ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

THE COURTYARD RESIDENCES APARTMENT COMPLEX

Plot No. 04, Street No. 73, Sector F-11/1, Islamabad.

An Environmental Impact Assessment Report has been prepared to fulfill the regulatory requirements of the Pakistan Environmental Protection Act, 1997, and subsequent Pak-EPA Regulations, 2000.

A Project by ACS Builders & Developers

ACS
BUILDERS & DEVELOPERS

THE COURTYARD RESIDENCES APARTMENT COMPLEX

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Construction of Residential Services Apartments

Final Report
May, 2025

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Abbreviations

Acronym	Title
BOD	Biochemical Oxygen Demand
CDA	Capital Development Authority
CEC	Capital Environmental Consultants
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
E&S	Environmental and Social
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EMP	Environmental Management Plan
ERP	Emergency Response Plan
GHG	Greenhouse Gas(es)
GIP	Good Industry Practice
ha	Hectare
IEE	Initial Environmental Examination
IUCN	International Union for Conservation of Nature and Natural Resources
kV	Kilovolts
LAA	Land Acquisition Act
NCS	National Conservation Strategy
MW	Megawatts
MCI	Municipal Corporation Islamabad
NEQS	National Environmental Quality Standards
NGO	Non-governmental Organization
NOC	No Objection Certificate
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
O&M	Operations and Maintenance
PGA	Peak Ground Acceleration
PPE	Personal Protective Equipment
EPA	Environment Protection Agency
PEPA	Pakistan Environmental Protection Act
PM	Particulate Matter
PM_{10}	Particulate Matter ≤10 microns
RAMSAR	Wetlands of International Importance
SPM	Suspended Particulate Matter

TSS	Total suspended solids
UNFCCC	United Nations Framework Convention on Climate Change
VECs	Valued Environmental and Social Components
WB	World Bank
WHO	World Health Organization
WHS	World Heritage Sites
WWF	World Wildlife Fund for Nature

EXECUTIVE SUMMARY

This Environmental Impact Assessment (EIA) report evaluates the potential environmental impacts of "The Courtyard Residences Apartment Complex" at Plot No. 04, Street No. 73, Sector F-11/1, Islamabad, covering a land area of 86,152 sq. ft. The proposed development consists three blocks i.e., Block-A (upto 31st floor), Block B (upto 45th floor) and Block C (upto 20th floor). This document has been prepared to fulfill the regulatory requirements of the Pakistan Environmental Protection Act, 1997, and subsequent Pak-EPA Regulations, 2000. Major environmental concerns include air quality, noise, traffic congestion, solid waste generation, and potential biodiversity impacts. Mitigation measures have been identified to ensure compliance with environmental standards and sustainability goals.

The project design comprises 3 basements+46 stories building located at street no.73 Plot No. 04, Sector F-11/1, Islamabad near Hilal road. Key components include residential apartments, car parking area, gymnasium, cafe, and other amenities. Allotment from CDA has been acquired and site ownership rests with the proponent. Total project area is around 15.82 Kanals, the project details have been summarized as under.

Table E.1: Details of the Project

Project design	A Residential Apartments tower with a total footprint of 86,152.00 Sq. ft. and height 626'-6".
Location	Plot No. 04, Street No. 73, Sector F-11/1, Islamabad
Total Area of Plot	15.82 Kanals (86,152 sq. ft. or 9,572.44 Sq. Yd.)
Covered Area	515,676.72 Sq. ft.
Plot category	Residential
Total No of Floor	3B + 01 Ground + 45 Floors
Total number of apartments	364
Parking Capacity	606 parking spots
Facilities	• residential apartments • combat & martial arts area • day care area • cafe area • kids play area/office • badminton court • tennis court
Services	• water supply system • electricity network • emergency generator • cable TV • security • telecommunication • sewerage treatment system and • rainwater harvesting

The project's eye captivating design ensures to maximize space and boast interiors with abundant natural light. In each apartment, there is state of the art finishing making it a much more pleasurable place. All the infrastructure facilities will be provided at the site as per the applicable national and international standards and codes.

Eco-friendly building features have been adopted in the design with the objective to ensure environmental sustainability. Some key eco-friendly aspects of project design include:

- Energy efficient lighting,
- maximum use of day light and natural ventilation
- rainwater harvesting system,
- water treatment plant and reuse within building,
- high performance, double glazed Glass to reduce HVAC load
- dual flush system for toilets

A detailed geotechnical Study has been conducted for the project to determine the geotechnical parameters of the subsurface deposits. The subsurface deposits up to the explored depth consist of the following units: filling material, and, gravel, mudstone, sandstone, clay stone, siltstone, conglomerate. The overall situation of the socioeconomics, water and sewerage system, solid waste collection system has been discussed in detailed in the baseline section of the study.

The EIA study for the project has been conducted to fulfill the legislative requirements as laid down in Section 12 of Pakistan Environmental Protection Act, 1997. The EIA study aims at developing the environmental profile of the project area so as to evaluate the existing physical, biological and socioeconomic aspects leading to respective impacts due to construction and operations of the project. The main objective of the EIA study is to ensure that:

- Any major adverse impact on the environment (physical, ecological and social) during different phases of projects viz. siting, design, construction and operation are identified.
- Adverse impacts are appropriately addressed and adequate mitigation measures are incorporated in the siting, design, construction and operation phases of project.
- Socioeconomic aspects are identified, and mitigated.
- Alternatives to achieve the objectives are analyzed.
- Environmental Management Plan (EMP) for sustainable development and operation of the project is developed for implementation and monitoring of the project activities.

Following key environmental and social aspects are discussed in the EIA Report.

- Topography
- Seismicity, Vulnerability to seismic shocks
- Vulnerability to soil erosion
- Vulnerability of site to storm water drainage
- Effect on ecology
- Operation of traffic
- Air and noise impacts including fugitive dust and operation of equipment during construction
- Waste Management

In order to assist the proponent in environmental management during construction and operation, an Environmental Management and Monitoring Plan (EMMP) has been developed for the supervision and monitoring of the mitigation measures and ensuring their effectiveness. Procedures for implementation of EMMP may be further refined by the proponent as per requirements on site. The main aspects covered in the EMMP includes roles and responsibilities, scope of EMMP, management program, mitigation matrix, and monitoring plan etc.

Assessment of the environmental aspects and screening of potential impacts of the proposed activities pertaining to the Project finds that:

- The project site comprises approximately 15.82 Kanals of land in F-11/1 just beside the Abu Dhabi Towers (Left), Al-Safa Heights-2 (Front) apartments and ideally suits project objectives of creating residential facility in the prime location of Islamabad.
- The site has mostly flat topography with very little variation. Slope cutting /stabilization is therefore not involved.
- Project does not lie inside or adjacent to any protected area or buffer zone of protected area. Also, there are no gazetted archaeological sites located within the close vicinity of proposed project.
- Land acquisition for the project is not involved as the land has already been acquired.
- Average domestic daily water requirement is estimated to be around 107,000 US gallons /day of water. Some key measures adopted in the project design for water conservation include:
    - Rainwater harvesting
    - Treatment plant for sewage treatment and reuse of treated water in horticulture and other non-potable uses.
    - dual flush technology for toilets
    - Reuse of Air Conditioning water
- The air quality of the site according to the ambient air monitoring results has been classified as unpolluted. Air quality of the air shed of macro-environment as well as that of the site itself will have no significant impact due to location of the project. Temporary disturbance during construction will need to be managed effectively to avoid impact due to dust and other emissions on nearby residents.
- Water analysis of the groundwater being used at project site also indicates good water quality and within NEQS limits. The results of water quality analysis are annexed with the report.
- The construction activities will have to be carefully scheduled to avoid hindrance to ongoing activities in the surrounding like traffic which may get affected from vehicles moving in and out of the site for transportation of construction material.
- A peak ground acceleration of 0.25g 0.32g has been taken as design basis for earthquake for construction of the building.
- The project site is not close to any industrial units and therefore does not receive any impact from the emissions and discharges from the industrial units.

Assessment of impact of activities during construction and operation stages of project shows that the impacts will be of temporary nature and small order. They are not expected to have any significant adverse impacts on the microenvironment and macro-environment of the Project. The minor impacts resulting from said activities or operation of facilities would be mitigated. Based on the findings of the EIA study and screening of potential environmental and social impacts, it is recommended that:

- The structures and materials conform to recommended standards and follow standard practice of civil works.

- Environmentally sound materials and goods are selected, with priority being accorded to products meeting national and international standards.
- Traditionally well-tried materials are chosen for provision of utilities services in the Project.
- Temporary inconveniences due to construction works are minimized through planning and coordination with local population and organizations in the neighborhood.
- The foundations be of concrete on bearing soil. Bearing capacity, settlement, static and dynamic loading conditions should be determined in view of seismic conditions pertaining zone 2B (Moderate to High hazards) and taken into account in the working designs.
- The stability of soil be verified before laying the foundations.
- Environmental Performance Monitoring to be an integral part of the Project to ensure environmental safeguards.
- Constant and transparent liaison should be maintained with community and other stakeholders in the vicinity to address any concerns they may have during construction and operation phase of the project.
- Record of bird collisions and injuries/death should be maintained for evaluation purposes and improvement where required.
- Provisions for renewable energy should be considered in the building design. For this purpose, solar panels of adequate capacity may be installed at roof top.
- Energy conservation designs should be considered such as automatic lighting systems which detect daytime and human presence and shut off automatically.
- Constant liaison should be maintained with nearby communities to address their concerns/complaints during construction and operation. For this purpose, a grievance register may be developed and maintained to document any complaints received and address them in a systematic manner.
- Biannual/annual environmental performance review to evaluate the project’s environmental performance, progress on conservation measures adopted may be undertaken for improvement purposes.

The nature of Project, it’s siting; adoption of adequate measures to minimize waste and control pollution and traffic congestion during construction as well as operation stages of the project will have negligible residual impact of low significance on the microenvironment and macro-environment. Construction and operation of the project is not expected to have unacceptable/severe impact on the aesthetics and air shed of the microenvironment and macro-environment. Nevertheless, the impacts can be effectively mitigated through careful planning, suitable landscaping, waste management, traffic management and adopting appropriate mitigation measures suggested. The management plan is provided along with a program of environmental monitoring to ensure that all measures are adopted as intended, and to determine whether the environment is protected as envisaged.

The EIA study, based on the findings and recommendations given above suggests that the construction and operation of the project will, on adoption of the suggested mitigation measures and EMMP will be an environmentally acceptable proposal.

The consultant therefore recommends that the EIA Report may be approved with the provision that the suggested mitigation measures and EMMP will be adopted in letter and spirit.

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1. INTRODUCTION

This report presents the findings of Environmental Impact Assessment (EIA) Study conducted for the proposed project "The Courtyard Residences Apartment Complex" located near Hilal Road at Plot No.04, Street No. 73, Sector F-11/1, Zone-1, Islamabad, in compliance with the requirements of Pakistan Environmental Protection Act, 1997 (PEPA 1997).

The project involves the construction of a residential apartment building comprising 03 basements + ground + 45 storey building. Key components include Residential apartments, gymnasium, day care area, cafe area, kids play area/office. The project will comprise of three towers, for residential apartments, while the gym, Day Care Area, Cafe Area, Kids Play Area/office will be on ground floor.

This full-scale structure with modern facilities and extensive architectural art will be built out in the nuances of current European architecture, serving as the greatest gateway for both local and foreign companies. Guests and residents can enter the building from several places, and parking will be designated for apartment dwellers. Courtyard Residences Apartment Complex will be an earthquake-resistant construction equipped with the latest technical breakthroughs, such as central temperature management and power conservation technologies.

1.1. Legal basis for Environmental Impact Assessment & Project Categorization

Section 12 of Pakistan Environmental Protection Act 1997 requires that every new development project has to be preceded by an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) depending upon the nature and scope of the project and scale of impacts associated with the project.

The Pak Environmental Protection Agency (Review of IEE/EIA) Regulations 2000 categorize projects into two separate schedules depending on whether a project requires an IEE (Schedule-I) or an EIA (Schedule-II). The Regulations also require that all projects located in environmentally sensitive areas ensure submission of an EIA.

Schedule I categorizes those projects which are small scale projects or which have narrow range of environmental impacts pertaining to these activities. Schedule II includes projects which are expected to impose severe environmental impacts and need thorough evaluation prior to commencement of project activities.

Waste projects are categorized on capacity and nature. Toxic hospital waste disposal through incineration is listed in Schedule II under following category:

Category J: Other Projects

1. Any other project for which filing of an EIA is required by the Federal Agency under sub-regulation (2) of Regulation 5.

Accordingly, EIA for the project is submitted to EPA.

This EIA report serves to assess the current environment of project area, the proposed project activities, and their impact on the ambient environment. The report has assessed the potential impacts and addressed both the positive and negative impacts of the project.

1.2. The Proponent

Project Director,
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Contact No.: +92-345 9142007
Email: a.ahmed1206@yahoo.co.uk
Mailing Address:

1.3. EIA Consultant

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Address: Office # 95, Street 50, Sector G-13/2.
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Website: www.capitalenv.com.pk

1.4. Project Overview

The project site is located in Sector F-11/1, Islamabad, near F-11 Markaz, and is accessible via Street No. 73. It is surrounded by multi-storey apartment buildings on the north, west, and east sides, while a water nullah passes near the southern boundary of the plot which carries storm water and wastewater from nearby residential settlements.

The project design comprises 3 basements + 46 stories (G + 45 F) building. The project will have three block i.e., Block-A (upto 31floor), Block B (upto 45 floor) and Block C (upto 20 floor). The total land of the Courtyard Residences Apartment Complex is approximately 86,152.00 Sq.ft. (15.82 Kanal) with covered area of 515,676.72 Sq.ft. Key components include residential apartments, car parking area, gymnasium, cafe, and other amenities. Allotment letter has been acquired and site ownership rests with the proponent. The project details have been summarized as under.

