housing Supply Trend in Nasirabad and Panchlaish

Considering these projects have been constructed in the past 10-12 years, there is a low quantum of unsold units in the completed projects. Due to the recessionary slowdown, ongoing projects have lower levels of absorption averaging 30%-40%, while upcoming projects have marginal absorption.

Most of the apartment complexes are of multi-storied formats have a typical ground plus 9/10 structures, and an average inventory of 25-50 apartment units. The projects here all offer fairly standardized yet high quality amenities such as power back-up, piped gas connections, club membership, recreational amenities, security and covered parking spaces. In terms of the product offering, the very early projects were traditionally styled apartment complexes without much design or aesthetic component. However, the more recently completed and ongoing projects offer better, modern contemporary design and superior amenities. A typical list of amenities offered in residential apartment projects in this region is provided in **Annexure – 13.3.** The table below provides a snapshot of the upcoming and completed residential project profiles in Nasirabad and Panchlaish areas:

Table 3: Profile of Major Residential Projects in Nasirabad and Panchlaish

Major Residential Projects in Nasirabad and Panchlaish ²⁸					
Project Name	Developer	Project Location	Project Status	Total Supply (In Units)	Current Absorption (In Units)
Swapna Chaya	Airbell Development Technologies Ltd.	Panchlaish	Ongoing	130	20
Equity Village	Equity Property Management Ltd.	Panchlaish	Completed	112	112
Mahfuz Manor	Sanmar Properties Ltd.	Nasirabad	Completed	91	85
Crosswinds	ABC Real Estate Ltd.	Panchlaish	Ongoing	56	12
Crimson Clover	C A Properties Development Ltd.	Nasirabad	Completed	55	55
Sweet Sonata	Eternal Design & Development Ltd.	Nasirabad	Ongoing	53	42

In comparison, the unorganized housing market comprising plotted developments and local developer projects constructed through land sharing model, is much larger. The surrounding colonies of CDA Nasirabad Housing Society, Amirbagh Housing Society, Probortak circle, Shugandha, Muradpur and Panchlaish all constitute a varied mix of small plotted houses and small (10-15) multi-storied apartment projects. Major differences between these and private developer projects include differences in apartment construction quality, size and scale of developer, branding, and amenities offered. Compared to private sector housing, the product offerings, product specifications and amenities in such non-organized segment are much inferior.

From a product sizing and pricing stand point, the average per sq. ft. sale rate in the region averages between BDT 6,000 to 8,000 per sq. ft. with average apartment ticket sizes ranging between BDT 90 lacs to BDT 185 lacs for a typical 3 Bedroom Hall Kitchen (BHK) and 4 BHK type apartment of 1,500-1,800 sq. ft. and 2,000-2,300 sq. ft.²⁹ respectively. In comparison to apartment ticket sizes in other regional micro-markets, Nasirabad-Panchlaish market lies at the premium end of the residential housing market. With presence of all large Dhaka based and local developers in the neighbouring Khulshi area with limited land available to construct, the locations close to Khulshi are becoming a preferred locations from developer perspective. Being around just 2 km from North Khulshi, the proposed NHA PPP project in Nasirabad is expected to witness reasonably high levels of interest from private developers.

²⁸ Source: KPMG Analysis

²⁹ Source: KPMG Analysis

5.2.2.2 Khulshi Residential Market

Located 2 km west off the subject site along the Zakir Hossain road, the Khulshi residential micro-market is one of the most prominent residential locations within Chittagong, featuring a rich mix of premium organized segment residential apartments. Almost all large Dhaka based and local developers have one project in Khulshi and it is a preferred location from developers' perspective. Khulshi accrues the same location advantages associated with Nasirabad and Panchlaish due to regional proximity (2-3 km). This market constitutes 2 sub micro-markets – i.e. North Khulshi (*Khulshi Hills*) and South Khulshi. Both these markets have a distinct real estate profile in terms of product offering, developer mix and image perception.

For the purpose of the market analysis, the market of Khulshi has been defined to include residential projects in areas like Khulshi Hills, Ispahani Hills, North Khulshi, South Khulshi and areas along the Zakir Hossain road. Provided below is a visual perspective of the Khulshi micro-market:

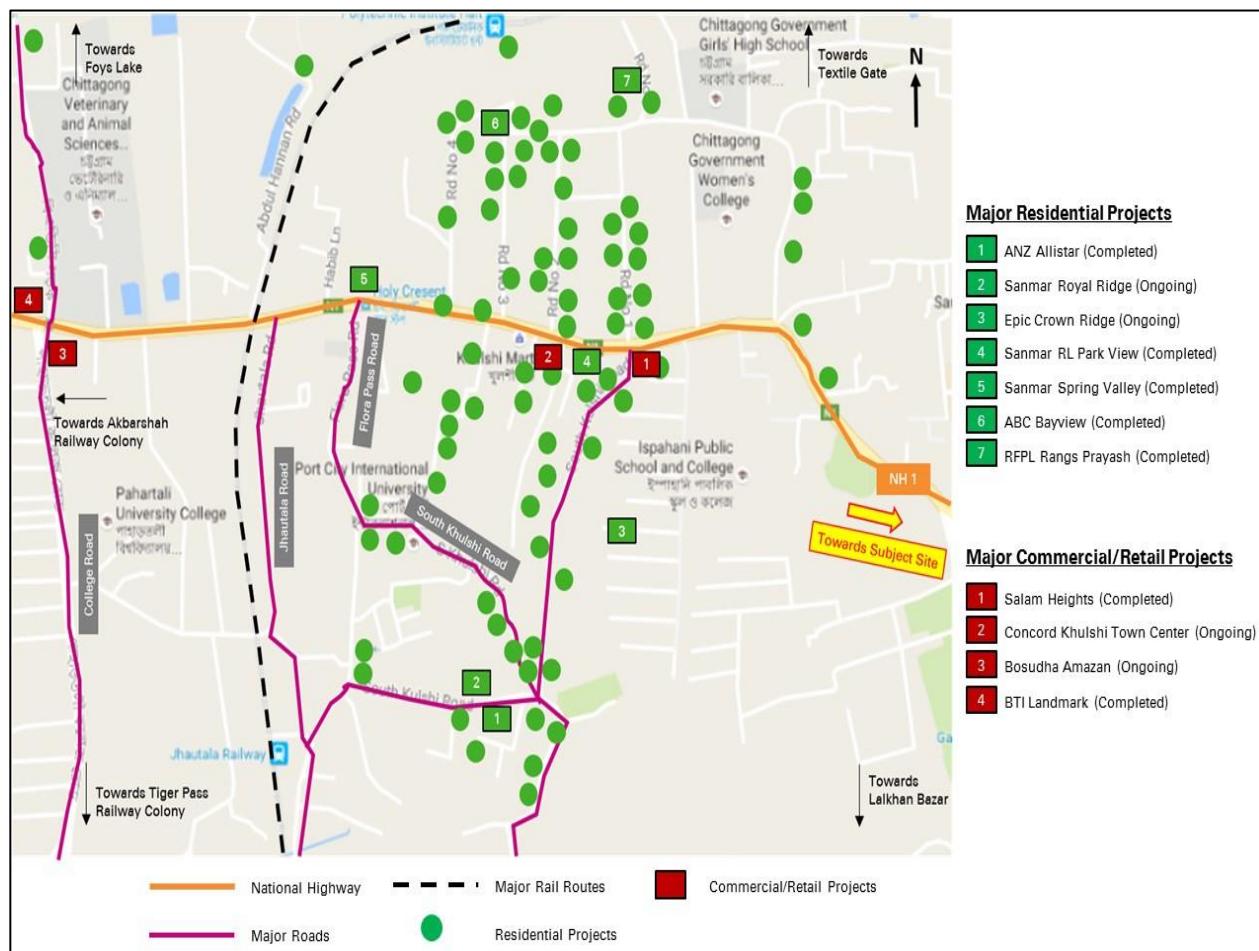


Figure 27: Map of Residential and Commercial Projects in Khulshi

Zakir Hossain road is the key artery connecting Khulshi to Nasirabad GEC Circle and this also bifurcates the markets into South and North Khulshi. The smaller branches coming out of this road into North Khulshi are the main centres for commercial and residential activities.

North Khulshi, also referred to as Khulshi hills features a mix of large bungalows and some of the best apartment projects in terms of internal layout, landscaping, quality of construction, design, amenities, etc.

within Chittagong. It is thus the preferred location for Chittagong residents of most affluent class. With very limited supply of land that can be developed, Khulshi hills has become one of the costliest locations within Chittagong. Some of the prominent developers in the region include Sanmar Group, Equity Property Management Company, and ANZ Properties Limited

In comparison; South khulshi has a relatively inferior profile characterized by highly congested layout, haphazard and ad hoc plotted housing development, higher number of apartment projects by small developers, dated designs and amenities. As a result, this region has become the second best option compared to North Khulshi. Prominent developers that have projects in this area include CA Property Development Ltd (CPDL), ANZ Properties Limit, Navana Real Estate and Ranks FC Properties Limited.

Based on primary market survey, the organized residential apartment market in Khulshi is estimated at approximately 1,200 – 1,300 apartment units³⁰. At an overall level, Khulshi represents 10%-11% of the market share in supply of apartment units³¹. Provided below is a visual analysis of residential apartment market in Khulshi based on primary information collated from market surveys:

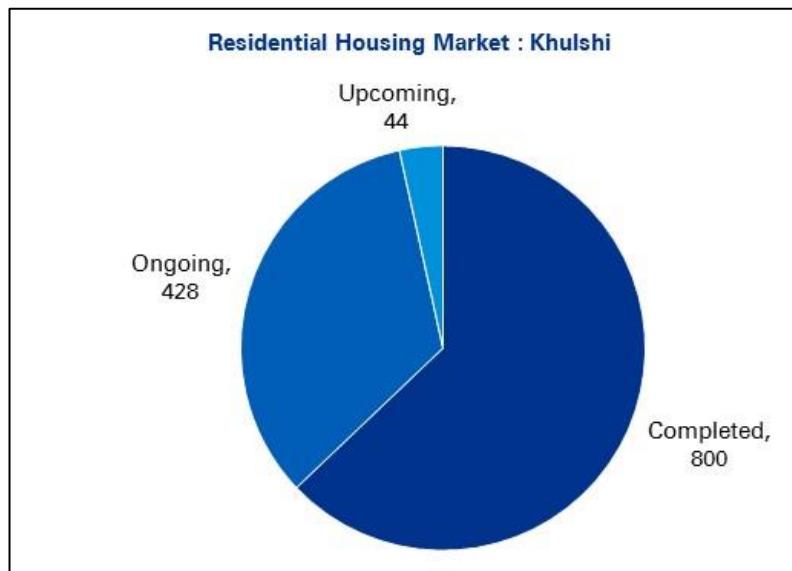


Figure 28: Status of Residential Projects in Khulshi³²

With increasing popularity of Khulshi hills, land owners are keenly looking forward to offering their land parcels for sale in lieu of the high expected capital gains on land sale as well as housing units in the project. With the current price realizations, developers are interested to take up projects in the region. As a result, there is a substantial share of upcoming apartments. The figure below provides the supply trend for residential apartments in Khulshi micro-market:

³⁰ Source: KPMG Analysis

³¹ Source: KPMG Analysis

³² Source: KPMG Analysis

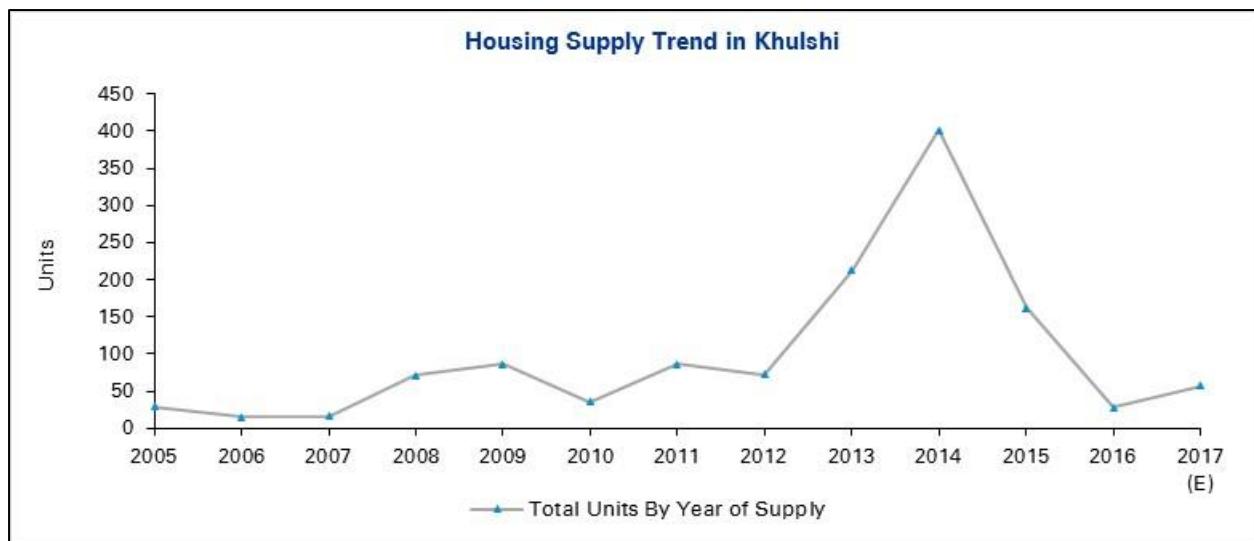


Figure 29: Housing Supply Trend in Khulshi

This region started witnessing substantial activity from 2010 onwards; however, land availability remained a constraint to the growth of the market. As land became available, the market also expanded between years 2013-2014, wherein large local developers and Dhaka based developers starting purchasing land and constructing mid-scale to large-scale housing projects. Considering land availability crunch in North Khulshi, developers have started focussing on developing South Khulshi as the next best location. As a result, large part of the total supply of apartments in ongoing and upcoming projects is coming up in South Khulshi. Some of the prestigious developer projects in the region are highlighted in the table below:

Table 4: Profile of Major Residential Projects in Khulshi

Major Residential Projects in Khulshi					
Project Name	Developer	Project Location	Project Status	Total Supply (In Units)	Current Absorption (In Units)
Royal Rudge	Sanmar Properties Ltd.	Khulshi	Ongoing	60	45
Spring Valley	Sanmar Properties Ltd.	Khulshi	Completed	56	50
Allistar	ANZ Properties Ltd.	Khulshi	Completed	56	56
Crown Ridge	Epic Properties Ltd.	Khulshi	Ongoing	56	26
Bayview	ABC Real Estate Ltd.	Khulshi	Completed	51	51
Rangs Prayash	Ranks FC Properties Ltd	Khulshi	Completed	47	47
RL Park View	Sanmar Properties Ltd.	Khulshi	Completed	44	44

A typical list of amenities offered in residential apartment projects in this region is provided in **Annexure – 13.3**. The typical profile of residential offerings in this region constitutes mostly 3 BHK and 4 BHK apartment units with average size range of 1,200 sq. ft.–2,000 sq. ft. and 2,200 sq. ft. – 3,000 sq. ft. apartments respectively. The apartment size offerings in this region are fairly larger than most areas within Chittagong

and carry a ticket size ranging between BDT 1.5 cr. – BDT 2.5 cr.³³, making this as one of the higher priced market in the region.

5.2.2.3 Kazir Dewri and Jhoutola Residential Market

The residential micro-markets Kazir Dewri and Jhoutola are located south-east off Nasirabad within an approximate radius of 2 to 4 km. Emanating from this geographical proximity, these regions have also benefited from the outward growth of real estate activity from Nasirabad, and Panchlaish. For the purpose of the market analysis, the micro-market of Kazir Dewri has been defined to include areas like Chawk Bazar, Chatteshwari Road, College Road, Badurtala, Devpahar and Kapash Gola Road. Similarly, the micro-market of Jhoutola is defined to constitute the locations such as Jamal Khan area, Love Lane, Momin Road, Hazari Goli, Enayet Bazar, Rabeya Rahman Lane, Andarkilla, and Nandan Kanan.

Despite being served by the key routes of Chatteshwari Road and Jamal Khan road, this micro-market has poor connectivity owing to congestion and high density of real estate activity. These micro-market regions were the first to feature real estate activity by private developers due to the northward progression of residential and commercial activity, away from the old CBD area of New Market. This is also one of the primary reasons for the strong presence of commercial real estate projects in the vicinity. As commercial activity grew in northward direction, Agrabad and Jhoutola witnessed a spurt of residential projects and Agrabad emerged as the new CBD. The region of Kazir Dewri also is a critical hub for social activities with presence of MA Aziz Stadium, Shishu Park and Chittagong Club all located within the region. In degree of market importance, these two micro markets are the third most active real estate hubs after Nasirabad,

³³ Source: KPMG Analysis

Panchlaish and Khulshi. Provided below is a visual perspective of the Kazir Dewri and Jhoutola micro-markets:

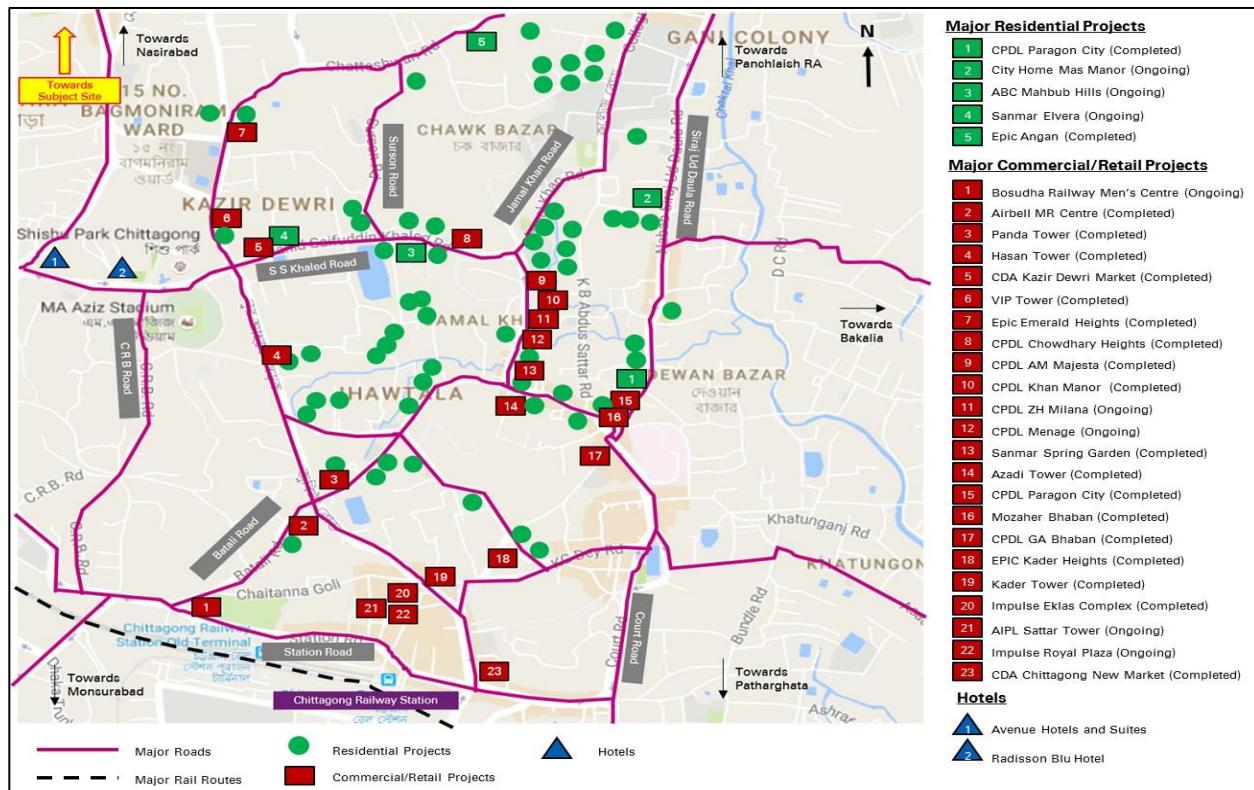


Figure 30: Map of Residential, Commercial and Hotel Projects in Kazir Dewri and Jhoutola

Jamal Khan road is the main activity centre in the micro-market region and together with Devpahar, College Road and Chatteshwari features a dense mix of commercial and residential projects. With a good concentration of educational institutions along College road, the areas of Jamal Khan, Kazir Dewri and Chawk Bazar have a good catchment population around them. Jamal Khan is also a major commercial centre with numerous commercial projects lining this arterial route. These micro-market locations are also close to the emerging alternate CBD of Nasirabad and the areas around Station Road and Enayat Bazaar are home to multiple commercial projects. Due to the commercial importance of this region – as an off shoot to new market area – the micro market has seen a fair share of interest from private developer for development of residential projects. Some of the prominent developers in the region include CA Property Development Ltd., Sanmar Properties Limited, Moulana Development Company, and Equity Property Management group. A typical list of amenities offered in residential apartment projects in this region is provided in **Annexure – 13.3**

Land sharing model is the main development model, and with commercial projects around, developers are able to realize a good price for residential apartment sales in the region. A major share of the projects in these micro-markets are completed projects, which came up between the years 2010 to 2016, where majority of the supply came in the years between 2013 and 2014.

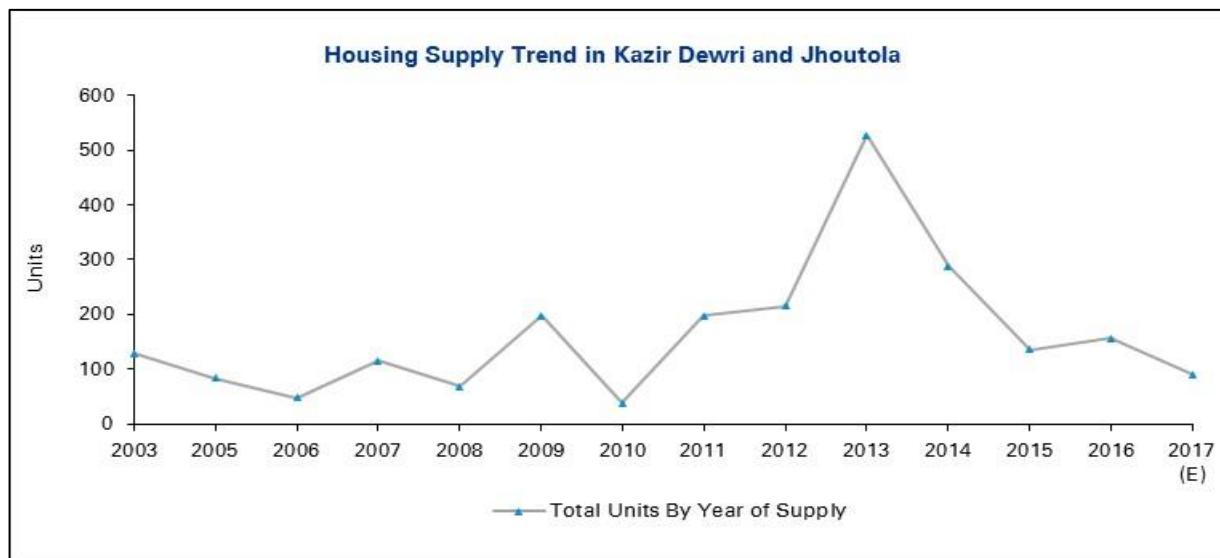


Figure 31: Housing Supply Trend in Kazir Dewri and Jhautola

Provided below is a visual analysis of residential apartments market in Kazir Dewri and Jhoutola based on primary information collated from market surveys:

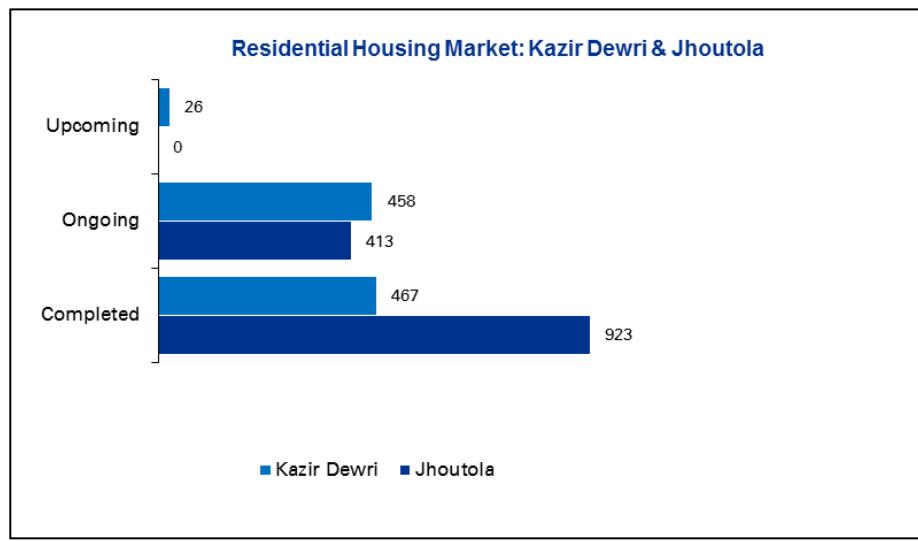


Figure 32: Status of Residential Projects in Kazir Dewri and Jhoutola³⁴

³⁴ Source: KPMG Analysis

Based on primary market survey information, the organized residential apartments market in Kazi Dewri and Jhoutola micro-markets is estimated at approximately 2,500–2,700 apartment units, out of which projects by prominent developer constitute 2,200–2,300 apartment units across projects³⁵. At an overall level, these locations represents approximately 20% of the market supply of apartment units in Chittagong³⁶. Majority of the inventory in this micro-market comprises the 3 BHK format apartments, and only a handful of projects provide the 4 BHK offerings. From a product sizing and pricing stand point, the average per sq. ft. sale rate in the region averages between BDT 6,000 to 8,000 sq. ft. The average apartment sizes for 2 BHK, 3 BHK and 4 BHK apartments range between 800-1,200 sq. ft., 1,100-1,800 sq. ft. and 2,000-2,400 sq. ft. respectively. Some of the projects by prestigious developers in the region are highlighted in the table below:

Table 5: Profile of Major Residential Projects in Kazir Dewri and Jhoutola

Major Residential Projects in Kazir Dewri and Jhoutola					
Project Name	Developer	Project Location	Project Status	Total Supply (In Units)	Current Absorption (In Units)
Paragon City	CPDL	Jhoutola	Completed	109	109
Angan	Epic Properties Ltd.	Kazir Dewri	Completed	99	99
Mas Manor	City Homes Property Ltd.	Jhoutola	Ongoing	84	69
Mahbub Hills	ABC Real Estate Ltd.	Jhoutola	Ongoing	68	37
Elvera	Sanmar Properties	Kazir Dewri	Ongoing	60	60

As the land availability in the region is gradually becoming limited, fewer projects are being developed in the region, leading to an increase in real estate prices of existing projects and extension of development activity to peripheral areas such as Nandan Kanan and Katalgonj. Katalgonj, Chawk Bazar, Kazir Dewri, SS Khalid Road, and Nandan Kanan are the emerging areas with numerous ongoing and upcoming developer projects being constructed.

5.2.2.4 Agrabad and Halishahar Residential Market

Agrabad is the heart of all commercial activity since it is the central business district for the city. The Sheikh Mujib Road runs through the main commercial belt of Agrabad, linking up to CDA Avenue in the North. Therefore, this area enjoys good connectivity and linkages with the Chittagong Sea Port, Shah Amanat Airport, Chittagong Railway station, the alternate CBD of Nasirabad as well the peripheral residential and commercial hubs of Kazir Dewri and Jhoutola. The area of Agrabad is primarily a business district and has limited presence of residential projects. However, the surrounding housing estates of Shantibagh, Bashundhara, Mohuripara Residential Area and Halishahar Residential Estate are large housing hubs acting as the main catchment area for all commercial projects.

³⁵ Source: KPMG Analysis

³⁶ Source: KPMG Analysis

For the purpose of the analysis, the micro-market of Agrabad is defined to encompass the areas of Dewanhat Mor, Mansurabad, Chowmohoni, Bapari Para, CDA Avenue Road, Chotopool, Agrabad Access Road, and Boropool Circle. Similarly, the micro-market of Halishahar is defined to include the areas of main Halishahar Housing Estate, Bou Bazar, Shantibagh, Bashundhara Residential area, Bangladesh Bank Colony, Boropool More, Mohuripara Residential Area, Shabujbag, Khaja Road, Nayabazar and Eidgah areas. Provided below is a visual perspective of the Agrabad and Halishahar micro-markets:

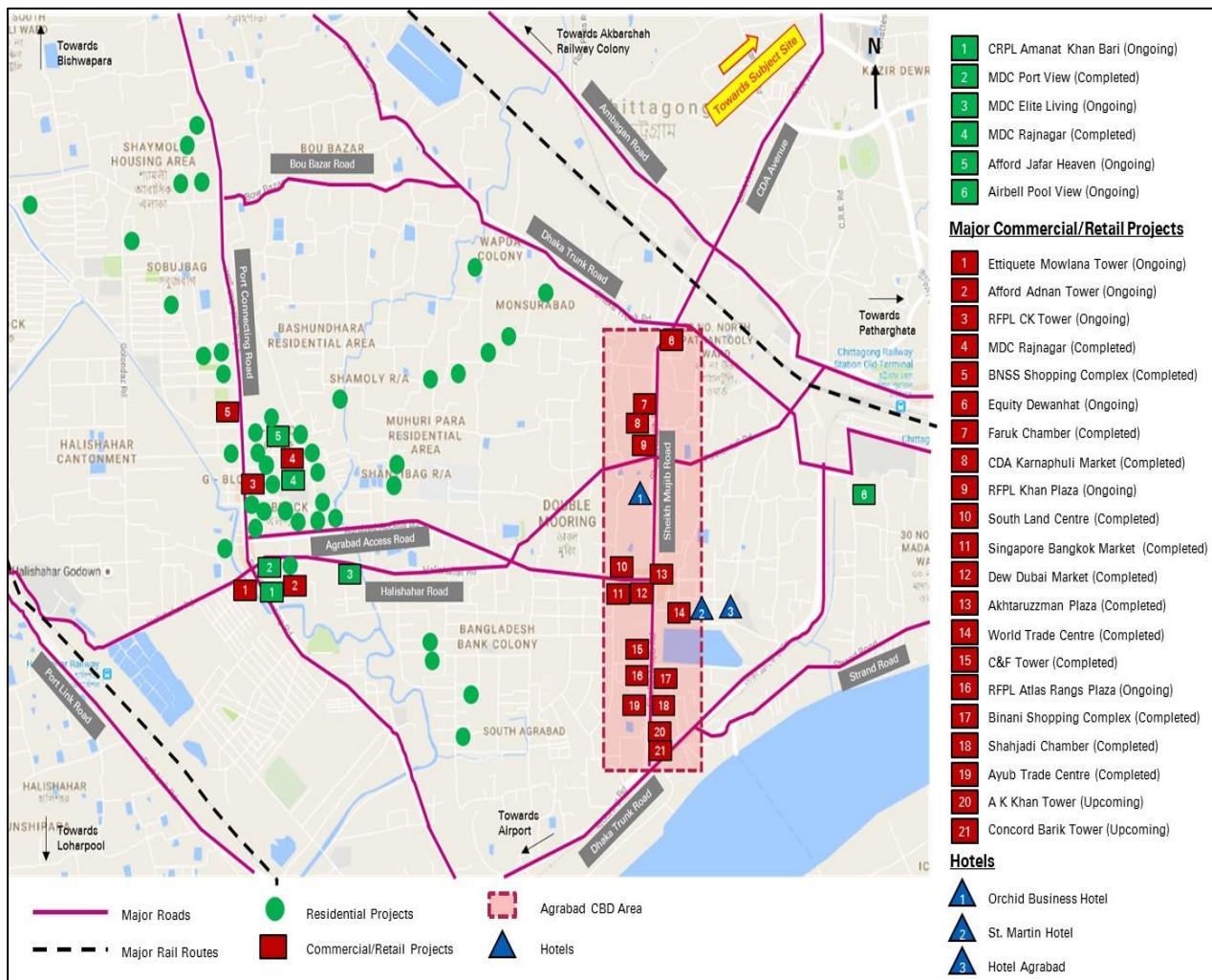


Figure 33: Map of Residential, Commercial & Hotel Projects in Agrabad and Halishahar areas

As observed from the map, the Agrabad area is the prime commercial hub for the city, featuring the largest concentration of commercial projects in Chittagong. This area has limited presence of residential apartment projects and is fed by the surrounding catchment residential areas. The region of Halishahar is however the prime residential activity hub for the region, featuring a varied mix of stand-alone apartment projects as well as numerous multi-storied stand-alone apartment projects. Government housing sector agencies such as the NHA and CDA have also developed numerous housing colonies and estates in this region which comprises a mix of plotted residential houses/ bungalows as well as multi-storied apartments. A large concentration of apartment projects constructed by local developers also exists in this region indicating prevalence of the land development model adopted by many developers and land owners in the region. Since the local government has announced plans to develop the port connecting road as a major transit

route, residential activity has picked up in this region in a big way. One of the biggest upsides from development perspective is the availability of large and competitively priced land parcels in the region. Being towards the south and west of the city, this region is a suburb to the main city areas and thus has witnessed relatively lower levels of private developer activity. The graphic below provides an overview of the residential supply trends in the Agrabad and Halishahar regions:



Figure 34: Housing Supply Trend in Agrabad & Halishahar

The supply trend for the region is indicative of the developer interest in the region. As observed from the supply chart, the Halishahar Agrabad market has witnessed higher developer interest in the past 4-5 years due to the preference of developers for other residential hubs such as Nasirabad, Kazir Dewri, etc. As the land availability has started to shrink for apartment developers in established residential hubs, their focus has now shifted to the outer regions and Halishahar has been the primary benefactor of this outward growth of residential real estate activity. Refer the graph below, this recent focus in developer interest is evidently reflected by the higher share of ongoing and upcoming projects in the region compared to completed projects.

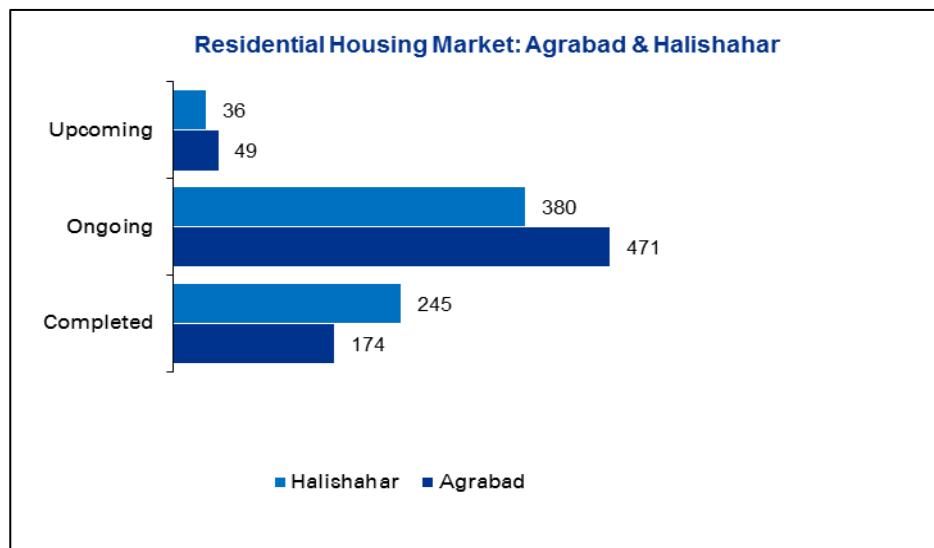


Figure 35: Status of Residential Projects in Agrabad and Halishahar³⁷

Based on primary market survey information, the organized residential apartment market in Agrabad and Halishahar micro-markets is estimated at approximately 1,800–2,500 apartment units, out of which, prominent developer projects constitute 1,300–1,400 apartment units across projects³⁸. At an overall level, these locations represents approximately 10-12% of the market supply of apartment units in Chittagong³⁹.

A typical characteristic of this micro-market region of Halishahar is the high prevalence of the 3 BHK format apartments offered in projects by private developers. With reference to the sizing and pricing of apartments offered by developers, the average per sq. ft. sale rate in the region lies between BDT 3,500 to 5,000 per sq. ft. With the average apartment sizes for 3 BHK apartments being 1,200 – 1,800 sq. ft., the typical ticket size for apartments in this region varied between BDT 35 lacs to BDT 90 lacs. Compared to the other prime and established hubs, affordability factor is higher in projects located in Halishahar.

In comparison, the micro-market of Agrabad has slightly better characteristics in terms of product offering and pricing. While this market too indicates a preference for 3 BHK format apartments, there are some project offering the 2 BHK and 4 BHK apartment types. From a sizing and pricing standpoint, Agrabad fares slightly better as the average per sq. ft. sale rate in the region ranges between BDT 3,800 to 6,000 sq. ft. The sizing of 2 BHK apartments ranges from 700–900 sq. ft., whereas the 3 BHK format sizes are in the 1,100-1,600 sq. ft. range⁴⁰.

Some of the projects by reputable developers in the region are highlighted in the table below:

³⁷ Source: KPMG Analysis

³⁸ Source: KPMG Analysis

³⁹ Source: KPMG Analysis

⁴⁰ Source: KPMG Analysis

Table 6: Profile of Major Residential Projects in Agrabad and Halishahar

Major Residential Projects					
Project Name	Developer	Project Location	Project Status	Total Supply (In Units)	Current Absorption (In Units)
Amanat Khan Bari	Coral Reef Properties Ltd.	Agrabad	Ongoing	84	69
Port View	Moulana Development Company Ltd.	Agrabad	Completed	101	101
Elite Living	Moulana Development Company Ltd.	Agrabad	Ongoing	150	75
Rajnagar	Moulana Development Company Ltd.	Halishahar	Completed	121	108
Pool View	Airbell Development Technologies Ltd.	Agrabad	Ongoing	49	9
Jaffar Heaven	Afford Properties Ltd.	Halishahar	Ongoing	40	20

The projects in this region offer relatively inferior amenities and the overall inventory within projects is also not very large. A typical list of amenities offered in residential apartment projects in this region is provided in **Annexure – 13.3**. The quality of offering is also evidenced by the stature/ brand of developers developing the current projects in the region. Despite the current positioning of this micro-market, this region is slated to emerge as one of the major micro-market vis-à-vis the established residential hubs in central Chittagong, where land saturation will push activity to this micro-market.

5.2.3 Residential Demand Supply Analysis

The previous sections provided a detailed analysis of each of the key residential micro-markets in Chittagong. Summarizing the analysis of micro markets, a consolidated demand supply analysis has been undertaken. The demand supply analysis discussed hereunder also encompasses other smaller micro-markets for housing activity in Chittagong.

5.2.3.1 Supply Side Analysis

Based on primary market survey information and interactions with local developers and industry stakeholders such as REHAB, the organized residential apartments market in Chittagong is estimated to comprise close to 18,000 – 20,000 apartment units comprising a mix of small scale private contractors projects as well as prestigious organized sector developer led apartment projects. Out of this, approximately 12,000 – 15,000 apartment units have been supplied by large local and Dhaka based real estate developers⁴¹. The supply trend for all such organized sector apartment projects has been presented in the graph below:

⁴¹ Source: KPMG Analysis



Figure 36: Supply Trend for Private Developer Apartments in Chittagong City

The advent of organized sector housing started in Chittagong post 2006, where the residential market grew at a Compound Annual Growth Rate (CAGR) of 49% between the years 2006 to 2014. A significant quantum of residential supply was introduced between the years 2011 to 2014, when the apartments market grew at 82% CAGR. However, the market supply slowed down drastically post 2015 owing to the stock market crash and the deterioration of socio-political situation, hampering the investment capacity of all real estate developers. However, the real estate markets have recovered marginally since then and are expected to stabilize after a correction over the course of next 2 – 3 years.

With reference to the share of micro markets in overall supply, the Nasirabad micro market accounts for the largest share of overall supply across all categories of projects (completed, ongoing and planned). Other prominent markets include Jhoutala, Khulshi, Panchlaish, and Kazir Dewari. Jalalabad Housing Society is also a significantly large micro market having 9% share of overall supply due to high aggregation of large housing inventory projects in the region. The following graph provides a snapshot of the micro market shares in overall supply of organized sector apartment projects in the Chittagong region:

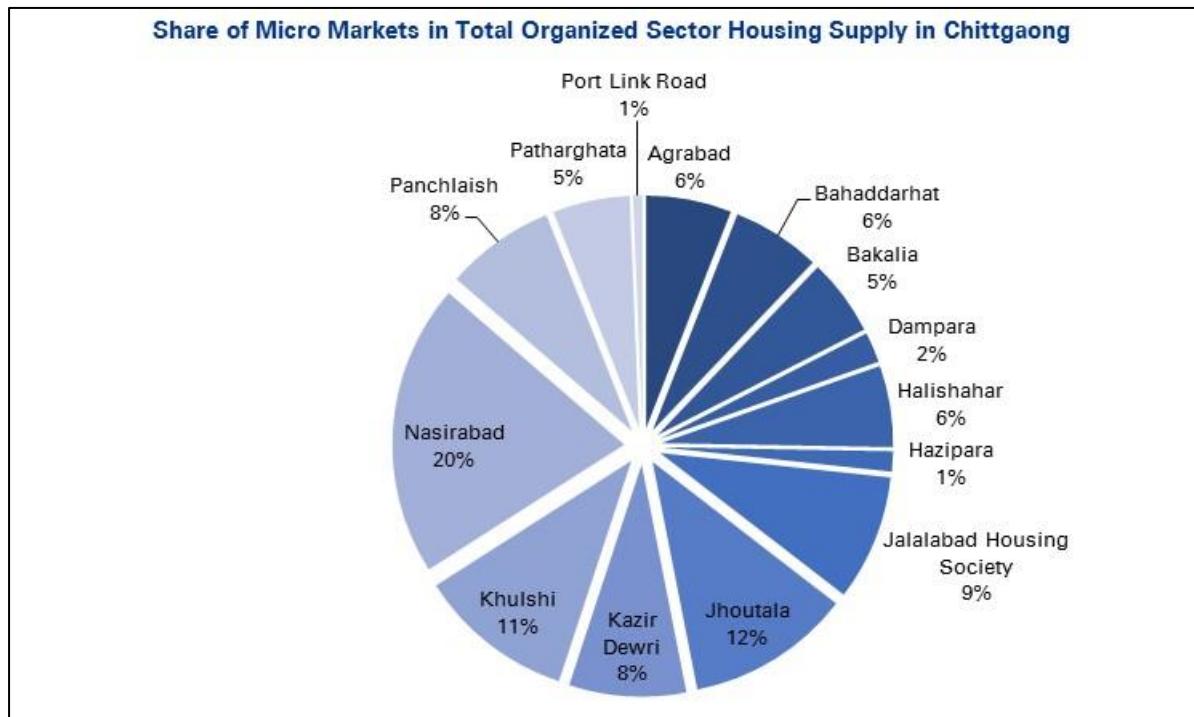


Figure 37: Share of Micro Markets in Total Organized Sector Housing Supply in Chittagong

With reference to project types, 90% of all housing units supplied in the region are based on pure apartment complex format as indicated in the graph below. Unlike the pure apartment projects, which only feature apartment housing, mixed use developments feature a mix of commercial and residential real estate within the same project. In this format, the commercial real estate components typically feature on the lower floors (Ground to 2nd Floors) of the apartment complex building, with the higher floors featuring apartment units. A reasonable 8% share of apartments have been developed as part of mixed use projects in the region. The precedence of condominiums is fairly low, accounting for a meagre 2% share of all apartment units developed⁴².

⁴² Source: KPMG Analysis

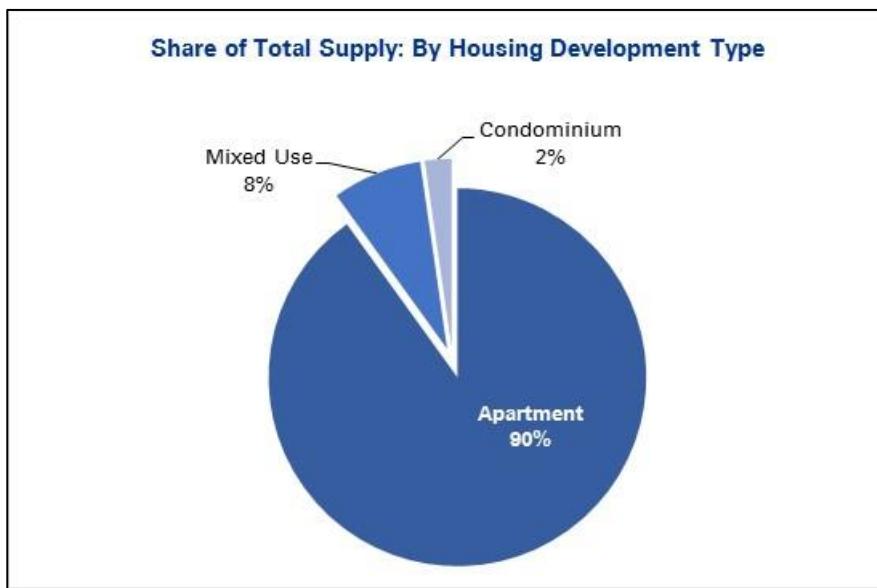


Figure 38: Share of Total Organized Sector Housing Supply in Chittagong: By Development Type

From a configuration perspective, the 3 BHK format type dominates the supply landscape accounting for an approximately 65% - 70% of all apartment units supplied in the Chittagong market. This is followed closely by the 4 BHK format type which is estimated to comprise approximately 20% - 25%⁴³ of all apartment units supplied in the Chittagong. The balance is accounted for by 2 BHK format - estimated to be 8% to10% and above 4 BHK format apartment units (<1%)⁴⁴.

5.2.3.2 Demand Side Analysis

Demand for apartment housing has been fairly good in relation to the units supplied in the market, highlighting a positive absorption trend. Analysing the demand-supply holistically between years 2001 to 2016 across all categories of projects (*completed, ongoing and upcoming*), an approximately 25% vacancy level has been estimated as prevailing currently in the organized housing market. Negligible vacancy levels exist in projects launched and delivered before year 2005. Demand levels were able to keep pace with the growth in supply between the years 2006 – 2011. However, demand has not been able to catch up with the increase in supply post 2011, resulting in slow absorption levels over the past 5 - 6 years. The following graph provides a visual summary of the demand-supply situation for organized sector residential apartments in Chittagong, across all categories of projects.

⁴³ Source: KPMG Analysis

⁴⁴ Source: KPMG Analysis

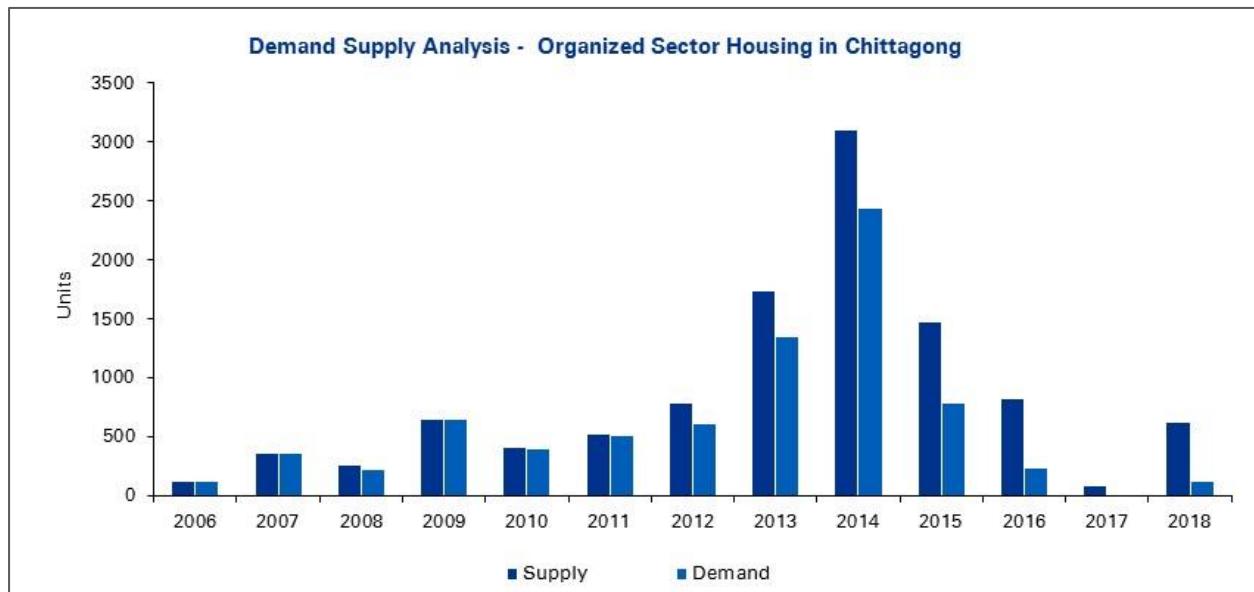


Figure 39: Y-o-Y Demand Supply Trend: Organized Sector Apartment Projects in Chittagong

A visual summary analysis of the demand-supply situation at the micro market level is presented in the following graph:

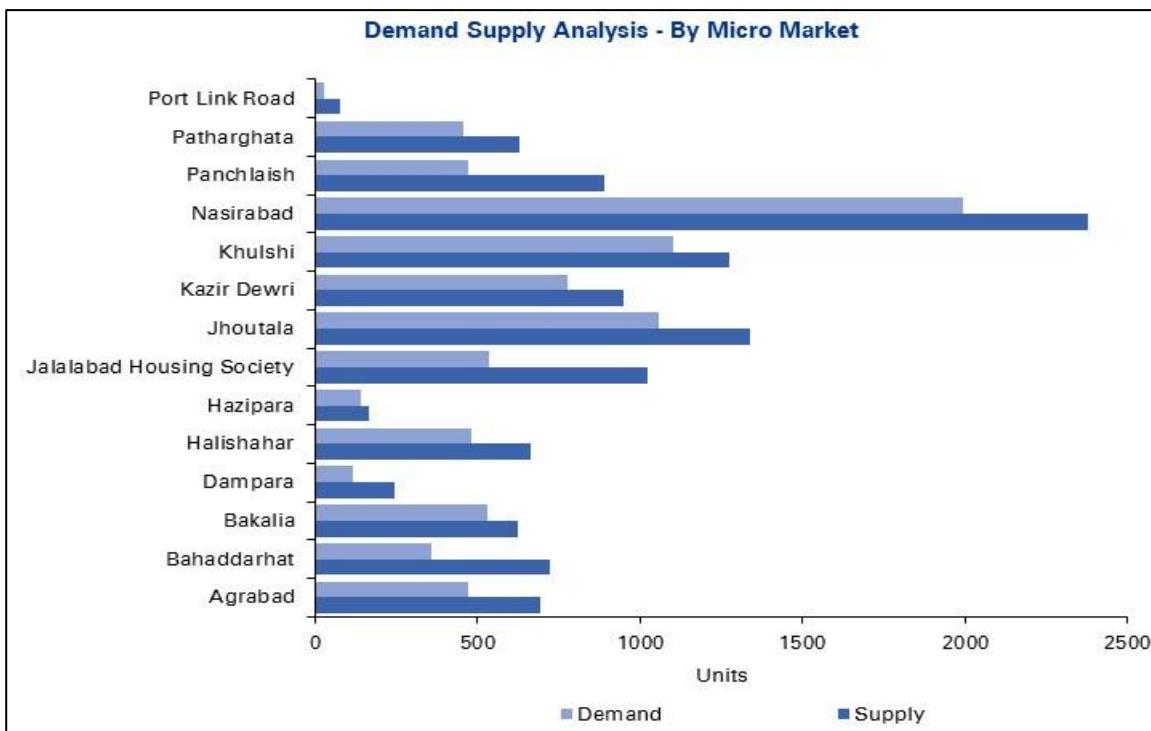


Figure 40: Micro Market Wise Demand Supply Analysis

Vacancy or unsold apartment units is an outcome of multiple factors such as overall size of the project, inventory of units supplied, location of the project, builder reputation, product offering, pricing and

competition. These factors typically lead to some degree of vacancy in projects. However, certain micro markets have been seen to compensate aptly for such variances. As seen from the graph above, prominent and established residential hubs such as Nasirabad, Khulshi, Jhoutala, and Kazir Dewri have comparatively low levels of vacancy – ranging between 13% - 21%. Considering that these micro markets also have a reasonable supply of ongoing and upcoming projects and are the higher ticket size locations, these vacancy levels can be considered reasonably acceptable. Compared to other residential micro markets which offer relatively lower ticket sizes and larger inventory of projects, such as Halishahar having 27% vacancy levels, the demand supply situation for micro markets in proximity to the subject site indicate attractive demand levels. Considering the location of the subject site is part of Nasirabad and lies in proximity to prominent neighbouring residential hubs, demand potential for the subject site looks encouraging from a demand supply perspective.

5.2.4 Residential Pricing Analysis

The pricing of residential real estate is a critical factor influencing buying decision of apartment buyers. Pricing of real estate projects typically move in sync with the demand supply scenario wherein prices tend to rise during real estate boom periods and correct downwards during low demand and over supply market situations. Market prices have followed a similar trend in Chittagong over the years and are currently undergoing correction as developers are pushing sales through discounts to unlock the capital investments in projects. The following graph provides an indicative trend of average pricing for organized segment apartments over the past 5 – 7 years:



Figure 41: Pricing Trends: Average of Project Launch Rates in Chittagong Market

Despite the demand slowdown, there has been limited correction in the pricing levels for apartment housing units. Most projects launched by developers in the boom period had very high prices which comprised both – demand premium and higher construction costs. With the current recessive trends, most developers are holding their inventories or offering limited discounts, averaging out the differentials between launch rates and current market rates to some extent.

While the average pricing levels have moved only marginally, the actual effect of pricing changes can be more accurately understood by analysing the pricing levels by each micro-market region. The following graph provides an indicative understanding of the pricing differentials between various locations:

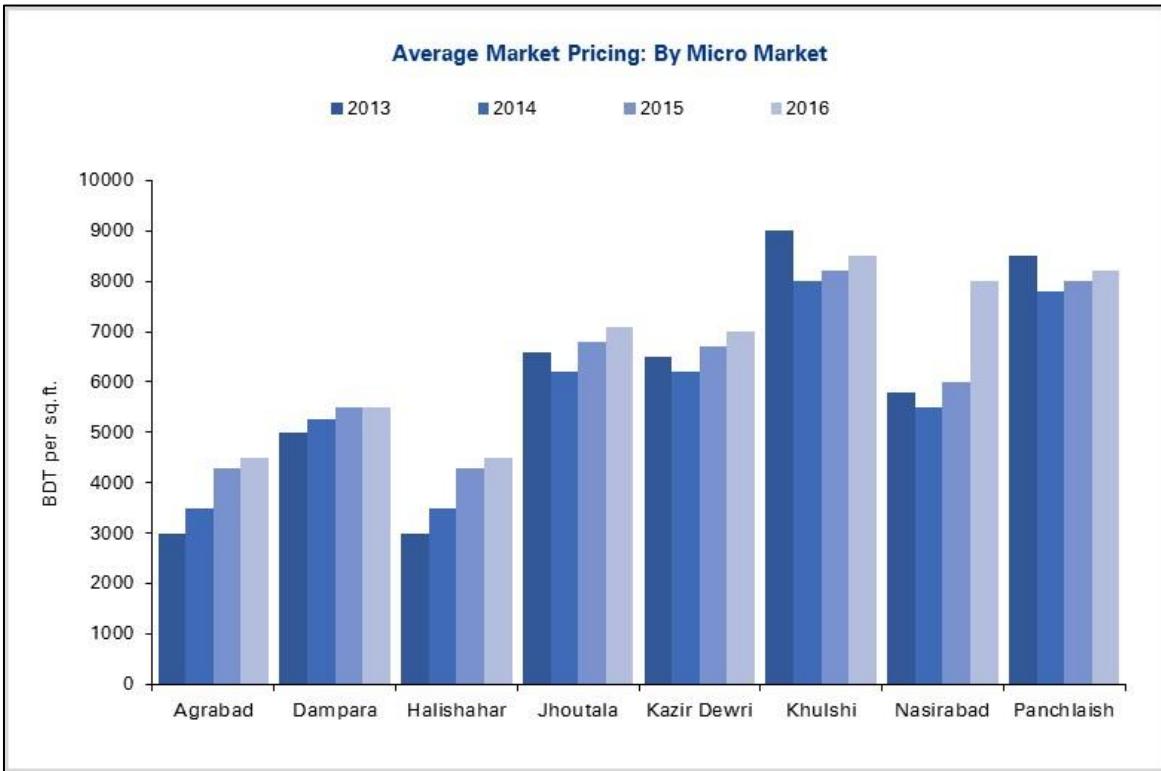


Figure 42: Pricing Trends: By Micro Market

The differential in pricing across micro-markets can be attributed to relative premiums or upsides accrued by certain prime locations, developer presence and quality of apartment projects. As can be seen from the data presented, different micro markets have witnessed different degrees of Y-o-Y price changes. Premium residential hubs have witnessed substantial price corrections whereas other non-prime locations have either witnessed a very small increase or have reached stabilized price levels. For example some price corrections have been observed in the prime markets of Khulshi and Jhoutala and Panchlaish whereas emerging locations such as Nasirabad have undergone a steady marginal increase in pricing over the past 3-4 years. The present recessionary phase in the real estate in Chittagong has severely impacted pricing and is expected to correct marginally downwards before stabilizing. Going forward, the prices are not expected to change much considering the demand supply situation and the general slowdown in residential real estate buying.

5.2.5 Residential Analysis Summary

The residential real estate market in Chittagong is an established market having a continuous demand for quality and affordable housing. The product offerings from organized sector developers cater to multiple price segments and have takers across different levels of ticket sizes. Depending upon the location of the project and the developers repute, the product offerings vary to keep up with the demand. Established residential hubs such as Nasirabad, Khulshi, Panchlaish, Kazir Dewri and Jhoutala enjoy a location advantage due to their central location and attract a premium over other locations. The buyer profile of these regions

essentially constitutes quality-conscious mid-high ticket size buyer segment. Emerging hubs such as Halishahar and Jalalabad housing society cater to a more price conscious lower ticket size buyer segment. The demand supply dynamics are also favourable wherein demand has been able to keep up with the supply. Despite the recent slowdown in the real estate market, there has been slow yet continuous demand for apartments in the city. 3 BHK formats are the preferred choice of developers and buyers alike and the size ranges offered within this segment ensure offerings being available for a cross section of budget-premium buyers. The 4BHK format is typically preferred by the high end buying segment, looking for large sized apartments in prime locations. The pricing may differ depending upon a multitude of factors, wherein location, land cost and developer brand are the critical determinants. With established hubs becoming increasingly congested and having limited availability of land, developers are looking at alternate locations to cater to the demand for housing. Developers are planning additional supply to meet future demand, expected to be taken up by the market over the course of coming 5-6 years. As land becomes available to developers across locations, more projects are expected to be taken up through the land sharing model.

Since the subject site is located at the most attractive location within the Nasirabad micro market, surrounded by prime established residential hubs, it is expected to witness significant interest from private developers. The location offers good potential for developing a mix of 3 BHK and 4 BHK apartments catering to the mid- high end buyer segments. A limited supply of condominiums may also be offered for the top end buyer segment. Though the land area available allows for a large inventory, considering the market appetite and the current recessionary trend, it is important that the project be launched in phases, offering an average of 100 odd apartments per year to ensure a steady demand supply situation. In summary the potential to develop residential housing /apartments in the location is promising and is expected to be received well by buyers and developers alike.

5.3 Commercial Real Estate Market

Commercial real estate market in Chittagong broadly comprises two main segments – commercial office segment and retail/ shopping places. Traditionally, the commercial market comprised traders and logistics companies engaged in port related commercial activities. Majority of the commercial space on offer consisted of unorganized shops and commercial complexes located in and around residential and trading hubs. Initially, commercial complexes did not follow any strict format, but as the market evolved, most developers started adopting the two floored mixed use development format, comprising shops on the lower floors and apartments/ housing units on the top floors. The New Market area along with the areas surrounding port and Station road comprised the erstwhile commercial area. As the commercial activities grew, the need for office and retail/ shopping space also increased. In order to attain a planned development approach, Chittagong Development Authority developed the Agrabad Commercial Area as the Central Business District (CBD) area. For the past two decades, Agrabad has remained the commercial heart of Chittagong city along with the peripheral areas surrounding the main commercial zone. The commercial real estate development format for Agrabad primarily constituted the mixed use format comprising retail shopping spaces at the lower floors and commercial offices in the first to third floors. Later on CDA established the Agrabad shopping complex which was the first large scale organized shopping area in Chittagong. The shopping centre features both shops as well as small offices. After the real estate boom Agrabad region witnessed substantial growth in commercial activity which resulted in more organized format commercial real estate being developed. With land availability reducing, construction in these development formats went higher. The new format commercial projects featured 8 – 10 multi-storied mixed use developments offering retail/ shopping spaces in the initial floors (typically ground to third floor) along with office spaces in the higher floors (4th – 10th floor). These developments also offered features such as elevators, security systems, basement parking, etc. However, these projects also have limited differentiating factors that can enable some of them to stand-out from the remaining projects.

Eventually, Agrabad became congested and had limited land availability leading to private developers focussing their attention to the emerging area of CDA Avenue and Nasirabad. In the past few years, Agrabad has become the traditional CBD, with majority of the new developments coming up in Nasirabad, making this the new emerging CBD area for Chittagong. The region currently features some of the new landmark commercial real estate projects constructed by leading local and national developers.

Considering the varied development formats (comprising shopping centres, stand-alone multi-storied commercial complexes, residential commercial mixed used towers etc.), the regional fragmentation of commercial activity and low presence of prominent developers, organized commercial real estate is expected to become the preferred format in the region in a gradual manner. There is no organized format shopping spaces equivalent of a mall featuring a mix of shopping spaces, food courts, multiplex and recreational amenities. The closest comparator in the city is Sanmar Ocean City located on CDA avenue near GEC More, Nasirabad. There is a market gap where organized shopping formats are very much required.

Substantial vacancy levels across the new and upcoming projects indicate that the Chittagong commercial market seems to be facing an oversupply situation. Even iconic commercial projects such as World Trade Centre developed by Chittagong Chamber of Commerce & Industry (CCCI) and CDA have slow absorption levels, indicating the slowdown in commercial real estate market. However, as the commercial situation improves with growth in trade, retail and services sector, the demand for commercial real estate is expected to continue for locations along the CDA Avenue road and Nasirabad is expected to be the biggest benefactor in this commercial market transition. The following sections provide a thorough analysis of the demand drivers for this growth and discusses the key commercial markets within Chittagong.

5.3.1 Commercial Real Estate Market— Key Drivers and Trends

The commercial market in Chittagong has traditionally been an export and trade driven space, consisting mainly of the shipping and logistics companies. Retail and shopping market has been localized to large residential agglomerations acting as the feeders for local shopping complexes. While these traditionally established locations have still remained important for the city's commercial market, new areas have emerged and are now displacing the prominent commercial and shopping centres. Despite the transition and growth in commercial space demand, the organized segment of high end commercial real estate market is still at a nascent stage. The overall market appetite is small and very few large players are undertaking commercial projects.

As a general rule, commercial real estate market performance is contingent upon macro drivers and is influenced by market trends. Summarized below are the key trends in the commercial real estate market in Chittagong:

5.3.1.1 Key trends in Commercial Real Estate Market

- **Transition to organized development formats with differentiated amenities:** there is an increasing preference among buyers to take up organized space formats that are dedicated commercial and retail real estate offerings, typically in a stand-alone (corporate tower) format. The portfolio of requirements w.r.t amenities and facilities has expanded, leading to developers differentiating their projects based on the facilities offered. Developer driven projects are increasingly being preferred over CDA type shopping complex projects. Demand for commercial spaces being offered on low congestion areas are also attracting a marginal premium. A similar trend has been observed in case of retail and shopping spaces wherein shops in organized format developments (*such as Sanmar Ocean City*) command a premium compared to high street format shops in Agrabad commercial area.
- **Preference for buying over renting of commercial space:** Unlike developed market where commercial spaces are typically leased or rented out, sale model is the primary preference of commercial buyers in Chittagong. While leasing or renting is undertaken through the Salaami model⁴⁵, most buyers of commercial space are owners that set up their own shop or commercial office space. Instances of sub-leasing are very infrequent and are in fact the exception.
- **Displacement Demand:** Erstwhile commercial space owners in Chittagong are gradually moving to organized formats, leading to a large displacement demand being created for emerging and new formats. This transitioning base of commercial space users has led to a higher than normal supply for commercial real estate in a small market like Chittagong because of enhanced private developer activity in organised formats.
- **Long Offtake Periods:** In general, the city's real estate market has undergone a period of sluggish sales and this trend is expected to continue for one to two years as the economy recovers. With the artificial demand being created by 'moving buyers', the overall absorption for commercial spaces is taking quite a long time.
- **Delayed Project Delivery:** With low frequency of sales and low quantum of absorption, commercial project developers are facing a credit crunch and are not able to reach break-even for the expected quantum of supply. As a result, delivery of projects has been delayed or in other cases, projects launched 3-4 years back are still being constructed (floor wise) and floor wise handover is taking place in some

⁴⁵ Salaami Model: A locally prevalent rental model adopted for leasing commercial office and shopping spaces in Chittagong. In this model, the owners offer their commercial space on rent against payment of a substantially large upfront amount, with the balance being paid as rental (sometimes equated to an installment). The purchaser under the salami is thus like an equated owner of the commercial space sold. As per market interactions, Salaami pre-payments may even be close to 90% of the total purchase price of the commercial property.

projects. This has attributed to the prevalence of a large number of incomplete or ongoing projects in the city.

- **Shrinking Market Appetite** – With the existing supply, developers are also tapering off the supply and the general demand for commercial real estate has become slower. With no new major economic activity driver, the market appetite has lately shrunk as compared with previous 2 – 3 years.
- **Price Corrections and Lower Realizations:** the real estate market in Chittagong is undergoing a recessive cycle after going through the boom period between 2008 -2012. One major outcome of this has been the price corrections and discounts being offered by private developers on real estate assets. To ensure regularity of inward sales revenues, the market has been observed to adopt a discounted sales approach and this trend is expected to continue in the future 1-2 years.

While the above trends indicate a negative situation for commercial real estate in Chittagong, there are major positives as well which have kept the commercial real market activity moving along.

5.3.1.2 Key Drivers for Commercial Real Estate Market

The following points summarize the major drivers for commercial demand of office spaces as well as shops in Chittagong.

- **New and Replacement Demand :** With changing buyer preferences, there is substantial replacement demand where commercial buyers move to better commercial projects in emerging CBD area and require more facilities and amenities. This is true for both commercial offices and shop buyers that have either shifted base from Agrabad to Nasirabad or set up an additional branch office or shopping outlet in Nasirabad.
- **Growing dominance of services sector buyers:** large share of the demand for commercial office space in Chittagong now comes from the services sector, especially the BFSI segment. While the erstwhile buyers mostly comprised traders, logistics companies and exporters, large part of the demand currently emanates from banking and finance related companies. There is also a constant but small demand for commercial spaces from companies engaged in the telecom and IT/ ITeS services sector as this is an emerging commercial sector.
- **Alternate Investment Demand from Domestic Investors:** Compared to Dhaka, Chittagong is still an emerging market with potential to grow, which has resulted in a reasonably high investment demand for commercial real estate. Commercial properties, especially shops, have also witnessed demand since the foreign remittances often get channelled into this as an alternate investment to residential properties.
- **Gradually Improving Foreign Investments:** Many foreign corporates; especially China and Singapore based firms; and international consumer product brands have made inroads into Bangladesh and are increasingly targeting Chittagong for setting up local offices and retail stores as trade and commercial activities have grown and consumer preferences have changed in favour of global brands.

5.3.2 Key Commercial Hubs in Chittagong

As mentioned earlier, the commercial real estate market in Chittagong is highly fragmented, regionally dispersed and very localized to micro market locations. There exists several regional pockets within the city which have commercial offices or shopping areas but these cannot be classified as major markets or organized segment real estate zones, when analysed at city level. For instance, the following areas are the localized commercial shopping locations with local projects that constitute the small, unorganized yet important sub micro-markets within Chittagong:

High Street Commercial Zones

- New Market area
- Chittagong Shopping Complex, Gate No 2 Area

- Bay Shopping Centre, EPZ, Chittagong
- Stadium Market
- Jamal Khan Road
- Bangkok Singapore Market, Agrabad
- Singapore Market, Hazeepara, Agrabad
- Mimi Market
- Zahur Hawkers' Market, Jubilee road

Mixed Use Commercial Towers/ Shopping Complexes

- Amin Centre, Lalkhan Bazar,
- Moti Tower, Chawk Bazar,
- Keari Plaza, Chawk Bazar,
- Lucky Plaza, Agrabad
- Chittagong Computer City/ Zohura Tower, Agrabad
- South Land Centre, Agrabad,
- Monni Plaza,
- Aktaruzzaman Centre,
- VIP Tower
- Apollo Shopping Centre,
- IFCO Centre,
- Chittagong Trade Centre
- Afmi Plaza
- Basuda Plaza
- Yunusco City Centre, GEC Circle
- Sanmar Ocean City, Nasirabad

In addition to the dispersed localised commercial projects above, large centralized commercial shopping zones have been developed by CDA to achieve planned development as per the city master plan. Some of these include:

- Agrabad Commercial Area
- Momin Road Commercial Area
- Jubilee Road Commercial Area
- Sholosahar Commercial Area (Near Muradpur)
- Station Road Commercial Area
- Court Road Commercial Area

Though the above list features many commercial areas, commercial real estate space in these projects mainly comprises high street format or mixed use development format buildings that have relatively inferior amenities, poor building facilities, and rudimentary layout design & concepts. Only a handful of these markets or projects can be classified as international standard, pure play or dedicated commercial real estate projects.

At a micro-market level, the organized segment commercial real estate market in Chittagong can be segmented into 2-3 key commercial zones that account for 80% of the organized market supply⁴⁶, and have projects within them that can be considered as benchmarks. These includes the existing CBD area of Agrabad, the alternate CBD of Kazir Dewari/ Jhoutala and emerging CBD of CDA Avenue and Nasirabad.

The following sections cover the detailed analysis of commercial real estate in these 3 micro-market locations. It is to be noted that for the purpose of analysis and the feasibility study, only benchmark-able organized segment projects have been considered since this is the segment expected to be developed on subject site.

5.3.2.1 Agrabad Commercial Market

Agrabad Commercial Area was developed by Chittagong Development Authority as the central business district (CBD) area for the city and it has, for the past 2 decades, remained the commercial heart of Chittagong city feeding the peripheral residential areas. The erstwhile CBD of New Market area and the emerging CBD of CDA avenue both are within a distance of 5-10 km. Agrabad has good connectivity to transit hubs like the Railway Station and the Airport and is thus the first stop for city visitors. The proximity to the EPZ and port areas has also led to Agrabad continuing to maintain its importance as the commercial centre of the city.

Chittagong Development Area (CDA) established the Agrabad commercial area, housing shops and offices to support the burgeoning commercial space demand in the city. The Agrabad shopping complex was the first large scale organized format shopping area in Chittagong, which featured a multi-storied aggregation of standardized shops with centralized maintenance and parking spaces. The shopping centre featured both shops as well as small offices. Given the commercial history of Agrabad, the development profiles and formats of commercial real estate in the region have been extremely varied and fragmented. Now, the area comprises a dense mix of commercial projects. Also, though Agrabad commercial zone is the commercial epicentre for the city, there are very few projects that represent the organized segment of commercial real estate.

⁴⁶ Source: KPMG Analysis

The following map provides a visual perspective of the commercial projects in the region:

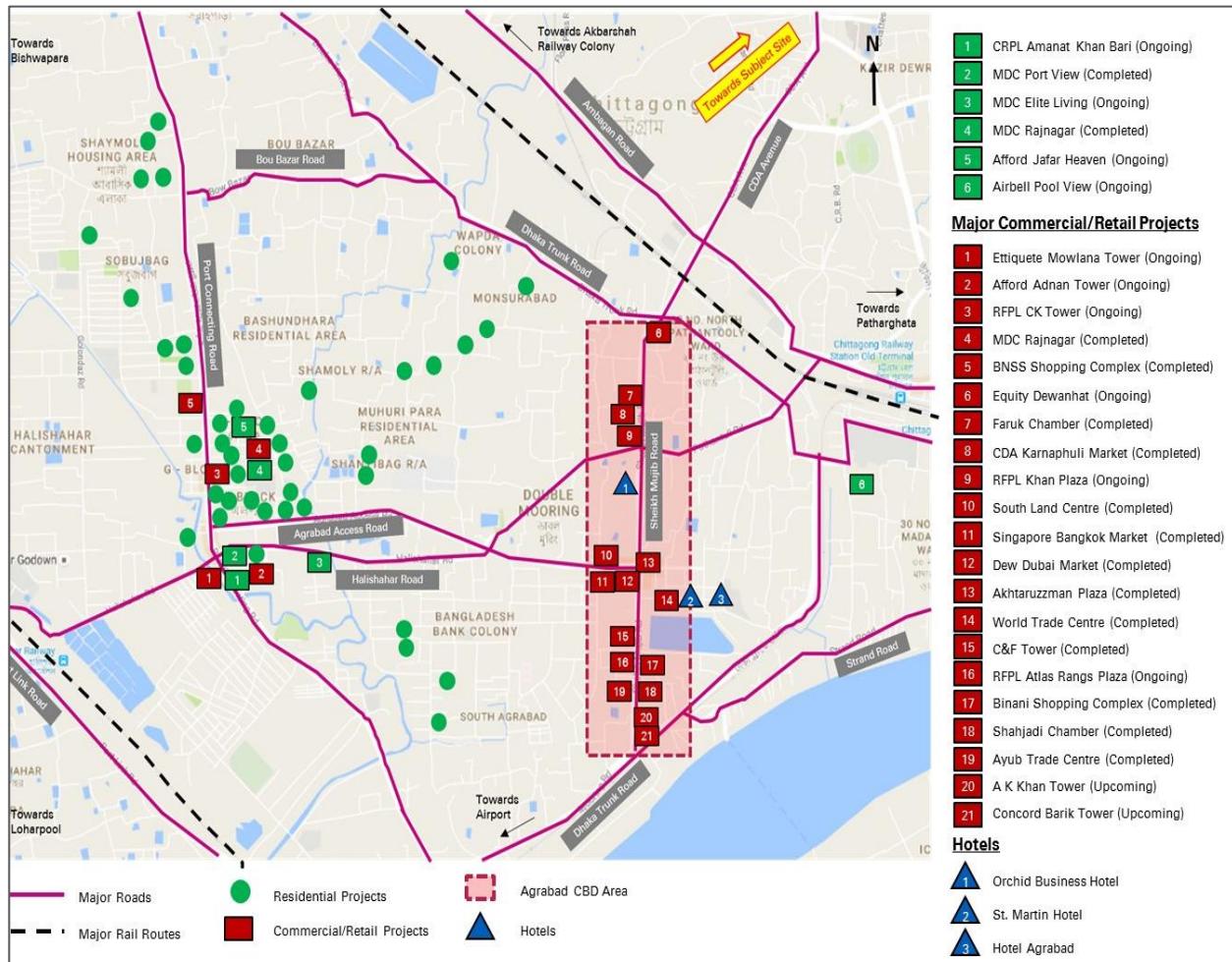


Figure 43: Visual Perspective of Agrabad Commercial Zone

As can be seen from the above map, Sheikh Mujib Road is the commercial artery of Agrabad, lined with large commercial projects on both sides of this main road. This region has the largest and most dense concentration of commercial establishments in the city. The presence of large residential colonies of Halishahar, Shantibagh, Bashundhara and BB Colony has ensured a large catchment population for commercial establishments in Agrabad commercial zone. There is also a good presence of hotels in and around the region that provides support to the commercial visitors to this region. The region is also well connected to New Market and CDA Avenue, further strengthening its position as a commercial market. Agrabad has remained the preferred choice of private commercial real estate developers from within Chittagong as well as the developers from Dhaka.

Due to the large residential agglomeration surrounding the site and the relative scale of space compared to neighbouring commercial areas of New Market and Station Road, Agrabad is also the largest shopping district in Chittagong, and has numerous shopping plazas within the area. Agrabad is the central hub for the city and attracts consumers from all parts of town. Some of the prominent shopping complexes in the Agrabad include: Singapore Bangkok Market, Singapore Market, South Land Centre, Dew Dubai market, Binani Shopping Complex, Shahjadi Chamber to name a few. While some of these shopping plazas are pure retail formats having only shops, others are multi-storied mixed use formats that house retail shopping

spaces at the lower floors and commercial offices in the upper floors. This is especially in the case of tower projects. Retail shop owners operate out of both – high street shops along the roads as well as shops forming part of commercial complexes and mixed use tower projects. The tenant mix for commercial office spaces mainly comprises logistics and trade, banking, financing, trading, insurance and IT/ ITeS companies. The retail mix comprises mainly of consumer good (clothing, footwear, etc.) stores, electronics stores, food outlets and restaurants. There is also a large number of hawkers selling cheap everyday products on the streets and this also is a lifeline for many local residents. The following images provide a visual perspective of the commercial projects and tenant mix for Agrabad area:



Figure 44: Prominent Commercial Developments in Agrabad Commercial Zone

A typical list of amenities offered in commercial projects in this region is provided in **Annexure -13.4**.

A recent addition to the commercial market of Chittagong has been the development of the iconic World Trade Centre building, which has redefined the commercial real estate. Equipped with all modern facilities, the trade centre is one of the premier organized format and dedicated commercial development focussing primarily on business activities. Constructed on 74.84 kathas of land, the building has an automatic integrated building management system, captive power sub-station, automatic gas generator, fire

extinguishing facilities, exhibition centre, shopping mall, food corner, commercial offices as well as CCCI's captive office and exhibition centre. In addition, the office support amenities are also provided such as International conference centre, exclusive IT zone, conference room, international media language centre, health club, banquet hall, snooker room, tennis court, swimming pool and billiard room, a five-star standard hotel and rooftop helipad. This is a landmark development for the city and is the best example of the organized segment commercial real estate in Chittagong.

Based on primary market survey information, the organized commercial real estate market in Agrabad and Halishahar micro-markets is estimated to be close to 14,63,000 sq. ft.⁴⁷, while the unorganized segment may be almost double of the organized segment at an overall city level. Together these locations represent approximately 45%-50% of the organized format commercial market supply in Chittagong. The following graph provides a break-up of the project status in Agrabad by stage of completion:

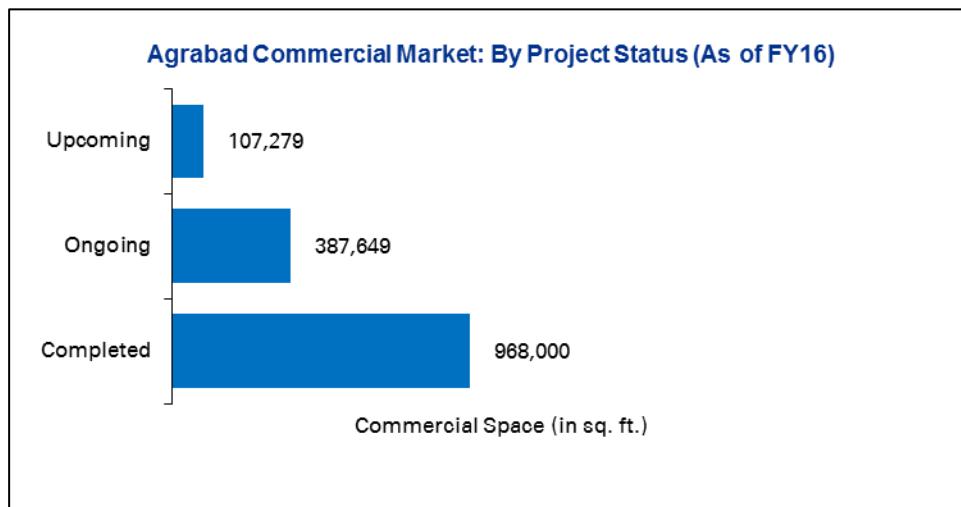


Figure 45: Status of Commercial Projects in Agrabad Commercial Market

As observed from the status of projects, majority of the real estate in Agrabad constitutes completed commercial projects. There is also a substantial additional supply currently being constructed and expected to be delivered over the next 2-3 years. Given the significance of Agrabad in the overall commercial market, there is further planned supply in the region expected to be taken up for construction in the coming 3-4 years.

In reference to the sizing and pricing of commercial spaces offered by developers, office spaces are sold in the upper floors of the building where the average per sq. ft. sale rate may lie between BDT 18,000–20,000 per sq. ft. For retail spaces, typically the lower floors (*Ground to 3rd floor*) are offered wherein maximum premium is payable for ground floor. Retail space sale prices on ground floors may range between BDT 30,000-45,000 per sq. ft. and prices typically fall by BDT 5,000 per sq. ft. for each higher floor offered. On an average, the price for retail shopping spaces may range between BDT 28,000–30,000 per sq. ft.⁴⁸

These are quoted rates and actual transacted rates may differ depending upon the final negotiations between buyers and sellers, location and size of the shops, type and size of project, etc. These

⁴⁷ Source: KPMG Analysis

⁴⁸ Source: KPMG Analysis

developments offer basic amenities such as lifts, maintenance, limited parking in basement, and basic security. From a design perspective, glass and steel facades are also offered in such buildings. However these are much inferior in relation to international standards and lack centralized air conditioning, CCTV security, centralized fire-fighting systems, energy saving systems, etc. However, owing to the location and buyers' lack of concern for world class amenities, there are many takers for such commercial projects. The table below provides a snapshot of the typical profile of commercial projects in Agrabad:

Major Commercial/ Retail Projects in Agrabad ⁴⁹					
Project Name	Developer	Project Location	Project Status	Total Supply (In Sq. ft.)	Current Absorption (In Sq. ft.)
World Trade Centre	Chittagong Chamber of Commerce and Industry & Concord Developers	Agrabad	Completed	850,000	~170,000
Akhtaruzzman Centre	CPDL/Rupayan Group	Agrabad	Completed	~120,000	~70,000
Rajnagar	Moulana Development Company Ltd.	Halishahar	Completed	15,000	15,000
Atlas Rangs Plaza	Ranks FC Properties Ltd.	Agrabad	Ongoing	112,700	20,000
Dewanhat	Equity Property Management Ltd.	Agrabad	Ongoing	93,500	46,700
Khan Plaza	Ranks FC Properties Limited	Agrabad	Ongoing	144,000	30,000

Figure 46: Profile of Major Commercial Projects in Agrabad and Halishahar

The developer profile of the region features the top names in the Chittagong real estate industry such as Concord Group, AK Khan & Co., CA Property Developers Limited (CPDL), Equity Property Management Ltd., Moulana Development Company Ltd., to name a few.

Over the years, the region has eventually become congested and has limited availability of land for new developments. There is also a supply glut in the region as many partly constructed buildings and marked commercial plots are currently lying unoccupied or unused. Due to the varied mix of commercial developments, the region lacks the feel of an organized commercial business district. As a result, both commercial buyers and commercial project developers are gradually shifting to emerging areas such as CDA Avenue and Nasirabad, further impacting the demand supply equation. Going forward, the region of Agrabad is expected to lose its prominence as the commercial centre of Chittagong as new and better developments come up in emerging business districts such as CDA Avenue and Nasirabad. This has been the general trend in the past 1-2 years.