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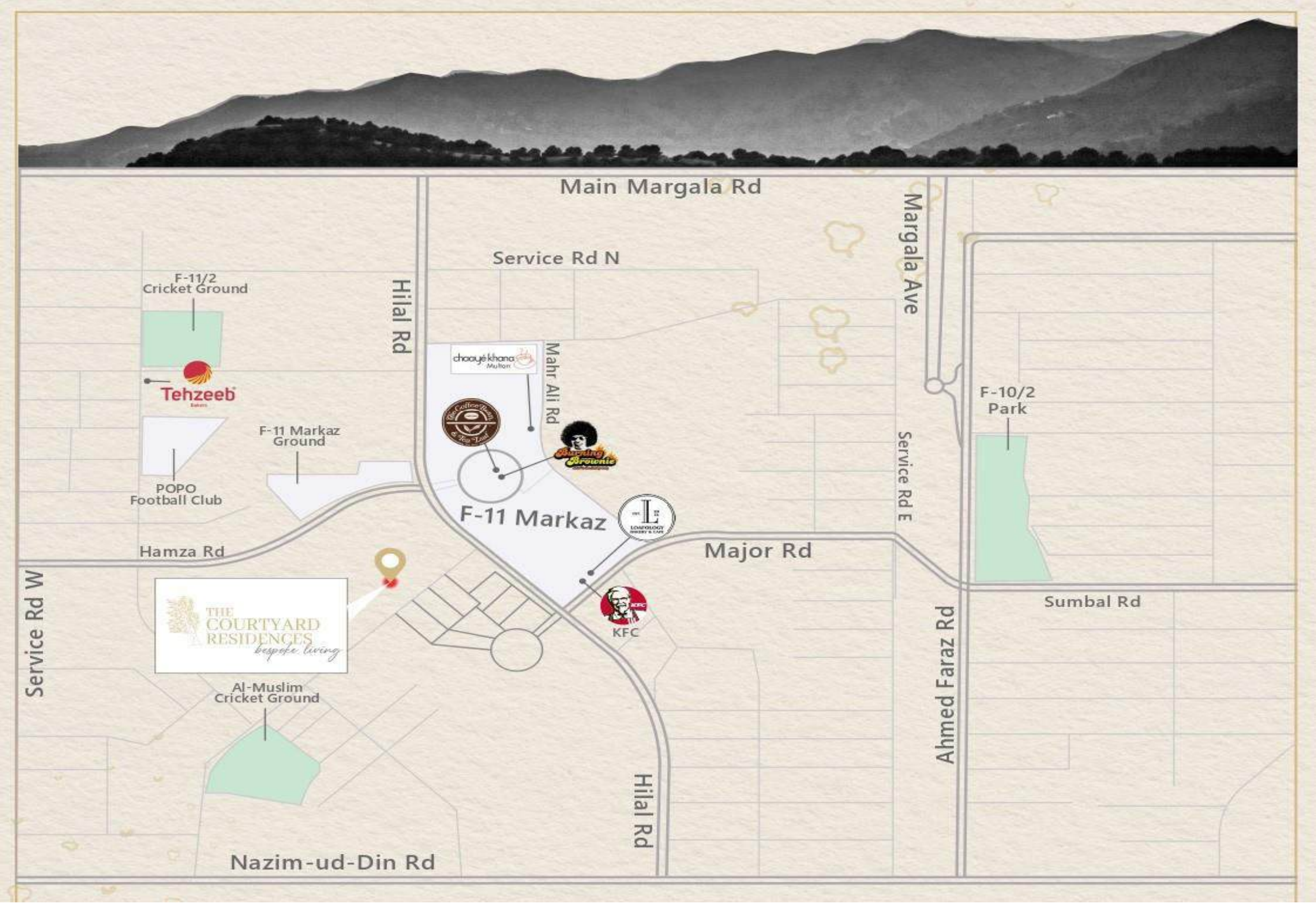

Figure 1.1: Project Location Map

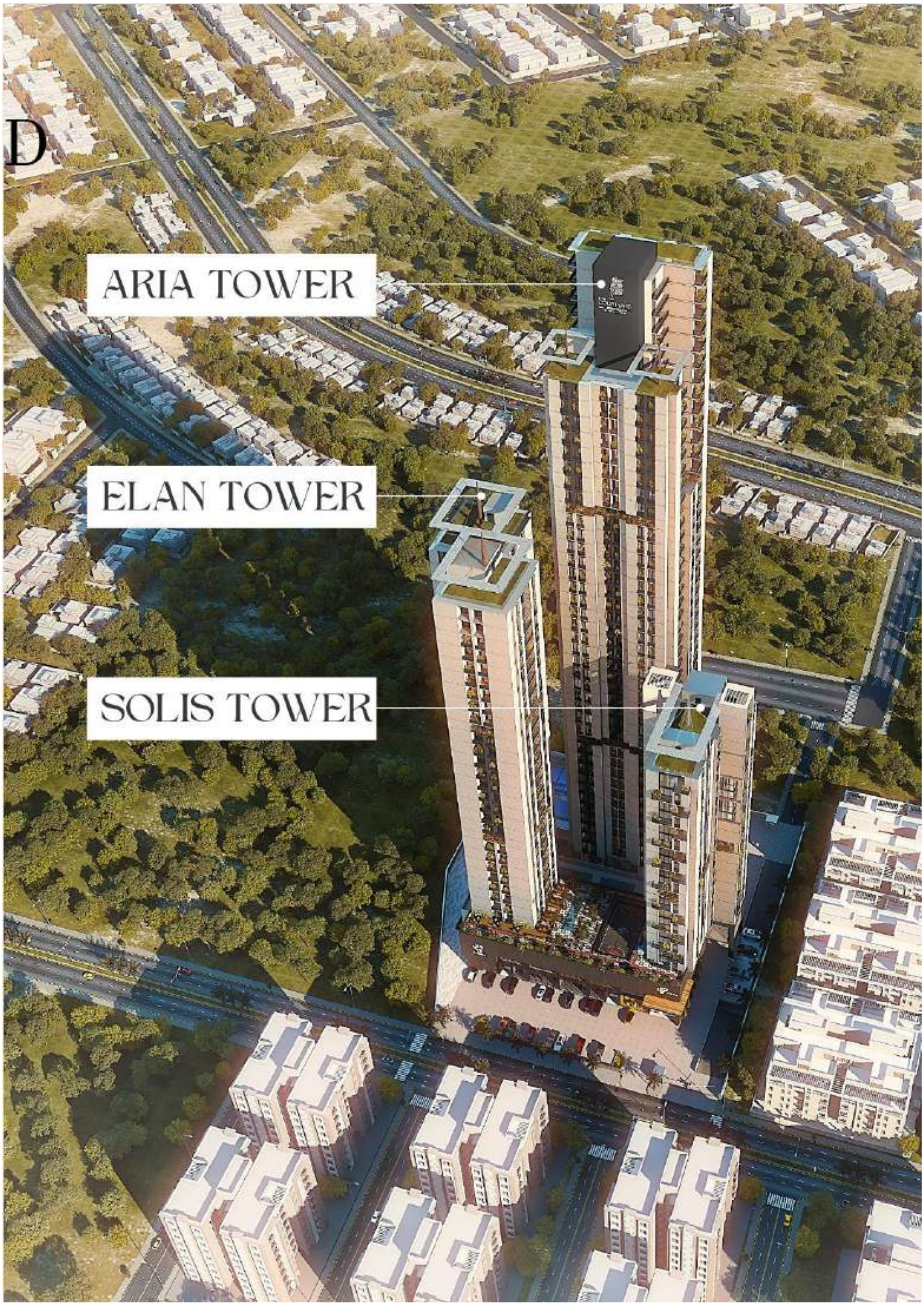

Figure 1.2: Conceptual View of Project

1.5. CSR (Corporate Social Responsibility) Initiatives by the Proponent

Having always been a pillar of trust, development and success in the real estate sector by contributing to the growth of Pakistan, ACS Builders supports regional development and progress. ACS Builders stands to grow by using its progressive vision and contribution to humanity, thereby adding national and international value to the society as a whole.

Islamabad hosts a large number of parks; every sector is blessed to have several playgrounds. ACS Builders felt its duty to participate in a program where it can contribute to the betterment of the society.

1.6. Scope & objectives of EIA Study

The EIA study provides the current status of environmental conditions of project area to predict and evaluate the future impacts on the physical, ecological and social environment. The EIA study has accordingly been done to focus on ascertaining that:

- All major and minor positive or negative impacts on the environment (physical, biological, social and ecological) during the different stages inception as well as pre-construction, construction and operation of project are identified.
- If there is a negative impact, it is mitigated as far as possible through specified design and construction management, and
- Any residual short term or long term negative impact is identified clearly and made known to all stake holders as well as those likely to be affected.
- Appropriate and adequate mitigation measures to minimize the adverse impacts are suggested and procedures for their implementation provided.
- Environmental Management Plan for sustainable construction and operation of the project is developed which forms an essential part of the EIA report.

1.7. Methodology for Environmental Assessment Study

1.7.1. Review of Project Activities

The EIA study starts with review of project activities using the information from the client. In a scoping session with the Proponent, different aspects of the Project were discussed in terms of various environmental issues. Details of the past and proposed project activities were collected from the proponent. The impacts associated with the project were reviewed and mitigation measures were specified. In subsequent meetings with the Proponent the observations were communicated.

1.7.2. Review of Policy, Legislation and Guidelines

The relevant national legislations, guidelines were reviewed to set the environmental standards and environmental management plan that the project would be required to adhere to during the construction and operation phase of the project.

1.7.3. Review of Secondary Data

The project related information provided by the client was reviewed by the CEC experts to identify key areas of study and analysis/assessment. Besides information from the proponent, available secondary data including environmental studies on similar projects by CEC and other consultants was also reviewed. Available literature on project area was reviewed to gather information for development of social and environmental baseline profiles for the subject EIA covering the following:

- Physical environment: topography, geology, soils, water resources, ambient air and climate
- Biological environment: habitat types, flora and fauna, habitats within the proposed site and its surroundings
- Socio-economic environment: settlements, socio-economic conditions, infrastructure and land use; and
- Heritage aspects: sites of cultural, archaeological or historical significance.

1.7.4. Field Data Collection

CEC team carried out site surveys to gather primary data on the physical, biological and socioeconomic conditions of the project area. Discussions were held with the members of the nearby resident in the project area to collect area-specific primary information along with their views and concerns regarding the project activities. Site was surveyed to assess present environmental conditions of the site with respect to geology, topography, air and noise quality and hydrology etc.

1.7.5. Identification and Assessment of Impacts

Potential impacts which may arise from proposed project activities were identified. These include effects on physical, biological, and socio-economic environment. Impacts were identified, in particular, on the ecology and hydrology of the project area and assessed on the basis of field data collected from project site. Besides this, secondary data, expert opinion, and monitoring results were also used and reviewed during impact assessment.

1.7.6. Recommendations for Mitigation and Monitoring Measures

Keeping in view the baseline data collected and impacts identified, mitigation measures were recommended to minimize, reduce, eliminate, or compensate for the potential environmental and social impacts on the project zone of influence. Mitigation measures were recommended on the basis of the past experience, best industry practices, legislative requirements and professional judgment.

1.7.7. Development of Environmental Management Plan (EMP)

Environmental management plan (EMP) was developed for effective implementation of the recommended mitigation measures in the EIA report. EMP included suggested measures and management plan to minimize the identified negative impacts, and monitoring programme to monitor residual impacts, if any, during the construction and operation. The EMP includes the following:

- Mitigation and monitoring plan

- Defining roles and responsibilities of the proponent and contractors
- Requirements for communication, documentation and training during implementation of the project
- Change management plan to cover unforeseen events / environmental conditions during the project; and
- Training program

1.7.8. Reporting

Upon completion of all field and desktop work, the findings and outcome of the EIA study were documented in the EIA report. The format of the EIA report conforms to the guidelines provided in the Pakistan Environmental Assessment Procedures, 1997, and Review Procedures 2000.

1.7.9. Structure of the Report

The EIA report is presented in one volume and describes the proposed project activities, environmental conditions of the project area, relevant legislation and guidelines, assessment of the project impacts, recommendations for mitigation measures and an environmental management and monitoring plan. The text is supported by photographic records, maps, figures and tables as needed in different sections of the EIA report.

The current EIA document is structured as follows:

- Chapter 1 Presents the background, objectives, scope and approach and methodology adopted for the study;
- Chapter 2 Describes the legislative and policy framework for the project;
- Chapter 3 Provides an overall description of project activities;
- Chapter 4 Provides environmental and social baseline conditions of project area;
- Chapter 5 Provides and outcome of Public Consultation and information disclosure
- Chapter 6 Presents screening of alternatives and potential environmental and social impacts of the project, and appropriate mitigation measures;
- Chapter 7 Provides Environmental Management and Monitoring Plan (EMMP);
- Chapter 8 Provides conclusion and recommendations based on findings of EIA study.

1.8. The EIA Study Team

Table 1.1: List of EIA Study Team

S. No.	Name	Position in Project
1	Mr. Shahbaz Ahmed	Team Leader and Senior Environmentalist
2	Mr. Jamal Qureshi	Technical Advisor
3	Prof. Dr. Asad Ghufran	Ecologist
4	Miss. Hira Khan	Sr. Environmentalist and project Coordinator
5	Mr. Sajid Iqbal	Environmentalist and field officer

2. LEGISLATIVE FRAMEWORK, ENVIRONMENTAL REGULATIONS AND GUIDELINES

2.1 General

Before initiation of any project, the mandatory legislations enacted by government and other regulatory agencies need to be studied. Governments from time to time have enacted many environmental rules, regulations, laws and guidelines specifying different requirements for diverse kind of projects. Therefore, it would be necessary to study the environmental laws pertaining to different projects before its execution so that protection of environment can be ensured. In this section, same methodology would be followed by studying those rules, regulations and laws that are relevant to the Project. The main among these are:

- National Environmental Laws & Legislations
- Provincial Environmental Laws & Legislations
- National Environmental Guidelines
- International Treaties

These laws & guidelines have been included in the mitigation measures and Environmental Management Plan (EMP), which have been formulated for better environmental and ecological management.

2.2 Policy Framework

The Pakistan National Conservation Strategy (NCS), which was approved by the Federal Cabinet in March 1992, is the principal policy document for environmental issues in the country. The NCS signifies the country's primary approach towards encouraging sustainable development, conserving natural resources, and improving efficiency in the use and management of resources. The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant to the proposed project are biodiversity conservation, restoration of rangelands, pollution prevention and abatement, and the preservation of cultural heritage.

Pakistan is a signatory to the Convention on Biological Diversity, and is thereby obligated to develop a national strategy for the conservation of biodiversity. The Government of Pakistan constituted a Biodiversity Working Group, under the auspices of the Ministry of Environment, to develop a Biodiversity Action Plan for the country, which was completed after an extensive consultative exercise. The plan, which has been designed to complement the NCS and the proposed provincial conservation strategies, identifies the causes of biodiversity loss in Pakistan and suggests a series of proposals for action to conserve biodiversity in the country. The Pakistan Environmental Protection Council (PEPC) has approved the action plan and steering committees at the federal and provincial levels have been formed to implement it.