⁴⁹ Source: KPMG Analysis

5.3.2.2 Kazir Dewri – Jhoutola Commercial Market

The regions of Kazi Dewri, Chawk Bazaar, Jhoutola, herein after collectively referred to as Kazir Dewri-Jhoutola Commercial Market, constitutes the second largest agglomeration of commercial real estate in Chittagong. Located within a radius of 3-4 km of each other and approximately 5–8 km from Agrabad, the Kazir Dewri-Jhoutola commercial market is considered to be the alternate CBD area for Chittagong city. As Agrabad became more congested and land parcels were unavailable, private developers started exploring locations for undertaking new commercial projects. The following map provides a visual perspective of the concentration of prominent commercial developments in the Kazir Dewri-Jhoutola commercial market:

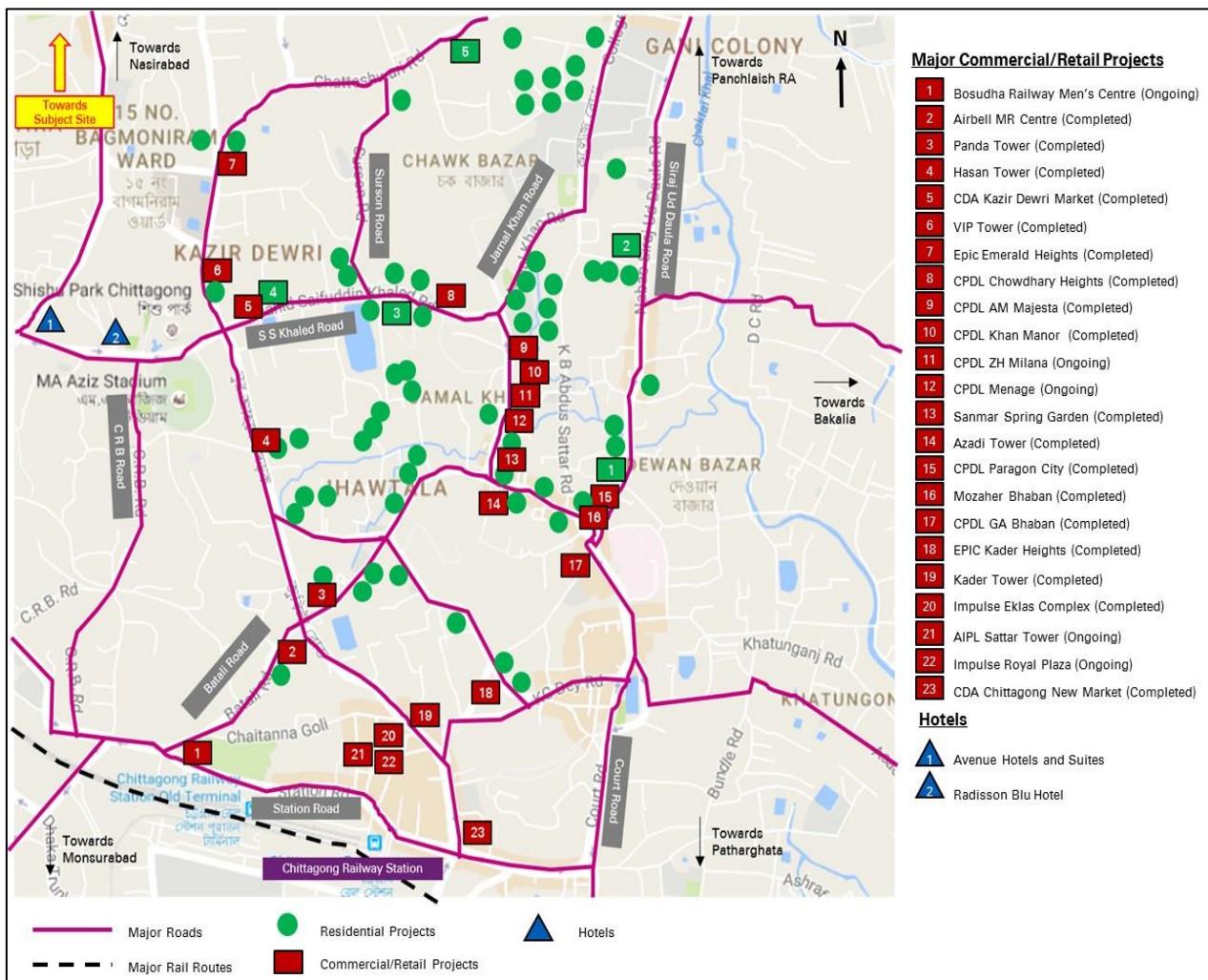


Figure 47: Visual Perspective of Commercial Projects in Kazir Dewri - Jhoutola Markets

Exploiting the land development model and the regional proximity to Agrabad, the Kazir Dewri-Jhoutola commercial market provided opportunities to developers for supplying organized format commercial projects. As seen from the map above, the concentration of projects is highest along the Jamal Khan Road, Enayet Bazar Road, Jubilee Road and Siraj Ud Daula Road. Since this market was the second to come up after Agrabad, the commercial projects here share the typical characteristics of the Agrabad commercial zone. However a major difference is the higher proportion of multi-storied mixed use commercial tower projects as compared to small and unorganized shopping plazas. Having been developed recently, the commercial projects in Kazir Dewri-Jhoutola commercial market feature better organized retail and

commercial office and retail real estate. The preferred format for developments is mixed use development where lower floors feature shopping areas and upper floors feature office spaces or residential apartments. The tenant profile in this region comprises banking, financing, trading, insurance and IT/ ITeS companies. The retail mix comprises mainly of premium brands of consumer goods (*clothing, footwear, etc.*), food outlets and restaurants.

Over the years, the commercial and retail real estate has become more contemporary, with better designs and multi-storied formats and therefore, developers have started aggressively marketing projects based on the concepts. The developer profile operating in the micro-market region is slightly better than that of Agrabad based developers, and is mainly dominated by local Chittagong based developers such as C A Property Development Limited, Epic Property Management, Airbell Properties Limited, etc. The Kazir Dewri-Jhoutola commercial market also features select projects that offer pure commercial offices and shopping spaces. A snapshot of the popular commercial buildings in region is provided below:



Figure 48: Select Commercial Projects in Kazir Dewri - Jhoutola Market

Based on primary market survey information, the organized commercial real estate market in Kazir Dewri-Jhoutola commercial micro-markets is estimated to be approximately 710,000 sq. ft.⁵⁰, and the unorganized segment may be equivalent to the organized segment space. These micro-market locations represent

⁵⁰ Source: KPMG Analysis

approximately 20%-25% of the organized format commercial market supply in Chittagong. The following graph provides a break-up of the project status by stage of completion:

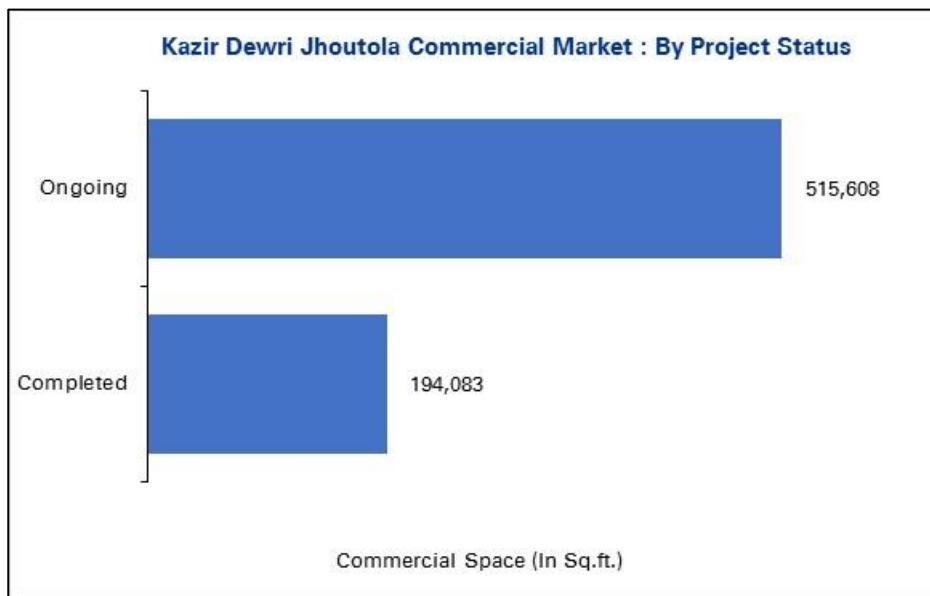


Figure 49: Status of Commercial Projects: Kazir Dewri and Jhoutola Market

As observed from the status of projects, majority of the real estate in the area constitutes ongoing commercial projects and there is negligible upcoming/ future supply planned. Of the upcoming supply, currently being constructed, the projects are expected to be delivered over the next 3-4 years.

With reference to the pricing of commercial spaces offered by developers, office spaces are sold in the upper floors of the building where the average price per sq. ft. sale rate may lie between BDT 20,000–22,000 per sq. ft. For retail spaces, typically the lower floors (*Ground to 3rd floor*) are offered wherein maximum premium is payable for ground floor.

Retail space sale prices on ground floors may range between BDT 35,000-45,000 per sq. ft. and prices typically fall by BDT 5,000 per sq. ft. for each higher floor offered. On an average the price for retail shopping spaces may range between BDT 28,000–30,000 per sq. ft.⁵¹ These are quoted rates and actual transacted rates maybe differ depending upon the final negotiations between buyers and sellers, location and size of the shops, type and size of project, etc.

The table below provides a snapshot of the typical profile of prominent commercial projects in the micro-market region:

⁵¹ Source: KPMG Analysis

Table 7: Profile of Major Commercial Projects in Kazir Dewri-Jhoutola Market

Major Commercial/ Retail Projects in Kazir Dewri Jhoutola Market ⁵²					
Project Name	Developer	Project Location	Project Status	Total Supply (In Sq. ft.)	Current Absorption (In Sq.ft.)
GA Bhaban	CA Properties Development Ltd.	Anderkilla	Completed	54,000	54,000
AM Majesta	C A Properties Development Ltd.	Jamal Khan	Completed	15,200	15,200
Paragon City	C A Properties Development Ltd.	Sirrajuddula Road	Completed	33,300	33,300
Khan Manor	C A Properties Development Ltd.	Jamal Khan	Completed	12,100	12,100
Spring Garden	Sanmar Properties Ltd.	Jamal Khan	Completed	15,800	15,800
MR Centre	Airbell Development Technologies Ltd.	Enayet Bazar	Completed	24,300	24,300
Kader Heights	Epic Properties Ltd.	Nandan Kanan	Completed	30,000	24,000
ZH Milana	C A Properties Development Ltd.	Jamal Khan	Ongoing	12,900	12,900
Impulse Properties Limited	Impulse Eklas Complex	Jubilee Road	Ongoing	67,500	5,000
Impulse Properties Limited	Impulse Royal Plaza	Amtala	Ongoing	11,2500	10,000

Going forward, the commercial market in this region is expected to undergo a major demand supply shift wherein the ongoing projects will witness continued demand over the coming years. With limited upcoming/future projects and commercial growth moving further north-west towards Nasirabad, this micro market shall serve as the alternate CBD, feeding the carry over demand from Agrabad, New Market and Station Road areas.

5.3.2.3 CDA Avenue – Nasirabad Commercial Market

The commercial area of CDA Avenue starts from Tiger Pass roundabout to Muradpur spanning a distance of 4 km. Most of the commercial real estate activity starts at the intersection of the Mohammed Ali Road and ends at Sholashohor Circle gate no.2. This entire stretch is lined with commercial real estate development comprising a mix of traditional shops, small offices, mixed use developments, and commercial tower projects.

⁵² Source: KPMG Analysis

The region around GEC Circle in Nasirabad has the highest concentration of commercial projects and is considered to be the emerging CBD area of Chittagong. The emergence of CDA Avenue and Nasirabad is attributable to the outward growth of commercial activity from Agrabad commercial area, driven primarily by the availability of land in Nasirabad. The following map provides a visual perspective of the location of commercial real estate projects in Nasirabad and along the CDA Avenue:

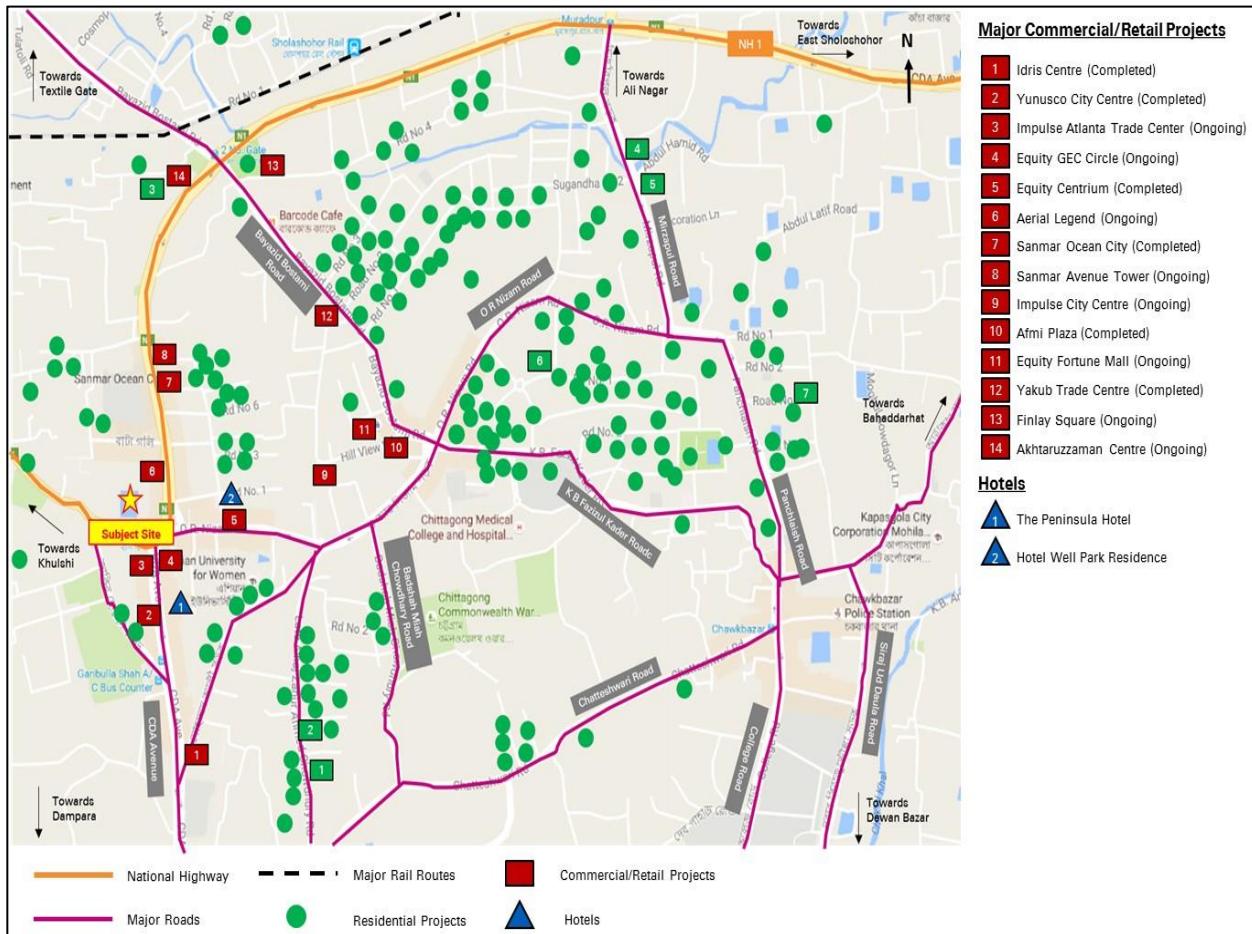


Figure 50: Visual Perspective of Commercial Projects in Nasirabad

As shown in the map, the region enjoys good connectivity with surrounding residential and commercial hubs and is served by the arterial ring road of CDA Avenue, along with other major connecting links such as O.R. Nizam Road, and Dhaka Trunk Road. The region's attractiveness has been further accentuated due to the upcoming flyover project, creating seamless connectivity between port, airport, Agrabad and CDA Avenue.

Since the region of Nasirabad has come up recently, the commercial real estate in the region is characterized by contemporary designs, concept based developments, larger scale of projects, better construction quality, and high end commercial and organized retail formats. A typical list of amenities offered in commercial projects in this region is provided in **Annexure -13.4**. Even in terms of size and scale of developments, this region features the city's large scale real estate developments. A major factor for developers constructing the new and upscale projects in the region is the demand from surrounding catchment of premium residential projects in Panchlaish, OR Nizam Road and Bayazid Bostami Road. Since the new formats have come up and regional consumers have gradually started preferring more organized development formats

with better tenant and brand mix, the retail developments in the region have come up as the primary alternate shopping hub for the city residents. This region features some of the popular retail establishments in the city such as Sanmar Ocean City, Yunusco Hallmark and AFMI Plaza, which are landmark developments for the citizens.

A critical differentiating factor for the Nasirabad commercial market is the price premium enjoyed by commercial real estate developments here, as these offer far superior product offerings compared to the competing developments in the city. Provided below is a snapshot of the commercial developments in the region:

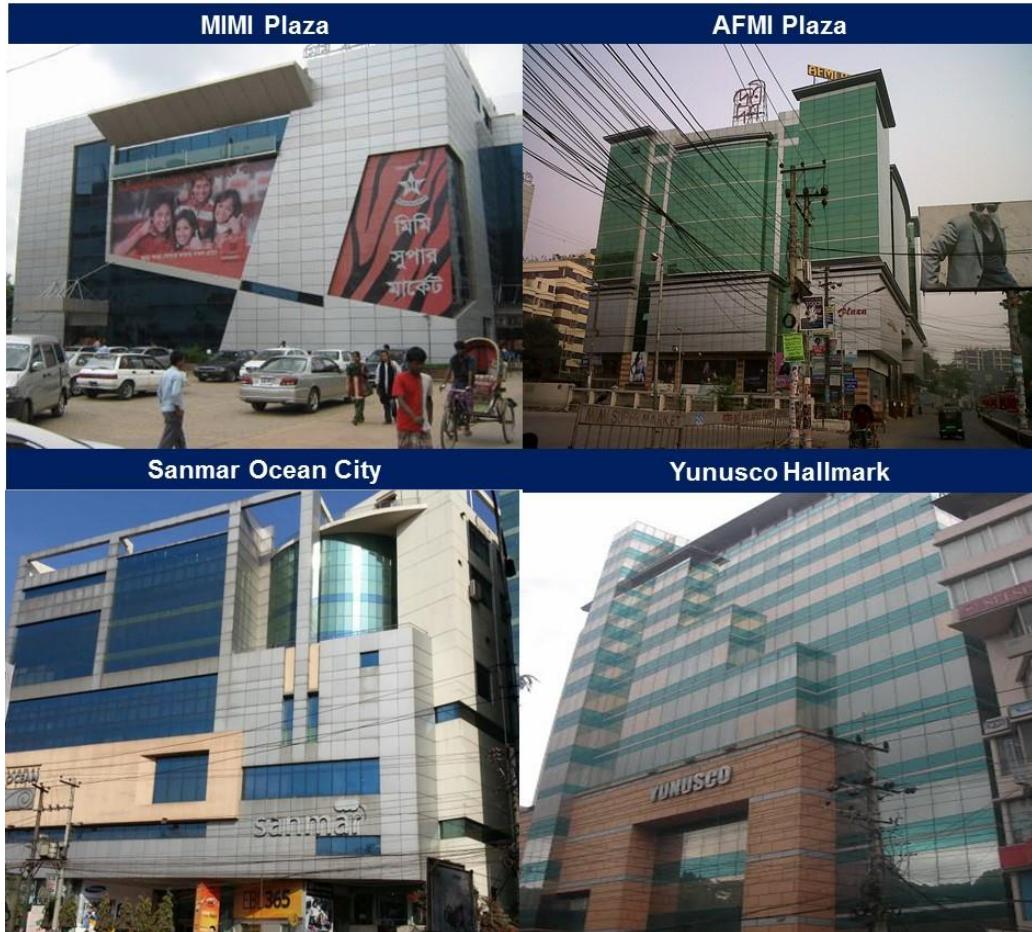


Figure 51: Select Commercial Projects in CDA Avenue-Nasirabad-Panchlaish Market

Based on primary market survey information, the organized commercial real estate market in CDA Avenue-Nasirabad-Panchlaish commercial micro-markets is estimated to be approximately 10,00,000 sq. ft.⁵³, while the unorganized segment is much smaller compared with the organized segment space. The micro-market locations represent approximately 30%-35% of the organized format commercial market supply in the city of Chittagong. The graph below provides a summary of the status of project completion in the micro market region:

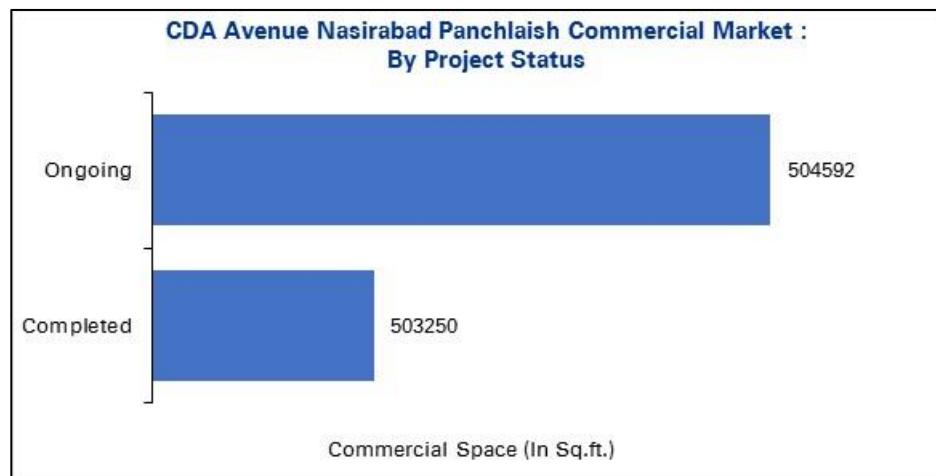


Figure 52: Status of Commercial Projects: CDA Avenue-Nasirabad-Panchlaish Market

With reference to the pricing of commercial spaces offered by developers, office spaces are sold in the upper floors of the building where the average price per sq. ft. sale rate may lie between BDT 25,000–28,000 per sq. ft. Retail space sale prices on ground floors may range between BDT 40,000–50,000 per sq. ft. while price on an average for retail shopping spaces ranges range between BDT 25,000–35,000 per sq. ft.⁵⁴ These are quoted rates and actual transacted rates maybe differ depending upon the final negotiations between buyers and sellers, location and size of the shops, type and size of project, etc. The table below provides a snapshot of the typical profile of prominent commercial projects in the micro-market region:

⁵³ Source: KPMG Analysis

⁵⁴ Source: KPMG Analysis

Table 8: Profile of Major Commercial Projects in CDA Avenue-Nasirabad-Panchlaish Market

Major Commercial/ Retail Projects in CDA Avenue Nasirabad Panchlaish Market ⁵⁵					
Project Name	Developer	Project Location	Project Status	Total Supply (In Sq. ft.)	Current Absorption (In Sq. ft.)
Ocean City	Sanmar Properties Ltd.	GEC Circle	Completed	420,000	419,200
Centrium	Equity Property Management Ltd.	GEC Circle	Completed	15,000	15,000
Avenue Tower	Sanmar Properties Limited	CDA Avenue	Ongoing	89,000	9,400
Equity GEC Circle	Equity Property Management Ltd.	Nasirabad	Ongoing	87,800	41,900
Finlay Square	Finlay Properties Limited	Nasirabad	Ongoing	40,800	40,800
Fortune Mall	Equity Property Management Ltd.	Nasirabad	Ongoing	70,900	70,900
Legend	Aerial Properties Limited	CDA Avenue	Ongoing	160,000	40,000

5.3.3 Commercial Demand Supply Analysis

The previous sections provided a detailed analysis of each of the key commercial micro-markets in Chittagong. Summarizing the analysis of micro markets, a consolidated demand supply analysis has been done assimilating the findings at a city level. The demand supply analysis discussed hereunder also encompasses other smaller micro- markets for housing activity in Chittagong.

5.3.3.1 Supply Side Analysis

Based on primary market survey information and interactions with local developers and industry stakeholders such as REHAB, the organized commercial market in Chittagong is estimated to be approximately 35,00,000 sq. ft. comprising mainly organized sector commercial projects. The supply trend for all such organized sector apartment projects has been presented in the graph below:

⁵⁵ Source: KPMG Analysis

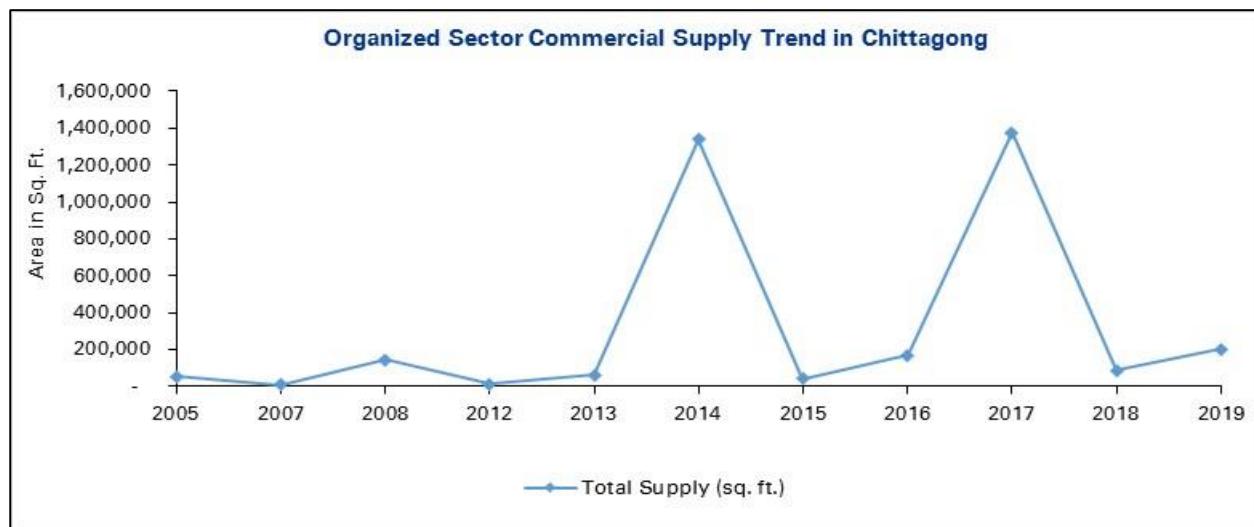


Figure 53: Supply Trend for Commercial Space in Chittagong

As observable from the supply trend graph, the region witnessed sporadic spurts of commercial supply before year 2012. Post 2012, as commercial demand shifted from established hubs of Agrabad and Jhoutala markets, Nasirabad witnessed a substantial jump in commercial projects between 2013 and 2015. The supply underwent a correction phase in 2015 as developers slowed down on new project activity. However, with the freeing up of tracts of land and the overall regional profile of CDA avenue improving due to upcoming infrastructure and residential projects, the commercial supply witnessed a resurgence in 2016. Given the emerging importance of Nasirabad as the new commercial centre for Chittagong, prominent developers operating in the region are capitalizing on the opportunity by constructing a large quantum of supply across ongoing projects. The following graph provides a summary of the project statuses across locations:

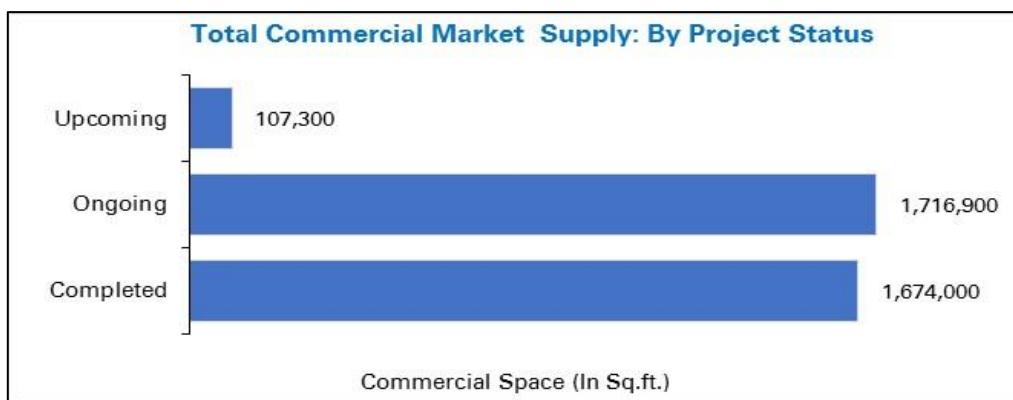


Figure 54: Total Commercial Supply: By Project Status

With reference to the share of micro markets in overall supply, the Agrabad micro market accounts for the largest share of overall supply (42%), and the micro markets of Jhoutala and Nasirabad markets account for the remaining substantial portion of overall commercial supply at 20% and 26% respectively. The following graph provides a snapshot of the micro market shares in overall supply of organized sector commercial supply in the Chittagong region.

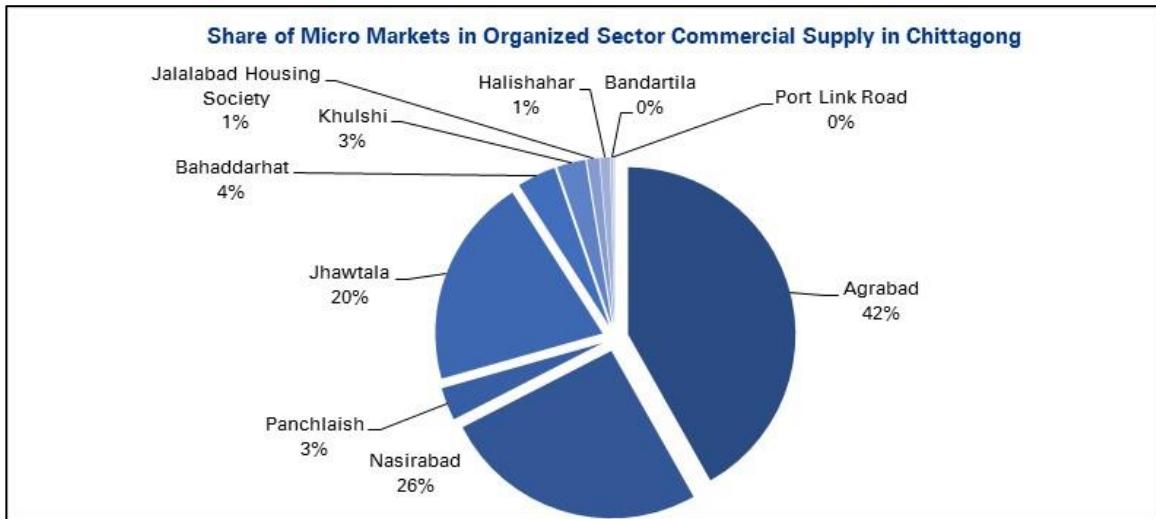


Figure 55: Share of Micro Markets in Total Organized Sector Commercial Supply in Chittagong

5.3.3.2 Demand Side Analysis

The graph below provides a visual summary of the commercial demand supply situation over the past few years.

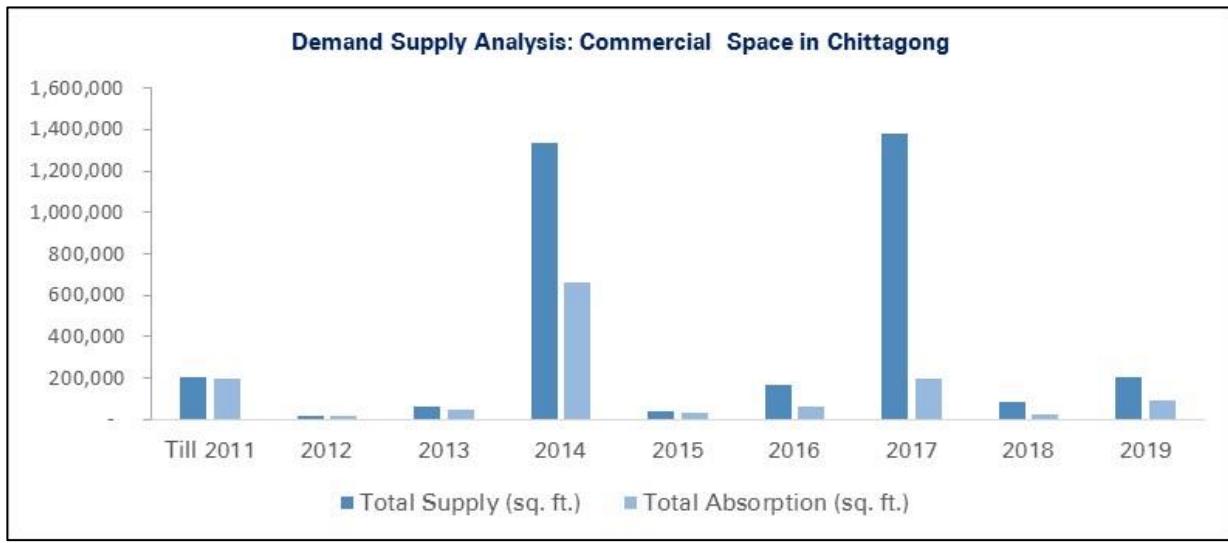


Figure 56: Commercial Real Estate Demand Supply Trend

As seen from the chart above, the total supply of commercial space available in the market outstrips the demand and the entire market has substantial inventory of commercial space lying unabsorbed. The commercial space offered in earlier projects, between years 2011 - 2013, have been taken up to a large extent and have limited unabsorbed space (6% of supplied space). However the commercial space supplied

across projects after 2014 have witnessed falling absorption levels and there is high degree of vacancy in the market. Factoring the supply in ongoing and upcoming projects, the average absorption levels at an overall market level remain fairly low at 38% - 40%.

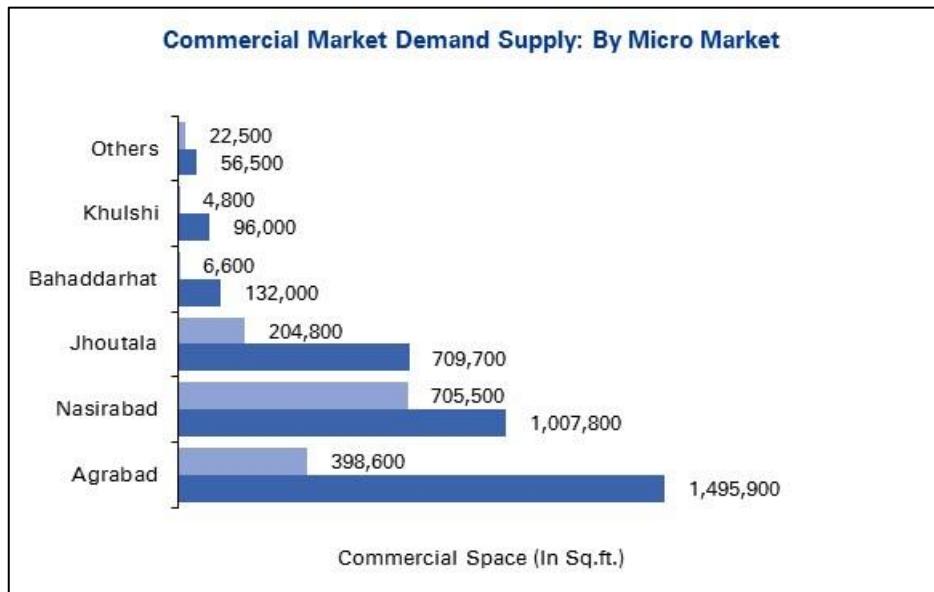


Figure 57: Commercial Demand Supply Trend: By Micro-Market Region

Considering the quantum of supply available in the major market of Agrabad and Jhoutala, the average absorption levels are very low, averaging approximately 30%. Since Nasirabad is the go-to commercial location now and for the future, the region has witnessed healthy absorption levels averaging 70%, despite the large quantum of supply. Other smaller micro market regions have very low absorption levels since the major share of the supply consists of ongoing and upcoming projects. Looking at the absorption levels for Nasirabad, the potential for supplying high quality upscale commercial real estate seems promising.

5.3.4 Commercial Pricing Analysis

The pricing of commercial space varies depending upon whether the use is intended for the commercial office space or retail shopping spaces. As a general rule, within a mixed use projects, shopping spaces are provided on the lower floors for maximizing the footfalls, whereas commercial spaces are offered in the upper floors. Due to the high footfall location within the commercial projects, retail spaces accrue a premium over commercial spaces. Pricing is also contingent upon the building design and concept, project location and land prices therein, developer brand, construction quality, development specifications, support amenities and facilities offered. The prices represent the blended average of commercial office sale rates across floors in a commercial project. The absolute prices may vary depending upon the floor for which the commercial space is bought, with higher floors being relatively cheaper than lower floors. A key aspect to note is that typically transactions in commercial space follow the sale model (outright purchase or sale) and instances of leasing or renting out of commercial spaces are exceptions to the general trend in the market. Thus, the pricing analysis primarily focuses on sale prices for commercial real estate across micro markets. Despite the differences in offerings and format of development, the benchmark market prices for specific commercial locations/ markets tend to be uniform. On the basis of this understanding, the average market prices for commercial real estate in prominent commercial markets is summarized in the graphs below:

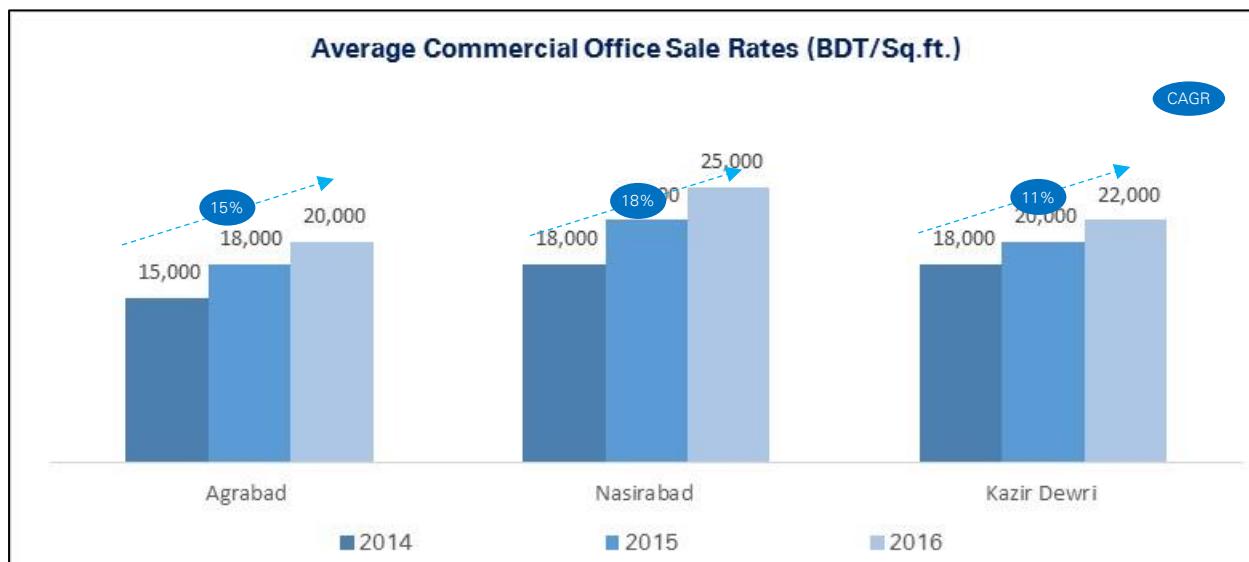


Figure 58: Commercial Office Sale Prices: Major Micro Markets

As seen from the graph above, the micro market of Nasirabad commands a premium over the competing commercial office space micro markets due to better profile, product offering and location factors. In terms of growth in prices, the Nasirabad market has seen a relatively better growth (CAGR 18%) compared to other established markets. Though Agrabad is still the main commercial micro market for the city, relatively inferior real estate profile of the region (*in terms of projects, product mix, etc.*) and high congestion have led to lower level of pricing compared to other competing markets. The micro market of Kazir Dewri - Jhoutala is positioning as the better alternate to Agrabad and a relatively cheaper location compared to Nasirabad and thus has intermediate pricing levels. With the current over supply situation in the market, all micro markets are expected to undergo some price corrections before the demand picks up and prices bounce back. Out of the three major commercial office micro markets, Nasirabad is expected to lead on the pricing front and shall continue to demand a relatively marginal premium over competing markets.

Summarized below are the average sale prices for commercial shopping spaces across key micro markets:

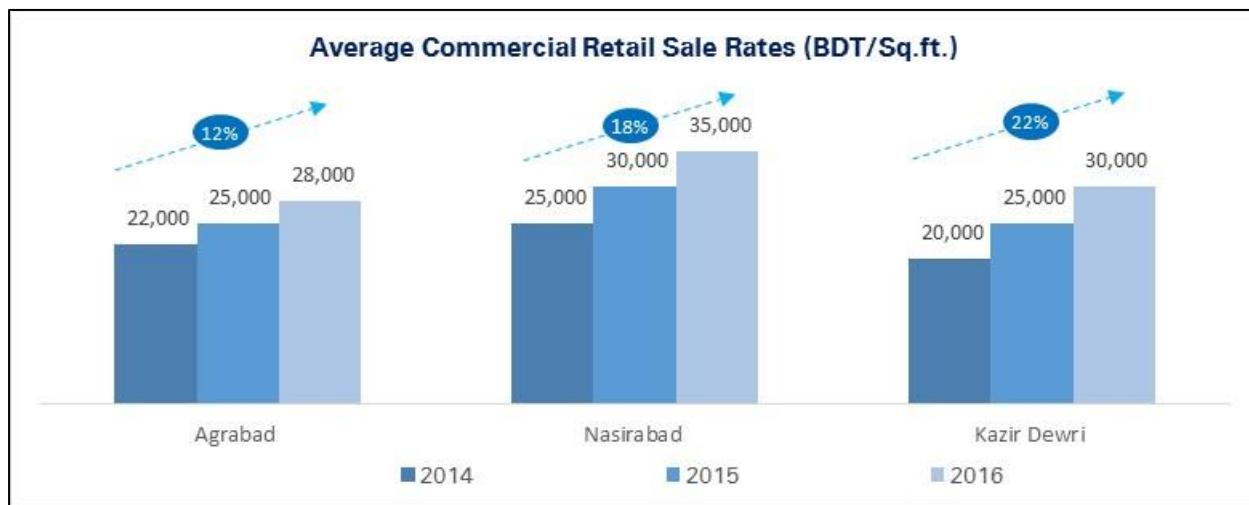


Figure 59: Commercial Retail Sale Prices: Major Micro Markets

Compared with office sale prices, average/ blended retail commercial sale prices are higher owing to the preferred location premium attracted by retail spaces. Within the three major micro-markets, Nasirabad accrues a marginal premium over Kazir Dewri and Agrabad market, primarily attributable to the locational advantage and development profile of retail shopping centres. While Kazir Dewri Jhoutala market has undergone the fastest growth in the past few years, the Nasirabad market is expected to witness a faster rise in the prices going forward.

5.3.5 Commercial Market Summary

Assimilating the findings of the commercial market analysis, it is evident that the commercial market of Nasirabad is poised to emerge as the future commercial hub. The Nasirabad micro-market is the preferred location for top Chittagong based and Pan-Bangladesh real estate developers given the overall connectivity, linkages, regional commercial profile, and direction of future growth in commercial activity. The current demand supply dynamics indicate an oversupply situation with poor demand levels (40%), given the substantial quantum of commercial supply being constructed in the ongoing and upcoming commercial projects. With the overall slowdown in real estate market, and gradually improving socio-economic and political situation, the commercial market is expected to recover only after the next 2-3 years.

However, with growing local business and changing consumer preferences for better quality of commercial real estate avenues, the market is expected to continue to witness spurts of demand over the period. Given the fact that the subject site is at the heart of the emerging CBD of Nasirabad and the expected project development timelines of next 2-3 years, it can be reasonably concluded that the site shall carry high commercial attractiveness. This shall attract private developers to undertake development of an upscale, multi-amenity, organized commercial office complex along with a large shopping mall at the proposed site.

5.4 Hospitality Real Estate Market

5.4.1 Overview of Hospitality Market – Key Drivers and Trends

As one of the prominent emerging economies of South Asia, Bangladesh in recent years has experienced increased domestic travel and notable growth in foreign tourist arrivals, fuelling demand for hotels in key destinations i.e. Dhaka, Chittagong, Cox Bazar and Sylhet. These are the four primary commercial/ leisure destinations in Bangladesh, driving demand for hospitality investments in the country. The Bangladesh market currently has only 3,500⁵⁶ hotel rooms in the organized sector, majority of which are in the upscale segments indicating a huge supply arbitrage in the mid income, budget and economy segments. With limited room supply in the organized market, rising contribution of Food & Beverage (F&B) revenues, increased growth in RMG (Ready Made Garment) industry and increasing profits owing to lower operational cost, Bangladesh provides a lucrative destination for hospitality investments.

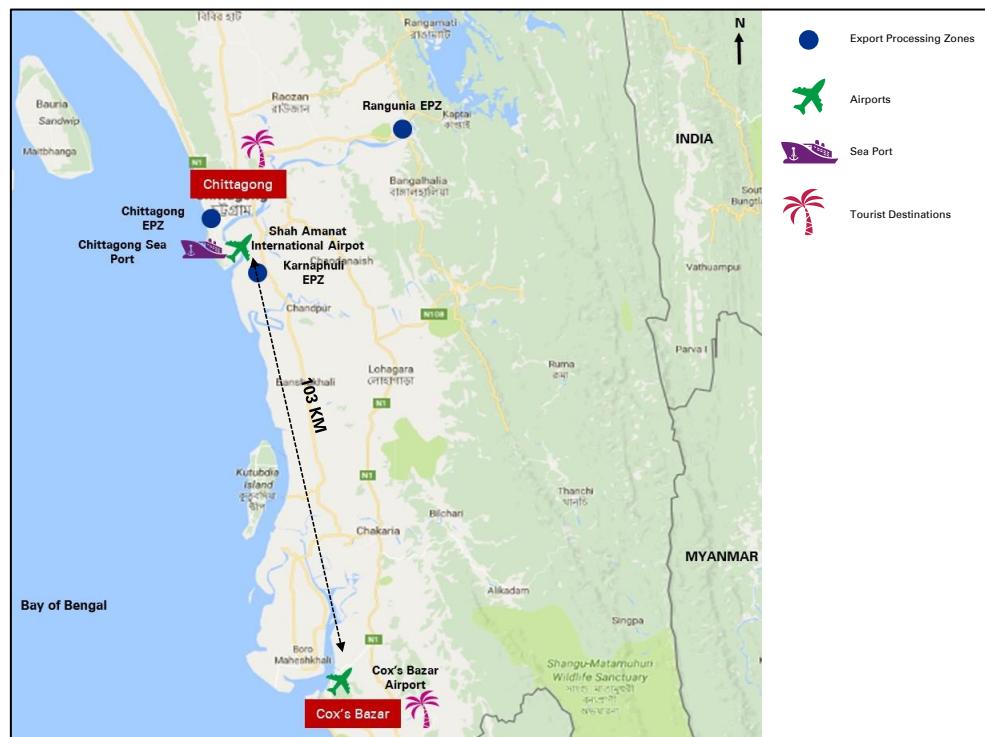


Figure 60: Chittagong city and Neighbourhood

As discussed in the previous chapters, Chittagong is a major commercial hub of Bangladesh and the largest port in the country. Chittagong is home to key manufacturing centres, Export processing zones (EPZs) and gas exploration companies. Being the largest port, Chittagong is responsible for close to 92% of the imports and exports of the country. The city attracts various investors from global markets like Europe and South Asia, however majority of these travellers prefer to stay in Dhaka owing to limited availability of branded hotels in the Chittagong city. Also, Chittagong witnesses very few tourists footfalls as majority treat Chittagong as a transit point for onward journey to Cox bazar- a sought after leisure destination.

⁵⁶ Source:- HVS publication – “In Focus: Bangladesh – The Dark Horse” published in November 2015

The hospitality industry in Chittagong is a fairly organized market comprising approximately 750 hotel keys spread across three main micro markets i.e. Agrabad commercial area, Nasirabad and Station road. In reference to segments, the market comprises 3 main hotel categories as follows:-

Premium Upscale category (5 star hotels) – Majorly caters to foreign business travellers, cricketers, Army, Airline officials and Government officials, etc. e.g. - Radisson Blu (the only internationally branded 5 star hotel in the city).

Mid-segment/ Service apartments / Budget segment (3/4 star hotels) – Business travellers from South East Asia (Majorly the Indian subcontinent). e.g. – The Peninsula, Hotel Agrabad, Well Park Residence, Orchid Business Hotel, etc.

Economy segment / Unorganized sector – Domestic business travellers and local people in transit. E.g. Executive residences, Hotel Swiss International etc.

Out of the 3 segments, the hotel industry in Chittagong is dominated by 3 star / budget hotels catering mainly to business travellers. Presence of premium segment hotels is negligible as there is only one 5 star hotel in the city, i.e. Radisson Blu. The hotel started its construction in the mid of 2009 and was constructed at a cost of BDT 7,500 million. Currently the hotel is owned by Army's Sena Hotel Development Limited and operated by the Radisson group.

Majority of the hotel demand generated in the Chittagong city is through the commercial segment which accounts for 81% of the total accommodated room nights. Majority of business travellers with interests in the EPZ travel to the city three or four times a year with each visit ranging from two days to a week. The MICE segment contributes 5% to the total hospitality demand which majorly includes trade conferences. Apart from trade, growth in IT, telecom, BFSI has also led to an increased need for quality branded hotels in the city.



Figure 61: Chittagong Hotel Market Segmentation

Chittagong hotel market is primarily driven by demand generated from the EPZs, financial institutions in Agrabad and its port. Also, Chittagong is the second largest city in the Bangladesh and a large transportation node. Hence the city has a high demand potential for room nights that currently is untapped due to paucity of quality branded hotels.

The hospitality market of Chittagong has immense potential for quality branded hotels in the mid / budget segment and above to cater to the business travellers in the city. Various branded hotel operators have shown keen interest in the Chittagong hospitality market by partnering with local real estate developers and corporates. Numerous prominent brands have declared plans to set up new hotels in Chittagong. These developments indicate a positive outlook for the city's hospitality hubs in the long term.

5.4.2 Key Hospitality Hubs in Chittagong

The Chittagong hospitality market currently consists of three major micro markets driven by demand generated due to the presence of existing commercial hubs in these locations. As discussed in the previous sections, these micro markets majorly cater to business traveller from South Asia dealing with garments exports along with other goods to various countries. The key micro markets comprise Nasirabad, Nasirabad and Station Road.

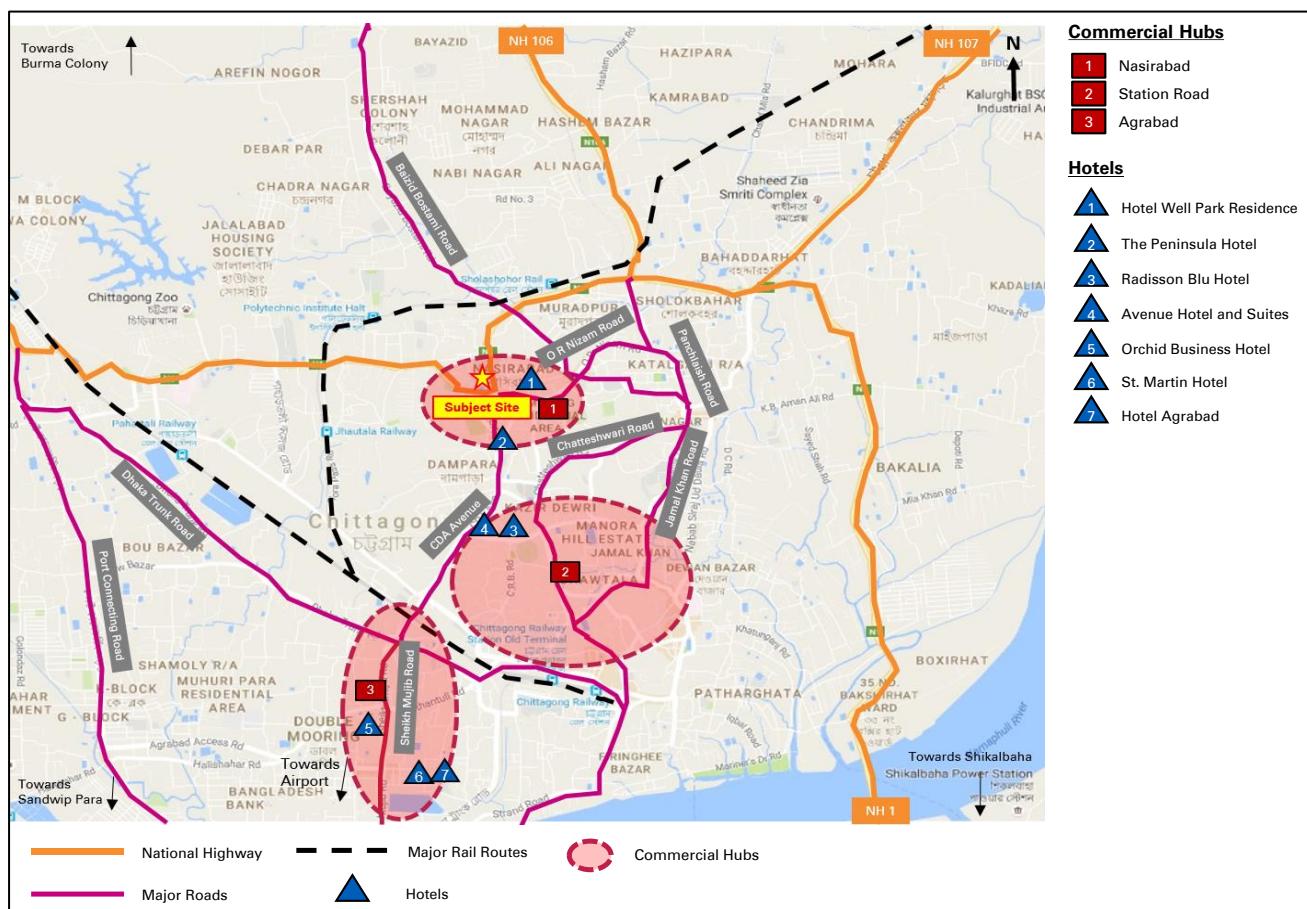


Figure 62: Major Hospitality hubs in Chittagong City

The map above depicts various hospitality micro markets in Chittagong city. The subject site forms part of the Nasirabad micro market which is considered to be one of the emerging destination for trade and commerce. The location is anticipated to be the new commercial business district of Chittagong city. The table below provides information on key existing hotels and their distances from the subject site. Both Well park residences and the Peninsula hotel are expected to be primary competition, owing to their proximity to the subject site.

Table 9: Profile of Prominent Hotels in Chittagong City

Key Hotels in the Chittagong city						
S. No	Hotel	Micro Market	Keys	Hotel Segment	Approximately Distance from site	Approximately Time Taken
1	Radisson Blu Hotel	Station Road	241	5 Star	1.8 km	7 min
2	The Peninsula Hotel	Nasirabad	144	4 Star	160 m	2 min
3	Hotel Well Park Residence	Nasirabad	112	3 Star	250 m	4 min
4	Hotel Agrabad	Agrabad	101	3 Star	4.2 km	16 min
5	St. Martin Hotel	Agrabad	74	3 Star	4.2 km	16 min
6	Orchid Business Hotel	Agrabad	47	3 Star	3.5 km	12 min
7	Avenue Hotel and Suites	Station Road	35	3 Star	2 km	8 min

5.4.2.1 Nasirabad Hospitality Market

The region of Nasirabad has come up as a major commercial alternate to the Agrabad CBD area and as a result features substantial commercial projects like the Sanmar Ocean City, Fortune Mall, Equity Centrium, etc. Presence of these commercial projects, central location of the area within the city, excellent connectivity to Agrabad commercial area drive the hospitality demand in this micro-market. The customer profile consists of corporate travellers, working in sectors like IT, Telecom, finance, consulting, etc. These travellers prefer Nasirabad as it is fairly less congested than Agrabad and lies in proximity to established commercial developments in the micro-market.

The micro-market currently houses 2 key organized sector/ benchmark-able hotels in the city – Well Park Residence and The Peninsula along with some other smaller unrated hotels. The organized market in the micro-market comprises 256 rooms and the market exhibits healthy occupancies in the range of 50% to 60%. However, currently the micro-market is devoid of any 5 star category or international branded hotel chains – a preferred hotel segment for many foreign nationals and corporate travellers. The Average Room Rate (ARR) in the micro market is estimated to be in the range of BDT 3,000 to BDT 3,500 while rack rates may vary between BDT 4,000–BDT 6,000 per night.

5.4.2.2 Station Road hospitality Market

The station road market consists of locations like Jhoutala, Kazir Dewri, and Jamal Khan, etc. The micro-market primarily consists of congested commercial and residential development owing to its proximity to the Railway station and the old CBD of Chittagong city. The demand for hospitality is majorly through local travellers visiting Chittagong or neighbouring areas.

This micro-market is characterized by the dominance of unorganized non-star category hotels and guest houses catering to transit visitors and local business travellers. This micro-market does not have any

organized sector star category hotels. Since both Radisson Blu and Avenue Hotel & Suites are located in close proximity, these hotels have been defined as part of the Station road micro-market.

The mid segment hotels are known to do better than the premium segments in the Chittagong market. An example of this is the Avenue Hotel & Suites, which enjoys high occupancies in the range of 75% to 90% given its small rooms inventory (35 Keys) and mid-budget rack rates. The ARRs for such 3 star/ budget segment hotel developments in the micro-market may range between BDT 2,000–BDT 3,000. In contrast, the performance of the premium segment hotels is much worse. Radisson Blu is the only 5 star development in the city of Chittagong having a total of 276 rooms. Being the premium segment in a majorly mid-low budget market of Chittagong, the hotel witnesses low occupancies in the range of 35% to 40%. The typical rack rates for the hotel ranges between BDT 9,000–BDT 11,000. However, considering the large room inventory (241 keys) and high rack rates, the overall Average Room Rate (ARR) for the hotel is very low, ranging between BDT 5,000–BDT 7,500. While the current situation does not seem promising for premium segment hotels, the future performance is expected to improve as the market grows.

5.4.2.3 Agrabad Hospitality Market

Agrabad commercial area is the CBD of Chittagong city. Owing to its proximity to the EPZ, the airport, the port, majority of the trade related business is conducted in this micro-market. The customer profile of the micro-market comprises business travellers from South Asia who operate in the sectors of garment trading, textile manufacturing, etc. Being one of the oldest established commercial locations near the port, the airport and the EPZ, the micro-market absorbs majority of the business travellers coming to Chittagong.

The total room inventory in this micro-market is estimated to be approximately 220 across 3 main hotels in the region. Out of these, Hotel Agrabad is one of the most successful hotels in Chittagong city. Being one of the oldest and largest hotels in the region, the hotel has a good market positioning and long list of clientele. The hotel also has good occupancy levels; in spite of the large inventory, the typical average occupancy lies in the 70%-75% range throughout the year. Due to the steady demand, the hotel is able to achieve an Average Room Rate (ARR) of BDT 4,000 to BDT 6,000.

While the other two hotels are of importance considering their location, their hospitality offering is not benchmark-able to any star category hotels or organized segment hotels. Historically, the micro-market of Agrabad has been a prominent and sought after location owing to its proximity to the port, airport and the EPZ and is expected to continue creating steady demand in the coming years. However, with the region becoming increasingly congested and due to issues like narrow access roads and traffic jams around EPZ, some part of the demand for hotels in Agrabad is expected to shift to Nasirabad, especially the demand from business travellers. Thus, the emerging CBD of Nasirabad is expected to be the recipient of a sizable carryover demand from Agrabad in the future.

5.4.3 Hospitality Demand Supply and Pricing Analysis

The total stock of hotel rooms in the organized sector is ~750 which include majorly the mid segment rooms (3 star rooms and serviced apartments) and limited 5 star rooms. As indicated earlier the Chittagong hospitality market is devoid of a 4 star hotel barring The Peninsula in the organized sector. Majority of the mid-segment hotels (3 star) in the organized sector have been operational in the city for more than a decade and have catered to the business travellers from South Asia. These travellers majorly export goods to various other countries by taking advantage of the cost differential of manufacturing in Chittagong. Also, the demand for 3/4 star rooms is generated through tourist travelling to Cox bazar and utilizing Chittagong as a transit point.

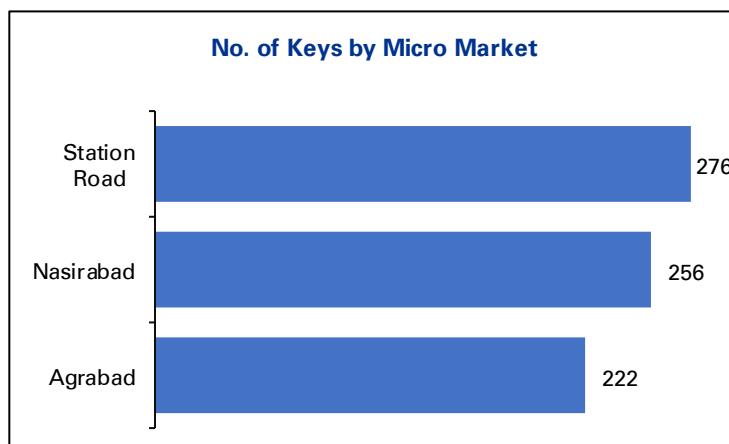


Figure 63: No. of Rooms/ Room Keys by Micro Market

As indicated in the above figure, station road has the highest number of rooms/ keys with the largest inventory of rooms provided by Radisson Blu. Agrabad, being the location of choice for various business travellers throughout the last decade has lost its edge with the emergence of Nasirabad, which offers better infrastructural facilities, less congested roads and a central location.

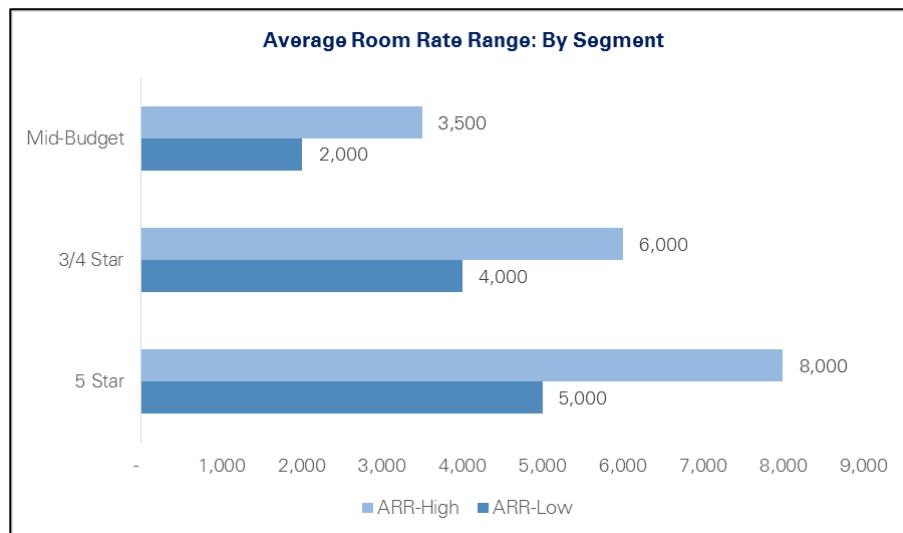


Figure 64: Segment Wise Average Room Rates in BDT

The average room rates (ARR's) for mid segment (3/4 star and service apartment) hotels in Chittagong city are in the range of BDT 4,000 to BDT 6,000. The 5 star hotels manage to attain an ARR of BDT 6,500 – BDT 7,000 in general. While the budget segment hotels have a low relative ARR, these hotels lead in term of overall room occupancies.

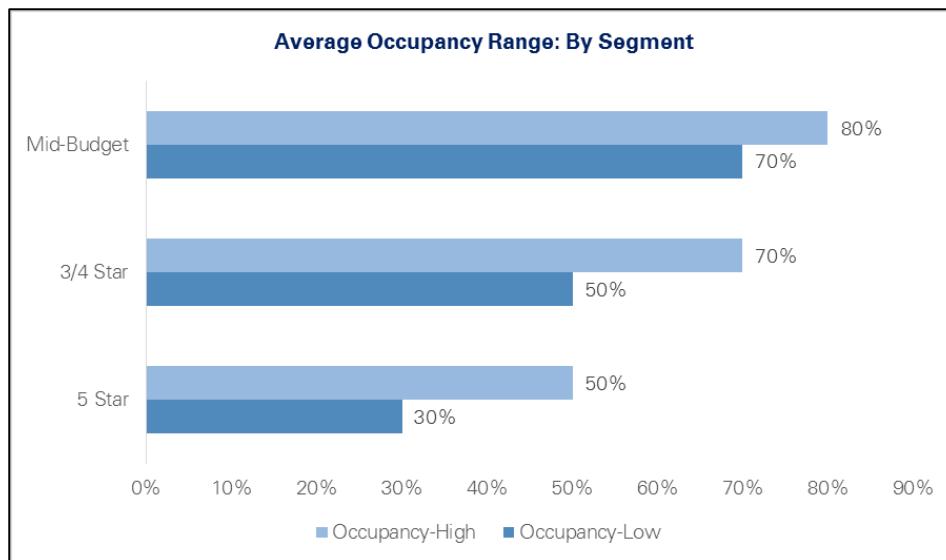


Figure 65: Segment wise occupancies

The occupancy for the 3/4 star segment in the Chittagong micro market is in the range of 50% to 70% depending on the micro market and the size of the Hotel. For example - The Avenue hotel & suites has very high occupancy (80%) in lieu of lesser number of room inventory (35) and excellent connectivity from CDA Avenue road. Hotels in the Nasirabad micro market have an average occupancy range of 50% to 60% for the 3/4 star hotel segment being the area of choice for corporate travellers. Radisson Blu, has witnessed low occupancies owing to limited inflow of upscale travellers in the city and a large inventory of hotel rooms.

In respect to future projected demand, there are many 'announced' plans by major hospitality chains to add room inventory to the city. The upcoming / planned supply in the city consist of various branded hotels. JW Marriott has signed a major deal with a large Chittagong based company, Pacific Jeans to operate a 250 key five star luxury hotel in the city. According to the deal, Pacific Jeans would be responsible for construction of the Hotel and would be the ultimate owner of the property. The Accor group has also plans to operate a 170 room property under its Novotel Brand. The hotel would be located in the CBD of the city and would be easily accessible to the Chittagong EPZ and the airport. Both Westin and the Le-Meridian are also planning to enter the Chittagong hospitality market.

Based on our interactions with market participants and industry leaders, the hospitality market of Chittagong is expected to have an addition of 800 to 1000 rooms in the total hotel inventory by 2020. However, the above mentioned hotels have been in the planning stage for the past few years. The major reasons for these hotels to not start operations/ construction is the current low occupancy levels and low average daily rates for branded hotels in the city. Currently, the Chittagong hospitality market is in an oversupply state with the unorganized players absorbing the major chunk of business travellers. Chittagong hospitality market is also highly price sensitive market with business travellers preferring cheaper unorganized hotels over other branded hotels providing premium facilities.

5.4.4 Hospitality Analysis Summary

Chittagong city currently has limited branded hotels with Radisson Blu being the only branded hotel in the 5 star category. The business travellers from South Asia do not have any budget/ mid segment internationally branded hotels to cater to their requirements (affordability and branded hotel facilities). The subject site has excellent connectivity through the CDA avenue road and the Dhaka Trunk road. Also, located in Nasirabad, the subject site is located at the centre of the emerging commercial hub with burgeoning demand from corporate travellers. Hence, located in Nasirabad (new CBD of Chittagong city) the subject site would be an apt location for development of a branded mid segment hotel (3 star category or service apartment) and above.

Based on our analysis, a mid-segment hotel (Branded) and above with 45 to 50 keys would appropriately absorb the demand from business travellers (majorly corporate) at the subject site. Also, as discussed, since the demand is highly price sensitive, an average rack rate BDT 4,000 to 5,000 would appeal to these business travellers. Considering the current demand supply situation in the city and the upcoming supply of additional rooms, the proposed hotel development may be targeted for operationalization by 2022, as the economic and tourism activity picks up in the region and the customer preference changes from the unorganized small hotels to more refined hospitality options.

5.5 Land Pricing Benchmarks Analysis

The objective of this analysis was to undertake an assessment of the commercial transacted price benchmarks for land transactions in the region, which provides an indicative representation of the site land parcel's market value. Under the PPP model, the land provided by the implementing government authority is the government equity in the project. To assess the market value of the site land parcel, information was collated using a mix of primary and secondary research. Primary research involved in-person interactions with government representatives from revenue department under the District Magistrate's office and Revenue Collectorate officials, relevant regional authorities such as LGED as well as local property brokers. Secondary research involved tracking land transaction rates through online real estate portals. To support the findings, several interactions were also undertaken with regional real estate developers to assess the market benchmark value of the site land parcel. Two main sources of information were used to assess the market value of the project, as discussed in detail further.

5.5.1 Property Mauza Rates under Revenue Collectorate Office

The local government revenue department regularly assesses transacted land prices by way of tracking land sale records registered at the time of transfer of land ownership at the time of sale. On the basis of the assessment of past records and self-assessed land valuations, the department also revises and publishes benchmark land value rates, popularly referred to as Mauza rates. These rates define the government assessed value of land parcels, classified and differentiated on the basis their status of development, their location, and defined use. The following table summarizes the latest mauza rates published by the Collectorate Department, effective as of January 2015:

The subject site is located in the East Nasirbad area of the Panchlaish ward (thana). As per the circle rate (mauza rate) benchmarked by the government authority, the price of land depending - upon on whether is commercial use or empty land - ranges between BDT 8.3 Crores – BDT 2.6 Crores per acre. However, it was mentioned during interactions with the government officials that since the subject site is located adjacent to GEC more, the actual price of the NHA land parcel could be 1.5 – 3 times the prescribed mauza rates, thus estimating the land value between BDT 12.5 Crores to BDT 25 Crores per acre.

Table 10: Ward Wise Benchmarked Land Prices across Micro Markets

THANA WISE MAUZA RATES EFFECTIVE AS OF JANUARY 2015 (BDT Cr/Acre)		
Thana and Location	House/ Residence/ Shop Land	Empty Land
KOTWALI THANA		
Khulshi North Hiils (Pahartoli North)	15.0	2.9
Khulshi Hills South (Pahartoli South)	13.3	5.4
KHULSHI THANA		
East Nasirabad	8.5	1.8
South Pahartoli	6.9	2.3
PANCHLAISH THANA		
Khulshi	6.7	3.6
Panchlaish	5.5	3.2
East Nasirabad	8.3	2.6
North Nasirabad (Industrial)	13.2	0.0

5.5.2 Developer Estimates and Transacted Land Rates

In addition to the mauza rates, interactions with several developers were conducted to estimate the sale price of land as per the transacted sale price of the developers in the region as well as their estimates of the possible land value. Based on information collected, it is estimated that the actual market value of land in Nasirabad currently ranges between BDT 1.5 Crore – 3 Crore per katha (720 sq. ft.), i.e. BDT 90 Crores – 180 Crores per acre.

The latest land price benchmark available from market interactions was based on a transaction concluded 6 months back, wherein a 7 katha (5,040 sq. ft.) land parcel of an existing diagnostic centre, located on O.R. Nizam Road (500 meters from the site) was sold for a total value of BDT 22 Crores, making the value of the land parcel approximately BDT 3.14 Crore per katha or BDT 189 crores per acre.

While the broad range may remain true for the region, majority of the developers estimated the market price of the subject site land parcel to be approximately BDT 1.5 Crore – BDT 2 Crore per katha, i.e. BDT 90 Crores – 120 Crores per acre.

6 Willingness to Pay Survey Analysis

To estimate the demand for residential and commercial (office and shop) real estate among the consumers of Chittagong and their ability and willingness to pay for these assets, a "Willingness to Pay" survey was conducted. A questionnaire based survey was conducted on a representative sample of 101 respondents comprising both residential and commercial asset class owners (potential consumers) across prime locations within Chittagong city. The questionnaires employed for conducting the primary surveys are provided in **Annexure – 13.5**. Out of the total 101 respondents, 50 respondents were residential apartment owners and 51 respondents were commercial (office and shop) owners.

The primary survey has been conducted with objective of evaluating the end consumer preferences for proposed real estate components and assessing their feedback on their willingness to pay for the certain configurations of real estate development at the subject site. Two key real estate components have been evaluated as part of the survey as follows:

1. **Residential:** The primary survey was conducted to evaluate the current preferences and new purchase behaviour of the residential real estate consumers in Chittagong, in addition to the demographic profile of the respondent and the current usage patterns. The sample size of this category was **50**. The survey captures respondent's perception of GEC More as a residential locality and their willingness to pay and pricing preferences for a residence in the location. To draw out a broad estimation of future demand, current preferences for apartment sizes, inclination towards buying a new apartment and acceptable pricing trends were studied.
2. **Commercial:** The survey was conducted in prime commercial areas of Chittagong to assess demand and marketability of envisaged commercial office and shopping spaces at GEC More. The sample size of this category was **51**. Apart from an assessment of the respondent's current commercial space demand characteristics, a comprehensive assessment of the prevalent commercial scenario w.r.t commercial space preferences was also undertaken. The factors responsible for present commercial demand, the pricing and the space size trends prevailing in the city were considered herein.

6.1 Residential Survey: Respondent Findings

Demographic Profile

Majority of the respondents of the sample size are male (approximately 88%) and bulk of them (approximately 68%) have an average household size of 3 or 4 members. Nearly 65% of the respondents are earning an annual income in the range of BDT 300,000 to BDT 500,000. 60% of the total respondents are in the age group of 31 to 40 years.

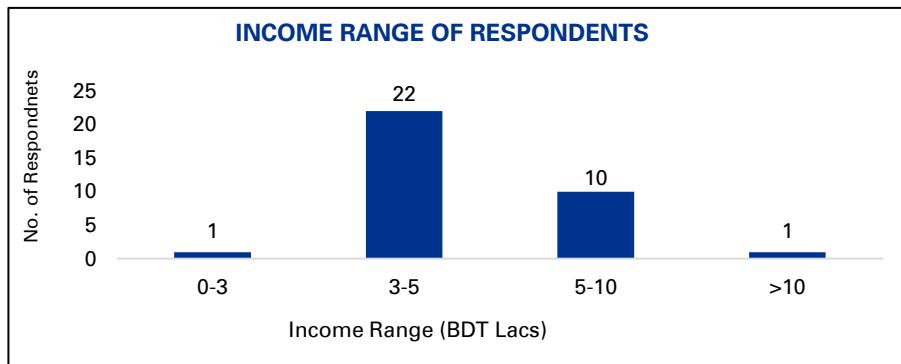


Figure 66: Income Range of Respondents

The survey included a healthy mix of respondents based on their ownership status. 28 out of 50 respondents have self-owned residences while the rest are residing in rented accommodation. In addition, 75% of the respondents own only a single residence in their city of residence.

~64% of the respondents are residing in a 3 bedroom residential apartments developed by a private developer. Approximately, 83% of the respondents prefer a 3 Bedroom Hall Kitchen (BHK) residence with the size range of 1200 – 1500 sq. ft. 31 out of 50 respondents stated that they preferred to live in a Government Flat/ Apartment owing to its affordable pricing. The respondents who otherwise prefer apartments by private developers cited “better construction quality” and “Better Brand” as the key reasons for their preference.

Respondent Feedback on GEC More as a Preferred Location

The factor of ‘Location’ (44%) along with ‘Proximity to Support Amenities (20%)’ were assessed as the primary factors guiding the consumer choice of residences by the respondents. Amongst the most popular locations for residential purposes, GEC and New Market areas were rated as the preferred locations with 20% of respondents indicating their preference for respective locations. The other preferred location stated was the area of Khulshi. Respondents further indicated that ‘Piped Gas Supply, Power Supply and Water Supply’ are the most important amenities for selecting residential accommodation by the private developer.

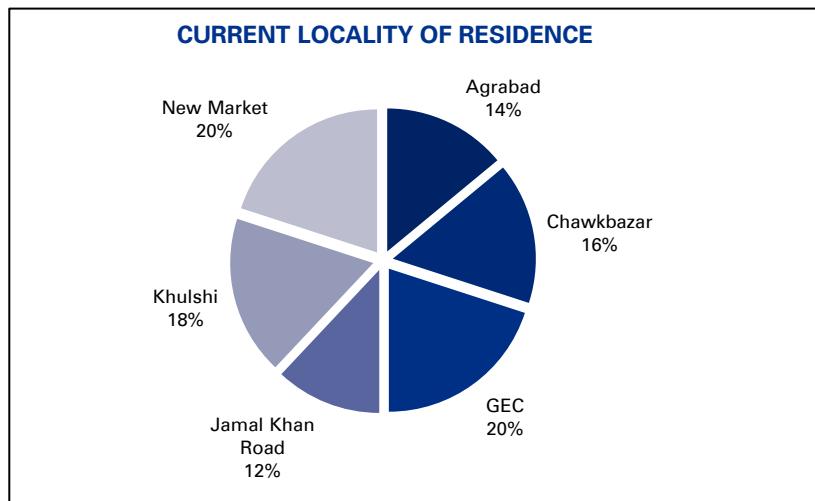


Figure 67: Current Locality of Respondent's Residence

Approximately 73% of the respondents expressed that they were considering purchase of a new flat/apartment. In addition, 87.5% of the respondents consider GEC as a good location for a new residence purchase and about half (~49%) of the respondents are willing to buy or rent a new flat at GEC More location.

Substantial number of respondents are willing to pay a premium if the flat is located in proximity to business/office complex (42%) and social facilities (38%). Nearly 61% of the respondents stated their willingness to pay premium for a residential apartment option, if available in GEC More location. Majority of these respondents are willing to pay a 5-10% premium, primarily on account of proximity to business/ office complexes.

Pricing and Sizing Preference Analysis

According to the respondents, approximately 68% of the prevailing rentals are in range of BDT 10,000 – 20,000 per month. Furthermore, ~62% of the respondents consider BDT 20,000–25,000 per month as an acceptable rental range for a new residence in GEC more location. Approximately, 23% of the respondents indicated they have paid a purchase price of over and above BDT 80 Lacs for purchasing an apartment in the location while 15% respondents also mentioned having paid between BDT 30–40 Lacs for purchasing an apartment in the vicinity.

~59% of the respondents indicated that they would pay less than BDT 60 Lacs for purchasing a new accommodation in the city, however if given a choice to buy an apartment in GEC More, ~60% of the respondents consider a price between BDT 60-80 Lacs as an acceptable price for purchasing a flat.

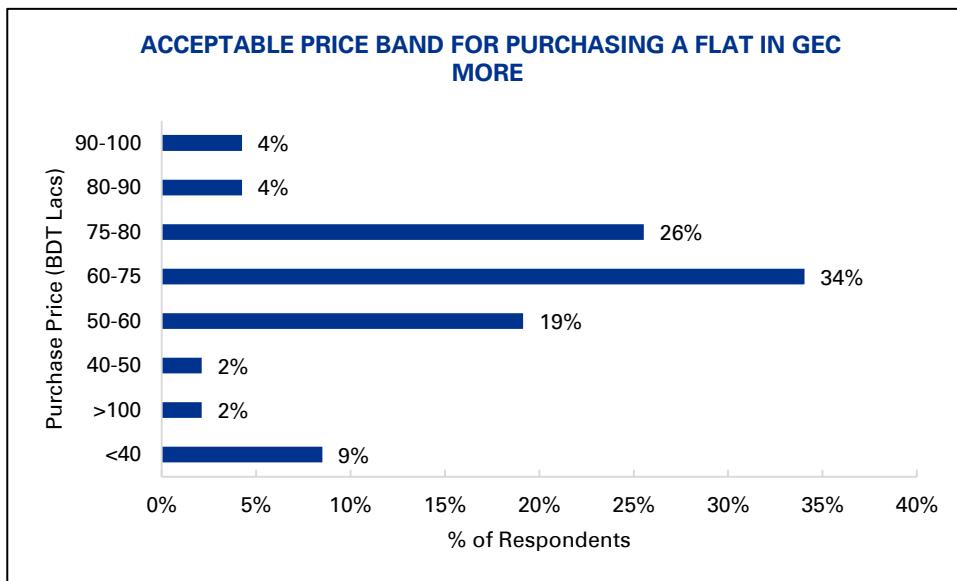


Figure 68: Acceptable Price Band for Purchase of a Flat in GEC

Approximately 76% of the respondents are currently staying in apartments ranging from 1,000 – 1,500 sq. ft. Also, approximately 57% of the respondents would choose an apartment in the size range of 1,000-1,500 sq. ft., while 38% would prefer the size range of 1,500-2,000 sq. ft. in case they were evaluating a new accommodation. An ideal size for a new apartment in GEC More was indicated as 1,000 – 1,500 sq. ft. by ~46% of the respondents.

Residential Segment Summary

On the basis of the above survey, a large residential development with 3 BHK format flats of size range 1,000 – 1,500 sq. ft. is expected to witness good response from potential buyers. GEC More is the preferred location for renting/ buying by majority of the respondents. Respondents would be willing to pay a rent of BDT 20,000-25,000 in GEC More and in case of purchase, be willing to pay a price between BDT 60-80 Lacs for an accommodation in GEC More.

6.2 Commercial Survey: Respondent Findings

Demographic Profile

Majority of the respondents of the sample size are male (approximately 96%) and bulk of them (approximately 58%) have an average household size of 4 and 5 members. Nearly 63% of the respondents earning are in the annual income range of BDT 500,000 to BDT 1,500,000. About 59% and 33% of the total respondents lie in the age group of 31 to 40 years and 41 to 50 years respectively; thus the age bracket of 31 to 50 years emerged as the majority at 92% of sample size for commercial survey respondents.

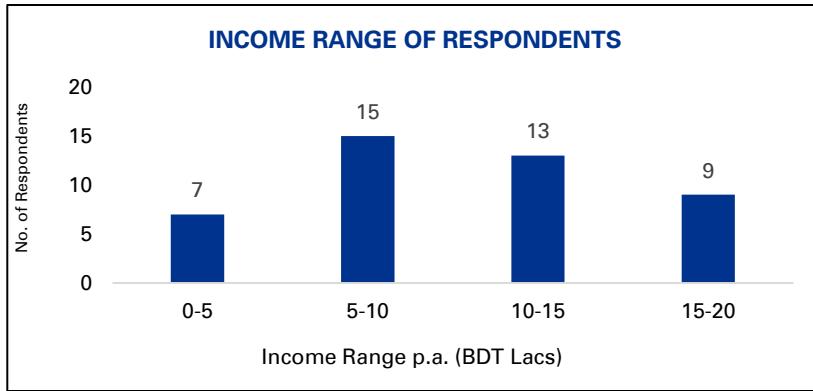


Figure 69: Income Range of Respondents

The survey includes a healthy mix of respondents based on their ownership status. 82% of the respondents were commercial shop owners and the balance owned commercial office spaces. 34 out of 51 respondents stated they prefer commercial space constructed by private developers as compared to commercial and retail spaces available within commercial real estate projects developed by government. The majority of the respondents stated their preference for continuing with their current ownership structure while evaluating a new commercial space. Of the 25 respondents who currently operate out of rented commercial spaces, 72% expressed their willingness to take up a new space (office or retail) on rent in the future. Similarly, out of 26 respondents who currently already own a commercial space, 58% indicated willingness to buy a new space for office or retail use in the future.

Respondent Feedback on GEC More as a Preferred Location

Location has been the primary factor for choosing the current locality for acquiring the commercial space and high importance has been attributed to amenities such as CCTV/ Security Guard, Power Supply and Water Supply by the respondents. Amongst the most popular locations for commercial premises, GEC and Agrabad were the leading choices with ~29% and ~27% of respondents respectively possessing commercial premises in these two locations, followed by New Market (22%). Furthermore, the aforesaid locations were highly rated on the attractiveness scale by the respondents as prime commercial/ business locations.

76% of the respondents indicated that they were considering acquiring a new commercial space at the GEC more location. In addition, ~96% of the respondents consider GEC as a good location for a new shop or an office space and approximately 65% of the respondents are willing to buy or rent a new shop or office space in GEC more.

84% of the respondents would be willing to pay a premium to purchase or rent a shop or commercial space in GEC More location. Also, 57% of these respondents would be willing to pay a 5-10% premium because of its proximity to other business/ office complex/ shopping complex.

Pricing and Sizing Preference Analysis

62% of the respondents indicated that the current average rentals are close to BDT 35,000 per month. As indicated in the graph below, ~81% of the respondents have paid much less (BDT 30,000 per sq. ft.) as purchase price for acquiring the commercial shop space at their current locations. 50% of the respondents indicated their willingness to pay a price greater than 30,000 BDT per sq. ft. for purchasing a new commercial premises/ shop in GEC.

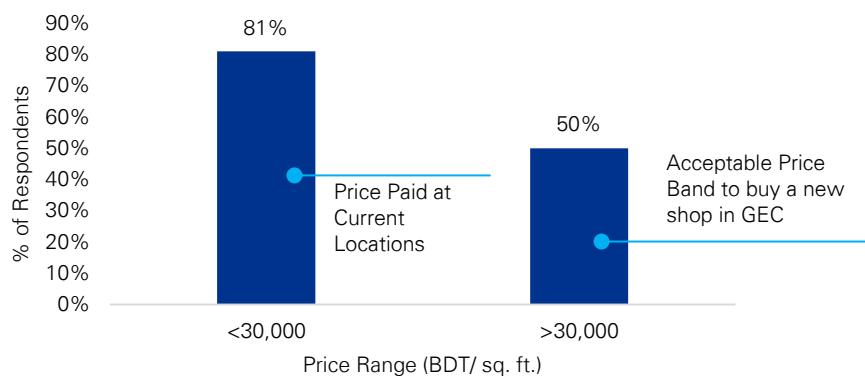


Figure 70: Purchase Price Trends for Commercial Shops

More than 50% of the respondents currently occupy shops with size range of 200-300 sq. ft. A similar fraction of people further consider 200-300 sq. ft. as the ideal size for purchasing new shops within the envisaged commercial retail project at GEC more.

For office space, half of the respondents are currently paying rentals in excess of BDT 40,000 per month with almost 1 out of 3 respondents having paid a purchase price of BDT 35,000-40,000 per sq. ft. Almost 78% of the all respondents considered their purchase price or a marginally higher price band as the acceptable price range for purchasing a new office space in GEC More.

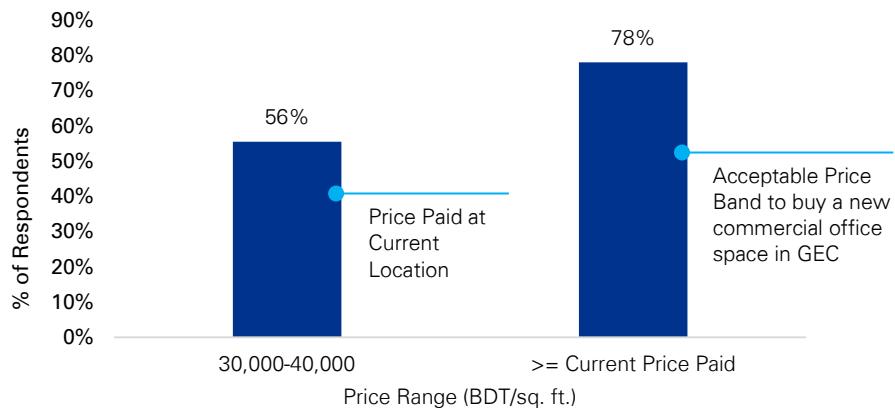


Figure 71: Purchase Price Trends for Commercial Office Space

Approximately 36% of the respondents currently own office spaces in the size range of 1,000-2,000 sq. ft. with 27% respondents also owning spaces in the higher area range of 2,000-3,000 sq. ft. and 3,000-5,000 sq. ft. respectively. Majority of the people in each space category consider current size or size lesser than current size of office space as an ideal size for purchase of an office space at GEC More.

Commercial Segment Summary

On the basis above survey, it is found that more than 75% of the respondents were open to considering purchase of new commercial space and GEC was rated as one of the most sought after locations for a shop or office space.

As per the survey, the current pricing for commercial shop space is less than BDT 30,000 sq. ft. but majority expressed willing to pay above this price to acquire a new shop in GEC more location.

7 Concept Plan

7.1 Existing Site and its development

The subject site is located at GEC More, Nasirabad and has a total area of 8.498 acres. The ownership of the site lies with National Housing Authority (NHA), Bangladesh. The coordinates of the site and elevation are as follows:

- Latitude: $22^{\circ} 21' 35.73''$ N
- Longitude: $91^{\circ} 49' 14.80''$ E
- Elevation: 14.215 m (above MSL)



Figure 72: Sample pictures of existing infrastructure and features of the site

The topography of the site is undulating with mounds/ elevations and it has a number of levels. The site has a large water body of approximately 31,000 sq. ft. and a number of fruit bearing and non-fruit bearing trees and bushes. The existing infrastructure on the site includes the divisional and sub-divisional offices of National Housing Authority, bungalows and other residential accommodation for officers and staff, club, garages and a mosque. Additionally, there exists supporting infrastructure like internal roads, power networks and water supply and sewerage connections.

The entire site is envisaged to be developed as a high-rise – a multi-storied commercial cum residential complex with modern amenities. The development is proposed to be undertaken through PPP (Public-Private Partnership). The envisaged PPP involves development of residential buildings and office for NHA by the private partner in area allocated to NHA as well as development of residential apartments and commercial space (office, retail and/ or hotel) in the area allocated to the private partner, which will be retained and sold by the private partner. The private partner shall be responsible for development of the subject site and NHA shall be responsible for providing the land for the proposed development.

As discussed in the previous chapters, the real estate market study elaborates the current market dynamics for the subject site and its real estate development potential. Based on this analysis discussed in detail as part of the preceding chapters, we have conceptualized the type of asset classes, quantum to be developed and the product mix for each of the asset classes, most suited for the subject site, from a market as well as technical perspective. The land allocation as well as the Concept Plan has been finalised post discussions with the **Hon'ble Minister of Housing and Public Works, PPP Authority and National Housing Authority held during 14-22 March 2017 and with the Chairman, National Housing Authority on 08 May 2017**. This section furnishes the details about the envisaged product mix along with the proposed components of the project, the concept plan and the area and development assumptions.

7.2 Land Allocation

The site with a total area of approximately 8.5 acres has been divided into three parts – the NHA and Developer portion with area of 1.07 acres and 7.20 acres respectively and balance area of 0.23 acre for the existing mosque. The NHA portion will be situated towards the north of the plot adjoining Bata Goli. In the NHA portion, the real estate components (residential accommodation and office spaces for NHA) are to be developed as per NHA's specifications. The Developer's or private partner's portion will be situated towards the south of the plot and will have frontage (adjoining the Zakir Hossain Road). The product mix for the developer part has been derived from site level analysis and findings from the market study for feasibility analysis; however, they will be left to the discretion of the developer. For the feasibility study, the developer portion is assumed to feature a multi-segment mix comprising varied apartments, commercial offices, shopping/ retail spaces and a hotel.

Table 11: Land Area Split between NHA and Developer under PPP

Particulars	Area Split (Acres)	% Area Split
Total Site Land Area	8.50	100%
Area for NHA	1.07	12%
Area for Private Developer	7.20	85%
Area for existing Mosque	0.23	3%

The mosque, which forms part of the project site and is situated on 0.23 acres of land will be redeveloped by the private developer at his cost as a three-storied mosque on the same area where the current mosque stands. The detailed map of the intended land use plan has been provided below.

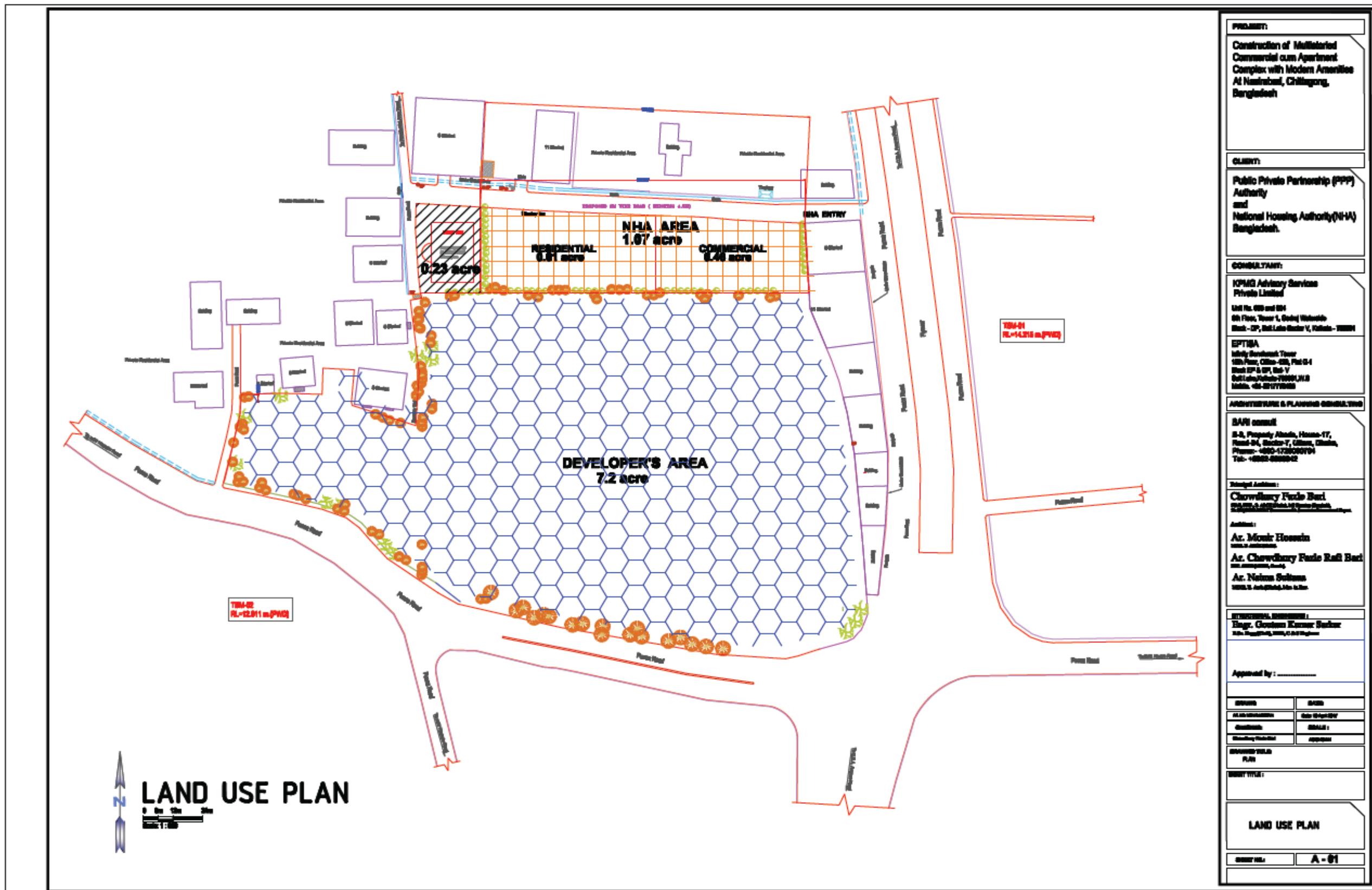


Figure 73: Map of land allocation

7.3 Product Mix

7.3.1 Area Break-Up for NHA Real Estate Components

NHA's portion of the plot, which is approximately 1.07 acres in area will comprise the NHA's office and residential accommodation for its officers and staff. The final product mix in NHA's portion has been finalized by NHA in discussion with the Ministry of Housing and Public Works (MoHPW). It has been envisaged that the development will consist of three buildings/ towers of at least 15 floors each, out of which, one tower near the entrance will be developed for commercial purpose (including office space for NHA) and the other two towers will be developed for residential purpose. The total available FAR in the NHA's portion will be utilized for this development. Based on this, it has been estimated that 57% or approximately 0.61 acres shall be utilised for the development of residential apartments for NHA officers and staff and the remaining 43% or approximately 0.46 acres shall be utilised for the development of commercial office for NHA. The existing building structures present on the site shall be demolished by the private developer for creation of commercial and residential buildings for NHA's use. The summary of area break up for NHA's portion of 1.07 acres is provided below:

Table 12 : Component wise break-up in NHA's portion

Particulars	Percentage	Land area (acre)	Built up area (sq. ft.)
Total Plot Area	100%	1.07	350,250
Residential Zone	57%	0.61	198,000
Commercial Zone	43%	0.46	152,250

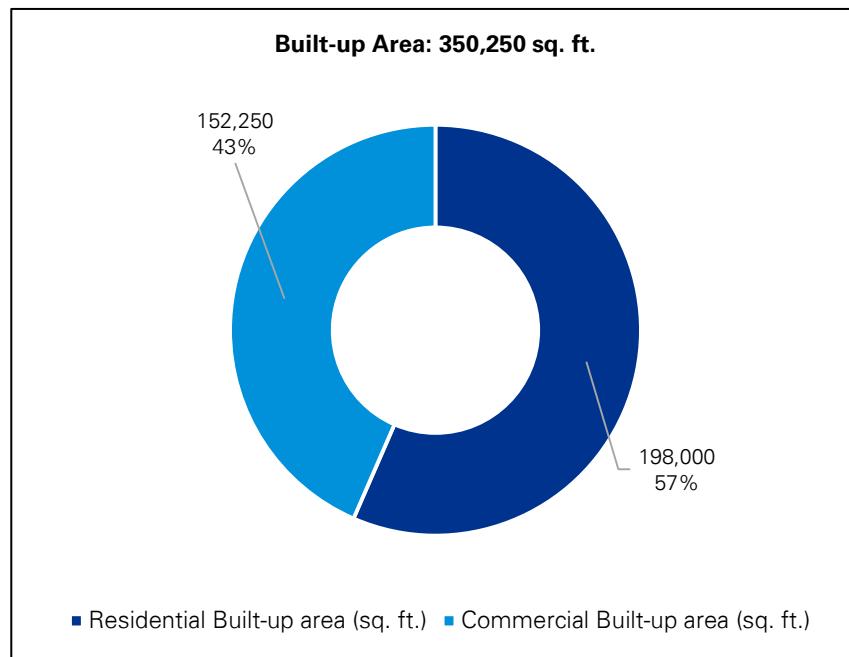


Figure 74: Break-up of area in NHA's portion

The detailed break-up of the total built up area for residential and commercial real estate components proposed to be developed and handed over to NHA have been summarized in the tables below:

Table 13: Detailed Area Statement for Residential Components for NHA

Detailed Area Allocation for Residential Components for NHA				
Typology	Total Units	Built up area (sq. ft.)	Parking Units	Saleable area⁵⁷ (sq. ft.)
Tower 1- Type 1 & Type 2	46	72,800	42	85,800
Tower 2- Type 3 & Type 4	80	95,200	48	112,200
Total	126	168,000	90	198,000

Considering that the apartments constructed for NHA staff shall be allotted to various NHA employee cadres, a varied mix of apartment configurations have been assumed.

The following table provides a summary of the commercial space assumed to be developed for NHA:

Table 14: Detailed Area Statement for Commercial Component for NHA

Detailed Area Allocation for Commercial Component for NHA					
Typology	Floor Area Per Unit (sq. ft.)	Number of Floors (excl. Ground Floor)	Built-up area (sq. ft.)	Parking units	Saleable area⁵⁸ (sq. ft.)
NHA Office Building	7,250	19	137,750	70	152,250
Total	7,250	19	137,750	70	152,250

7.3.2 Area Break-up for Private Developer Components

An area of around 7.20 acres will be allocated to the private developer for development of multi-storied commercial and residential complex for sale. This area allocated to the private developer will have frontage towards the south of the site (on Zakir Hossain Road). NHA will grant development rights to the private developer to develop 7.20 acres in the form of a long term lease of 99 years. In the 7.20 acres, a strip of 20 feet width along the front boundary (towards south of the plot) will be used for beautification and landscaping at the private developer's cost, which will be a no-development zone. The developer's product mix in the 7.20 acres will be left to the discretion of the developer without any stipulations from the Ministry of Housing and Public Works (MoHPW) or NHA. However, commercial tower/s shall ideally comprise at least 20 floors, whereas residential towers shall comprise at least 25 floors.

However, for the purpose of the feasibility study we have assumed a mix of residential, commercial and hospitality components based on our understanding of the real estate market of Chittagong and the demand supply dynamics of various asset classes in the subject site and competing micro-markets. This translates around 4.2 acres being utilised as a residential zone and around 3 acres being utilized as a commercial zone

⁵⁷ Area inclusive of ground floor, basement and common area

⁵⁸ Area inclusive of ground floor and basement

comprising retail spaces, office spaces and a hotel. The rationale for the envisaged product mix for the Private Developer has been summarised in the figure below.

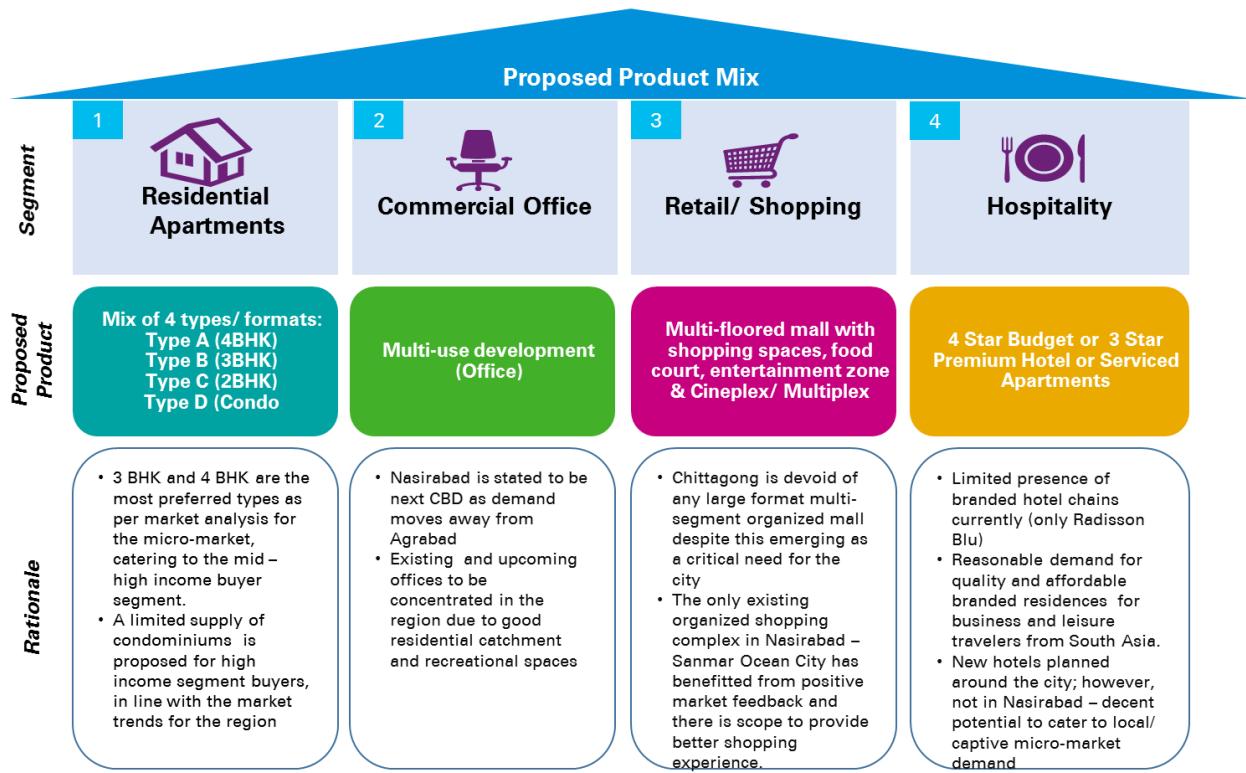


Figure 75: Proposed product mix and rationale

Further details of the area split between components have been provided below:

Table 15: Detailed Area Summary: Developer Real Estate Components

Detailed Area Statement – Developer				
Particulars		Land area (acre)	Percentage	Built up area (sq. ft.)
Total Plot Area		7.2	100%	2,946,450
Residential Zone		4.2	58%	1,718,000
Commercial Zone	Total	3.0	42%	1,228,450
	Retail	-	25%	737,070
	Office	-	13%	368,535
	Hospitality (Hotel)	-	4%	122,845

Of the total area available to developer, 58% (approximately 4.20 acres) is assumed to be utilised for development of residential apartments and condominiums and 42% (approximately 3 acres) is expected to

be utilised for various commercial purposes such as retail, office and hospitality. From the total built-up area available, 25% is assumed to be utilised for retail space, 13% for office space and around 4% area has been allotted for hospitality, which includes development of a 3/4 budget hotel. This is shown below:

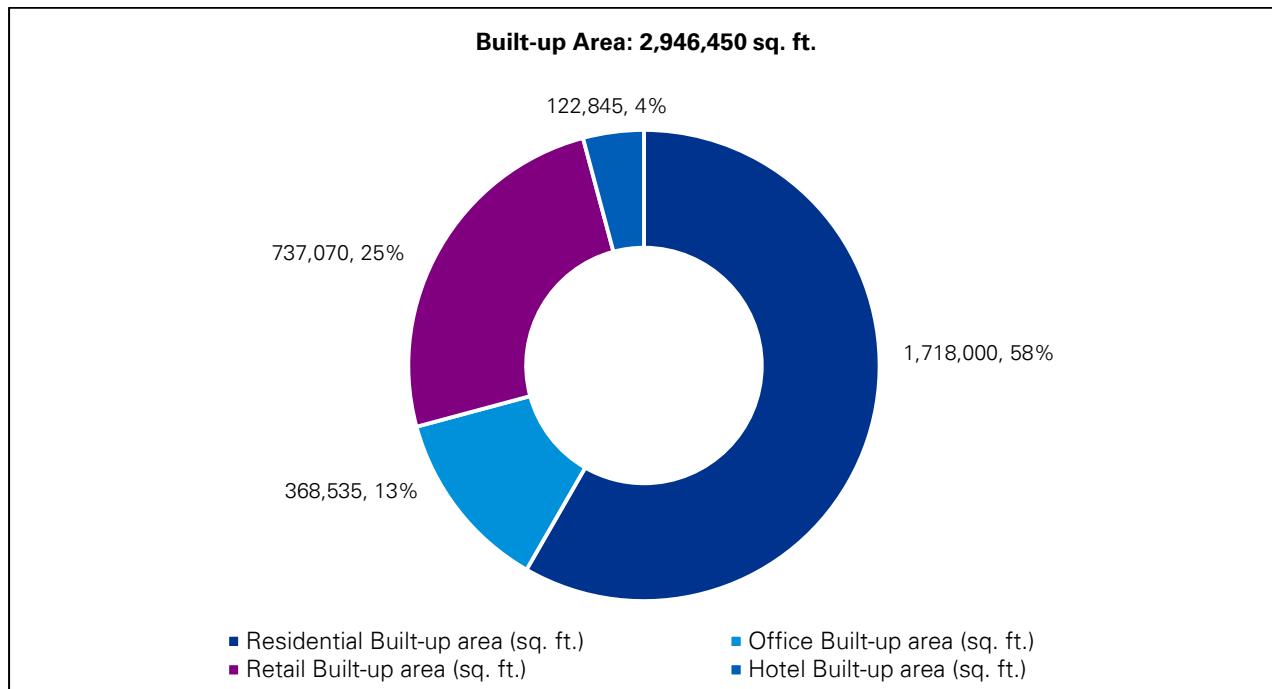


Figure 76: Break-up of Built-up area in Developer portion

A detailed break-up of area allocation and product mix for the residential and commercial components proposed for development by private developer is provided in the tables below:

Table 16: Detailed Area Statement for Developer's Residential Component

Residential Product Mix for Private Developer					
Component	Area per Unit (sq. ft.)	Number of Units	Built-up area (sq. ft.)	Parking units	Saleable area ⁵⁹ (sq. ft.)
Type A	2,000	96	192,000	64	212,000
Type B	1,500	384	576,000	100	636,000
Type C	1,250	480	600,000	210	662,000
Type D/ Condominiums	2,000	96	192,000	70	208,000
Total		1,056	1,560,000	444	1,718,000

⁵⁹ Area inclusive of ground floor, basement and common area

Table 17: Detailed Area Statement for Developer's Commercial Component

Commercial Product for Private Developer					
Component	Area Per Floor (sq. ft.)	Number of Floors (excl. Ground Floor)	Built-up area (sq. ft.)	Parking units	Saleable area ⁶⁰ (sq. ft.)
Commercial Product comprising office, retail and hotel	49,138	22	1,081,036	600	1,228,450
Total	49,138	22	1,081,036	600	1,228,450

The envisaged Concept Plan as discussed above has been captured on the map shown below.

⁶⁰ Area inclusive of ground floor and two levels of basement



Figure 77: Map of finalised concept plan

8 Technical Assessment

For assessment of the technical feasibility of the proposed project, a total station survey and a geo-technical investigation was conducted on the subject site. The key findings from both the survey and the investigation have been summarised below.

8.1 Station survey findings

A Topographical Survey using an electronic total station was conducted on the site to ascertain the exact land area and prepare a contour map of the site. The topographical survey involved contour interval of 0.25m for flat land and 0.50m for slopes and hills. The survey findings showed that the total area of the Nasirabad site was actually 8.498 acres as against the earlier estimated 8.39 acres.

8.2 Geo-technical suitability

A detailed Geo-technical Investigation was conducted to ascertain the soil quality and determine the suitability of the envisaged project at the site. The summarized findings of the geo-technical investigation (Report attached as **Annexure – 13.9**) that have a direct bearing on design and planning of the project are as follows:

- SPT, cohesion, angle of internal friction, unit weight of soil indicate that the soil layers have very good load bearing capacity and are suitable for multi-storied building
- Mat or Pile foundation would be required for the proposed apartment building
- Either shallow or deep foundation is preferred and for heavy loads, Piled Raft foundation may also be constructed
- Earthquake forces must be considered in design [According to BNBC, Section 2.5.4.1 and seismic Zoning map of Bangladesh, (Page 6-52)]

9 Financial Feasibility Assessment and PPP Transaction Structuring

On the basis of the concept plan (comprising land allocation and product mix) discussed in the previous section, the financial feasibility assessment has been undertaken. This section on financial feasibility focusses on the development feasibility for the proposed real estate components for the private developer if the project is undertaken through PPP. The section outlines the key assumptions related to development timelines and phasing, development scale, development configuration, development and maintenance costs i.e. both capex and opex, financing costs, demand phasing and sales revenues for various real estate components, all of which are important inputs to the financial feasibility for the project. A financial model has been developed integrating all the assumptions and the returns from the project have been calculated. Further, various possible scenarios pertaining the PPP structure of the project were also evaluated. The following sections discuss the various assumptions and other inputs to the financial model in detail.

9.1 Development Phasing Assumptions

It has been assumed that the developer shall complete the construction over a span of 6 years in a phased manner. Construction of NHA components and developer real estate components shall commence in parallel. It has been assumed that the NHA components will be completed within a period of 1 year. Since the assumed product mix of the private developer comprises multiple components, the residential component is assumed to be constructed first serving as the main source of sales revenue initially. As the development becomes recognized and sales increase, retail, commercial and hospitality components shall be developed. As shown above, the total built-up area for the project is approximately 0.35 million sq. ft. in NHA portion and approximately 3.0 million sq. ft. in developer portion.

9.1.1 Construction Phasing – NHA Components

The subject site currently situates the divisional and sub-divisional offices of National Housing Authority (NHA) and residential accommodation for its officer and staff. These are spread in various locations across the site. The current offices and residential accommodation of NHA will have to be demolished for construction of commercial real estate and residential accommodation within the site both for NHA portion and Developer portion. This will have some impact on the operations of NHA's operations. To minimize this impact, the construction period for NHA's residential and commercial components has been assumed to be one year.

9.1.2 Construction Phasing for Private Developer Components

The construction timelines for developer components have been assumed to span six years. The construction of various types of apartment has been assumed to be completed within the first 4 years. 2 BHK, 3 BHK and 4 BHK apartments will be taken up from the first year itself and will be completed in a phased manner over 3 years. The condominiums will be priced higher and it has been assumed that their construction will be undertaken from second year onward and will be completed in a phased manner over 3 years. The commercial office spaces and the retail zone have been phased in a manner so as to complement the demand created by the apartment development and their construction will be undertaken over a period of 4 years starting from second year onward. Phasing of the hotel has been done towards the end of the total construction period as demand is generated from operationalization of the commercial component. Construction phasing for developer real estate components has been summarized in the table below:

Table 18: Construction Phasing – Developer

Construction Phasing for Developer Real Estate Components						
Year	1	2	3	4	5	6
Residential						
2 BHK	20%	40%	40%	-	-	-
3 BHK	35%	35%	30%	-	-	-
4 BHK	35%	35%	30%	-	-	-
Condominiums	-	30%	30%	40%	-	-
Commercial						
Office Space	-	10%	20%	30%	40%	-
Retail Shopping	-	20%	20%	30%	30%	-
Hotel	-	-	-	-	50%	50%

9.2 Demand and Absorption Assumptions

The sales phasing has been assumed only for the developer portion as the rest of the developed area would be handed over to NHA's for its use. Based on interaction with regional real estate developers and the current market absorption average, the demand phasing has been undertaken. The demand has been spread over a period of 5-6 years since the current market cannot support the entire quantum of real estate being conceptualized. Further, the initial absorption rates have been kept low since it takes time for the demand for the project to materialize.

The residential component of the real estate is constructed first and the demand for the residential component will materialize first due to the marketing effort from the private developer. However, considering the market exhibited sluggish demand levels for commercial office spaces, absorption for commercial space is assumed to commence after a period.

Factoring in the absence of a quality organized retail development in the region, and the residential real estate being created, the proposed mall or retail spaces are expected to generate demand. The absorption rates have been kept at levels equivalent to those of the commercial office spaces. The demand for hotel is expected to materialize post its completion. The table below summarizes the absorption schedule assumed for various developer real estate components:

Table 19: Absorption Phasing for Developer Real Estate Components

Demand Phasing for Developer Real Estate Components							
Year	1	2	3	4	5	6	7
Residential							
2 BHK	5%	10%	20%	20%	20%	25%	-
3 BHK	10%	15%	20%	25%	30%	-	-
4 BHK	10%	15%	20%	25%	30%	-	-
Condominiums	-	5%	20%	20%	25%	30%	-
Commercial							
Office Space	-	-	15%	20%	25%	30%	10%

Demand Phasing for Developer Real Estate Components							
Year	1	2	3	4	5	6	7
Retail Shopping	-	-	15%	20%	25%	30%	10%
Hotel	-	-	-	-	-	100%	-

Demand phasing for the NHA real estate components shall be guided by allotment and sales policies adopted by the NHA (if any). Since the allotment of apartments and captive office space in the NHA portion is not related to the developer, revenues from such allotments are not considered as a revenue stream for the developer.

9.3 Cost Assumptions

9.3.1 Capital Expenditure Assumptions

Capital expenditure mainly comprises the construction costs of the real estate components – residential and commercial components in both NHA and Developer portions. Additionally, support infrastructure costs for both the portions have also been considered.

The capital cost for the individual components of the project has been estimated on the basis of the finalized concept plan. The concept plan provided an overall idea of the number of buildings, the number of floors in each building and the built-up area of each building. With these inputs and utilizing the rates from the Bangladesh PWD Schedule of Rates 2014, the total capital costs have been calculated. The estimated capital costs for Residential and Commercial components in NHA and Developer portion are shown below:

Table 20: Construction Cost Assumptions for NHA Components

Construction Cost Assumptions for NHA Components	
Component	Total Cost (BDT Million)
Housing Component	473.11
Type 1 & Type 2	205.81
Type 3 & Type 4	267.30
Commercial component	802.27
NHA office	802.27
Total	1,275.38

Table 21: Construction Cost Assumptions for Developer Components

Construction Cost Assumptions for Developer Components	
Component	Total Cost (BDT Million)
Housing Component	4,366.67
Type A	544.84
Type B	1,670.03
Type C	1,617.25

Construction Cost Assumptions for Developer Components	
Component	Total Cost (BDT Million)
Type D (Condominium)	534.55
Commercial component	6,691.95
Commercial office	2,007.59
Retail Mall	4,015.17
Hotel	669.19
Total	11,058.62

The various support infrastructure costs required for the property comes to approximately BDT 226 Million for NHA portion and BDT 2,046 Million for Developer portion. The detailed break-up of the support infrastructure costs have been provided in the table below.

Table 22: Break-up of Support Infrastructure Costs

Support Infrastructure Cost Assumptions		
Component	NHA portion Total Cost (BDT Million)	Developer portion Total Cost (BDT Million)
Water Supply and Drainage	102.03	884.69
Internal road network	0.03	3.25
Landscaping	31.88	276.46
Land Development Cost	0.42	29.15
Boundary Cost	3.00	7.00
External Electrification	89.28	774.10
Redevelopment of Mosque	-	71.13
Total	226.64	2,045.79

9.3.2 Development Cost Assumptions

The other major costs involved in the project are the Project Development costs. These costs have been assumed based on industry benchmarked cost standards collated from several interactions with the regional developers. The Transaction Advisor Fees are the fees being paid to KPMG (inclusive of Taxes). The development costs are shown below:

Table 23: Development Cost Assumptions

Project Development Cost Assumptions		
Component	Unit	Value
SPV/Company Incorporation Cost	BDT Million	5
Project Launch & Marketing Expense	BDT Million	15
Project Management Services Expense	% of Construction Cost	4.50
Transaction Advisors Fees	BDT Million	37.9

Project Development Cost Assumptions		
Component	Unit	Value
Project Financing Fee	% of Construction Cost	2
Architect and Master Planner Fees	BDT Million	10

For the development costs, the phasing assumptions are summarized in the table below, in line with typical industry standards:

Table 24: Phasing of Development Cost

Development Cost Phasing						
Year	1	2	3	4	5	6
SPV/ Company Incorporation	100%	-	-	-	-	-
Project Launch & Marketing Expense	20%	30%	30%	10%	10%	-
Project Management Services Expense	10%	20%	20%	20%	20%	10%
Transaction Advisor Fees	100%	-	-	-	-	-
Project Financing Fees	100%	-	-	-	-	-
Architect and Master Planning Fees	100%	-	-	-	-	-

9.3.3 Financing Assumptions

Financing of the project usually comprises a mix of external debt/ loan funding and equity funding from the developer. In line with typical industry standards and local market benchmarks, a debt equity ratio of 70:30 has been assumed as the financing mix for this project. Typically, loan is available to developers at interest rates of 11%–14% for a loan tenure of 8–10 years, with a 12–24 month moratorium. The interest rate is assumed at 12%. The various financing assumptions have been mentioned below.

Table 25: Financing Cost Assumptions

Financing Cost Assumptions	
Particular	Value
Equity	30%
Debt	70%
Cost of Debt/ Interest Rate	12%
Loan Repayment (No. of Years)	9
Principal Moratorium (No. of Years)	2

9.3.4 Operating Cost Assumptions

The assumptions for the Operating Expenses for real estate components in the Developer portion are in line with the market practices relevant to similar developments in the real estate market. Since the residential, commercial and retail developments will be subject to sale, the operating expenses for these typically also include administrative expenses, promotion/ marketing expenses, brokerage charges, etc. The hotel development is assumed to be operated by a reputable brand/ hotel chain, undertaking hotel operations in lieu of a management fee from the private developer. In addition, operational costs involved with operation of the hotel relating to manpower, utility costs, maintenance and repair costs, etc. have been

assumed as per industry benchmarks. The operating cost assumptions for the various components included in the financial model have been provided in the table below:

Table 26: Operating Expense/ Cost Assumptions for Developer Components

Operating Cost Assumptions for Developer Components		
Component	Unit	Assumption
Residential		
Administrative expenses	% of revenue	3%
Advertising / Promotions / Marketing expenses	% of revenue	2%
Brokerage on Sales	% of revenue	2%
Commercial, Retail and Hospitality		
Advertising / Promotions / Marketing expenses	% of revenue	2%
Brokerage on Sales	% of revenue	2%
Hotel Operational Expenses	% of revenue	20%
Management Fee/ Brand Royalty	% of revenue	20%

9.3.5 Project Capital Cost Summary

On the basis of the various capital cost assumptions mentioned above, the total project cost is estimated to be approximately **BDT 15,745 million** wherein civil construction cost for both NHA and Developer components is estimated at **BDT 12,334 million** and the support infrastructure cost is estimated at a total value of **BDT 2,272 million**. The detailed break-up of the construction cost and the total project cost components have been summarised below:

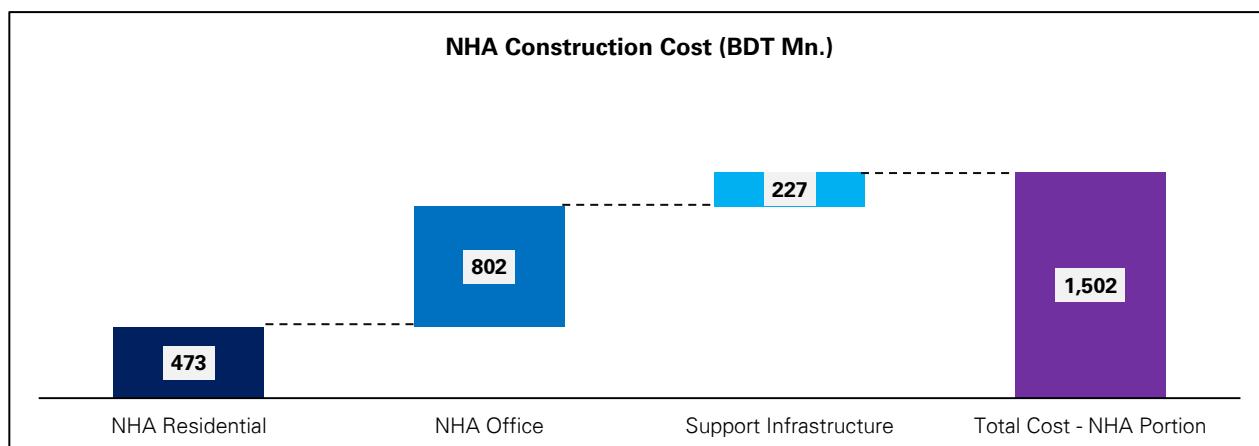


Figure 78: Break-up of capital cost of NHA component

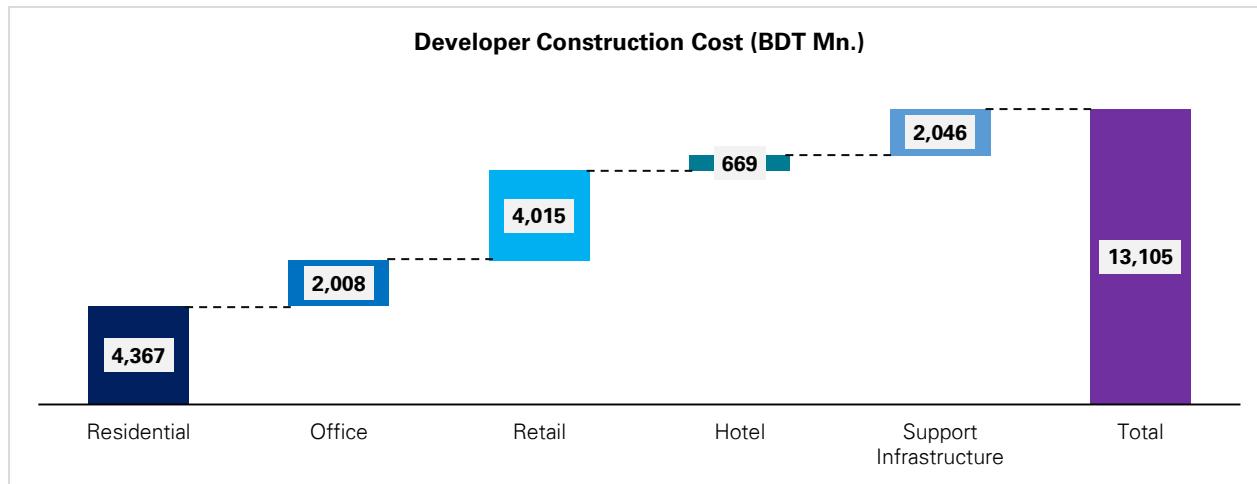


Figure 79: Break-up of capital cost for Developer Component

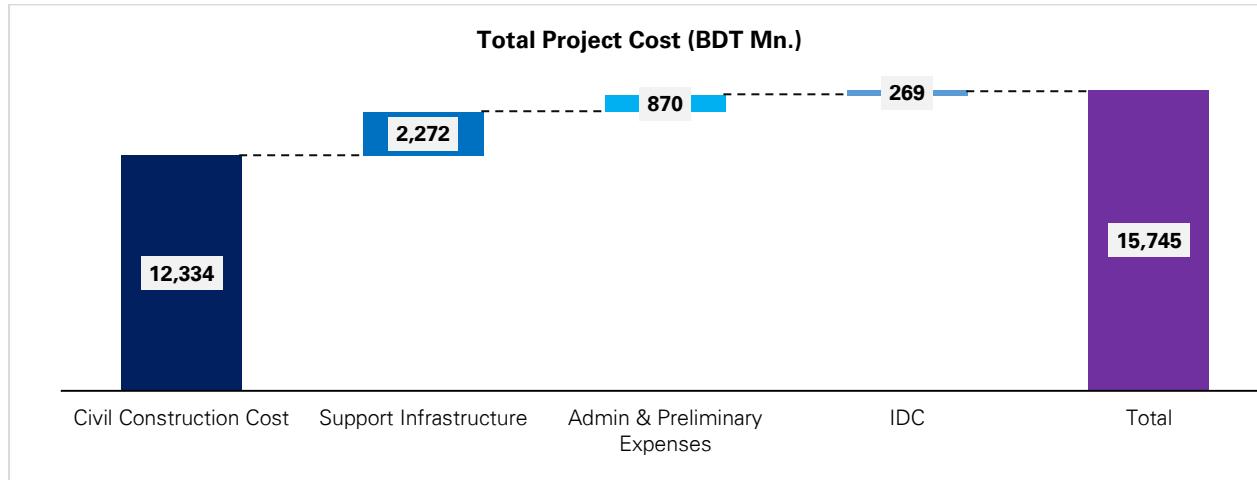


Figure 80: Break-up of Total Project Cost

9.4 Revenue Assumptions

As detailed in the market analysis, the residential pricing in the Nasirabad locality is in the range of BDT 5,000 to 7,000 per sq. ft. Though the current market conditions indicate a slowdown situation, the real estate market is expected to correct itself in the near to mid-term. The proposed project envisages to develop and sell approximately 1,050 units over a span of 6-7 years. To achieve this, an initial momentum would be needed for the project. Hence, the residential pricing for the sale of different apartment configurations has been assumed at a discount as compared with existing market prices.

In addition, the provision of car parking is assumed to generate additional revenue per car park whereas, additional facilities such as club membership and utilities have been assumed to generate additional revenues per apartment unit. These are based on typical parking and club membership fee standards.

The price realisation for a commercial development is dependent on aspects such as the location of the development, pricing levels in competing developments, market potential, etc. Currently, the office market in Chittagong is moving at a slow pace since a large quantum of inventory already exists in the market.

However, the Nasirabad location being an emerging CBD area may generate demand. Based on the market study carried out in the city of Chittagong, the price realisation from the office commercial space is assumed.

The shopping mall will be the first organized retail space development in Chittagong comprising a mix of shopping retail spaces, food courts and entertainment spaces such as a multiplex. The development is expected to garner strong interest from investors and end users. Also, the developer interactions indicate that the Nasirabad market has an appetite for organized retail shopping spaces. Based on our interaction with prominent developers of retail real estate, the sale value/ capital value for the ground floor space is assumed to be BDT 40,000 per sq. ft., which gradually decreases for each upper floor with a minimum price of 20,000 per sq. ft. for retail space on 5th floor. The ground floor revenues have been assumed to be marginally higher as compared to capital values of other floors, since the ground floor provides higher footfalls for retail investors.

As discussed in the hospitality section, a mid-segment branded hotel (3/4 star) would be developed at the subject site. Based on the market analysis, the ARR for the hotel has been assumed to be BDT 3,500. Initially, an occupancy of 35% is assumed for the first 2 years after operationalization as the hotel demand picks up gradually with the commercial development coming into existence. After that, the market demand for hotel component is expected to improve, stabilizing at an average occupancy of 55% from the 6th year. The brand fee and the F&B revenue have been assumed to be 30% based on interaction with various market participants. A summary of revenue assumptions is provided in the table below:

Table 27: Initial Revenue Assumptions for Developer Component

Revenue Assumptions		
Component	Unit	Assumption
Residential Sale Price		
Type A	BDT per sq. ft.	5,500
Type B	BDT per sq. ft.	5,000
Type C	BDT per sq. ft.	4,500
Type D-Condominiums	BDT per sq. ft.	6,500
Club Membership & Utilities	BDT Annual	24,000
Car Park Charges (Per Car Park)	BDT per unit	350,000
Commercial Office		
Office Space Average Sale Price	BDT per sq. ft.	22,000
Car Park Charges (Per Car Park)	BDT per unit	350,000
Retail/Shopping Space		
Ground Floor Sale Price	BDT per sq. ft.	40,000
First Floor Sale Price	BDT per sq. ft.	35,000
2nd & 3rd Floors Sale Price	BDT per sq. ft.	30,000
4th Floor Sale Price	BDT per sq. ft.	25,000
5th Floor – Above Sale Price	BDT per sq. ft.	20,000
Car Park Charges (Per Car Park)	BDT per unit	350,000
Hotel Component		
Average Room Rate (ARR)	BDT per room	3,500

Stabilized Occupancy (Year 6 onwards from start of operations)	Percentage	55%
F&B Revenue as % of RR	Percentage	30%
Other Revenue as % of RR	Percentage	30%

These revenue assumptions made by KPMG were modified on the basis of the observation by National Housing Authority (NHA) that “per unit revenue assumption made by KPMG in the financial model is on lower side, and the same may be increased by 10% across the types/ categories.”

The Final Revenue Assumptions are provided below:

Table 28: Final Revenue Assumptions for Developer Component

Revenue Assumptions		
Component	Unit	Assumption
Residential Sale Price		
Type A	BDT per sq. ft.	6,050
Type B	BDT per sq. ft.	5,500
Type C	BDT per sq. ft.	4,950
Type D-Condominiums	BDT per sq. ft.	7,150
Club Membership & Utilities	BDT Annual	26,400
Car Park Charges (Per Car Park)	BDT per unit	385,000
Commercial Office		
Office Space Average Sale Price	BDT per sq. ft.	24,200
Car Park Charges (Per Car Park)	BDT per unit	385,000
Retail/Shopping Space		
Ground Floor Sale Price	BDT per sq. ft.	44,000
First Floor Sale Price	BDT per sq. ft.	38,500
2nd & 3rd Floors Sale Price	BDT per sq. ft.	33,000
4th Floor Sale Price	BDT per sq. ft.	27,500
5th Floor – Above Sale Price	BDT per sq. ft.	22,000
Car Park Charges (Per Car Park)	BDT per unit	385,000
Hotel Component		
Average Room Rate (ARR)	BDT per room	3,850
Stabilized Occupancy (Year 6 onwards from start of operations)	Percentage	55%
F&B Revenue as % of RR	Percentage	30%
Other Revenue as % of RR	Percentage	30%

9.5 Financial Returns Summary

On the basis of the revenue and cost assumptions detailed above, the Financial Returns have been calculated for the Base Case. In the Base Case of the project, there is no payment from the private developer to National Housing Authority – in the form of Upfront Premium or Revenue Share or Built-up area. In the Base Case, the private developer develops the project in developer's portion as per its discretion and market understanding and NHA's portion as per NHA's specifications and hands over the developed residential accommodation and office space in NHA's portion to National Housing Authority.

The summary of the Financial Returns from the project for the Base Case are shown below:

Table 29: Return Statement for Base Case

Returns Summary: Without Upfront Premium and Share of Revenues to NHA	
Component	Assumption
Land Sharing Ratio (NHA : Private Developer)	1.07 : 7.20 (in acre)
Equity-Debt Ratio	30 : 70
Total Project Cost	BDT 15,745 million
Equity Financing	BDT 4,724 million
Debt Financing	BDT 11,022 million
Project IRR	32%
Equity IRR	50%

Based on the base case assumptions, the total revenues generated from the project over a period of 15 years are expected to be approximately BDT 43,258 million. The capital expenditure during the period, including interest during construction (IDC), is expected to be BDT 15,745 million. Given the assumed debt equity ratio of 70:30, equity financing is expected to be BDT 4,724 million and debt financing to be BDT 11,022 million. This structure is able to generate favourable returns: the Project Internal Rate of Return (PIRR) achieved is 32% whereas the Equity Internal Rate of Return (EIRR) is 50%. Based on local market research, it is understood that the expected rate of return by local developers on equity put into a project lie in the range of 25%-30%. Consequently, the base case scenario provides returns, which are much above expectations of the developers. The Financial Statements for the Base Case are provided in **Annexure – 13.7**.

9.6 Assessment of structuring options for the PPP project

A successful PPP Project involves both risk and reward sharing between the public authority and the private partner. In the instant project, the 7.20 acres of land being proposed to be handed over by the public authority i.e. National Housing Authority (NHA) to the private developer has an approximate market value of BDT 450 crores. The office and residential apartments for NHA being developed in NHA's portion of 1.07 acres will involve only a portion of the price of land. To ensure that the compensation to NHA is commensurate with the approximate value of land, a few structuring options were evaluated. These were based on the overall nature and requirements of the project and KPMG's past experience. These are outlined below:

Option 1: Fixed upfront premium or annuity to NHA

In this option, NHA receives the required commercial space and housing units from the private developer. The developer receives land on transfer/ long term lease for development and sale of real estate components on the prime land parcel. In addition, NHA receives fixed payment from the developer – upfront amount or over a fixed period of time (annuity payments) for giving development rights on the prime land parcel. The Allotment of NHA part will be done only for NHA's internal use with no additional inventory. Thus there will be limited competition between the private developer and NHA residential and commercial spaces on the same site.

This PPP project structure may have the following issues:

- Annuity payments may pose a challenge from a monitoring perspective.
- It is a rigid model and even in case of market downside, the developer has to bear the entire burden of the Fixed Payment

Option 2: Additional housing units to NHA

In this option, NHA receives the prescribed commercial space and housing units while developer receives prime land to construct and sell real estate components. Moreover, NHA receives additional residential units, over and above prescribed number and these additional units may be allotted to NHA personnel or made available for sale.

The main issues of this option are outlined below:

- The bid evaluation becomes difficult as different bidders may provide built-up area across various locations within the site
- The built-up area of NHA and the private developer competes for the same pool of customers within the same market and this leads to reduced realization from the underlying land. Thus, non-compete provisions need to be factored in with respect to disposal price or allotment timeframe applicable to NHA.

Option 3: Revenue share to NHA

In this option, the developer receives land on transfer/ long term lease for development and sale of real estate components on the prime land parcel. NHA receives revenue share from the developer as a result of sale of real estate in the developer's area. This ensures that the developer can plan, develop and market the entire parcel of land offered to it with no undesirable competition with NHA

The main issue of this option is outlined below:

- This option needs long term monitoring by NHA and creation of suitable mechanism to ensure revenue share throughout the lifecycle of the project or significant part of it

Further, we have evaluated the three options from various perspectives/ parameters such as Ease of Bid Evaluation, Benefit to NHA from Project upside and Impact to Bidder due to market downside, among others. This analysis is showcased below:



Figure 81: Comparative Evaluation of the Three Project Structuring options across parameters

The above analysis shows that Option 3 can be deemed as positive across most of the above parameters, whereas the other options will be positive or normal in some parameters and negative in remaining parameters. Therefore, Option 3 was recommended by KPMG as the optimum project structure for the Commercial cum Residential complex project of National Housing Authority (NHA).

Further, **discussions were held with the Chairman, NHA and the Director General, PPP Authority on 08 May 2017 (minutes attached in Annexure – 13.6)**, to analyse the merits and demerits of the various options mentioned above. The involved stakeholders unanimously agreed to adopt Option 3 discussed above as the suitable PPP structure for the project. It was further agreed that the private developer will have to pay an upfront premium of BDT 50 Crore or 500 Million to NHA. In addition, the private developer will have to provide share of revenues accruing to him from the sale of real estate in his area. The share of revenue to NHA shall be a minimum of 20% and this shall be the Bidding Parameter. The finalized structuring option has been encapsulated in the schematic below:

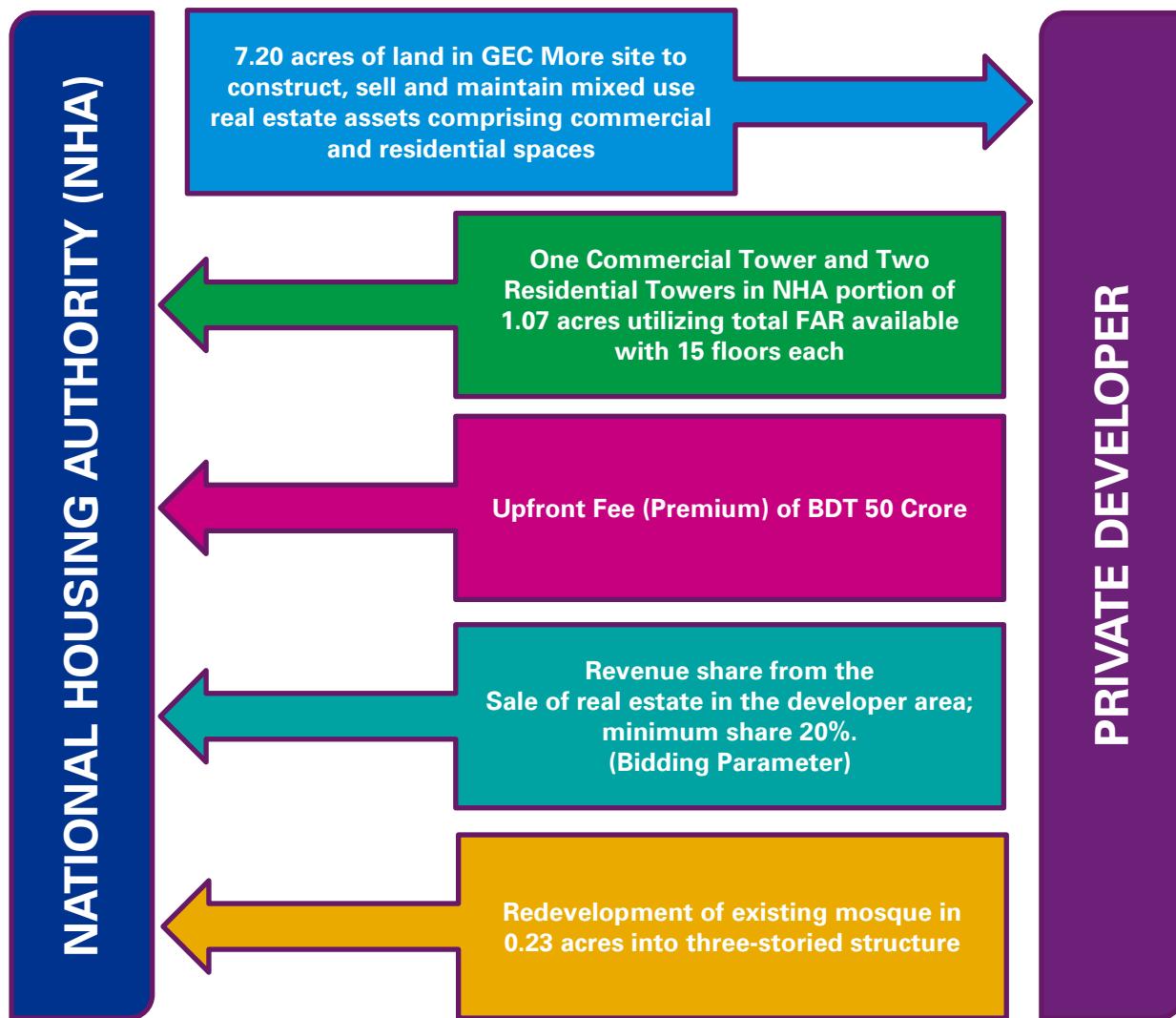


Figure 82: Final PPP Project Structure

On the basis of the project structure finalized above and the revenue and cost assumptions detailed elsewhere in this report, the returns accruing to the project and to the equity investor of the project were calculated. This is shown below:

Table 30: Return Statement for the Finalized Project Structure

Returns Summary: With Upfront Premium of BDT 500 Million and 20% Share of Revenues	
Component	Assumption
Land Sharing Ratio (NHA : Private Developer)	1.07 : 7.20 (in acre)
Equity-Debt Ratio	30 : 70
Total Project Cost	BDT 16,330 million
Equity Financing	BDT 4,899 million

Debt Financing	BDT 11,431 million
Project IRR	16%
Equity IRR	23%

The total revenues accruing to the private developer from the project over a period of 15 years are expected to be approximately BDT 34,607 million. The capital expenditure during the period, including interest during construction (IDC), is expected to be BDT 16,330 million. This includes the Upfront Premium of BDT 500 million and capitalised interests thereon. Given the assumed debt equity proportion of 70:30, equity financing is expected to be BDT 4,899 million and debt financing to be BDT 11,431 million. This structure is able to generate favourable returns: the Project Internal Rate of Return (PIRR) achieved is 16% whereas the Equity Internal Rate of Return (EIRR) is 23%. This is close to the expected rate of return of local developers on equity put into a project, which is in the range of 25%-30%. The Financial Statements for this project structure are provided in **Annexure – 13.8**.

In the last part of this section, we have provided a brief outline of PPP Financing in Bangladesh, which includes the agencies involved in PPP financing of infrastructure projects and a list of infrastructure projects which have been financed by these agencies. This is expected to lead to a better understanding of the PPP financing ecosystem and may be required at the procurement stage or post-award to achieve quick financial closure.

9.7 PPP Financing in Bangladesh

There are multiple agencies financing PPP projects in Bangladesh. The brief profiles of some of these agencies are provided below:

1. Infrastructure Development Company Limited (IDCOL):

Infrastructure Development Company Limited (IDCOL) was established on 14 May 1997 by the Government of Bangladesh to take care of the growing needs in infrastructure and energy projects financing. IDCOL, licensed by the Bangladesh Bank as a non-bank financial institution (NBFI) on 5 January 1998, has emerged as the market leader in the space of infrastructure and private sector energy financing in Bangladesh. Since its inception IDCOL has justified its vision by promoting and optimizing private sector participation in numerous infrastructure and renewable energy projects through multiple public-private-partnership (PPP) initiatives. The projects financed by IDCOL cover a wide spectrum ranging from power to ports and Environmental Services.

2. Bangladesh Infrastructure Finance Fund Limited (BIFFL):

Bangladesh Infrastructure Finance Fund Limited (BIFFL) was established in 2011 by a resolution of the cabinet of the Government of Bangladesh and is owned by the Ministry of Finance. BIFFL is a non-bank financial institution (NBFI) taking care of the need for investment in infrastructure sector of Bangladesh. BIFFL envisages attracting private investment from both local and foreign investors and in turn invests in various infrastructure projects in Bangladesh. BIFFL has been successful in promoting Bangladesh's economic growth by encouraging private sector investment in numerous infrastructure projects. BIFFL has extended its helping hand to infrastructure projects ranging from power to telecommunication systems, by extending financial facilities in the form of debt or equity and securing both domestic and foreign investment within the context of a robustly designed and well-governed investment vehicle.

3. International Finance Corporation(IFC):

IFC is a member of the World Bank Group and the largest global development institution with exclusive focus on the private sector in developing countries. IFC boasts of having catered to private sector players

across the globe with special focus on infrastructure related projects in a variety of sectors ranging from transportation to water systems. Through the last six decades, IFC has been supporting World Bank Group's global goals of ending extreme poverty and boosting shared prosperity by raising global standards of living. IFC's advice in public-private partnerships (PPPs) is aiding national and municipal governments in developing countries partner with the private sector to improve access to various infrastructure related services.

4. CDC Group:

CDC is UKs Development Finance Institution (DFI) and was founded in 1948 to support the building of businesses in Africa and South Asia. CDC, the world's oldest DFI, aims to provide scarce capital to private sector in the developing countries and thereby helping these nations to eradicate poverty. CDC invests in a range of sectors such as manufacturing, infrastructure, etc. with a focus on job creation. It aims to demonstrate that it is possible to invest in a challenging environment and intends to support growth of all sizes of business. The investment instruments of CDC include equity and debt instruments.

5. European Investment Bank:

The European Investment Bank is the European Union's bank establishment to finance sustainable investment projects which contribute to furthering EU policies. Since 1993, the EIB has been authorized to lend in Asia. Since then it has been supporting a variety of projects in sectors such as renewable energy, water, etc. EIB possesses expertise in project loans, equity and funds investments in a broad spectrum of sectors that contribute to employment, growth and environmental sustainability of the region.

6. Proparco:

Proparco is a subsidiary of Agence Française de Développement (AFD) and was established four decades ago to support sustainable development by focusing on private sector funding. It operates across 80 countries and aids financing of corporate private sector projects. Infrastructure sector is one of the key focus sectors for Proparco as it realizes that efficient infrastructure plays a key role in improving the living conditions of the population in developing countries. Hence, it focusses on sectors such as energy, transport, telecommunication network, among others. With the full range of financial instruments from equity to senior loans, Proparco efficiently meets the financing needs of the private sector.

7. Asian Development Bank:

The Asian Development Bank (ADB) was established in 1960s as a financial institution to foster economic growth and cooperation in the Asia Pacific region. Besides Public Sector Financing, ADB also provides Private Sector (Non-Sovereign) Financing. Acting as a catalyst for private investments, ADB provides financial assistance to developmental projects provided the projects demonstrate clear developmental impact. The ADB's Private Sector Operations Department (PSOD) structures and finances investments for private sector companies across a wide spectrum of industry sectors ranging from infrastructure to urban development.

8. Islamic Finance and Investment Limited:

Islamic Finance and Investment Limited (IFIL), incorporated in Bangladesh in 2001, is a full-fledged financial institution and is licensed by the Bangladesh Bank. IIFL extends investments to industrial sectors and effectively caters to the client's needs, thereby promoting the socio-economic development of the country. The company operates under the Bangladesh Bank and provides Project Finance for specific projects of any size.

In addition to the above, commercial banks in the country provide financing for infrastructure projects.

Details on debt funding provided to private players in select Infrastructure projects are provided below:

Table 31: Debt Funding provided to private sector players in select infrastructure projects

S. No.	Lender Name	Borrower Name	Project Name	Type of funding	Total Value of Project	Sector	Loan Provided
1	IDCOL	Panama Sonamasjid Port Link Limited (PSPLP)	Development of Sonamasjid land port	Debt	BDT 130 Million	Ports	BDT 80 Million
2	ADB	Sylvan Agriculture Limited	PRAN Agribusiness Project	Debt	USD 35.8 Million	Agro-industry	USD 25.10 Million
3	BIFFL	Regent Energy and Power Limited	108 MW Gas based Power Plant of Regent Energy and Power Limited	Debt	USD 81.58 Million	Power	USD 12.2 Million Interest Rate: 15%
	IFC						USD 20.6 Million
	IDCOL						USD 30 Million
4	BIFFL	First Dhaka Elevated Expressway Ltd.(FDEEL)	Construction of Dhaka Elevated Expressway	Debt	BDT 89,400 Million	Transport	BDT 4,000 Million

10 Assessment of Environmental and Social Impact

As part of the Feasibility Study for building a Multi-storied Commercial cum Residential Complex in Chittagong, an Assessment of Environmental and Social Impact of the project was conducted by the project team. As a first step, a screening assessment was undertaken as a precursor to a more detailed exercise. After the screening, an Initial Environmental Examination (IEE) was undertaken by the Environmental Expert. The findings related to Environmental and Social impacts both from the screening and IEE, are provided below:

10.1 Summary of Environmental Impact of the Project

The key environmental issues identified during the screening were as follows:

- Trees and undergrowth in the site may have presence of fauna (mammals and reptiles)
- Solid waste/ hazardous waste may be generated during construction and operation
- Wastewater/ septage/ sewage may be generated during construction and operation
- Project will lead to cutting of a large number of trees during construction and/or operation
- Possible damage to the water body (large pond) at the site
- Increased risk of air pollution and noise pollution during construction

The summary of findings from the Initial Environmental Examination (IEE) is provided below:

- As per ECR 1997, the project can be categorized under Orange B (Category #8 – hotels, multi-storied commercial and apartment buildings)
- Rule 7 of ECR 1997 states that the proponent of such projects must obtain a Location Clearance Certificate and an Environmental Clearance Certificate (ECC) from the Department of Environment (DOE)
- Initial Environment Examination (IEE) has to be conducted to fulfil the requirements of the Department of Environment
- The project is expected to have little potential for environmental impacts
- The few environmental impacts that have been identified can be mitigated by the measures mentioned in the IEE and EMP
- **IEE document will be sufficient and acceptable to DoE as part of the ECC application and further study for impact assessment will not be necessary**

The Initial Environmental Examination (IEE) report is attached as **Annexure – 13.10.**

10.2 Summary of Social Impact of the Project

The ownership of the site for the proposed Multi-storied Commercial cum Residential Complex in Chittagong rests with the National Housing Authority (NHA). The people residing within the project site are the employees of National Housing Authority. The project also does not involve any land acquisition and consequently no rehabilitation and resettlement issue is envisaged. Further, the following aspects of the project are also pertinent in this context:

- The proposed project is not expected to cause impact on the local community or private structures (such as residential and commercial), and common properties. Based on the field visits of the project team, no impact is expected on private land and private properties like housing, shops, commercial buildings, religious and community infrastructure.

- No social impacts post construction can be perceived. The proposed project does not have any adverse impact on women and/ or girls and does not widen gender inequality. The proposed project will not have any physical or economic displacement.
- There are no indigenous people or ethnic minority groups present in the project location

Only the following social adverse impacts are envisaged from the project, which are minor in nature:

- Relocation of families of employees staying within the project site
- Access may be difficult to the mosque within the site for the general public
- Access may be difficult to the water body within the site for the general public

In contrast, the social impact of the project is envisaged to be largely positive. The project size will be large with a total capex of approximately BDT 16,000 million and scope will involve both residential and commercial real estate across various categories. This is expected to create both direct and indirect employment during the construction and the operational phases of the project in fairly large numbers.

11 Developer Workshop in Chittagong

A Developer workshop was conducted by KPMG on behalf of National Housing Authority, Bangladesh in Chittagong to create awareness about the GEC More PPP Project among the prominent developers of Bangladesh. The developer workshop was held on 25 May 2017 in The Peninsula, Chittagong. Most of the prominent developers of Chittagong participated in the workshop. The developer Tropical Homes sent its representatives from Dhaka. The following is the list of developers who participated in the workshop:

- CPDL
- Epic Properties
- Equity Property Management
- Tropical Homes
- ABC Real Estate
- MDCL
- Ranks FC Properties
- Finlay Properties
- Rupayan Group
- Mir Akhter Hossain

The National Housing Authority was represented by Mr. Kawser Morshed, Executive Engineer, NHA and Mr. Choton Chowdhury, Sub-divisional Engineer, NHA.

The KPMG team presented to the participants the following aspects of the Project:

- Project Background
- Site and Location Overview
- Concept Plan
- PPP Project Structure
- Key Project Features
- Timelines

The project concept, the project structure and key project features were explained to the participants in detail. The queries of the participants on the project were answered and comments and suggestions of the developers were collated so as to incorporate them suitably during the Phase 2 of the project involving PPP Procurement Process Development and Implementation.

The proceedings during the workshop are showcased in the pictures below:



Figure 83: Photographs of Developer Workshop in Chittagong

12 Way Forward

The submission of the Final Feasibility Study Report marks the end of Phase 1: Detailed Feasibility Study and Project Development for Multi-storied Commercial cum Residential Complex at Chittagong.

Subsequent to this, the Phase 2: PPP Procurement Process Development and Implementation will commence. The main objective of the Phase 2 is to help National Housing Authority, the primary implementing agency to on-board a private partner/ developer to develop the project in line with the Project Structure finalized during Phase 1.

It has been already decided that the procurement shall be single stage. The major deliverables in Phase 2 shall be as follows:

- **Project Information Memorandum**
- **Invitation for Bid (IFB) document with Technical and Financial Eligibility and Evaluation Criteria**
- **Contract Document with terms and conditions for successful execution of the project**

Further, the team from KPMG would also assist the National Housing Authority in engaging with the market, running the procurement process (including handling bidders' queries, bid evaluation and selection of the developer to undertake the project) and formalizing a governance and monitoring structure for implementing the project. The KPMG team shall also arrange a short offshore Study Tour for up to 1 week for 3 (three) government officials (as nominated from the Ministry of Housing and Public Works/ National Housing Authority/ PPP Authority) to showcase similar projects that have been delivered in other countries or regions.

13 Annexure

13.1 Technical Brief for Total Station Survey

Description of Services:

The scopes of services envisaged for this assignment for all purpose of achieving or executing the services are as follows:

Part I: Total Station/Topographical Survey:

1. Standards to be employed:
 - i. Area Description in sq.m. and acre
 - ii. Direction: Magnetic North
 - iii. Contour Interval: 0.25m for flat land and 0.50m for slopes and hills
 - iv. Grid Interval: 5m X 5m
 - v. Spot Levels: Between 10mts to 15mts
 - vi. Leveling Requirements: The leveling work shall be carried out by any conventional method; the leveling work shall be connected with S.O.I. benchmark; and if S.O.I. benchmark is not available nearby then the leveling work shall be carried out by any using local benchmark.
 - vii. Inventory Label Requirements (for built structure and open plots only): Name of the feature; area statement; general size of the feature; municipal survey no. if any; built type (kutcha or pucca or semi pucca); general built use (commercial, residential, institutional etc.); demarcation of the main entrance to the built.
 - viii. Output Format: 1:1 scale digital copy of 2 dimensional ACAD 2000 format drawings complete with all information and attributes. All components and features to be recorded in separate layers and blocks nomenclature appropriately. Survey information to be submitted in Excel Sheet as per requirements.
2. Survey Features expected to be recorded but not limit to the following:
 - i. Building footprints
 - a. Historic buildings, monuments, protected and notified structures and ruins of significance
 - b. Religious and culturally significant structures like temples, mosques, gurdwara, burial grounds, cremation grounds, etc.
 - c. Other built structures as per their property divisions (in case of commercial and mixed use each unit should be demarcated separately)
 - d. Compound walls of any built or vacant property
 - e. Encroachments, overhangs, extensions, etc.
 - f. Slums and squatter boundaries
 - g. Temporary shops and shacks
 - ii. Topographical features
 - a. Spot levels and spot elevations (in case of undulating surfaces and slopes the density of spot levels can be increased)
 - b. Terrain contours and their heights (from MSL)
 - c. Any specific sharp & noticeable changes such as mounds, ditches, cuttings, excavations, major erosions, etc.
 - iii. Natural features
 - a. Water bodies, ponds, natural tanks, marshy areas, etc.
 - b. Trees (only for girth size more than 200 mm), plants, orchards, etc. - with their girth centre, approximate canopy diameter and the local species name.
 - c. Large untended green, wooded areas forest covers, shrubs and bushes (only area demarcation)
 - d. Natural drains, springs, nallahs, etc. (with direction of flow and datum line, HFL and MFL)
 - e. Aquifers, water recharge areas, etc. if any (general demarcations)

- iv. Services & amenities (with IL & CL)
 - a. Storm water drains, open drains, exit points, collection points, etc. (with general dimensions) for both above grade and buried.
 - b. Drainage systems, manholes, pumping stations, sewerage system, septic tanks, etc.
 - c. Water supply lines, water kundis (taps), operation valves, OHTs hand-pumps, boring wells, tube wells, wells, harvesting or recharging facilities chambers and pumping stations
 - d. Electric lines, poles, DPs and substations, high-tension lines, transformers, etc. with visible connections.
 - e. Telephone lines, poles, DPs, etc. with visible connections
 - f. Public toilets, urinals, drinking water fountains
- v. Infrastructure
 - a. Tar roads, metal roads, cart tracks, kutch road, highways, road divider, traffic island, etc. complete with levels, hard shoulder and material labeling.
 - b. Unpaved and paved pathways, terraces, etc.
 - c. Bunds, culvert, bridges, etc.
 - d. Authorized parking, sidewalks, footpaths, pedestrian trails
 - e. Road signage, directional signage, fixed information plaques, etc.
 - f. Tree guards, barriers, railings, fencing, etc.
 - g. Community dustbins, garbage collection units, dhalaos, etc.
- vi. Landscape features
 - a. Tended greens like lawns, parks, park fixtures, etc.
 - b. Gardens, traditional water channels, etc.
 - c. Immovable street furniture like benches, platforms, illumination units, park lights, street lights, etc.
 - d. Manmade water bodies, moats, etc.
 - e. Urban sculptures, statues, pedestrian stops, etc.

Part II: Compilation of Total Station/Topographical Report for each sites (as per practice standards) which should entail but not limit to the following:

1. 3 colored copies of print of the total station survey in adequate paper size not less than A2 size.
2. 3 colored copies of print of the typical cross sections in adequate paper size not less than A3 size.
3. 3 copies of B/W printed survey schedule in A4 size paper.
4. Any other observation or special inputs made on site

Deliverables:

- a. Field data in soft copy for all survey;
- b. ACAD 2000 outputs of TSS in soft copies for each site on CD
- c. Survey Schedule in Excel format in soft copy.
- d. Any other as/specifications mentioned above

13.2 Technical Brief for Geo-technical Investigation

Description of Services:

The scopes of services envisaged for this assignment for all purpose of achieving or executing the services are as follows:

Part I: Geological Extant Report:

- a. Geology of the proposed site;
- b. General suitability to the proposed activity;
- c. General stability assessment; and
- d. OB study
- e. Any other relevant geological information.

Part II: Geo-technical Investigation (as per Standard & testing schedules):

- a. Exploratory Boreholes of 75/100 mm diameter at identified locations to a minimum depth of 30.00 m or till satisfactory values of SPT are obtained
- b. Open Excavation up to 3.0m depth
- c. Standard Penetration Test at suitable interval in depth or change of strata or at every change of strata, whichever is earlier;
- d. Collection of disturbed/undisturbed soil samples for determining physical and or engineering properties from both borehole(s) and SPT
- e. All necessary laboratory investigations to determine physical properties such as CBR, Modulus of sub-grade reaction, grain size distribution, liquid limit, plasticity index etc. for disturbed/undisturbed soil samples; and
- f. Recording the depth of ground water table in each borehole (if observed).

Part III: Compilation of Analytical Report (as per practice standards) which should contain but not limit to the following:

- a. Borehole sample analysis: Depth (mtr); Soil Classification; N -Value; Grain size (%); Density (gm/cc) wet; Density (gm/cc) dry; Shear parameter; etc.
- b. Soil tests: Unconfined compressive strength (kg/cm²); Maximum Moisture content (%); Natural Moisture content (%); Liquid Limit (%); Plastic Limit (%); Plastic Index; etc.
- c. Detailed Calculation Table of Safe Bearing Capacity of soil;
- d. Other necessary information as mandated by standard practices; and
- e. Conclusions and recommendations.

Deliverables:

- a. Field data in soft copy for all investigations;
- b. Laboratory test results in soft copy; and
- c. One hard and soft copy of report for the site.

13.3 Profile of Amenities provided in Residential Projects of Private Developers

Profile of Amenities Offered in Private Developer Projects in Key Residential Markets										
Amenities	Nasirabad/Panchlaish/Khulshi								Kazir Dewri/Jhoutola	Agrabad
Projects ➔	Equity-GF Fortune Mall	Navana - Fazilat Hillcrest	Navana - South Park	Navana - Jalal Palace	Navana - Madani Tower	CPDL Crimson Clover	Epic Crown Ridge	Epic NPrangon	Equity Riverfront	
Building Facilities										
Car parking	✓	✓	✗	✓	✗	✓	✗	✓	✓	✓
Car Lift	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
Central AC	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
Imported Sanitary and Electricity Fixtures/Fittings	✓	✓	✓	✗	✗	✗	✗	✓	✓	✓
Passenger Lifts	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓
Power Backup	✓	✓	✓	✓	✓	✓	✗	✓	✓	✗
Water reservation and purifier system	✗	✓	✗	✗	✗	✗	✓	✗	✓	✓
Security Facilities										
Fire Fighting Equipment	✓	✓	✗	✗	✗	✓	✓	✓	✓	✗
CCTV	✓	✗	✗	✗	✗	✓	✓	✓	✓	✓
Intercom	✗	✓	✗	✓	✗	✗	✗	✓	✓	✓
Recreational Facilities										
Community Space	✗	✓	✗	✓	✓	✓	✓	✓	✓	✗
Conference Room	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗
Sports Facilities	✗	✗	✗	✗	✗	✓	✓	✓	✓	✗
Gymnasium/Health Club	✗	✓	✓	✓	✓	✓	✓	✓	✓	✗
BBQ Space	✗	✓	✗	✗	✗	✓	✓	✗	✗	✗
Children Play Area	✗	✗	✓	✓	✓	✓	✓	✗	✗	✗
Solar Panel	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗
Prayer Room	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗
Club House	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗
Swimming Pool and Spa/Sauna	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗
Wi-fi facility	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗

13.4 Profile of Amenities provided in Commercial Projects of Private Developers

Profile of Amenities Offered in Private Developer Projects in Key Commercial Markets			
Amenities	Nasirabad/Panchlaish/Khulshi		Agrabad
Projects ➔	Equity - GF Fortune Mall	Finlay - Finlay Square	Ranks FC - Atlas Rangs Plaza
Car parking	✓	✓	✓
Car Lift	✓	✗	✗
Passenger Lifts	✓	✓	✓
CCTV Surveillance	✓	✓	✗
Central AC	✓	✓	✓
Fire Fighting Equipment	✓	✓	✓
Power Backup	✓	✓	✓
Imported Sanitary Fixtures/Fitting	✓	✗	✗
Underground Water Reservoir	✓	✗	✗
Exclusive Atrium	✗	✓	✗
ATM Booth	✗	✓	✗
Children Play area	✗	✓	✗
Digital Theatre	✗	✓	✗
Security Alarm	✗	✓	✓
Gymnasium	✗	✓	✗
Swimming Pool	✗	✓	✗
Club House	✗	✓	✗
Prayer Space	✗	✓	✓
Wi-Fi Facility	✗	✗	✓
Earthquake Resistant Structure	✗	✗	✓

13.5 Survey Questionnaire

Survey Questionnaire – 1

Residential - Willingness to Pay Survey No ____

Respondent Details:

1. Name of the respondent _____ Age _____ Family size _____ Sex: Male Female
2. Annual Income (BDT) _____
3. Employment type: Business Govt. Service Pvt. Service Self Employed Dependant/Unemployed

Respondent Residential Details:

4. City/Locality of residence _____
5. Residence Ownership Type: Owned Rented
6. No. of Residence Owned in City of Residence: 1 Flat 2 Flats 3 Flats 4 or more Flats
7. Residence Type: 2 BHK Pvt. Developer Flat 3 BHK Pvt. Developer Flat 4 BHK Pvt. Developer Flat Pvt. Developer Flat Condominium 2 BHK Govt. Flat 3 BHK Govt. Flat 4 BHK Govt. Flat
8. Residence Size (in sq. ft.): _____
9. Purchase Price/ Monthly Rental: _____ Taka

Respondent Purchase Preference

10. Which type of apartment do you prefer: Government Flat/Apartment Developer Flat/Apartment
11. Why do you prefer the chosen type: Better Construction Quality Developer Brand Better Size & Layout Affordable Pricing Better Amenities (Parking, Open Spaces, Balconies) Recreational Amenities Offered Better Re-sale Perceived Safety & Trust Better Loans & Payment Schemes Plans
12. What type and size of apartment do you prefer? 2 BHK of _____ sq. ft. 3 BHK of _____ sq. ft. 4 BHK of _____ sq. ft. Condominium of _____ sq. ft.
13. What are the reasons for choosing your current residence: Location Developer Brand Total Size Price Amenities offered (CCTV Security, Parking, Power Back Up) Proximity to Support Amenities (Parks, Schools/ Offices) Quality of Construction Any other reason
14. How would you rate the above preference factors (1 – Low, 6 – Medium, 9 – High)
15. How would you rate the following Amenities in order of importance (1 – Low, 6 – Medium, 9 – High):

- CCTV/ Guard/ Security Parking Power Back Up Water Supply Back up/Harvesting Piped Gas Supply Local Shops Club house Parks & Surrounding Green Area Lift Children's Play Area Energy Efficient/Green Building
16. Would you pay a premium if the flat is located in proximity to: Business/Office Complex Shopping Complex Recreational Facilities Social Facilities (such as school, college, university)

Respondents New Apartment Purchase Behaviour

17. Are you evaluating a new flat/apartment purchase? Yes No
18. What will be the main source of information considered by you when making the choice: Developer Brochure Newspaper Advertisement TV/ Radio Advertisement Info provided by Company sales representatives Exhibitions and Property Fairs Word of Mouth View of Sample Flat Recommendations/ Personal References
19. What size range of apartment do you consider ideal? <1000 sq. ft. 1000-1500 sq. ft. 1500-1700 sq. ft. 1800 -2000 sq. ft. 2000-2500 sq. ft. >2500 sq. ft.
20. What is an acceptable price band for purchasing an accommodation? <40 lacs BDT 40 – 50 lacs BDT 50 -60 lacs BDT 60 -75lacs BDT 75 – 80 lacs BDT 80 – 90 lacs BDT 90-100 lacs BDT >100 lacs BDT

Respondents Perception for GEC More

21. Do you think GEC More is a good location for a new residence? Yes No
22. If yes/no, why do you think so: _____
23. Would you be willing to buy or rent a new flat in GEC more location? Yes – Buy Yes – Rent No
24. If yes/no, why: _____
25. What is an ideal size & type for the new apartment in GEC More location: <1000 sq. ft. 1000-1500 sq. ft. 1500-1700 sq. ft. 1800 -2000 sq. ft. 2000-2500 sq. ft. >2500 sq. ft.
26. What is an acceptable price band you will be willing to pay for purchasing a flat in GEC More location: <40 lacs BDT 40 – 50 lacs BDT 50 -60 lacs BDT 60 -75lacs BDT 75 – 80 lacs BDT 80 – 90 lacs BDT 90- 100 lacs BDT >100 lacs BDT
27. What is an acceptable rental price band you will be willing to pay for renting an apartment in GEC More location: <20,000 taka per month 20,000 - 25,000 taka per month 25,000 - 30,000 taka per month 30,000 - 35,000 taka per month 35,000 - 40,000 taka per month >40,000 taka per month
28. Would you be willing to pay a premium to stay in GEC More? Yes No

29. What are the amenities or facilities for which you will be willing to pay a premium?
30. What is the maximum %age premium over market price you would prefer paying for an accommodation in GEC More? Below 5% 5%- 10% 10- 15% 15- 20% 20% or more

Survey Questionnaire – 2

Commercial - Willingness to Pay Survey No ____

Respondent Details

1. Name of the respondent _____ Age _____ Family size _____ Sex: Male Female
2. Annual Income (BDT) _____
3. Type of Commercial Space Owner: Commercial Shop Owner Commercial Office Space Owner

Respondent Commercial Space Details

4. Ownership Status of Commercial Premises: Owned Rented
5. Premises Mix Type: Stand Alone Shop/Office Space Within Commercial Tower/Shopping Complex
6. Location of Commercial Premises Within City: _____
7. Average Size of Commercial Shop Space acquired: <100 sq. ft. 100 – 200 sq. ft. 200 – 300 sq. ft. 300 – 500 sq. ft. 500 – 1000 sq. ft. 1000 – 1500 sq. ft. 1500 – 2000 sq. ft. >2000 sq. ft.
8. Purchase Price Paid for Commercial Shop acquired: <10,000 taka/sq. ft. 10,000 – 15,000 taka/sq. ft. 15,000 – 20,000 taka/sq. ft. 20,000 – 25,000 taka/sq. ft. 25,000 – 30,000 taka/sq. ft. 30,000 – 35,000 taka/sq. ft. 35,000 – 40,000 taka/sq. ft. > 40,000 taka/sq. ft.
9. Rental Paid for Commercial Shop acquired: <10,000 taka p.m. 10,000 – 15,000 taka p.m. 15,000 – 20,000 taka p.m. 20,000 – 25,000 taka p.m. 25,000 – 30,000 taka p.m. 30,000 – 35,000 taka p.m. 35,000 – 40,000 taka p.m. > 40,000 taka p.m.
10. Size of Commercial Office Space: <1000 sq. ft. 1,000 – 2,000 sq. ft. 2,000 – 3,000 sq. ft. 3,000 – 5,000 sq. ft. 5,000 – 7,500 sq. ft. 7,500 – 10,000 sq. ft. >10,000 sq. ft.
11. Purchase Price Paid for Commercial office space acquired: <5,000 taka/sq. ft. 5,000 -10,000 taka/sq. ft. 10,000 – 15,000 taka/sq. ft. 15,000 – 20,000 taka/sq. ft. 20,000 – 25,000 taka/sq. ft. 25,000 – 30,000 taka/sq. ft. 30,000 – 35,000 taka/sq. ft. 35,000 – 40,000 taka/sq. ft. > 40,000 taka/sq. ft.
12. Rental Paid for Commercial office space acquired: <10,000 taka p.m. 10,000 – 15,000 taka p.m. 15,000 – 20,000 taka p.m. 20,000 – 25,000 taka p.m. 25,000 – 30,000 taka p.m. 30,000 – 35,000 taka p.m. 35,000 – 40,000 taka p.m. > 40,000 taka p.m.