- Mid-term Review of NCS: Key Findings: An overview of the key environmental issues facing Pakistan is as follows:

- Per capita water availability in Pakistan has been decreasing at an alarming rate. In 1951, the per capita availability was 5300 cubic meter which has now decreased to 1105 cubic meter just touching water scarcity level of 1000 cubic meter.
- Almost all fresh water resources are severely polluted due to discharge of untreated industrial and municipal wastes. Pollution of coastal waters due to waste discharges and oil spills coupled with reduced freshwater flows is resulting in declining fish yields.
- About 55 percent of population has access to a relatively safe drinking water source. Potable water quality, assessed against WHO standards, fails to meet all the specified criteria, confirming evidence of extremely high pollutant loads.
- Approximately 35 percent of population has access to adequate sanitation facilities.
- Air pollution is on the rise, especially in urban areas. Recent surveys conducted by Pakistan Environmental Protection Agency (PEPA) revealed presence of very high levels of suspended particulate matter (about 6 times higher than the World Health Organization's guidelines). 'Smog' also seriously affects almost entire Punjab during December and January every year.
- Noise pollution has become a serious issue in major urban centers.
- Of about 54,850 tons of solid waste generated daily in urban areas, less than 60 per cent is collected. No city in Pakistan has proper waste collection and disposal system for municipal, hazardous or healthcare wastes.
- The deforestation rate has been estimated at 0.2-0.5 percent per annum. Forest cover, which was 4.8 percent of total land area in 1992, could hardly be increased substantially despite all efforts.
- Degradation and encroachment of natural forests, rangelands and freshwater and marine ecosystems are resulting in loss of biodiversity. At least four mammal species, including tiger, swamp deer, lion and Indian one-horned rhinoceros, are known to have become extinct from Pakistan while at least 10 ecosystems of particular value for the species richness and uniqueness of their floral and faunal communities are considered to be critically threatened.
- Desertification affects over 43 million hectares of land annually.
- Pakistan is a highly energy in-efficient country. It uses approximately same amount of energy to generate 1 dollar of GNP as the USA.

The situation just mentioned is the result of a number of constraining factors including high population growth rate, prevailing poverty, unplanned urban and industrial expansion, insufficient emphasis on environmental protection in the government policies, lack of public awareness and education and above all the ailing economy which has caused deficiencies in institutional capacity and resources for effective environmental management.

The mid-term review of the NCS led the Government of Pakistan (GOP) and United Nations Development Program (UNDP) to jointly initiate an umbrella support program called the National Environmental Action Plan-Support Program (NEAP-SP) that was signed in October 2001 and implemented in 2002. The development objective supported by NEAP-SP is environmental sustainability and poverty reduction in the context of economic growth. The primary objective of NEAP is to initiate actions and programs for achieving a state of environment that safeguards public health, promotes sustainable livelihood, and enhances the quality of life of the people in Pakistan. The NEAP identifies four primary areas, (1) Clean air (2) Clean water (3) Management of solid waste (4) Ecosystem management. The plan also presents five additional areas of concern (i) Management of fresh water resources (ii) Marine pollution (iii) Toxic and hazardous substances handling and disposal (iv) Energy conservation and management (v) Compliance with international treaties and protocol.

Studies conducted by GOP and Donor Agencies in Pakistan have identified a number of environmental concerns with regard to energy, water and air pollution, waste management, irrigated agriculture, and biodiversity. These studies suggest an overall degradation in the quality and impoverishment of renewable natural resources such as water, forests and other flora as well as key biological habitats. The GOP, private sector and civil society have, with few exceptions, not responded positively to meet the challenges from these concerns.

The Mid-Term Development Framework: 2005-2010 (MTDF 2005-10) of the Planning Commission has been developed in line with the National Environment Action Plan (NEAP) objectives, and the same focuses on four core areas i.e., clean air, clean water; solid waste management, and Ecosystem management. The Plan has been prepared keeping in mind Pakistan’s experience with such initiatives in the last decade; the current capacity to undertake planning, implementation and oversight and the identified needs for improvement in such capacity. The MTDF clearly specifies issues in environment which need to be addressed.

2.2.1 National Environmental Policy, 2005

The National Environmental Policy, 2005 aims to protect, conserve and restore Pakistan’s environment in order to improve the quality of life for the citizens through sustainable development. It provides an overarching framework for addressing the environmental issues facing Pakistan, particularly pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification, natural disasters and climate change. It also gives direction for addressing the cross sectorial issues as well as the underlying causes of environmental degradation and meeting international obligations.

The National Environmental Policy, 2005 while recognizing the goals and objectives of the National Conservation Strategy, National Environmental Action Plan and other existing environment related national policies, strategies and action plans, provide broad guidelines to the Federal Government, Provincial Governments, Federally Administrated Territories and Local Governments for addressing environmental concerns and ensuring effective management of their environmental resources.

2.2.2 The Biodiversity Action Plan

The Biodiversity Action Plan, 2000 has been the most significant direct step towards addressing the issue of loss of biodiversity. It details the current status, trends, direct & indirect causes of loss of biodiversity; its principles, goals and aims; proposals for an action plan including planning & policies, legislation, identification and monitoring, in situ & ex-situ conservation, sustainable use, research and training, public education and awareness, Environmental Impact Assessment, information extraction and financial resources etc. The Wild Birds and Animals Protection Act 1912[1], the West Pakistan Wildlife Protection Ordinance 1959, the Wildlife

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[1] The Wild Birds and Animals Protection Act 1912 (Act No.VIII of 1912 dated 18.09.1912)

Protection Rules 1972, provide for the protection of flora and fauna in the territory, including vegetation and protected forests.

2.3 Administrative and Institutional Setup for Environmental Management

Environmental issues are governed by three levels of the government viz. Federal, Provincial and Local Government. The Ministry of Environment and Local Government is the Ministry at the Federal level, which oversees the affairs of the environment in the country.

The PEPC has been formed by the Federal Government. It comprises Prime Minster /Chief executive as the chairperson, the Minister of the Ministry of Environment, Local Government and Rural Development as the vice-Chairperson; Governors of the Provinces; Ministers in charge of the subject of environment in the Provinces; Secretary to the Federal Government in charge of the Ministry of Environment, Local Government and Rural Development; Director General Federal EPA; heads of other federal and provincial departments; environmentalists and community representatives including scientists. The functions and powers of the Council include formulation of national environmental policy, enforcement of PEPA 1997, approval of the NEQS, incorporation of environmental considerations into national development plans and policies and provide guidelines for the protection and conservation of biodiversity in general and for the conservation of renewable and non-renewable resources.

The Federal government has also established the Federal EPA, which is headed by a Director General and has wide-ranging functions given in PEPA 1997. These include the preparation and coordination of national environmental policy for approval by the PEPC, administering and implementing the PEPA 1997 and preparation, revision or establishment of NEQS.

The Provincial Environmental Protection Agencies are established by the respective Provincial Governments. A Director General who exercises powers delegated to him by the Provincial Government heads each Provincial EPA. IEEs and EIAs are submitted to provincial EPAs for approval.

The proposed project would be located in federal Capital. Hence this EIA Report will be submitted to the Federal EPA for review and issue of environmental approval. Coordination of the environmental monitoring activity will be responsibility of Pak EPA; in this case Pak EPA has been duly authorized to enforce environmental compliance.

2.4 Statutory Framework

The constitution of Pakistan contains provision for environmental protection and resource conservation. The constitution mentions environmental pollution and the ecology as a subject in the concurrent legislative list, meaning that both the provincial and federal government may initiate and make legislation for the purpose. Article 9 of the Constitution defines the right to life as a “fundamental right” in these words “No person shall be deprived of life or liberty save in accordance with law”. The Supreme Court of Pakistan in its judgment in the case Shehla Zia and others vs. WAPDA (1994) declared that the right to a clean environment is part of the fundamental constitutional right to life.

Several laws exist for the protection of the environment. Some of these laws are Federal and the rest Provincial in character. The promulgation of the Environmental Protection Ordinance 1983 was the first codifying legislation on the issue of environmental protection. This was indeed a consolidated enactment to plug the gaps and remove defects/deficiencies in the legislation. The promulgation of this ordinance was followed, in 1984, by the establishment of the Pakistan Environmental Protection Agency, the primary government institution dealing with environmental issues. Significant work on developing environmental policy was carried out in the late 1980s, which culminated in the drafting of the Pakistan National Conservation Strategy. Provincial environmental protection agencies were also established at about the same time. The Pak Environmental Quality Standards were established in 1993.

Prior to the 18th Amendment to the Constitution of Pakistan in 2010, the legislative powers were distributed between the federal and provincial governments through two 'lists' attached to the Constitution as Schedules. The Federal list covered the subjects over which the federal government had exclusive legislative power, while the 'Concurrent List' contained subjects regarding which both the federal and provincial governments could enact laws. The subject of 'environmental pollution and ecology' was included in the Concurrent List and hence allowed both the national and provincial governments to enact laws on the subject.

However, as a result of the 18th Amendment this subject is now in the exclusive domain of the provincial government. The main consequences of this change are as follows: i) The Ministry of Environment at the federal level have been abolished. Its functions related to the national environmental management haves been transferred to the provinces. The international obligations in the context of environment will be managed by various ministries and departments of the federal government, ii) The Pakistan Environmental Protection Act 1997 (PEPA 1997) is technically no longer applicable to the provinces and is applicable only in the Islamabad Capital Territory. The provinces are required to enact their own legislation for environmental protection.

2.4.1 Pakistan EPA (Review of IEE/EIA) Regulations 2000

The Pakistan Environmental Protection Agency (Review of EIA/IEE) Regulations 2000 define Schedules (I & II) of projects falling under the requirement of IEE or EIA. This EIA Study has, for environmental classification of the Project into Category A or B, taken account of the requirements of the Environmental Protection Agency (Review of EIA/IEE) Regulations 2014 which define Schedules (I & II) as follows:

Schedule I: A project falls in Schedule I if it is likely to have adverse environmental impacts, but of lesser degree or significance than those for category 'A' and all the mitigation measures to handle the impact is manageable. Such types of projects need IEE report including EMP.

Schedule II: Projects are categorized in Schedule II if they generate significant adverse environmental impacts that require a comprehensive management plan, or if the project is located within or passes through: a) Areas declared by the Government of Pakistan as environmentally sensitive (National Parks/Sanctuaries/Game Reserve), b) Areas of international significance (e.g. protected wetland as designated by the RAMSAR Convention), or c) Areas designated by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) as cultural heritage sites.

According to Environmental Protection Agency Regulation, 2000, a project falling in any category listed in Schedule II shall file an EIA with the Pakistan Environmental Protection Agency. The proposed project falls in category J of Schedule II hence require an EIA study.

2.4.2 Pakistan Environmental Assessment Guidelines

The Federal EPA has prepared a set of guidelines for conducting environmental and social assessments. The guidelines derive from much of the existing work done by international donor agencies and NGOs. The package of regulations, of which the environmental and social guidelines form a part, includes the PEPA 1997 and the NEQS. These guidelines are listed below followed by comments on their relevance to proposed project:

- Policy and Procedures for Filing, Review and Approval of Environmental Assessments, Pakistan Environmental Protection Agency, September 1997: These guidelines define the policy context and the administrative procedures that govern the environmental assessment process from the project pre-feasibility stage to the approval of the environmental report. The section on administrative procedures has been superseded by the IEE-EIA Regulations, 2000.
- Guidelines for the Preparation and Review of Environmental Reports, Pakistan Environmental Protection Agency, 1997: The guidelines on the preparation and review of environmental reports target project proponents and specify:
  - i. The nature of the information to be included in environmental reports
  - ii. The minimum qualifications of the EIA conductors appointed
  - iii. The need to incorporate suitable mitigation measures at every stage of project implementation
  - iv. The need to specify monitoring procedures.
- The terms of reference for the reports are to be prepared by the project proponents themselves. The report must contain baseline data on the Study Area, detailed assessment thereof, and mitigation measures.
- Guidelines for Public Consultation, Pakistan Environmental Protection Agency, May 1997: These guidelines support the two guidelines mentioned above. They deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in any impact assessment study.
- Sectoral Guidelines for Environmental Reports: Housing estates and new Town developments: These guidelines are prepared to look specifically at the Environmental impacts resulting from constructing housing estates and townships in Pakistan. The guidelines examine the alternatives on site and technology and impacts on the social and physical environment, during the construction and operation phases of the project and devices proposals for mitigation measures.

The EIA report submission and approval procedure is summarized below:

a) Ten hardcopies of the EIA and two soft copies will be submitted together with a review fee and form included as Schedule V of the IEE-EIA Regulations.

b) The EPA will conduct a preliminary scrutiny and reply within 10 days of the submittal of the report

  a. confirming completeness, or
  b. asking for additional information, if needed, or

c. returning the report requiring additional studies, if necessary.

c) If accepted, the EPA will set a date for public hearing and publish a notice in the print media. According the law, a minimum of 15-day notice is required for the public hearing.

d) The EPA will review the EIA taking into account the any public comments received during the hearing or otherwise.

e) The EPA is required to make every effort to complete the EIA review process within four (04) months of the issue of confirmation of completeness under regulation 9.

f) The approval granted at the end of the review process, is valid for three years to start construction.

g) Once the project construction is complete, the proponent is required to submit a request to EPA for confirmation of compliance. An environmental management plan for the operation phase is to accompany the request.

2.4.3 National Environmental Quality Standards (NEQS)

The NEQS are uniform standards applicable to all kind of industrial and municipal effluents. Different Parameters are set showing permissible levels of pollutants in liquid effluent and gaseous emission. These were first promulgated in 1993 and were last revised in 2000. For liquid effluent, there are 32 parameters showing permissible level of pollutants before its discharge into sea, inland water & sewage. And, for gaseous emission, there are 16 parameters.

2.4.4 Pakistan Penal Code, 1860[2]

The Pakistan Penal Code deals with offences where public or private property and/or human lives are affected due to the intentional or accidental misconduct of an individual or body of people. In the context of environment, Section XIV of PPC deals with the offences affecting the public health, safety, convenience, decency, morals and environmental pollution and empowers the local authorities to control noise, noxious emissions and disposal of effluents. The NEQS/SEQS enforced by the EPAs supersede the application of this legislation on industries and municipalities. The Penal Code, however, can provide a basis for the client to coordinate its activities with the local authorities to ensure that its construction activities do not become a cause of public nuisance or inconvenience.