Respondent Preference

13. Which type of commercial space do you prefer: Local/Govt. Shopping Complex/ Office Tower
Private Developer Shopping Complex/Office Tower
14. Why do you prefer the chosen type: Better Construction Quality Brand value Better Size & Layout Affordable Pricing Better Amenities (*Parking, Security, Lifts, Power Maintenance, Power Back Up*) Better Footfalls Better Re-sale value Perceived Safety Features Better Loans & Payment Schemes Plans
15. What are the reasons for choosing your current location for acquiring the shop or commercial office:
Location (*Proximity to Residential & Commercial centres*) Developer Brand Availability of Required Size Competitive Price Amenities offered (*CCTV Security, Parking, Power Back Up*) Any other reason
16. How would you rate the above preference factors (1 – Low, 6 – Medium, 9 – High)
17. How would you rate the following Amenities in order of importance (1 – Low, 6 – Medium, 9 – High):
 CCTV/ Guard/ Security Parking Power Supply & Back Up Water Supply Back up/Harvesting
 Piped Gas Supply Local Shops Club house Parks & Surrounding Green Area Lift & Centralized Maintenance Energy Efficient/Green Building Any other amenities
18. Would you pay a premium if the commercial office/shop is located: In proximity to Residential Colony
 In proximity to Other Business/Office Complex In proximity to Other Shopping Complex Nearby Recreational Facilities In proximity to Social Facilities (*such as school, college, university*) Nearby Hotels Nearby Recreational Facilities Part of established/operational commercial complex/tower
 Part of established/operational shopping plaza

Respondents New Purchase Behaviour

19. Are you evaluating acquiring a new shop or commercial office space? Yes - Shop Yes – Office Space No
20. Would you prefer to purchase the space or rent space? Buy Rent
21. What will be the main source of information considered by you when making the purchase choice: Developer Brochure Newspaper Advertisement TV/ Radio Advertisement Info from Sales Representatives Exhibitions and Property Fairs Word of Mouth Recommendations/ Personal References

Respondents Perception for GEC More

22. How would you rate the following locations on attractiveness as “prime commercial business location”
(1- Low Attractiveness, 6 – Medium Attractiveness, 9 – High Attractiveness)

- Agrabad Nasirabad/GEC More Khulshi Jamal Khan Road Golpahar More New Market
23. Do you think GEC More is a good location for a new shop or office space? Yes No
24. If yes/no, why so: _____
25. Would you be willing to buy or rent a new shop or office space in GEC more location? Yes – Buy
Yes – Rent No
26. If yes/no, why: _____
27. What **size range of shop** would you consider ideal for purchase? <100 sq. ft. 100 – 200 sq. ft.
200 – 300 sq. ft. 300 – 500 sq. ft. 500 – 1,000 sq. ft. 1,000 – 1500 sq. ft. 1,500 – 2,000 sq. ft.
 >2,000 sq. ft.
28. What is an **acceptable price band for purchasing a new shop** space of this size? <10,000 taka/sq. ft.
 10,000 – 15,000 taka/sq. ft. 15,000 – 20,000 taka/sq. ft. 20,000 – 25,000 taka/sq. ft. 25,000 – 30,000 taka/sq. ft. 30,000 – 35,000 taka/sq. ft. 35,000 – 40,000 taka/sq. ft. > 40,000 taka/sq. ft.
29. What **size range of commercial office space** would you consider ideal for purchase? <1,000 sq. ft.
 1,000 – 2,000 sq. ft. 2,000 – 3,000 sq. ft. 3,000 – 5,000 sq. ft. 5,000 – 7,500 sq. ft. 7,500 – 10,000 sq. ft. >10,000 sq. ft.
30. What is an **acceptable price band for purchasing a new commercial office space** of this size?
<5,000 taka/sq. ft. 5,000 -10,000 taka/sq. ft. 10,000 – 15,000 taka/sq. ft. 15,000 – 20,000 taka/sq. ft.
 20,000 – 25,000 taka/sq. ft. 25,000 – 30,000 taka/sq. ft. 30,000 – 35,000 taka/sq. ft. 35,000 – 40,000 taka/sq. ft. > 40,000 taka/sq. ft.
31. Would you be willing to pay a premium to purchase or rent a shop or commercial space in GEC More location? Yes No
32. What are the amenities or facilities for which you will be willing to pay a premium?
33. What is the maximum %age premium over market price you will be ready to pay for shop or commercial space in GEC More? Below 5% 5%- 10% 10- 15% 15- 20% 20% or more

13.6 Minutes of Meeting with NHA and PPP Authority

Minutes

Minutes of meeting –Multi-storied Commercial cum Residential Complex with modern amenities at Nasirabad, Chittagong

Venue	Grihayan Bhaban, National Housing Authority Office, Segunbagicha
Date	08 May 2017
In attendance	Mr. Khandaker Akhtaruzzaman, Chairman, National Housing Authority Mr. S. A. M. Fazlul Kabir, Member (E&C), National Housing Authority Ms. Salwa Zaman, Sub-divisional Engineer (Civil), National Housing Authority Mr. Faruque Ahmed, Director General, PPP Authority Mr. M. Murshed Haider, Consultant, PPP Authority Mr. Sumouleendra Ghosh, Director, KPMG Mr. Ankush Kumar Chakraborty, Manager, KPMG

Item Agenda items

Discussions on the Feasibility Study, Project Structure and Bid Parameters

1. This meeting was held to finalize the Project Structure and Bid Parameters of the Real Estate Project in GEC More Chittagong on the 8.5 acres of land of National Housing Authority.
2. The Final Feasibility Report in presentation format had already been submitted by KPMG to National Housing Authority and PPP Authority, Bangladesh. This final feasibility report was prepared based on the meetings held during 14-22 March 2017 between the Hon'ble Minister of Housing and Public Works, National Housing Authority, Bangladesh, PPP Authority, Bangladesh and KPMG and decisions finalized therein.
3. The KPMG team presented the findings of the Final Feasibility Report to National Housing Authority and requested their decisions on 3-4 important issues:
 - Finalization of the concept plan of the project (as provided in Annexure) –
 - 1.07 acres allocated to NHA at the northern side of the project adjoining

Minutes of meeting - ESCL Inception Report
08 May 2017

Item Agenda items

Bata Goli three buildings/ towers of at least 15 floors each, out of which, one tower near the entrance will be developed for commercial purpose (including office space for NHA) and the other two towers will be developed for residential purpose. The towers will be developed by the private developer as per specifications provided by NHA.

- The mosque, which is part of the project site will be redeveloped by the private developer at his cost as a three-storied mosque on the same area where the current mosque stands. Area allocated for this would be around 0.23 acres (same as the existing size).
- The balance area (around 7.2 acres) will be allocated to the private developer for development of multi-storied commercial and residential complex. This will be located towards the southern side of the plot (i.e. frontage of the plot). NHA will grant right to the private developer to develop this balance area, which may be in the form of long-term lease for 99 years. Some of the key features for such development should be as follows:
 - A strip of 20 feet width along the front boundary (towards south of the plot) would be used for beautification and landscaping at the private developer's cost. This strip would be a no-development zone.
 - The mix of commercial and residential built-up area can be left to the discretion or judgment of the private developer without any stipulations from the Ministry or NHA.
 - The commercial tower/s shall comprise at least 20 floors, whereas residential towers shall comprise at least 25 floors.
- Finalization of the Project Structure – Upfront Premium and Revenue Share from sale of real estate in Developer's area or Upfront Premium and Share of Built-up area in Developer's area.
- The Bidding Parameter of Project – Upfront Premium or Share of Revenue/ Built-up area

4. The KPMG team explained that till a 15% share of the revenue of built-up area, the returns from the project and those accruing to the private developer are reasonable. Further, the KPMG team provided the following return scenarios for various share of revenues:

Revenue Share	Project IRR	Equity IRR
10%	17%	26%
15%	14%	20%
20%	11%	10%
25%	7%	-

Minutes of meeting - BSCL Inception Report
08 May 2017

Item	Agenda items
5.	NHA observed that per unit revenue assumption made by KPMG in the financial model is on lower side, and the same may be increased by 10% across the types/ categories. Accordingly, KPMG carried out a sensitivity analysis and presented to NHA.
6.	The National Housing Authority decided on the following: <ul style="list-style-type: none"> • The Concept Plan prepared by KPMG is accepted • The private developer will have to provide share of revenues accruing to him from sale of real estate in his area of 7.2 acres to NHA • Additionally, the private developer will have to pay an upfront premium of BDT 50 Crore to NHA • Revenue assumption made by KPMG in the financial model to be increased by 10% across the categories • The share of revenues will be a minimum of 20% and this shall be the Bidding Parameter On the basis of these decisions, the consultant - KPMG was asked to submit the final feasibility study report in document format and proceed to the next phase, i.e. submission of IFB document.
7.	The KPMG team thanked the Chairman and others from NHA for the discussion and the meeting ended.

(Mr. Sumouleendra Ghosh)

Director

KPMG Advisory Services
Pvt. Ltd.

(Mr. Faruque Ahmed)

Director General

PPP Authority

(Mr. S. A. M. Fazlul Kabir)

Member (E&C)

National Housing Authority

(Mr. Khandaker Akhtarszaman)

Chairman

National Housing Authority

13.7 Financial Statements: Base Case

Profit & Loss Statement

(All Figures in BDT million)

Parameter	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5	Yr. 6	Yr. 7	Yr. 8	Yr. 9	Yr. 10	Yr. 11	Yr. 12	Yr. 13	Yr. 14	Yr. 15
EBITDA	725	1,213	6,210	8,141	10,193	9,911	3,107	22	26	29	33	33	34	35	35
Depreciation	-	-	-	-	-	17	17	17	17	17	17	17	17	17	17
Earnings before Interest & Taxes (EBIT)	725	1,213	6,210	8,141	10,193	9,894	3,090	6	9	12	16	16	17	18	19
Interest Payments	32	237	506	629	704	640	397	198	66	-	-	-	-	-	-
Earnings Before Tax (EBT)	693	976	5,704	7,512	9,489	9,254	2,694	(193)	(57)	12	16	16	17	18	19
Taxes	208	293	1711	2254	2847	2781	793	-	-	-	-	-	-	-	2
Profit After Tax (PAT)	485	683	3,993	5,259	6,643	6,473	1,901	(193)	(57)	12	16	16	17	18	17

Cash Flow Statement

(All Figures in BDT million)

Parameter	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5	Yr. 6	Yr. 7	Yr. 8	Yr. 9	Yr. 10	Yr. 11	Yr. 12	Yr. 13	Yr. 14	Yr. 15
Sources															
Promoters Equity	4,724	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Term Loan	532	2,888	2,689	2,113	2,449	350	-	-	-	-	-	-	-	-	-
PAT	485	683	3,993	5,259	6,643	6,473	1,901	(193)	(57)	12	16	16	17	18	17
Depreciation	-	-	-	-	-	17	17	17	17	17	17	17	17	17	17
Total Sources	5,741	3,571	6,682	7,372	9,092	6,839	1,917	(176)	(41)	29	33	33	34	35	33
Uses															
Capital Expenditure	5,256	2,888	2,689	2,113	2,449	350	-	-	-	-	-	-	-	-	-
Debt Repayment	-	-	1,102	1,653	1,653	2,204	2,204	1,102	1,102	-	-	-	-	-	-
Total Uses	5,256	2,888	3,791	3,766	4,102	2,554	2,204	1,102	1,102	-	-	-	-	-	-
	485	683	2,891	3,605	4,989	4,285	(287)	(1,278)	(1,143)	29	33	33	34	35	33

Balance Sheet

(All Figures in BDT million)

	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5	Yr. 6	Yr. 7	Yr. 8	Yr. 9	Yr. 10	Yr. 11	Yr. 12	Yr. 13	Yr. 14	Yr. 15
Assets															
Fixed Assets															
Gross Fixed Assets	5,256	8,144	10,833	12,946	15,396	15,745	15,745	15,745	15,745	15,745	15,745	15,745	15,745	15,745	15,745
Acc. Depreciation	-	-	-	-	-	17	33	50	67	84	100	117	134	151	167
Net Fixed Assets	5,256	8,144	10,833	12,946	15,396	15,728	15,712	15,695	15,678	15,662	15,645	15,628	15,611	15,595	15,578
Cash & Bank balance	485	1,168	4,059	7,664	12,653	16,938	16,651	15,373	14,230	14,259	14,292	14,325	14,359	14,393	14,427
	5,741	9,312	14,892	20,610	28,049	32,667	32,363	31,068	29,909	29,921	29,937	29,953	29,970	29,988	30,005
Liabilities															
Term Loan	532	3,421	5,008	5,467	6,263	4,409	2,204	1,102	-	-	-	-	-	-	-
Promoters Equity	4,724	4,724	4,724	4,724	4,724	4,724	4,724	4,724	4,724	4,724	4,724	4,724	4,724	4,724	4,724
General Reserve	485	1,168	5,161	10,419	17,062	23,534	25,435	25,242	25,185	25,197	25,213	25,230	25,247	25,265	25,281
	5,741	9,312	14,892	20,610	28,049	32,667	32,363	31,068	29,909	29,921	29,937	29,953	29,970	29,988	30,005

13.8 Financial Statements: Selected PPP Structure

Profit & Loss Statement

(All Figures in BDT million)

Parameter	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5	Yr. 6	Yr. 7	Yr. 8	Yr. 9	Yr. 10	Yr. 11	Yr. 12	Yr. 13	Yr. 14	Yr. 15
EBITDA	569	952	4,875	6,391	8,002	7,774	2,432	9	10	12	13	13	14	14	14
Depreciation	-	-	-	-	-	17	17	17	17	17	17	17	17	17	17
Earnings before Interest & Taxes (EBIT)	569	952	4,875	6,391	8,002	7,757	2,415	(8)	(6)	(5)	(4)	(3)	(3)	(3)	(3)
Interest Payments	62	292	552	669	737	665	412	206	69	-	-	-	-	-	-
Earnings Before Tax (EBT)	506	660	4,323	5,722	7,265	7,092	2,004	(214)	(75)	(5)	(4)	(3)	(3)	(3)	(3)
Taxes	152	198	1297	1717	2180	2133	586	-	-	-	-	-	-	-	-
Profit After Tax (PAT)	355	462	3,026	4,005	5,086	4,959	1,418	(214)	(75)	(5)	(4)	(3)	(3)	(3)	(3)

Cash Flow Statement

(All Figures in BDT million)

Parameter	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5	Yr. 6	Yr. 7	Yr. 8	Yr. 9	Yr. 10	Yr. 11	Yr. 12	Yr. 13	Yr. 14	Yr. 15
Sources															
Promoters Equity	4,749	150	-	-	-	-	-	-	-	-	-	-	-	-	-
Term Loan	1,037	2,793	2,689	2,113	2,449	350	-	-	-	-	-	-	-	-	-
PAT	355	462	3,026	4,005	5,086	4,959	1,418	(214)	(75)	(5)	(4)	(3)	(3)	(3)	(3)
Depreciation	-	-	-	-	-	17	17	17	17	17	17	17	17	17	17
Total Sources	6,141	3,405	5,715	6,119	7,535	5,326	1,434	(197)	(58)	12	13	13	14	14	14
Uses															
Capital Expenditure	5,786	2,943	2,689	2,113	2,449	350	-	-	-	-	-	-	-	-	-
Debt Repayment	-	-	1,143	1,715	1,715	2,286	2,286	1,143	1,143	-	-	-	-	-	-
Total Uses	5,786	2,943	3,832	3,828	4,164	2,636	2,286	1,143	1,143	-	-	-	-	-	-

Balance Sheet

(All Figures in BDT million)

	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5	Yr. 6	Yr. 7	Yr. 8	Yr. 9	Yr. 10	Yr. 11	Yr. 12	Yr. 13	Yr. 14	Yr. 15
Assets															
Fixed Assets															
Gross Fixed Assets	5,786	8,729	11,419	13,532	15,981	16,330	16,330	16,330	16,330	16,330	16,330	16,330	16,330	16,330	16,330
Acc. Depreciation	-	-	-	-	-	17	33	50	67	84	100	117	134	151	167
Net Fixed Assets	5,786	8,729	11,419	13,532	15,981	16,314	16,297	16,280	16,263	16,247	16,230	16,213	16,196	16,180	16,163
Cash & Bank balance	355	816	2,699	4,990	8,361	11,051	10,199	8,859	7,658	7,670	7,683	7,696	7,709	7,723	7,737
Total Assets	6,141	9,546	14,118	18,522	24,342	27,365	26,496	25,140	23,921	23,916	23,913	23,909	23,906	23,903	23,900
Liabilities															
Term Loan	1,037	3,830	5,376	5,775	6,509	4,572	2,286	1,143	-	-	-	-	-	-	-
Promoters Equity	4,749	4,899	4,899	4,899	4,899	4,899	4,899	4,899	4,899	4,899	4,899	4,899	4,899	4,899	4,899
General Reserve	355	816	3,843	7,848	12,934	17,893	19,311	19,097	19,022	19,017	19,013	19,010	19,007	19,004	19,001
Total Liabilities	6,141	9,546	14,118	18,522	24,342	27,365	26,496	25,140	23,921	23,916	23,913	23,909	23,906	23,903	23,900

13.9 Geo-technical Investigation

**GEOTECHNICAL INVESTIGATION
FOR
THE CONSTRUCTION OF MULTI-STORIED COMMERCIAL CUM
APARTMENT COMPLEX WITH MODERN AMENITIES AT
NASIRABAD, CHITTAGONG, BANGLADESH.**

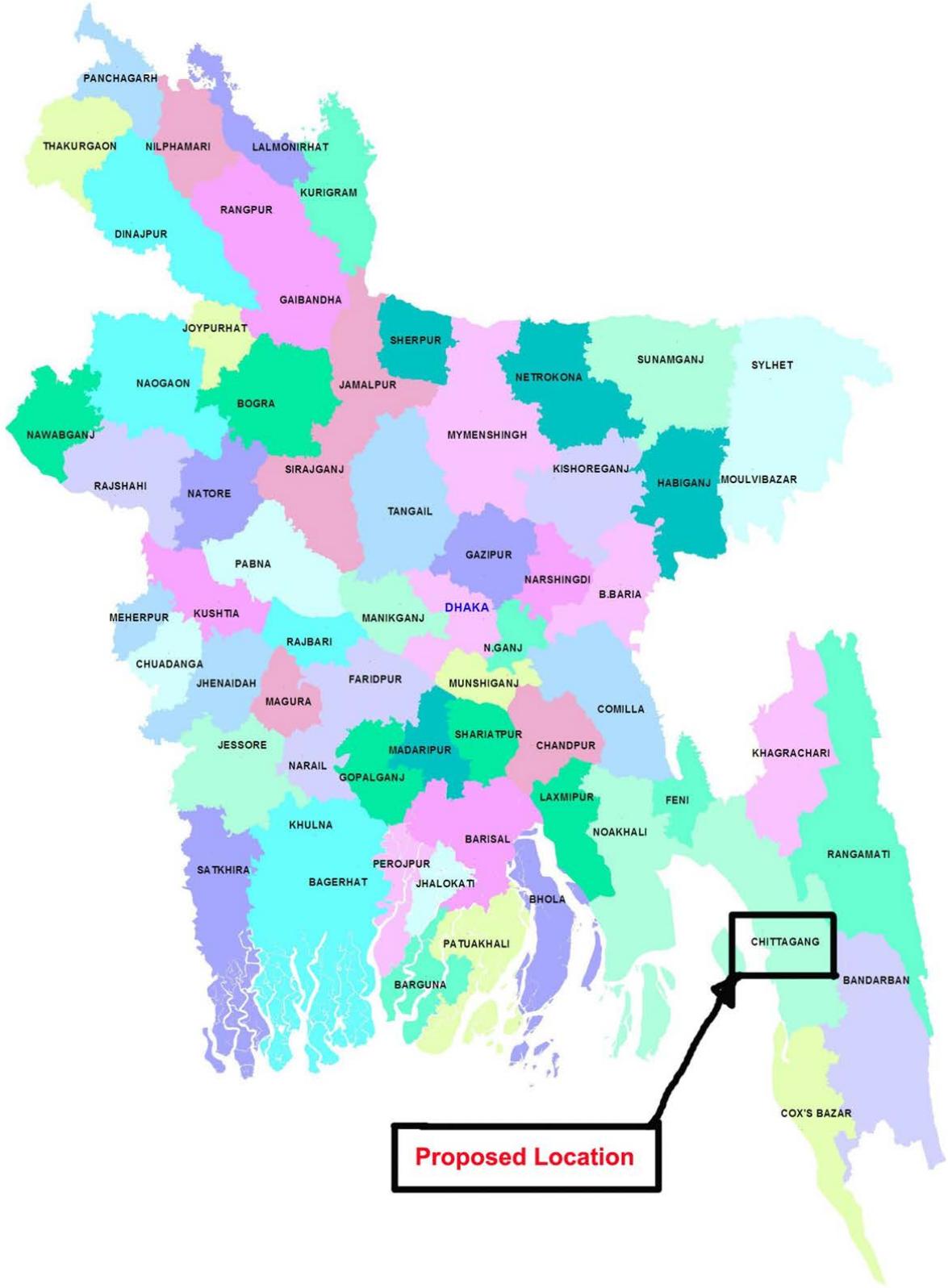


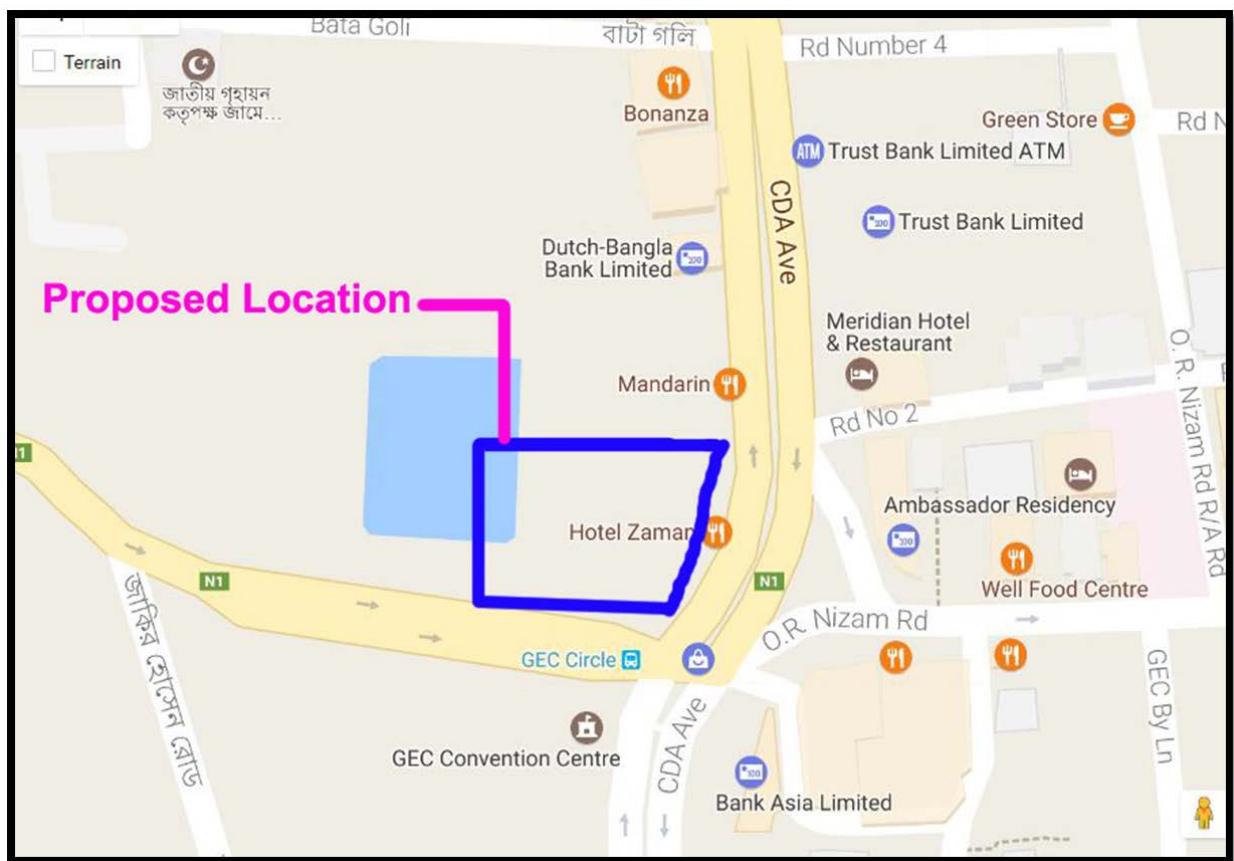
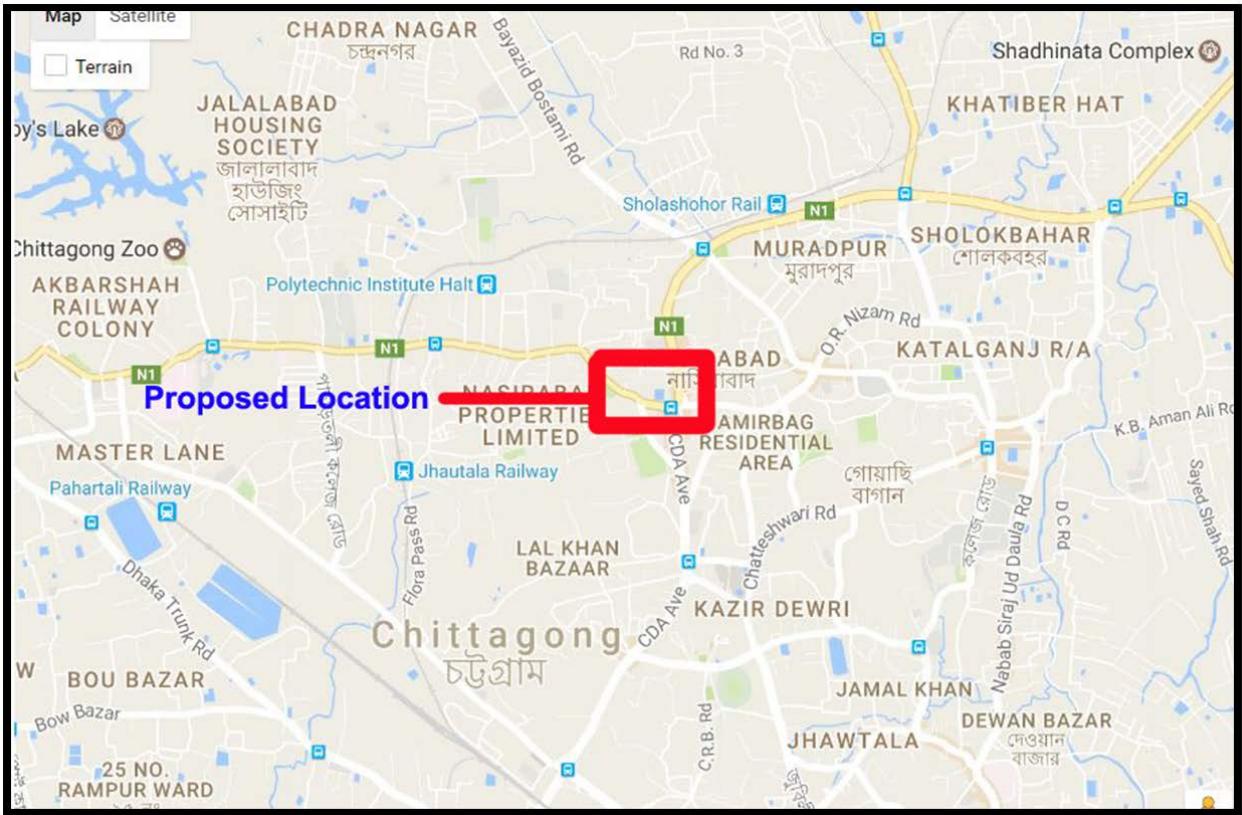
FEBRUARY TO MARCH-2017

CLIENT:

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Dhaka-1216**

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- SITE PLAN WITH LOCATION OF BORE HOLES
- BORE LOGS
- LABORATORY TEST RESULTS
- FIELD BORE LOGS

Chapter-1

1.1 GENERAL SCOPE

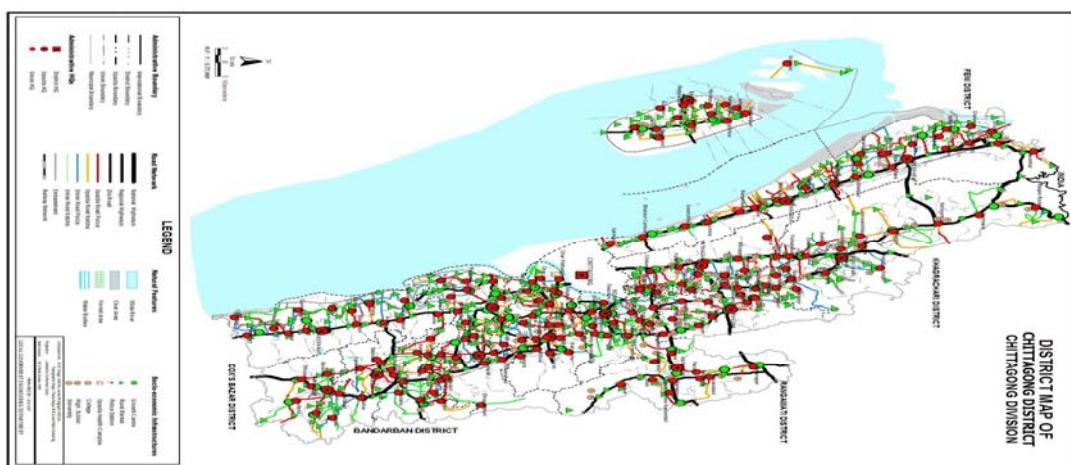
The sub-soil investigation at site is must to obtain information required in safe and economic design and construction of structures. It provides the designer required data regarding **mechanical, physical, geotechnical and engineering** properties of the sub-soil formation upon which the proposed structure/ structures will be built, the exploration is equally necessary for analyzing the safety, or cause of failure of existing work, for selecting construction materials and deciding upon construction method to be applied. A timely and intelligently planned site investigation is, the prerequisite to the **safe, efficient and economic** design and construction of structure. This report presents the specific and detailed information regarding the sub-soil profile encountered at the site for the construction of the **Proposed Multi-storied Commercial cum Apartment Complex, Nasirabad, Chittagong.**

1.2 INTRODUCTION

Sub-soil investigation work has been done in **February to March–2017** for the construction of **Multi-storied Commercial cum Apartment Complex with Modern Amenities at Nasirabad, Chittagong, Bangladesh.** Because for any civil engineering structure; reliable and accurate sub-soil investigation is essential. Safety of the superstructure as well as the cost of foundation depend much on the sub- soil investigation. This report presents details of the sub-soil investigation, and preliminary design/information regarding the type of foundation (proposed for building) etc. The sub-soil investigation work has been done by **Suchana Engineers Limited, 272/A West Agargaon, Dhaka -1207.**

1.3 DESCRIPTION OF THE SITE

As described earlier the site is at **Nasirabad, Chittagong.** To keep record of the elevation of the soil surface/Road level (at Bore holes locations) all depends are measured from the existing soil surface. The existing soil surface is not at road/land level; here the **R.L** and **Coordinates is the REFERENCE LEVEL**



1.4 SITE RECONNISSANCE

Chittagong is very different in terms of topography. It is situated within $22^{\circ}14'$ and $22^{\circ}24'$ N Latitude and between $91^{\circ}46'$ and $91^{\circ}53'$ E Longitude and on the Right Bank of the river Karnafuli. Due to its geographical location, Chittagong city suffers from numerous natural disasters like landslide, water logging, cyclone, flood etc. But at present landslides are the most burning issues in respect of Chittagong City Corporation (CCC) area. Because Chittagong hills are degrading by different anthropogenic stress such as hill cutting for construction, sand and clay mining purpose, increasing settlement in foothills. This eastern offshoot of the Himalayas, turning south and southeast, passes through Assam and Tripura State and enters Chittagong across the river Feni. The range loses height as it approaches Chittagong town and breaks up into small hillocks scattered all over the town. This range appears again on the southern bank of the Karnafuli river and extends from one end of the district to the other. Chandranath or Sitakunda is the highest peak in the district, with an altitude of 1152 feet above mean sea level. Nangarkhana to the north of Chittagong town is 289 feet high. In the town itself, there is a peak known as Batali Hill, which used to be 280 feet high and was the highest point in the town. There was a light post at the top of Batali Hill for the guidance of vessels far away in the sea. This famous hill, like other beautiful hills and hillocks in the city of Chittagong, is being gradually levelled up and reduced in height for the construction of houses.

1.5 NUMBER OF BORING, SPT AND UNDISTURBED SAMPLING

Description of the number of bore holes and number of samples etc. are the following.

Number of Bore- Holes ----- 08 Nos.

Undisturbed samples could be collected-----05 Nos.

1.6 EQUIPMENTS, METHOD OF BORING & SPT USING THE WORK

For the boring work own Boring/SPT set (with Tripod stand, Sampling Tube, Spoon, etc) of the firm has been used manually. Wash Boring method was used for advancing the Bore hole. A simple procedure for making relatively deep holes in soil deposits is wash boring. This is a most common method for advancing test hole.

SPT—The tests consist of driving a **SPILT SPOON SAMPLER** having **50.80 mm (2 in.)** outer diameter and **35 mm (1.375 in)** inner diameter. The spilt spoon is driven **450mm (18 in)** into the ground by means of a **63.5 kg (140 lbs)** hammer falling freely from a height of **750 mm (30 in)**

into the drill rod. The number of hammer blows for **150 mm (6 in)** of penetration of the sampler is recorded. The total number of blows required to drive the sampler for the **2nd 15 cm (6 in)** and **3rd 15 cm (6 in)** of penetration is called the **Standard Penetration Resistance**, which is represented by 'N'. The **1st 15 cm (6 in)** penetration of the sampler is discarded as seating drive.

Note: Thickness and Angle Shape of the edge etc are as per ASTM

The standard penetration tests were performed at **1.00 m (3.28 ft.)** Intervals in the all bores up to the final depth. The depth-wise SPT values have been presented in the form of curves in the respective Bore Logs.

1.7 LABORATORY TESTS REQUIRED AND THOSE ACTUALLY PERFORMED

For economic and safe foundation designs; we need reliable laboratory testing .Undisturbed samples should be of proper quality also. Less tests should be done but with reliability. During boring, the SPT have been done and recorded. Disturbed soil has been visually classified to identify its plasticity, soil type, etc.

The following laboratory tests have been performed:

- Grain size analysis test
- Direct shear test
- Unconfined compression test
- Hydrometer test (Combined)
- Specific gravity test
- Atterberg limit test
- Natural moisture content test
- Density test

1.8 SIZE OF DIFFERENT TYPES OF SOIL PARTICLE

A soil may contain various size of grains ranging from large boulder, gravel, sand and size of silt and clay. This is given below.

Boulder	Greater than 75 mm (3 inch)
Gravel	75 mm(3 inch) to greater than 4.75 mm.
Sand	4.75 mm to greater than 0.075 mm
Silt & clay	Less than 0.075 mm

1.9 PERCENTAGE OF DIFFERENT SIZE OF PARTICLES

The percentage of Gravel, Sand, and Fines (silt & clay) may be stated in the terms of indicating a range of percentage as follows.

Trace	1% to 10%
Some	10% to 25 %
Adjective (sandy, clayey)	25% to 35%
And	35% to 50%

2.0 CONSISTENCY OF COHESIVE SOIL

Standard penetration test (**SPT**) data or ‘N’ value is available for a particular soil layer, then consistency can be defined as the following.

Consistency	N - Value
Very-Soft	0 to 2
Soft	2 to 4
Medium Stiff	4 to 8
Stiff	8 to 16
Very Stiff	16 to 30
Hard	> 30

2.1 COMPACTNESS OF NON COHESIVE LAYERS

For non cohesive soil the compactness can be defined as the following if the n-values are available.

Compactness	N - Value
Very loose	0 to 4
Loose	4 to 10
Medium dense	10 to 30
Dense	30 to 50
Very Dense	Over 50

2.2 RECORDING OF GROUND WATER TABLE

The ground water table is determined by measuring to the stabilized water level in the bore hole after a suitable time lapse- often 24 to 48 hour later. In soils with high permeability, such as sands and gravel, 24 hour is adequate for the water level to stabilize unless the hole has been somewhat sealed with drilling mud. In soil with low permeability such as silt, fine silty sands and clays, it may take several days to several weeks for the GWT to stabilize.

2.3 DISCUSSION ON SCOUR-DEPTH DETERMINATION

For designing of a bridge/water-structure in alluvial stream; we need to know the Silt-Factor in order to calculate the Scour-Depth (there are several formulas). Silt-Factor $f = 1.76\sqrt{d_{50}}$. Here d_{50} is the mean diameter or diameter of particles corresponding to 50% finer in the grain-size analysis curve. If more less than 50% of a soil retained on the No. 200 (0.075 mm) sieve then it is possible to determine d_{50} by sieve analysis. But if the stream is alluvial and more than 50% soil is passing the No. 200 sieve then hydrometer test may be performed for d_{50} or mean diameter determination in order to calculate the Silt Factor (for scour-depth determination). Alternatively the following values may be used also.

Soil Type		Mean Diameter (d_{50}) in mm	Silt-factor (f)
Silt	Very Fine	0.081	0.50
	Fine	0.120	0.60
	Medium	0.233	0.85
	Standard	0.323	1.00
Sand	Medium	0.505	1.25
	Coarse	0.725	1.50

2.4 CO-ORDINATES OF BORE HOLES

The field work executed of different locations of various co-ordinates. The list of co-ordinates of field work is as follows.

Bore Holes	Co-ordinates		Elevation (m)	Remarks
	Northing	Easting		
BH-1	381258.576	2471391.151	13.01	TBM-1, R.L= 14.215m
BH- 2	381235.334	2471424.522	12.72	
BH- 3	381348.097	2471502.895	10.01	
BH- 4	381438.968	2471487.155	11.52	
BH- 5	381363.008	2471476.770	10.50	
BH- 6	381436.451	2471427.478	13.50	
BH- 7	381331.430	3471417.548	13.49	
BH- 8	381448.011	2471362.934	14.50	

2.3 CORRECTION OF STANDARD PENITRATION TEST (SPT) (Ref. Foundation Engineering Hand Book by Robert W. Deen)

Factor that can affect the SPT: The measured N value can be influenced by the type of soil, such as the amount of fines and gravel size particles in the soil. Saturated sands that contains appreciable fine soil particles, such silty or clayey sands, could be abnormally high N values if they have a tendency to dilate or abnormally low N values if they have a tendency to contract during the undrained shear condition associated with driving the SPT sampler tip or barrel the driving resistance (hence increase N value) by becoming stuck in the SPT sampler tip or barrel.

A factor that could influence the measured N value is ground water. It is important to maintain a level of water in the borehole at the above the in situ ground water level. This is to prevent ground water from rushing into the bottom of the borehole, which could loosen the sand and result in low measured N values.

Besides soil and ground water conditions, there are different testing factors that can influence the accuracy of the SPT reading. For example, the hammer efficiency, borehole diameter and the rod length could influence the measured N value. The following equation is used to compensate for these testing factors by multiplying together four factors as follows (Skempton, 1986)

$$N_{60} = C_b C_r C_s N E_m / 0.60$$

Where

N_{60} = standard penetration test N value corrected for field testing procedure

C_b = borehole diameter correction ($C_b = 1.00$ for borehole of 65 to 115mm,

1.05 for 150mm diameter and 1.15 for 200 mm diameter hole)

C_r = rod length correction ($C_r = 0.75$ for up to 4m of drill rods, 0.85 for 4 to 6m of drill rods, 0.95 for 6 to 10 m of drill rods, and 1.00 for drill rods excess of 10m)

C_s = Standard sampler { $C_s = 1.00$, sampler without linear (not recommended),

1.20}

N = measured standard penetration test N value

E_m = efficiency of the SPT hammer in percent

Chapter-2

3.1 EVALUATION OF BEARING CAPACITY EQUATIONS

A) Shallow Foundation:

Bearing Capacity by Terzaghi's Equation

[Foundation Analysis and Design by Joheph E. Bowles (4th edition)]
For Strip and Square footing (Page-188)

$$q_{ult} = C N_c S_c + q N_q + 0.5 \gamma B N \gamma S_y$$

B) Mat Foundation

(By N-Value for 50mm settlement, page - 438)

$$q_a = (N55 * Kd) F2$$

[F2= 0.08 for SI unit]

[Kd = 1+0.33D/B ≤ 1.33]

For non cohesive soil

[Principle of Geotechnical Engineering by Braja M. Das (6th edition)]

(Mat foundation over a sand deposited for 25mm settlement, page - 153)

$$\text{Meyerhof Equation : } q_{net(all)} = 11.98 N_{60} [1 + 0.33 D_f / B] [S_c / 25] \leq 15.93 N_{60} \{S_c (\text{mm}) / 25\}$$

For cohesive soil

[Soil mechanics and Foundation by Dr. B.c Punmia (16th edition)]

(Mat foundation over a clay deposited for 50mm settlement, page - 715)

$$\text{Terzaghi's Equation: } q_{nt} = 5.7 [1 + 0.3 B / L] c$$

$$\text{Skempton's Equation: } q_{nt} = 5 [1 + 0.2 D / B] [1 + 0.2 B / L] c$$

[D/B ≤ 2.5 or the factor 5[1+0.2D/B] don't exceed 7.5

C) Deep Foundation

Bearing Capacity by Meyerhof's Equation

[Foundation Analysis and Design by Joheph E. bowles (4th edition), Page-743)

Ultimate End Bearing (P_{PU})

$$P_{PU} = A_p \times 40 \times N \times \{L_b / B\} \leq A_p (400 \times N) \text{ in KN}$$

A_p = Area of pile tip

N = Av. of N – value of $8B$ above to $3B$ below of pile tip

L_b / B = Depth ratio of point into point bearing strata

Ultimate Skin Resistance

The skin resistant is calculated below. **Vizayvergiya & Focht (λ method)** is used calculation.

$$\text{For non cohesive, } f_s = \lambda \times N \text{ (in Kpa)}$$

(where $\lambda = 1.0$ for pile with small volume displacement)

$$\text{For cohesive soil, } f_s = \lambda (q_u^- + 2s_u) \text{ in Kpa}$$

(where value of λ from Fig. 16-16 (Foundation Analysis & Design by Joseph E. Bowles)

[By Empirical equation, $C = S_u = q_u / 2 = (0.25 * N / 2 * 1000)$ (in Psf) in absence of elaborate data may be taken equal to $q_u / 2$]

Terzaghi's equation for shallow foundation

$$q_{ult} = C N_c + q N_q + 0.5 \gamma B N_y \text{ for Strip footing}$$

Type of foundation	BH No	Width of foundation, meter	Depth of foundation, meter	c (kPa) & ϕ degree	Ultimate bearing capacity, kPa	Allowable bearing capacity, kPa	Remarks
Strip	1	2.00	1.50	100	583.05	194.35	
	1	3.00	3.00	110	656.10	218.70	
	2	2.00	1.50	32	607.024	202.34	
	2	3.00	3.00	34	1493.574	497.86	
	3	2.00	1.50	130	754.05	251.35	
	3	3.00	3.00	150	884.10	294.70	
	4	2.00	1.50	110	640.05	213.35	
	4	3.00	3.00	120	713.10	237.70	
	5	2.00	1.50	70	412.05	137.35	
	5	3.00	3.00	80	485.10	161.70	
	6	2.00	1.50	120	697.05	232.35	
	6	3.00	3.00	130	770.10	256.70	
	7	2.00	1.50	120	697.05	232.35	
	7	3.00	3.00	130	770.10	256.70	
	8	2.00	1.50	125	725.55	241.85	
	8	3.00	3.00	135	798.60	266.20	

Note:

- i) c & ϕ value are taken from laoratory test results and comprising/corelation depth basis
- ii) N_{60} =Corrected SPT and Hamer efficiency, 51%
- iii) $\gamma_{sat} = 19.00 \text{ kN/m}^3, 18.00 \text{ kN/m}^3$ & $\gamma_w = 9.80 \text{ kN/m}^3$
- iv) Factor of safety of 3.00

Terzaghi's equation for shallow foundation

$$q_{ult} = CN_c S_c + q N_q + 0.5 \gamma B N_y S_y \text{ for Square footing}$$

Type of foundation	BH No	Size of foundation	Depth of foundation	c (kPa) & φ degree	Ultimate bearing capacity, kPa	Allowable bearing capacity, kPa	Remarks
Square	1	2 x 2	1.5	100	754.05	251.35	
	1	3 x 3	3.0	110	828.15	276.05	
	2	2 x 3	1.5	32	560.91	186.97	
	2	3 x 3	3.0	34	1396.34	465.45	
	3	2 x 2	1.5	130	976.35	325.45	
	3	3 x 3	3.0	150	1124.55	374.85	
	4	2 x 3	1.5	110	828.15	276.05	
	4	3 x 3	3.0	120	902.25	300.75	
	5	2 x 2	1.5	70	531.75	177.25	
	5	3 x 3	3.0	80	605.85	201.95	
	6	2 x 3	1.5	120	902.25	300.75	
	6	3 x 3	3.0	130	976.35	325.45	
	7	2 x 2	1.5	120	902.25	300.75	
	7	3 x 3	3.0	130	976.35	325.45	
	8	2 x 3	1.5	125	939.3	313.10	
	8	3 x 3	3.0	135	1013.4	337.80	

Note:

- i) c & φ value are taken from laoratory test results and comprising/corelation depth basis
- ii) N_{60} =Corrected SPT and Hamer efficiency, 51%
- iii) $\gamma_{sat} = 19.00 \text{ kN/m}^3, 18.00 \text{ kN/m}^3$ & $\gamma_w = 9.80 \text{ kN/m}^3$
- iv) Factor of safety of 3.00

Different equation for shallow foundation of Mat

For N-value

$$q_a = (N_{55} * K_d) F_2$$

For over a sand layer

$$\text{Meyerhof Equation: } q_{\text{net}} = 11.98 N_{60} [1 + 0.33 D_f / B] [S_c / 25] \leq 15.93 N_{60} \{S_c (\text{mm}) / 25\}$$

For over a clay layer

$$\text{Terzaghi's Equation: } q_{\text{net}} = 5.7 [1 + 0.3 B / L] c$$

$$\text{Skempton's Equation: } q_{\text{net}} = 5 [1 + 0.2 D / B] [1 + 0.2 B / L] c$$

Type of footing	Soil Layer	Equation	BH No	Size of foundation, meter	Depth of foundation, meter	N ₆₀ , c (kPa) & φ degree	Allowable bearing capacity, kPa	Remarks
Mat	Clay	N-Value	1	10x15	3	23	316.25	
				15x20	6	36	508.50	
		Terzaghi	1	10x15	3	100	695.4	
				15x20	6	110	764.94	
		Skempton	1	10x15	3	100	600.67	
				15x20	6	110	708.40	
	Sand	N-Value	2	10x15	3	12	165.00	
				15x20	6	32	452.00	
		Meyerhof	2	10x15	3	12	150.88	
				15x20	6	32	396.01	
	Clay	N-Value	3	10x15	3	25	343.75	
				15x20	6	43	607.38	
		Terzaghi	3	10x15	3	130	904.02	
				15x20	6	150	1043.1	
		Skempton	3	10x15	3	130	780.87	
				15x20	6	150	966.00	
	Clay	N-Value	4	10x15	3	18	247.50	
				15x20	6	39	550.88	
		Terzaghi	4	10x15	3	110	764.94	
				15x20	6	120	834.48	
		Skempton	4	10x15	3	110	660.73	
				15x20	6	120	772.80	
	Clay	N-Value	5	10x15	3	14	192.50	
				15x20	6	38	536.75	
		Terzaghi	5	10x15	3	70	486.78	
				15x20	6	80	556.32	
		Skempton	5	10x15	3	70	420.47	
				15x20	6	80	515.20	

Type of footing	Soil Layer	Equation	BH No	Size of foundation, meter	Depth of foundation, meter	N ₆₀ , c (kPa) & φ degree	Allowable bearing capacity, kPa	Remarks
Mat	Clay	N-Value	6	10x15	3	23	316.25	
				15x20	6	37	522.63	
		Terzaghi	6	10x15	3	120	834.48	
				15x20	6	130	904.02	
		Skempton	6	10x15	3	120	720.80	
				15x20	6	130	837.20	
	Clay	N-Value	7	10x15	3	22	302.50	
				15x20	6	37	522.63	
		Terzaghi	7	10x15	3	120	834.48	
				15x20	6	130	904.02	
		Skempton	7	10x15	3	120	720.80	
				15x20	6	130	837.20	
	Clay	N-Value	8	10x15	3	31	426.25	
				15x20	6	43	607.38	
		Terzaghi	8	10x15	3	125	869.25	
				15x20	6	135	938.79	
		Skempton	8	10x15	3	125	750.83	
				15x20	6	135	869.40	

Note:

- i) c & φ value are taken from laoratory test results and comprising/corelation depth basis
- ii) N₆₀=Corrected SPT and Hamer efficiency, 51%

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SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 450mm
Factor of safety =2.50

BH-01

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	$S_u=c_{u0}/2$ in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	5	4	C	0.45	10.8	25.0	2.120	57.93	90.08	148.01	59.20	5.94
3.00	27	23	C	0.40	21.6	134.8	2.120	304.86	486.43	791.29	316.52	31.77
4.50	37	31	S	-	-	-	2.120	371.52	666.58	1038.10	415.24	41.67
6.00	42	36	C	0.30	43.2	209.7	2.120	665.71	756.66	1422.37	568.95	57.10
7.50	50	43	S	-	-	-	2.120	755.79	900.79	1656.58	662.63	66.50
9.00	50	43	S	-	-	-	2.120	845.87	900.79	1746.66	698.66	70.12
10.50	50	43	S	-	-	-	2.120	935.95	900.79	1836.74	734.69	73.73
12.00	50	43	S	-	-	-	2.120	1026.03	900.79	1926.81	770.73	77.35
13.50	50	43	S	-	-	-	2.120	1116.11	900.79	2016.89	806.76	80.97
15.00	50	43	S	-	-	-	2.120	1206.18	900.79	2106.97	842.79	84.58
16.50	50	43	S	-	-	-	2.120	1296.26	900.79	2197.05	878.82	88.20
18.00	50	43	S	-	-	-	2.120	1386.34	900.79	2287.13	914.85	91.82
19.50	50	43	S	-	-	-	2.120	1476.42	900.79	2377.21	950.88	95.43
21.00	50	43	S	-	-	-	2.120	1566.50	900.79	2467.29	986.91	99.05
22.50	50	43	S	-	-	-	2.120	1656.58	900.79	2557.37	1022.95	102.66
24.00	50	43	S	-	-	-	2.120	1746.66	900.79	2647.44	1058.98	106.28
25.50	50	43	S	-	-	-	2.120	1836.74	900.79	2737.52	1095.01	109.90
27.00	50	43	S	-	-	-	2.120	1926.81	900.79	2827.60	1131.04	113.51
28.50	50	43	S	-	-	-	2.120	2016.89	900.79	2917.68	1167.07	117.13
30.00	50	43	S	-	-	-	2.120	2106.97	900.79	3007.76	1203.10	120.75

Note: S = Non cohesive & C = Cohesive

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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 500mm
Factor of safety =2.50

BH-01

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	Su=c=qu/2 in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	5	4	C	0.45	10.8	25.0	2.355	64.37	100.09	164.45	65.78	6.60
3.00	27	23	C	0.40	21.6	134.8	2.355	338.74	540.47	879.21	351.68	35.30
4.50	37	31	S	.-	.-	.-	2.355	412.80	740.65	1153.45	461.38	46.30
6.00	42	36	C	0.30	43.2	209.7	2.355	739.68	840.74	1580.42	632.17	63.45
7.50	50	43	S	.-	.-	.-	2.355	839.77	1000.88	1840.64	736.26	73.89
9.00	50	43	S	.-	.-	.-	2.355	939.86	1000.88	1940.73	776.29	77.91
10.50	50	43	S	.-	.-	.-	2.355	1039.94	1000.88	2040.82	816.33	81.93
12.00	50	43	S	.-	.-	.-	2.355	1140.03	1000.88	2140.91	856.36	85.95
13.50	50	43	S	.-	.-	.-	2.355	1240.12	1000.88	2240.99	896.40	89.96
15.00	50	43	S	.-	.-	.-	2.355	1340.21	1000.88	2341.08	936.43	93.98
16.50	50	43	S	.-	.-	.-	2.355	1440.29	1000.88	2441.17	976.47	98.00
18.00	50	43	S	.-	.-	.-	2.355	1540.38	1000.88	2541.26	1016.50	102.02
19.50	50	43	S	.-	.-	.-	2.355	1640.47	1000.88	2641.34	1056.54	106.04
21.00	50	43	S	.-	.-	.-	2.355	1740.56	1000.88	2741.43	1096.57	110.05
22.50	50	43	S	.-	.-	.-	2.355	1840.64	1000.88	2841.52	1136.61	114.07
24.00	50	43	S	.-	.-	.-	2.355	1940.73	1000.88	2941.61	1176.64	118.09
25.50	50	43	S	.-	.-	.-	2.355	2040.82	1000.88	3041.69	1216.68	122.11
27.00	50	43	S	.-	.-	.-	2.355	2140.91	1000.88	3141.78	1256.71	126.13
28.50	50	43	S	.-	.-	.-	2.355	2240.99	1000.88	3241.87	1296.75	130.14
30.00	50	43	S	.-	.-	.-	2.355	2341.08	1000.88	3341.96	1336.78	134.16

Note: S = Non cohesive & C = Cohesive

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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 600mm
Factor of safety =2.50

BH-01

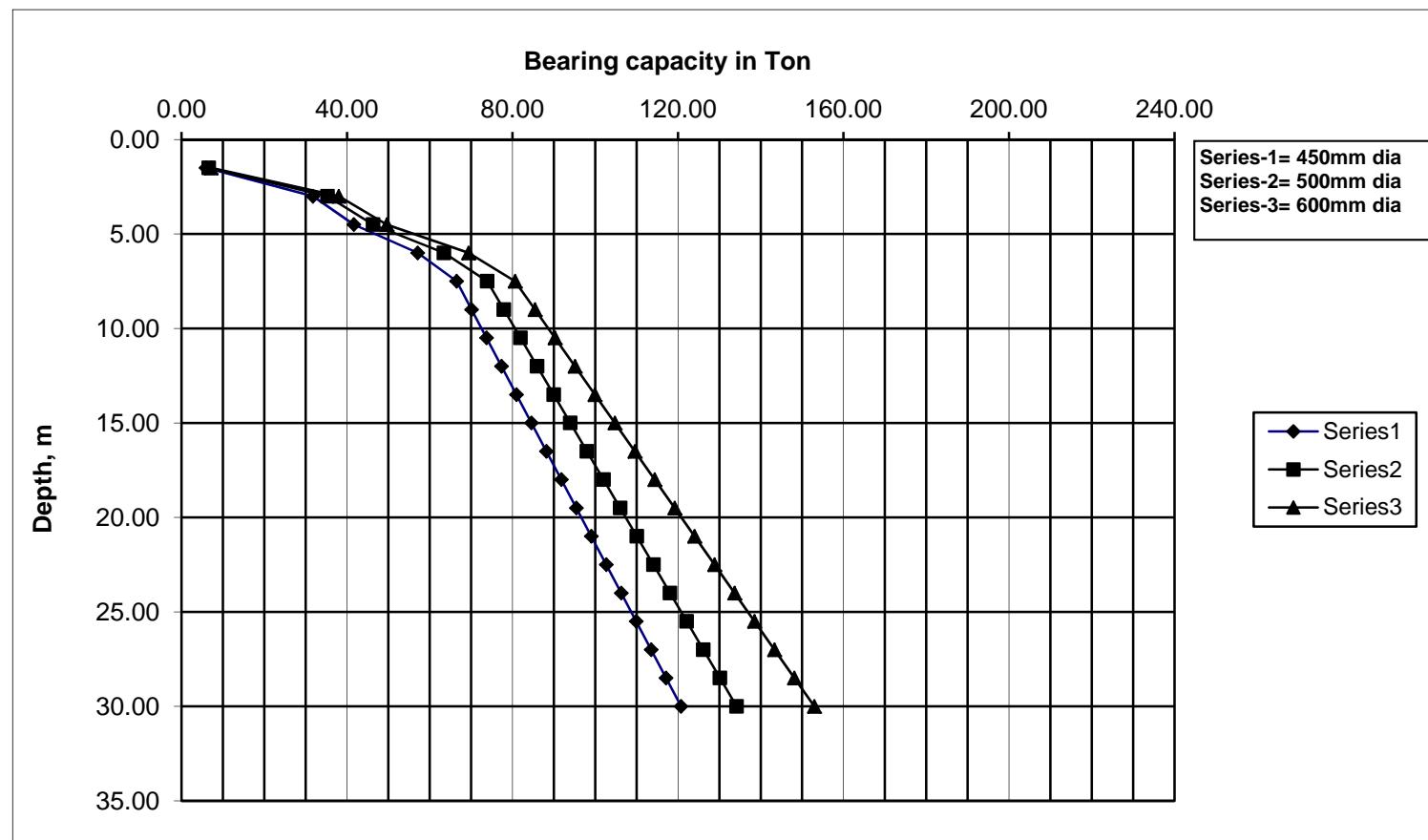
Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	$S_u=c_{qu}/2$ in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	5	4	C	0.45	10.8	25.0	2.826	77.24	100.09	177.33	70.93	7.12
3.00	27	23	C	0.40	21.6	134.8	2.826	406.48	540.47	946.96	378.78	38.02
4.50	37	31	S	-	-	-	2.826	495.36	740.65	1236.01	494.40	49.62
6.00	42	36	C	0.30	43.2	209.7	2.826	887.62	840.74	1728.35	691.34	69.38
7.50	50	43	S	-	-	-	2.826	1007.72	1000.88	2008.60	803.44	80.63
9.00	50	43	S	-	-	-	2.826	1127.83	1000.88	2128.70	851.48	85.46
10.50	50	43	S	-	-	-	2.826	1247.93	1000.88	2248.81	899.52	90.28
12.00	50	43	S	-	-	-	2.826	1368.04	1000.88	2368.91	947.56	95.10
13.50	50	43	S	-	-	-	2.826	1488.14	1000.88	2489.02	995.61	99.92
15.00	50	43	S	-	-	-	2.826	1608.25	1000.88	2609.12	1043.65	104.74
16.50	50	43	S	-	-	-	2.826	1728.35	1000.88	2729.23	1091.69	109.56
18.00	50	43	S	-	-	-	2.826	1848.46	1000.88	2849.33	1139.73	114.39
19.50	50	43	S	-	-	-	2.826	1968.56	1000.88	2969.44	1187.77	119.21
21.00	50	43	S	-	-	-	2.826	2088.67	1000.88	3089.54	1235.82	124.03
22.50	50	43	S	-	-	-	2.826	2208.77	1000.88	3209.65	1283.86	128.85
24.00	50	43	S	-	-	-	2.826	2328.88	1000.88	3329.75	1331.90	133.67
25.50	50	43	S	-	-	-	2.826	2448.98	1000.88	3449.86	1379.94	138.49
27.00	50	43	S	-	-	-	2.826	2569.09	1000.88	3569.96	1427.98	143.31
28.50	50	43	S	-	-	-	2.826	2689.19	1000.88	3690.07	1476.03	148.14
30.00	50	43	S	-	-	-	2.826	2809.30	1000.88	3810.17	1524.07	152.96

Note: S = Non cohesive & C = Cohesive

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Graphical Representation of Pile's load bearing capacity

B.H-01



SEL

SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 450mm
Factor of safety =2.50

B.H-02

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	$S_u=c=qu/2$ in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	4	3	S	-	-	-	2.120	7.21	72.06	79.27	31.71	3.18
3.00	14	12	S	-	-	-	2.120	32.43	252.22	284.65	113.86	11.43
4.50	27	23	S	-	-	-	2.120	81.07	486.43	567.50	227.00	22.78
6.00	38	32	S	-	-	-	2.120	149.53	684.60	834.13	333.65	33.49
7.50	45	38	S	-	-	-	2.120	230.60	810.71	1041.31	416.52	41.80
9.00	50	43	S	-	-	-	2.120	320.68	900.79	1221.47	488.59	49.04
10.50	50	43	S	-	-	-	2.120	410.76	900.79	1311.55	524.62	52.65
12.00	50	43	S	-	-	-	2.120	500.84	900.79	1401.63	560.65	56.27
13.50	50	43	S	-	-	-	2.120	590.92	900.79	1491.70	596.68	59.88
15.00	50	43	S	-	-	-	2.120	681.00	900.79	1581.78	632.71	63.50
16.50	50	43	S	-	-	-	2.120	771.07	900.79	1671.86	668.74	67.12
18.00	50	43	S	-	-	-	2.120	861.15	900.79	1761.94	704.78	70.73
19.50	50	43	S	-	-	-	2.120	951.23	900.79	1852.02	740.81	74.35
21.00	50	43	S	-	-	-	2.120	1041.31	900.79	1942.10	776.84	77.96
22.50	50	43	S	-	-	-	2.120	1131.39	900.79	2032.18	812.87	81.58
24.00	50	43	S	-	-	-	2.120	1221.47	900.79	2122.26	848.90	85.20
25.50	50	43	S	-	-	-	2.120	1311.55	900.79	2212.33	884.93	88.81
27.00	50	43	S	-	-	-	2.120	1401.63	900.79	2302.41	920.97	92.43
28.50	50	43	S	-	-	-	2.120	1491.70	900.79	2392.49	957.00	96.05
30.00	50	43	S	-	-	-	2.120	1581.78	900.79	2482.57	993.03	99.66

Note: S = Non cohesive & C = Cohesive

SEL

SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 500mm
Factor of safety =2.50

B.H-02

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	$S_u=c+qu/2$ in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	4	3	S	-	-	-	2.355	8.01	80.07	88.08	35.23	3.54
3.00	14	12	S	-	-	-	2.355	36.03	280.25	316.28	126.51	12.70
4.50	27	23	S	-	-	-	2.355	90.08	540.47	630.55	252.22	25.31
6.00	38	32	S	-	-	-	2.355	166.15	760.67	926.81	370.72	37.21
7.50	45	38	S	-	-	-	2.355	256.22	900.79	1157.01	462.80	46.45
9.00	50	43	S	-	-	-	2.355	356.31	1000.88	1357.19	542.87	54.48
10.50	50	43	S	-	-	-	2.355	456.40	1000.88	1457.27	582.91	58.50
12.00	50	43	S	-	-	-	2.355	556.49	1000.88	1557.36	622.94	62.52
13.50	50	43	S	-	-	-	2.355	656.57	1000.88	1657.45	662.98	66.54
15.00	50	43	S	-	-	-	2.355	756.66	1000.88	1757.54	703.01	70.56
16.50	50	43	S	-	-	-	2.355	856.75	1000.88	1857.62	743.05	74.57
18.00	50	43	S	-	-	-	2.355	956.84	1000.88	1957.71	783.08	78.59
19.50	50	43	S	-	-	-	2.355	1056.92	1000.88	2057.80	823.12	82.61
21.00	50	43	S	-	-	-	2.355	1157.01	1000.88	2157.89	863.15	86.63
22.50	50	43	S	-	-	-	2.355	1257.10	1000.88	2257.97	903.19	90.65
24.00	50	43	S	-	-	-	2.355	1357.19	1000.88	2358.06	943.22	94.66
25.50	50	43	S	-	-	-	2.355	1457.27	1000.88	2458.15	983.26	98.68
27.00	50	43	S	-	-	-	2.355	1557.36	1000.88	2558.24	1023.29	102.70
28.50	50	43	S	-	-	-	2.355	1657.45	1000.88	2658.32	1063.33	106.72
30.00	50	43	S	-	-	-	2.355	1757.54	1000.88	2758.41	1103.36	110.74

Note: S = Non cohesive & C = Cohesive

SEL

SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

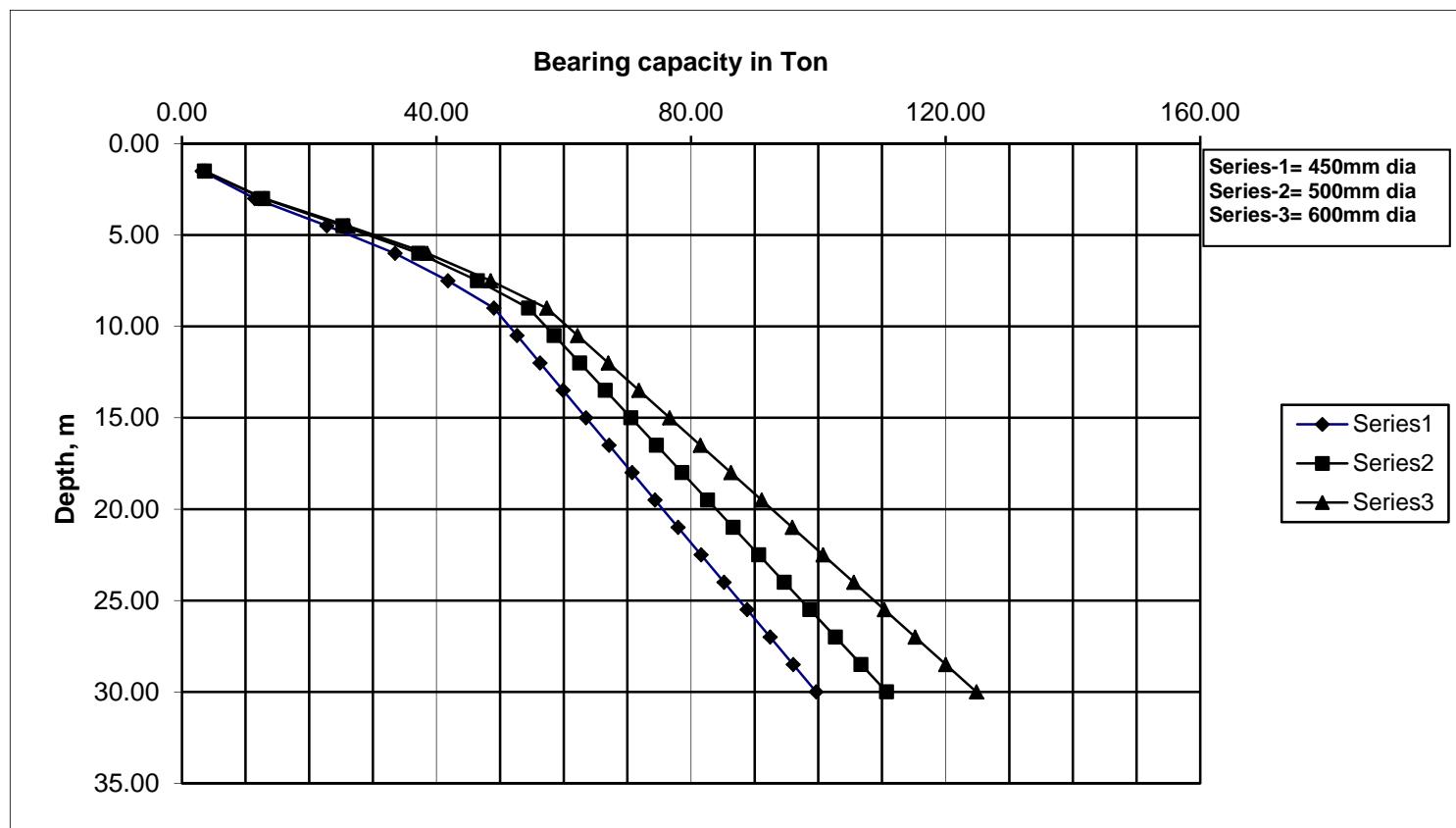
Pile diameter = 600mm
Factor of safety =2.50

B.H-02

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	$S_u=c+qu/2$ in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	4	3	S	-	-	-	2.826	9.61	80.07	89.68	35.87	3.60
3.00	14	12	S	-	-	-	2.826	43.24	280.25	323.48	129.39	12.99
4.50	27	23	S	-	-	-	2.826	108.09	540.47	648.57	259.43	26.04
6.00	38	32	S	-	-	-	2.826	199.37	760.67	960.04	384.02	38.54
7.50	45	38	S	-	-	-	2.826	307.47	900.79	1208.26	483.30	48.50
9.00	50	43	S	-	-	-	2.826	427.57	1000.88	1428.45	571.38	57.34
10.50	50	43	S	-	-	-	2.826	547.68	1000.88	1548.55	619.42	62.17
12.00	50	43	S	-	-	-	2.826	667.78	1000.88	1668.66	667.46	66.99
13.50	50	43	S	-	-	-	2.826	787.89	1000.88	1788.76	715.51	71.81
15.00	50	43	S	-	-	-	2.826	907.99	1000.88	1908.87	763.55	76.63
16.50	50	43	S	-	-	-	2.826	1028.10	1000.88	2028.97	811.59	81.45
18.00	50	43	S	-	-	-	2.826	1148.20	1000.88	2149.08	859.63	86.27
19.50	50	43	S	-	-	-	2.826	1268.31	1000.88	2269.18	907.67	91.10
21.00	50	43	S	-	-	-	2.826	1388.41	1000.88	2389.29	955.72	95.92
22.50	50	43	S	-	-	-	2.826	1508.52	1000.88	2509.39	1003.76	100.74
24.00	50	43	S	-	-	-	2.826	1628.62	1000.88	2629.50	1051.80	105.56
25.50	50	43	S	-	-	-	2.826	1748.73	1000.88	2749.60	1099.84	110.38
27.00	50	43	S	-	-	-	2.826	1868.83	1000.88	2869.71	1147.88	115.20
28.50	50	43	S	-	-	-	2.826	1988.94	1000.88	2989.81	1195.93	120.02
30.00	50	43	S	-	-	-	2.826	2109.04	1000.88	3109.92	1243.97	124.85

Note: S = Non cohesive & C = Cohesive

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Graphical Representation of Pile's load bearing capacity**B.H-02**

SEL

**SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207**

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 450mm

B.H-03

Note: S = Non cohesive & C = Cohesive

SEL

SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 500mm

B.H-03

Note: S = Non cohesive & C = Cohesive

SEL

**SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207**

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 600mm

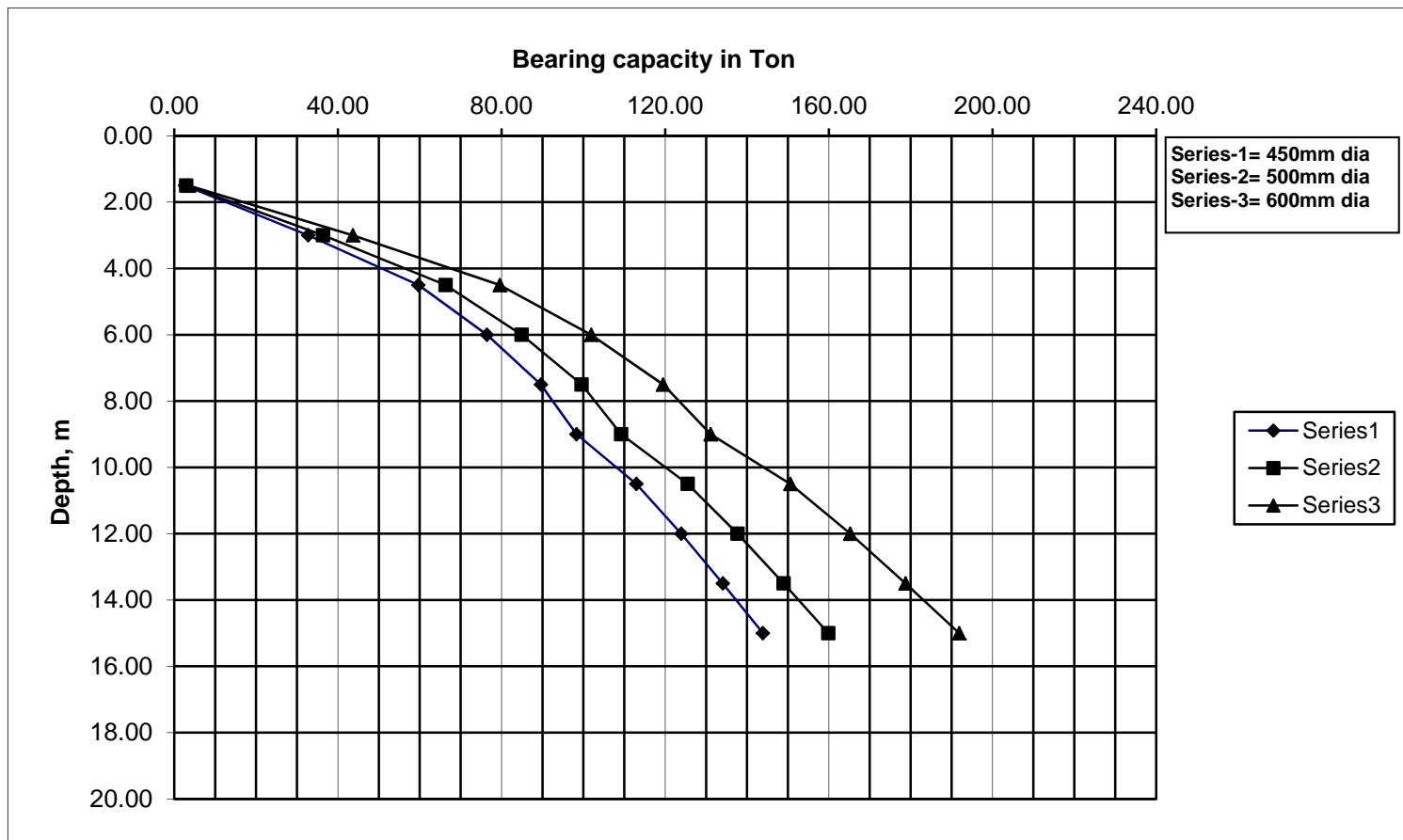
B.H-03

Note: S = Non cohesive & C = Cohesive

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Graphical Representation of Pile's load bearing capacity

B.H-03



SEL

**SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207**

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 450mm

Factor of safety =2.50

B.H-04

Note: S = Non cohesive & C = Cohesive

SEL

**SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207**

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 500mm
Factor of safety =2.50

B.H-04

Note: S = Non cohesive & C = Cohesive

SEL

**SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207**

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

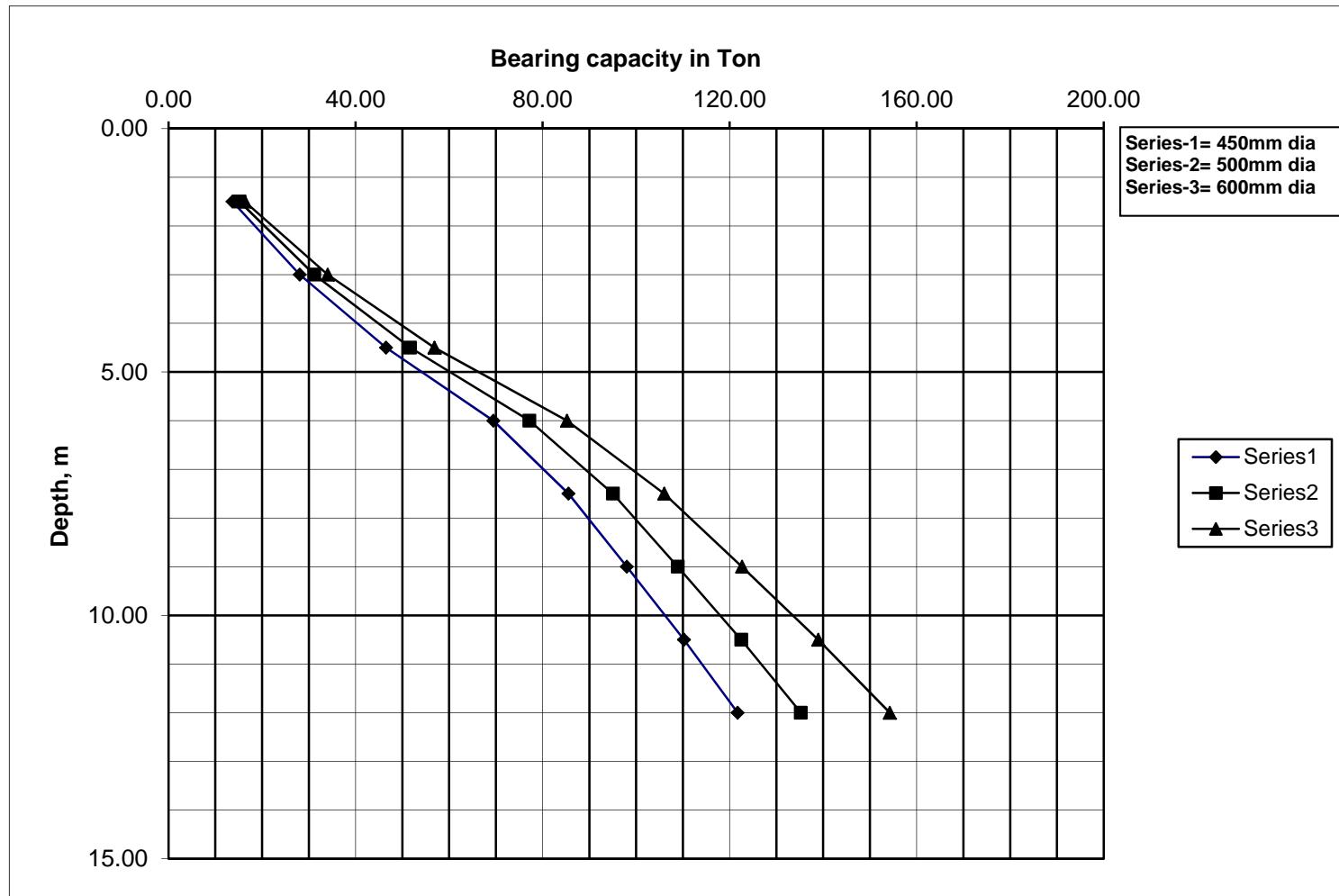
Determination of Pile Bearing Capacity

Note: S = Non cohesive & C = Cohesive

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Graphical Representation of Pile's load bearing capacity

B.H-04



SEL

**SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207**

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 450mm

B.H-05

Note: S = Non cohesive & C = Cohesive

SEL

SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 500mm
Factor of safety = 2.50

B.H-05

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	$S_u=c=qu/2$ in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	8	7	C	0.45	10.8	40.0	2.355	96.12	160.14	256.26	102.50	10.29
3.00	16	14	C	0.40	21.6	79.9	2.355	267.00	320.28	587.28	234.91	23.58
4.50	45	38	C	0.35	32.4	224.7	2.355	664.15	900.79	1564.94	625.98	62.82
6.00	50	43	C	0.30	43.2	249.7	2.355	1047.48	1000.88	2048.36	819.34	82.23
7.50	50	43	C	0.28	54.0	249.7	2.355	1412.38	1000.88	2413.25	965.30	96.88
9.00	50	43	C	0.26	64.8	249.7	2.355	1757.82	1000.88	2758.70	1103.48	110.75
10.50	50	43	C	0.24	75.6	249.7	2.355	2082.80	1000.88	3083.67	1233.47	123.79
12.00	50	43	C	0.22	86.4	249.7	2.355	2386.29	1000.88	3387.16	1354.87	135.98
13.50	50	43	C	0.20	97.2	249.7	2.355	2667.27	1000.88	3668.15	1467.26	147.26
15.00	50	43	C	0.19	108.0	249.7	2.355	2939.04	1000.88	3939.92	1575.97	158.17
16.50	50	43	C	0.18	118.8	249.7	2.355	3201.09	1000.88	4201.96	1680.79	168.69
18.00	50	43	C	0.17	129.6	249.7	2.355	3452.90	1000.88	4453.77	1781.51	178.79
19.50	50	43	C	0.17	140.4	249.7	2.355	3709.03	1000.88	4709.91	1883.96	189.08
21.00	50	43	C	0.16	151.2	249.7	2.355	3954.17	1000.88	4955.04	1982.02	198.92
22.50	50	43	C	0.16	162.0	249.7	2.355	4203.38	1000.88	5204.25	2081.70	208.92

Note: S = Non cohesive & C = Cohesive

SEL

SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 600mm
Factor of safety =2.50

B.H-05

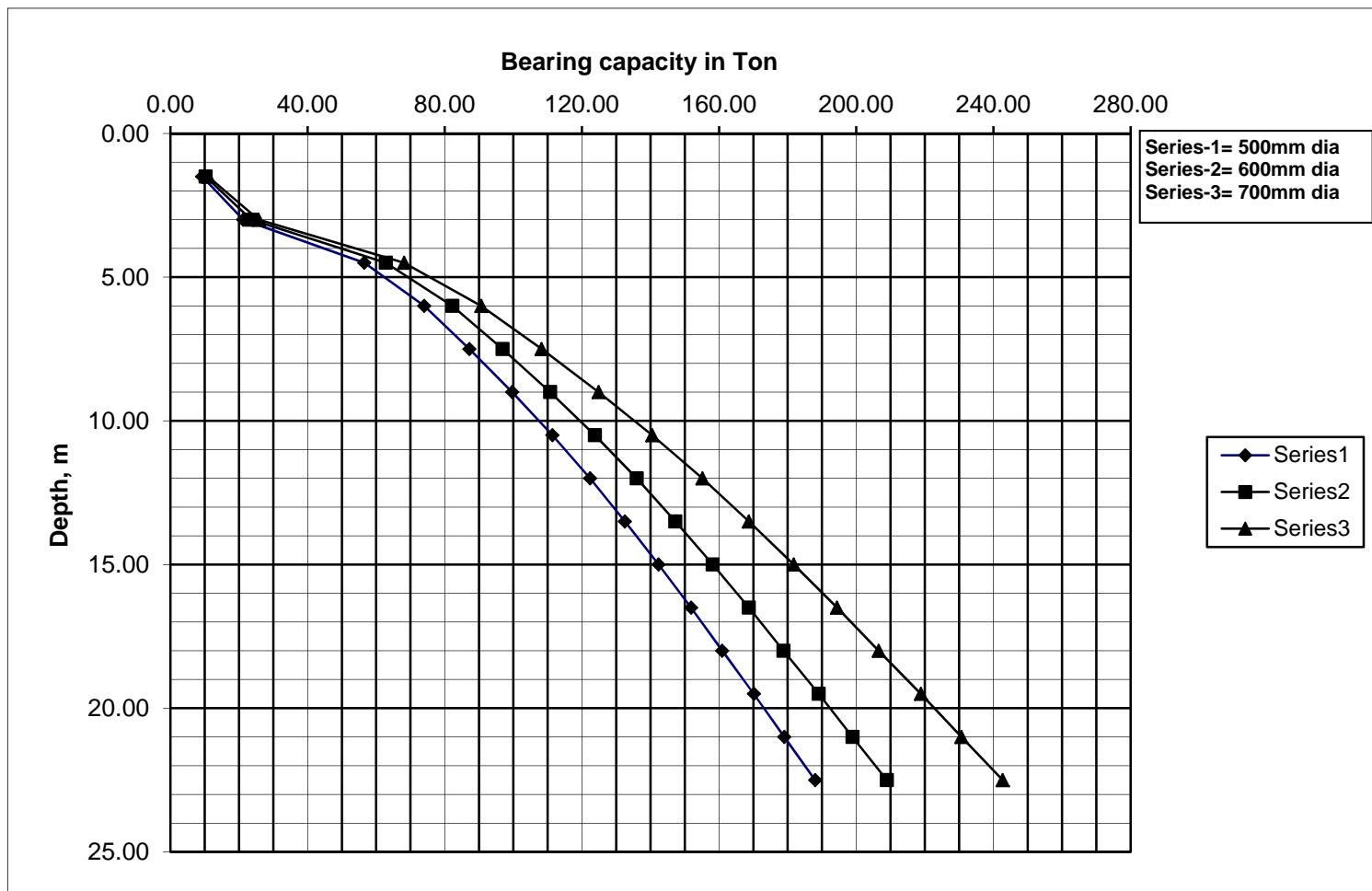
Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	$S_u=c=qu/2 \text{ in kPa}$	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	8	7	C	0.45	10.8	40.0	2.826	115.34	160.14	275.48	110.19	11.06
3.00	16	14	C	0.40	21.6	79.9	2.826	320.40	320.28	640.68	256.27	25.72
4.50	45	38	C	0.35	32.4	224.7	2.826	796.98	900.79	1697.77	679.11	68.16
6.00	50	43	C	0.30	43.2	249.7	2.826	1256.98	1000.88	2257.85	903.14	90.64
7.50	50	43	C	0.28	54.0	249.7	2.826	1694.85	1000.88	2695.73	1078.29	108.22
9.00	50	43	C	0.26	64.8	249.7	2.826	2109.39	1000.88	3110.26	1244.10	124.86
10.50	50	43	C	0.24	75.6	249.7	2.826	2499.36	1000.88	3500.23	1400.09	140.52
12.00	50	43	C	0.22	86.4	249.7	2.826	2863.55	1000.88	3864.42	1545.77	155.14
13.50	50	43	C	0.20	97.2	249.7	2.826	3200.73	1000.88	4201.60	1680.64	168.67
15.00	50	43	C	0.19	108.0	249.7	2.826	3526.85	1000.88	4527.73	1811.09	181.76
16.50	50	43	C	0.18	118.8	249.7	2.826	3841.31	1000.88	4842.18	1936.87	194.39
18.00	50	43	C	0.17	129.6	249.7	2.826	4143.48	1000.88	5144.35	2057.74	206.52
19.50	50	43	C	0.17	140.4	249.7	2.826	4450.84	1000.88	5451.71	2180.69	218.86
21.00	50	43	C	0.16	151.2	249.7	2.826	4745.00	1000.88	5745.88	2298.35	230.67
22.50	50	43	C	0.16	162.0	249.7	2.826	5044.05	1000.88	6044.93	2417.97	242.67

Note: S = Non cohesive & C = Cohesive

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Graphical Representation of Pile's load bearing capacity

B.H-05



SEL

SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 450mm
Factor of safety = 2.50

B.H-06

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	Su=c=qu/2 in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	20	17	C	0.45	10.8	99.9	2.120	200.82	360.32	561.13	224.45	22.53
3.00	27	23	C	0.40	21.6	134.8	2.120	447.75	486.43	934.17	373.67	37.50
4.50	43	37	C	0.35	32.4	214.7	2.120	790.37	774.68	1565.05	626.02	62.83
6.00	43	37	C	0.30	43.2	214.7	2.120	1090.91	774.68	1865.59	746.24	74.89
7.50	50	43	C	0.28	54.0	249.7	2.120	1419.32	900.79	2320.11	928.04	93.14
9.00	50	43	C	0.26	64.8	249.7	2.120	1730.22	900.79	2631.01	1052.40	105.62
10.50	49	42	C	0.24	75.6	244.7	2.120	2017.62	882.77	2900.39	1160.16	116.43
12.00	50	43	C	0.20	86.4	249.7	2.120	2265.93	900.79	3166.71	1266.69	127.13
13.50	50	43	C	0.19	97.2	249.7	2.120	2506.17	900.79	3406.96	1362.78	136.77
15.00	50	43	C	0.18	108.0	249.7	2.120	2737.89	900.79	3638.68	1455.47	146.07
16.50	50	43	C	0.17	118.8	249.7	2.120	2960.63	900.79	3861.42	1544.57	155.01

Note: S = Non cohesive & C = Cohesive

SEL

SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 500mm
Factor of safety =2.50

B.H-06

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	Su=c=qu/2 in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	20	17	C	0.45	10.8	99.9	2.355	223.13	400.35	623.48	249.39	25.03
3.00	27	23	C	0.40	21.6	134.8	2.355	497.50	540.47	1037.97	415.19	41.67
4.50	43	37	C	0.35	32.4	214.7	2.355	878.19	860.75	1738.94	695.58	69.81
6.00	43	37	C	0.30	43.2	214.7	2.355	1212.13	860.75	2072.88	829.15	83.21
7.50	50	43	C	0.28	54.0	249.7	2.355	1577.02	1000.88	2577.90	1031.16	103.49
9.00	50	43	C	0.26	64.8	249.7	2.355	1922.47	1000.88	2923.34	1169.34	117.36
10.50	49	42	C	0.24	75.6	244.7	2.355	2241.80	980.86	3222.65	1289.06	129.37
12.00	50	43	C	0.20	86.4	249.7	2.355	2517.70	1000.88	3518.57	1407.43	141.25
13.50	50	43	C	0.19	97.2	249.7	2.355	2784.63	1000.88	3785.51	1514.20	151.97
15.00	50	43	C	0.18	108.0	249.7	2.355	3042.10	1000.88	4042.98	1617.19	162.30
16.50	50	43	C	0.17	118.8	249.7	2.355	3289.59	1000.88	4290.46	1716.18	172.24

Note: S = Non cohesive & C = Cohesive

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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 600mm
Factor of safety =2.50

B.H-06

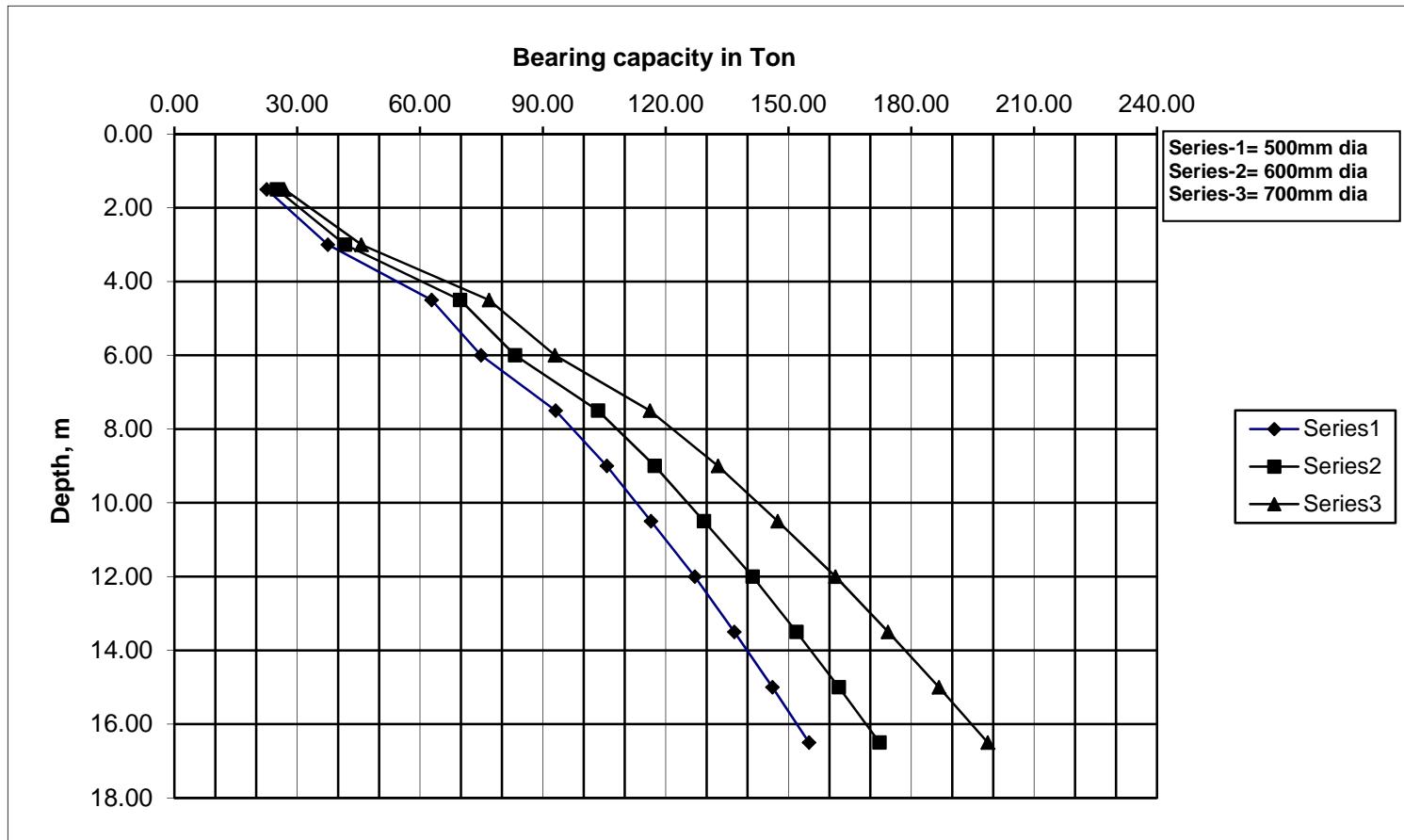
Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	Su=c=qu/2 in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	20	17	C	0.45	10.8	99.9	2.826	267.76	400.35	668.11	267.24	26.82
3.00	27	23	C	0.40	21.6	134.8	2.826	597.00	540.47	1137.47	454.99	45.66
4.50	43	37	C	0.35	32.4	214.7	2.826	1053.83	860.75	1914.58	765.83	76.86
6.00	43	37	C	0.30	43.2	214.7	2.826	1454.55	860.75	2315.30	926.12	92.95
7.50	50	43	C	0.28	54.0	249.7	2.826	1892.43	1000.88	2893.30	1157.32	116.15
9.00	50	43	C	0.26	64.8	249.7	2.826	2306.96	1000.88	3307.83	1323.13	132.79
10.50	49	42	C	0.24	75.6	244.7	2.826	2690.16	980.86	3671.01	1468.41	147.37
12.00	50	43	C	0.20	86.4	249.7	2.826	3021.24	1000.88	4022.11	1608.84	161.47
13.50	50	43	C	0.19	97.2	249.7	2.826	3341.56	1000.88	4342.44	1736.97	174.33
15.00	50	43	C	0.18	108.0	249.7	2.826	3650.52	1000.88	4651.40	1860.56	186.73
16.50	50	43	C	0.17	118.8	249.7	2.826	3947.50	1000.88	4948.38	1979.35	198.65

Note: S = Non cohesive & C = Cohesive

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Graphical Representation of Pile's load bearing capacity

B.H-06



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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 450mm
Factor of safety =2.50

B.H-07

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	Su=c=qu/2 in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	11	9	C	0.45	10.8	54.9	2.120	115.08	198.17	313.26	125.30	12.58
3.00	26	22	C	0.40	21.6	129.8	2.120	353.55	468.41	821.96	328.78	33.00
4.50	37	31	C	0.35	32.4	184.8	2.120	651.72	666.58	1318.30	527.32	52.92
6.00	43	37	C	0.30	43.2	214.7	2.120	952.26	774.68	1726.94	690.77	69.33
7.50	44	37	C	0.28	54.0	219.7	2.120	1245.10	792.69	2037.80	815.12	81.81
9.00	45	38	C	0.26	64.8	224.7	2.120	1528.48	810.71	2339.19	935.68	93.91
10.50	50	43	C	0.25	75.6	249.7	2.120	1833.15	900.79	2733.94	1093.57	109.75
12.00	50	43	C	0.23	86.4	249.7	2.120	2118.70	900.79	3019.49	1207.80	121.22

Note: S = Non cohesive & C = Cohesive

SEL

SUCHANA ENGINEERS LTD.
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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 500mm
Factor of safety =2.50

B.H-07

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	$S_u=c=qu/2$ in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	11	9	C	0.45	10.8	54.9	2.355	127.87	220.19	348.06	139.23	13.97
3.00	26	22	C	0.40	21.6	129.8	2.355	392.83	520.46	913.29	365.32	36.66
4.50	37	31	C	0.35	32.4	184.8	2.355	724.13	740.65	1464.78	585.91	58.80
6.00	43	37	C	0.30	43.2	214.7	2.355	1058.07	860.75	1918.82	767.53	77.03
7.50	44	37	C	0.28	54.0	219.7	2.355	1383.45	880.77	2264.22	905.69	90.90
9.00	45	38	C	0.26	64.8	224.7	2.355	1698.31	900.79	2599.10	1039.64	104.34
10.50	50	43	C	0.25	75.6	249.7	2.355	2036.83	1000.88	3037.71	1215.08	121.95
12.00	50	43	C	0.23	86.4	249.7	2.355	2354.12	1000.88	3354.99	1342.00	134.68

Note: S = Non cohesive & C = Cohesive

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SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 600mm
Factor of safety = 2.50

B.H-07

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	$S_u=c=qu/2$ in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	11	9	C	0.45	10.8	54.9	2.826	153.45	220.19	373.64	149.46	15.00
3.00	26	22	C	0.40	21.6	129.8	2.826	471.40	520.46	991.85	396.74	39.82
4.50	37	31	C	0.35	32.4	184.8	2.826	868.96	740.65	1609.60	643.84	64.62
6.00	43	37	C	0.30	43.2	214.7	2.826	1269.68	860.75	2130.43	852.17	85.53
7.50	44	37	C	0.28	54.0	219.7	2.826	1660.14	880.77	2540.91	1016.36	102.00
9.00	45	38	C	0.26	64.8	224.7	2.826	2037.98	900.79	2938.77	1175.51	117.98
10.50	50	43	C	0.25	75.6	249.7	2.826	2444.20	1000.88	3445.07	1378.03	138.30
12.00	50	43	C	0.23	86.4	249.7	2.826	2824.94	1000.88	3825.81	1530.33	153.59

Note: S = Non cohesive & C = Cohesive

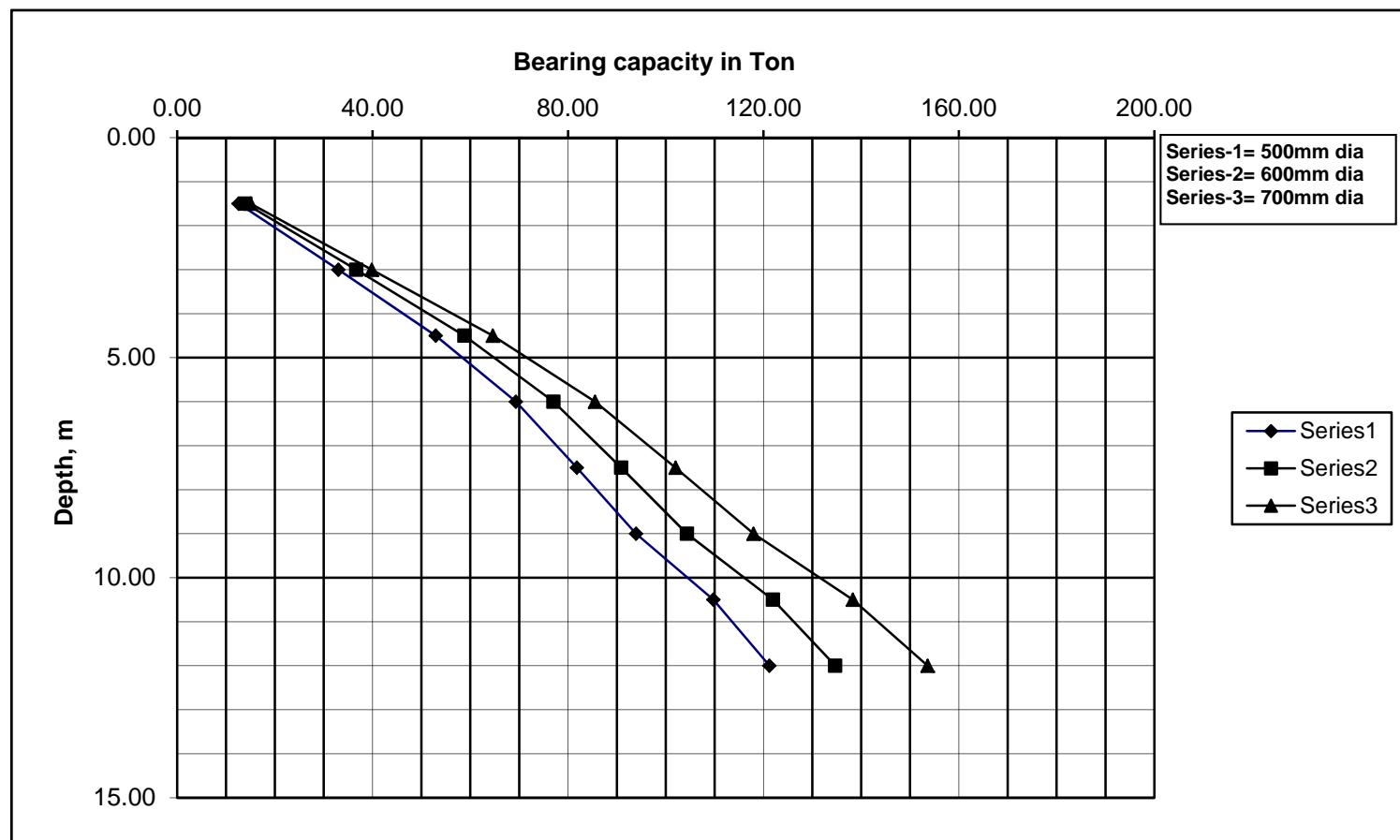
SEL

SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Graphical Representation of Pile's load bearing capacity

B.H-07



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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 450mm
Factor of safety =2.50

B.H-08

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	Su=c=qu/2 in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	25	21	C	0.45	10.8	124.8	2.120	248.45	450.39	698.84	279.54	28.05
3.00	37	31	C	0.4	21.6	184.8	2.120	580.05	666.58	1246.64	498.65	50.05
4.50	50	43	C	0.35	32.4	249.7	2.120	974.54	900.79	1875.32	750.13	75.28
6.00	50	43	C	0.3	43.2	249.7	2.120	1319.53	900.79	2220.32	888.13	89.13
7.50	50	43	C	0.28	54.0	249.7	2.120	1647.94	900.79	2548.73	1019.49	102.32
9.00	50	43	C	0.26	64.8	249.7	2.120	1958.84	900.79	2859.63	1143.85	114.80
10.50	50	43	C	0.25	75.6	249.7	2.120	2263.50	900.79	3164.29	1265.72	127.03
12.00	50	43	C	0.23	86.4	249.7	2.120	2549.06	900.79	3449.85	1379.94	138.49
13.50	50	43	C	0.21	97.2	249.7	2.120	2814.59	900.79	3715.38	1486.15	149.15
15.00	50	43	C	0.2	108.0	249.7	2.120	3072.06	900.79	3972.85	1589.14	159.49
16.50	50	43	C	0.19	118.8	249.7	2.120	3321.00	900.79	4221.79	1688.72	169.48
18.00	50	43	C	0.19	129.6	249.7	2.120	3574.29	900.79	4475.08	1790.03	179.65

Note: S = Non cohesive & C = Cohesive

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272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 500mm
Factor of safety =2.50

B.H-08

Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	$S_u=c=qu/2$ in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	25	21	C	0.45	10.8	124.8	2.355	276.05	500.44	776.49	310.60	31.17
3.00	37	31	C	0.4	21.6	184.8	2.355	644.50	740.65	1385.15	554.06	55.61
4.50	50	43	C	0.35	32.4	249.7	2.355	1082.82	1000.88	2083.69	833.48	83.65
6.00	50	43	C	0.3	43.2	249.7	2.355	1466.15	1000.88	2467.02	986.81	99.04
7.50	50	43	C	0.28	54.0	249.7	2.355	1831.04	1000.88	2831.92	1132.77	113.69
9.00	50	43	C	0.26	64.8	249.7	2.355	2176.49	1000.88	3177.36	1270.95	127.55
10.50	50	43	C	0.25	75.6	249.7	2.355	2515.00	1000.88	3515.88	1406.35	141.14
12.00	50	43	C	0.23	86.4	249.7	2.355	2832.29	1000.88	3833.16	1533.27	153.88
13.50	50	43	C	0.21	97.2	249.7	2.355	3127.33	1000.88	4128.20	1651.28	165.72
15.00	50	43	C	0.2	108.0	249.7	2.355	3413.40	1000.88	4414.27	1765.71	177.21
16.50	50	43	C	0.19	118.8	249.7	2.355	3690.00	1000.88	4690.88	1876.35	188.31
18.00	50	43	C	0.19	129.6	249.7	2.355	3971.44	1000.88	4972.31	1988.92	199.61

Note: S = Non cohesive & C = Cohesive

SEL

SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Determination of Pile Bearing Capacity

Pile diameter = 600mm
Factor of safety =2.50

B.H-08

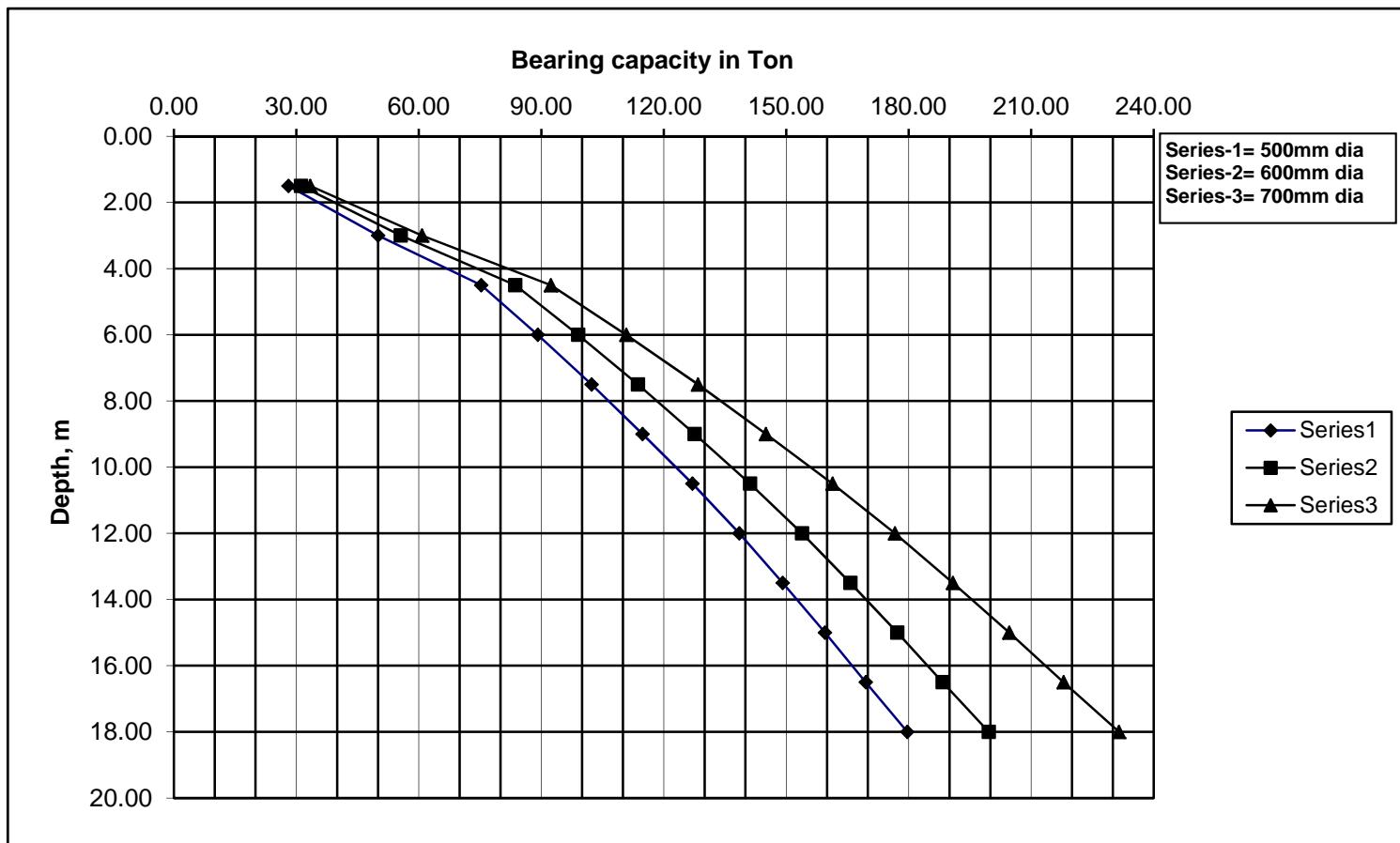
Depth in m	SPT value (N)	Corrected SPT (N60)	Sample type	Lamda factor	Effective vertical stress (q)	$S_u=c=qu/2$ in kPa	Surface area of pile in sq.m	Ultimate skin resistance in kN	Ultimate end bearing in kN	Ultimate pile capacity in kN	Allowable pile capacity in kN	Allowable pile capacity in ton
1.50	25	21	C	0.45	10.8	124.8	2.826	331.26	500.44	831.70	332.68	33.39
3.00	37	31	C	0.4	21.6	184.8	2.826	773.40	740.65	1514.05	605.62	60.78
4.50	50	43	C	0.35	32.4	249.7	2.826	1299.38	1000.88	2300.26	920.10	92.34
6.00	50	43	C	0.3	43.2	249.7	2.826	1759.38	1000.88	2760.25	1104.10	110.81
7.50	50	43	C	0.28	54.0	249.7	2.826	2197.25	1000.88	3198.13	1279.25	128.39
9.00	50	43	C	0.26	64.8	249.7	2.826	2611.79	1000.88	3612.66	1445.06	145.03
10.50	50	43	C	0.25	75.6	249.7	2.826	3018.01	1000.88	4018.88	1607.55	161.34
12.00	50	43	C	0.23	86.4	249.7	2.826	3398.75	1000.88	4399.62	1759.85	176.62
13.50	50	43	C	0.21	97.2	249.7	2.826	3752.79	1000.88	4753.67	1901.47	190.83
15.00	50	43	C	0.2	108.0	249.7	2.826	4096.08	1000.88	5096.95	2038.78	204.61
16.50	50	43	C	0.19	118.8	249.7	2.826	4428.00	1000.88	5428.88	2171.55	217.94
18.00	50	43	C	0.19	129.6	249.7	2.826	4765.72	1000.88	5766.60	2306.64	231.50

Note: S = Non cohesive & C = Cohesive

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Graphical Representation of Pile's load bearing capacity

B.H-08



3.3 CONCLUSION

Through the observation of the overall field and laboratory test results from the tables and the bore logs and study the N-values etc. the following geotechnical parameters are explained as follows:

Soil surface is about road level and ground water table are moderate varies in all the bore holes. The cohesive layers are pre and over consolidated in nature, since water contents are closer to plastic limit. SPT, cohesion, angle of internal friction, unit weight of soil indicate that these layers are very good for multi-storied building. Settlement in this layer will also be very low.

In general the soil is cohesive in nature at about top to bottom (except Bh no. 1 & 2) are stiff and cohesive top to bottom level. Up to 3.00 m from soil surface are usually stiff to very stiff and high cohesive layers. These layers possess medium bearing capacity and shearing strength. From 3.00 to 6.00 m are very stiff to hard and high cohesive layers (except Bh no.2) with higher bearing capacity & shear strength. From 6.00 to 30.00 m are hard to very hard and cohesive layers with higher shear strength and very good load bearing capacity. Further underlying non cohesive/cohesive layer up to the final depth of all bore holes are resistant and hence safe & suitable for the foundation for the transfer of loads of the building.

3.4 RECOMMENDATION

According to our observation & regarding this soil condition, the mat or pile foundation would be required for the proposed apartment building. Hence experienced structural design engineer and geotechnical engineer are required to work component by component to select the appropriate foundation type needed for the proposed site for the **construction of Multi-storied Commercial cum Apartment Complex with Modern Amenities at Nasirabad, Chittagong, Bangladesh**. Recommendation for a foundation type does not depend only on soil parameters rather some other factors like architectural layout, loading condition, importance factor, financial constrains, availability of construction materials in particular region & construction technique etc. also play important role.

However, either shallow or deep foundation is preferred. For heavy loads Piled Raft foundation may be constructed also. The allowable bearing capacity (detail) of such a foundation of different size is provided at borehole wise in table (Chapter-2). The foundation, type, size and depth would be selected design engineer. The estimated Pile capacity should be confirmed by Integrity and Load test results.

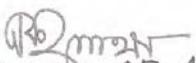
Capacity of a typical footing has been shown later. But though the bearing capacity are calculated and shown earlier , But the design engineer has to decided the **type, depth, and size** of foundation depending on the load and he has to recalculate the bearing capacity of the foundation (since it depends on **depth, size and other factors**). The structural designer may take preliminary value of

bearing capacity (calculated herein) and fix up the final size and depth of the foundation. Hence the calculation shown earlier may help one in taking decision.

Precautionary Measure

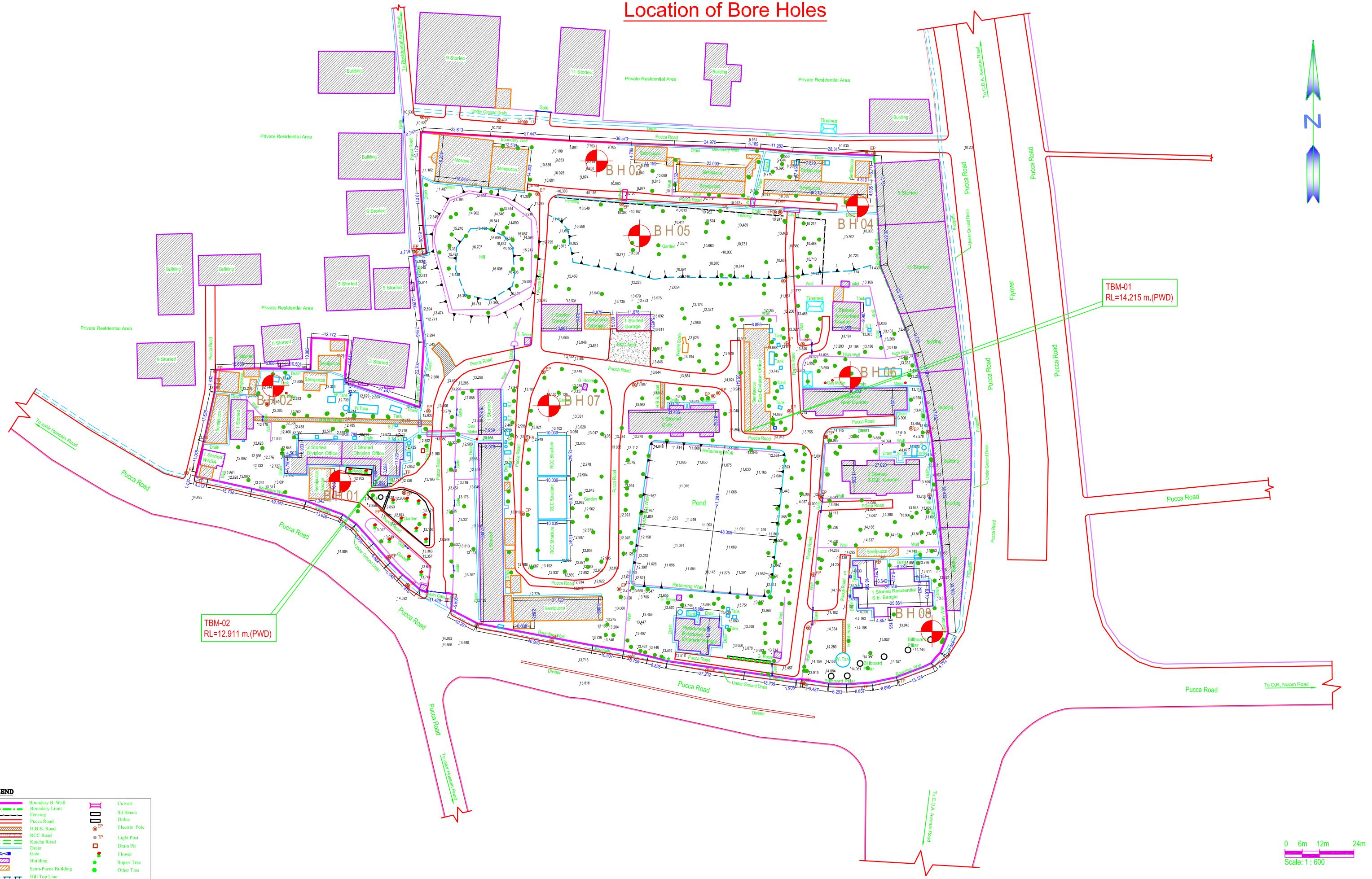
- a) *In case of any excavation, it should be designed properly taking care of existing structure, utility lines & available techniques.*
- b) *Earthquake forces must be considered in design (According to BNBC, Section 2.5.4.1 and seismic Zoning map of Bangladesh, (Page 6-52)*
- c) *Whenever any soil improvement measures are taken or pile is driven must be carried out to ensure that the bearing capacity settlement criterion commensurate to design value.*

Necessary soil parameters those may be required for mat/pile or any other alternative foundation design are provided in different graphs, data, tables etc. of the sub-soil report.


05.4.2017
AMAL KRISHNA SAHA
B. Sc Engineer (Civil), MIEB-13301
Sr. Geotec. Engineer
Suchana Engineers Ltd.
272/A West Agargaon, Dhaka-1207.

Attachment

Location of Bore Holes



BORE LOG (Bore Hole # -01)

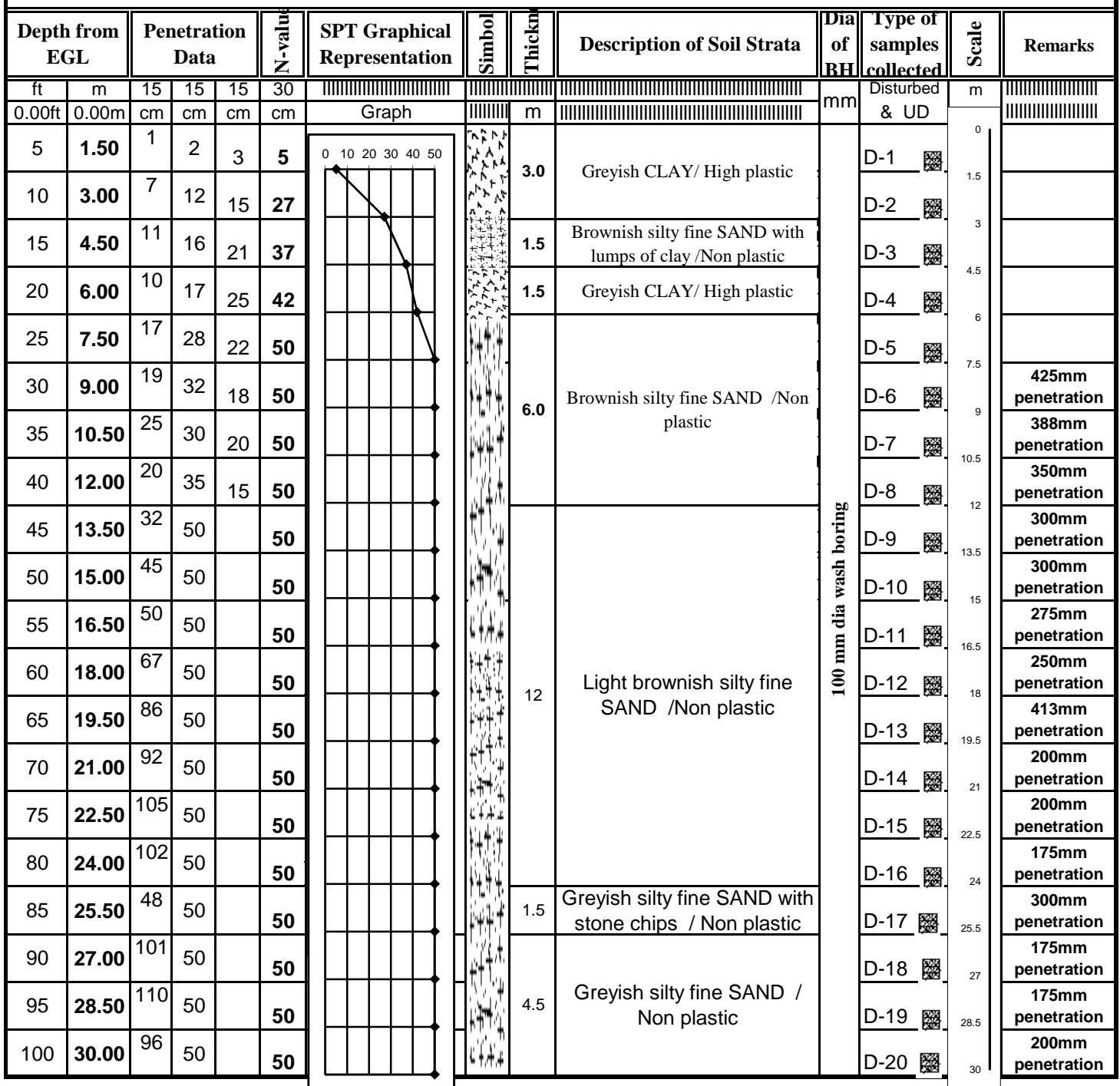
Suchana Engineers Ltd 272/A West Agargaon Modina Saluk Dhaka -1207	Scheme : Construction of Multi-storied Commercial cum Apartment Complex with Modern Amenities Client : EPTISA SERVICIOS INGENIERIA S.L Location : Nasirabadi, Chittagong, Bangladesh	B.H Depth : 30.00m GWT : 2.450m Started : 11/3/2017 Completed : 12/3/2017
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[Elevation= 13.01m]

N- 381258.576

E-2471391.151

[TBM-1=14.215m (PWD)]



[Bore hole terminated due to Shell and very hard layers]



BORE LOG (Bore Hole # -02)

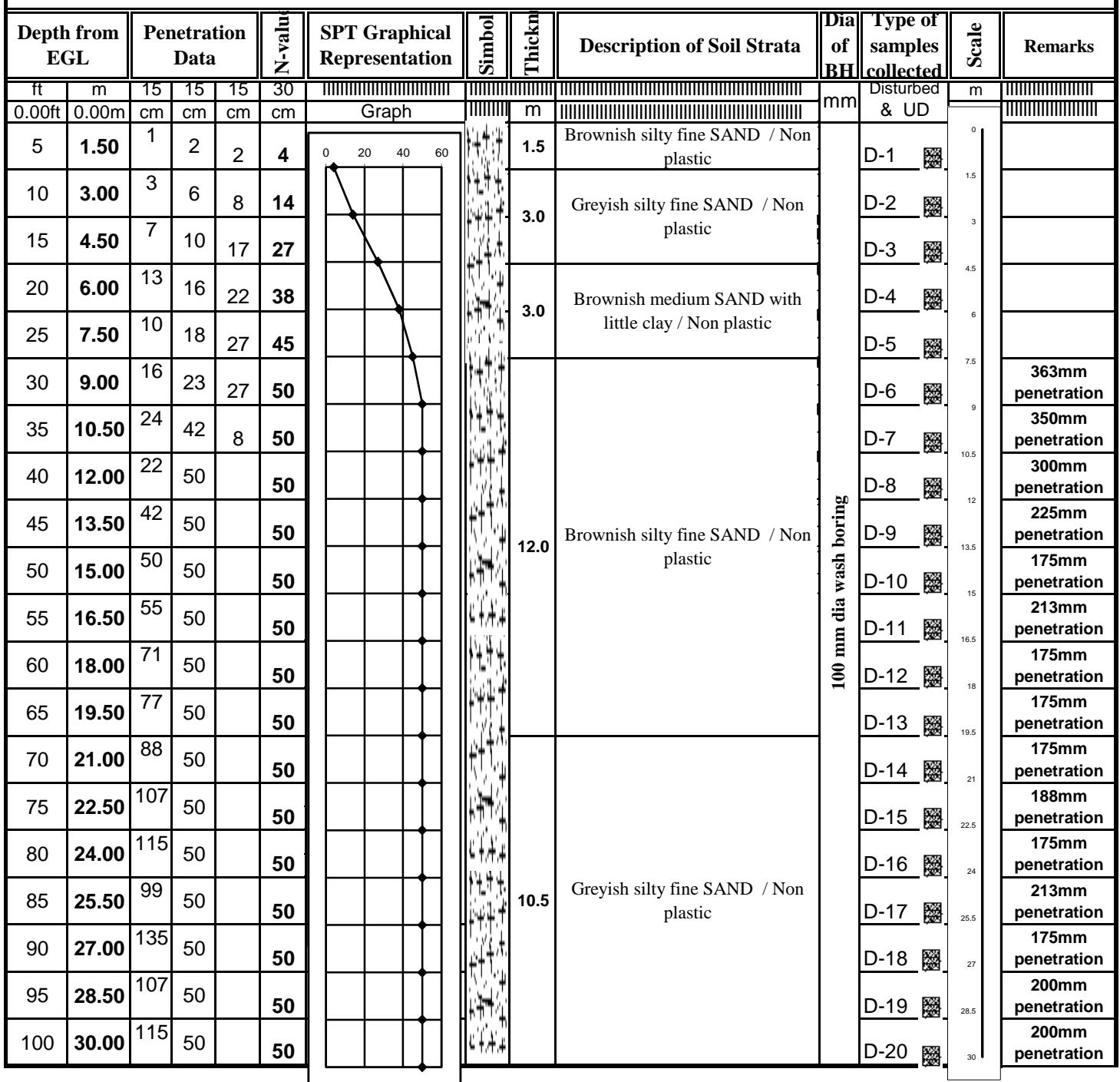
Suchana Engineers Ltd 272/A West Agargaon Modina Saluk Dhaka -1207	Scheme : Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities Client : EPTISA SERVICIOS INGENIERIA S.L Location : Nasirabadi, Chittagong, Bangladesh	B.H Depth : 30.00m GWT : 2.750m Started : 9/3/2017 Completed : 10/3/2017
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[Elevation= 12.72m]

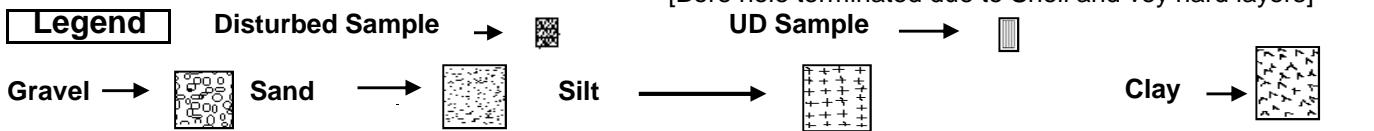
N-381235.334

E-2471424.522

[TBM-1=14.215m (PWD)]



[Bore hole terminated due to Shell and very hard layers]



BORE LOG (Bore Hole # -03)

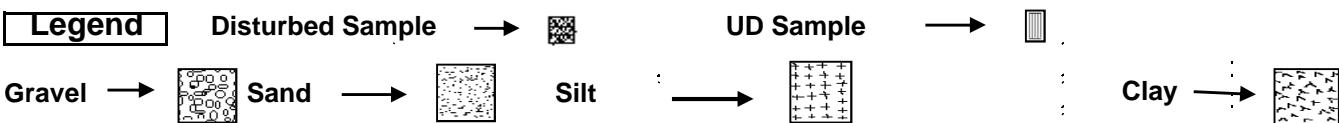
Suchana Engineers Ltd 272/A West Agargaon Modina Saluk Dhaka -1207				Scheme : Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities Client : EPTISA SERVICIOS INGENIERIA S.L Location : Nasirabadi, Chittagong, Bangladesh				B.H Depth : 15.00m GWT : 0.000m Started : 13/3/2017 Completed : 13/3/2017			
[Elevation= 10.01m]				N-381348.097				E-2471502.895			
[TBM-1=14.215m (PWD)]											
Depth from EGL	Penetration Data			N-value	SPT Graphical Representation	Symbol	Thickness	Description of Soil Strata	Dia of BH	Type of samples collected	Scale
ft	m	15	15	15	30				mm	Disturbed & UD	m
0.00ft	0.00m	cm	cm	cm	cm				mm		
5	1.50	1	1	1	2					0	
10	3.00	4	9	20	29					D-1	1.5
15	4.50	9	18	28	46					D-2	3
20	6.00	8	24	26	50					D-3	4.5
25	7.50	12	28	22	50					D-4	6
30	9.00	6	19	27	46					D-5	7.5
35	10.50	13	27	23	50					D-6	9
40	12.00	15	28	22	50					D-7	10.5
45	13.50	16	28	22	50					D-8	12
50	15.00	30	40	10	50					D-9	13.5
										D-10	15

Graph

0 20 40 60

15.0 Greyish CLAY / High plastic

100 mm dia wash boring



BORE LOG (Bore Hole # -04)

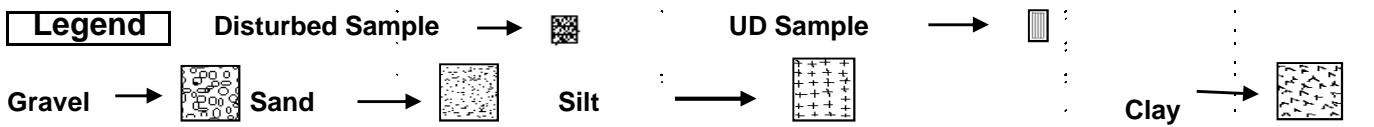
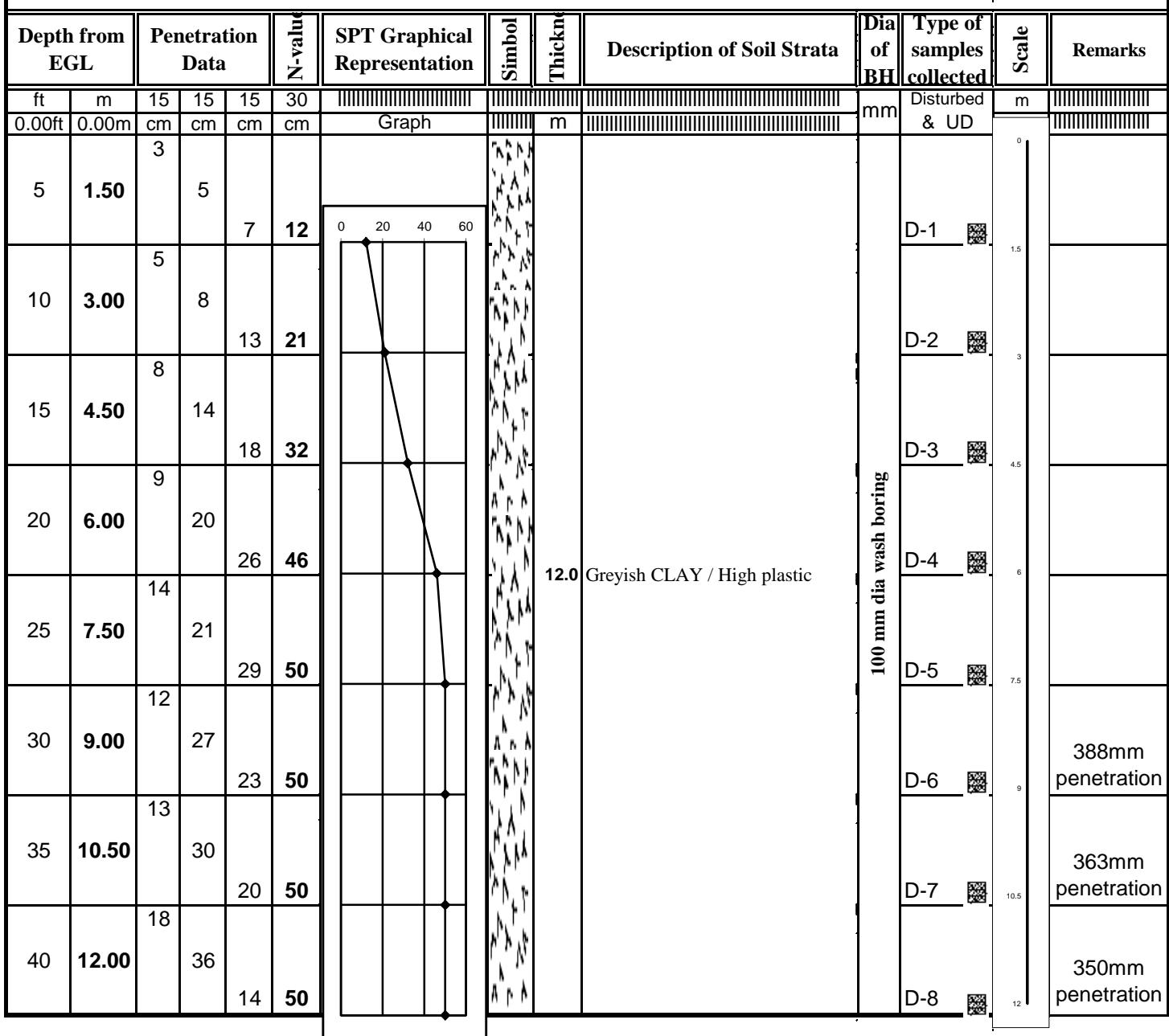
Suchana Engineers Ltd 272/A West Agargaon Modina Saluk Dhaka -1207	Scheme : Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities Client : EPTISA SERVICIOS INGENIERIA S.L Location : Nasirabadi, Chittagong, Bangladesh	B.H Depth : 12.00m GWT : 0.600m Started : 14/3/2017 Completed : 15/3/2017
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[Elevation= 11.52m]

N-381438.968

E-2471487.155

[TBM-1=14.215m (PWD)]



BORE LOG (Bore Hole # -05)

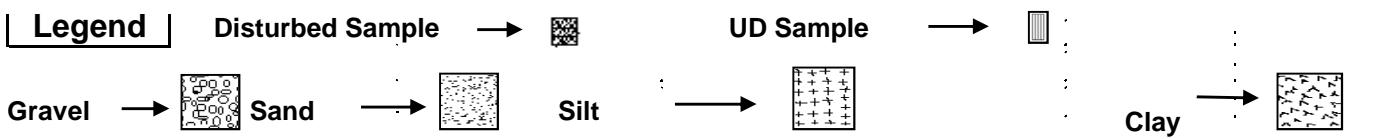
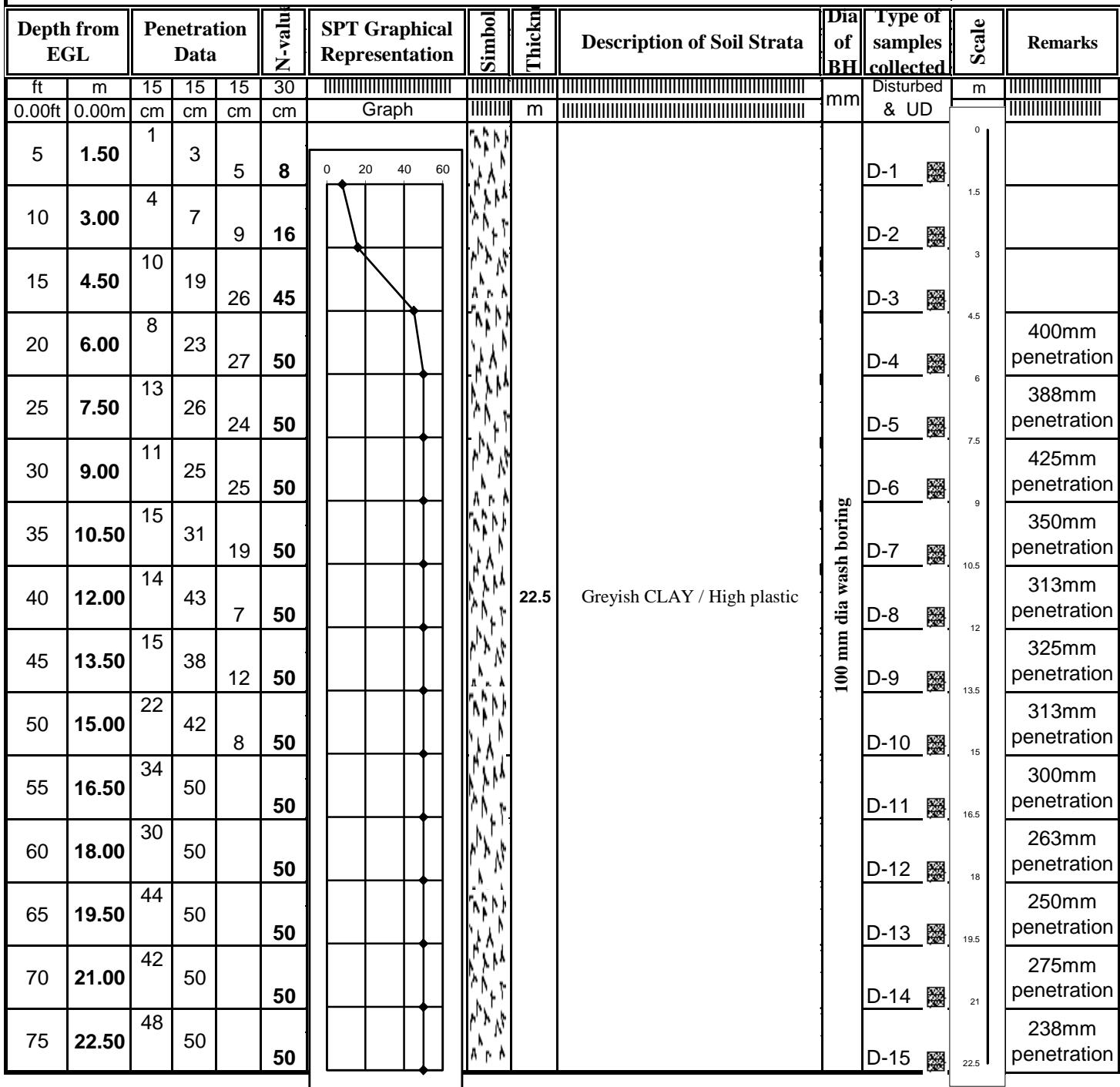
Suchana Engineers Ltd 272/A West Agargaon Modina Saluk Dhaka -1207	Scheme : Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities Client : EPTISA SERVICIOS INGENIERIA S.L Location : Nasirabad, Chittagong, Bangladesh	B.H Depth : 22.50m GWT : 0.900m Started : 16/3/2017 Completed : 17/3/2017
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[Elevation= 10.50m]

N-381363.008

E-2471476.770

[TBM-1=14.215m (PWD)]



BORE LOG (Bore Hole # -06)

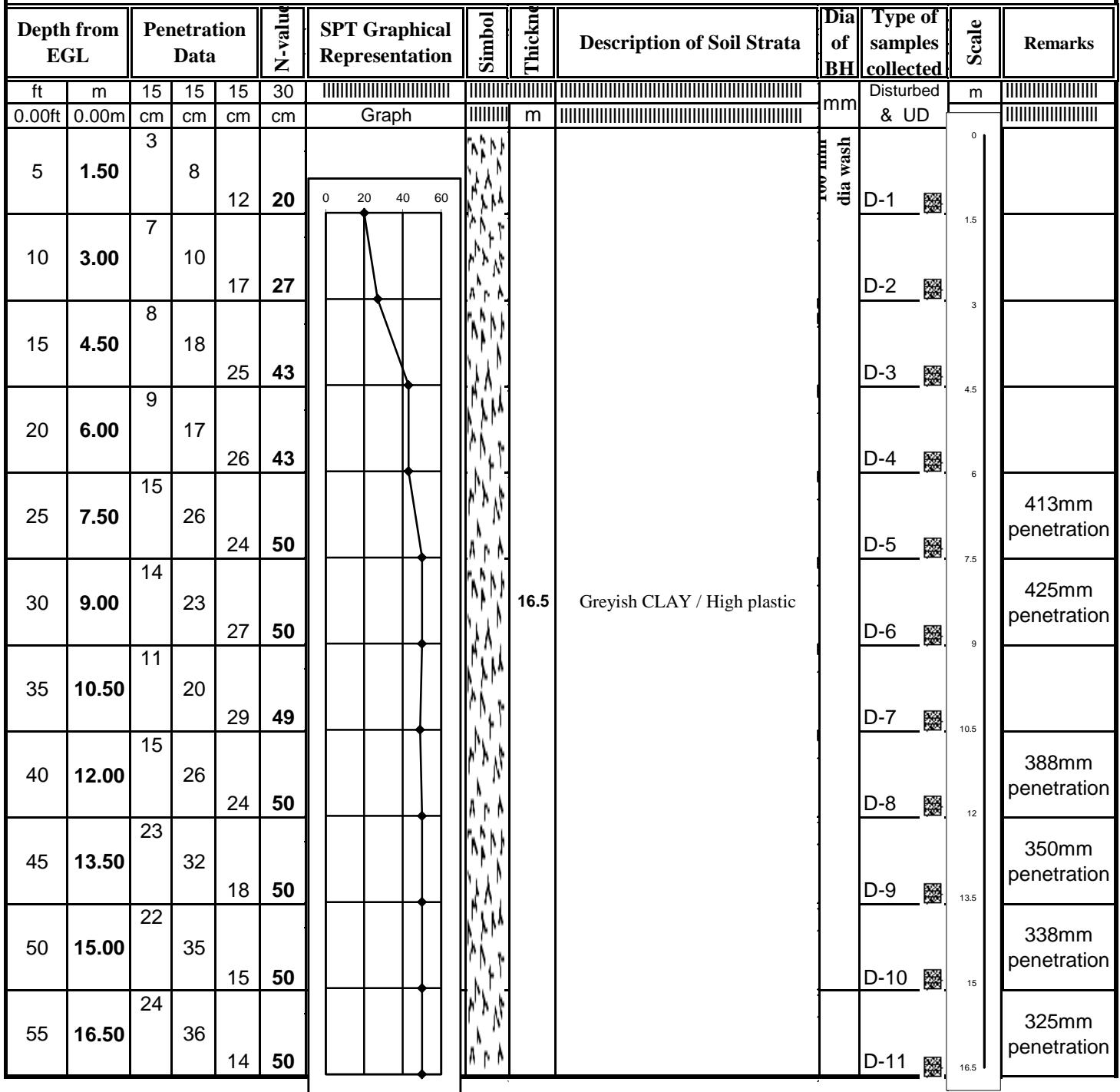
Suchana Engineers Ltd 272/A West Agargaon Modina Saluk Dhaka -1207	Scheme : Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities Client : EPTISA SERVICIOS INGENIERIA S.L Location : Nasirabad, Chittagong, Bangladesh	B.H Depth : 16.50m GWT : 3.750m Started : 18/3/2017 Completed : 19/3/2017
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[Elevation= 13.50m]

N-381436.451'

E-2471427.478

[TBM-1=14.215m (PWD)]



Legend

Disturbed Sample →

UD Sample →

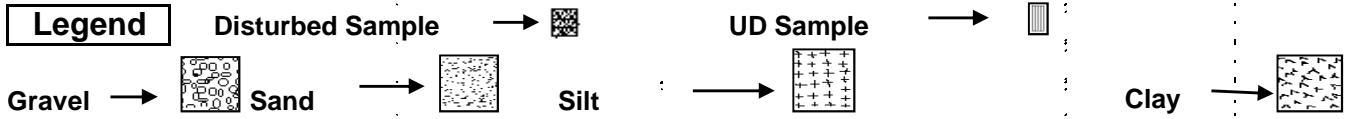
Gravel → Sand →

Silt →

Clay →

BORE LOG (Bore Hole # -07)

Suchana Engineers Ltd 272/A West Agargaon Modina Saluk Dhaka -1207				Scheme : Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities Client : EPTISA SERVICIOS INGENIERIA S.L Location : Nasirabad, Chittagong, Bangladesh				B.H Depth : 12.00m GWT : 2.750m Started : 8/3/2017 Completed : 9/3/2017					
[Elevation= 13.49m]				N-381331.430				E-2471417.548				[TBM-1=14.215m (PWD)]	
Depth from EGL		Penetration Data		N value	SPT Graphical Representation	Symbol	Thickness	Description of Soil Strata		Dia of BH	Type of samples collected	Scale	Remarks
ft	m	15	15	15	30		mm	Disturbed & UD	m	mm	mm	mm	mm
0.00ft	0.00m	cm	cm	cm	cm	Graph	m						
5	1.50	4	5	6	11		12.0	0 to 120 mm dia wash					
10	3.00	5	10	16	26				D-1	0	1.5		
15	4.50	6	15	22	37				D-2	1.5	3		
20	6.00	8	18	25	43				D-3	3	4.5		
25	7.50	9	17	27	44				D-4	4.5	6		
30	9.00	10	20	25	45				D-5	6	7.5		
35	10.50	13	26	24	50				D-6	7.5	9		
40	12.00	15	29	21	50				D-7	9	10.5	413mm penetration	
									D-8	10.5	12	375mm penetration	



BORE LOG (Bore Hole # -08)

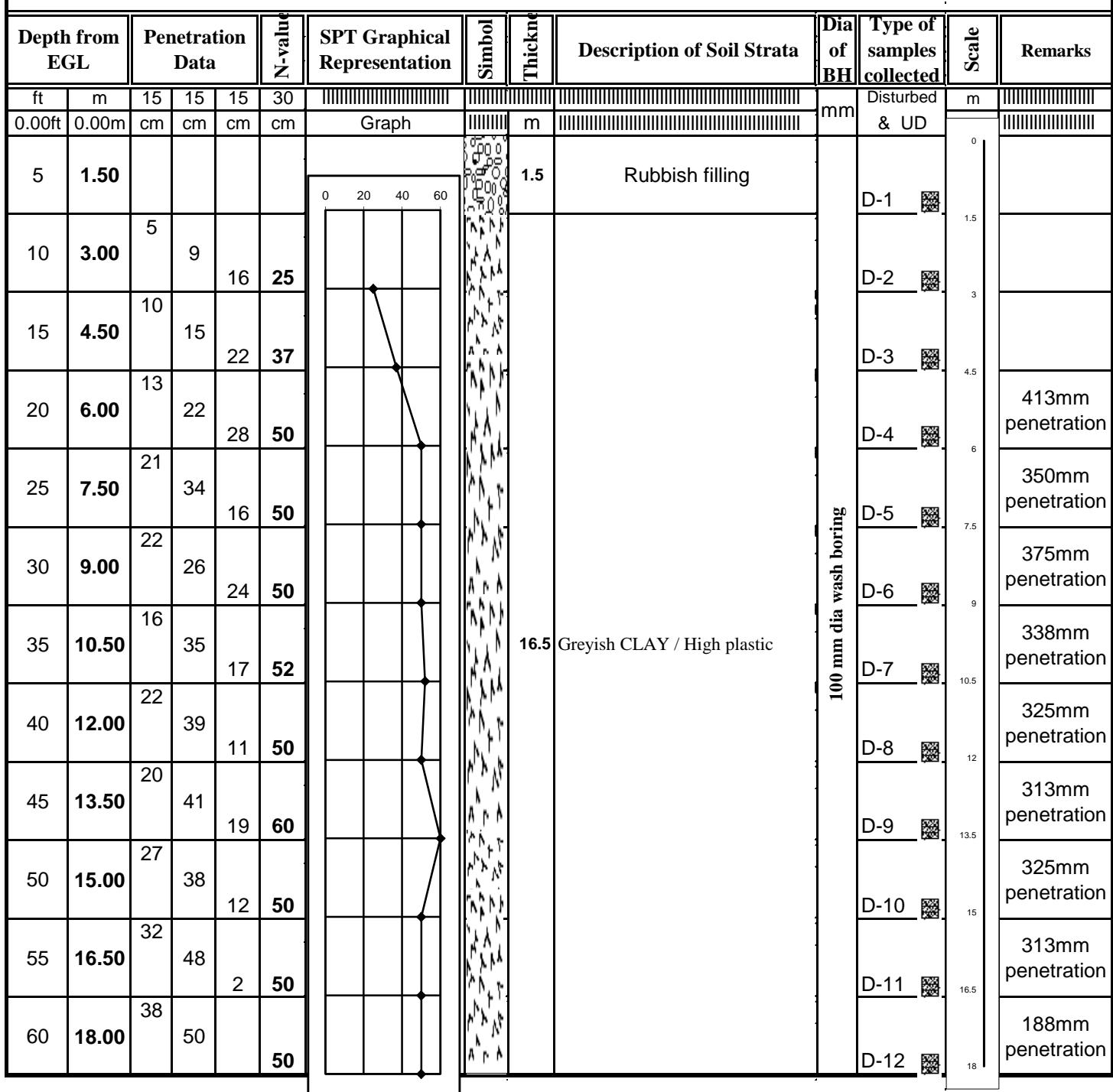
Suchana Engineers Ltd 272/A West Agargaon Modina Saluk Dhaka -1207	Scheme : Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities Client : EPTISA SERVICIOS INGENIERIA S.L Location : Nasirabad, Chittagong, Bangladesh	B.H Depth : 18.00m GWT : 2.150m Started : 20/3/2017 Completed : 21/3/2017
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[Elevation= 14.50m]

N-381448.011

E-2471362.934

[TBM-1=14.215m (PWD)]



SEL

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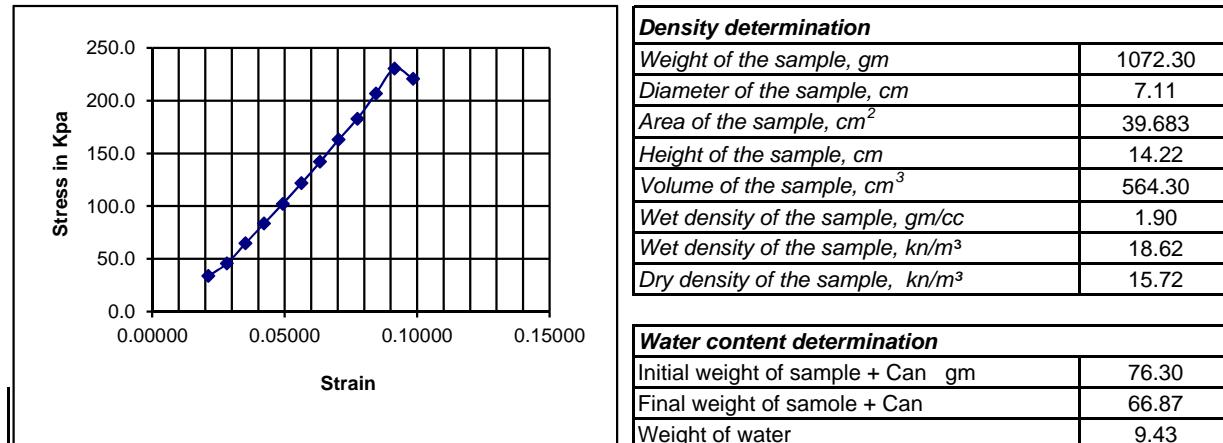
SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Unconfined Compression Test

BH-1	Depth: 2.40m-2.90m	Sample no. UD-1
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Description of Sample :Greyish Clay

<i>Deformation Dial reading</i>	<i>Specimen deformation</i>	<i>Strain</i>	<i>Corrected area</i>	<i>Load dial reading (div)</i>	<i>Total load on specimen</i>	<i>Sample stress</i>
0.01mm	cm	$\epsilon = \Delta L / L_0$	cm ²	0.001mm	KN	Kpa
200	0.2	0.01406	40.249	65	0.0520	12.9
300	0.3	0.02110	40.538	150	0.1370	33.8
400	0.4	0.02813	40.832	200	0.1870	45.8
500	0.5	0.03516	41.129	280	0.2670	64.9
600	0.6	0.04219	41.431	360	0.3470	83.8
700	0.7	0.04923	41.738	440	0.4270	102.3
800	0.8	0.05626	42.049	525	0.5120	121.8
900	0.9	0.06329	42.364	615	0.6020	142.1
1000	1	0.07032	42.685	710	0.6970	163.3
1100	1.1	0.07736	43.010	800	0.7870	183.0
1200	1.2	0.08439	43.340	910	0.8970	207.0
1300	1.3	0.09142	43.676	1020	1.0070	230.6
1400	1.4	0.09845	44.017	985	0.9720	220.8



Results :
Cohesion, $q_u = 230.6$ Kpa
Cohesion, $c_u = 115.30$ Kpa
Strain = 9 %

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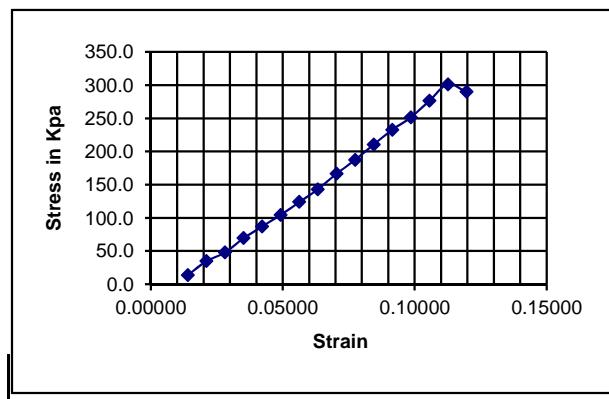
SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Unconfined Compression Test

BH-3	Depth: 3.70m-4.20m	Sample no. UD-3
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Description of Sample :Yellowish Clay

<i>Deformation Dial reading</i>	<i>Specimen deformation</i>	<i>Strain</i>	<i>Corrected area</i>	<i>Load dial reading (div)</i>	<i>Total load on specimen</i>	<i>Sample stress</i>
0.01mm	cm	$\epsilon = \Delta L / L_0$	cm ²	0.001mm	KN	Kpa
200	0.2	0.01406	40.249	70	0.0570	14.2
300	0.3	0.02110	40.538	155	0.1420	35.0
400	0.4	0.02813	40.832	210	0.1970	48.2
500	0.5	0.03516	41.129	300	0.2870	69.8
600	0.6	0.04219	41.431	375	0.3620	87.4
700	0.7	0.04923	41.738	450	0.4370	104.7
800	0.8	0.05626	42.049	535	0.5220	124.1
900	0.9	0.06329	42.364	620	0.6070	143.3
1000	1.0	0.07032	42.685	725	0.7120	166.8
1100	1.1	0.07736	43.010	820	0.8070	187.6
1200	1.2	0.08439	43.340	925	0.9120	210.4
1300	1.3	0.09142	43.676	1030	1.0170	232.9
1400	1.4	0.09845	44.017	1120	1.1070	251.5
1500	1.5	0.10549	44.363	1240	1.2270	276.6
1600	1.6	0.11252	44.714	1360	1.3470	301.2
1700	1.7	0.11955	45.071	1320	1.3070	290.0



Results :

Cohesion, $q_u = 301.2$ Kpa
Cohesion, $c_u=150.60$ Kpa
Strain = 11%

Density determination

Weight of the sample, gm	1080.30
Diameter of the sample, cm	7.11
Area of the sample, cm ²	39.683
Height of the sample, cm	14.22
Volume of the sample, cm ³	564.30
Wet density of the sample, gm/cc	1.91
Wet density of the sample, kn/m ³	18.76
Dry density of the sample, kn/m ³	15.81

Water content determination

Initial weight of sample + Can gm	68.30
Final weight of samole + Can	60.02
Weight of water	8.28
Weight of can gm	15.81
Weight of Sample gm	44.21
Moisture content, %	18.7

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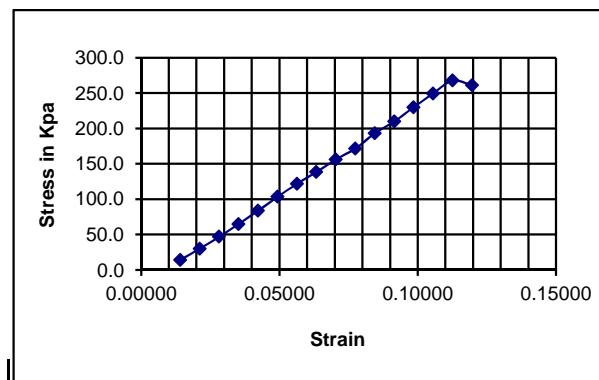
SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Unconfined Compression Test

BH-4	Depth: 5.20m - 5.70m	Sample no. UD-4
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Description of Sample :Greyish Clay

Deformation Dial reading	Specimen deformation	Strain	Corrected area	Load dial reading (div)	Total load on specimen	Sample stress
0.01mm	cm	$\epsilon = \Delta L / L_0$	cm ²	0.001mm	KN	Kpa
200	0.2	0.01406	40.249	70	0.0570	14.2
300	0.3	0.02110	40.538	135	0.1220	30.1
400	0.4	0.02813	40.832	205	0.1920	47.0
500	0.5	0.03516	41.129	280	0.2670	64.9
600	0.6	0.04219	41.431	360	0.3470	83.8
700	0.7	0.04923	41.738	445	0.4320	103.5
800	0.8	0.05626	42.049	525	0.5120	121.8
900	0.9	0.06329	42.364	600	0.5870	138.6
1000	1.0	0.07032	42.685	680	0.6670	156.3
1100	1.1	0.07736	43.010	750	0.7370	171.4
1200	1.2	0.08439	43.340	850	0.8370	193.1
1300	1.3	0.09142	43.676	930	0.9170	210.0
1400	1.4	0.09845	44.017	1025	1.0120	229.9
1500	1.5	0.10549	44.363	1120	1.1070	249.5
1600	1.6	0.11252	44.714	1210	1.1970	267.7
1700	1.7	0.11955	45.071	1190	1.1770	261.1



Density determination

Weight of the sample, gm	1076.94
Diameter of the sample, cm	7.11
Area of the sample, cm ²	39.683
Height of the sample, cm	14.22
Volume of the sample, cm ³	564.30
Wet density of the sample, gm/cc	1.91
Wet density of the sample, kn/m ³	18.70
Dry density of the sample, kn/m ³	15.80

Water content determination

Initial weight of sample + Can gm	62.30
Final weight of samole + Can	55.06
Weight of water	7.24
Weight of can gm	15.81
Weight of Sample gm	39.25
Moisture content, %	18.4

Results :

Cohesion, $q_u = 267.7$ Kpa
Cohesion, $c_u = 133.85$ Kpa
Strain = 11%

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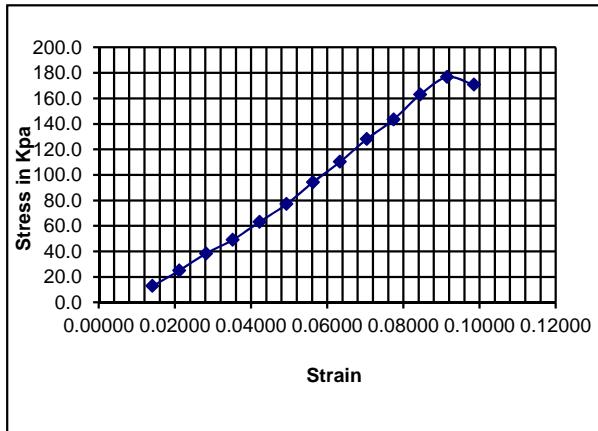
SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Unconfined Compression Test

BH-5	Depth: 3.70m-4.20m	Sample no. UD-5
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Description of Sample :Greyish Clay

Deformation Dial reading	Specimen deformation	Strain	Corrected area	Load dial reading (div)	Total load on specimen	Sample stress
0.01mm	cm	$\epsilon = \Delta L / L_0$	cm ²	0.001mm	KN	Kpa
200	0.2	0.01406	40.249	65	0.0520	12.9
300	0.3	0.02110	40.538	115	0.1020	25.2
400	0.4	0.02813	40.832	170	0.1570	38.5
500	0.5	0.03516	41.129	215	0.2020	49.1
600	0.6	0.04219	41.431	275	0.2620	63.2
700	0.7	0.04923	41.738	335	0.3220	77.1
800	0.8	0.05626	42.049	410	0.3970	94.4
900	0.9	0.06329	42.364	480	0.4670	110.2
1000	1	0.07032	42.685	560	0.5470	128.1
1100	1.1	0.07736	43.010	630	0.6170	143.5
1200	1.2	0.08439	43.340	720	0.7070	163.1
1300	1.3	0.09142	43.676	785	0.7720	176.8
1400	1.4	0.09845	44.017	765	0.7520	170.8



Density determination

Weight of the sample, gm	1070.52
Diameter of the sample, cm	7.11
Area of the sample, cm ²	39.683
Height of the sample, cm	14.22
Volume of the sample, cm ³	564.30
Wet density of the sample, gm/cc	1.90
Wet density of the sample, kn/m ³	18.6
Dry density of the sample, kn/m ³	16.2

Water content determination

Initial weight of sample + Can gm	83.40
Final weight of samole + Can	74.56
Weight of water	8.84
Weight of can gm	15.81
Weight of Sample gm	58.75
Moisture content, %	15.0

Results :

Cohesion, $q_u = 176.80$ Kpa
Cohesion, $c_u = 88.40$ Kpa
Strain = 9%

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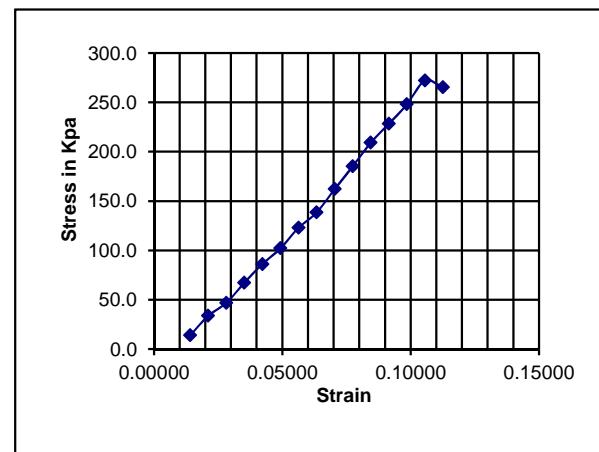
SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Unconfined Compression Test

BH-6	Depth: 2.40m-2.90m	Sample no. UD-6
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Description of Sample :Greyish Clay

<i>Deformation Dial reading</i>	<i>Specimen deformation</i>	<i>Strain</i>	<i>Corrected area</i>	<i>Load dial reading (div)</i>	<i>Total load on specimen</i>	<i>Sample stress</i>
0.01mm	cm	$\epsilon = \Delta L / L_0$	cm ²	0.001mm	KN	Kpa
200	0.2	0.01406	40.249	70	0.0570	14.2
300	0.3	0.02110	40.538	150	0.1370	33.8
400	0.4	0.02813	40.832	205	0.1920	47.0
500	0.5	0.03516	41.129	290	0.2770	67.3
600	0.6	0.04219	41.431	370	0.3570	86.2
700	0.7	0.04923	41.738	440	0.4270	102.3
800	0.8	0.05626	42.049	530	0.5170	123.0
900	0.9	0.06329	42.364	600	0.5870	138.6
1000	1	0.07032	42.685	705	0.6920	162.1
1100	1.1	0.07736	43.010	810	0.7970	185.3
1200	1.2	0.08439	43.340	920	0.9070	209.3
1300	1.3	0.09142	43.676	1010	0.9970	228.3
1400	1.4	0.09845	44.017	1105	1.0920	248.1
1500	1.5	0.10549	44.363	1220	1.2070	272.1
1600	1.6	0.11252	44.714	1200	1.1870	265.5