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[2] Pakistan Penal Code (XLV of1860)6th October 1860

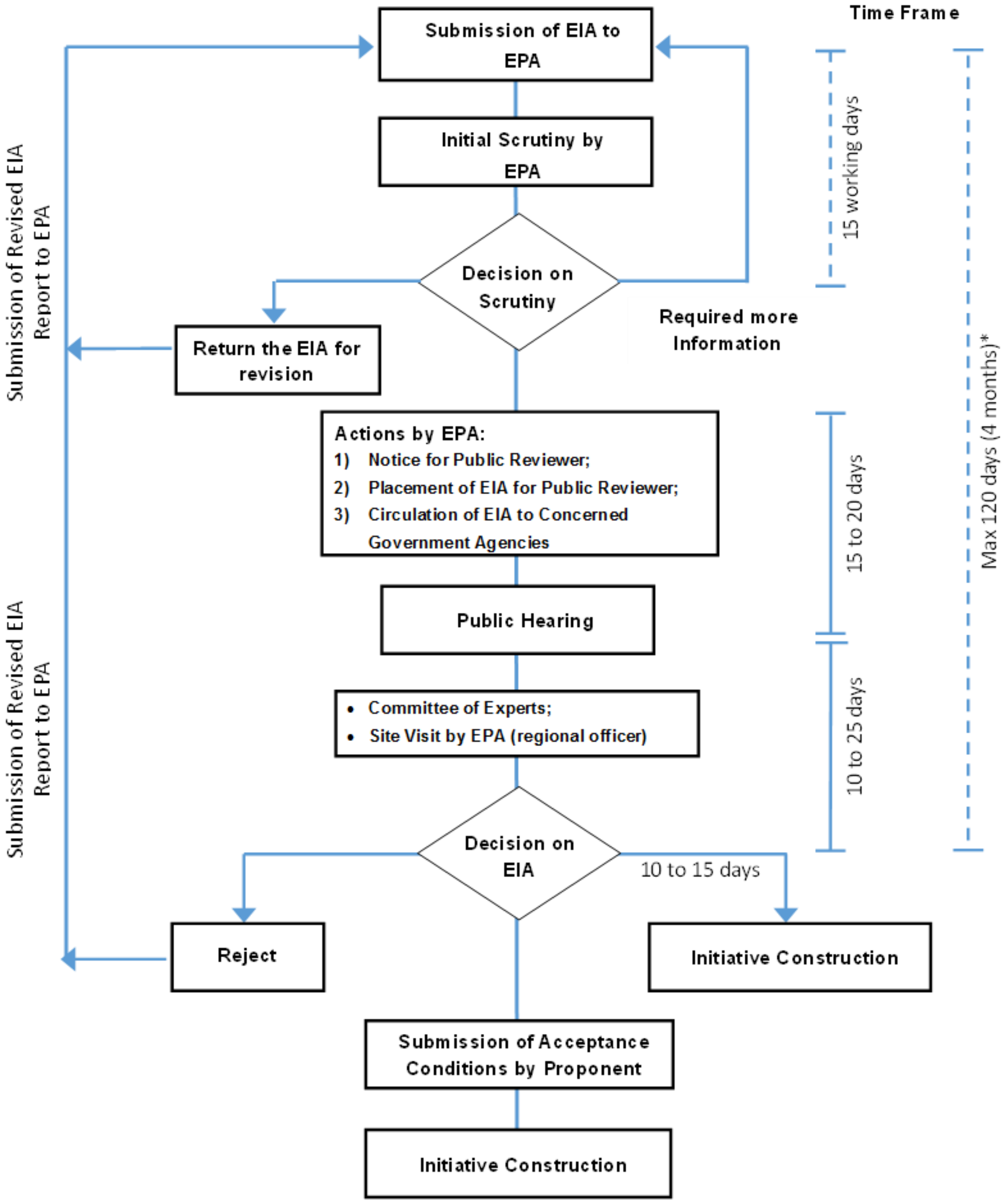

Figure.1: EIA Review and Approval Procedure

2.4.5 Antiquities Act 1975[3]

The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. The act is designed to protect antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments; etc. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area that may contain such articles of archaeological significance.

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[3] Act VII of 1976(Gazette of Pakistan, Extraordinary, Part 1, 14th January, 1976

Under the Act, the Project proponents are obligated to ensure that no activity is undertaken within 61 m (200 ft) of a protected antiquity, and to report to the GoP's Department of Archaeology any archaeological discovery made during the course of the project.

The federal Department of Archaeology maintains a master register containing basic and vital information on the protected monuments and sites including full measurements of the protected area, description, location and Government Notification number with date of protection. The central directorate general of Archaeology has a separate list which is continuously updated as and when new sites are declared as protected.

2.4.6 Land acquisition Act, 1894[4]

This act provides law for the acquisition of land needed for public purposes and for companies and for determining the amount of compensation to be made on account of such acquisitions. The law provides details of various peculiarities involved in acquisition of land such as preliminary investigation, objection to acquisition, declaration of intended acquisition, enquiry into measurements, value & claims, taking possession, reference to court and procedure thereon, apportionment of compensation, payment, temporary occupation of land, acquisition of land for companies, disputes resolutions, penalties and exemptions etc. This act has 55 sections addressing different areas. Such as section-4(2) mentions that it shall be lawful for any official authorized by the Collector to enter upon and survey, to dig or to do all other acts necessary to ascertain that whether the land is adapted for such purpose. The project site has already been acquired by the proponent and there are no issues of resettlement or involuntary resettlement associated with the project.

2.4.7 Forest Act 1927

The Forest Act deals with the matters related with protection and conservation of natural vegetation/habitats. In that regard it empowers the concerned agency to declare protected and reserved forest areas and maintaining the same. In spite of the fact that it recognizes the right of people for access to the natural resources for their household use, it prohibits unlawful cutting of trees and other vegetation. The Project site does not encompass any reserve/protected forest area.

2.4.8 Cutting of Trees (prohibition) Act, 1992

The Cutting of Trees Act mandates that no person shall, without prior written approval from authorized officer shall cut, fell or damage trees growing in:

- First Zone (Area adjacent to and beyond the external frontier of Pakistan to a line at four kilometers measured from the external frontiers of Pakistan) if the number of remaining trees in any field falls short of the number to be calculated at the rate of fifteen trees per acre
- Second Zone (Area adjacent to and beyond the first zone extending towards Pakistan to a line of four kilometers measured from the first zone) if the number of remaining trees in any field falls short of the number to be calculated at the rate off ten trees per acre.

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[4] The Land Acquisition Act 1894 (Act of 1894) http://punjabelaws.gov.pk/laws/12.html

This does not apply to a tree growing on land occupied as the site of a town or village or in a dwelling-house.

Section 3: It prohibits any person, without prior approval, from cutting, felling or damaging any tree growing in first and second zones as mentioned above.

Section 4: It imposes penalty of fine which may extend to five thousand rupees for contravention relating to first zone and to two thousand and five hundred rupees for contravention relating to second zone.

The project site is not located in the zones as mentioned above; therefore, the provisions of this law does not apply to the project.

2.5 Policies, laws, legislations and governing bodies in Federal Capital

2.5.1 Pakistan Environmental Protection Act, 1997

The Pakistan Environmental Protection Act, 1997 (PEPA) is the fundamental legislation empowering the government to formulate regulations for protecting the environment. It is broadly applicable to air, water, soil, marine and noise pollution, as well as to the handling of hazardous waste. Penalties have been prescribed for those contravening the provisions of the Act. The powers of the federal and provincial Environmental Protection Agencies (EPAs) have also been considerably enhanced under this legislation. In addition, the EPAs have been empowered to conduct inquiries into possible breaches of environmental law either upon the registration of a complaint or on their own accord. Under section 12 of PEPA (1997), no project involving construction activities or any change in the physical environment can be undertaken unless an Initial Environmental Examination (IEE) or EIA, as required, is conducted and a report submitted to the federal or provincial EPA.

2.5.2 Pakistan Environmental Protection Agency

Pak EPA is headed by Director General (DG) with the aim to exercise the powers and perform the functions assigned to it under the provisions of this Act and the rules and regulations made thereunder. The Agency shall have technical and legal staff and may form advisory committees.

Pak EPA would have powers to enter or inspect under a search warrant issued by Environmental Protection Tribunal or a Court search at any time, any land or building etc. where there are reasonable grounds to believe that an offence under this Act has been or is being or likely to be committed. EPA may also take samples, arrange for testing or confiscate any article in discharge of their duties.

Some key functions and powers of Pak EPA under the PEPA 1997 are to:

a) administer and implement this Act and the rules and regulations made;
b) prepare, in co-ordination with the appropriate Government Agency and in consultation with the concerned sectoral Advisory Committees, national environmental policies for approval by the Council;
c) take all necessary measures for the implementation of the national environmental policies approved by the Council;
d) prepare and publish an annual National Environment Report on the state of the environment;

e) prepare, establish and revise the National Environmental Quality Standards with approval of the Council:
f) ensure enforcement of the National Environmental Quality Standards;
g) establish standards for the quality of the ambient air, water and land, by notification in the official Gazette in consultation with the Provincial Agency concerned
h) summon and enforce the attendance of any person and require him to supply any information or document needed for the conduct of any enquiry or investigation into any environmental issue;
i) arrange for test and analysis of the samples at a certified laboratory;

2.5.3 ICT Development Laws and Regulations

The Capital Development Authority (CDA) has the responsibility for the overall planning, provision and supervision of public health services, covering adequate sanitation and garbage disposal within the territorial limits of the Islamabad Capital Territory (ICT). It also has the responsibility for the coordination of public health services with other relevant agencies. This includes collection, transportation and safe disposal of liquid and solid waste collected from residential areas, commercial areas, open spaces etc.

The CDA operations are governed generally by the provisions of the Islamabad Capital Territory Municipal Bye Laws, 1968 as amended from time to time; and specifically by the Islamabad Regulations 1979 (Upkeep of Cleanliness) as amended from time to time.

Recently, some departments have been shifted to Municipal Corporation Islamabad (MCI) including Water, sanitation and environment and issues related to water, sewerage, and environment are now taken care by the relevant administration of MCI.

2.5.4 Islamabad Capital Territory (Zoning) Regulation, 2005

For administration and land use characterization, through this regulation the Islamabad Capital territory has been delineated into following five zones;

Zone-1

This zone constitutes sectors up to the existing alignment of the G.T. road from the point of intersection of G.T. road with Shah rah-e-Kashmir to the point of the Nicolson Monument inclusive of sector H-14, H-15, H-16, H-17, I-14, I-15, I-16, I- 17.

Zone -2

The zone consists of an area bounded by G.T. road in the north & north east, north of Shah rah-e-Kashmir and Capital limits in the west, comprising residential sectors G-15 (part), G-16, G-17, F-15 (part), F-16, F-17, E-15 (part), E-16, E-17, D-16, D-17, C-17, AND B-17.

Zone -3

Margalla Hills National Park as notified under section 21 of the Islamabad Wildlife (Protection, Preservation, and Conservation& Management) Ordinance 1979, other protected ranges, forest areas and un- acquired land falling between the Margallah Hills & north of Murree Road shall constitute this zone.

Zone-4

This zone comprises Islamabad Park and rural periphery wedged between Murree road towards north and Lehtrar road towards south and extending beyond Simly road up to the ICT limits in the north east. This zone excludes the part of Margalla Hills National Park and Rawal Lake.

Zone-5

This zone comprises areas falling south of Islamabad Park and extending up to outer limits of ICT towards south, south west and south east.

2.5.5 Islamabad Wildlife Ordinance, 1979

The Islamabad Wildlife (Protection, Preservation, Conservation and Management) Ordinance 1979 provides the protection, preservation, conservation and management of wildlife in Islamabad Capital Territory. Main aim of this ordinance is the preservation and conservation of wildlife, flora and fauna for sustainable development and also to comply with the concept of national parks internationally. It puts restriction on killing, hunting, capturing of animals in the Park either manually or using any tool /weapon. The ordinance does not consider killing of animals as unlawful if done in self-defense. Section 21 of the Ordinance identifies certain activities such as visit for education and recreation purpose, development of access road, recreational areas such as hotel etc., permissible within a National Park with the provision that the said activities will be undertaken only after the approval of Authorized Officer (a person whom the Federal Government or any officer empowered by the Federal Government in this behalf may appoint to carry out all or any of prepossess of this Ordinance).

2.5.6 Islamabad Capital Territory Local Government Act, 2015

This Act is expedient to establish an elected local government system to devolve political, administrative and financial responsibility and authority to the elected representatives of the local governments; to promote good governance, effective delivery of services and transparent decision making through institutionalized participation of the people at local level; and, to deal with ancillary matters.

2.5.7 Islamabad Residential Sector Zoning (Building Control) Regulations, 1993

These regulations apply to all private residential plots in Islamabad except those in the Diplomatic Enclave. These regulations specify the type of buildings that can be constructed on residential plots and the purposes for which the respective residential plots can be used. It also provides guidance regarding the FAR, ground coverage, maximum built-up area etc.

2.5.8 Islamabad Fire prevention and Life Safety Regulations 2010

These regulations authorize the CDA to enter and inspect the buildings in ICT regarding the fire provisions and fire safety arrangements for the residential and commercial building. It authorizes CDA to seal the building and /or impose penalty on the building management in case of violations regarding fire safety arrangement.

2.5.9 Islamabad Capital Territory Municipal Bye Laws 1968

The ICT Municipal bye-laws are required for regulating the erection and re-erection of, management of, or additions and alterations to buildings in the Federal Capital. Under these regulation, guidance has been provided with respect to:

☐ Drainage and Sanitation

☐ Fire Resistant and Fire Precautions

☐ Fire Resistance and Fire Precautions

☐ Temporary Works in Connection with Building Operations

3. PROJECT DESCRIPTION

3.1 General

Located at the heart of the scenic city of Islamabad, the Courtyard Residences Apartment Complex is a residential project which has been envisaged to deliver an elegant accommodation, state of the art facilities and everything within the reach of its residents in the highly fashionable enclave of F-11/1.

The project design includes three basements and a 46-story skyscraper, near Hilal Road, Street No.73 Plot No. 04, Sector F-11/1, Islamabad. The project will have three block i.e., Block-A (upto 31floor), Block B (upto 45 floor) and Block C (upto 20 floor). The total land of the Courtyard Residences Apartment Complex is approximately 86,152.00 Sq.ft. (15.82 Kanal) with covered area of 515,676.72 Sq.ft. Key components include residential units, a parking lot, a gymnasium, a cafe, and other facilities. The CDA has issued the allotment letter for the project, and the proponent now owns the land. The project details are summarized below in Table 3.1:

Table 3.1: Details of the Project

Project design	A Residential Apartments tower with a total footprint of 86,152.00 Sq. ft. and height 626'-6".
Location	Plot No. 04, Street No. 73, Sector F-11/1, Islamabad
Total Area of Plot	15.82 Kanals (86,152 sq. ft. or 9,572.44 Sq. Yd.)
Covered Area	515,676.72 Sq. ft.
Plot category	Residential
Total No of Floor	3B + 01 Ground + 45 Floors
Total number of apartments	364
Parking Capacity	606 parking spots
Facilities	• residential apartments • combat & martial arts area • day care area • cafe area • kids play area/office • badminton court • tennis court
Services	• water supply system • electricity network • emergency generator • cable TV • security • telecommunication • sewerage treatment system and • rainwater harvesting

3.2 Project Location & Accessibility

The project site is located near Hilal Road at Plot No. 04, Street No. 73, Sector F-11/1, Zone-1, Islamabad. Site coordinates are Lat 33.681344°, Long 72.987572° beside the Abu Dhabi Towers (Left), Al-Safa Heights-2 (Front) apartments. Location map is given in figure 3.1. The project site is readily approachable by all the primary roads of Islamabad i.e. Srinagar Highway, Jinnah Ave., Constitution Ave., and Islamabad highway.