Density determination

Weight of the sample, gm	1083.60
Diameter of the sample, cm	7.11
Area of the sample, cm ²	39.683
Height of the sample, cm	14.22
Volume of the sample, cm ³	564.30
Wet density of the sample, gm/cc	1.92
Wet density of the sample, kn/m ³	18.82
Dry density of the sample, kn/m ³	15.98

Water content determination

Initial weight of sample + Can gm	85.60
Final weight of samole + Can	75.04
Weight of water	10.56
Weight of can gm	15.81
Weight of Sample gm	59.23
Moisture content, %	17.8

Results :

Cohesion, $q_u = 272.10$ Kpa
Cohesion, $c_u = 136.05$ Kpa
Strain = 10 %

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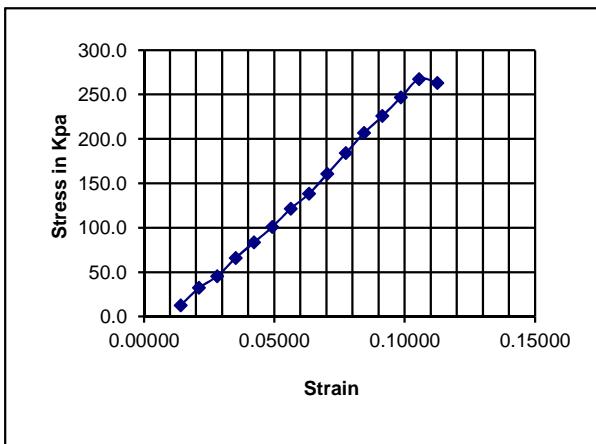
SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Unconfined Compression Test

BH-7	Depth: 3.70m-4.20m	Sample no. UD-7
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Description of Sample :Greyish Clay

Deformation Dial reading	Specimen deformation	Strain	Corrected area	Load dial reading (div)	Total load on specimen	Sample stress
0.01mm	cm	$\epsilon = \Delta L / L_0$	cm ²	0.001mm	KN	Kpa
200	0.2	0.01406	40.249	65	0.0520	12.9
300	0.3	0.02110	40.538	145	0.1320	32.6
400	0.4	0.02813	40.832	200	0.1870	45.8
500	0.5	0.03516	41.129	285	0.2720	66.1
600	0.6	0.04219	41.431	360	0.3470	83.8
700	0.7	0.04923	41.738	435	0.4220	101.1
800	0.8	0.05626	42.049	525	0.5120	121.8
900	0.9	0.06329	42.364	600	0.5870	138.6
1000	1.0	0.07032	42.685	700	0.6870	160.9
1100	1.1	0.07736	43.010	805	0.7920	184.1
1200	1.2	0.08439	43.340	910	0.8970	207.0
1300	1.3	0.09142	43.676	1000	0.9870	226.0
1400	1.4	0.09845	44.017	1100	1.0870	247.0
1500	1.5	0.10549	44.363	1200	1.1870	267.6
1600	1.6	0.11252	44.714	1190	1.1770	263.2



Density determination	
Weight of the sample, gm	1071.80
Diameter of the sample, cm	7.11
Area of the sample, cm ²	39.683
Height of the sample, cm	14.22
Volume of the sample, cm ³	564.30
Wet density of the sample, gm/cc	1.90
Wet density of the sample, kn/m ³	18.61
Dry density of the sample, kn/m ³	15.76

Water content determination	
Initial weight of sample + Can gm	75.80
Final weight of samole + Can	66.59
Weight of water	9.21
Weight of can gm	15.81
Weight of Sample gm	50.78
Moisture content, %	18.1

Results :
Cohesion, $q_u = 267.60$ Kpa
Cohesion, $c_u = 133.80$ Kpa
Strain = 10

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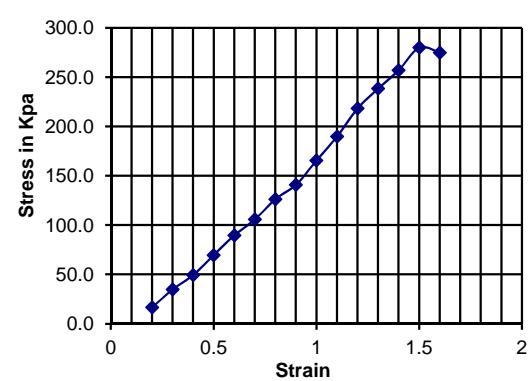
SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Unconfined Compression Test

BH-8	Depth: 3.70m-4.20m	Sample no. UD-8
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Description of Sample : Greyish Clay

<i>Deformation Dial reading</i>	<i>Specimen deformation</i>	<i>Strain</i>	<i>Corrected area</i>	<i>Load dial reading (div)</i>	<i>Total load on specimen</i>	<i>Sample stress</i>
0.01mm	cm	$\epsilon = \Delta L / L_0$	cm ²	0.001mm	KN	Kpa
200	0.2	0.01406	40.249	80	0.0670	16.6
300	0.3	0.02110	40.538	155	0.1420	35.0
400	0.4	0.02813	40.832	215	0.2020	49.5
500	0.5	0.03516	41.129	300	0.2870	69.8
600	0.6	0.04219	41.431	385	0.3720	89.8
700	0.7	0.04923	41.738	455	0.4420	105.9
800	0.8	0.05626	42.049	545	0.5320	126.5
900	0.9	0.06329	42.364	610	0.5970	140.9
1000	1	0.07032	42.685	720	0.7070	165.6
1100	1.1	0.07736	43.010	830	0.8170	190.0
1200	1.2	0.08439	43.340	960	0.9470	218.5
1300	1.3	0.09142	43.676	1055	1.0420	238.6
1400	1.4	0.09845	44.017	1145	1.1320	257.2
1500	1.5	0.10549	44.363	1255	1.2420	280.0
1600	1.6	0.11252	44.714	1242	1.2290	274.9



Density determination

Weight of the sample, gm	1092.80
Diameter of the sample, cm	7.11
Area of the sample, cm ²	39.683
Height of the sample, cm	14.22
Volume of the sample, cm ³	564.30
Wet density of the sample, gm/cc	1.94
Wet density of the sample, kn/m ³	18.98
Dry density of the sample, kn/m ³	16.93

Water content determination

Initial weight of sample + Can gm	84.30
Final weight of samole + Can	72.45
Weight of water	11.85
Weight of can gm	15.81
Weight of Sample gm	56.64
Moisture content, %	20.9

Results :

Cohesion, $q_u = 280.00$ Kpa
Cohesion, $c_u = 140.00$ Kpa
Strain = 15%

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Specific Gravity test

BH No	1	1	2	3	3	4
Depth in m	3.00	6.00	6.00	3.00	9.00	1.50
Pycnometer. no.	A	B	C	D	F	G
Observed temparature, Tx in oC	25	25	25	25	25	25
Weight of soil in Oven dried, Ws gm	20.00	20.00	20.00	20.00	20.00	20.00
Weight of Pycnometer + water, W2 (at Tx) in gm	150.32	155.09	144.96	149.27	171.20	174.44
Wt. of Pycnometer + water + soil, W1 (at Tx) in gm	162.84	167.62	157.41	161.82	183.77	187.00
Specific Gravity, Gt (at Tx)= Ws/(Ws+W2)-W1	2.663	2.667	2.638	2.674	2.681	2.677
Density of water at Tx oC in gm/cc				0.9971		
Density of water at Tx 20 oC in gm/cc				0.9982		
Specific Gravity, G at Tx 20 oC in gm/cc	2.658	2.662	2.634	2.669	2.676	2.673

BH No	4	5	5	6	6	7
Depth in m	6.00	4.50	10.50	10.50	15.00	4.50
Pycnometer. no.	H	I	J	K	L	M
Observed temparature, Tx in oC	25	25	25	25	25	25
Weight of soil in Oven dried, Ws gm	20.00	20.00	20.00	20.00	20.00	20.00
Weight of Pycnometer + water, W2 (at Tx) in gm	175.91	149.61	173.89	173.71	157.19	157.52
Wt. of Pycnometer + water + soil, W1 (at Tx) in gm	188.45	162.14	186.44	186.28	169.77	170.07
Specific Gravity, Gt (at Tx)= Ws/(Ws+W2)-W1	2.670	2.667	2.674	2.681	2.685	2.674
Density of water at Tx oC in gm/cc				0.9971		
Density of water at Tx 20 oC in gm/cc				0.9982		
Specific Gravity, G at Tx 20 oC in gm/cc	2.665	2.662	2.669	2.676	2.680	2.669

BH No	8	8	8
Depth in m	6.00	12.00	16.50
Pycnometer. no.	N	P	A
Observed temparature, Tx in oC	25	25	25
Weight of soil in Oven dried, Ws gm	20.00	20.00	20.00
Weight of Pycnometer + water, W2 (at Tx) in gm	151.84	151.84	150.32
Wt. of Pycnometer + water + soil, W1 (at Tx) in gm	164.40	164.42	162.95
Specific Gravity, Gt (at Tx)= Ws/(Ws+W2)-W1	2.677	2.685	2.703
Density of water at Tx oC in gm/cc		0.9971	
Density of water at Tx 20 oC in gm/cc		0.9982	
Specific Gravity, G at Tx 20 oC in gm/cc	2.673	2.680	2.698

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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

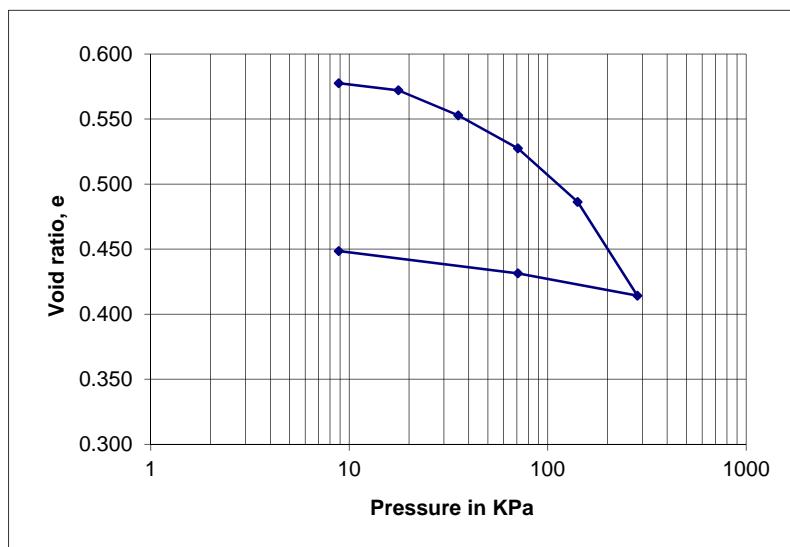
Consolidation Test

Void ratio and coefficient of consolidation calculation

Pressure	Final dial reading	Final dial reading	Change in Specimen height (cm)	Final Specimen height (cm)	Height of void (cm)	Instant void ratio, e
KN/m ²	0.01mm/div	cm	Δh , cm	H _i	H _v =H _i -H _s	H _v /H _s
0	0	0	0	2.30	0.843	0.579
8.85	2	0.002	0.002	2.30	0.841	0.578
17.70	12	0.012	0.01	2.29	0.833	0.572
35.40	50	0.05	0.04	2.26	0.805	0.553
70.80	125	0.125	0.075	2.23	0.768	0.527
141.60	260	0.26	0.135	2.17	0.708	0.486
283.20	365	0.365	0.11	2.06	0.603	0.414
70.80	340	0.34	-0.03	2.09	0.628	0.431
8.85	315	0.315	-0.03	2.11	0.653	0.449

BH-3
Sample no. UD-3
Depth:3.70m-4.20m
Sample : Clay soil

Data:



Height of sample,H _i (cm)	2.30
Dia of sample, cm	6.00
Area of sample, cm ²	28.3
Height of solid,H _s (cm)	1.46
Wt of wet sample, gm	128.30
Wt of dry sample, gm	109.87
Sp. Gravity, G _s	2.669

Results

<i>Initial void ratio, e</i>	0.579
<i>Compression Index, C_c</i>	0.239
<i>Swelling Index, C_s</i>	0.019
<i>Wet density γ_o, gm/cc</i>	1.97
<i>Dry density, γ_d, gm/cc</i>	1.69

Figure: Void ratio vs Stress, e log p crve

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

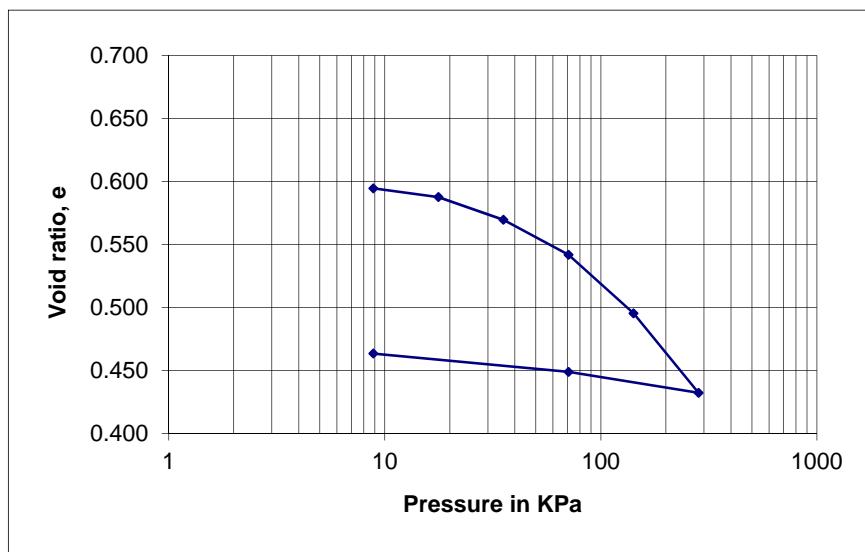
Consolidation Test

Void ratio and coefficient of consolidation calculation

Pressure	Final dial reading	Final dial reading	Change in Specimen height (cm)	Final Specimen height (cm)	Height of void (cm)	Instant void ratio, e
KN/m ²	0.01mm/div	cm	Δh , cm	H _i	H _v =H _i -H _s	H _v /H _s
0	0	0	0	2.30	0.859	0.596
8.85	2	0.002	0.002	2.30	0.857	0.595
17.70	14	0.014	0.012	2.29	0.847	0.588
35.40	52	0.052	0.04	2.26	0.821	0.570
70.80	130	0.13	0.078	2.22	0.781	0.542
141.60	275	0.275	0.145	2.16	0.714	0.495
283.20	366	0.366	0.09	2.06	0.623	0.432
70.80	342	0.342	-0.02	2.09	0.647	0.449
8.85	321	0.321	-0.02	2.11	0.668	0.463

BH-4
Sample no. UD-4
Depth: 5.20m-5.70m
Sample : Clay soil

Data:



Height of sample, H _i (cm)	2.30
Dia of sample, cm	6.00
Area of sample, cm ²	28.3
Height of solid, H _s (cm)	1.44
Wt of wet sample, gm	126.35
Wt of dry sample, gm	108.54
Sp. Gravity, G _s	2.665

Results

Initial void ratio, e	0.596
Compression Index, C _c	0.210
Swelling Index, C _s	0.016
Wet density γ_o , gm/cc	1.94
Dry density, γ_d , gm/cc	1.66

Figure: Void ratio vs Stress, e log p crve

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Consolidation Test

Void ratio and coefficient of consolidation calculation

Pressure	Final dial reading	Final dial reading	Change in Specimen height (cm)	Final Specimen height (cm)	Height of void (cm)	Instant void ratio, e
KN/m ²	0.01mm/div	cm	Δh , cm	Hi	Hv=Hi-Hs	Hv/Hs
0	5	0.005	0	2.30	0.901	0.644
8.85	15	0.015	0.01	2.29	0.891	0.637
17.70	30	0.03	0.015	2.29	0.886	0.633
35.40	65	0.065	0.04	2.27	0.866	0.619
70.80	135	0.135	0.07	2.23	0.831	0.594
141.60	278	0.278	0.143	2.16	0.758	0.542
283.20	376	0.376	0.10	2.06	0.660	0.472
70.80	350	0.35	-0.03	2.09	0.686	0.490
8.85	330	0.33	-0.02	2.11	0.706	0.505

BH-5
Sample no. UD-5
Depth:3.70m-4.20m
Sample : Clay soil

Data:

Height of sample,Hi (cm)	2.30
Dia of sample, cm	6.00
Area of sample, cm ²	28.3
Height of solid,Hs (cm)	1.40
Wt of wet sample, gm	122.32
Wt of dry sample, gm	105.24
Sp. Gravity, Gs	2.662

Results

Initial void ratio, e	0.644
Compression Index, Cc	0.233
Swelling Index, Cs	0.016
Wet density γ_o , gm/cc	1.88
Dry density, γ_d , gm/cc	1.62

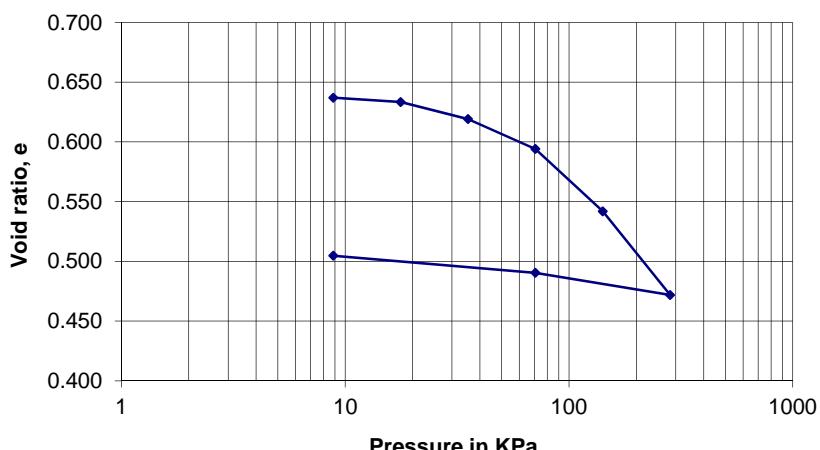


Figure: Void ratio vs Stress, e log p crve

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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

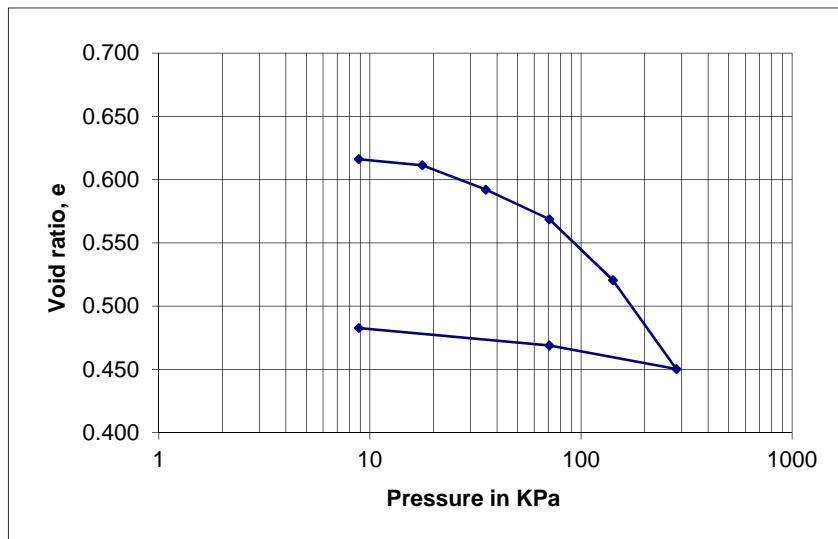
Consolidation Test

Void ratio and coefficient of consolidation calculation

Pressure	Final dial reading	Final dial reading	Change in Specimen height (cm)	Final Specimen height (cm)	Height of void (cm)	Instant void ratio, e
KN/m ²	0.01mm/div	cm	Δh , cm	H _i	H _v =H _i -H _s	H _v /H _s
0	0	0	0	2.30	0.901	0.620
8.85	6	0.006	0.006	2.29	0.895	0.616
17.70	19	0.019	0.013	2.29	0.888	0.611
35.40	60	0.06	0.04	2.26	0.860	0.592
70.80	135	0.135	0.075	2.23	0.826	0.569
141.60	280	0.28	0.145	2.16	0.756	0.521
283.20	382	0.382	0.10	2.05	0.654	0.450
70.80	355	0.355	-0.03	2.08	0.681	0.469
8.85	335	0.335	-0.02	2.10	0.701	0.483

BH-6
Sample no. UD-6
Depth:3.70m-4.20m
Sample : Clay soil

Data:



Height of sample, H _i (cm)	2.30
Dia of sample, cm	6.00
Area of sample, cm ²	28.3
Height of solid, H _s (cm)	1.45
Wt of wet sample, gm	129.50
Wt of dry sample, gm	109.84
Sp. Gravity, G _s	2.676

Results

<i>Initial void ratio, e</i>	0.620
<i>Compression Index, C_c</i>	0.233
<i>Swelling Index, C_s</i>	0.015
<i>Wet density γ_o, gm/cc</i>	1.99
<i>Dry density, γ_d, gm/cc</i>	1.69

Figure: Void ratio vs Stress, e log p crve

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

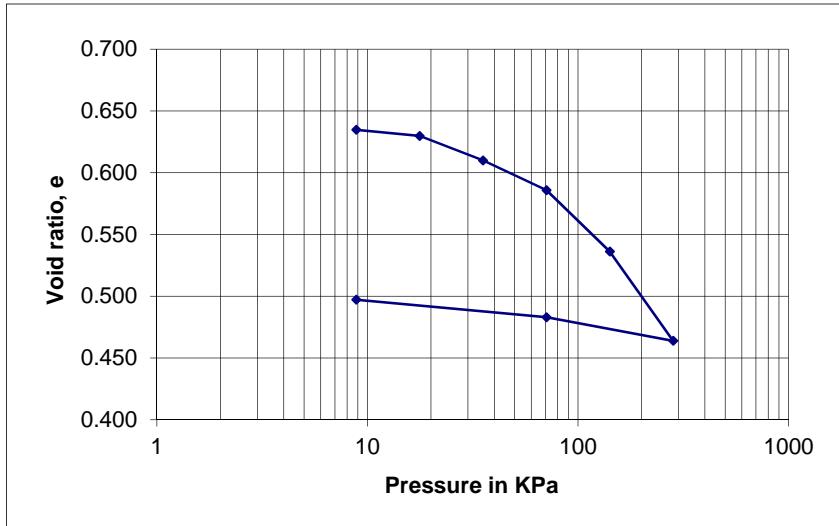
Consolidation Test

Void ratio and coefficient of consolidation calculation

Pressure	Final dial reading	Final dial reading	Change in Specimen height (cm)	Final Specimen height (cm)	Height of void (cm)	Instant void ratio, e
KN/m ²	0.01mm/div	cm	Δh , cm	Hi	Hv=Hi-Hs	Hv/Hs
0	0	0	0	2.30	0.901	0.639
8.85	6	0.006	0.006	2.29	0.895	0.635
17.70	19	0.019	0.013	2.29	0.888	0.630
35.40	60	0.06	0.04	2.26	0.860	0.610
70.80	135	0.135	0.075	2.23	0.826	0.586
141.60	280	0.28	0.145	2.16	0.756	0.536
283.20	382	0.382	0.10	2.05	0.654	0.464
70.80	355	0.355	-0.03	2.08	0.681	0.483
8.85	335	0.335	-0.02	2.10	0.701	0.497

BH-7
Sample no. UD-7
Depth: 3.70m-4.20m
Sample : Clay soil

Data:



Height of sample, Hi (cm)	2.30
Dia of sample, cm	6.00
Area of sample, cm ²	28.3
Height of solid, Hs (cm)	1.41
Wt of wet sample, gm	125.70
Wt of dry sample, gm	106.35
Sp. Gravity, Gs	2.669

Results

Initial void ratio, e	0.639
Compression Index, Cc	0.240
Swelling Index, Cs	0.016
Wet density γ_o , gm/cc	1.93
Dry density, γ_d , gm/cc	1.63

Figure: Void ratio vs Stress, e log p crve

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

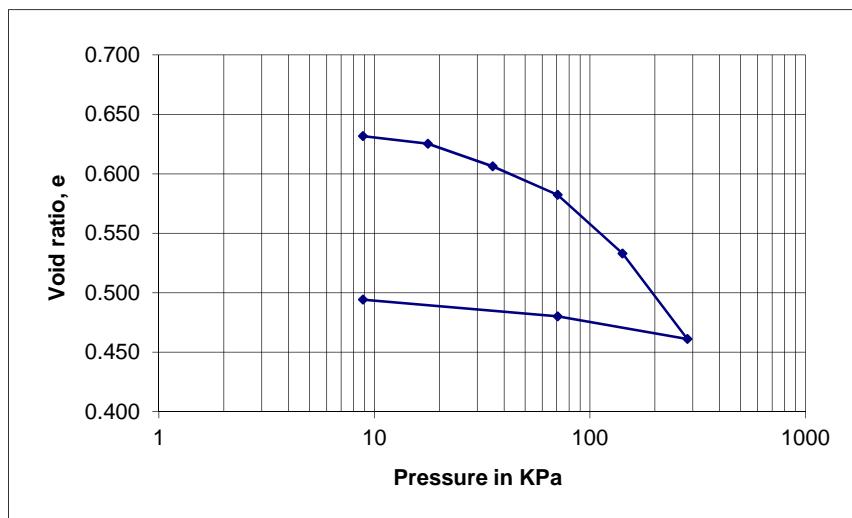
Consolidation Test

Void ratio and coefficient of consolidation calculation

Pressure	Final dial reading	Final dial reading	Change in Specimen height (cm)	Final Specimen height (cm)	Height of void (cm)	Instant void ratio, e
KN/m ²	0.01mm/div	cm	Δh , cm	H _i	H _v =H _i -H _s	H _v /H _s
0	0	0	0	2.30	0.901	0.635
8.85	5	0.005	0.005	2.30	0.896	0.632
17.70	19	0.019	0.014	2.29	0.887	0.625
35.40	60	0.06	0.04	2.26	0.860	0.606
70.80	135	0.135	0.075	2.23	0.826	0.582
141.60	280	0.28	0.145	2.16	0.756	0.533
283.20	382	0.382	0.10	2.05	0.654	0.461
70.80	355	0.355	-0.03	2.08	0.681	0.480
8.85	335	0.335	-0.02	2.10	0.701	0.494

BH-8
Sample no. UD-8
Depth:3.70m-4.20m
Sample : Clay soil

Data:



Height of sample, H _i (cm)	2.30
Dia of sample, cm	6.00
Area of sample, cm ²	28.3
Height of solid, H _s (cm)	1.42
Wt of wet sample, gm	130.00
Wt of dry sample, gm	107.15
Sp. Gravity, G _s	2.673

Results

Initial void ratio, e	0.635
Compression Index, C _c	0.239
Swelling Index, C _s	0.016
Wet density γ_o , gm/cc	2.00
Dry density, γ_d , gm/cc	1.78

Figure: Void ratio vs Stress, e log p crve

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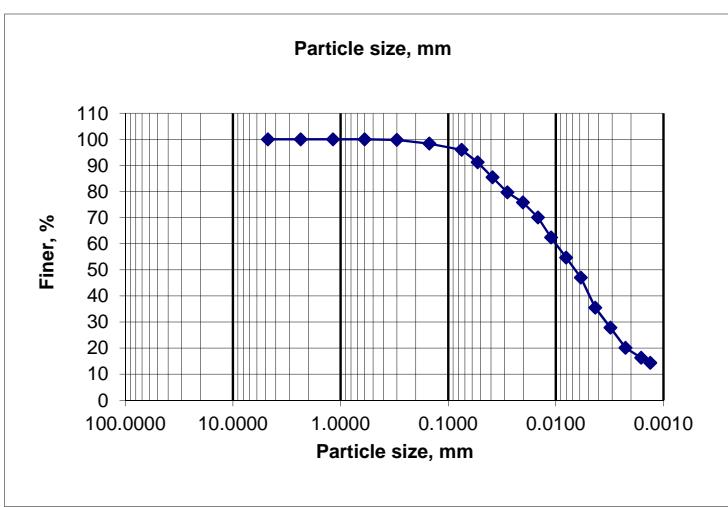
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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
25/3/2017	8:30	0.5	24	47	47.5	8.4	0.01301	0.0533	95	91
	8:31	1	24	44	44.5	8.9	0.01301	0.0388	89	85
	8:32	2	24	41	41.5	9.4	0.01301	0.0282	83	80
	8:34	4	24	39	39.5	9.7	0.01301	0.0203	79	76
	8:38	8	24	36	36.5	10.2	0.01301	0.0147	73	70
	8:45	15	24	32	32.5	10.9	0.01301	0.0111	65	62
	9:00	30	24	28	28.5	11.5	0.01301	0.0081	57	55
	9:30	60	24	24	24.5	12.2	0.01301	0.0059	49	47
	10:30	120	24	18	18.5	13.2	0.01301	0.0043	37	36
	12:30	240	24	14	14.5	13.8	0.01301	0.0031	29	28
	4:30	480	24	10	10.5	14.5	0.01301	0.0023	21	20
26/3/2017	12:30	960	24	8	8.5	14.8	0.01301	0.0016	17	16
	7:12	1440	24	7	7.5	15	0.01301	0.0013	15	14

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
1	3.00	Clay	0.6	0	0	100
			0.3	0.1	0.2	100
			0.15	0.8	1.6	98
			0.075	2	4	96



Results:

Description	Size, mm	Percent
Sand	4.75-0.075	4
Silt	0.075-0.005	60
Clay	0.005-0.001	36
Colloids	< 0.001	0

Grain size parameters	
Silt factor, f	0.15
Coefficient of curvature, Cz	
Coefficient of uniformity, Cu	

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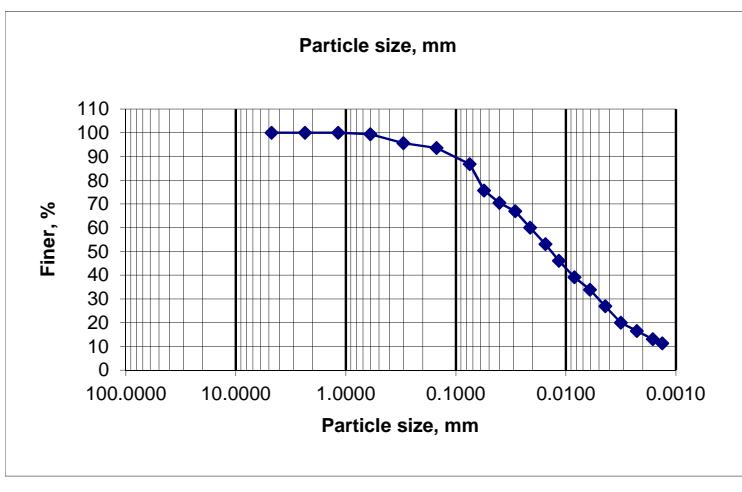
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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
25/3/2017	8:30	0.5	24.0	43	43.5	9.1	0.01301	0.0555	87	76
	8:31	1	24.0	40	40.5	9.6	0.01301	0.0403	81	70
	8:32	2	24.0	38	38.5	9.9	0.01301	0.0289	77	67
	8:34	4	24.0	34	34.5	10.6	0.01301	0.0212	69	60
	8:38	8	24.0	30	30.5	11.2	0.01301	0.0154	61	53
	8:45	15	24.0	26	26.5	11.9	0.01301	0.0116	53	46
	9:00	30	24.0	22	22.5	12.5	0.01301	0.0084	45	39
	9:30	60	24.0	19	19.5	13.0	0.01301	0.0061	39	34
	10:30	120	24.0	15	15.5	13.7	0.01301	0.0044	31	27
	12:30	240	24.0	11	11.5	14.3	0.01301	0.0032	23	20
	4:30	480	24.0	9	9.5	14.7	0.01301	0.0023	19	17
26/3/2017	12:30	960	24.0	7	7.5	15	0.01301	0.0016	15	13
	7:12	1440	24.0	6	6.5	15.2	0.01301	0.0013	13	11

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
1	6.00	Clay	0.6	0.3	0.6	99
			0.3	2.2	4.4	96
			0.15	3.2	6.4	94
			0.075	6.6	13.2	87



Results:

Description	Size, mm	Percent
Sand	4.75-0.075	13
Silt	0.075-0.005	60
Clay	0.005-0.001	27
Colloids	< 0.001	0

Grain size parameters	
Silt factor, f	0.17
Coefficient of curvature. Cz	
Coefficient of uniformity, Cu	

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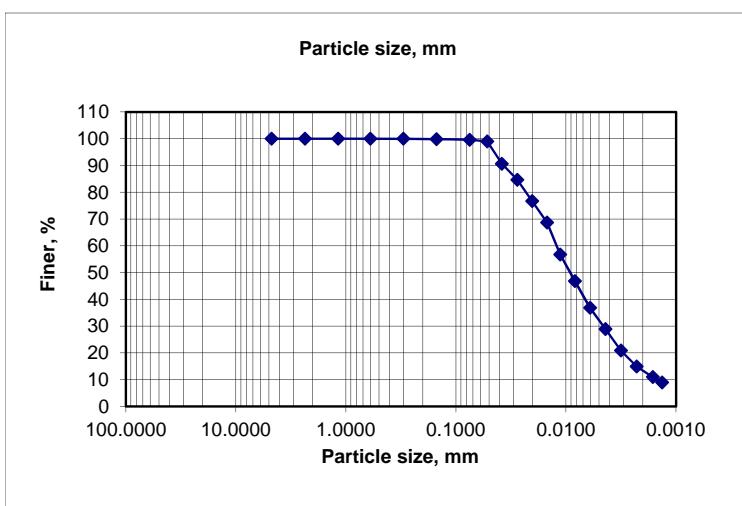
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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, R _o	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
25/3/2017	8:30	0.5	24.0	49	49.5	8.1	0.01290	0.0519	99	99
	8:31	1	24.0	45	45.5	8.8	0.01290	0.0383	91	91
	8:32	2	24.0	42	42.5	9.2	0.01290	0.0277	85	85
	8:34	4	24.0	38	38.5	9.9	0.01290	0.0203	77	77
	8:38	8	24.0	34	34.5	10.6	0.01290	0.0148	69	69
	8:45	15	24.0	28	28.5	11.5	0.01290	0.0113	57	57
	9:00	30	24.0	23	23.5	12.4	0.01290	0.0083	47	47
	9:30	60	24.0	18	18.5	13.2	0.01290	0.0061	37	37
	10:30	120	24.0	14	14.5	13.8	0.01290	0.0044	29	29
	12:30	240	24.0	10	10.5	14.5	0.01290	0.0032	21	21
	4:30	480	24.0	7	7.5	15	0.01290	0.0023	15	15
26/3/2017	12:30	960	24.0	5	5.5	15.3	0.01290	0.0016	11	11
	7:12	1440	24.0	4	4.5	15.5	0.01290	0.0013	9	9

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
3	3.00	Clay	0.6	0	0	100
			0.3	0	0	100
			0.15	0.1	0.2	100
			0.075	0.2	0.4	100



Results:

Description	Size, mm	Percent
Sand	4.75-0.075	0
Silt	0.075-0.005	70
Clay	0.005-0.001	30
Colloids	< 0.001	0

Grain size parameters

Silt factor, f	0.17
Coefficient of curvature, Cz	1.20
Coefficient of uniformity, Cu	8.1

SEL

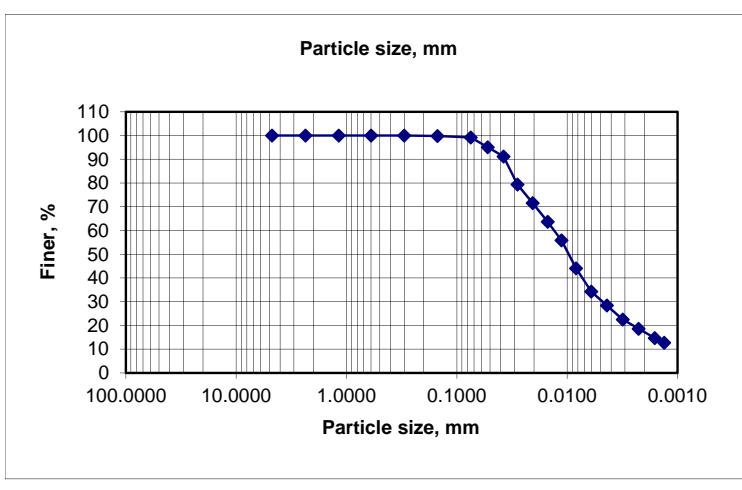
SUCHANA ENGINEERS LTD.
GEOTCHNICAL LABORATORY

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
25/3/2017	8:30	0.5	24.0	48	48.5	8.3	0.01290	0.0526	96	95
	8:31	1	24.0	46	46.5	8.6	0.01290	0.0378	92	91
	8:32	2	24.0	40	40.5	9.6	0.01290	0.0283	80	79
	8:34	4	24.0	36	36.5	10.2	0.01290	0.0206	72	72
	8:38	8	24.0	32	32.5	10.9	0.01290	0.0151	64	64
	8:45	15	24.0	28	28.5	11.5	0.01290	0.0113	56	56
	9:00	30	24.0	22	22.5	12.5	0.01290	0.0083	45	44
	9:30	60	24.0	17	17.5	13.3	0.01290	0.0061	35	34
	10:30	120	24.0	14	14.5	13.8	0.01290	0.0044	29	28
	12:30	240	24.0	11	11.5	14.3	0.01290	0.0031	23	23
	4:30	480	24.0	9	9.5	14.7	0.01290	0.0023	19	19
26/3/2017	12:30	960	24.0	7	7.5	15	0.01290	0.0016	15	15
	7:12	1440	24.0	6	6.5	15.2	0.01290	0.0013	13	13

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
3	9.00	Clay	0.6	0	0	100
			0.3	0	0	100
			0.15	0.1	0.2	100
			0.075	0.4	0.8	99



Results:

Description	Size, mm	Percent
Sand	4.75-0.075	1
Silt	0.075-0.005	69
Clay	0.005-0.001	30
Colloids	< 0.001	0

Grain size parameters		
Silt factor, f		0.31
Coefficient of curvature, Cz		
Coefficient of uniformity, Cu		

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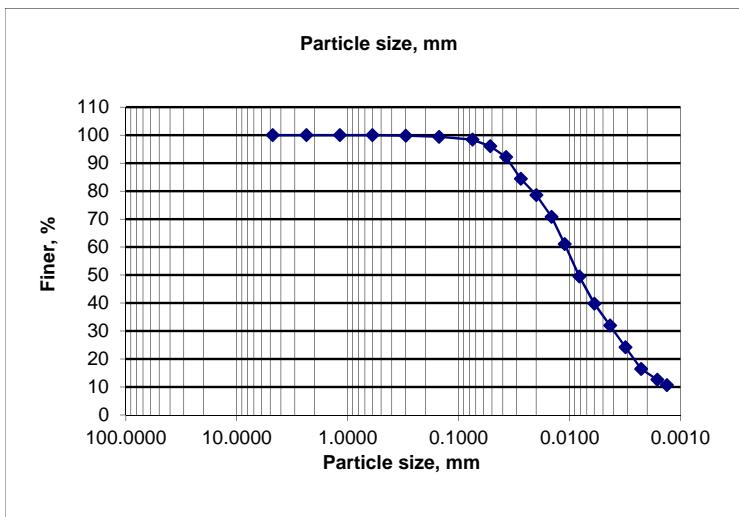
SUCHANA ENGINEERS LTD.
GEOTCHNICAL LABORATORY

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
25/3/2017	8:30	0.5	24.0	49	49.5	8.1	0.01290	0.0519	98	96
	8:31	1	24.0	47	47.5	8.4	0.01290	0.0374	94	92
	8:32	2	24.0	43	43.5	9.1	0.01290	0.0275	86	84
	8:34	4	24.0	40	40.5	9.6	0.01290	0.0200	80	79
	8:38	8	24.0	36	36.5	10.2	0.01290	0.0146	72	71
	8:45	15	24.0	31	31.5	11.1	0.01290	0.0111	62	61
	9:00	30	24.0	25	25.5	12	0.01290	0.0082	50	49
	9:30	60	24.0	20	20.5	12.9	0.01290	0.0060	41	40
	10:30	120	24.0	16	16.5	13.5	0.01290	0.0043	33	32
	12:30	240	24.0	12	12.5	14.2	0.01290	0.0031	25	24
	4:30	480	24.0	8	8.5	14.8	0.01290	0.0023	17	16
26/3/2017	12:30	960	24.0	6	6.5	15.2	0.01290	0.0016	13	13
	7:12	1440	24.0	5	5.5	15.3	0.01290	0.0013	11	11

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
4	1.50	Clay	0.6	0	0	100
			0.3	0.1	0.2	100
			0.15	0.3	0.6	99
			0.075	0.8	1.6	98



Results:

Description	Size, mm	Percent
Sand	4.75-0.075	2
Silt	0.075-0.005	63
Clay	0.005-0.001	35
Colloids	< 0.001	0

Grain size parameters	
Silt factor, f	0.16
Coefficient of curvature, Cz	
Coefficient of uniformity, Cu	

SEL

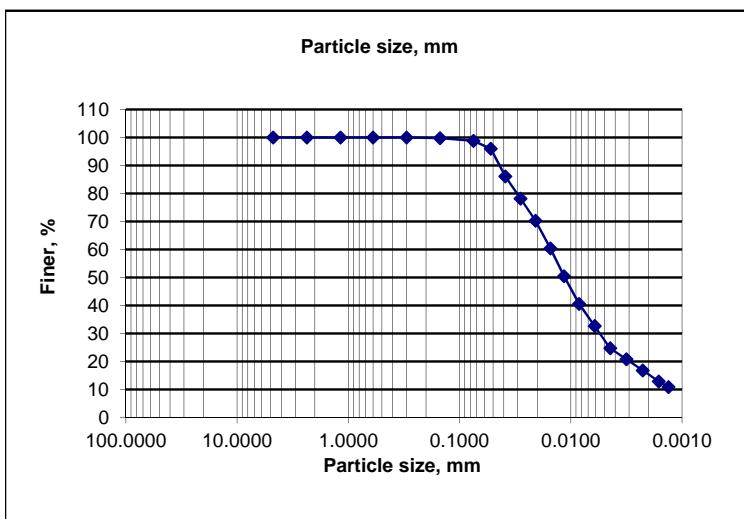
SUCHANA ENGINEERS LTD.
GEOTCHNICAL LABORATORY

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
25/3/2017	8:30	0.5	24.0	48	48.5	8.3	0.01290	0.0526	97	96
	8:31	1	24.0	43	43.5	9.1	0.01290	0.0389	87	86
	8:32	2	24.0	39	39.5	9.7	0.01290	0.0284	79	78
	8:34	4	24.0	35	35.5	10.4	0.01290	0.0208	71	70
	8:38	8	24.0	30	30.5	11.2	0.01290	0.0153	61	60
	8:45	15	24.0	25	25.5	12	0.01290	0.0115	51	50
	9:00	30	24.0	20	20.5	12.9	0.01290	0.0085	41	41
	9:30	60	24.0	16	16.5	13.5	0.01290	0.0061	33	33
	10:30	120	24.0	12	12.5	14.2	0.01290	0.0044	25	25
	12:30	240	24.0	10	10.5	14.5	0.01290	0.0032	21	21
	4:30	480	24.0	8	8.5	14.8	0.01290	0.0023	17	17
26/3/2017	12:30	960	24.0	6	6.5	15.2	0.01290	0.0016	13	13
	7:12	1440	24.0	5	5.5	15.3	0.01290	0.0013	11	11

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
4	6.00	Clay	0.6	0	0	100
			0.3	0	0	100
			0.15	0.1	0.2	100
			0.075	0.6	1.2	99



Results:

Description	Size, mm	Percent
Sand	4.75-0.075	1
Silt	0.075-0.005	71
Clay	0.005-0.001	28
Colloids	< 0.001	0

Grain size parameters		
Silt factor, f		0.19
Coefficient of curvature, Cz		
Coefficient of uniformity, Cu		

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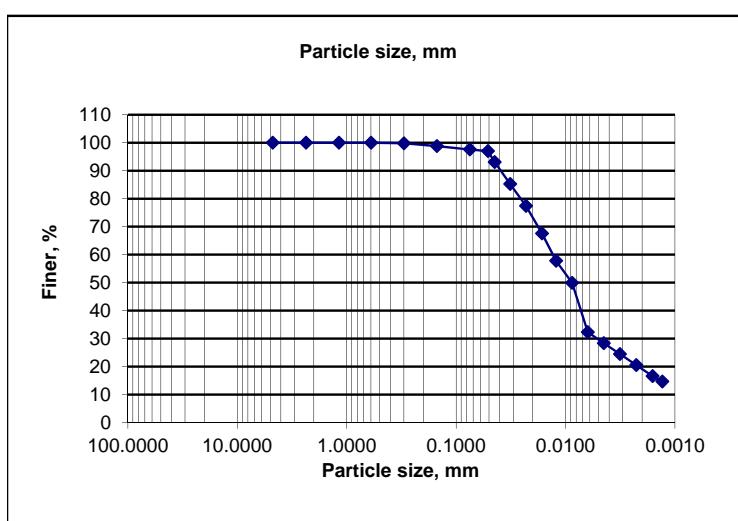
SUCHANA ENGINEERS LTD.
GEOTCHNICAL LABORATORY

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
28/3/2017	8:30	0.5	24.0	49	49.5	7.9	0.01290	0.0513	99	97
	8:31	1	24.0	47	47.5	11.9	0.01290	0.0445	95	93
	8:32	2	24.0	43	43.5	12.4	0.01290	0.0321	87	85
	8:34	4	24.0	39	39.5	12.7	0.01290	0.0230	79	77
	8:38	8	24.0	34	34.5	13	0.01290	0.0164	69	68
	8:45	15	24.0	29	29.5	13.5	0.01290	0.0122	59	58
	9:00	30	24.0	25	25.5	13.7	0.01290	0.0087	51	50
	9:30	60	24.0	16	16.5	14.2	0.01290	0.0063	33	32
	10:30	120	24.0	14	14.5	14.5	0.01290	0.0045	29	28
	12:30	240	24.0	12	12.5	14.7	0.01290	0.0032	25	25
	4:30	480	24.0	10	10.5	14.8	0.01290	0.0023	21	21
29/3/2017	12:30	960	24.0	8	8.5	14.9	0.01290	0.0016	17	17
	7:12	1440	24.0	7	7.5	14.8	0.01290	0.0013	15	15

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
5	4.50	Clay	0.6	0	0	100
			0.3	0.1	0.2	100
			0.15	0.6	1.2	99
			0.075	1.2	2.4	98



Results:		
Description	Size, mm	Percent
Sand	4.75-0.075	2
Silt	0.075-0.005	68
Clay	0.005-0.001	30
Colloids	< 0.001	0

Grain size parameters	
Silt factor, f	0.16
Coefficient of curvature, Cz	
Coefficient of uniformity, Cu	

SEL

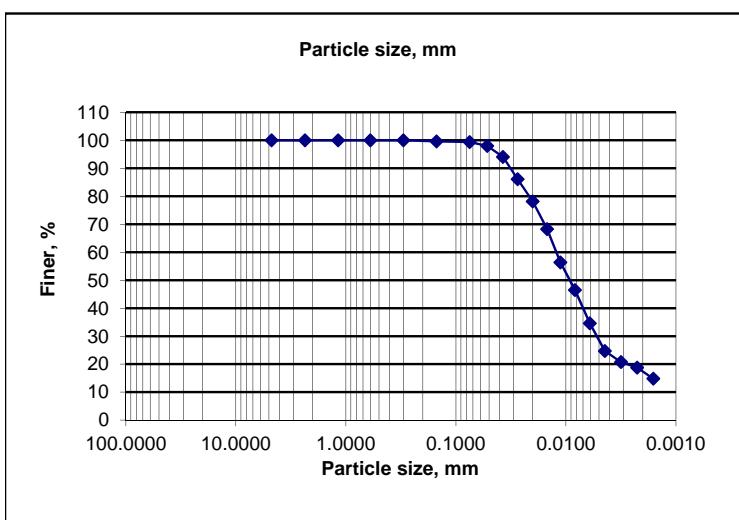
SUCHANA ENGINEERS LTD.
GEOTCHNICAL LABORATORY

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Valu of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
28/3/2017	8:30	0.5	24.0	49	49.5	8.1	0.01290	0.0519	99	98
	8:31	1	24.0	47	47.5	8.4	0.01290	0.0374	95	94
	8:32	2	24.0	43	43.5	9.1	0.01290	0.0275	87	86
	8:34	4	24.0	39	39.5	9.7	0.01290	0.0201	79	78
	8:38	8	24.0	34	34.5	10.6	0.01290	0.0148	69	68
	8:45	15	24.0	28	28.5	11.4	0.01290	0.0112	57	56
	9:00	30	24.0	23	23.5	12.4	0.01290	0.0083	47	47
	9:30	60	24.0	17	17.5	13.3	0.01290	0.0061	35	35
	10:30	120	24.0	12	12.5	14.2	0.01290	0.0044	25	25
	12:30	240	24.0	10	10.5	14.5	0.01290	0.0032	21	21
	4:30	480	24.0	9	9.5	14.7	0.01290	0.0023	19	19
29/3/2017	12:30	960	24.0	7	7.5	15	0.01290	0.0016	15	15
	7:12	1440	24.0	6	6.5	15.2	0.01290	0.0013	13	13

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
5	10.50	Clay	0.6	0	0	100
			0.3	0	0	100
			0.15	0.2	0.4	100
			0.075	0.3	0.6	99



Results:	Description	Size, mm	Percent
	Sand	4.75-0.075	1
	Silt	0.075-0.005	72
	Clay	0.005-0.001	27
	Colloids	< 0.001	0

Grain size parameters	
Silt factor, f	0.16
Coefficient of curvature. Cz	
Coefficient of uniformity, Cu	

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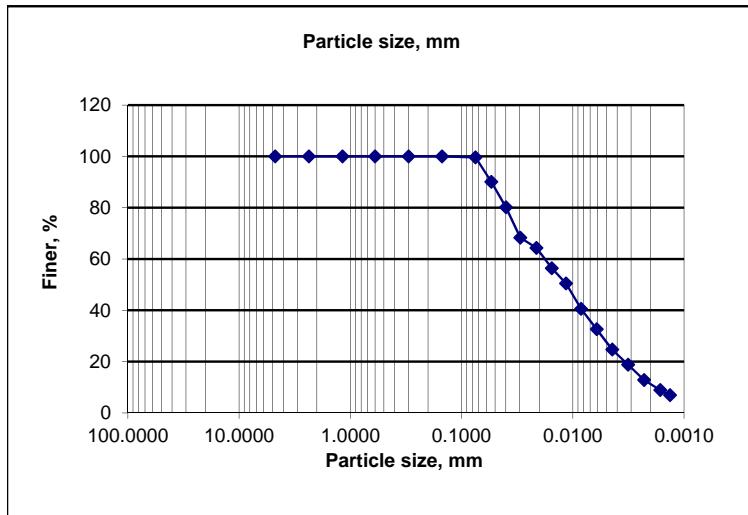
SUCHANA ENGINEERS LTD.
GEOTCHNICAL LABORATORY

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
28/3/2017	8:30	0.5	24.0	45	45.5	8.8	0.01290	0.0541	90	90
	8:31	1	24.0	40	40.5	9.6	0.01290	0.0400	80	80
	8:32	2	24.0	34	34.5	10.6	0.01290	0.0297	68	68
	8:34	4	24.0	32	32.5	10.9	0.01290	0.0213	64	64
	8:38	8	24.0	28	28.5	11.5	0.01290	0.0155	56	56
	8:45	15	24.0	25	25.5	12	0.01290	0.0115	50	50
	9:00	30	24.0	20	20.5	12.9	0.01290	0.0085	41	41
	9:30	60	24.0	16	16.5	13.5	0.01290	0.0061	33	33
	10:30	120	24.0	12	12.5	14.2	0.01290	0.0044	25	25
	12:30	240	24.0	9	9.5	14.7	0.01290	0.0032	19	19
	4:30	480	24.0	6	6.5	15.2	0.01290	0.0023	13	13
29/3/2017	12:30	960	24.0	4	4.5	15.5	0.01290	0.0016	9	9
	7:12	1440	24.0	3	3.5	15.6	0.01290	0.0013	7	7

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
6	10.50	Clay	0.6	0	0	100
			0.3	0	0	100
			0.15	0	0	100
			0.075	0.2	0.4	100



Results:

Description	Size, mm	Percent
Sand	4.75-0.075	0
Silt	0.075-0.005	75
Clay	0.005-0.001	25
Colloids	< 0.001	0

Grain size parameters

Silt factor, f	0.21
Coefficient of curvature. Cz	0.63
Coefficient of uniformity, Cu	10.0

SEL

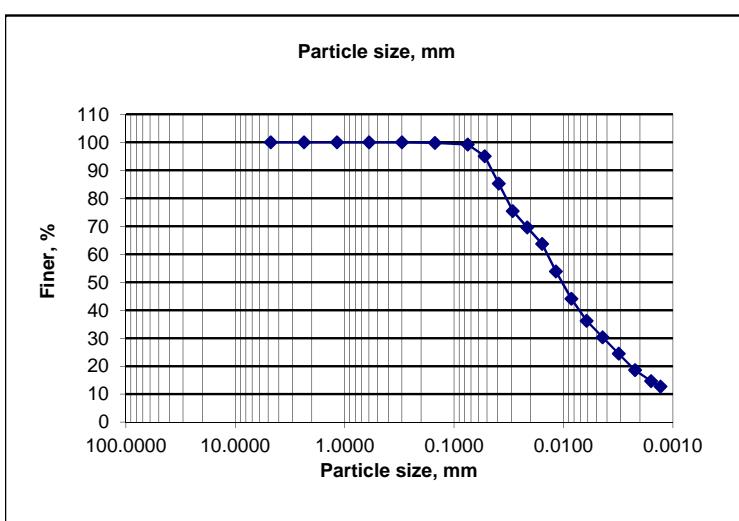
SUCHANA ENGINEERS LTD.
GEOTCHNICAL LABORATORY

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
28/3/2017	8:30	0.5	24.0	48	48.5	8.3	0.01290	0.0526	96	95
	8:31	1	24.0	43	43.5	9.2	0.01290	0.0391	86	85
	8:32	2	24.0	38	38.5	10.2	0.01290	0.0291	76	75
	8:34	4	24.0	35	35.5	11.1	0.01290	0.0215	70	70
	8:38	8	24.0	32	32.5	11.9	0.01290	0.0157	64	64
	8:45	15	24.0	27	27.5	12.5	0.01290	0.0118	54	54
	9:00	30	24.0	22	22.5	13	0.01290	0.0085	45	44
	9:30	60	24.0	18	18.5	13.7	0.01290	0.0062	37	36
	10:30	120	24.0	15	15.5	14	0.01290	0.0044	31	30
	12:30	240	24.0	12	12.5	14.2	0.01290	0.0031	25	25
	4:30	480	24.0	9	9.5	14.3	0.01290	0.0022	19	19
29/3/2017	12:30	960	24.0	7	7.5	14.5	0.01290	0.0016	15	15
	7:12	1440	24.0	6	6.5	14.7	0.01290	0.0013	13	13

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
6	15.00	Clay	0.6	0	0	100
			0.3	0	0	100
			0.15	0.1	0.2	100
			0.075	0.4	0.8	99



Results:

Description	Size, mm	Percent
Sand	4.75-0.075	1
Silt	0.075-0.005	67
Clay	0.005-0.001	32
Colloids	< 0.001	0

Grain size parameters	
Silt factor, f	0.18
Coefficient of curvature, Cz	
Coefficient of uniformity, Cu	

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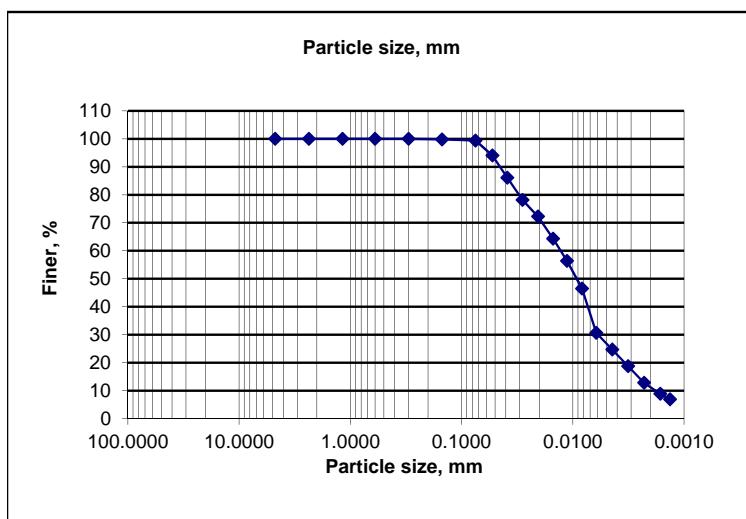
SUCHANA ENGINEERS LTD.
GEOTCHNICAL LABORATORY

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
28/3/2017	8:30	0.5	24.0	47	47.5	8.4	0.01290	0.0529	95	94
	8:31	1	24.0	43	43.5	9.1	0.01290	0.0389	87	86
	8:32	2	24.0	39	39.5	9.7	0.01290	0.0284	79	78
	8:34	4	24.0	36	36.5	10.2	0.01290	0.0206	73	72
	8:38	8	24.0	32	32.5	10.9	0.01290	0.0151	65	64
	8:45	15	24.0	28	28.5	11.5	0.01290	0.0113	57	56
	9:00	30	24.0	23	23.5	12.4	0.01290	0.0083	47	47
	9:30	60	24.0	15	15.5	13.7	0.01290	0.0062	31	31
	10:30	120	24.0	12	12.5	14.2	0.01290	0.0044	25	25
	12:30	240	24.0	9	9.5	14.7	0.01290	0.0032	19	19
	4:30	480	24.0	6	6.5	15.2	0.01290	0.0023	13	13
29/3/2017	12:30	960	24.0	4	4.5	15.5	0.01290	0.0016	9	9
	7:12	1440	24.0	3	3.5	15.6	0.01290	0.0013	7	7

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
7	4.50	Clay	0.6	0	0	100
			0.3	0	0	100
			0.15	0.1	0.2	100
			0.075	0.3	0.6	99



Results:

Description	Size, mm	Percent
Sand	4.75-0.075	1
Silt	0.075-0.005	73
Clay	0.005-0.001	26
Colloids	< 0.001	0

Grain size parameters		
Silt factor, f		0.17
Coefficient of curvature, Cz		1.26
Coefficient of uniformity, Cu		7.9

SEL

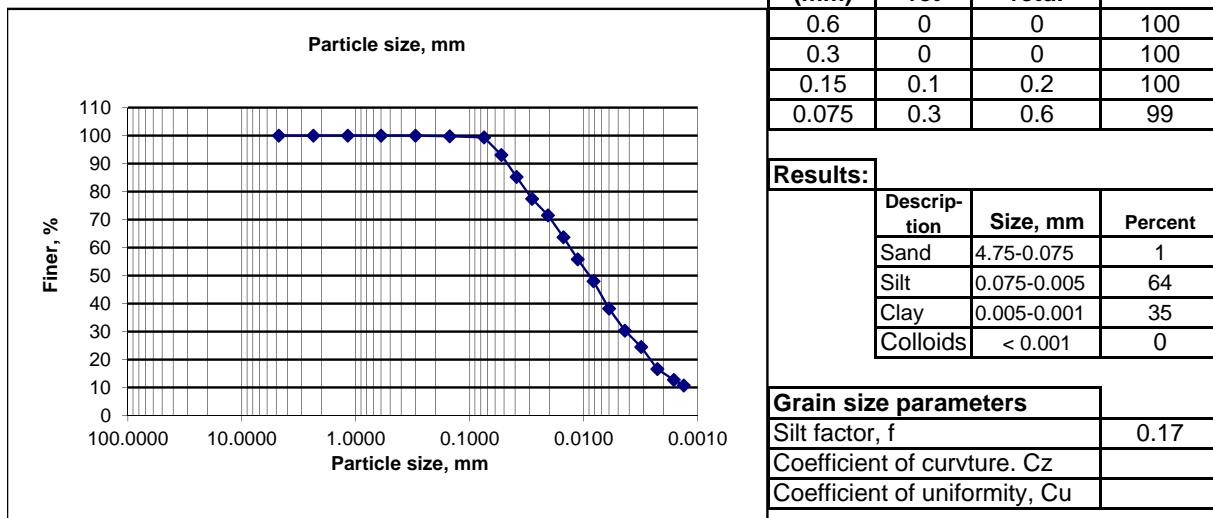
SUCHANA ENGINEERS LTD.
GEOTCHNICAL LABORATORY

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
28/3/2017	8:30	0.5	24.0	47	47.5	8.4	0.01290	0.0529	94	93
	8:31	1	24.0	43	43.5	9.1	0.01290	0.0389	86	85
	8:32	2	24.0	39	39.5	9.7	0.01290	0.0284	78	77
	8:34	4	24.0	36	36.5	10.2	0.01290	0.0206	72	72
	8:38	8	24.0	32	32.5	10.9	0.01290	0.0151	64	64
	8:45	15	24.0	28	28.5	11.5	0.01290	0.0113	56	56
	9:00	30	24.0	24	24.5	12.2	0.01290	0.0082	49	48
	9:30	60	24.0	19	19.5	13.0	0.01290	0.0060	39	38
	10:30	120	24.0	15	15.5	13.7	0.01290	0.0044	31	30
	12:30	240	24.0	12	12.5	14.2	0.01290	0.0031	25	25
	4:30	480	24.0	8	8.5	14.8	0.01290	0.0023	17	17
29/3/2017	12:30	960	24.0	6	6.5	15.2	0.01290	0.0016	13	13
	7:12	1440	24.0	5	5.5	15.3	0.01290	0.0013	11	11

BH No	Depth in m	Soil Type	Sieve analysis	
8	6.00	Clay		



SEL

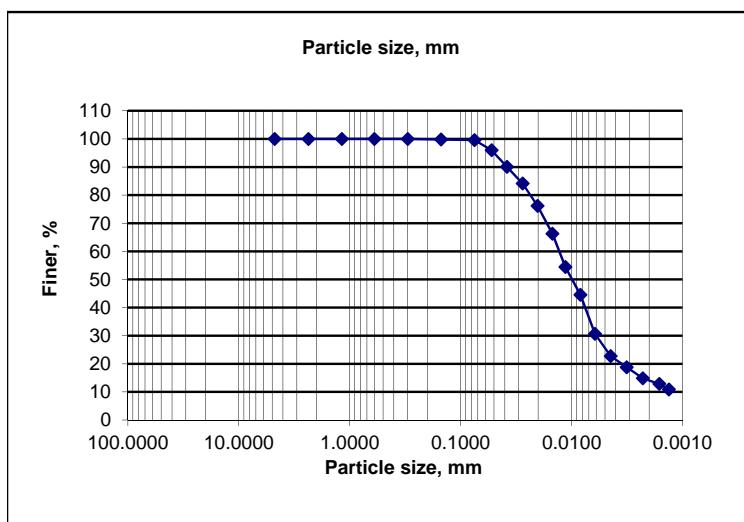
SUCHANA ENGINEERS LTD.
GEOTCHNICAL LABORATORY

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
28/3/2017	8:30	0.5	24.0	48	48.5	8.3	0.01290	0.0526	96	96
	8:31	1	24.0	45	45.5	8.8	0.01290	0.0383	90	90
	8:32	2	24.0	42	42.5	9.2	0.01290	0.0277	84	84
	8:34	4	24.0	38	38.5	9.9	0.01290	0.0203	76	76
	8:38	8	24.0	33	33.5	10.7	0.01290	0.0149	66	66
	8:45	15	24.0	27	27.5	11.7	0.01290	0.0114	54	54
	9:00	30	24.0	22	22.5	12.5	0.01290	0.0083	45	45
	9:30	60	24.0	15	15.5	13.7	0.01290	0.0062	31	31
	10:30	120	24.0	11	11.5	14.3	0.01290	0.0045	23	23
	12:30	240	24.0	9	9.5	14.7	0.01290	0.0032	19	19
	4:30	480	24.0	7	7.5	15	0.01290	0.0023	15	15
29/3/2017	12:30	960	24.0	6	6.5	15.2	0.01290	0.0016	13	13
	7:12	1440	24.0	5	5.5	15.3	0.01290	0.0013	11	11

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
8	12.00	Clay	0.6	0	0	100
			0.3	0	0	100
			0.15	0.1	0.2	100
			0.075	0.2	0.4	100



Results:		
Description	Size, mm	Percent
Sand	4.75-0.075	0
Silt	0.075-0.005	75
Clay	0.005-0.001	25
Colloids	< 0.001	0

Grain size parameters	
Silt factor, f	0.51
Coefficient of curvature, Cz	
Coefficient of uniformity, Cu	

SEL

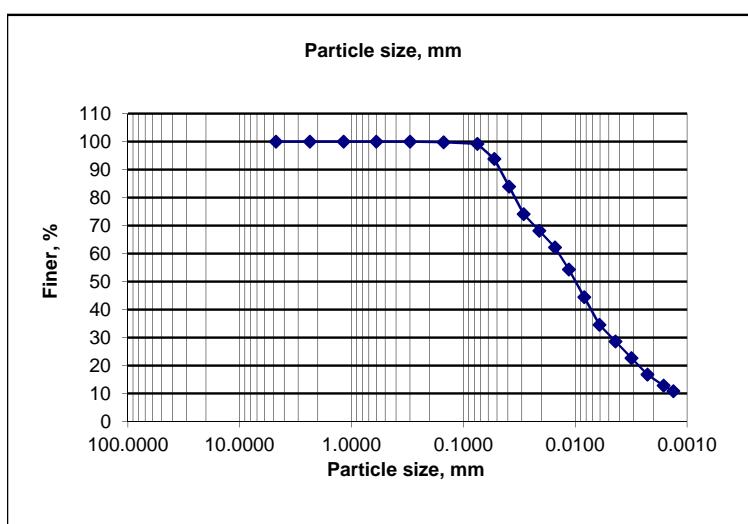
SUCHANA ENGINEERS LTD.
GEOTCHNICAL LABORATORY

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Hydrometer Test

Date	Time (A.M)	Elapsed time t(min)	Room Temp. C	Hydrometer reading, Ro	Reading after meniscus correction	Effective depth, L (cm)	Value of K table	Particle size (mm)	Percent finer	Adjustment % fines for total Specimen
28/3/2017	8:30	0.5	24.0	47	47.5	8.4	0.01290	0.0529	95	94
	8:31	1	24.0	42	42.5	9.2	0.01290	0.0391	85	84
	8:32	2	24.0	37	37.5	10.1	0.01290	0.0290	75	74
	8:34	4	24.0	34	34.5	10.6	0.01290	0.0210	69	68
	8:38	8	24.0	31	31.5	11.1	0.01290	0.0152	63	62
	8:45	15	24.0	27	27.5	11.7	0.01290	0.0114	55	54
	9:00	30	24.0	22	22.5	12.5	0.01290	0.0083	45	44
	9:30	60	24.0	17	17.5	13.3	0.01290	0.0061	35	35
	10:30	120	24.0	14	14.5	13.8	0.01290	0.0044	29	29
	12:30	240	24.0	11	11.5	14.3	0.01290	0.0031	23	23
	4:30	480	24.0	8	8.5	14.8	0.01290	0.0023	17	17
29/3/2017	12:30	960	24.0	6	6.5	15.2	0.01290	0.0016	13	13
	7:12	1440	24.0	5	5.5	15.3	0.01290	0.0013	11	11

BH No	Depth in m	Soil Type	Sieve analysis			
			Sieve (mm)	Cu.wt ret	% Cu. retd.	% Finer
8	16.50	Clay	0.6	0	0	100
			0.3	0	0	100
			0.15	0.1	0.2	100
			0.075	0.4	0.8	99



Results:

Description	Size, mm	Percent
Sand	4.75-0.075	1
Silt	0.075-0.005	69
Clay	0.005-0.001	30
Colloids	< 0.001	0

Grain size parameters

Silt factor, f	0.26
Coefficient of curvature. Cz	
Coefficient of uniformity, Cu	

SEL

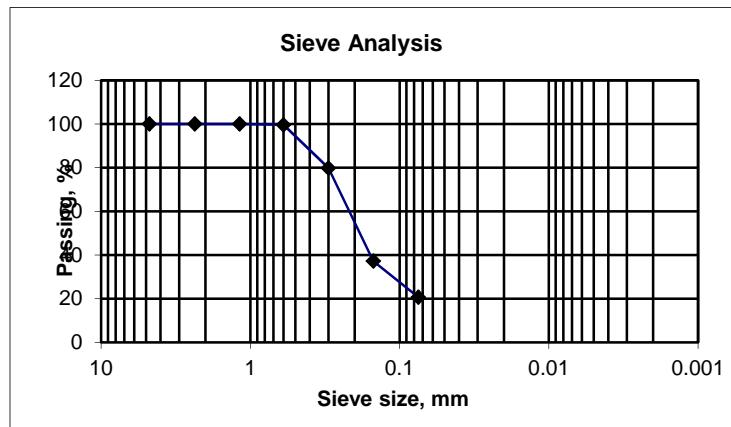
SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Sieve Analysis Test

Sample description: Fine sand	Initial weight: 100.00gm	Method of test: Washing (0.075mm)
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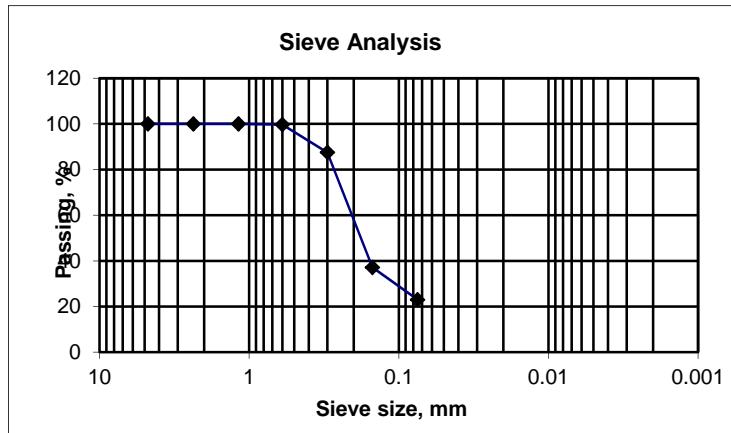
Sieve size mm	Cu. retd. wt. gm	% cu. retd. wt. gm	Passing, %
4.75	0	0	100
2.36	0	0	100
1.180	0	0	100
0.600	0.4	0.4	100
0.300	20.2	20.2	80
0.150	62.8	62.8	37
0.075	79.3	79.3	21
Pan	1.3	99.9	
	F.M	0.83	



BH -No.	Depth in m
1	15.00

Results
F.M
0.83
% Silt & clay
21

Sieve size mm	Cu. retd. wt. gm	% cu. retd. wt. gm	Passing, %
4.75	0	0	100
2.36	0	0	100
1.18	0	0	100
0.6	0.3	0.3	100
0.3	12.5	12.5	88
0.15	62.9	62.9	37
0.075	77	77	23
Pan	1.2	1.2	
	F.M	0.76	



BH -No.	Depth in m
1	27.00

Results
F.M
0.76
% Silt & clay
23

SEL

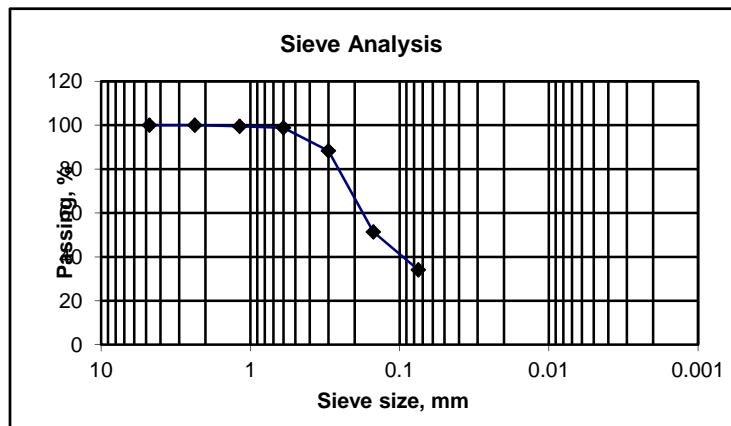
SUCHANA ENGINEERS LTD.
272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Sieve Analysis Test

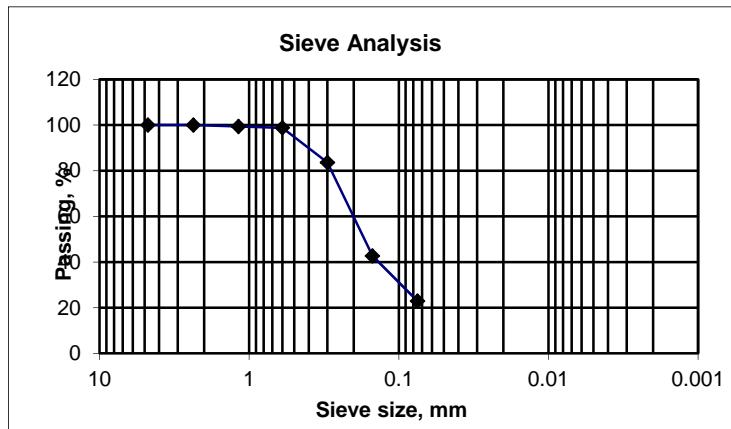
Sample description: Fine sand Initial weight: 100.00gm Method of test: Washing (0.075mm)

Sieve size mm	Cu. retd. wt. gm	% cu. retd. wt. gm	Passing, %
4.75	0	0	100
2.36	0	0	100
1.180	0.5	0.5	100
0.600	1.2	1.2	99
0.300	11.7	11.7	88
0.150	48.6	48.6	51
0.075	65.9	65.9	34
Pan	2.1	99.9	
F.M	0.62		



Results	
BH -No.	Depth in m
2	3.00
F.M	0.62
% Silt & clay	34

Sieve size mm	Cu. retd. wt. gm	% cu. retd. wt. gm	Passing, %
4.75	0	0	100
2.36	0	0	100
1.18	0.6	0.6	99
0.6	1.2	1.2	99
0.3	16.4	16.4	84
0.15	57.3	57.3	43
0.075	77.1	77.1	23
Pan	1.4	1.4	
F.M	0.76		



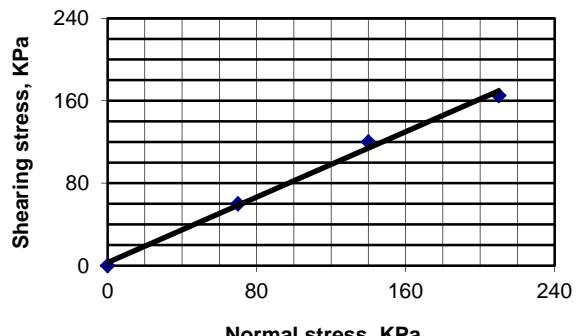
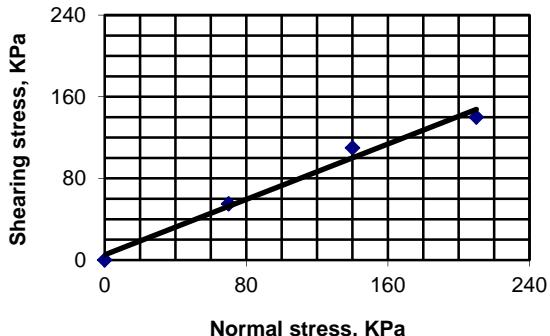
Results	
BH -No.	Depth in m
2	13.50
F.M	0.76
% Silt & clay	23

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Direct Shear Test

B.H # - 01, Depth 7.50 m

BH # 01, Depth: 15.00m

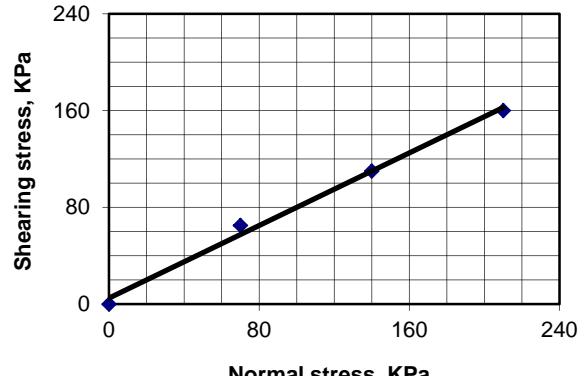
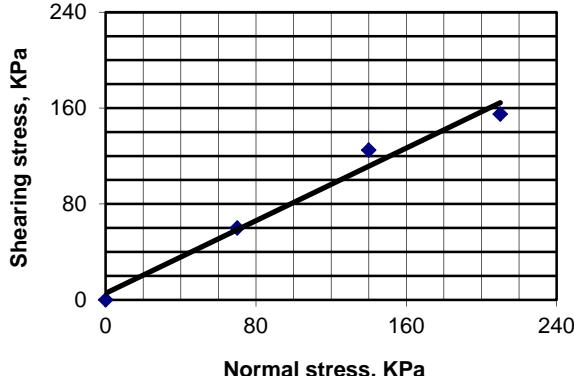


Shearing Angle (degree)	36
Cohesion C (kPa)	0

Shearing Angle (degree)	39
Cohesion C (kPa)	0

B.H # - 01, Depth 21.00 m

BH # 01, Depth: 27.00m



Shearing Angle (degree)	38
Cohesion C (kPa)	0

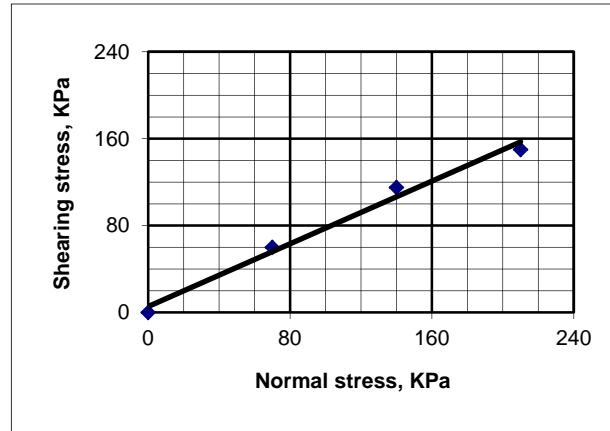
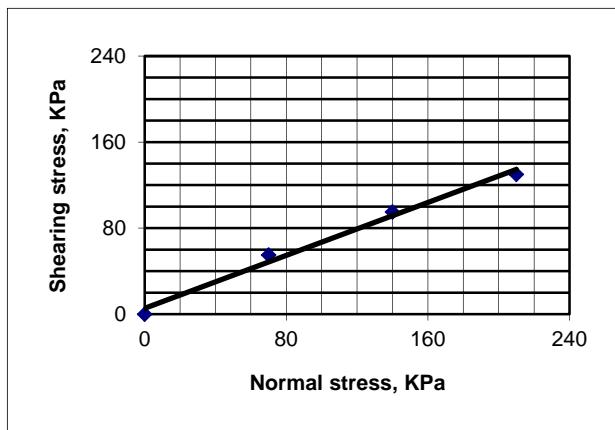
Shearing Angle (degree)	38
Cohesion C (kPa)	0

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Gondamara, Banskhali Upazila, District-Chittagong

Direct Shear Test

B.H # - 02, Depth 4.50 m

BH # 02, Depth: 12.00m

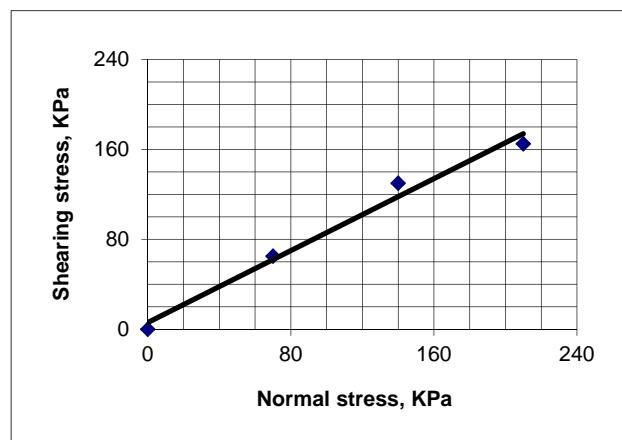
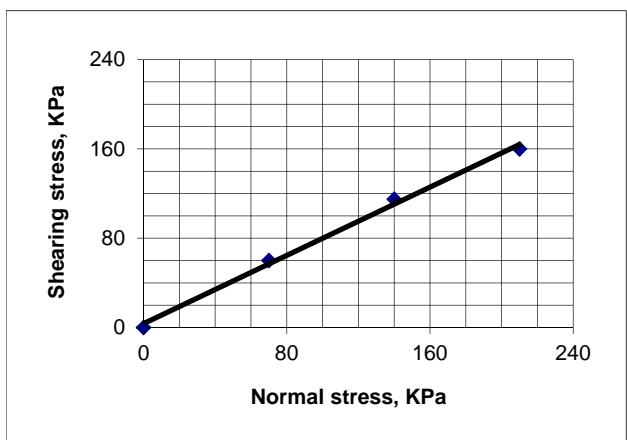


Shearing Angle (degree)	34
Cohesion C (kPa)	0

Shearing Angle (degree)	37
Cohesion C (kPa)	0

B.H # - 02, Depth 21.00 m

BH # 02, Depth: 27.00m



Shearing Angle (degree)	38
Cohesion C (KPa)	0

Shearing Angle (degree)	40
Cohesion C (KPa)	0

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272/A West Agargaon, Dhaka -1207

SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Natural Moisture Content test

Natural Moisture Content

B.H No.	1	3	4	5	6	7
Depth in meter	6.00	6.00	3.00	6.00	13.50	7.50
Initial weight of sample + Can gm	96.43	86.62	99.50	94.70	87.12	93.67
Final weight of samole + Can	85.23	77.13	87.76	84.48	77.04	82.56
Weight of water	11.20	9.49	11.74	10.22	10.08	11.11
Weight of can gm	26.84	23.75	24.79	21.77	20.04	20.93
Weight of Sample gm	58.390	53.380	62.970	62.710	57.000	61.630
Moisture content, %	19	18	19	16	18	18

Natural Moisture Content

B.H No.	8	8	8
Depth in meter	3.00	10.50	15.00
Initial weight of sample + Can gm	84.80	88.59	90.31
Final weight of samole + Can	73.79	78.31	80.35
Weight of water	11.01	10.28	9.96
Weight of can gm	21.93	20.31	23.04
Weight of Sample gm	51.86	58.00	57.31
Moisture content, %	21	18	17

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SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Atterberg Limit Test

Name of test	LL	LL	LL	PL	PL
Trial no	1	2	3	1	2
Can #	60	53	51	98	76
Initial weight of sample + Can, gm	31.79	31.22	35.28	28.51	26.59
Final weight of samole + Can	26.55	26.02	28.46	27.27	25.44
Weight of water	5.24	5.20	6.82	1.24	1.15
Weight of can gm	16.81	16.82	17.18	21.77	20.32
Weight of Sample gm	9.74	9.20	11.28	5.50	5.12
% Moisture content	53.80	56.52	60.46	22.55	22.46
Nos of Blow	34	26	13		23