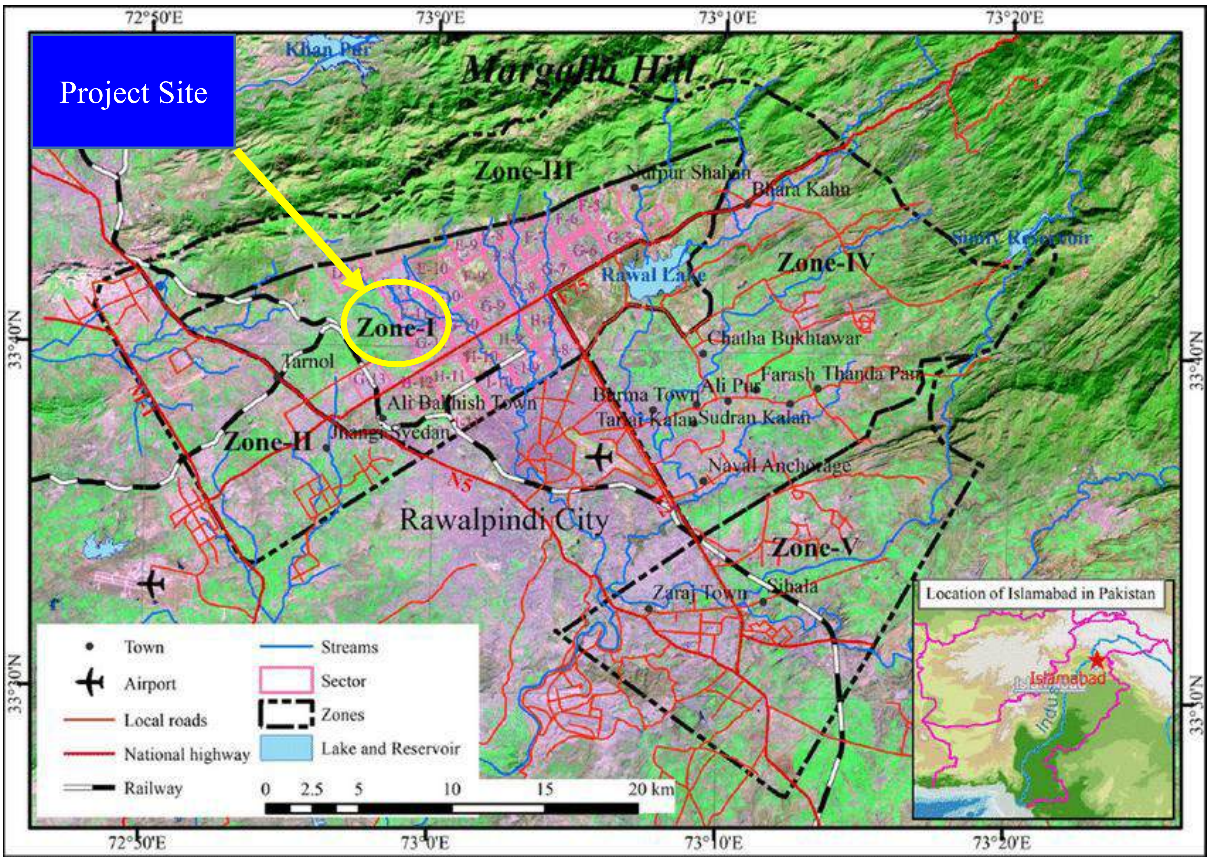


Figure 3.1: Location-Zooning map of Islamabad.

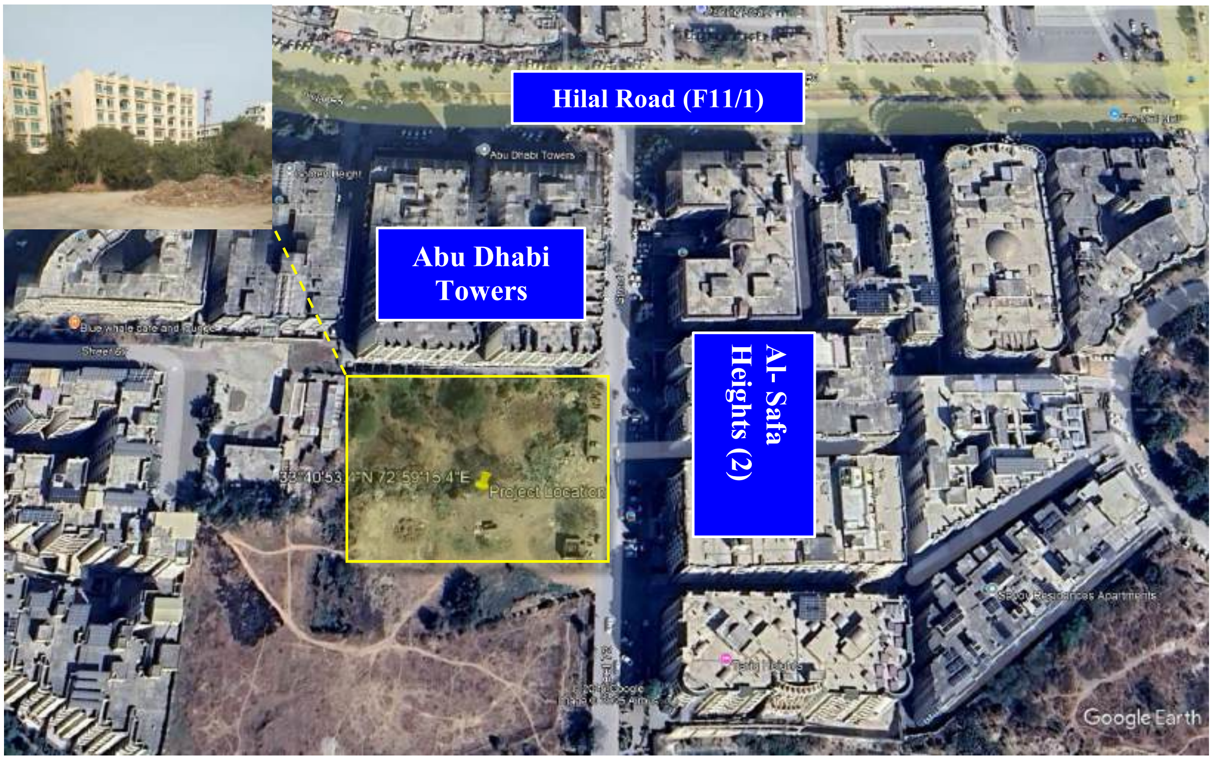


Figure 3.1: Location Map of the project site

3.3 Land Tenure, Use, Ownership and Management

Land has been acquired from CDA for the project and site ownership rests with the proponent. Land use would be residential. Copy of allotment from CDA is attached as Annex-I.

3.4 Project Design

The project's design endeavors to provide a unique modern lifestyle which reflects the essence of comfort and opulence. It would offer exclusive new style of luxury apartments surrounded by residential apartment buildings and views of Margallah hills. It comprises a total of 364 luxury apartments including 2, 3 and 4 bed apartments. Overall floor layout plan is attached as Annexure - IV and individual layout plans of each apartment is shown below.

3.5 Other facilities and services

The project features modern living in its design and offers latest services and facilities to its residents through:

- Digital Identification Network
- Smart Electric and Gas meters
- Reverse Osmosis Plant
- 24/7 Smart security through CCTV
- gym (one each for ladies and gents)
- day care
- kids play area
- community lounge

- cafes
- badminton court
- tennis court
- roof top gardens
- covered parking

Figure 3.2: Front view of the project

Figure 3.3: Typical Plan of Type-D apartment

Figure 3.4: Layout of Studio apartment

Figure 3.5: Layout plan of Type-B apartment

Figure 3.6: Layout of 2 Bed Type B apartment

Figure 3.7: Layout of Type C apartments

3.6 Parking Facility

The project will provide parking spaces for 606 cars in total with 3 basements designated for parking. There will be separate and designated parking facility for guests. Three basements have been planned for parking.

The project will also include internal roads for vehicles that will be for the residents, customers, services and ancillary operations which will also include access for fire brigade services. There will also be paved paths for movement of residents.

3.7 Environmental Considerations of Project Design

Maximum efforts have been made by the proponent to make the project design as environmentally sustainable as possible. Below are some key eco-friendly features of the project:

☐ Circulation areas have natural light, Fresh Air circulation and LED sensor lights with provision of being connected to solar panels on roof.

☐ High performance, double glazed Glass is being used to reduce HVAC load.

☐ External walls and roofs above air conditioned areas will have insulation to reduce Heat Gain.

☐ Light weight internal walls are being proposed to reduce structural load, provide better heat and sound insulation along with better fire resistance.

☐ Water Meters, Chilled water and electrical prepaid meters have been proposed for each apartment to encourage energy conservation.

☐ Gray water is being treated and reused for plantation through drip irrigation. Water Closets with dual flushing system will be used to conserve water.

☐ Soft landscape on Ground floor has been maximized with Minimal Hard landscape to reduce heat sink effect.

☐ Rain water harvesting is taking place.

☐ Garbage sorting and recycling is being proposed for the project.

3.8 Design Basis for Earthquake

For the purpose of seismic design of buildings, Pakistan has been divided into five zones. These zones are based on the peak ground acceleration ranges. According to this zoning, Islamabad has been classified into Zone 2B corresponding to peak ground acceleration range of 0.16g to 0.24g. Buildings are generally designed for a level of earthquake ground motion that has a 10% probability of exceedance in 50 years.

In order to ensure adequate seismic safety, the proposed project has been designed with respect to seismic design requirements of Zone 3 instead of Zone 2B. Project's design basis for earthquake are shown below.

Table 3.2: Design basis for earthquake

Seismic Zone	3
Peak ground acceleration	0.24g to 0.32g
Intensity (Modified Mercalli)	IX to XI
Magnitude (Richter)	6.6 to 7.4

3.9 Project Schedule

Construction of the project shall be completed in tentatively thirty-six (36) months.

3.10 Utilities

Lines for all required utilities including electricity, gas, telecommunications, and water supply run through the project area. Below are the estimated utilities requirements.

3.10.1 Water

Water will be required for domestic and recreational purposes for the project including cafeteria, gymnasium, departmental store, and swimming pools etc. Total Water Requirement of the Project (Domestic Use) is 107,000 US Gallons/Day. Main source of water for project will be water supply from CDA. As backup, the proponent is also considering to extract from underground through one (01) tube well of 400-600 ft. depth which will be stored in an underground tank of 86,500 US Gallons holding capacity. From this tank, water will be first treated by means of filtration and clarified treated water will be transferred into underground storage tank. There shall be another Under Ground Water Tank for Fire Fighting (01) Tank with capacity of 86,500 US Gallons

The total water demand for different areas is shown in figure 3.8 below. Average daily domestic requirement of water is estimated to be 30gallons/persons/day to be sourced from local supply made by CDA. Other uses include water for firefighting, swimming pools, gymnasium, cafeteria etc.

Where possible, fresh water supply will be substituted/supplemented by treated water, harvested rainwater or AC water. For horticulture, treated sewage water will be used. Similarly, for firefighting, harvested rainwater in combination with groundwater will be used to reduce load on fresh water supply. In essence, maximum efforts will be focused towards water conservation through recirculation and /or reuse after treatment.

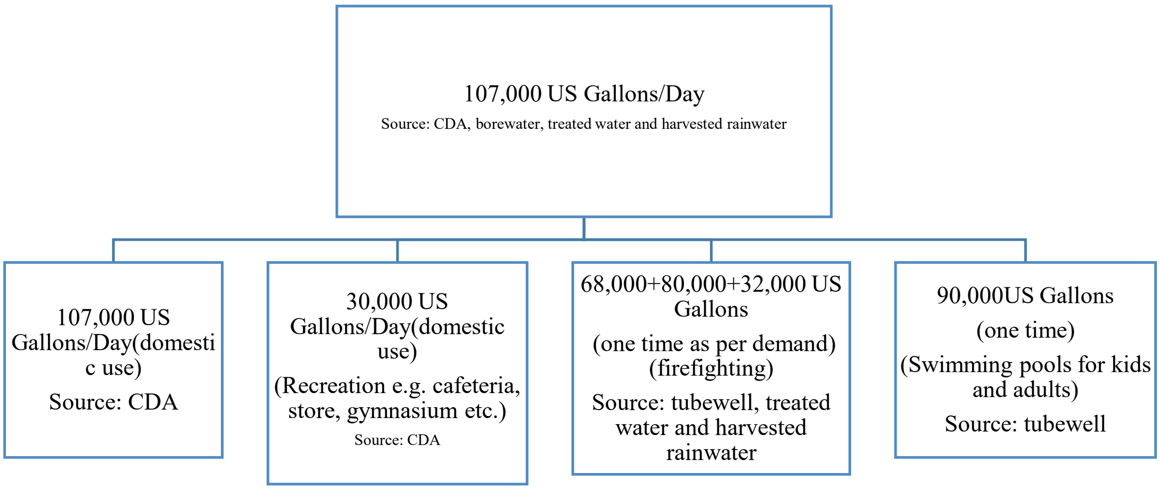
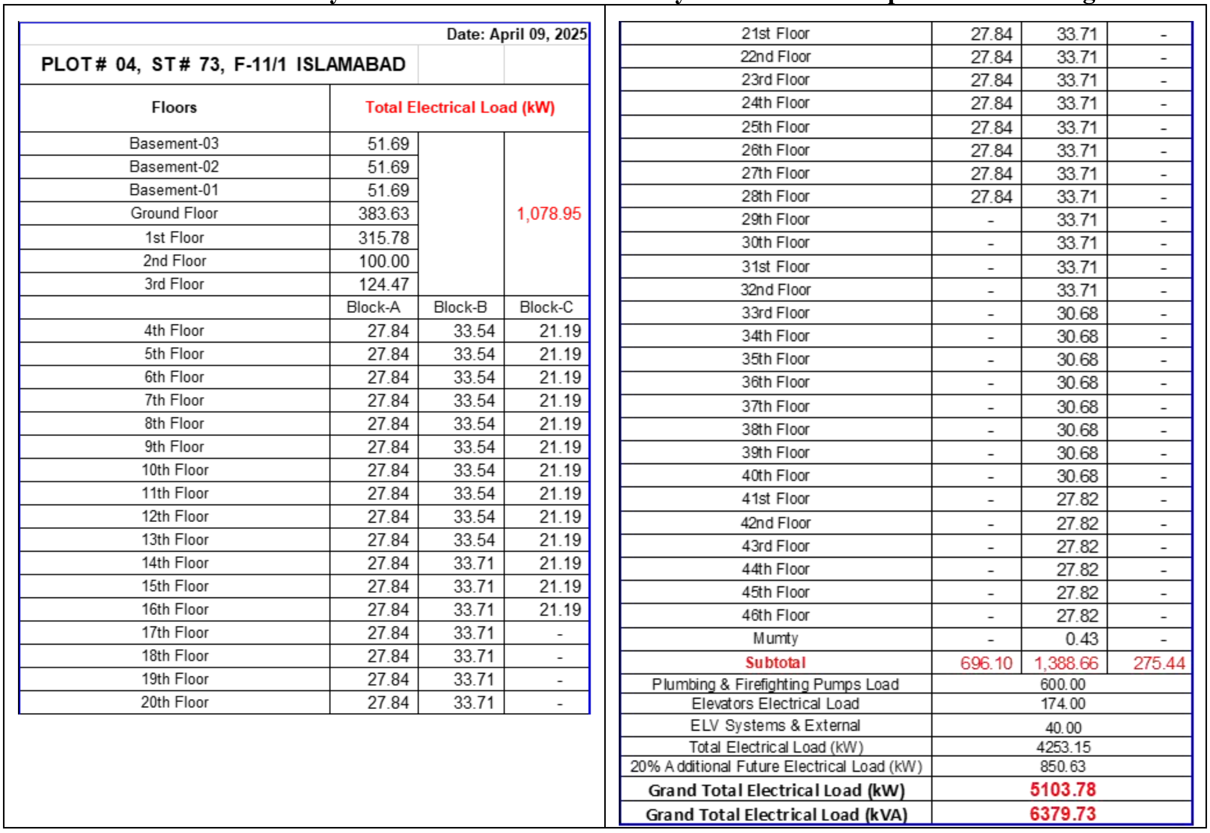