Bh No-8

Depth : 4.50 m



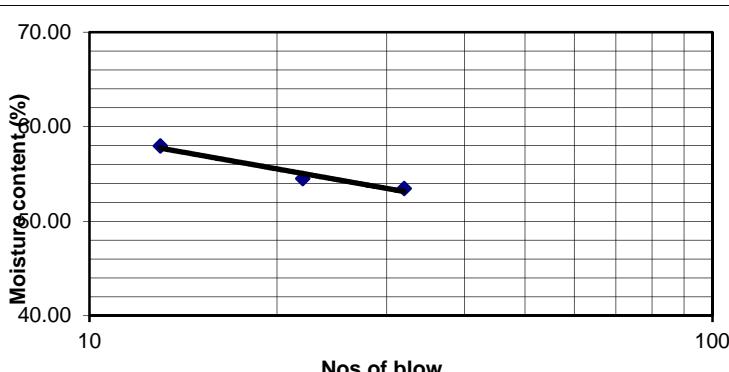
Results:

Liquid Limit (LL), %	58
Plastic Limit (PL), %	23
Plasticity Index (PI), %	35

Name of test	LL	LL	LL	PL	PL
Trial no	1	2	3	1	2
Can #	144	151	146	98	99
Initial weight of sample + Can, gm	23.20	21.82	21.48	33.13	33.14
Final weight of samole + Can	20.03	18.86	19.04	29.58	31.42
Weight of water	3.17	2.96	2.44	3.55	1.72
Weight of can gm	14.10	13.43	14.83	14.10	23.05
Weight of Sample gm	5.93	5.43	4.21	15.48	8.37
% Moisture content	53.46	54.51	57.96	22.93	20.55
Nos of Blow	32	22	13		22

Bh No-8

Depth : 18.00 m



Results:

Liquid Limit (LL), %	55
Plastic Limit (PL), %	22
Plasticity Index (PI), %	33

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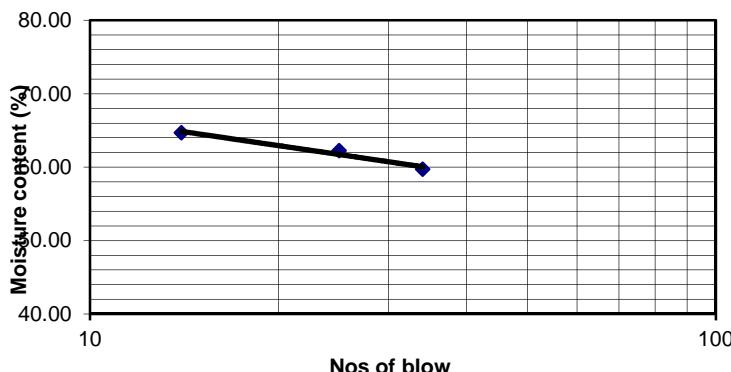
SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Atterberg Limit Test

Name of test	LL	LL	LL	PL	PL
Trial no	1	2	3	1	2
Can #	50	136	120	89	71
Initial weight of sample + Can, gm	30.54	34.54	29.71	29.77	32.79
Final weight of samole + Can	25.62	28.88	25.02	28.90	31.23
Weight of water	4.92	5.66	4.69	0.87	1.56
Weight of can gm	17.38	19.79	17.77	21.02	23.63
Weight of Sample gm	8.24	9.09	7.25	4.45	7.60
% Moisture content	59.71	62.27	64.69	19.55	20.53
Nos of Blow	34	25	14		20

Bh No-1

Depth : 1.50 m



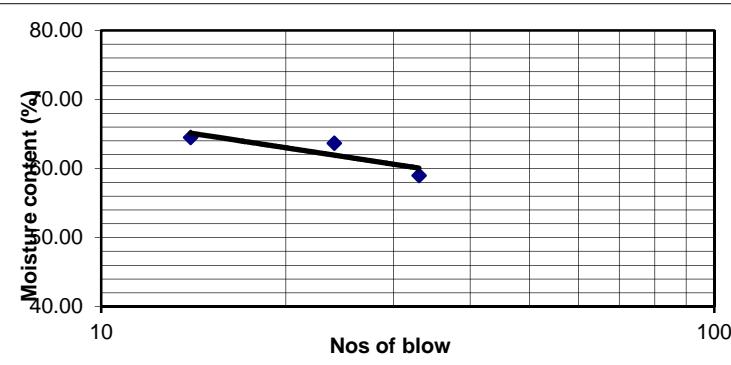
Results:

Liquid Limit (LL), %	62
Plastic Limit (PL), %	20
Plasticity Index (PI), %	42

Name of test	LL	LL	LL	PL	PL
Trial no	1	2	3	1	2
Can #	149	141	122	89	91
Initial weight of sample + Can, gm	24.37	20.88	21.02	26.93	28.44
Final weight of samole + Can	20.72	17.69	17.59	25.83	27.36
Weight of water	3.65	3.19	3.43	1.10	1.08
Weight of can gm	14.53	12.68	12.27	21.03	22.73
Weight of Sample gm	6.19	5.01	5.32	4.80	4.63
% Moisture content	58.97	63.67	64.47	22.92	23.33
Nos of Blow	33	24	14		23

Bh No-3

Depth : 4.50 m



Results:

Liquid Limit (LL), %	62
Plastic Limit (PL), %	23
Plasticity Index (PI), %	39

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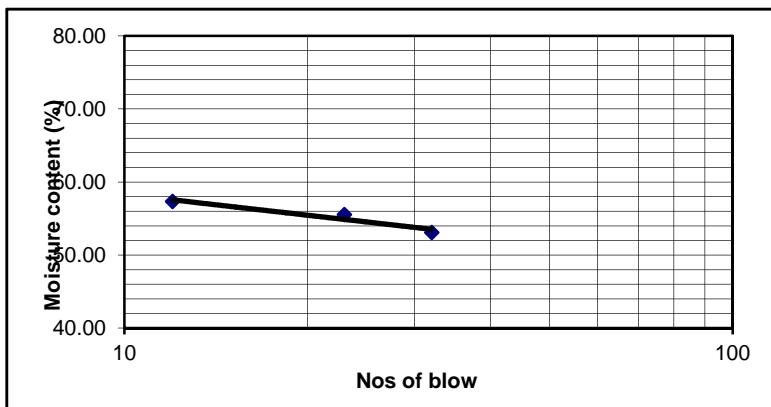
SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Gondamara, Banskhali Upazila, District- Chittagong

Atterberg Limit Test

Name of test	LL	LL	LL	PL	PL
Trial no	1	2	3	1	2
Can #	139	147	127	76	96
Initial weight of sample + Can, gm	20.12	20.89	16.92	26.49	29.64
Final weight of samole + Can	16.84	18.54	15.20	25.45	28.62
Weight of water	3.28	2.35	1.72	1.04	1.02
Weight of can gm	10.66	14.31	12.20	20.30	23.75
Weight of Sample gm	6.18	4.23	3.00	5.15	4.87
% Moisture content	53.07	55.56	57.33	20.19	20.94
Nos of Blow	32	23	12		21

Bh No-6

Depth : 16.50 m



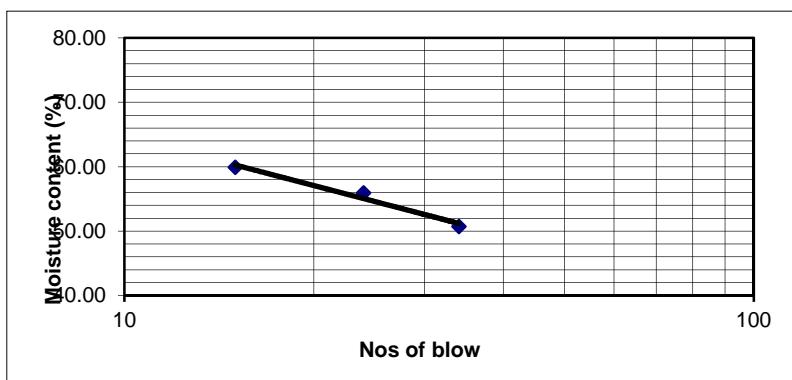
Results:

Liquid Limit (LL), %	55
Plastic Limit (PL), %	21
Plasticity Index (PI), %	34

Name of test	LL	LL	LL	PL	PL
Trial no	1	2	3	1	2
Can #	134	148	146	81	83
Initial weight of sample + Can, gm	22.93	21.84	25.97	31.42	30.65
Final weight of samole + Can	19.69	18.91	21.80	29.20	28.58
Weight of water	3.24	2.93	4.17	2.22	2.07
Weight of can gm	13.30	13.67	14.84	20.94	20.79
Weight of Sample gm	6.39	5.24	6.96	8.26	7.79
% Moisture content	50.70	55.92	59.91	26.88	26.57
Nos of Blow	34	24	15		27

Bh No-7

Depth : 12.00 m



Results:

Liquid Limit (LL), %	54
Plastic Limit (PL), %	27
Plasticity Index (PI), %	27

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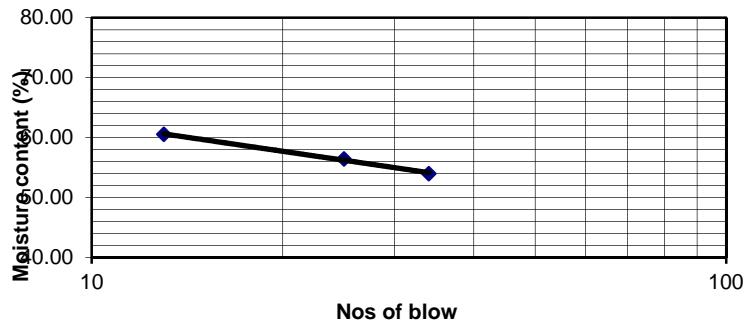
SCHEME	CLIENT	LOCATION
Construction of multi-storied Commercial cum Apartment Complex with Modern Amenities	EPTISA SERVICIOS INGENIERIA S.L	Nasirabad, Chittagong, Bangladesh

Atterberg Limit Test

Name of test	LL	LL	LL	PL	PL
Trial no	1	2	3	1	2
Can #	131	142	145	97	71
Initial weight of sample + Can, gm	23.47	20.05	19.08	32.74	29.04
Final weight of samole + Can	20.16	18.12	17.10	31.68	28.05
Weight of water	3.31	1.93	1.98	1.06	0.99
Weight of can gm	14.03	14.70	13.83	26.85	23.63
Weight of Sample gm	6.13	3.42	3.27	4.83	4.42
% Moisture content	54.00	56.43	60.55	21.95	22.40
Nos of Blow	34	25	13	22	

Bh No-4

Depth : 7.50 m



Results:

Liquid Limit (LL), %	56
Plastic Limit (PL), %	22
Plasticity Index (PI), %	34

Name of test	LL	LL	LL	PL	PL
Trial no	1	2	3	1	2
Can #	133	143	121	92	95
Initial weight of sample + Can, gm	23.35	19.64	20.26	28.52	29.75
Final weight of samole + Can	19.82	17.39	17.50	27.12	28.45
Weight of water	3.53	2.25	2.76	1.40	1.30
Weight of can gm	13.57	13.61	13.02	20.04	21.94
Weight of Sample gm	6.25	3.78	4.48	7.08	6.51
% Moisture content	56.48	59.52	61.61	19.77	19.97
Nos of Blow	35	25	15	20	

Bh No-5

Depth : 7.50 m



Results:

Liquid Limit (LL), %	59
Plastic Limit (PL), %	20
Plasticity Index (PI), %	39

Summary of Laboratory Test Results

Sl #	Name of Test	BH #	Depth in m	Results obtained	Remarks
1.a	Grain Size Analysis test	1	15.00	FM=0.83, Silt & clay= 21%	
1.b	do	1	27.00	FM=0.76, Silt & clay= 23%	
1.c	do	2	3.00	FM=0.62, Silt & clay=34%	
1.d	do	2	13.50	FM=0.76, Silt & clay= 23%	
2.a	Direct Shear test	1	7.50	Shearing angle= 36^0 , Cohesion= 0 kPa	
2.b	do	1	15.00	Shearing angle = 39^0 , Cohesion= 0 kPa	
2.c	do	1	21.00	Shearing angle = 38^0 , Cohesion= 0 Kpa	
2.d	do	1	27.00	Shearing angle = 38^0 , Cohesion= 0 kPa	
2.e	do	2	4.50	Shearing angle= 34^0 , Cohesion= 0 kPa	
2.f	do	2	12.00	Shearing angle = 37^0 , Cohesion= 0 kPa	
2.g	do	2	21.00	Shearing angle = 38^0 , Cohesion= 0 Kpa	
2.h	do	2	27.00	Shearing angle = 40^0 , Cohesion= 0 kPa	
3.a	Hydrometer test (Combined)	1	3.00	Sand=4%, Silt=60% & Clay=36%	
3.b	do	1	6.00	Sand=13%, Silt=60% & clay=27%	
3.c	do	3	3.00	Sand=0%, Silt=70% & clay=30%	
3.d	do	3	9.00	Sand=1%, Silt=69% & Clay=30%	
3.e	do	4	1.50	Sand=2%, Silt=63% & Clay=35%	
3.f	do	4	6.00	Sand=1%, Silt=71% & clay=28%	
3.g	do	5	4.50	Sand=2%, Silt=68% & clay=30%	
3.h	do	5	10.50	Sand=1%, Silt=72% & Clay=27%	
3.i	do	6	10.50	Sand=0%, Silt=75% & Clay=27%	
3.j	do	6	15.00	Sand=1%, Silt=67% & Clay=32%	
3.k	do	7	4.50	Sand=1%, Silt=73% & clay=26%	
3.l	do	8	6.00	Sand=1%, Silt=64% & clay=35%	
3.m	do	8	12.00	Sand=0%, Silt=75% & Clay=25%	
3.n	do	8	16.50	Sand=1%, Silt=69% & Clay=30%	
4.a	Specific Gravity test	1	3.00	2.658	
4.b	do	1	6.00	2.662	
4.c	do	2	6.00	2.634	
4.d	do	3	3.00	2.669	
4.e	do	3	9.00	2.676	
4.f	do	4	1.50	2.673	
4.g	do	4	6.00	2.665	
4.h	do	5	4.50	2.662	
4.i	do	5	10.50	2.669	
4.j	do	6	10.50	2.676	

4.k	do	6	15.00	2.680	
4.l	do	7	4.50	2.669	
4.m	do	8	6.00	2.673	
4.n	do	8	12.00	2.680	
4.o	do	8	16.50	2.698	
5.a	Unconfined Comp. test	1	2.40-2.90	c =115.30 kPa, strain=13%	
5.b	do	3	3.70-4.20	c =150.60 kPa, strain=15%	
5.c	do	4	5.20-5.70	c =133.85 kPa, strain=15%	
5.d	do	5	3.70-4.20	c =88.40 kPa, strain=13%	
5.e	do	6	2.00-2.90	c =136.05 kPa, strain=15%	
5.f	do	7	3.70-4.20	c =133.80 kPa, strain=15%	
5.g	do	8	3.70-4.20	c =140 kPa, strain=15%	
6.a	Consolidation test	3	3.70-4.20	e= 0.579, Cc=0.239	
6.b	do	4	5.20-5.70	e= 0.596, Cc=0.210	
6.c	do	5	3.70-4.20	e= 0.644, Cc=0.233	
6.d	do	6	3.70-4.20	e= 0.620, Cc=0.233	
6.e	do	7	3.70-4.20	e= 0.639, Cc=0.240	
6.f	do	8	3.70-4.20	e= 0.635, Cc=0.239	
7.e	Atterberg Limit test	1	1.500	L _L =62%, P _L =20% & P _I =42%	
7.b	do	3	4.50	L _L =62%, P _L =23% & P _I =39%	
7.c	do	4	7.50	L _L =56%, P _L =22% & P _I =34%	
7.d	do	5	7.50	L _L =59%, P _L =20% & P _I =39%	
7.e	do	6	16.50	L _L =55%, P _L =21% & P _I =34%	
7.f	do	7	12.00	L _L =54%, P _L =27% & P _I =27%	
7.e	do	8	4.50	L _L =58%, P _L =23% & P _I =35%	
7.f	do	8	18.00	L _L =55%, P _L =22% & P _I =33%	
8.a	Natural Moisture Content test	1	6.00	19%	
8.b	do	3	6.00	18%	
8.c	do	4	3.00	19%	
8.d	do	5	6.00	16%	
8.e	do	6	13.30	18%	
8.f	do	7	7.50	18%	
8.g	do	8	3.00	21%	
8.h	do	8	10.50	18%	
8.i	do	8	15.00	17%	

13.10 Environmental Assessment Report

Initial Environmental Examination

**Multi-storied commercial
cum residential complex at
Chittagong**

July 2017

List of Abbreviations

BAPA	Bangladesh Paribesh Andolon
BELA	Bangladesh Environmental Lawyers' Association
BNBC	Bangladesh National Building Code
BPC	Bangladesh Parjatan Corporation
BRTA	Bangladesh Road Transport Authority
BWDB	Bangladesh Water Development Board
CBO	Community Based Organization
CCC	Chittagong City Corporation
CCEA	Cabinet Committee on Economic Affairs
CDA	Chittagong Development Authority
DOE	Department of Environment
DSC	Design and Supervision Consultant
ECA	Environment Conservation Act, 1995
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rules, 1997
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ES	Environment Specialist
FGD	Focused Group Discussion
IEC	Important Environmental Component
IEE	Initial Environmental Examination
IP	Indigenous People
MoHPW	Ministry of Housing and Public Works
NGO	Non-Government Organization
PDB	Power Development Board
PIU	Project Implementation Unit
PPP	Public-Private Partnership
RAJUK	Rajdhani Unnayan Kartripakkha
REB	Rural Electrification Board
SDG	Sustainable Development Goals
ToR	Terms of Reference
WASA	Water and Sewerage Authority

Weights and Measures

ha	hectare
km	kilometre
m	Meter
m²	square meter
mm	millimetre
km/h	kilometre per hour

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Introduction

1.1 Background of the Project

With increasing demand for commercial and residential buildings in Chittagong, relevant public sector authorities like National Housing Authority (NHA), Chittagong City Corporation, Chittagong Development Authority, etc. are continuously pursuing the development and promotion of real estate activities to cater to the need for commercial and residential space for people. A few such initiatives have already been taken and implemented by these agencies in various areas of Chittagong but mostly through public sector financing where construction contractors were engaged for development of land and building with milestone based construction payment.

Experiencing the constraints and challenges for real estate development through public financing and the recent success of Public-private Partnership (PPP) in Bangladesh, NHA as the Implementing Agency, under the Ministry of Housing and Public Works (MoHPW) has decided to develop approximately 8.5 acres of its land through PPP and received Cabinet Committee on Economic Affairs (CCEA) approval on 4 November 2015 for construction of a multi-storied commercial cum residential apartment complex with modern amenities at Nasirabad, Chittagong (the "Project"). Further, NHA requested support from the PPP Authority for project development and transaction advisory services for the above project. The PPP Authority engaged a Transaction Advisor for the provision of technical, commercial, financial, transaction, environmental and social advisory services to support the process of appointment of a PPP developer for this project. The instant environmental study is being conducted on behalf of the Transaction Advisor for fulfilling the requirement as mentioned above.

National Housing Authority (NHA) formed under NHA Act, 2000 under the Ministry of Housing and Public Works (MoHPW), Bangladesh has the following objectives:

- Ensuring housing for all with special emphasis on the disadvantaged, shelter-less, destitute, and low and middle-income group people;
- Making available land for housing at an affordable price;
- Mobilization of resources for housing through personal savings and financial institutions;
- Developing the institutional and legal framework to facilitate housing; and
- Providing encouragement to universities, research institutions and research centers for research on housing development.

To achieve the above mentioned objectives, a Housing Strategy under the National Housing Policy (NHP) has been envisaged with the following salient features:

- Housing will be given due priority in the national development plans;
- The role of the Government in housing will be to supply serviced land at reasonable price and to help create and promote housing financing institutions;
- Efforts will be made to increase affordability of the disadvantaged and the low income groups through providing credit for income generation;
- Improvement and rehabilitation of the existing housing stock will be given priority by the Government alongside new housing;
- Encroachment on public land and unauthorized constructions will be discouraged;
- Facilitation of incremental house building by ensuring wider application of resources; and

- Conservation of the natural environment and preservation of cultural heritage in new housing projects.

As part of its objectives, NHA continuously pursues the development and promotion of real estate activities to cater to the needs for commercial and residential facilities of the citizens.

1.2 Purpose of the Study

DOE, the Environmental authority of Bangladesh has a controlling mechanism over the developmental activities by the legislation – ECA'95 and rules – ECR'97. The legislation and rules mention that environmental clearance from Department of Environment, Bangladesh is mandatory for any kind of development activities. It also categorizes development activities into 4 different categories such as (i) Green (ii), Orange A, (iii) Orange B and (iv) Red, depending on the anticipated potential negative impacts from the project. As per ECR'97 the proposed project is under Orange B Category and has some potential for minor adverse environmental impacts on wetlands, fisheries, ecology, biodiversity, etc. These impacts are site specific and mostly reversible with mitigation measures. However, depending on the extent of impact, the Project requires an Initial Environmental Examination (IEE). This assessment will identify the potential environmental impacts due to implementation of the project and will suggest appropriate mitigation measures relating to the location, design, construction and operation of all physical works proposed under this project. IEE report will clarify the situation of the project to the Department of Environment and fulfil the requirements for obtaining Location Clearance Certificate (LCC) and an Environmental Clearance Certificate (ECC) from DOE. IEE will also determine whether a detailed EIA will be required or not.

This Initial Environmental Examination (IEE) has been undertaken to (i) assess the extent and magnitude of impacts that the proposed Project for 'Commercial cum Residential Apartment Complex for National Housing Authority (NHA) in Chittagong' will produce on the overall environment within and around the Project site; (ii) propose mitigation measures in respect of adverse impacts and enhance beneficial impacts; and (iii) formulate an Environment Management Plan (EMP).

1.3 Extent of IEE Study

Bangladeshi law requires that the environmental impacts of development projects are identified and assessed as part of the planning and design process, and that action is taken to reduce those impacts to acceptable levels. This is done through the environmental assessment process, which has become an integral part of project development and implementation worldwide.

The National Laws of Bangladesh classify the project depending on the significance of its Environmental impacts, which are related to the type and location of the project, the sensitivity, scale, nature and magnitude of its potential impacts, and the availability of cost-effective mitigation measures.

1.4 Methodology and approach of IEE Study

The project is under Orange B Category and IEE has to be conducted to fulfil the requirements of the Department of Environment. The following steps were followed for conducting IEE study:

- Review and analysis of the existing environment related rules and policies like Environmental Conservation Act 1995, Environment Conservation Rules 1997, Wetland Policy 1998, Bangladesh National Building Code 2006, Bangladesh Natural Water Body Protection Act 2000, etc.
- Identification of environmental compliances requirement for the project.
- Coordination with Government Agencies (CDA, BWDB, BRTA, WASA, DOE) and other NGOs (BELA, BAPA) on their concerns about the project.

- Review and analysis of the environmental plans and programs of the Government, NGOs, Donors and other agencies around the project site.
- Assessment of available secondary data of relevant agencies (IEE/ EIA reports, contract agreements, and minutes of inter-ministerial meeting of RAJUK, BRTA, and BWDB).
- Conduct of field visit and identification of Important Environmental Components (IECs) for the project with respect to spatial and temporal boundary and analysis of impacts.
- Conduct of public consultation meetings with different groups and making a record of their concerns on the IEE report.
- Conduct of Focus Group Discussions (FGDs) through structured and semi structured questionnaires and documenting valuable suggestions.
- Taking photographs of the proposed site and surrounding areas for description of baseline features.
- Review of 30 years of meteorological data for the Chittagong region.
- Assessment of environmental impacts of the project reflecting location, design, construction and operation.

1.5 Environmental Compliance Requirements of Bangladesh

Environmental Assessment, Protection, and Pollution Control: The main provisions for environmental protection and pollution control in Bangladesh are contained in the Environmental Conservation Act of 1995 (ECA 1995) and the Environmental Conservation Rules of 1997 (ECR 1997). These legislations also provide the principal mechanism for assessing and mitigating the environmental impacts of projects, both existing and proposed. Projects are classified as green, orange or red depending on their location and environmental impacts and accordingly High-rise Building falls under Orange-B Category (Ref. Orange-B Category #8 – hotels, multi-storied commercial and apartment buildings).

The ministry has given final approval for the Rules for conservation of trees - 2011 but this has not been passed in the parliament. So, cutting of trees beside roads and highways as well as in other open places continues without any serious obstruction from the authorities. In general, there is consensus among conscientious people that trees should not be cut and if any tree is cut, it should be compensated by planting trees in nearby areas and the number of trees newly planted should be at least double the number of trees cut. However, permission of the forest department is required for cutting trees in reserved forests.

Rule 7 of ECR 1997 states that the proponent of such projects must obtain a Location Clearance Certificate and an Environmental Clearance Certificate (ECC) from the Department of Environment (DOE). For Orange-B category projects, this requires submission of the following to the relevant DOE Divisional Officer:

- Completed application for Environmental Clearance Certificate, and the appropriate fees, shown in Schedule 13 of the Rules
- Report on the feasibility of the project
- Report on the IEE for the project, and its Process Flow Diagram, Layout Plan
- Report on the Environmental Management Plan
- No objection certificate from the local authority
- Emergency plan relating to adverse environmental impact and plan for mitigation of the effect of pollution; and
- Outline of the relocation and rehabilitation plan (where applicable).

1.6 Other Policies, Plans and Strategies

In addition to ECA and ECR, there are a number of other policies, plans and strategies, which are applicable to the Project. The National Building Code 2006 and National Labour Act 2006 have defined certain measures to ensure proper safety and work environment as well as the compensation measures to the labourers. By national law, in order to be compensated, Contractors must follow these safety provisions and compensation arrangements. The implementing agency must ensure that the appropriate occupational health and safety provisions have been included in the bidding documents and are being implemented by the Contractor. As per the Safe Drinking Water Supply and Sanitation Policy 1998, provision for arsenic free drinking water and adequate sanitation will have to be ensured for the site workers. The water quality needs to be monitored to ensure that the supplied water is safe for drinking.

The summary of environmental regulations and mandatory requirements for the proposed project is shown in **Table 1**.

Table 1: Summary of Environmental Regulations and Mandatory Requirements

Acts/ Guidelines	Purpose	Applicability to the Project
Environmental Conservation Act, 1995 and Environmental Conservation Rules, 1997	<ul style="list-style-type: none"> • Provides main provisions for environmental protection and pollution control in Bangladesh • Provides the principal mechanism for assessing and mitigating the environmental impacts of projects, both existing and proposed • Classifies projects as green, orange or red depending on their location and environmental impacts 	<p>Orange B Category" as per Rule 7(2)(C) in Schedule 1 of ECR 1997 [item no 08: Hotel, multi-storied commercial and apartment building]</p> <ul style="list-style-type: none"> • According to the Rule 7(C) of ECR 1997, this type of project requires an IEE to determine whether a detailed EIA may be required or not. • Rule 7 states a Location Clearance Certificate and an Environmental Certificate (ECC) must be obtained from the Department of Environment (DOE)
Wetland Policy, 1988	<p>The Policy is relevant to the Project because it seeks to:</p> <ul style="list-style-type: none"> • Conserve wetlands to sustain their ecological and socio-economic functions and further sustainable development. • Establish key principles for wetland sustainability and unsustainable practices • Maintain existing levels of biodiversity • Maintain wetland functions and values, and • Actively promote integration of wetland functions in resources management and economic development, decision taking. 	<p>According to the policy, Legal steps need to conserve the remaining wetland to sustain the ecological function.</p>

Acts/ Guidelines	Purpose	Applicability to the Project
The Protection and Conservation of Fish Rules, 1985	<p>The Protection and Conservation of Fish Rules 1985 are a set of rules in line with the overall objectives of the East-Bengal Protection and Fish Conservation Act. The Rules require that “no person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters”. Further, the Rules state “...no person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters”.</p> <p>The Project will comply with these rules by enacting appropriate mitigation measures to reduce the potential for pollution of waterways, depletion of fisheries or disturbance of fish populations within the Project area.</p>	No wastewater will be allowed to be discharged into the nearby water sources.
Housing Policy, 1999	<p>Section 4.7; Initiate planning to produce more forest products used to build infrastructure and attention to be given to Environmental Management</p> <p>Section 4.9; While implementing any new housing project, need to consider the local building modes, uphold and conserve the cultural heritage.</p>	Buffer zones of greenery need to be established in the housing area/ any other buildings constructed.

1.7 Scope of the Study

This is the IEE for the Commercial cum Residential Apartment Complex for National Housing Authority (NHA) in Chittagong. It discusses the environmental impacts and mitigation measures relating to the location, design, construction and operation of all physical works proposed under this Project. This IEE report will clarify the situation to the Department of Environment and fulfil the requirement for obtaining Location Clearance Certificate and an Environmental Clearance Certificate (ECC) from DOE. This report will identify the potential environmental impacts due to implementation of the Project and will suggest appropriate mitigation measures.

2 Description of the Project

2.1 Type, Category and Need

This is a Commercial cum Residential development, and as explained above it has been classified as Category Orange-B because it is not expected to have major negative environmental impacts. Under DOE procedures, such developments require an IEE to identify and mitigate the impacts, and to determine whether further study or a more detailed EIA may be required.

Commercial cum Residential development facilities in the existing NHA compound is necessary because:

- The existing facilities are not adequate to meet the present and future demand, and
- There is great potential and demand for office spaces, residential apartments and commercial development in the surrounding area.

National Housing Authority will implement this project as a model by adopting the PPP route, which may in future be replicated in other NHA owned sites as well as in other Government owned vacant or partially/under-utilized plots elsewhere in Bangladesh.

2.2 Location, Size and Implementation Schedule

The coordinates of the site are – Latitude 22° 21' 35.73"N and Longitude 91° 49' 14.80"E. The total area is 8.498 acres and ground elevation is 14.215 m (above MSL). The topography is undulating with mounds/elevations and a large water body. Vegetation noted include fruit bearing and non-fruit bearing trees and bushes. Approximate distance from the railway station is 4 km and the distance from the airport is 20 km.

Existing facilities within the area are – NHA Division Office, NHA Sub-division Office, other offices of NHA, bungalows for the executive engineer and superintending engineer, residential accommodation for other officers and staff, garages, club, mosque, internal roads, and sewerage network. Photographs of existing site are given in Annex 3 of this report.

The site has three parts – NHA and Developer portion with area of 1.07 acres and 7.20 acres respectively and balance area of 0.23 acre for the existing mosque. NHA real estate components are to be developed as per its specifications towards the north of the plot adjoining Bata Goli whereas the mix for developer part has been derived from site level analysis and findings from the market study and will have frontage. NHA part shall comprise residential and office spaces whereas the developer portion is expected to feature a multi-segment mix comprising of varied apartments, commercial offices, shopping/ retail spaces and a hotel.

Preliminary concept and design of NHA Complex in Chittagong has been undertaken by the Transaction Advisor in 2016-17. As this Project will be implemented on the basis of PPP model, the detailed design will be furnished by the Private developer/partner, and the IEE/EMP will be updated at the time of detailed design and will be revised by the Design and Supervision Consultants (DSC)/Independent Panel team. Construction of the complex and associated civil works would be undertaken over 72 months where the individual components will come up in phases. Once a component is completed, it will be sold out to prospective customers.

2.3 Description of the Project

a. Concept Plan

In general, the following salient features of the concept plan were finalized:

- The entire project site of 8.5 acres will be dedicated for high rise development;
- The area to be allocated to NHA will be around 1 acre located towards the northern side of the plot adjoining the Bata Goli;
- There will be three buildings/ towers of at least 15 floors each, out of which, one tower near the entrance will be developed for commercial purpose (including office space for NHA) and the other two towers will be developed for residential purpose;
- The mosque will be considered as part of the project site and will be redeveloped by the private developer at his cost as a three-storied mosque on the same area where the current mosque stands;
- The balance area (around 7.20 acres) will be allocated to the private developer for development of multi-storied commercial and residential complex towards the southern side of the plot on Zakir Hossain Road (i.e. frontage of the plot);
- NHA will grant development rights to private developer for developing 7.20 acres in the form of long-term lease of 99 years;
- A strip of 20 feet width along the front boundary (towards south of the plot) would be used for beautification and landscaping at the private developer's cost, which will be a no-development zone;
- The developer's product mix in the 7.2 acres will be left to the discretion of the developer without any stipulations from the Ministry or NHA. However, commercial tower/s shall ideally comprise at least 20 floors, whereas residential towers shall comprise at least 25 floors.

b. Description of the Building and Physical Infrastructures in Developer portion/area

As envisaged for the purpose of the feasibility study, the developer portion/ area will have a mix of residential apartments and commercial development. The residential apartments will be a mix of 4 types/ formats like Type A (4BHK), Type B (3BHK), Type C (2BHK), and Type D (Condo).

The commercial office will be used for multi-use development purposes. Retail/ shopping will be multi-floored mall with shopping spaces, food court, entertainment zone and Cineplex/ Multiplex.

Hotel will be 4 star budget or 3 star premium hotel or serviced apartments depending on decision during the detailed design stage.

Salient features from the developed Concept Plan can be summarized as below:

- Two separate entries will be provided, one for residential purpose and the other for commercial purpose;
- The existing water body will be maintained and utilized for recreation/ beautification purpose;
- The existing mosque in the north west corner will be developed as 3-storied building having a total floor area of 930.77 m²;
- In the NHA area, there will be 2 nos. 15 storied buildings one having a floor area of 6,800 sq. ft./floor and the other having a floor area of 5,200 sq. ft./floor and a 20-storied commercial building having floor area of 7,250 sq. ft./floor;

- In developer's area, commercial development in the south eastern corner will be a 23-storied building and will have a total floor area of 1,14,127 m²;
- In the developer's area, there will be 1 no.25-storied residential building having 8,000 sq. ft./floor (type-D/Condo), 5 nos. 25-storied residential buildings having 5,000 sq. ft./floor (type-C), 4 nos. 25-storied residential buildings having 6,000 sq. ft./floor (type-B), and 2 nos. 25-storied residential buildings having 4,000 sq. ft./floor (type-A).

Figures 1 to 4 provide the location maps and preliminary site layout details so far developed as part of the feasibility study.



Figure 1: Location of NHA Complex Site in Google map

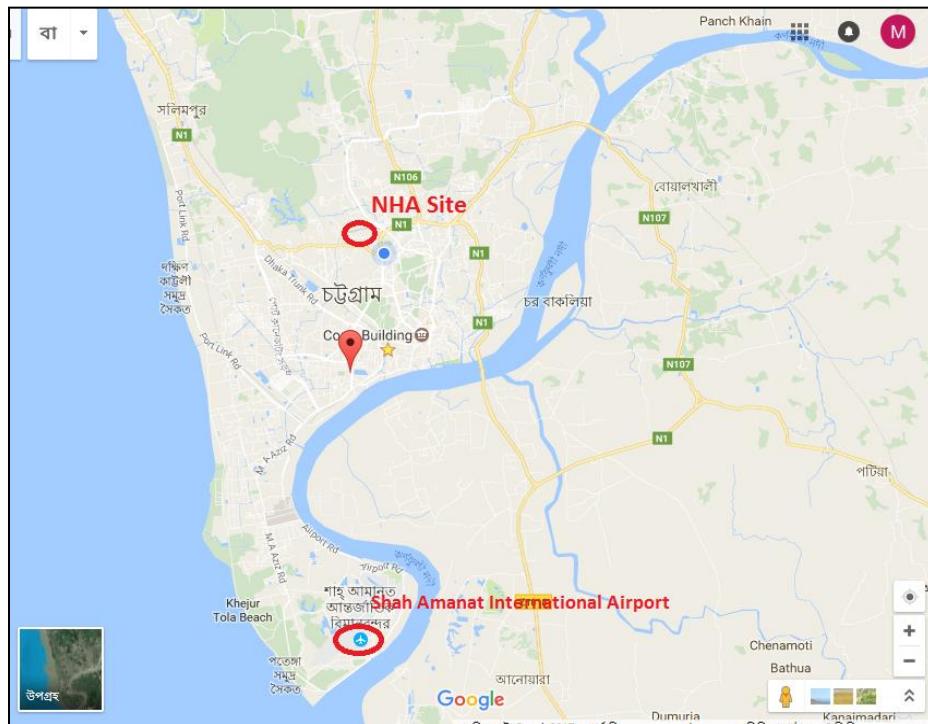


Figure 2: Location of the site with respect to International Airport



Figure 3: Topographical Survey of the site



Figure 4: Concept Plan of the Project

3 Description of the Environment

3.1 Physical Resources

3.1.1 Topography and Soils

Much of Bangladesh lies on the Gangetic-Bengal Plain, and is flat and low lying particularly around the delta, which floods extensively in the rainy season. North of Dhaka the land gradually begins to rise, towards the foothills of the Himalayas in the north. The influence of the rivers is evident in the soils, which are almost entirely alluvial and generally fertile in the central plains, with a predominantly loam and silt consistency. In the northern and eastern hills, the soils are well drained, coarse and loamy, and closer to the sea the land is often saline, particularly in the dry season.

The part of Bangladesh to which the port city of Chittagong belongs is dominated by the rivers Karnaphuli and Halda, which drain large quantities of water from the Chittagong Hill Tracts area into the Bay of Bengal. The other rivers in the Chittagong division are Rainkhiang, Thega, Kasalong, Ichamati, Bakkhali, Myani, Chingri, Sangu, Matamuhuri, Naf, Feni, etc. The predominant soil type in the Chittagong coastal plain is the acid sulphate soil. This soil contains sulphidic material, which turns extremely acidic if exposed to air. The other type is grey piedmont soil, which occurs extensively on the northern and eastern Piedmont Plains and locally on the Chittagong coastal plain.

Figure 5 representing the bio-ecological regions of Bangladesh shows the coastal plains (8a) where the city of Chittagong belongs. This region of Bangladesh comprises one of the most productive ecosystems of the world.

The topography of the proposed NHA Complex site is slightly undulating and located at a higher elevation than the adjacent approach road. Elevation changes occur within or around the site. The subsurface is characterized by sandy clay with silt and fine sand particles.

The type of soil available around the site of the NHA Complex is sandy clay soil, which is suitable for earth filling during construction activities. So some soil excavated during construction work may be re-used as filling material if it is found suitable as per test results. This soil will also be very good for plantation of trees and easy growth of trees.

3.1.2 Climate

The weather of Chittagong is characterized by tropical monsoon climate. The dry and cool season is from November to March; pre-monsoon season is from April to May, which is very hot. The sunny and the monsoon season is from June to October, which is warm, cloudy and wet. On an average, the temperatures are always high. A lot of rain (during the rainy season) occurs in the months of April, May, June, July, August September and October. It has dry periods in January and December. Overall, the warmest month is April and the coolest month is January. On the other hand, the wettest month is July and the driest is January. Around 70-80% of the annual rain falls during the months of April to October. The rain is often accompanied by strong winds, sometimes exceeding 100 km/h. The highest rainfall during the last ten years (2007 to 2016) recorded was 4,340 mm in the year 2007 and lowest of 2,379 mm in 2013. The highest maximum annual average temperature of 39.5°C was recorded in 2009 and the lowest maximum annual average temperature was 35.4°C in 2011. On the other hand, the highest minimum annual average is 12.5°C recorded in 2008 and the lowest of 9.5°C in 2011.

Wind data from the Bangladesh Meteorological Department Climate Division suggests that wind directions vary month-to-month in Chittagong, though predominantly in the NW, S, and NE directions.

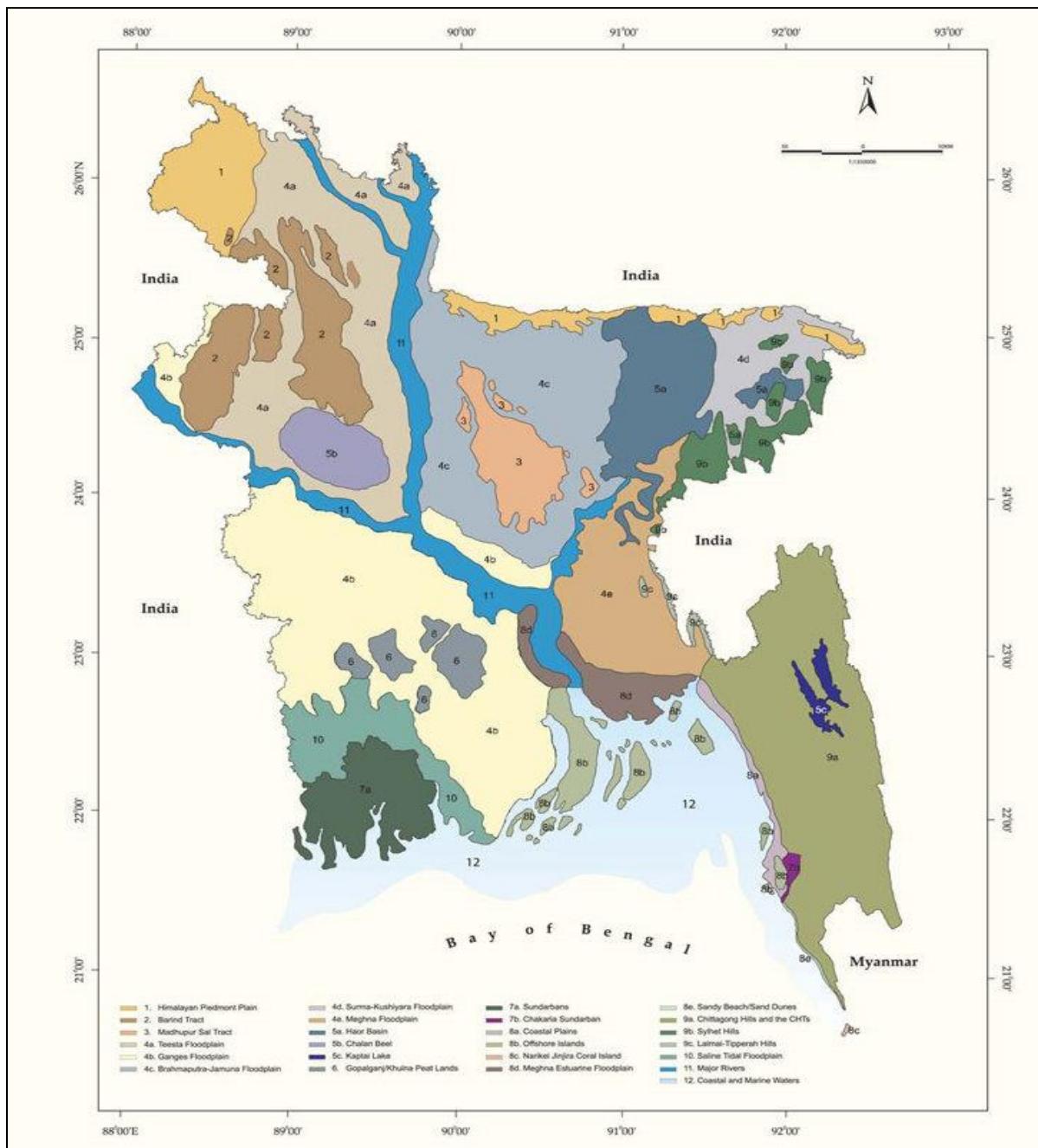


Figure 5: Bio-ecological map of Bangladesh

Although weather patterns are broadly similar throughout the country, differences in topography, winds and other factors produce some marked local variations. This is particularly evident in the annual rainfall of around 3,128 mm (in 2011) in Chittagong. Relative humidity, average dry bulb temperature, maximum and

minimum temperatures and rainfall patterns are represented in the figures below and are based on the raw data obtained from the Bangladesh Meteorological Department (**Figures 6,7,8 and 9**).¹

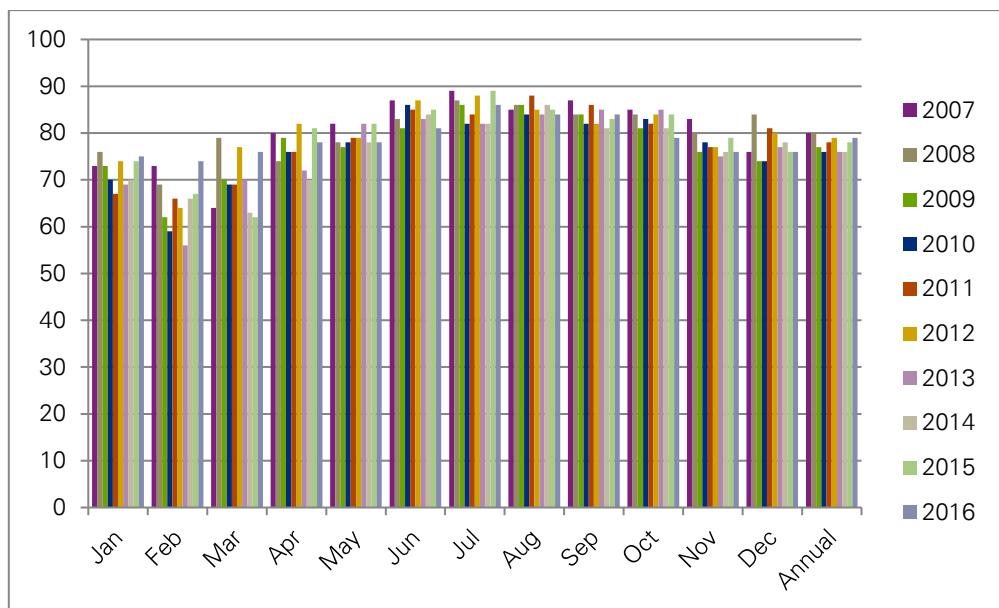


Figure 6: Monthly and annual humidity (%) in Chittagong (2007-2016)

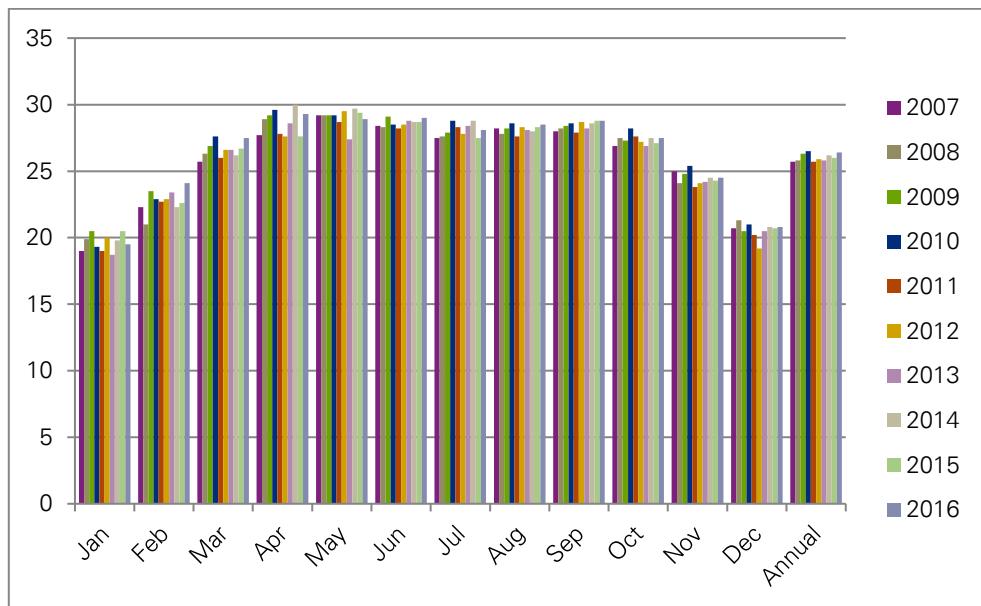


Figure 7: Monthly average dry bulb temperature (°C) in Chittagong (2007-2016)

¹ Source of raw data (Figures 3-2,3-3,3-4 and 3-5): Bangladesh Meteorological Department, April, 2017

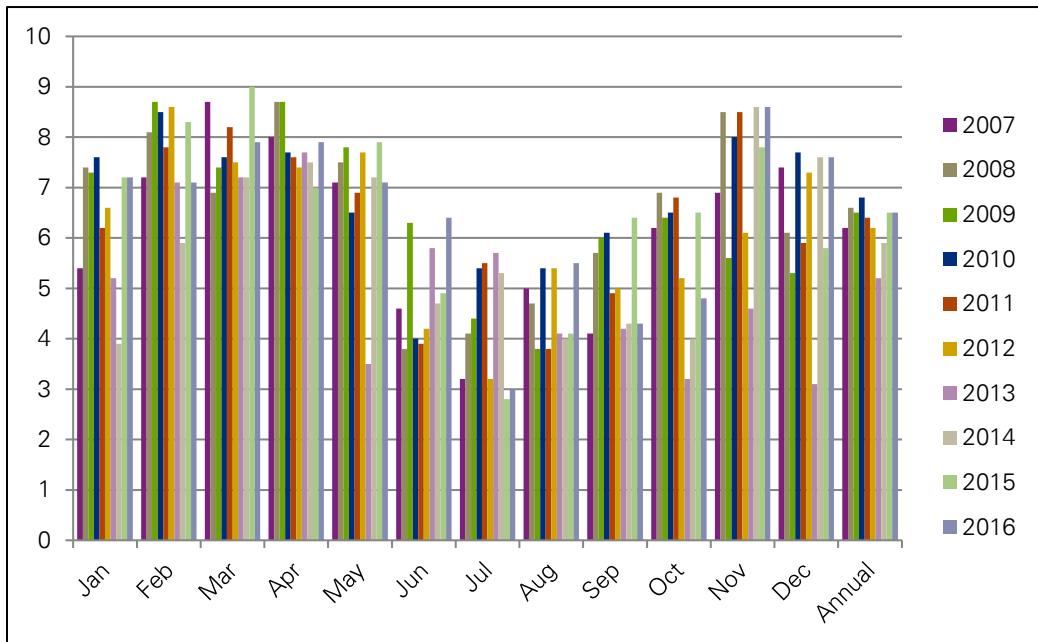


Figure 8: Monthly and annual average sunshine hours in Chittagong (2007-2016)

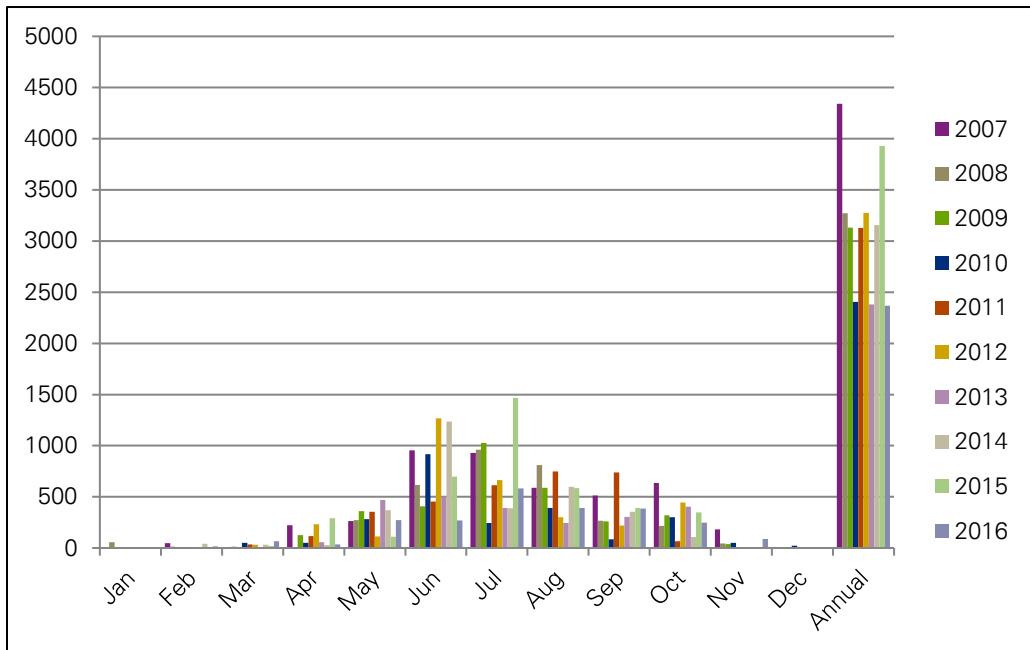


Figure 9: Monthly and annual total rainfall (mm) in Chittagong (2007-2016)

3.1.3 Air Quality

Air quality is generally good in rural Bangladesh, where there are few industries and low densities of population and vehicles. The situation is very different in the cities, where urbanization, industrialization and overcrowding create major air quality problems. In 1988, the World Bank estimated that around 15,000

deaths per year and a million cases of major illnesses are caused by air pollution in Dhaka, Chittagong and Rajshahi.

The main atmospheric pollutants are those produced by vehicles and industries and in particular by the burning of fuels. These include particulate matter, hydrocarbons, carbon dioxide, carbon monoxide, sulphur dioxide, oxides of nitrogen, lead, ammonia and hydrogen sulphide. Many of these cause respiratory problems in humans, plus other diseases if substances accumulate in the tissues. The main causes of poor air quality are:

- Poor roads and traffic management leading to severe traffic congestion;
- Use of high sulphur diesel by buses and trucks, and inadequate control of emissions;
- Heavy industrialization, and use of cheaper high-sulphur fuels (coal, wood and tyres) by smaller industries like brick kilns; and
- Poor solid waste management, leading to burning being the common method of treating garbage.

Surveys by the DoE show levels of Suspended Particulate Matter (SPM) and sulphur dioxide (SO_2) in Chittagong and other cities that exceed Bangladesh Air Quality Standards, and levels of atmospheric lead that are above World Health Organization (WHO) standards. These should fall over the next few years, as laws are being enforced reducing the number of two-stroke vehicles, and consumers change to vehicles using lower cost unleaded petrol and compressed natural gas.

3.1.4 Surface Water

Most of Bangladesh lies within the floodplains of the Ganges, Jamuna and Meghna rivers, which drain a catchment of around 1.72 million km² in India, Nepal, China, Bhutan and Bangladesh. Only 8% of the catchment is within Bangladesh, and because of its topography, flood-risk and population density, the quality and quantity of surface waters are major issues for the country. Chittagong lies in the South East Region, which is beside the river Karnaphuli and the Halda is an upstream tributary to this river. Karnaphuli is the largest and most important river in the Chittagong region, which originates in the Lushai hills in Mizoram state of India.

Like in other towns and cities of Bangladesh, the Chittagong city dwellers, too, use both surface and groundwater as a source of domestic water. Principal difference lies in the use of supply water based on treatment with some application of chlorine in Chittagong and other population centers. Pollution of rivers is a major problem, because of the discharge of industrial wastewater and inadequate sewerage system. Oil, waste materials and other toxic chemicals, discharged from ships and factories routinely pollute the Chittagong port channel and the Karnaphuli river mouth that threaten the very existence of the prime sea port of the country. The sewerage system using pipelines is not available in the city; the entire area is covered by open drains beside the roads. These open drains discharge to the canals and ultimately to the Karnaphuli river. The canals are often clogged due to indiscriminate dumping of municipal solid waste and other polluting materials. Water quality of the rivers Karnaphuli and Halda at various locations are shown below in **Table 2**.

Table 2: Surface Water Quality of the rivers Karnaphuli and Halda near Chittagong²

Location	pH	Chloride (mg/l)	T. Alkalinity (mg/l)	TS (mg/l)	TDS (mg/l)	SS (mg/l)	DO (mg/l)	BOD5 at 200 C, 5 days	COD (mg/l)
Karnaphuli River	6.36 – 9.86	2 - 13148	5.64 – 121	46 - 27700	45 - 20000	14.4 - 51000	0.00 – 7.91	0.21 – 9.17	11.39 – 179.87
Halda River	5.65 – 7.34	2.41 – 73.5	6.28 -90.78	100 - 740	30 - 200	20 - 653	3.02 – 9.90	0.70 – 5.08	14.78 – 49.28
WHO Standard	NYS	600	-	-	-	-	4 - 6	6	NYS

The following **Table 3** gives the seasonal variations of physico-chemical parameters of the water of Bakkhali and Karnaphuli river estuaries.

Table 3: Physico-Chemical Parameters of the water of Bakkhali and Karnaphuli River Estuaries³

Factor	MONTH											
	J	A	S	O	N	D	J	F	M	A	M	J
Water temp. (°C)	30.1	29.73	28.60	27.6	25.00	21.70	21.06	22.16	26.06	26.63	28.08	30.06
DO (mg/l)	3.21	3.56	4.23	3.15	3.55	5.37	3.14	2.74	1.89	2.33	2.47	3.79
pH	7.8	7.8	7.7	7.4	6.7	6.2	5.9	5.9	6.3	7.3	7.8	7.7
PO ₄ - P(mg/l)	0.17	0.13	0.13	0.08	0.11	0.09	0.11	0.13	0.14	0.12	0.17	1.5
MHW (m)	13.5	13.8	13.5	12.7	11.6	10.6	9.9	10	10.3	11	11.75	12.85
MLW (m)	3.07	3.24	3.05	2.62	2.01	1.4	0.92	0.69	0.8	1.33	2	2.65
Salinity (%)	8.7	7.53	4.53	9.17	11.33	15.04	17.07	18.42	17.42	11.78	5.94	2.63
Air temp. (°C)	31.7	30.1	29.1	28.26	25.13	23.13	22.03	21.8	26.26	27.18	29.06	30.83
Rainfall (cm)	56.52	29.49	16.43	12.29	2.54	0.076	0	0	0.18	2.77	31.22	51.16
BOD (mg/l)	2.02	1.12	1.04	1.37	1.51	1.61	1.02	1.86	3.38	3.13	3.51	2.22
NH ₃ (mg/l)	2.26	2.31	1.44	1.06	1.15	0.49	0.25	1.0	1.17	1.52	2.30	2.58
TDS (mg/l)	300.5	264.3	443.4	385.7	285.7	322.0	408.2	527.4	457.5	474.4	530.24	582.9
TSS (mg/l)	109.81	97.69	99.28	108.74	98.17	124.05	208.15	199.45	147.52	204.93	111.44	104.50

Note: MHW = mean high water, MLW = mean low water, DO=dissolved oxygen, BOD = biological oxygen demand, TDS= total dissolved solids, TSS = total suspended solids

The distance of the NHA site and effluent discharge point from the river Karnaphuli is about five kilometers. The storm water from the proposed commercial and residential complex site will not be large and will be allowed to drain through the drainage system of the CCC.

² Source: Pak. J. Anal. Environ. Chem. Vol. 11, No. 2 (2010) 1 – 11; NYS – Not Yet Started

³ M. M. Rasid, "Study on water quality and commercial ichtyofauna of the Bakkhali river estuary", MSc. Thesis, 1999, University of Chittagong, Bangladesh.

3.1.5 Ground Water

There are three main aquifers in the central region of Bangladesh:

- An upper (composite) aquifer, which can reach depths of 50 m and is covered with an upper silty clay layer of less than 20 m;
- A middle (main) aquifer of fine to heavy sands, which is generally 10-60 m thick and in most areas is hydraulically connected with the composite aquifer above; and
- A deep aquifer of medium, medium-to-fine or medium-to-coarse sand, which is generally found at depths below 100 m.

Chittagong WASA can supply only 175 MLD of water. CWASA has a water supply pipeline of 570 km. Production from surface water is 91 MLD from only one treatment plant in Mohara. There are 52 DTW in the entire CWASA jurisdiction. The production from ground water is 84 MLD. Present shortfall of water supply is about 325 MLD. With the available supply, demand of about 33% of the city population can be met. The ratio of surface water and ground water is 52:48. Ground water in Chittagong city contains high iron concentration (2~8 mg/l). That is why the wells strainer and the gravel pack become clogged with iron bacteria causing decline in water production within a few years of installation. Again ground water in the southwest area of the city contains Chloride and recently some well water was found to contain Manganese and Nitrate concentration exceeding the limit prescribed in Bangladesh Standard (As per JICA feasibility study report of 2000, Manganese was 0.17~0.28 mg/l and Nitrate was 1.2~13 mg/l). Also, it is found that the ground water level in the city center has been declining. As CWASA is not able to meet the demand of water supply in the city, many households and industries have constructed their own deep tube wells. It is obvious that due to extraction of water by CWASA and private tube wells, the ground water development in aquifer within Chittagong city area is constrained. As a result, ground water would no longer be a sustainable source of raw water for CWASA.⁴

Supply of potable water is an increasing problem for the water and sewerage authorities because of the depleting supplies and source contamination. Water for the proposed commercial and residential complex will initially be sourced from CWASA supply but provision will be kept for digging well within the site. The necessary clearance for digging well will be taken from CWASA. The ground water table in the site is more than 2 meters below the ground level; so there is no risk of contamination of ground water resources during the operational stage of the building.

3.1.6 Geology and Seismology

The National Seismic Zoning Map (**Figure 11**) produced by the Geological Survey of Bangladesh (GSB), divides the country into three regions: a high risk zone between Mymensingh and Sylhet in the north and north-east; a medium risk zone stretching diagonally from Rajshahi in the north-west through Dhaka and Comilla to Chittagong and Cox's Bazar in the south-east; and a low-risk zone in the south and south-west, around Khulna and Barisal. In the medium risk zone, shocks of moderate intensity are possible, with a probable maximum magnitude of 6-7 on the Richter scale. Seismic events in Bangladesh are relatively infrequent but historically have been severe. The Assam earthquake of 1897 was the largest in the region's history, when a force of 8.7 on the Richter scale caused extensive damage across Assam, Bengal and Bihar.

Chittagong city is the second largest metropolitan city of Bangladesh. It is a unique example in the country showing distinctive geomorphic divisions, ranging from undulating hill topography to tidal mud flats. Based

⁴ Status of Water and Sanitation Services in Chittagong WASA by Mohammed Osman Amin, Member Engineering, Chittagong WASA

on land satellite and SPOT (Satellite Positioning and Tracking) imageries, 3D-aerial photographic interpretation, and ground survey, eight major geomorphic units of the city have been identified, which are: tertiary hills, piedmont and valleys, alluvial plain, old tidal plain, tidal mud plain, supra tidal plain, natural levee and sandy beach. The general topography of the city can broadly be divided into two nearly equal halves following the Dhaka-Chittagong rail lines; the undulating north and plain south.



Figure 10: National Seismic Zoning Map of Bangladesh

The National Seismic Zoning Map of Bangladesh clarifies the seismological status of the various regions of the country. The city of Chittagong falls within the medium-risk zone. The earthquake risk factor for this zone – 2 is 0.15, while the risk factors for zone – 1 and zone – 3 are 0.075 and 0.25 respectively.

3.2 Ecological Resources

3.2.1 Habitats

The main physical features of Bangladesh are its mainly flat and low-lying topography, the dominant presence of the major rivers that drain enormous catchments in surrounding countries, a seasonal monsoon that swells river volumes for several months each year, and the resulting floods that inundate large areas of land. It is not surprising therefore that the aquatic habitats are the country's most important ecological resources.

There is a wide array of aquatic habitats throughout the country: natural and man-made, permanent and ephemeral, of varying sizes and characteristics. The rivers and floodplains are the most important, as they support species that are exploited by man, are the most productive of the habitats, and attract other important species, such as birds. However, as in other environmental sectors, the rapid urbanization and industrialization of the country and its expanding population (particularly the urban poor who use natural resources to supplement both food and income) have brought large scale damage and degradation to these areas.

3.2.2 Rivers

Most rivers in Bangladesh suffer under the influence of man, from the disposal of solid and liquid waste in urban and industrial areas around Chittagong and the other cities and towns, and from the diversion of water upstream for irrigation and/or power generation.

The river Karnaphuli passes on the eastern side of the main Chittagong city. The major rivers of this region are: Karnaphuli and its tributaries (e.g. Rainkhiang, Kasalong, Halda, Ichamoti, etc.); Bakkhali, Sangu, Matamuhuri, Naf, and Feni. Kutubdia and Maheshkhali channels are the coastal channels of the region. Continuous dumping of highly toxic liquid and solid wastes into the Karnaphuli River has created a situation that has deteriorated the quality of water in the river. The riverside factories, human waste, oil spilling by boats and vessels are responsible for pollution. Once the Karnaphuli used to produce a variety of fish; but now most of the fish species have vanished. Department of Environment and Chittagong City Corporation have failed to save the river from pollution, as about 300 factories on the banks of the river are discharging waste into the river.

3.2.3 Floodplains and Fisheries

Floodplains are the natural lowlands alongside rivers, which are inundated each year in the monsoon as the increased volumes of water overflow river banks. These zones are important ecologically as they are the areas into which the adults of many species of fish migrate to breed. Floodplains are rich in nutrients from the inundated soil and decaying vegetation, and are also rich in food in the form of dead insects, soil invertebrates, and aquatic plankton that frequently bloom under such conditions. They are also protected from the strong currents in the main river; so, are ideal areas for young fish to feed and grow, before entering the main river when water levels decrease. These areas also frequently attract large numbers of water birds, to feed on the juvenile fish in the shallow waters.

Chittagong coastal plain extends from the Feni River to the Matamuhuri delta, a distance of 121 kilometers. It comprises gently sloping piedmont plains near the hills, river floodplains alongside the Feni, Karnaphuli, Halda and other rivers, tidal floodplains along the lower courses of these rivers, a small area of young estuarine floodplain in the north, adjoining the sub-region of Young Meghna estuarine Floodplain, and sandy beach reaches adjoining the coast in the south. Sediments near the hills are mainly silty, locally sandy, with

clays more extensive in floodplain basins. The whole of the mainland is subjected to flash floods. Flooding is mainly shallow and fluctuates in depth with the tide (except where this is prevented by the river or the coastal embankments). The average daily rise in the tide is about two meters. Some soils on the tidal and estuarine floodplains become saline in the dry season.

Elsewhere in the country, floodplains have been similarly affected by flood protection schemes, land reclamation and urban development, and there is little doubt that such areas are far less productive than they once were. Even in the more rural areas the quality of floodplains is degraded, in this case by agricultural development, which exposes floodwaters to pesticides and fertilizers in the soil and crops.

3.2.4 Other Aquatic Habitats

There is a variety of other aquatic habitats throughout the country, and in urban areas these include man-made lakes in residential neighbourhoods, permanent and ephemeral pools in natural lowlands (known as beels), and flooded borrow pits excavated for building material. These are generally of little ecological value as the water is frequently polluted, and these areas are often characterized by dense growths of the water hyacinth *Echicornica crassipes*, which out-competes other plants through its rapid growth, although species such as water chestnut and lotus can be seen in places.

3.2.5 Terrestrial Ecology

The city of Chittagong is almost denuded of the trees and vegetation that once had beautified and made its environment congenial to terrestrial ecology specific to this area. Now trees can be found on the hills only. Rapid and continuous growth in the city population has encouraged various land-grabbers and led to proliferation of land development firms with a resulting erasure of wetlands, trees, greenery, vegetation and forest lands in and around the city and replacement by widespread concrete jungles in the name of high-rise buildings. The urban terrestrial fauna is very limited as a result, and mainly consists of animals able to live close to man, such as lizards and geckoes, scavenging birds like house sparrow and crows, mice, rats and other rodents, plus jackals, mongooses, squirrels and monkeys.

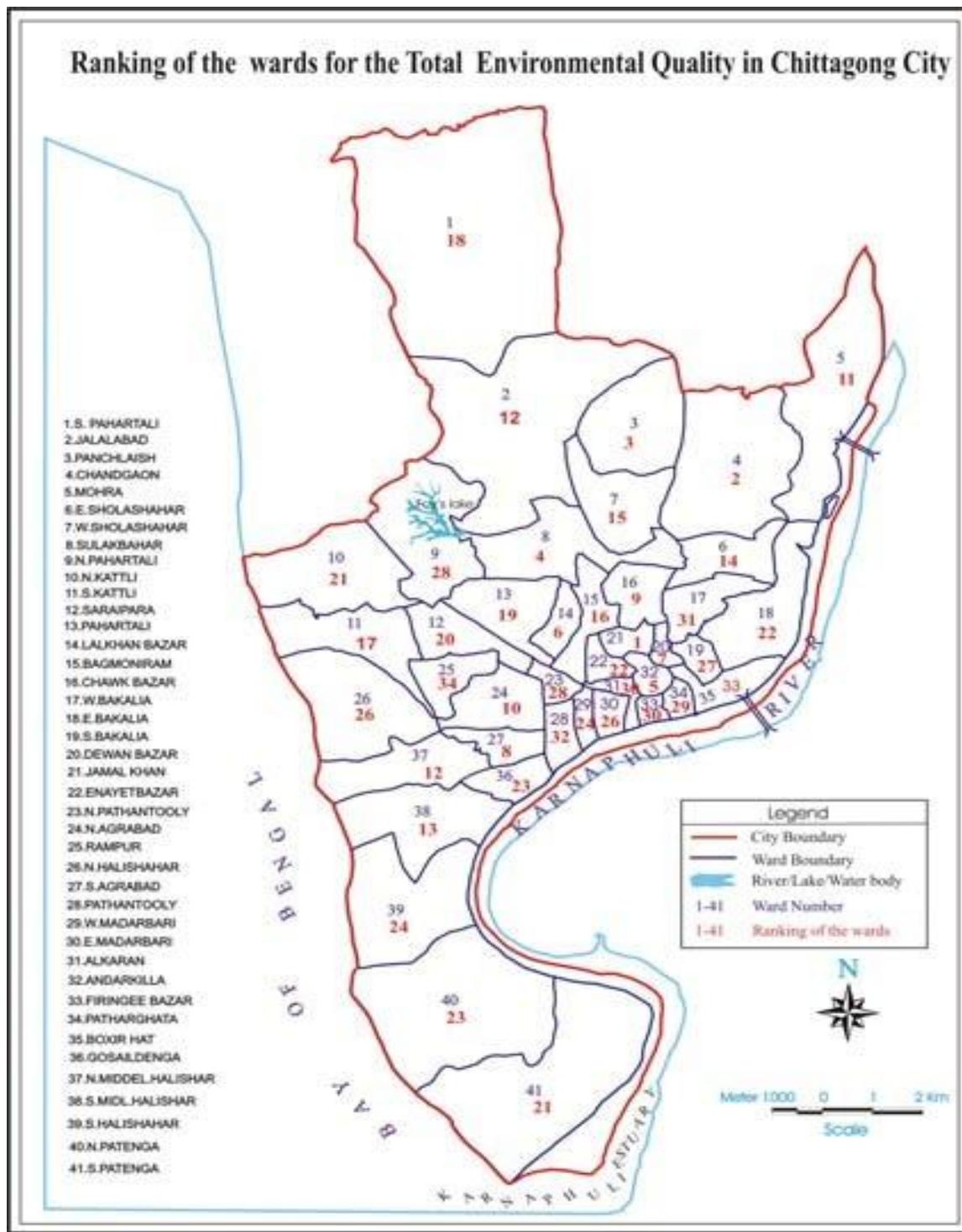


Figure 11: Ranking of the Wards of Chittagong for Total Environmental Quality

There is a wider range of species in the farming areas, but even these are mainly animals that are commonly found close to man, such as cattle egrets. Figure 12 gives an idea on the ranking of total environmental quality of 41 wards of the Chittagong city on the basis of the study based on information

from 492 respondents at household level.⁵ The proposed commercial and residential complex of NHA is located in ward no. 8, which is ranked 27th in order of merit in this study.

3.2.6 Protected Areas and Endangered Species

The beautiful buildings, mosques and shrines of Chittagong bear witness to its history from the ancient times to the present. Most of the old and new buildings of the city are built on top of low hills and hillocks and also along the valleys and plains. The massive Court Buildings which accommodate the Civil Courts, Criminal Courts and the offices of the Divisional Commissioner, Deputy Commissioner, and the District and Session Judges are on top of Fairy Hill. The top of this hill offers a panoramic view of the town below. One can see the Karnaphuli River up to its mouth and the Port area along its bank, the Deang and Banskhali Ranges to the south and the Hill Tracts to the east. All along the foothills are situated the General Post Office, the Municipal High School, New Market, and the Chittagong Development Authority Building. The General Hospital stands on top of the Rangmahal hill. The Telegraph Office, Divisional Forest Office, residences of the Divisional Commissioner and the Deputy Commissioner are situated on top of a hill range known as the Tempest Hills. The nearest protected and environmentally sensitive area, the famous shrine of Bayazid Bostami is about 8 km from the proposed NHA site.

The Chittagong region is characterized by three distinct ecological zones: inter-tidal zone, coastal plains and extensive hill areas. The northern and eastern parts of the region constitute the hilly areas and are commonly known as the Chittagong Hill Tracts. This area is covered by deep evergreen and deciduous forests which is a habitat of many wildlife species such as the Asian Elephant (*Elephas maximus*), White Duck (*Cairina scutulata*), Banrui (*Maris crassicaudata*), Banchhagal (*Capricornis sumatraensis*), Shajaru (*Hystrix indica*) and other endangered species. The coastline consists of a 100 km long sandy sea beach on the Bay of Bengal. The remainder of the region consists of plains. The proposed building is located in a small hilly area and thus there are no endangered species. Flora and fauna found in the project site are commonly found in developed and urban areas.

⁵ Kathmandu University Journal of Science, Engineering and Technology, Vol 1, Number IV, August 2007

3.3 Economic Development

3.3.1 Industry

Besides oil refinery and oil-blending plants, the Chittagong city has large cotton and jute-processing mills, tea and match factories, chemical and engineering works, iron and steel mills, fruit-canning, leather-processing, and shipbuilding industries.

Chittagong is a commerce and industry hub, and a port city, in south-eastern Bangladesh and the capital of an eponymous district and division. The city is home to Bangladesh's busiest seaport and has a population of over 5.5 million, making it the second largest city in the country.

Chittagong is one of the fastest growing cities in the world, with a GDP of \$25 Billion. A major commercial and industrial centre, the city also has a globally competitive special economic zone. With the Port of Chittagong being expanded and developed, the Dhaka Chittagong Highway being upgraded into a 4 lane divided highway, and Shah Amanat International Airport being upgraded, regional neighbours of Bangladesh have eyed Chittagong as a future regional transit hub. The port city is seen as crucial to the economic development of landlocked southern Asia including Northeast India, Bhutan, Nepal and parts of Southern China and Burma.

3.3.2 Infrastructure

Infrastructure is a major problem in all towns and cities of Bangladesh, wherein many facilities are inadequate to serve the needs of such a large population, after decades of under-funding and neglect. Sewerage system is not available in Chittagong. Throughout the rest of the country people use a variety of methods including septic tanks, pit latrines, and open defecation. Septic tanks malfunction because of inadequate design, construction or maintenance, or because the high water table impedes the soak-away function. Many buildings, including high-rise developments, have no sanitation system at all, and discharge their effluent into lakes, rivers, drainage ditches or onto open ground, causing unsightly areas, health risks and water pollution.

Solid waste in urban areas is the responsibility of the city corporation (CCC), and in most locations NGOs or CBOs operate the primary collection service, removing waste from houses and businesses each day, mainly on cycle-rickshaws. Domestic wastewater from the proposed building will pass through treatment by septic tank with adequate capacity and will be allowed to drain through the public sewerage/ drainage system of CCC.

As an Infrastructure development strategy, Public-Private Partnerships (PPP) may be a good solution to meet infrastructure development needs and to achieve the Sustainable Development Goals (SDG) as well. The Government plays a great role in PPPs as it forms a means to increase the quantity and quality of infrastructure investment. CDA is also interested in consultations between the CDA and private sector to start direct dialogue on PPP, and to work out the specific issues and recommendations. As per the development plan, CDA also expects local and foreign partners to be involved in the development process.

The transportation component of Chittagong Metropolitan Master Plan contains a present situation report, an immediate action plan and a long term development strategy for traffic and transportation. Under long term Development Strategy, an extensive development strategy has been undertaken for future transport planning purpose in Chittagong. CDA is working as per the principal recommendation of the strategy, which includes:

- Establishment of Roads hierarchically in the city;
- Highway improvement;

- Provision of Railway over bridge at several sites;
- Improvement of Road and Transport Services;
- Industrial Strengthening; and
- Improvements of other modes, namely waterways, aviation and railways.

CDA is playing a great role in minimizing the residential problem. More than 7,000 plots have been allocated and many of them have been handed over to minimize the residential problem. To ensure that all facilities like educational or health facility are in residential areas, CDA has been trying to invite different international institutions/ companies to open their branches in CDA's residential areas. Apollo Hospitals and Delhi Public school are a few of them. CDA is constructing a 20 storied commercial cum residential building (Kajir Dewri Kacha Bazar) in the downtown aimed at solving the housing problem and promoting the business sector. To promote the development of Garments sector, CDA with collaboration of BGMEA (Bangladesh Garments Manufacturing and Export Authority) is constructing a dormitory for the low income worker in the Garments Sector. Moreover, 'CDA Square' – is a project by CDA to create a replicable mechanism to deliver affordable flats to the middle income people by intensive and economical land use plan.

For development of business, CDA has developed some commercial and Industrial area also. Different shopping centres have been constructed and maintained by CDA. 'Biponi Bitan'- known as Chittagong New Market is an ancient market which is still a symbol of good architectural and structural design. Other Markets named - Pahartali market, Karnaphuli market, Sholoshahar Market are a few of them.

CDA takes various initiatives to enrich the tourism sector of Chittagong. The following tourist spots have been developed by CDA:

- Butterfly Park; and
- Nandonic DC Hill Park & CRB Landscape development (future development)

3.3.3 Transportation

Transport in Chittagong is similar to that in the capital, Dhaka. Large avenues and roads are present throughout the metropolis. There are various bus systems, taxis, and as well as smaller 'baby' or 'CNG' taxis, which are basically tricycle-structured motor vehicles. There are also traditional manual rickshaws, which are very common.

The Dhaka-Chittagong Highway, a major arterial highway, is the only way to get in the city through land. It is a very busy and a risky highway (currently it is a 2-lane highway), with an upgrade to 4 lanes being implemented. Chittagong can also be accessed by rail. It has a station on the meter gauge eastern section of the Bangladesh Railway. The headquarters of this railway are located here. There are mainly two railway stations in Station road Chittagong. Trains are available to travel to the Bangladeshi cities of Dhaka, Sylhet, Comilla, and Bhairab.

Shah Amanat International Airport serves as Chittagong's sole international airport, and the only route to get into the city by air. It is the second busiest airport in Bangladesh. It has international service to destinations such as Middle Eastern cities like Abu Dhabi, Dubai, Sharjah, Jeddah, Ras Al Khaimah, Muscat and Kolkata. Currently, Middle Eastern low-cost carriers like Flydubai, AirArabia, RAK Airways, Oman Air fly from here to international destinations in the Middle East. It was formerly known as MA Hannan International Airport, but was renamed on April 2, 2005 by the Government of Bangladesh.

3.3.4 Land Use

In most urban areas the expansion has been inadequately planned and controlled, because of ineffective planning and inadequate enforcement of the planning laws and implementation of the land use policies. As a result, inappropriate mix of land uses is commonplace (e.g. residential and industrial), and areas have grown without the development of supporting infrastructure (water, sanitation, schools, hospitals, etc.). Planning problems are compounded by natural and anthropogenic factors, which include: seasonal flooding, which limits the use of large areas; population expansion, which puts a high demand on land; and the high proportion of urban poor, who have little alternative but to erect makeshift shelters on vacant land, increasing the slum areas.

The urbanization pattern of Chittagong City is characterized by haphazard growth. Land use follows a similar general pattern in most towns and cities, with mainly urban uses in the centre and residential areas in the outskirts. The town centre normally houses the main business and commercial districts, and contains shops and offices lining the roads, often in high-rise developments. There are also service industries in these areas, including restaurants, convenience stores, vehicle repair, etc., plus residential units, often above the shops and offices. The urban fringe generally contains the better quality residential developments, and there are also shops and retail outlets, but less of industry. There is also some agriculture in the outskirts, particularly in the more rural parts of the city.

The proposed site for the NHA Complex is on the land owned by the National Housing Authority itself, and at present being used for office and residential facilities for the staff.

3.3.5 Power Sources and Transmission

The Bangladesh Power Development Board (BPDB) is responsible for the generation of power in the country, and distributes electricity to retail customers, as well as to two other distribution utilities: the Rural Electrification Board (REB); and the Dhaka Electric Supply Authority (DESA) in the capital. Electric power is generated in hydro, steam, gas-turbine and diesel power plants, and all the generating stations are interconnected through a national grid. As per the details available in February 2011, the total installed capacity of power generation is 6,658 MW and the maximum power generation is 4,699 MW.⁶ Karnaphuli Hydro Power Station is the only hydropower plant in the country located at Kaptai, about 50 km from the port city of Chittagong. This plant was constructed in 1962 as part of the 'Karnaphuli Multipurpose Project', and is one of the biggest water resources development projects of Bangladesh. After being commissioned in 1962, the plant could feed the national grid with 80 MW of electricity. In later years, the generation capacity was increased in two phases to a total of 230 MW. The plant not only plays an important role in meeting the power demand of the country but is also vital as a flood management installation for the areas downstream. The other two big power stations in the Chittagong region are Raozan (420 MW) and Sikalbaha (60 MW).

Power is provided to most urban areas through a network of electricity pylons and poles, mainly located beside roadways. These provide connections to individual houses, and revenue collection is aided by individual household meters. Generation was insufficient in the recent past to offer a continuous supply, and the providers operated a system of "load-shedding" whereby they turned off the supply for 1-2 hours each day to conserve the resource. But the situation has improved a lot over a period. Hotels, businesses and the more wealthy residents still use their own generators to augment the supply from the national grid.

⁶ Bangladesh Economic Review 2011 (Bangla Version)

The proposed site of the NHA Complex is located in the heart of the city. There is power supply available for the existing establishments. But the requirement will increase many folds after the completion of the complex. This will require installation of a substation within the complex area as per design needs.

3.3.6 Other Economic Development

The economic development of the country largely depends on the efficiency of Chittagong port. The sea-borne exports of Chittagong consist chiefly of readymade garments, knitwear, frozen food, jute and jute products, leather and leather products, tea, and chemical products. There is also a large trade by country boats, bringing chiefly cotton, rice, spices, sugar and tobacco. Sailing ships built in Chittagong include the Betsey, the Argo, and the Mersey. Ship breaking was introduced to the area in 1969. This industry is concentrated at Faujdarhat, a 16 kilometers long beach, 20 kilometers north-west of Chittagong. Chittagong is also home to a large number of industries from small to heavy.

Around 40% of the heavy industrial activities of the country is located in Chittagong city and adjacent areas, which include Dry-docks, Dock yards, Oil refineries, Steel mills, Power plants, Cement clinker factories, Automobile industries, Pharmaceutical industries, Chemical plants, Cable manufacturing units, Textile manufacturing units, Jute mills, Urea fertilizer factories along with other private sector medium size industrial developments and activities. A Korean company, Youngone Corporation, has established a special Korean Export Processing Zone (KEPZ) in the port city of Chittagong. The KEPZ is built on a land area of nearly 1,000 hectares and is expected to attract foreign direct investment worth \$1 billion. There is also a Karnaphuli Export Processing Zone, with the same acronym (KEPZ).

3.4 Social and Cultural Resources

3.4.1 Population and Communities

Chittagong city has a population of 5.5 million, of which 54.36% is male and 45.64% female. Population density per square km is 15,276. Islam is the most common religion among the people. 83.92% of the population is Muslim. Other major religions are Hinduism (13.76%); Buddhism (2.01%), Christianity (0.11%) and others (0.2%). The population has increased tremendously during the last two to three decades because of a variety of reasons.