Figure 3.8: Water balance for the project

3.10.2 Electricity

The project development will be supplied directly from the utility supplier via primary 132kV/11kV substation located inside the limits of Project plot. The project MV network will terminate on H.T switchgear located on Ground Floor of the primary substation accessible to local power authorities. The initial estimated Total Load for the project is 5.10 MW. The project will be supplied from the 11KV network via 10 x 630 kVA (11 kV/ 400 V) transformers located in substations distributed over the Project. As per NEPRA load assessment is given below;

Table 3.3: Electricity load assessment of the Courtyard Residential Apartment building:



			Date: April 09, 2025
PLOT# 04, ST# 73, F-11/1 ISLAMABAD			
Floors	**Total Electrical Load (kW)**		
Basement-03	51.69		1,078.95
Basement-02	51.69		
Basement-01	51.69		
Ground Floor	383.63		
1st Floor	315.78		
2nd Floor	100.00		
3rd Floor	124.47		
	Block-A	Block-B	Block-C
4th Floor	27.84	33.54	21.19
5th Floor	27.84	33.54	21.19
6th Floor	27.84	33.54	21.19
7th Floor	27.84	33.54	21.19
8th Floor	27.84	33.54	21.19
9th Floor	27.84	33.54	21.19
10th Floor	27.84	33.54	21.19
11th Floor	27.84	33.54	21.19
12th Floor	27.84	33.54	21.19
13th Floor	27.84	33.54	21.19
14th Floor	27.84	33.71	21.19
15th Floor	27.84	33.71	21.19
16th Floor	27.84	33.71	21.19
17th Floor	27.84	33.71	-
18th Floor	27.84	33.71	-
19th Floor	27.84	33.71	-
20th Floor	27.84	33.71	-
21st Floor	27.84	33.71	-
22nd Floor	27.84	33.71	-
23rd Floor	27.84	33.71	-
24th Floor	27.84	33.71	-
25th Floor	27.84	33.71	-
26th Floor	27.84	33.71	-
27th Floor	27.84	33.71	-
28th Floor	27.84	33.71	-
29th Floor	-	33.71	-
30th Floor	-	33.71	-
31st Floor	-	33.71	-
32nd Floor	-	33.71	-
33rd Floor	-	30.68	-
34th Floor	-	30.68	-
35th Floor	-	30.68	-
36th Floor	-	30.68	-
37th Floor	-	30.68	-
38th Floor	-	30.68	-
39th Floor	-	30.68	-
40th Floor	-	30.68	-
41st Floor	-	27.82	-
42nd Floor	-	27.82	-
43rd Floor	-	27.82	-
44th Floor	-	27.82	-
45th Floor	-	27.82	-
46th Floor	-	27.82	-
Mumty	-	0.43	-
Subtotal	696.10	1,388.66	275.44
Plumbing & Firefighting Pumps Load	600.00		
Elevators Electrical Load	174.00		
ELV Systems & External	40.00		
Total Electrical Load (kW)	4253.15		
20% Additional Future Electrical Load (kW)	850.63		
Grand Total Electrical Load (kW)	**5103.78**		
Grand Total Electrical Load (kVA)	**6379.73**		

Diesel for backup generators will be stored onsite to suffice for two weeks. Average quantity of Diesel to be stored onsite will be around 26,000 Gallons.

3.10.3 Natural Gas

There shall be no natural gas supply/fitting in the proposed building.

3.10.4 Construction material supplies

Main construction material to be used during the construction phase will include paving stones, cement, and reinforcement and cement blocks, crush, gravel, sand and steel.

Additionally, paints, glass, wood, tiles, aluminum, PVC/GI pipes, concrete/cement pipes, electric cables, etc. will be used during the different phases of construction. The materials will be transported by trucks to the project site, where they will be stored until moved to different locations as and when required.

3.11 Details of Construction Activities

3.11.1 Foundations and Below- Grade Construction

Excavation for the foundations and below-grade construction work will be made in accordance with recommendation of Geotechnical investigation. Foundation work would typically include the use of bobcats, rock-breakers, loaders, pumps, motorized concrete buggies, concrete pumps, jack hammers, pneumatic compressors, and a variety of hand-held tools, as well as dump trucks and concrete trucks. Excavated material would be disposed of off-site via trucks.

3.11.2 Building Shell and Core Construction

Construction of the exterior enclosure or "shell'' of the building would include construction of the building's framework (installation of beams and columns", floor decks, facade (exterior walls and cladding), and roof construction. These activities would require the use of tower cranes, compressors, personnel and material hoists, front-end loaders, concrete pumps, on-site bending jigs and a variety of hand-held tools, in addition to the delivery trucks bringing construction materials to the site. At the same time, infrastructure connections would be built. These include lines for water, sewer, storm water, electricity and telecommunications.

3.11.3 Interior Construction and Finishing

This stage would include the construction of interior walls, installation of lighting fixtures and interior finishes (flooring, painting, etc.), as well as mechanical and electrical works such as the

- Installation of elevators
- Internal and external pipe works
- Fire protection & Life safety systems
- Car Park Ventilation
- Electrical Distribution
- Emergency Lighting installations
- Lightning Protection
- Mirror Details

3.11.4 Campsite activities

The construction contractor will develop his own camp and offices for construction purposes. The facilities provided will include but not limited to portable cabins, kitchen, toilets and laundry area for which construction works will be restricted to leveling, grading, filling and compaction. The contractor will hire local manpower for different skilled and un-skilled jobs.

3.11.5 Civil Works

Civil works will include excavation, piling, formwork, reinforcement, concreting, masonry, plastering, painting, tin smithy and waterproofing with gas-flame sticking, construction of light separating walls, hung ceilings, flooring, lining and facing.

3.11.6 External Lighting

The exterior lighting system serves three functions for the movement of vehicles and pedestrians over frequented routes and places:

- Security
- Safety
- Representational Lighting

3.11.7 Emergency Lighting

Emergency lighting is part of the safety network of any premises. The purpose of emergency lighting is to ensure that lighting is provided promptly and automatically for a specified area. The emergency lighting is categorized as follows:

☐ Emergency escape lighting for safe exit from location;
☐ Open area lighting reducing the likelihood of panic and enabling safe movement towards escape routes.
☐ High risk task area lighting illumination for the safety of people involved in a potentially dangerous process.
☐ Emergency lighting is designed and placed on the escape routes, fire alarm call points, firefighting equipment and indicating obstructions to escape. The design of escape lighting fulfills the following functions:
☐ To indicate the escape routes clearly
☐ To provide illumination onto and long such routes as to follow safe movement towards and through the exit routes provided
☐ To ensure that fire alarm call points and firefighting equipment provided along escape routes can be readily located and used,
☐ An emergency resulting from breakdown of the automatic lighting system will be dealt with by the contingency plan.

3.11.8 Illumination

Combination of low consumption, high efficient lamps/bulbs will be used for apartments and all common areas like lift lobbies, stair case, Electro-mechanical rooms, car parks, corridors and passages etc. The lighting layout shall be designed to meet the recommended lighting levels as per prevailing international standards.

3.11.9 Construction Equipment and Machinery

Conventional construction equipment and machinery will be used for different construction activities. The equipment and machinery will include Dozers, Loaders, Tower crane, Mobile crane, Lorry, Dump trucks, Back Hoe, bar Blending machines, Water Bowser, Material Hoist, Passenger Hoist, Concrete Batching Plant, Mixers, Drilling Rigs, Concrete Placement Booms and Power Generators. Power generators will generate electricity for site office /camp and concrete batching plant.

Bearing capacity, settlement, static and dynamic loading conditions will be considered during design stage. Seismic conditions according to seismic zoning of Islamabad and project site area will be taken into account. Wind and all environmental conditions have been duly considered in the design. Color and finishing have been chosen with the aim of enhancing the visual aesthetics. After the completion of construction, the construction campsite will be restored to its original position.

3.11.10 Site Restoration

On completion of the construction phase, the campsite will be removed and construction equipment will be demobilized.

3.11.11 Staffing /Population

The construction of the proposed project will involve approximately workforce of 160 workers onsite. Preference will be given to local labor force for all unskilled jobs.

3.12 Waste Streams during the Construction Phase

The key source of emissions to air during construction activities will be exhaust gases from diesel engine generators, construction machinery and vehicle exhaust emissions. Fugitive dust emissions from construction activities and movement of vehicles will be the other main sources of air emissions.

Sewage from campsite will be routed to onsite septic tanks. Solid waste from construction activities would include mainly packaging, cardboard, food waste, removed vegetation, empty containers, cans etc. Recycling or reuse of waste material is the preferred option. However, where it is not possible, waste will be disposed of at nearest waste collection facility. The hazardous waste including oily rags, empty oil and chemical containers, oil contaminated soils etc. will be disposed through EPA certified waste contractor.

3.13 Waste Streams during operation

3.13.1 Wastewater management and reuse

Total wastewater production is estimated to be around 53,600 gallons per day. Of this wastewater, the grey water after collection from wash basin and showers will be collected and stored in a grey water tank for treatment at the dedicated wastewater treatment plant which would comprise filtration and aeration through pumping. The treated grey water will be stored in the treated water tank after chlorination. This treated grey water can then be used for irrigation and other non-potable uses. The Black Water part of the wastewater will be discharged into city sewers. For water conservation purposes, the project will also have the required setup for following water reuse options;

☐ Rainwater harvesting
☐ Air conditioning water reuse

3.13.2 Rainwater Harvesting

Storm water presents a great opportunity for water conservation. This water could be used to reduce the volume of water extracted from the borehole during times of rainfall, thus conserving the underground aquifer supply. Harvested rainwater may be used for non-potable uses. Alternatively, harvested rainwater could be used for irrigation of soft landscape areas only and to maintain a satisfactory level in the ponds.

Peak rainfall storm rate for Islamabad is (3 in/hr). Accordingly, Storm Water shall be collected in Rain Water Harvesting Tanks as a secondary storage at services floor & overflow pipes shall be connected to CDA Main Storm water line.. An independent storm water system is planned to collect and remove off site water from all buildings, and from all external and perimeter areas.

The system components shall include roof drains and gutters, ramp gratings and where necessary surface water catch basins and manholes.

3.13.3 Reuse of Air Conditioning (AC) water

Air conditioning water is another useful commodity that can be effectively reused after necessary treatment. The Condensate return from AC units will be connected to the waste pipe and will be collected in grey water tank which will be reused after treatment.

Inverted Wells

In order to improve groundwater recharging, the project in consultation with Pak EPA and CDA will identify low lying adjacent areas for construction of inverted wells.

3.13.4 Solid waste management

The solid waste during project operation will mainly be of domestic non-hazardous type including food waste, used papers, plastic, packing material, etc. Daily estimated quantity of waste generation is around 500kg including waste from apartments and restaurant /cafes. Onsite segregation of waste into hazardous and non-hazardous will be considered through provision of separate waste bins for different type of wastes. Waste disposal from the project will be made through approved waste contractor to ensure safe and appropriate waste disposal.

3.13.5 Air Emissions

There will be limited sources of air emissions during project operation including mainly:

☐ Exhaust emissions for vehicles entering the building premises.
☐ Emissions from standby power generators
☐ Exhaust air from heating, ventilation and air condition systems

Gaseous emissions of significance would be from the standby power generators and would include gases such as Carbon dioxide (CO_2), Carbon Monoxide (CO) oxides of Nitrogen (NO_x), fine particulate matter and oxides of Sulphur (SO_x).

The stack emissions would depend on the quality and quantity of fuel used by the standby generators & the power production system. Preliminary estimates suggest that the emissions would be localized into the microenvironment of the project and will not be significant.

The backup generators will be installed at ground floor at the backside of the building and in open air to ensure quick dispersion of gases. Initial planned stack height for generators is around 80 meters.

3.14 Fire Safety provisions/ arrangements for the project

The project’s fire safety arrangements can be categorized into three subheadings as below:

☐ Fire Protection systems
☐ Fire detection systems
☐ Life safety plan

3.14.1 Fire Protection Systems

Stand pipes, hose reels and automatic sprinklers / extinguisher are used in compliance with relevant NFPA standards for the total covered area of the building. (Building Code of Pakistan – Fire Safety Provisions 2016).

3.14.2 Fire Detection & Alarm Services

The fire alarm system will provide monitoring and standby power complying with UL, NFPA and local civil defense requirements. The system shall be configured as a Fire Alarm System with capability of being fully integrated with Voice Alarm and Public Address System.

The fire alarm system will facilitate accurate identification of the source of heat/smoke/fire in their early stages to minimize occurrence of false alarms. All Smoke detectors shall be smoke and heat combined units and heat detectors shall be rate-of-rise detectors.

UPS for the Fire Alarm System will be provided.

3.14.3 Life Safety Plan

All travel distances and location of exits are provided based on NFPA and Building Code of Pakistan - Fire Safety Provisions 2016.

3.14.4 Fire safety in Fuel Storage areas

The storage area for fuel will have secondary containment for oil spill control and will be equipped with fire and smoke detectors as well as stationary and portable fire extinguishers. The storage will be manually supervised to immediately attend to any fire hazard.

4. ENVIRONMENTAL & SOCIAL BASELINE

This section provides a detailed environmental and social baseline profile of the project area where the proposed project will be undertaken. The information presented in this section covers:

- Physical Environment
- Ecological Environment
- Socioeconomic Environment

Information for the above areas has been collected from both primary and secondary sources. Secondary data included maps prepared by the Geological survey of Pakistan, Soil survey of Pakistan, published literature; Census Reports etc. Primary data was collected through field surveys, onsite environmental monitoring and discussions with the locals. The baseline information of the project area is required for identification and assessment of potential social and environmental impacts associated with the implementation of the project. On the basis of baseline information, the project interventions would be addressed and mitigation measures proposed. The baseline information also helps to indicate the specific issues to be monitored during project execution as well as during operational phase.