One of the main reasons for the population growth has been the influx of rural migrants, attracted by the prospect of easier lives and increased income in urban areas. When these fail to materialize, the inevitable result is an increase in the urban poor and an expansion of slums. Thirty five percent of the urban population of the country now lives in slums, which is almost 15 million people, and in the eight city corporations there are almost 10,000 slums, 55% in Dhaka and 20% in Chittagong.

3.4.2 Health Facilities

Health facilities are generally more widely available in towns and cities than in the rural areas. However, the cost of the service is quite high and therefore, it is not widely used by poorer people and slum dwellers in particular. This along with various other factors, including poor sanitation and nutrition (which decrease immunity and resistance), overcrowding (which facilitates disease transmission) and poor public and environmental health mean that the urban poor suffer disproportionately from ill health. As a result, child morbidity and mortality, malnutrition and growth retardation are all higher in slum areas. There are also gender inequalities, with mortality in years 1-4 being 28 per 1,000 births in boys, compared to 38 in girls.

People in urban areas suffer many of the diseases associated with overcrowding and poor sanitation, including dysentery, diarrhoea, whooping cough, gastro-enteritis, TB, etc. In the larger cities like Dhaka and

Chittagong they also suffer from respiratory problems and other illnesses caused by excessive exposure to traffic pollutants.

Chittagong Medical College Hospital with more than 600 beds is the largest government-run health service provider in Chittagong. This huge medical facility has many wards, cabins and units. At present, this facility also provides medical treatment of ICU and CCU for the patients in serious conditions. Other medical service institutes in the city include General Hospital, Upazila Health Complex, Family Welfare Center, TB Hospital, Infectious Disease Hospital, Diabetic Hospital, Mother and Children Hospital and Police Hospital. Notably, the total health service of Chittagong is developing day by day. Many non-government hospitals and clinics also belong to the city. Chittagong Metropolitan Hospital, Surgiscope Hospital, CSCR, Centre Point Hospital, National Hospital, etc. are the noteworthy non-government hospitals and clinics of Chittagong City.

Public health facilities provide good service, but many are under staffed and under resourced, and the ratio of beds to population is inadequate. Facilities are significantly better in the private sector, but the services are expensive, and out of reach of most people excepting the wealthier citizens.

3.4.3 Educational Facilities

The overall literacy rate in the city area (population aged 7 years and above) is 69.73%; compared to the national average of 45.3% as per 2001 census. In the city area, male literacy rate is 72.85%, while for female; the corresponding figure is 65.76%. The main reason for this is the large-scale immigration to the city area of the families who either are already literate or who after settlement made use of the extensive educational facilities available in the city to make them more competitive in the local job market.

Chittagong University, Chittagong Medical College and Chittagong University of Engineering and Technology are totally funded by the Government. Chittagong is home to two of the nation's most prominent public universities, and is the site of one of Bangladesh's largest universities, the University of Chittagong, established in 1966. The university is located in a remote place in the outskirts of the city (22 km north) of Chittagong. Current student enrolment is more than 20,000. The other public university is Chittagong University of Engineering and Technology established in 1968. Formerly, it was named Bangladesh Institute of Technology (BIT). The University is situated by the side of the Chittagong-Kaptai road some 25 km off from the centre of Chittagong City. The Asian University for Women (AUW), another famous higher education centre located in Chittagong, is being established as a leading institution of higher learning for women.

At present, in Chittagong, there are quite a few private universities like BGC Trust University Bangladesh (2002), International Islamic University, Chittagong, University of Science and Technology-USTC (1992), Southern University, Bangladesh(1998), Premier University (PU), and University of Information Technology & Sciences. Recently, Chittagong Government Veterinary College (CGVC) has been upgraded to Chittagong Veterinary and Animal Sciences University (CVASU), which consists of one department providing theoretical, out-campus work based learning and excellent scientific and technological education to 300 students. It is the first university in Bangladesh of this type. Some examples of private medical colleges of Chittagong are: Chittagong Ma O Shishu Medical College, Southern Medical College, Chittagong International Dental College, BGC Trust Medical College, etc.

3.4.4 Socio- Economic Conditions

With an annual per capita income of \$1,466, Bangladesh is one of the least developed countries in the world. Agriculture is the dominant sector nationally (employing 50% of the labour force and contributing 23% of the GDP), followed by manufacturing (10% of the labour force and 16% of the GDP respectively).

With significant growth in the export of ready-made garments, Bangladesh earned around \$31 billion in the last fiscal year, and a further \$15 billion from the export of manpower, mainly to the Middle East.

The port city of Chittagong accommodates almost 3% of the total population and is the second most urbanized area in the country. In this area people are engaged in various activities, mainly in business, industry and transport and communication. There are around 200 garment factories, in which more than two hundred thousand people work, mainly women. Other types of manufacturing are also major employers, as is the construction industry. In a study based on BBS data, Chittagong region has the highest per capita per month income of Tk. 6,430 followed by Barisal (Tk. 5,970), Khulna (Tk. 5,960), Sylhet (Tk. 5,690), Dhaka (Tk. 5,540) and Rajshahi (Tk. 4,980).⁷

The trend of rural-urban migration is largely a result of a lack of secure employment and sustenance in the rural areas, so people move to the cities where they believe there are better job opportunities. As noted above, these rarely materialize and the end result is an increase in the urban poor, and an expansion of the slums. Large percentage of the population of Bangladesh lives on very low rate of income, and such people are mainly the urban poor and the rural poor. Slum dwellers in the towns and cities include people who are in regular employment, plus large numbers who are unemployed and who obtain an income from the streets where they can. Employed slum dwellers work mainly in construction or in factories, or as domestic servants, rickshaw operators, street vendors, etc.

3.4.5 Physical and Cultural Heritage

Bangladesh has many sites, buildings and artefacts that are of historical and cultural significance. Many date back to the British colonial period from the mid-19th to the mid-20th centuries, and some are from earlier periods, including the Muslim era of the 13th to 17th centuries, the Sena dynasty of the 12th and 13th centuries, and even the Gupta Buddhist era of the 4th to 7th centuries A.D. However, construction practices that pay scant regard to the possible discovery of ancient remains have meant that most of the older sites that remain are located well away from urban areas.

The main archaeological heritage and relics of Chittagong are Bronze statues (8th and 9th centuries, in Anwara Upazila), Fakira Mosque (Hathazari), Musa Khan Mosque (1658), Kura Katni Mosque (1806), Kala Mosque (16th century), Chhuti Khan Mosque (Mirsharai), Kadam Mobarak Mosque (1719), Andar Killah Mosque, Wali Khan Mosque (1790), Badar Awlia Dargah, Bakshi Hamid Mosque of Banskhali (1568), Chittagong Court Building (1893), Collegiate School, Ethnological Museum (1974). The proposed building complex site is not adjacent to any of the enumerated archaeological heritage and relics of Chittagong.

3.4.6 Indigenous Peoples

The majority of Bangladesh's people are Bengalis, and approximately 2.5 million are indigenous peoples belonging to 45 different ethnic groups. These people are concentrated in the north, and in the Chittagong Hill Tracts (CHT) in the south-east of the country. Their historical background, economic activities, social structure, religious beliefs and festivals make them distinctive. There is no specific pocket in the Chittagong City Corporation where indigenous people can be found; rather they have mixed with other people of the community. Within the Chittagong City Corporation, they are getting similar facilities as other citizens there; but they are not having enough opportunities within their own community because mainly of the isolated locations in different rural areas.

⁷ Rahman & Hossain: Convergence in per Capita Income across Regions

In Bangladesh, there are many tribal people living in Sylhet, Dinajpur, Cox's Bazar, Mymensingh, Rajshahi, etc. But majority of tribal people live in Chittagong Hill tracts. It is the home of eleven tribes – groups such as Chakma, Marma, Tripura, Tanchangya, Lushai, Pankho, Bawm, Mro, Khyang, Khumi and Chak. Among all of them the Chakma are the largest ethnic group in Bangladesh. Majority of them are Buddhists and the rest of them are Hindus, Christians, etc. Also a good number of mainstream Bengali live in this area. But their appearance, language and culture traditions are markedly different from other Bengali speaking people living in other parts of Bangladesh.

The tribal people of CHT lead a simple life. The tribal families are matriarchal and female is the head of a family. In their community the women are more hard-working than the male and basically they are the main productive force. The tribal people are extremely independent and self-confident. They grow their own food by Jhum cultivation. Their girls weave their own clothes and they are very skilful in making beautiful handicrafts. By selling the clothes and the handicrafts they earn some money and help their family. The common feature is their way of life, which still speaks of their main occupation. Some of them are still involved in hunting with bows and arrows.

Environmental degradation has made their lives even more difficult. They have become the victims of the negative impacts of modernization, as they lack the education and awareness to be able to harness and enjoy the benefits that Bangladesh's economic growth has created.

4 Anticipated Environmental Impacts and Mitigation Measures

The present report assesses the impacts of the proposed activities on various environmental attributes of the project site.

Methodology: Issues for consideration have been raised by the following means: (i) input from interested and affected parties, if any; (ii) desktop research of information relevant to the proposed project; (iii) site visit and professional assessment by environment specialist engaged by the Transaction Advisory Consultant; and (iv) evaluation of proposed design scope and potential impacts based on the environment specialist's past experience. Categorization of the project and formulation of mitigation measures have been guided by the checklist in Annex 1: Rapid Environmental Assessment Checklist and the Environmental Screening Summary has been given in Annex 2.

4.1 Location and Design Impacts

In case of this Project, there are few impacts that can clearly be said to result from the design or location of the project. This is because:

- The infrastructure involves relatively straightforward construction at a single site; so, it is unlikely that there will be major impacts when the facility is built;
- The proposed location of the project is in an area where the NHA authority already has valid ownership as per Government regulations and there are very minor activities that can cause environmental degradation, and there are no sensitive areas or receptors nearby; and
- If the project operates in the manner intended, it should be a hygienic and well managed facility that functions with few emissions and without major negative impacts.

Planning principles and design considerations have been reviewed and incorporated into the site planning process, whenever possible. The concepts considered in the design of the NHA Complex are:

- All the components should have garbage vats adequate in size to accommodate solid waste collected from the target area.
- All the components should be provided with independent supply of safe water.
- Water points, hoses and cleaning equipment must be provided in sufficient numbers. Cleaning program must be performed regularly.
- Industrial three phase electricity should be supplied and a standby generator installed.
- Each component should have its own drain and all drains must be accessible for cleaning for efficient wastewater system.
- The building components should be protected by fencing to keep out from trespassing animals specially dogs/ cats, etc.
- Relevant national rules in solid waste management should be strictly enforced.
- Entire complex would be managed by private organizations/ parties through competitive bidding process following government public-private partnership guidelines.
- Techniques, installation, management and training should be focused on minimization of water consumption, minimization of energy use, minimization of emission to air and minimization of noise.
- Future extensions or possibilities to add some other installations should be kept in mind during the design period and during the period of construction.

Interested private developers will bid based on the concept and details included in the bid documents. The bidders will be advised to make their own diligence study prior to the bidding. Necessary documents and studies will be made available to them for their evaluation. It will be up to the bidders to maximize the use of resources made available to them.

No impact is anticipated due to the location as the proposed site is owned by the Bangladesh's National Housing Authority. Resettlement Plan by the NHA will be developed internally for any type of compensation, restoration, or relocation pertaining to this project. It may be mentioned here that all responsibilities and costs for relocation of employees from within the project site during the construction on site lie with NHA and not the private developer.

4.2 Construction Impacts

Construction method: The work comprises the construction of Commercial cum Residential Apartment Complex for NHA including all its supporting infrastructure within the NHA portion of the land as well as commercial and/ or residential complex including all its supporting infrastructure as per the private developer's market assessment in private developer's portion. The following activities will be involved as part of the construction work:

- Preparation of the ground by forming to level and grade and excavating locally for foundations or, if necessary, by excavating unsuitable fill material and replacing with imported compacted backfill.
- Shaping of ground to suit footings and floor slab layout and falls and to allow exterior ground drainage.
- Laying and backfilling over underground and under floor drains.
- Boxing foundations and placing reinforcement with column starter bars.
- Pouring of slab and footings and curing.
- Construction of unreinforced masonry infill panels.
- Placing reinforcement, boxing, and pouring columns.
- Placing reinforcement for lintel beams and pouring concrete.
- Casting in bolts and anchor plates as necessary in the columns and lintels.
- Fabrication and fixing roof trusses and bracing.
- Placing and fixing purlins.
- Fixing roof cladding, gutters and downpipes.
- Wall framing with cladding panels and insect mesh as necessary.
- Fixing of external rails for sliding doors.
- Placing and fixing internal beams for rails plus fitting rails and hangers.
- Constructing weather covers for sliding door rails.
- Hanging of hinged doors.
- Internal wall and floor plastering as required.
- Painting as required.
- Electrical Services.
- Supply and/ or manufacture and installation of mechanical equipment.
- Construction of external effluent disposal system.
- Construction of solid waste disposal systems.

As explained above, the land on which the project is to be developed is currently being used for similar purposes. Large format commercial and residential complex may be developed by the private developer.

There is open space beside the main road and it is easily accessible by the trucks used for onward transportation of the wastes to the sanitary landfill sites. So during construction, there will be some very minor impacts on the people. There will also be no issue of resettlement of affected persons.

The site is located in a slightly undulated area with level difference of approximately 3 meters. One small hillock also forms part of the site. The sides of the hill may have risk of failure in case proper protection measures are not taken. To avoid this risk of landslide, the construction work should be carried out during the dry season when there will be no rainfall. The positions of the buildings will be so chosen as to avoid the edges of the hill.

Most of the site will be excavated to around 1.50 meter to create the cavities for the foundations of the buildings and paved areas. This will be done by backhoe digger and the excavated sand and soil will be loaded into trucks and transported to the municipal landfill for disposal. Piling will be needed for high rise portions of the buildings.

All of the buildings and other structures will have Reinforced Cement Concrete (RCC) foundations; so, metal reinforcement bars will be put into position in the cavities by hand. Concrete (mixed on site or elsewhere) will then be poured into the cavities to form the foundations and floors of the buildings and other structures and the paved surfaces of the roads.

The above-ground RCC elements will then be created by enclosing lengths of metal reinforcement in wooden shuttering and pouring in the concrete, which sets to form the structure. This is then repeated in the next portion of reinforcement and so on to create the completed structure. The brick walls of the building, toilets and boundary wall will then be created between the RCC supports by masons laying bricks and mortar by hand. Surfaces will be finished by plastering or tiling. Doors, windows, electrical fittings and pipe-work for water supply and drainage will also be added by craftsmen and labourers.

All materials will be brought to site on small trucks and offloaded and positioned by hand, and crane will be used for any heavier elements such as the steel supports and reinforcement bars, doors and the metal gates for the entrance to the site. All debris will be cleared at the end of construction by loading onto a truck and disposing it at the municipal landfill. Disposal sites for excavated soils and contaminated materials will be identified and agreed upon with the DoE before the commencement of any civil works.

There is sufficient space for a staging area, construction equipment, and stockpiling of materials. However, the contractor will need to remove all construction and demolition wastes on a daily basis.

Screening Out Areas of No Significant Impact: From the descriptions given it is clear that implementation of this project will not have major environmental impacts because the construction work is relatively small scale and straightforward, and will be conducted at only one site. Because of this there are several aspects of the environment that are not expected to be affected by the construction process and these can be screened out of the assessment at this stage. These are shown in Table 4, with an explanation of the reasoning in each case. These environmental sectors have thus been screened out and will not be mentioned further in assessing the impacts of the construction process.

Table 4: Fields in which construction is not expected to have significant impacts

Field	Rationale
Climate	Short-term production of dust is the only effect on atmosphere

Field	Rationale
Geology and seismology	Excavation will not be large enough to affect these features
Forests, wildlife, endangered species, protected areas	There are no forests, protected nature conservation areas or important habitats or species at or near this site
Coastal resources	NHA Complex site is far from the sea and this is deep inside the city centre, and such small structure will not affect the coastal resources
Agriculture, tourism	There is no agriculture at or near these sites; there will be positive impact on tourism
Population and communities	Construction will not affect population numbers, location or composition
Health and education facilities	There are no schools, clinics, hospitals, etc. at or near this site
Physical or cultural heritage	There are no culturally important buildings or locations at or near this site
Indigenous Peoples (IP)	The proposed site is not used by indigenous peoples or minority communities
Archaeology, palaeontology	No material of archaeological or paleontological significance has been found by previous construction projects in these areas
Ecological value	There are no protected areas in the vicinity of this site and no special ecological interest exists within the boundary of the site under consideration. Construction should therefore have no ecological impacts.

Impacts due to excavations: Excavating the foundations for the buildings, roads, walkways and other structures on sites is expected to produce around 2,000 m³ of waste soil and stone. This is a relatively small quantity and it can be taken to the municipal disposal site without special precautions to reduce the amount of dumping. The material could be put to beneficial use if it was utilized at the landfill to cover waste; so, arrangements should be made by the Contractors with the landfill operators to deposit the waste in a suitable location where it can be used for this purpose. In any case, disposal sites for excavated soils and contaminated materials will be identified and agreed upon with the DoE before the commencement of the excavation activities.

Excavation is likely to be conducted in the dry season to avoid the difficult conditions that can occur when earthworks are carried out during rain. Precautions will therefore be needed to limit dust so that it does

not affect surrounding areas or workers on site. Another physical impact associated with large-scale excavation is the effect on drainage and the local water table if groundwater and/or surface water collect in the cavities as they are dug.

Impacts due to alteration of the site: The presence of diggers, trucks and other vehicles and machinery and the developing structures as they are created is expected to gradually alter the landscapes of this site. However, most of this area is generally very "busy" visually and although there are no features of any special landscape interest at or around the site, the construction site should be masked from view by erecting screens.

Impacts on site-specific economy: All of the construction related to this project will be conducted on land that is at present owned by the Bangladesh's National Housing Authority and at present being used for similar purpose. So, there will be no negative economic impact on the local people due to the construction of this project.

Construction work can provide short-term socio-economic gains for local communities if contractors employ local people in the workforce. To ensure that these benefits are directed to communities that are most affected by the work, contractors are often encouraged to employ people who live in the immediate vicinity of construction sites. This is possible in this case because of the presence of inhabitants in the locality; so, the contractor should offer employment to any person who is willing to work on the present site (in breaking bricks and in other activities) and who is not already employed by some other company. A few such persons may be economically disadvantaged and their conditions would be improved by even a relatively short period of temporary employment.

Impacts on utilities: There are some temporary infrastructure on the land (power lines, and possibly also water supply pipes); so, there could be minor impacts from the disruption of supply of these facilities due to damage during construction.

Impacts on accessibility: Excavation work can also have economic impacts if heavy vehicles carrying materials to the site and transporting excavated waste to the disposal site cause significant disruption of traffic, particularly where work is conducted in an urban environment such as this. However any such impacts should not be significant in this case, because dump trucks normally have a capacity of 25-30 m³ so the disposal of 2,000 m³ of soil and stone will require a relatively small number of truck movements: around 80.

Impacts on social and cultural resources: Construction activities inevitably produce noise and dust, and these plus the visual appearance of the site and restrictions in access caused by excavation and the presence of vehicles and machinery, are generally the factors that disturb people who live or work in the vicinity. These should however not be major problems in this case as there are no people living on or near this site and the people who work there are already well adapted to this type of disturbance. The construction work is also small in scale, so it should not be necessary to apply measures to reduce noise, dust or other disturbance, beyond the dust suppression measures.

There are some major permanent public buildings at or near the site, and given the current land-use there are unlikely to be any locations that are of any special social or cultural importance to the community (shrines, meeting places, etc.). This should be confirmed by consulting labourers who work on the site during the construction stage and in the unlikely event that there are such locations; assistance should be given in relocating the site and any associated artefacts. One mosque is located in the north-west corner of the site, which should be protected. Similarly, one pond within the site should remain as it is without any attempt to alter it significantly.

Impacts on health and safety: As is usual on construction sites, the health and safety of workers will need to be protected by measures, which the contractor will be required to adopt. As adjacent areas are usually heavily used for the storage and processing of building materials, the contractor should also include measures to ensure the safety of the public.

4.3 Operation and Maintenance Inputs

Sufficient, safe, potable and constant supply of fresh water will be made available at adequate pressure throughout the premises. Suitable facilities for washing of hands including nail brushes, soaps or detergents will be provided to the workers. All sanitary facilities will be equipped with suitable flushing appliance.

Land contamination: The project site will not contaminate the land the way other industrial operations can. The main reason for this is that this building complex will not use any chemicals that can have any detrimental effect on the environment.

Generation of Waste Materials and By-Products: In general, pollutants generated from this building complex will include: wastewater from toilet and cleaning of premises, and mud-fed rainwater drainage during rainy seasons.

Generation of Wastewater: The liquid waste of the building complex is not expected to be very high in biological oxygen demand. Also, the quantity is expected to be relatively small and it will be allowed to drain through the existing municipal covered surface drains.

Health, hygiene, and safety: Spread of diseases to workers and their families may occur due to inadequate provision of certain safety equipment and lack of practice of safety rules and precautions.

When the project is completed, it is expected to provide a modern sanitary facility for the workers and staff and people residing in/ using the various residential and commercial building as well as systematic handling and transportation of solid waste without causing environmental pollution. Provided this occurs, there should be no negative environmental impacts. These are identified in Table 5 below, with an explanation of the reasoning in each case. These factors are thus screened out of the impact assessment and will not be mentioned further.

Table 5: Fields in which operation and maintenance of the completed NHA Complex is not expected to have significant impacts

Field	Rationale
Geology, seismology	Operating the project should not affect these factors.
Forests, wildlife, endangered species, protected areas	There are no forests, protected nature conservation areas or important habitats or species at or near the site.
Coastal resources	Project site is far from the sea and located deep inside the city and such a small structure will not affect the coastal resources.

Field	Rationale
Tourism, population and communities, health and education facilities	This is a place of tourist attraction, and there are no inhabited areas or health/ education facilities near the project site. There will be only positive impact on these issues.
Physical or cultural heritage, archaeology, palaeontology	There are no areas of social, cultural or historical interest or importance near the site.
Indigenous Peoples	There are no IP or minority communities near the site.

4.4 Mitigation Measures

There are no impacts that are expected to be significant or complex in nature, or that need an in-depth study to assess the impact. Thus, the project is unlikely to cause significant adverse impacts. The potential adverse impacts that are associated with design, construction and O&M can be mitigated to acceptable levels with the following mitigation measures (**Table 6**).

Table 6: Recommended Mitigation Measures

Parameter	Mitigation Measures
Planning Phase	
Work schedule	<ul style="list-style-type: none"> • Ensure careful planning and scheduling of the activities. <p>(Scheduling of the activities and preparation of traffic management plan will be done by the Contractor immediately after the start of construction activities. These plans will be approved by the Private Developer's supervisory staff or the DSC)</p>
Barricades and warning signs	<ul style="list-style-type: none"> • Use easily transportable barricades and warning signs such as those made of high reflector plastic materials. • Also use aluminized rolled warning signs to warn the public.
Workers	<ul style="list-style-type: none"> • Employ workers with adequate experience, training, and know-how. It is always advantageous for the contractor to employ workers with adequate experience, training, and know-how in the line of work that they are doing. These people are usually reliable and can be counted upon to exercise good judgment in the field.

Parameter	Mitigation Measures
Legislation, permits, and agreements	<ul style="list-style-type: none"> In all instances, the private developer, their consultant and contractor must remain in compliance with relevant local and national legislation. A copy of the IEE must be kept on site. Ensure Environmental Clearance is obtained prior to award of contract.
Access to site	<ul style="list-style-type: none"> Access to site will be via existing roads. The contractor/ developer will need to ascertain the existing condition of the roads and repair damage due to construction.
Setting up of construction camp ⁸	<ul style="list-style-type: none"> Choice of site for the contractor's camp requires the private developer's environment management specialist's permission and must take into account location of local residents, businesses, and existing land uses. A site plan must be submitted to the environment management specialist for approval. If the contractor chooses to locate the camp site on private land, he must get prior permission from the environment management specialist and the landowner. Under no circumstances may open areas or the surrounding bushes be used as a toilet facility. Recycling and the provision of separate waste receptacles for different types of waste should be encouraged.
Establishing equipment lay-down and storage area ⁹	<ul style="list-style-type: none"> Storage areas should be secure so as to minimize the risk of crime. They should also be safe from access by children, animals, etc. The contractor should submit a method statement and plans for the storage of hazardous materials (fuels, oils, and chemicals) and emergency procedures to the Private Developer's supervisory staff or the DSC
Materials management – sourcing ¹⁰	<ul style="list-style-type: none"> The contractor should prepare a source statement indicating the sources of all materials (including topsoil, sands, natural gravels, crushed stone, asphalt, clay liners, etc.), and submit these to the environment management specialist for approval prior to commencement of any work.

⁸ Careful planning of the construction camp can ensure that time and costs associated with environmental management and rehabilitation is reduced.

⁹ Storage areas can be hazardous and unsightly and can cause environmental pollution if not designed and managed carefully.

¹⁰ Materials must be sourced in a legal and sustainable way to prevent offsite environmental degradation.

Parameter	Mitigation Measures
Education of site staff on general and environmental conduct ¹¹	<ul style="list-style-type: none"> • Ensure that all site personnel have a basic level of environmental awareness training. • Staff operating equipment (such as excavators, loaders, etc.) should be adequately trained and sensitized to any potential hazards associated with their task. • No operator should be permitted to operate critical items of mechanical equipment without having been trained by the contractor. • All employees must undergo safety training.
Construction Phase	
Excavated materials	<ul style="list-style-type: none"> • Hauling vehicles must always be present at the excavation site. • The developer can process the excavated materials and use these as selected backfill materials. • If excavated materials are not suitable for reuse, the developer and/or contractor should deposit these in an area designated by Chittagong City Corporation. • The developer and/or contractor should coordinate with the landfill operators for the disposal of excavated materials. • The developer should identify and obtain clearance from DOE for disposal sites of excavated soils and contaminated materials. • The contractor should obtain from the environment management specialist approval for disposal of excavated materials. • It should remove waste rapidly by loading material onto trucks as soon as it is excavated; • It should cover or damp down working areas and stockpiled soil in dry, windy weather; and • It should use tarpaulins to cover loose material during transportation to and from the site. • It should maintain record of excavated materials, disposal dates, and methods. • It should conduct the work in the dry season as this will reduce these impacts, and as the excavation in this case is shallow and small in scale there should be no impact on the water table.
Hauling of Construction Materials	<ul style="list-style-type: none"> • The contractor must maintain all the materials necessary in his inventory so that these can be easily hauled to the construction site when needed.

¹¹ These points need to be made clear to all staff on site before the project begins.

Parameter	Mitigation Measures
	<ul style="list-style-type: none"> Advance signage for affected parking areas must indicate duration and alternative parking arrangements.
Access	<ul style="list-style-type: none"> The developer and/or contractor should make available in his stock steel plates and wooden planks, which will be deployed on top of excavations to provide temporary access to buildings, street crossings, and other areas where these will be necessary. Advance road signage must indicate the road detour and alternative routes. Sign boards should be provided for pedestrians to inform them of nature and duration of construction works and contact numbers for concerns/ complaints.
Occupational health and safety	<ul style="list-style-type: none"> The developer and/or contractor should employ workers with adequate experience, training and know-how. These workers should be led by an experienced supervisor or engineer, who will provide the leadership in daily activities. A general regard for the social and ecological well-being of the site and adjacent areas is expected of the site staff. Workers need to be made aware of the following general rules: (i) consume no alcohol/drugs on site; (ii) prevent excessive noise; (iii) construction staff should make use of the facilities provided to them, as opposed to ad hoc alternatives (e.g. fire for cooking, the use of surrounding bushes as a toilet facility); (iv) no fires are permitted on site except if needed for the construction works; (v) trespassing on private/commercial properties adjoining the site is forbidden; (vi) other than pre-approved security staff, no workers should be permitted to live on the construction site; and (vii) no worker may be forced to do work that is potentially dangerous or that he/she is not trained to do. The developer and/or contractor must monitor the performance of construction workers to ensure that the points relayed during their induction have been properly understood and are being followed. If necessary, a translator should be called to the site to further explain aspects of environmental or social behaviour that are unclear. The rules that are explained in the worker conduct section must be followed at all times.
Community health and safety	<ul style="list-style-type: none"> Developer's and/or contractor's activities and movement of staff will be restricted to designated construction areas. Should the construction staff be approached by members of the public or other stakeholders, staff should assist them in locating the environment management specialist or representative of the developer, or provide a number through which they may contact the environment management specialist or the developer. The conduct of the construction staff when dealing with the public or other stakeholders should be in a manner that is polite and

Parameter	Mitigation Measures
	<p>courteous at all times. Failure to adhere to this requirement may result in the removal of staff from the site by the developer.</p> <ul style="list-style-type: none"> • Disruption of access for local residents, commercial establishments, institutions, etc. must be minimized and must have the environment management specialist's permissions. • There should be provision of walkways and metal sheets where required to maintain access for people and vehicles. • Businesses and institutions should be consulted regarding operating hours, and factor this in work schedules. • The developer and/or contractor is to inform neighbours in writing of disruptive activities at least 24 hours beforehand. This can take place by way of leaflets placed in the post-boxes giving the environment management specialist's and developer's details or other methods approved by the environment management specialist. • There should be sign boards for pedestrians to inform them of nature and duration of construction works and contact numbers for concerns/ complaints. • The developer and/or contractor will ensure that there is provision of alternate access to business establishments during the construction, so that there is no closure of these shops or any loss of clientele. • The developer and/or contractor will ensure that any damage to properties and utilities will be restored or compensated to pre-work conditions. • Lighting on the construction site should be pointed downwards and away from oncoming traffic and nearby houses. • The site must be kept clean to minimize the visual impact of the site. • If screening is being used, this must be moved and re-erected as the work front progresses. • Machinery and vehicles are to be kept in good working order for the duration of the project to minimize nuisance to neighbours due to noise. • Notice of particularly noisy activities must be given to residents/ businesses adjacent to the construction site. Examples of these include: noise generated by jackhammers, diesel generator sets, excavators, etc. • Noisy activities must be restricted to the times given in the project specifications. • The environment management specialist and the developer are responsible for ongoing communication with those people who are interested in or affected by the project. • A complaints register (refer to the grievance redressal mechanism) should be housed at the site office. This should be in carbon copy format, with numbered pages. Any missing pages must be

Parameter	Mitigation Measures
	<p>accounted for by the developer. This register is to be tabled during monthly site meetings.</p> <ul style="list-style-type: none"> Interested and affected parties need to be made aware of the existence of the complaints book and the methods of communication available to them. The developer and/or contractor must address queries and complaints by: (i) documenting details of such communications; (ii) submitting these for inclusion in complaints register; (iii) bringing issues to the environment management specialist's attention immediately; and (iv) taking remedial action as per environment management specialist's instruction. The developer and/or contractor should immediately take the necessary remedial action on any complaints/ grievances received by him and forward the details of the grievance along with the action taken to the environment management specialist within 48 hours of receipt of such complaint/ grievance.
Community and public awareness	<ul style="list-style-type: none"> Storage facilities and other temporary structures on-site should be located such that they have as little visual impact on local residents as possible. Special attention should be given to the screening of highly reflective materials on site. In areas where the visual environment is particularly important or privacy concerns for surrounding buildings exist, the site may require screening. This could be in the form of shade cloth, temporary walls, or other suitable materials prior to the beginning of construction.
Construction camps and storage areas	<ul style="list-style-type: none"> The developer and/or contractor should ensure that open areas or the surrounding bushes are not being used as toilet facility. The developer and/or contractor should ensure that all litter is collected from the work and camp areas daily. Bins and/ or skips should be emptied regularly and waste should be disposed of at the pre-approved site. Waybills for all such disposals are to be kept by the contractor for review by the environment management specialist. The developer and/or contractor should ensure that the camp and working areas are kept clean and tidy at all times. After construction work, all structures comprising the construction camp are to be removed from site or handed over to the property owner/ community as per mutual agreement (if established on private/ community land). The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint, etc. and these should be cleaned up.

Parameter	Mitigation Measures
	<ul style="list-style-type: none"> • All hardened surfaces within the construction camp area should be ripped, all imported materials removed, and the area should be top soiled and regressed. • The developer and/or contractor must arrange the cancellation of all temporary services.
Dust and air pollution	<ul style="list-style-type: none"> • Vehicles travelling to and from the construction site must adhere to speed limits so as to avoid producing excessive dust. • Access and other cleared surfaces, including backfilled trenches, must be dampened whenever possible and especially in dry and windy conditions to avoid excessive dust. • Vehicles and machinery are to be kept in good working order and to meet manufacturer's specifications for safety, fuel consumption, etc. • The developer and/or contractor is to have the equipment examined as soon as possible, should excessive emissions be observed,
Noise levels	<ul style="list-style-type: none"> • Noise-generating equipment must be fitted with silencers. • If a worker is exposed to noise above a noise exposure limit, the developer and/or contractor must investigate options for engineered noise control such as using low-noise excavators, jackhammers, drills, and power generators. • If it is not practicable to reduce noise levels to or below noise exposure limits, the developer and/or contractor must post warning signs in the noise hazard areas. Workers in a posted noise hazard area must wear hearing protection.
Utilities	<ul style="list-style-type: none"> • A list of affected utilities and operators should be prepared • A contingency plan should be prepared to include actions to be done in case of unintentional interruption of services.
Water quality	<ul style="list-style-type: none"> • Every effort should be made to ensure that any chemicals or hazardous substances do not contaminate the soil or water on-site. • Care must be taken to ensure that runoff from vehicle or plant washing does not enter the surface/ ground water. • Site staff should not be permitted to use any stream, river, other open water body, or natural water source adjacent to or within the designated site for the purposes of bathing, washing of clothing, or for any construction or related activities. Municipal water (or another source approved by the environment management specialist) should instead be used for all activities such as washing of equipment or disposal of any type of waste, dust suppression, concrete mixing, compacting, etc. • All concrete mixing must take place on a designated, impermeable surface.

Parameter	Mitigation Measures
	<ul style="list-style-type: none"> • No vehicles transporting concrete to the site may be washed on-site. • No vehicles transporting, placing, or compacting asphalt or any other bituminous product may be washed on-site. • All substances required for vehicle maintenance and repair must be stored in sealed containers until they can be disposed of or removed from the site. • Hazardous substance/ materials are to be transported in sealed containers or bags.
Waste management	<ul style="list-style-type: none"> • Wastes must be placed in the designated skips/ bins, which must be regularly emptied. These should remain within demarcated areas and should be designed to prevent wastes from being blown out by wind. • Littering on-site is forbidden and the site should be cleared of litter at the end of each working day/ night period. • Recycling is to be encouraged by providing separate receptacles for different types of wastes and making sure that staff is aware of their uses. • All waste must be removed from the site and transported to a disposal site or as directed by the environment management specialist. Waybills proving disposal at each site should be provided for the environment management specialist's inspection. • Construction rubble should be disposed of in pre-agreed, demarcated spoil dumps that have been approved by the environment management specialist, or at disposal sites.
Conservation of natural environment	<ul style="list-style-type: none"> • As the work front progresses; the developer and/or contractor is to check that vegetation clearing has the prior permission of the environment management specialist. • Only trees that have been marked beforehand are to be removed, if cutting of trees is required. • The entire area has to be cleaned and maintained immediately after completion of the construction activities to make sure that existing tranquillity of the surrounding area is not disturbed in any way.
Cultural and historical environment	<ul style="list-style-type: none"> • Labourers who work on the site during the construction stage should be consulted for this purpose and in the unlikely event that there are social and cultural resources in the site; assistance should be given in relocating the site and any associated artefacts. • All the staff and labourers of the contractor are to be informed about the possible items of historical or archaeological value, which include old stone foundations, tools, clay-ware, jewellery, remains, fossils, etc.

Parameter	Mitigation Measures
	<ul style="list-style-type: none"> If something of this nature is uncovered, Department of Archaeology should be contacted and work should be stopped immediately.
Safeguards supervisors	<ul style="list-style-type: none"> The contractor should appoint one environment safeguard supervisor who will be responsible for assisting the developer in implementation of EMP, coordinating with the DSC, consultations with interested/ affected parties, reporting, and grievance redressal on a day-to-day basis. The resettlement issue will be resolved before the site will be handed over to the Developer for construction activities.
Operation and Maintenance Phase	
General	<ul style="list-style-type: none"> O&M Manuals should be developed to include all aspects of the management and operation of the building complex All workers should be trained to the highest standards available in Bangladesh and given refresher training at least annually Access to the construction site should be controlled for public/ personnel; Locked rooms or cages should be used for waste storage; Toilets should be cleaned daily; Clean hand washing areas with adequate soap and towels should be provided; Clothing and laundry service for workers should be provided; and The facility should be cleaned after the work each day. The waste storage area and other adjacent areas should be sprinkled or sprayed regularly with disinfectants to avoid any spread of disease. Plates and stops should be inserted to prevent vermin from gaining access to the building. Where insect screening is required, this should consist of nylon insect mesh securely fixed to 150 × 50 reinforcement mesh with galvanized tie wire. Edges should be finished with a screw fixed beading strip where possible (all galvanized). Audit of O&M procedures should be undertaken at regular intervals (by an Independent Monitoring Agency)
Land contamination	<ul style="list-style-type: none"> Waste should not be stored outside the building complex premises to avoid issues of aesthetic nature
Wastewater	<ul style="list-style-type: none"> After treatment, the discharge standards need to be followed similar to the standards mentioned in Schedule 10 of the ECR 1997 for inland water discharge

Parameter	Mitigation Measures
Odour	<ul style="list-style-type: none">• Odour should be identified and sources should be characterized to determine any action required.• Wastes should be stored properly inside the premises, preferably in an aerated area to minimize biodegradation and foul odour• Vendors should be asked to pick up waste on a daily basis to minimize degradation and odour• Wastes and by-products should be enclosed during transport, loading/ unloading and storage• Frequent cleaning should be carried out in material storage areas to prevent odour
Noise	<ul style="list-style-type: none">• Activities and vehicle movements should be avoided after working hours.• Vehicles should be fitted with silencers.• Vehicles and machinery are to be kept in good working order.

The successful operation of the project complex in the manner intended should bring significant benefits to the stakeholders by making the environment cleaner than before.

5 Information Disclosure, Consultation and Participation

5.1 Project Stakeholders

Primary stakeholders are:

- Companies that operate on the proposed complex;
- People who work at the site, either employed by the NHA authority, a company or self-employed;
- Companies and workers operating in areas adjacent to the complex site; and
- Companies and private individuals who are benefitted from the proposed complex.

Secondary stakeholders are:

- Government institutions whose remit includes areas or issues affected by the project (City Corporations, Planning Authorities, Department of Public Health Engineering, Local Government Engineering Department, Ministry of Finance, Ministry of Health, Ministry of Environment, Roads and Highways Department, etc.);
- NGOs, CBOs and other representatives of persons who may be affected by the project; and the beneficiary community in general.

5.2 Consultation and Disclosure

The private developer will extend and expand the consultation and disclosure process significantly during implementation of the complex. The private developer should appoint an experienced NGO to handle this key aspect of the program, who will conduct a wide range of activities in the target urban areas to ensure that the needs and concerns of stakeholders are registered, and are addressed in project design, construction or operation where appropriate. The program of activities will be developed during the detailed design stage, and is likely to include the following:

Consultation during detailed design:

- Focus-group discussions with affected persons and other stakeholders (including women's groups, NGOs and CBOs) to hear their views and concerns, so that these can be addressed in project design where necessary; and
- Structured consultation meetings with the institutional stakeholders (Government bodies and NGOs) to discuss and approve key aspects of the project.

Consultation during construction:

- Public meetings with major stakeholders to discuss and plan work programs and allow issues to be raised and addressed once construction has started; and
- Smaller-scale meetings to discuss and plan construction work with primary stakeholders to reduce disturbance and other impacts, and provide a mechanism through which affected persons can participate in project monitoring and evaluation.

Project disclosure:

- Public information campaigns (via newspaper, TV and radio) to explain the project to the urban populations and prepare them for any disruption they may experience once the construction program is underway;
- Public disclosure meetings at key stages to inform the public of progress and future plans, and to provide copies of summary documents in the Bangla language; and
- Formal disclosure of completed project reports by making copies available at convenient locations in the target city, informing the public of their availability, and providing a mechanism through which comments can be made.

5.3 Public Consultations Conducted

Different techniques of consultation with stakeholders were used by the Environment Specialist of the Transaction Advisor during the planning stage of project preparation (interviews, public meetings, group discussions, etc.). A questionnaire was designed and environmental information was collected. Apart from this, a series of public consultation meetings were conducted during the project preparation. Various forms of public consultations (consultation through ad hoc discussions on-site) have been used to discuss the project and involve the community in planning the project design and mitigation measures. Issues discussed and feedback received along with details of date, time, location, and list of participants are given in **Annex 4**.

6 Environmental Management Plan

6.1 Implementation Arrangement

The Private Developer: The private developer will have its own team for implementation of the complex. The team will be responsible for implementation of the project under strict supervision ensuring excellent quality. A consultant company will be responsible for day to day supervision of quality and recommendation for bill payment. The scope of the private developer shall include the following:

- Developing, supplying, managing and maintaining the complex, in accordance with the provisions of the contract, good industry practice and applicable Laws;
- Observing and fulfilling the environmental and other requirements as specified in the IEE/ EMP and under all applicable laws and applicable permits at all time during the service delivery period;
- Applying for and obtaining all necessary clearances and/or approvals for the construction of the building complex from all the concerned governmental agencies;
- Coordinating with the Environment Specialist on updating the IEE/ EMP based on detailed designs;
- Procuring and maintaining in full force and effect, as necessary, appropriate proprietary rights, licenses, contracts and permissions for materials, methods, processes and systems used in or incorporated into the project;
- Appointing, supervising, monitoring and controlling the activities of sub-contractors under their respective project contracts as may be necessary;
- Being responsible for safety, soundness and durability of the complex, including all structures forming part thereof;
- Ensuring that the complex site remains free from all encroachments and taking all steps necessary to remove encroachments, if any;
- Removing promptly from the complex site all surplus construction machinery and materials, waste materials (including, without limitation, hazardous materials and wastewater), rubbish and other debris and keeping the area in a neat, clean and hygienic condition and in conformity with the applicable Laws and applicable Permits.

Environmental Specialist: The environment specialist will take care of all environmental issues encountered during implementation of the project.

Contractors: The Contractor's scope shall include the following:

- Carrying out the Engineering, procurement and construction of the complex, in accordance with the provisions of the contract, good industry practice and applicable Laws;
- Observing and fulfilling the environmental and other requirements as specified in the IEE/ EMP and under all applicable laws and applicable permits at all time during the construction period;
- Providing all assistance to the Project personnel of the private developer as may be reasonably required for the performance of his/ her duties and services under this project;
- Providing the Environment Specialist reports on a regular basis during the construction period in accordance with the provisions of the contract;
- Appointing, supervising, monitoring and controlling the activities of sub-contractors under their respective project contracts as may be necessary;
- Making efforts to maintain harmony and good industrial relations amongst the personnel employed by private developer in connection with the performance of the contractor's obligations under the contract;

6.2 Capacity Building

A training program has been developed to build the capability of the private developer. This will be conducted by the Environment Specialist. The private developer will be required to (i) conduct environmental awareness and orientation of workers prior to their deployment to work sites; (ii) train the workers to the highest standards available in Bangladesh and given a refresher training at least annually.

The suggested outline of the training program is presented in Table 7. The capacity building and training program will be updated during the detailed design stage to incorporate the contractors output.

Table 7: Indicative Capacity Building and Training Program for the Complex at GEC More Site

Description	Contents	Schedule	Participants
To be conducted by Environment Specialist			
Program 1 Orientation program/ workshop for contractors and supervisory staff	<ul style="list-style-type: none"> Environmental issues during construction Implementation of EMP Monitoring of EMP implementation Reporting requirements 	1 day	Supervisory staff of the private developer
To be conducted by private developer			
Program 2 Orientation and safety Issues	<ul style="list-style-type: none"> Project implementation activities detailed in drawings; safeguard policy requirements as per Government of Bangladesh rules; safety instructions and use of PPEs¹² by the staff and workers 	1 day	Staff and workers of the private developer and Contractor

¹²**Personal protective equipment (PPE)** refers to protective clothing, helmets, goggles, or other garment or equipment designed to protect the wearer's body from injury. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. Protective equipment may be worn for job-related occupational safety and health purposes, as well as for sports and other recreational activities. "Protective clothing" is applied to traditional categories of clothing, and "protective gear" applies to items such as pads, guards, shields, or masks, and others.

Description	Contents	Schedule	Participants
Program 3 Action plan for implementation of the project	<ul style="list-style-type: none"> • Detailed action plan for implementation of the project in a timely and qualitative manner 	1 day	Staff and workers of the private developer and Contractor

6.3 Environmental Management Action Plan (EMP)

The EMP will guide the environmentally sound construction of the project and ensure efficient lines of communication between the Environment Specialist, supervisory staff and contractors. The EMP identifies activities according to the following three phases: (i) site establishment and preliminary activities, including finalizing IEE/ EMP; (ii) construction stage; and (iii) post-construction/ operational stage. **Table 8** outlines the mitigation measures and persons responsible for implementation and monitoring. The EMP will be updated by Environment Specialist during the detailed design stage.

Environmental monitoring program: Prior to commencement of any civil work, the contractors shall submit a compliance report¹³ to the Environment Specialist ensuring that all identified pre-construction environmental impact mitigation measures as detailed in the EMP, will be undertaken. The Environment Specialist will review the report, and thereafter supervisory staff of the Private Developer will allow commencement of civil works. Supervisory staff of the Private Developer and the Environment Specialist will be responsible for monitoring the program.

¹³This compliance report will include information on (i) barricades and warning signs; (ii) area for setting up of construction camps; (iii) methodology for surveys; (iv) area for establishing lay-down and storage; (v) sources of materials; (vi) records of environmental awareness, safety training, and orientation of workers prior to deployment to work sites; (vii) contact information of the environmental and resettlement supervisors; and (viii) construction method statement.

Table 8: Environmental Management Action Plan

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
Planning phase						
Capacity Building	<ul style="list-style-type: none"> Develop a capacity building and training program to ensure (i) all workers are trained to the highest standards available in Bangladesh and provided refresher training at least annually; and (ii) Private Developer's supervisory staffs are given a high level of training and other support, sufficient to achieve the expected standards. 	Contractor	Private Developer's supervisory staff or DSC	Capacity building and training program	Annually	All applicable laws and regulations
Work schedule	<ul style="list-style-type: none"> Ensure careful planning and scheduling of the activities 	Contractor	Private Developer's supervisory staff or DSC	Plan and schedules	Prior to approval of detailed design documents	Detailed Design documents
Barricades and warning signs	<ul style="list-style-type: none"> Use easily transportable barricades and warning signs such as those made of high reflector plastic materials. Use aluminized rolled warning signs to warn the public 	Contractor	Private Developer's supervisory staff or DSC	Lists and samples of warning signs and barricades	Prior to approval of detailed design documents	Detailed Design documents
Workers	<ul style="list-style-type: none"> Employ workers with adequate experience, training, and know-how. It is always advantageous for the contractor to employ workers with adequate experience, training, and know- 	Contractor	Private Developer's supervisory staff or DSC	Workers list (for internal monitoring)	Prior to commencement of construction	Detailed Design documents

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	how in the line of work that they are doing. These people are usually reliable and can be counted upon to exercise good judgment in the field.					
Community and public awareness	<ul style="list-style-type: none"> A massive awareness campaign must precede any construction activity in order to make the public aware of the extent of the problem that might be present during the period of construction. Open liaison channels should be established among the Private Developer authority, the contractors, and the interested and affected parties such that any queries, complaints, or suggestions can be dealt with quickly and by the appropriate persons. 	Contractor	Private Developer's supervisory staff or DSC	Communication and participation strategy	Prior to approval of detailed design documents	Detailed Design documents
Legislation, permits, and agreements	<ul style="list-style-type: none"> In all instances, Developer authority, contractors and consultants must remain in compliance with relevant local and national legislation. A copy of the IEE must be kept on-site 	Contractor	Private Developer's supervisory staff or DSC	All applicable permits and approvals	Prior to start of civil works and as necessary	Ensure location clearance and ECC from DOE is obtained as per guidance provided in ECR 1997 prior to award of contract
Access to site	<ul style="list-style-type: none"> Access to site will be via existing roads. The contractor 	Contractor	Private Developer's	Traffic management plan	Prior to approval of detailed design documents	<ul style="list-style-type: none"> No complaints received

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	will need to ascertain the existing condition of the roads and repair damage due to construction.		supervisory staff or DSC			<ul style="list-style-type: none"> Minimal traffic disturbance
Setting up of construction camp	<ul style="list-style-type: none"> Choice of site for the contractor's camp requires the DSC's and/or environment management specialist's permission and must take into account location of local residents, businesses, and existing land uses. A site plan must be submitted to the environment management specialist for approval. In case the contractor chooses to locate the camp site on private land, he must get prior permission from the environment management specialist and the landowner. Under any circumstances, the open areas or the surrounding bushes should not be used as a toilet facility. Recycling and the provision of separate waste receptacles for different types of waste should be encouraged. 	Contractor	Private Developer's supervisory staff or DSC	Location plan	Prior to approval of detailed design documents	<ul style="list-style-type: none"> Approved location plan Construction method No complaints received
Establishing equipment lay-down and storage area	<ul style="list-style-type: none"> Storage areas should be secured so as to minimize the risk of crime. They should also 	Contractor	Private Developer's supervisory staff or DSC	Location plan	Prior to approval of detailed design documents	<ul style="list-style-type: none"> Approved location plan

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<ul style="list-style-type: none"> be safe from access by children, animals, etc. The contractor should submit a method statement and plans for the storage of hazardous materials (fuel, oils, and chemicals) and emergency procedures. 					<ul style="list-style-type: none"> Construction method No complaints received
Materials management – sourcing	<ul style="list-style-type: none"> The contractor should prepare a source statement indicating the sources of all materials (including topsoil, sands, natural gravels, crushed stone, asphalt, clay liners, etc.), and submit these to the environment management specialist for approval prior to commencement of any work. 	Contractor	Private Developer's supervisory staff or DSC	List of sources	Prior to approval of detailed design documents	All applicable permits (e.g. from Mining Department for quarries, borrow pits, sands and gravel)
Education of site staff on general and environmental conduct ¹⁴	<ul style="list-style-type: none"> Ensure that all site personnel have a basic level of environmental awareness training. Staff operating equipment (such as excavators, loaders, etc.) should be adequately trained and sensitized to any potential hazards associated with their task. 	Contractor	Private Developer's supervisory staff or DSC	Records of training	Prior to start of civil works and recruitment of any new employee	Revised/ Updated IEE/EMP (capacity building)

¹⁴ These points need to be made clear to all staff on site before the project begins.

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<ul style="list-style-type: none"> No operator should be permitted to operate critical mechanical equipment without having been trained by the contractor. All employees must undergo safety training. 					
Construction phase						
Excavated materials	<ul style="list-style-type: none"> Hauling vehicles must always be present at the excavation site. The contractor can process the excavated materials and use these as selected backfill materials. If excavated materials are not suitable for reuse, the contractor should deposit these in an area designated by Chittagong City Corporation. Coordinate with the landfill operators for the disposal of excavated materials. Obtain approval from the environment management specialist for disposal of excavated materials. Remove waste rapidly by loading material onto trucks as soon as it is excavated; Cover or moisten working areas and stockpiled soil in dry or windy weather; and 	Contractor	Private Developer's supervisory staff or DSC	Construction method statement	As work progresses	<ul style="list-style-type: none"> Construction method Detailed design documents Identify and obtain clearance from DoE for disposal sites of excavated soils and contaminated materials

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<ul style="list-style-type: none"> • Use tarpaulins to cover loose materials during transportation to and from the site. • Maintain record of excavated materials, disposal dates, and methods. • Conduct the work in the dry season to reduce these impacts, and as the excavation in this case is shallow and small in scale, there should be no impact on the water table. 					
Hauling of Construction Materials	<ul style="list-style-type: none"> • The contractor must maintain an inventory of all the materials necessary so that these can be easily hauled to the construction site when needed. • Advance signage for affected parking areas must indicate duration and alternative parking arrangements. 	Contractor	Private Developer's supervisory staff or DSC	Construction method statement	As work progresses	<ul style="list-style-type: none"> • Construction method • Detailed design documents
Access	<ul style="list-style-type: none"> • The contractor should keep steel plates and wooden planks available in his stock which may be deployed on top of excavations to provide temporary access to buildings, street crossings, and other areas where necessary. • Advance road signage must indicate the road detour and alternative routes. Sign boards should be provided for 	Contractor	Private Developer's supervisory staff or DSC	Construction method statement	As work progresses	<ul style="list-style-type: none"> • Construction method • Detailed design documents • Zero complaints from community/ sensitive receptors

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	pedestrians to inform them of the nature and duration of construction works and contact numbers for concerns/complaints.					
Occupational health and safety	<ul style="list-style-type: none"> • Employ workers with adequate experience, training, and know-how. • The workers should be led by an experienced supervisor or engineer, who will provide the leadership in daily activities. • A general regard for the social and ecological well-being of the site and adjacent areas is expected of the site staff. Workers need to be made aware of the following general rules: (i) no alcohol/drugs on site; (ii) prevent excessive noise; (iii) construction staff are to make use of the facilities provided for them, as opposed to ad hoc alternatives (e.g. fire for cooking, the use of surrounding bushes as a toilet facility); (iv) no fire should be permitted on site except if needed for the construction works; (v) trespassing on private/commercial properties adjoining the site is forbidden; (vi) other than pre-approved security staff, no workers should be permitted to live on 	Contractor	Private Developer's supervisory staff or DSC	<ul style="list-style-type: none"> • Occupational health and safety plan • Number of accidents and work-related injuries • Complaints from community 	As work progresses	<ul style="list-style-type: none"> • Construction method • Detailed design documents • Zero accident and work-related injuries • Zero complaints from community and workers

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<p>the construction site; and (vii) no worker may be forced to do work that is potentially dangerous or that he/ she is not trained to do.</p> <ul style="list-style-type: none"> • The contractor must monitor the performance of construction workers to ensure that the points related during their induction have been properly understood and are being followed. If necessary, a translator should be called to the site to further explain aspects of environmental or social behaviour that are unclear. • The rules that are explained in the worker conduct section must be followed at all times. 					
Community health and safety	<ul style="list-style-type: none"> • Contractor's activities and movement of staff will be restricted to designated construction areas. • Should the construction staff be approached by members of the public or other stakeholders, the staff members should assist them in locating the environment management specialist or contractor, or provide a number through which they may contact the environment management specialist or contractor. 	Contractor	Private Developer's supervisory staff or DSC	<ul style="list-style-type: none"> • Complaints from community • Activities based on the communication and participation strategy 	As work progresses	Zero complaints from community and workers

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<ul style="list-style-type: none"> • The conduct of the construction staff when dealing with the public or other stakeholders should be in a manner that is polite and courteous at all times. Failure to adhere to this requirement may result in the removal of staff from the site by the environment management specialist. • Disruption of access for local residents, commercial establishments, institutions, etc. must be minimized and must have the environment management specialist's permissions. • Provide walkways and metal sheets where required to maintain access for people and vehicles. • Consult businesses and institutions regarding operating hours, and factor this in work schedules. • The contractor is to inform neighbours in writing of disruptive activities at least 24 hours beforehand. This can take place by way of leaflets placed in the post-boxes, giving the environment management specialist's and contractor's details or other method approved by the environment management specialist. 					

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<ul style="list-style-type: none"> • Provide sign boards for pedestrians to inform them of nature and duration of construction works and contact numbers for concerns/ complaints. • The contractor will ensure that there is provision of alternate access to business establishments during the construction, so that there is no closure of these shops or any loss of clientele. • The contractor will ensure that any damage to properties and utilities will be restored or compensated to pre-work conditions. • Lighting on the construction site should be pointed downwards and away from incoming traffic and nearby houses. • The site must be kept clean to minimize the visual impact of the site. • If screening is being used, this must be moved and re-erected as the work front progresses. • Machinery and vehicles are to be kept in good working order for the duration of the project to minimize noise nuisance to neighbours. • Notice of particularly noisy activities must be given to residents/ businesses adjacent 					

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<p>to the construction site. Examples of these include: noise generated by jackhammers, diesel generator sets, excavators, etc.</p> <ul style="list-style-type: none"> • Noisy activities must be restricted to the times given in the project specification or general conditions of contract. • The environment management specialist and contractor are responsible for ongoing communication with those people who are interested in or affected by the project. • A complaints register (refer to the grievance redressal mechanism) should be housed at the site office. This should be in carbon copy format, with numbered pages. Any missing pages must be accounted for by the contractor. This register is to be tabled during monthly site meetings. • Interested and affected parties need to be made aware of the existence of the complaints register and the methods of communication available to them. • The contractor must address queries and complaints by: (i) documenting details of such communications; (ii) submitting these for inclusion in complaints register; (iii) bringing 					

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<p>issues to the environment management specialist's attention immediately; and (iv) taking remedial action as per environment management specialist's instruction.</p> <ul style="list-style-type: none"> The contractor should immediately take the necessary remedial action on any complaints/ grievances received by him and forward the details of the grievance along with the action taken to the environment management specialist within 48 hours of receipt of such complaint/ grievance. 					
Community and public awareness	<ul style="list-style-type: none"> Storage facilities and other temporary structures on-site should be located such that they have as little visual impact on local residents as possible. Special attention should be given to the screening of highly reflective materials on site. In areas where the visual environment is particularly important or privacy concerns for surrounding buildings exist, the site may require screening. This could be in the form of shade cloth, temporary walls, or other suitable materials prior to the beginning of construction. 	Contractor	Private Developer's supervisory staff or DSC	<ul style="list-style-type: none"> Complaints from community Activities based on the communication and participation strategy 	As work progresses	Zero complaints from community and workers

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
Construction camps and storage areas	<ul style="list-style-type: none"> The contractor is to ensure that open areas or the surrounding bushes are not being used as toilet facility. The contractor should ensure that all litter is collected from the work and camp areas daily. Bins and/or skips should be emptied regularly and waste should be disposed of at the pre-approved site. Waybills for all such disposals are to be kept by the contractor for review by the environment management specialist. The contractor should ensure that his camp and working areas are kept clean and tidy at all times. After construction work, all structures comprising the construction camp are to be removed from site or handed over to the property owner/community as per mutual agreement (if established on private/community land). The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint, etc. and these should be cleaned up. All hardened surfaces within the construction camp area should be ripped, all imported materials removed, and the 	Contractor	Private Developer's supervisory staff or DSC	<ul style="list-style-type: none"> Approved location plan Complaints from community 	As work progresses	<ul style="list-style-type: none"> Approved location plan Zero complaints from community and workers

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<p>area should be top soiled and regressed.</p> <ul style="list-style-type: none"> The contractor must arrange the cancellation of all temporary services. 					
Dust and air pollution	<ul style="list-style-type: none"> Vehicles travelling to and from the construction site must adhere to speed limits so as to avoid producing excessive dust. Access and other cleared surfaces, including backfilled trenches, must be dampened whenever possible and especially in dry and windy conditions to avoid excessive dust. Vehicles and machinery are to be kept in good working order and to meet manufacturer's specifications for safety, fuel consumption, etc. The contractor is to have the equipment seen to as soon as possible should excessive emissions be observed, 	Contractor	Private Developer's supervisory staff or DSC	<ul style="list-style-type: none"> Vehicle emission testing records Complaints from community 	As work progresses	<ul style="list-style-type: none"> No visible increase in dust and particulate matters Zero complaints from community
Noise levels	<ul style="list-style-type: none"> Noise-generating equipment must be fitted with silencers. If a worker is exposed to noise above a noise exposure limit, the contractor must investigate options for engineered noise control such as using low-noise 	Contractor	Private Developer's supervisory staff or DSC	<ul style="list-style-type: none"> Complaints from community Noise level monitoring record 	As work progresses	ECR 1997

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<ul style="list-style-type: none"> excavators, jackhammers, drills, and power generators. If it is not practicable to reduce noise levels to or below noise exposure limits, the contractor must post warning signs in the noise hazard areas. Workers in a posted noise hazard area must wear hearing protection. 					
Utilities	<ul style="list-style-type: none"> Prepare a list of affected utilities and operators Prepare a contingency plan to include actions to be taken in case of unintentional interruption of services. 	Contractor	Private Developer's supervisory staff or DSC	<ul style="list-style-type: none"> Number of affected utilities Length of time to restore disrupted services 	As work progresses	No disrupted service
Water quality	<ul style="list-style-type: none"> Every effort should be made to ensure that any chemicals or hazardous substances do not contaminate the soil or water on-site. Care must be taken to ensure that runoff from vehicle or plant washing does not enter the surface/ ground water. Site staff should not be permitted to use any stream, river, other open water body, or natural water source adjacent to or within the designated site for the purposes of bathing, washing of clothing, or for any construction or related activities. Municipal water (or 	Contractor	Private Developer's supervisory staff or DSC	<ul style="list-style-type: none"> Complaints from community Waste disposal manifest/ record 	As work progresses	<ul style="list-style-type: none"> No visible increase in water pollution due to the project Zero complaints from community

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<p>another source approved by the environment management specialist) should instead be used for all activities such as washing of equipment or disposal of any type of waste, dust suppression, concrete mixing, compacting, etc.</p> <ul style="list-style-type: none"> • All concrete mixing must take place on a designated, impermeable surface. • No vehicles transporting concrete to the site may be washed on-site. • No vehicles transporting, placing, or compacting asphalt or any other bituminous product may be washed on-site. • All substances required for vehicle maintenance and repair must be stored in sealed containers until they can be disposed of or removed from the site. • Hazardous substances/ materials are to be transported in sealed containers or bags. 					
Waste management	<ul style="list-style-type: none"> • Wastes must be placed in the designated skips/ bins which must be regularly emptied. These should remain within demarcated areas and should be designed to prevent wastes from being blown by wind. 	Contractor	Private Developer's supervisory staff or DSC	<ul style="list-style-type: none"> • Complaints from community • Waste disposal manifest/ record 	As work progresses	<ul style="list-style-type: none"> • No dumped wastes and litter at work sites at all times • Zero complaints from community

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<ul style="list-style-type: none"> • Littering on-site is forbidden and the site should be cleared of litter at the end of each working day/night period. • Recycling is to be encouraged by providing separate receptacles for different types of wastes and making sure that staff is aware of their uses. • All waste must be removed from the site and transported to a disposal site or as directed by the environment management specialist. Waybills proving disposal at the designated disposal site should be provided for the environment management specialist's inspection. • Construction rubble should be disposed of in pre-agreed, demarcated spoil dumps that have been approved by the environment management specialist, or at disposal sites. 					
Conservation of natural environment	<ul style="list-style-type: none"> • As the work front progresses; the contractor is to check that vegetation clearing has the prior permission of the environment management specialist. • Only trees that have been marked beforehand are to be removed, if cutting of trees is required. 	Contractor	Private Developer's supervisory staff or DSC	Vegetation clearing	As required	Only allowed trees/ vegetation to be cleared; allowed trees for cutting will be selected in case of unavoidable circumstances only, these will be properly recorded and a mandatory compensatory program

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<ul style="list-style-type: none"> • Clean the entire area and maintain immediately after completion of the construction activities to make sure that existing tranquillity of the surrounding area is not disturbed in any way. 					for plantation of at least two trees for each of the trees cut should be ensured
Cultural and historical artefacts	<ul style="list-style-type: none"> • Consult labourers who work on the site during the detailed design stage and in the unlikely event that there are social and cultural resources in the site; assistance should be given in relocating the site and any associated artefacts. • All the staff and labourers of the contractor should be sensitised about the possibility of finding items of historical or archaeological value, which includes old stone foundations, tools, clay ware, jewellery, remains, fossils etc. • If something of this nature is uncovered, Department of Archaeology should be contacted and work should be stopped immediately. 	Contractor	Private Developer's supervisory staff or DSC	Chance finds	As necessary	All chance finds shall be reported and turned over to the Department of Archaeology.
Safeguards supervisors	<ul style="list-style-type: none"> • The contractor should appoint one environment safeguard supervisor who will be responsible for assisting the contractor in implementation of 	Contractor	Private Developer's supervisory staff or DSC	Hiring and actual work	As work progresses	Continuous work output and reporting records

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	EMP, coordinating with the DSC, consultations with interested/ affected parties, reporting, and grievance redressal on a day-to-day basis.					
Operation and maintenance phase						
General	<ul style="list-style-type: none"> Develop O&M Manuals to include all aspects of the management and operation of the complex Train all workers to the highest standards available in Bangladesh and provide refresher training at least annually Control access for public/ personnel; Clean toilets daily; Provide clean hand washing areas and supply adequate soap and towels; Provide clothing and laundry service for workers; and Clean facility after the work of each day. The waste storage area and other adjacent areas should be sprinkled or sprayed regularly with disinfectants to avoid any spread of disease. 	Private Developer	Private Developer's supervisory staff	<ul style="list-style-type: none"> Specifications in the O&M Manual Public health survey (5 years) 	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
Land contamination	<ul style="list-style-type: none"> Do not store wastes outside the building premises to avoid issues of aesthetic nature 	Private Developer	Private Developer's supervisory staff	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
Wastewater	<ul style="list-style-type: none"> After wastewater treatment, the discharge standards need to be followed similar to the standards mentioned in Schedule 10 of the ECR 1997 for inland water discharge 	Private Developer	Private Developer's supervisory staff	Specifications in the O&M Manual	As determined in the O&M Manual	ECR 1997 (Rule 13: The standard limits of the discharge of liquid wastes shall be determine in accordance with the standards specified in Schedule 10)
Other wastes	<ul style="list-style-type: none"> All other wastes arising in the site should be properly disposed of by appropriate methods. The waste should be disposed into a solid waste bin (skip) and immediately transported out of the site in a closed wheelbarrow or similar other device. 	Private Developer	Private Developer's supervisory staff	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
Odour	<ul style="list-style-type: none"> Audit odour to identify and characterize sources and determine any action required. Carry out frequent cleaning of material storage areas to prevent odour 	Private Developer	Private Developer's supervisory staff	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
Noise	<ul style="list-style-type: none"> Activities and vehicle movements should be avoided after working hours. 	Private Developer	Private Developer's supervisory staff	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations

Parameter	Mitigation Measures	Implementation Responsibility	Monitoring Responsibility	Parameters to be Monitored	Monitoring Frequency	Guidelines/ Standards to be followed
	<ul style="list-style-type: none"> • Vehicles should be fitted with silencers. • Vehicles and machinery are to be kept in good working order. 					
Water use	<ul style="list-style-type: none"> • Minimize water use through dedicated metering for water consumption 	Private Developer/contractor	Private Developer's supervisory staff	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations
Health, hygiene and safety	<ul style="list-style-type: none"> • Workers should undergo regular medical check-up • Workers should be provided with protective gear like head cover, gloves, etc. • Provide training on safety to staff to avoid accidents • Regularly monitor the site to ensure compliance with occupational health and safety rules 	Private Developer/contractor	Private Developer's supervisory staff	Specifications in the O&M Manual	As determined in the O&M Manual	As specified in the O&M Manual and all applicable laws and regulations

6.4 Reporting

The Environment Specialist will submit monthly monitoring reports to the project manager of the private developer, and the project manager will discuss the report with the supervisory staff and take necessary action as required. The reports will be kept in a file for future record.

6.5 Environmental Costs

The private developer's cost for site establishment, preliminary activities, construction and environmental mitigation measures related to EMP implementation during planning, design, construction, and operations will be incorporated into the contractual agreements, which will be binding on him for implementation.

The mitigation measures during the operation phase are related to good operating practices, which will be the responsibility of the Private Developer. All monitoring during the operation and maintenance phase will be conducted by the Private Developer; therefore, there are no additional costs.

The activities identified in the EMP mainly include site inspections and informal discussions with workers and local community, and this will be the responsibility of the private developer with the assistance of ES, costs of which are part of project management.

Table 9 presents the estimated cost to implement the EMP. The EMP and the costs for the EMP implementation will be updated during detailed engineering design. The figures show that the total cost of environmental management and monitoring for the NHA Complex is BDT 4.38 million. It includes the cost of all surveys (long-term bi-annual wastewater monitoring will be done by DoE and test costs borne by operator according to DoE fee rates as per Schedule 14 of the ECR, 1997) and other expenses associated with implementing the EMP for this project during project implementation. It also includes the cost of the long-term survey of public health proposed in the EMP for this project.

Table 9: Environmental Management and Monitoring Costs for Tourism Complex

Item	Quantity	Unit Cost (BDT)	Total Cost (BDT)	Sub-total
1. Monitoring during Construction (3 years)				
Environmental Specialist	1 x 6 month	250,000 ¹⁵	1,500,000	
Survey Expenses	Lump Sum	1,300,000	1,300,000	2,800,000
2. Survey of Public Health (5 years)				
Domestic Consultant	5 x ½ month	200,000	500,000	
Supporting Staff	5 x ½ month	100,000	250,000	
Other Expenses (includes buying/ hiring of equipment for measuring environmental parameters, travelling expenses to the sample collection sites and sending the samples to the laboratories, etc.)	Lump Sum	830,000	830,000	1,580,000
TOTAL COST (BDT)				4,380,000

¹⁵ Unit cost of domestic consultants is based on current rates and includes fee, travel, accommodation and subsistence.

7 Findings and Recommendations

7.1 Findings

The exhaustive process described in this document has assessed the environmental impacts of all the elements of the proposed infrastructure project in the NHA Complex in Chittagong. Potential negative impacts were identified in relation to the design, construction and operation of the infrastructure, and mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the project development, and as a result some measures have already been included in the outline designs for the infrastructure. These include:

- Ensuring that National Housing Authority has suitable relocation plans as the site selected for the project is owned by Bangladesh National Housing Authority and contain some office and residential facilities; and
- Ensuring that there are no sensitive receptors around the site that is being used as office and residential facilitates.

This means that the environmental impact and its significance have already been reduced by amending both the design and location of elements of the project.

In the construction phase major negative impacts are not expected because the construction work is relatively small scale and straightforward and will be conducted at a single site. Other mitigation and enhancement measures are included in the EMP, which also shows the possible impact parameters, the body responsible for the mitigation, and the program for its implementation.

Operation and maintenance of the completed NHA complex will be the responsibility of the private developer up to the end of the maintenance and service delivery period. It will be vital that the facility is operated as per the highest professional standards because if this is not the case it could easily replicate the practices and effects that are common at other existing buildings in the city. These include impacts on:

- Worker health and safety—if equipment, procedures and hygiene are inadequate;
- Environment – if solid waste is not properly collected and transported on a daily basis.

The IEE includes a number of measures relating to the design to ensure that the facility operates as per requisite elevated standards and avoids these and other impacts. The main measures are that:

- All aspects of management and operation should be set out in O&M manuals prepared by an internationally reputed consultant;
- All workers are trained to the highest available standards and re-trained annually;
- Ensuring sufficient training and financial support to the supervision and monitoring staff of the private developer to achieve expected standards.

If these and the other mitigation measures recommended by the IEE are implemented, then the project complex should operate without any significant negative impacts.

Mitigation will be assured by an Environment Monitoring Program conducted during both construction and operation to ensure that all measures are provided as intended, and to determine whether the environment is protected as envisaged. This will include observations on and off site, document checks, and interviews with workers and beneficiaries during the construction stage, and weekly monitoring of all practices at the project Complex during the first five years of operation, by the private developer. Any requirements for remedial action will be reported to top management of the private

developer. There will also be a long-term survey to monitor the expected improvements in public health.

Finally, stakeholders were involved in developing the IEE through face-to-face discussions on site and a large public meeting held in the town, after which views expressed were incorporated into the IEE and the planning and development of the project. The IEE and other documents will be made available at public locations in the town and a summary will be disclosed to a wider audience. The consultation process will be continued and expanded during project implementation, when a nationally-recognized NGO will be appointed to handle this key element to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation.

7.2 Recommendations

There are two straightforward but essential recommendations that need to be followed to ensure that the environmental impacts of the project are successfully mitigated. These are that the Project Implementation Unit of the private developer should ensure that:

- All mitigation, compensation and enhancement measures proposed in this IEE report (Table 8) are implemented in full, as described in this document; and
- The EMP provided in this report is updated during detailed design and also implemented in full during construction and operation period.
- A copy of the EMP shall be kept on-site during the construction and operation period at all times.
- The EMP shall be made binding on the contractor operating on the site, and should be included in the contractual clauses. Non-compliance with, or any deviation from the conditions set out in this document shall constitute a failure in compliance.

8 Conclusions

The environmental impacts of the proposed NHA Complex have been assessed according to guidelines and results reported in this IEE. The potential adverse environmental impacts during the (i) construction period can be minimized by the mitigating measures and environmentally sound engineering and construction practices; and (ii) operations period can be managed by the mitigation measures and environmentally sound O&M practices.

In relation to Bangladeshi ECR 1997, the NHA Complex project is considered to have little potential for environmental impacts and can be classified as Orange – B category. The environmental impacts that have been identified can be mitigated by the measures mentioned in this IEE and EMP. So this IEE document will be sufficient and acceptable to DoE as part of the ECC application and further study for impact assessment will not be necessary.

9 Annexures

ANNEX 1: Rapid Environmental Assessment Checklist

Screening Questions	Yes	No	Remarks
A. Project Siting			
Is the project area			
(1) Densely populated?		X	
(2) Is it heavy with development activities?		X	The proposed site is located in Bangladesh's National Housing Authority (NHA) owned land. At present there are very light activities within this area.
(3) Is it adjacent to or within any environmentally sensitive areas?			
• Cultural heritage site		X	
• Protected Area		X	
• Wetland		X	
• Mangrove		X	
• Estuarine		X	
• Buffer zone of protected area		X	
• Special area for protecting biodiversity		X	
• Bay		X	
B. Potential Environmental Impacts			
Will the Project cause			
(1) impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.		X	
(2) deterioration of surrounding environmental conditions due to rapid urban population growth, commercial and industrial activity, and increased waste generation to the point that both manmade and natural systems are overloaded and the capacities to manage these systems are overwhelmed?		X	
(3) degradation of land and ecosystems (e.g. loss of wetlands and wild lands, coastal zones, watersheds and forests)?		X	
(4) dislocation or involuntary resettlement of people?		X	There will be no dislocation or involuntary resettlement of people. Staff residing within the campus will voluntarily leave the allocated

Screening Questions	Yes	No	Remarks
			residences as per instruction of the NHA authority.
(5) disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable group?		X	
(6) degradation of cultural property, and loss of cultural heritage and tourism revenues?		X	
(7) occupation of low-lying lands, floodplains and steep hillsides by squatters and low-income groups, and their exposure to increased health hazards and risks due to polluting industries?		X	
(8) water resource problems (e.g. depletion/degradation of available water supply, deterioration for surface and ground water quality , and pollution of receiving waters?		X	
(9) air pollution due to urban emissions?	X		During construction activities for hauling of materials and operations of excavation equipment; During operations, there will be no emissions
(10) risks and vulnerabilities related to occupational health and safety due to physical, chemical and biological hazards during project construction and operation?	X		During construction activities – occupational health and safety due to physical hazards;
(11) road blocking and temporary flooding due to land excavation during rainy season?		X	
(12) noise and dust from construction activities?	X		During construction phase only
(13) traffic disturbances due to construction material transport and wastes?	X		During construction phase only
(14) temporary silt runoff due to construction?	X		During construction phase only
(15) hazards to public health due to ambient, household and occupational pollution, thermal inversion, and smog formation?		X	
(16) water depletion and/or degradation?		X	
(17) overpaying of ground water, leading to land subsidence, lowered ground water table, and salinization?		X	
(18) contamination of surface and ground waters due to improper waste disposal?	X		During construction phase only
(19) pollution of receiving waters resulting in amenity losses, fisheries and marine resource depletion, and health problems?		X	

Screening Questions	Yes	No	Remarks
(20) large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		X	
(21) social conflicts if workers from other regions or countries are hired?	X		This can be easily avoided by hiring people from the region
(22) risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during operation and construction?		X	
(23) community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		X	

ANNEX 2: Environmental Screening Summary

No major environmental concerns were identified during screening. The ownership of the site is with Bangladesh's National Housing Authority and the site does not come under any declared forest area. The nearby sites of ecological importance are:

- Sonadia island, Saint Martin's island, and Teknaf peninsula (Cox's Bazar sea beach) - more than 50 km far from the site; and
- Bank of Karnaphuli river – about 5 km south-east from the site.

Key environmental issues:

- Trees and undergrowth in the site may have the presence of fauna (mammals & reptiles);
- Project will lead to cutting/ pruning of trees/ vegetation during construction/ operation;
- Solid waste/ hazardous waste may be generated during construction and operation;
- Wastewater/ septage/ sewage may be generated during construction and operation;
- Possible damage to the water body (large pond) at the site; and
- Increased risk of air pollution and noise pollution during construction.

Key social issues:

- Relocation of families of employees staying within the project site;
- Access may be difficult to the mosque within the site for the general public; and
- Access may be difficult to the water body within the site for the general public.

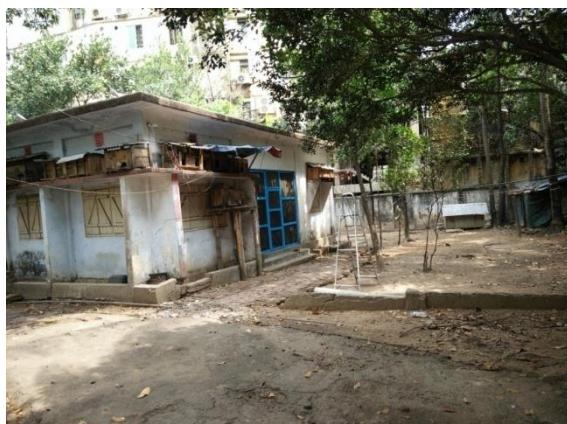
ANNEX 3: Photographs of the existing site conditions of the proposed Project Complex



Nameplate of the office at entrance



View of office from main entrance



Quarters for the staff



Entrance road to the store area



Road behind the administration building



View of mosque from the nearby high place



View of the north-eastern corner



Dilapidated condition of the administration office



Water body within the NHA compound



Large trees beside the water body



Buildings outside the north eastern corner



Road beside the officers' quarter



Officer's quarter



Roadway beside the drivers' quarters



Roadway beside the officers' quarters



Soil testing in the site



View of CDA flyover construction from NHA area



Garage and car parking area

ANNEX 4: Records of Public Consultations Conducted

The stakeholder consultation meeting was held at Chittagong National Housing Authority office compound at 9-30 AM on 9 March 2017 with the available staff of the organization.

Several small group discussions were held because all the staff of the organization could not leave their workplaces at a time, which would otherwise disrupt the normal official activities.



Figure 12: Meeting at the Sub-Divisional Engineer's Office

The Environment Specialist welcomed the participants in the meeting and explained goals and objectives of the project. He told that the Government of Bangladesh through the Bangladesh's National Housing Authority has undertaken a project to construct Commercial cum Residential Apartment Complex in Chittagong at the same location as of the existing office compound. This project would be implemented under Government's priority Public-Private Partnership (PPP) model, which would encourage investment from the private organizations. This project will enhance overall economic condition of the country in the long run by creating better office, residential and commercial facilities in a very attractive urban location.

It was disclosed in the discussion that NHA has its office buildings and other residential facilities for the staff, which will be re-developed into a modern office and residential accommodation for NHA and a commercial cum residential complex for sale to customers through PPP route. The developer will be responsible for the development of the complex at existing NHA office compound, and operate and maintain the complex during the contract tenure in order to support Government's policy of promoting and enhancing commercial, office and residential facilities in Bangladesh.

It was revealed during the discussion that the land proposed for construction of the commercial complex is owned by the Bangladesh National Housing Authority. It is a big area of about 34,416 m² (8.50 acres) located in a very attractive urban commercial location, and it will be sufficient for the construction of a commercial cum residential complex as per international standard design. It is at present being used for a very low profile purpose with insufficient return compared to the value of land in this area. The participants from the NHA staff clearly stated that the area proposed for construction of NHA complex will be kept free from any kind of external hindrance at their own initiative during the construction activities by the PPP developer in the site.

It was disclosed in the meeting that the project would be implemented soon and the local people would receive the benefit of getting employment as soon as the construction works would start. They also expressed their willingness to get long-term deployment after the implementation of the project. It was disclosed to the participants that the local people would get preference during selection of staff and workers for running the complex in a sustainable manner.

The participants were convinced that the socio-economic and environmental condition of the local people and the locality would be definitely better after implementation of the project and they showed their willingness to cooperate wholeheartedly during construction and operation and maintenance

phase of the commercial cum residential complex. However, the participants expressed the following concerns:

- There will be total dislocation of all existing office and residential facilities, proper arrangement should be made to minimize this;
- Alternative residential and office facilities should be ensured before starting construction activities;
- Design of the complex should include sustainable arrangement for all the existing facilities in a better way than the prevailing condition;
- Design of the complex should follow the architectural, structural, environmental and social requirements as per BNBC;
- All valuable official documents, especially the original land ownership papers should be preserved carefully;
- Helipad should be there on the roof of the commercial building;
- Design should incorporate the highest safety against earthquake;
- Entry to the mosque should be ensured for people in the surrounding area;
- Other discussion points included Modern security system, use of renewable energy, standby generators, independent arrangement for supply of water, waste management system, green area, medical facilities, playground, fountain in front of office building, Wi-Fi system, allocation of shops in the commercial area for the staff of NHA on a priority basis, etc.

There were no issues left for discussion and the meeting was closed with a vote of thanks to all participants.

Ministry of Housing and Public Works (MoHPW)
National Housing Authority (NHA)
 Commercial cum Residential Apartment Complex in Chittagong

Attendance Sheet

Time: 10 - 00 AM

Date: 9/3/2017

Place of meeting: NHA Ctg

Union/ Ward: #8 of CCC

Thana: Kulshi

Sl. No.	Name of Participant	Father's/ Husband's Name	Address	Mobile No.	Signature
1	Chotan Chowdhury	Mridul Chowdhury	Sub-division-2 NHA chittagong	01830219841	
2	MD. Ruhul Amin.	Tayezuddin	Sub-Assistant NHA - Ctg.	0171115384	
3	Md. Abdur Rashid Khan kar	Bos hir uddin	Sub-Assistant Engr. NHA - Ctg.	01721906556	
4	Md. Motijul Islam	Md. Motaher Hossain	Sub-Division-2 SA-E-1, Ctg. NHA	01720171165	
5	Md. Balbir	Abdul Latif	Office assister	01818329825	
6	MD. DELWAR HOSSAIN	ABDUL KHALEQUE HAWLADER	Assisstant Ctg. Division, etc.	01731291518	
7	MD. Nasir uddin	Late. Rahul Amin	Administrative Office (estate)	01913-628960	
8	Md. G. Muzfi Tep	(In MD. Ehsan)	Consultant-KPMG	0171537347	
9	Md. Abother	Md. Bicchu Wily	Kapton Sub-D-2 NHA, Ctg.	01829872711	
10	MAMUNUR RASHID	Noor Ahmed	Divisional Admin Area	01814-224329	
11	MD. Rezaul Hossain	khalfat Hossain	LDA cum HC	01749449267	
12	Ashok Kumar Karmaker	(In Ashok Kumar Karmaker)	Tracer	01821639222	
13					
14					
15					

Figure 13: Attendance Sheet for the Public Consultations

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