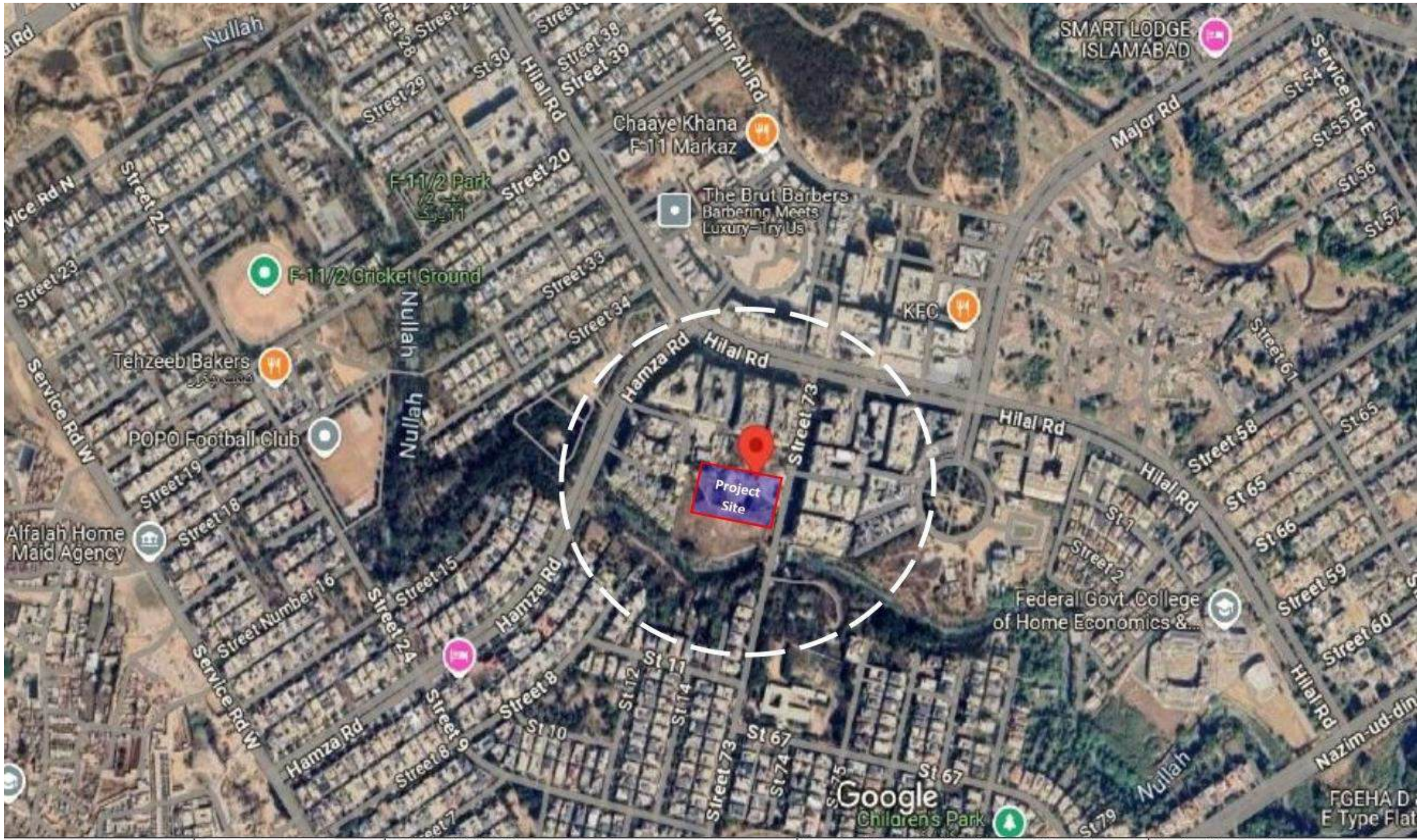
4.1 The Study area

The 15.82 Kanal project site and its vicinity within 1km radius is taken as microenvironment for the EIA while sector F-11/1 has been taken as the macro-environment. Figure 4.1 shown the project location, micro and macro-environment.

Sector F-11/1 is considered as one of the most modern enclaves of Islamabad and considered by many to be Islamabad's most desirable address. Some notable landmarks in the vicinity include the Abu Dhabi Towers, Tariq Heights, Al-Safa Heights, F-11 Markaz, and Al-Fateh Building.

	
F-11 Markaz	Tariq Heights
	
Al-Safa Heights	Jamia Masjid Ali-ul-Murtaza

Figure 4.1: Some notable landmarks in project area



N W E S	CEC	**Client:** ACS Builders	**Prepared by:** Capital Environmental Consultants Private Limited	Project Location Map
		Legend: Project location ▬	Environmental Impact Assessment of Courtyard Residences Apartment Complex	Ref: EIA/25/02

Figure 4.2: Project Location Map showing macro and microenvironment

4.2 Physical Environment

Detailed description of the physical resources is covered under the subjects of geology, soil condition, climate, surface and ground water resources, and seismology. The information is sourced from primary and secondary sources.

4.2.1 Geology and Soil condition

The dominant factor controlling the geology of the project area is the convergence of the Pakistan- India and Eurasian tectonic plates and the collision between the plates that began about 20 million years ago. This process produced complex structures and stratigraphy in the Islamabad-Rawalpindi area. The regional geology of the Islamabad-Rawalpindi area will be best understood by reference to the geologic map of Pakistan by GSP.

The sedimentary rocks of the Islamabad area record a long period of gentle geologic fluctuations and slow deposition while the Pakistan-India tectonic plate drifted northward across the Indian Ocean, followed by much more vigorous tectonic processes and rapid deposition in the shorter period since the Pakistan-India and Eurasian plates converged. Consequently, the 150-million-year (m.y.) period from the deposition of the Samana Suk Formation (Middle Jurassic) to the beginning of deposition of the Murree Formation (lower Miocene) is represented by only about 675 m of primarily marine sedimentary rocks, whereas the last 20 m.y. are represented by more than 7,572 m of continental sedimentary rock.

The area in and around Islamabad can be divided into three structural zones, trending generally east-northeast, that reflect compression and movement oriented S. 20° E.: In the north, the mountainous Margallah Hills consist of Jurassic through Eocene limestone and shale that are complexly folded and thrust along the Hazara fault zone. Uplift of these mountains probably formed a major topographic barrier during the last 1 m.y. south of the mountains, a southward-sloping piedmont bench, the piedmont fold belt, is underlain primarily by truncated folds in the sandstone and shale of the Rawalpindi Group. In the southernmost part of the area, the Soan River flows generally along the axis of the Soan syncline.

The areas are composed of either alluvium (clay or silt) or of gravel caps. The plains are formed of alluvial deposits laid by undulating and at various places it is badly dissected by gullies and ravines. The gravel and loess are especially important to the environmental geology because they form most of the building foundations and because gravel is the primary groundwater aquifer. Important minerals like limestone, marble, and fireclay are found in the area. Limestone is found abundantly in Margallah Hills and marble in the western section of Margallah range.

Clay soils in the area exhibit five strata, from bottom to top:

1. Coarse pebbles with sand or clay;
2. An alluvial stratum deposited by an older river system in the Soan Basin,
3. Alluvial deposits of the present river system
4. An airborne top layer of silt or clay (loess), and
5. Conglomerate and loose gravel deposits.

Soil sample analysis was carried out by the proponent through third party to determine the soil composition of project site. For this purpose, soil samples were taken from two locations and sample analysis was done in accordance with the methods of Food and Agriculture organization. Soil analysis results are shown in Table 4.1 and 4.2.

Table 4.1: Soil Nutrients Standards

Nutrients/parameter	Unit	Weak	Moderate	Good
Available Phosphorus(P)	Mg/kg	0-7	7.1-13	>13
Available Potassium (K)	Mg/kg	0-80	81-180	>180
PH	-	>8.01	7.50-8.00	7-7.50
Organic Matter	%age	<0.86	0.86-1.29	>1.29
Electrical Conductivity (EC)		>8	4.1-8	0-4

Table 4.2: Soil Quality in Project Area

Parameters	Test Results	
	Top soil	Sub soil
	1	2
Texture	Loam	Loam
Saturation (%)	32%	33%
pH	7.28	7.62
EC (dsm-1)	0.90	0.89
Organic Matter (%)	0.59%	0.53
Available P (mg/kg)	6.4	5.2
Available K (mg/kg)	80	100
Ca+2+Mg+2 (meq/L)	6.80	6.7
-2	0.80	0.70
-	6.1	6.0
Cl- (meq/L)	2.0	1.90
Na+	2.0	1.9

Source: Soil analysis of project site carried out by Soil and water-testing laboratory for research, Rawalpindi.

4.2.2 Geotechnical investigation of Project Site

In order to determine the geotechnical parameters of the subsurface deposits, M/s. Geotechnical Services were engaged by the proponent to perform the geotechnical investigation at the project site to determine geotechnical parameters of subsurface deposits. The investigation was conducted from October 13 to November 25, 2024.

A total of Six (06) boreholes up to the maximum depth of 106.0m below Existing Ground Level were drilled at the proposed locations. The straight rotary drilling method was used to drill in soil strata (overburden soils). The diameter of the boreholes was 96 mm. The details of boreholes drilled at the project site below the existing ground level are given below in the table. The recommendations regarding the type and bearing capacity of foundations have been provided in the geotechnical report which is attached as Annex-II of the report.

S. No.	Borehole No.	Depth (m)	Coordinates		Drilling Method
			Easting	Northing	
1	BH-01	28.0	33.681336	72.98763	Hydraulic Feed
2	BH-02	76.0	33.681232	72.987439	
3	BH-03	76.0	33.681513	72.987523	

4	BH-04	91.0	33.681353	72.987203	Straight Rotary Drilling Rig
5	BH-05	28.0	33.681664	72.987839	
6	BH-06	106.0	33.681706	73.987479	

4.2.2.1 Laboratory Testing

Following physical and chemical tests were performed on representative soil and water samples.

- Sieve Analysis (ASTM D-421)
- Natural Moisture Content (ASTM D-2216)
- Atterberg Limits (ASTM D-4318)
- Bulk & Dry Density (ASTM D-7263)
- Unconfined Compression Test (ASTM D-2166)
- Chemical Analysis of Soil and Water Samples (BS 1377 part 3)

The laboratory tests were performed as per the latest version of the relevant ASTM Standard as mentioned above. Summary of laboratory test results and detailed test result sheets are appended with the report as Annex – II

4.2.2.2 Subsurface Characteristics

A total of Forty-one (41) Sieve analyses were performed as per ASTM D-421 for soil classification. The classification test results indicate fine- and coarse-grained soils mostly comprised of Lean Clay with Sand / Lean Clay / Silty Clay / Sandy Silty Clay, Poorly Graded Gravel / Poorly Graded Gravel with Silt & Sand / Silty Gravel soil groups according to the Unified Soil Classification System (USCS). Test results indicated that soils consist of gravel content ranging from 0.0 % to 90.18%, sand content ranging from 2.14% to 63.69% and fine particles passing sieve no. 200 ranging from 1.39% to 97.49%.

4.2.2.3 Foundation Type

All the foundation design has been carried out considering the following design criteria:

- The allowable loads should not initiate the shear failure of the foundation soil/bedrock.
- The total as well as differential settlements of foundations caused by the application of allowable loads should be within specified tolerable limits i.e. maximum permissible settlement for mat foundation = 50.8 mm.
- The settlement of the individual and group of piles should be within the tolerable limits under the application of allowable loads.

4.2.2.4 Dewatering

Ground water table was encountered at a depth of 63.0-66.0ft below existing ground level. Excavations for foundation trenches, extending deeper than the groundwater level will encounter groundwater. Seepage of groundwater into excavations deeper than or around the groundwater level, may be excessive and some positive measures of effectively controlling groundwater level should be provided to enable construction of foundation in the dry. For the construction of foundation around ground water table, proper dewatering system may be required.

4.2.3 Topography

The terrain in the metropolitan area of Islamabad-Rawalpindi consists of plains and mountains whose total relief exceeds 1,175 m. The foot of Margallah range stands at an elevation of about 620 m and the top of the mountain is about 1,200 m. Four major tributaries, namely Saidpur Kas, Tenawali Kas, Bedarawali Kas, and Johd Kas, originate from Margalla Hills. The northern part of the metropolitan area lies in the mountainous terrain of the Margalla Hills, a part of the lower and outer Himalayas, which also includes the Hazara and Kala Chitta Ranges. The Margalla Hills, which reach 1,600-m altitude near Islamabad, consist of many ridges of Jurassic through Eocene lime stones and shales that are complexly thrusted, folded, and generally overturned. Margalla Hills Range acts as a wall forming the boundary of the Nullah Lai basin.

Due to extensive urbanization, most of the project area has been cleared and levelled for commercial and residential purposes and only the unused portions of land have retained their natural undulating topography. The project site also has relatively flat topography with plain landscape. There was no worthwhile vegetation onsite observed except for some shrubs and wild grass covering the site.

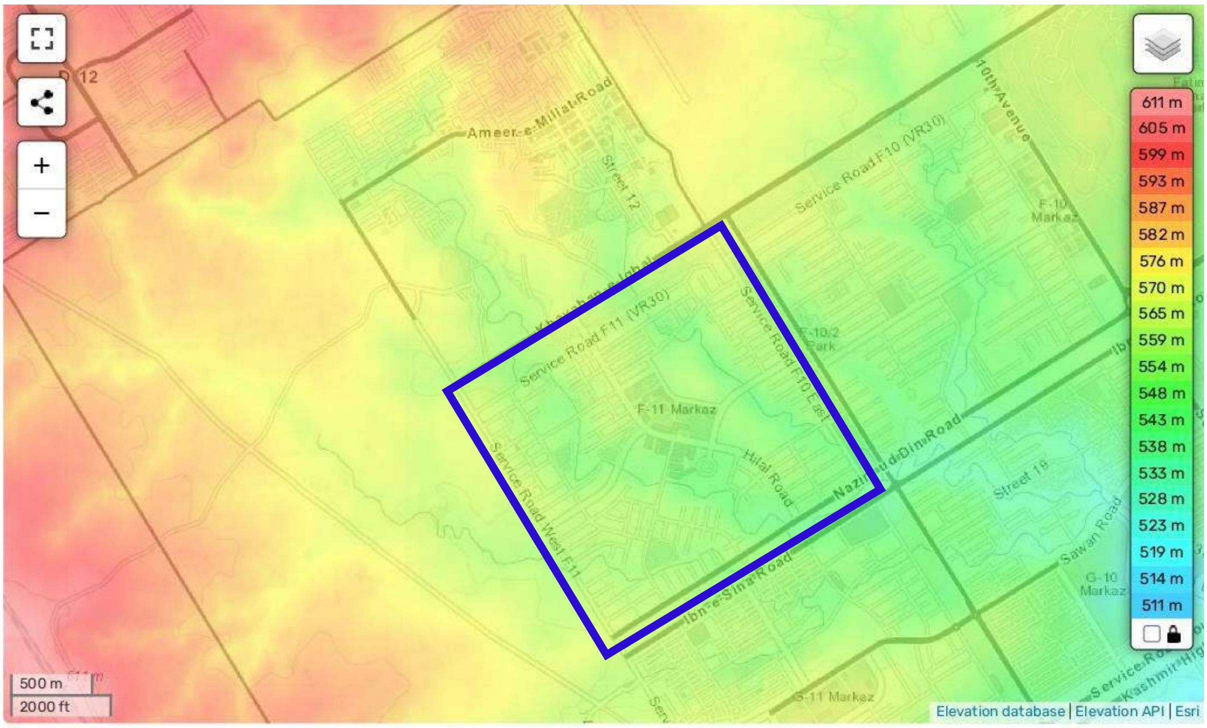


Figure 4.3: Overview of topography of macro-environment

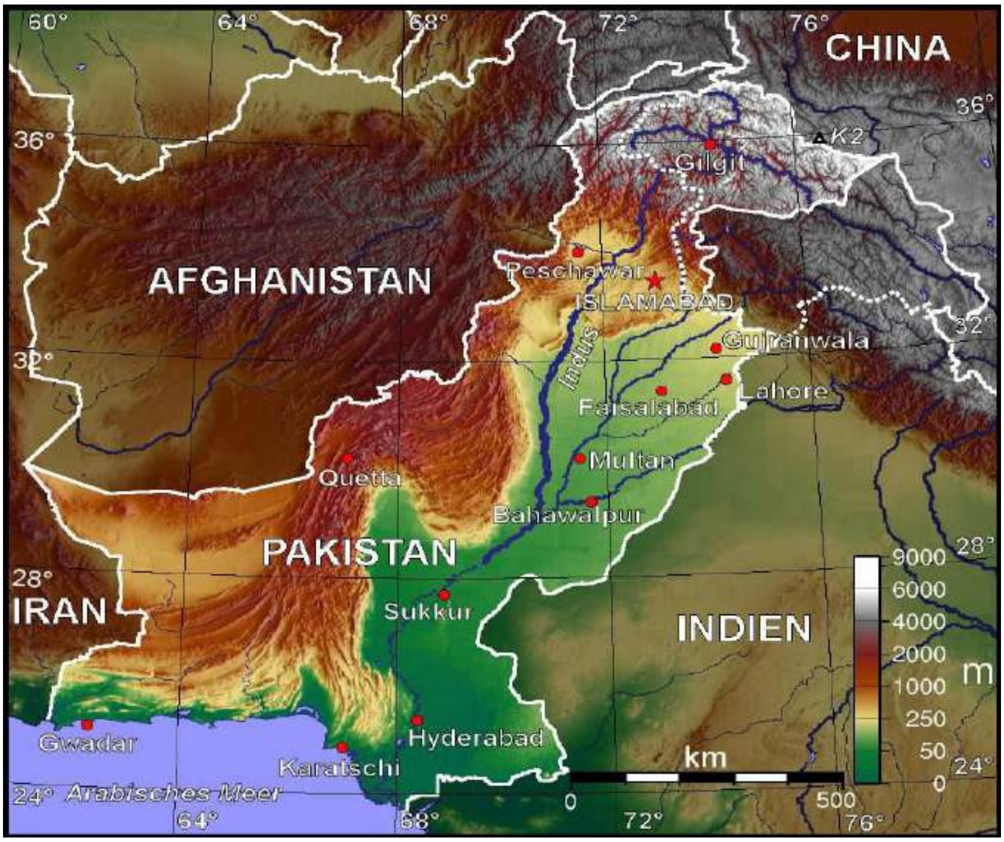


Figure 4.4: Topography of Islamabad

4.2.4 Existing Land Use

The project area is heavily urbanized and sees mixed land use including both commercial and residential. There are residential apartments as well as shopping centres, eateries, and business plazas /offices in the area. Remaining land use comprises infrastructure such as Roads.

4.2.5 Seismicity

Islamabad is on the south margin and leading edge of the Hazara fault zone. All the faults, except those south of Rawalpindi, are part of this fault zone. This zone consists of an arc of thrusted and folded rocks about 25 km wide and 150 km long that is convex to the south and extends west-southwestward away from the Himalayan syntaxis. More than 20 individual thrust sheets have been identified across the 25-km-wide zone north of Islamabad, but only 5 major thrusts lie within the area.

In the Islamabad area, some of the thrust faults are slightly oblique to the front of the Margala Hills; hence, they project west-southwestward beneath the cover of the piedmont fold belt. The extensions of these faults are prominent north of Fetehjang, 25 km west of Rawalpindi, where they form the south margin of the Kala Chitta Range, which is an en echelon extension of the structural pattern of the Margala Hills.

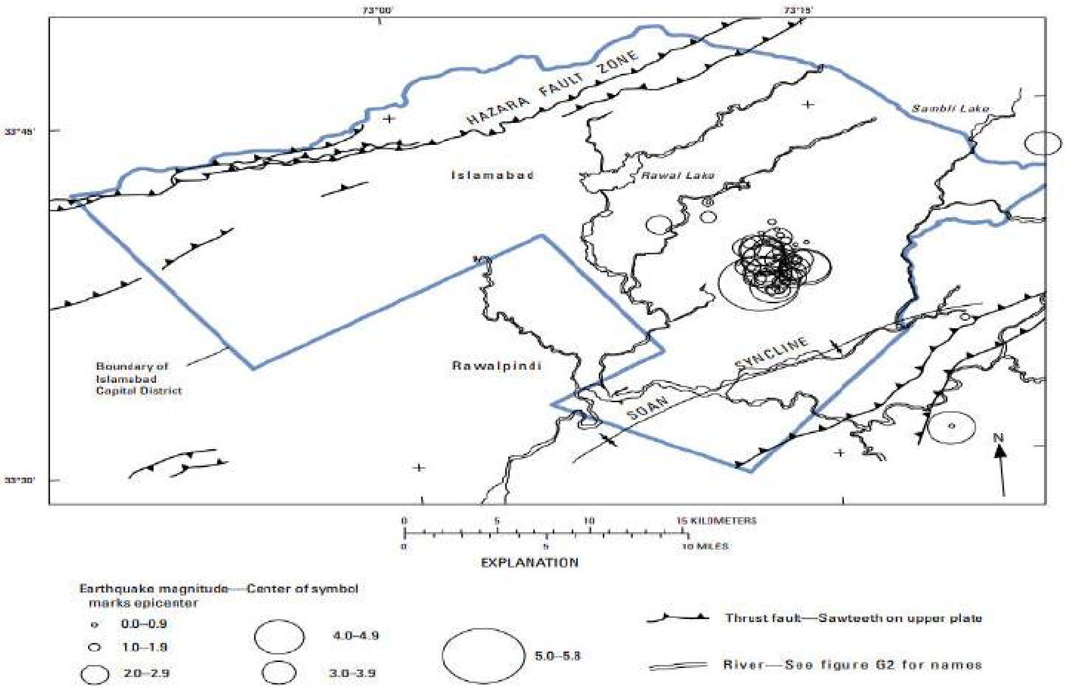


Figure 4.5: Potentially active faults in the Islamabad-Rawalpindi study area. Centers of circles are epicenters, and radii of circles are proportional to magnitude, (Source: Geological survey of Pakistan)

The thrust and fold structure of the Margala Hills immediately north of Islamabad is complex. The Margala Hills consist of at least five principal thrust sheets that repeat the pre-Miocene marine section. The structurally lowest sheet dips generally northward at about 30°, and the higher thrust sheets dip progressively more steeply, so that the northernmost and structurally highest are overturned and dip southward at about 85°. The thrusts have most commonly broken through the beds within or just beneath the Samana Suk Formation, although almost all pre-Miocene units are cut at some place in the study area. Higher in the section, thrusts are common at the base of the Margala Hill Limestone (probably within the shale of the Patala Formation) and within the overlying Chorgali Formation.

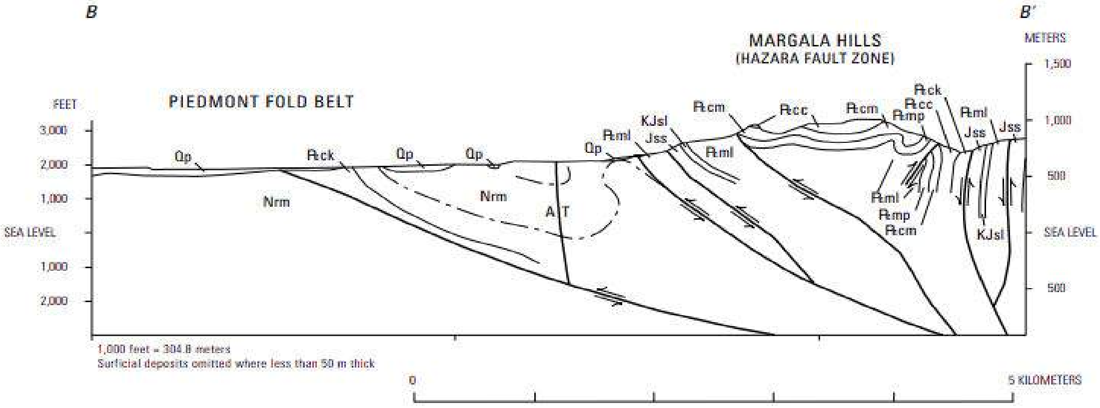


Figure 4.6: Geologic cross section in the Islamabad-Rawalpindi study area (modified from Williams and others, 1999).

Piedmont Fold Belt: The faults and folds in the piedmont fold belt south of the mountain front probably have high potential activity, although definitive exposures are sparse and discontinuous. The Pleistocene Lei Conglomerate, overlying the sandstone of the Murree Formation (lower Miocene), is folded in the broad anticline at Shakar Parian Park in Islamabad. The Lei Conglomerate also is tilted 80° southward along a thrust fault in the Kuldana Formation (lower Eocene) north of Golra, about 17 km northwest of Rawalpindi. The fault at Golra may be an eastward projection of the southward overthrusting of the mountain front along the south face of the Kala Chitta Range, a major range that begins about 25 km west of Rawalpindi and extends westward south of the Margala Hills. Major faults bounding the Khalri Murat Range, about 15 km south of the Kala Chitta Range, may also extend northeastward toward Rawalpindi, concealed beneath Quaternary eolian and alluvial deposits.

Seismic Hazard

The Islamabad-Rawalpindi area lies in a tectonically active zone, where faulting, folding, and earthquakes have been frequent in the recent geologic past. Quaternary deposits are tectonically deformed throughout the map area. In A.D. 25, the Buddhist monasteries at Taxila, 25 km west-northwest of Islamabad, were destroyed by an earthquake estimated at Modified Mercalli intensity IX (Adhami and others, 1980). More recently, a Richter magnitude 7.6 earthquake on 8th October, 2008, 65 miles north-northeast of Islamabad caused severe damage including collapse of Margalla Tower. Subsequently, the re-zoning of seismically active areas was carried out.

According to Building Codes for Pakistan, the project area falls in Zone 2B which corresponds to peak ground acceleration of 0.16 to 0.24g. Studies by National Engineering Services of Pakistan (NESPAK) indicated that a realistic seismic factor for building design should probably be higher than that indicated on the seismic zoning map of Pakistan (Adhami and others, 1980, p. 133). According to NESPAK, recommended design for 0.125-g (gravitational acceleration) horizontal acceleration for ordinary structures, and for 0.2 g without collapse for important structures (Adhami and others, 1980, p. 137). NESPAK (Adhami and others, 1980, p. 131) estimated that each year there is a 50 percent chance of a Richter magnitude 4 earthquake, an 8.33 percent chance of magnitude 5, a 1.67 percent chance of magnitude 6, a 0.26 percent chance of magnitude 7, and a 0.11 percent chance of magnitude 7.5 (recurrence intervals of 2, 12, 66, 380, and 912 years, respectively).

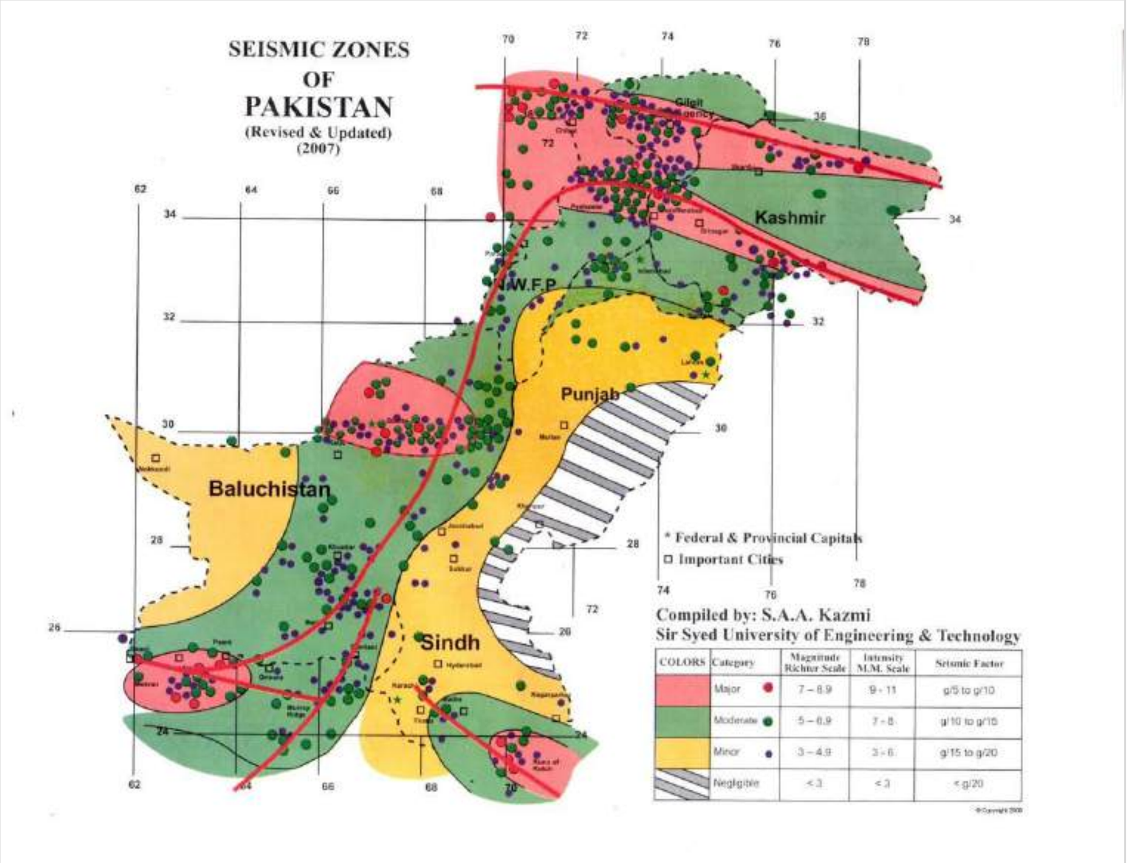


Figure 4.7: Seismic zoning map of Pakistan (Source: National Centre of Excellence in Geology)

4.2.6 Hydrology

Surface water

The project site is surrounded by multi-storey apartment buildings on the north, west, and east sides, while a water body passes near the southern boundary of the plot. The main surface water source in the Islamabad is the Nullah Lai originating from the Margallah hills in Islamabad passes through the city of Rawalpindi and flows into the River Soan. The Soan takes its rise from within a few kilometers of Murree Hill station; it flows down the deep valley and passes close to Rawalpindi city and finally joins the Indus 16 km below Makhad. The Nullah Lai has a number of tributaries carrying storm-water flows and the wastewater from the residential, commercial and industrial establishments. The summer rains begin in about second week of July and end about in the beginning of September. This Nullah is also used for disposal of solid waste, which not only contaminates water but also hinders its smooth flow.

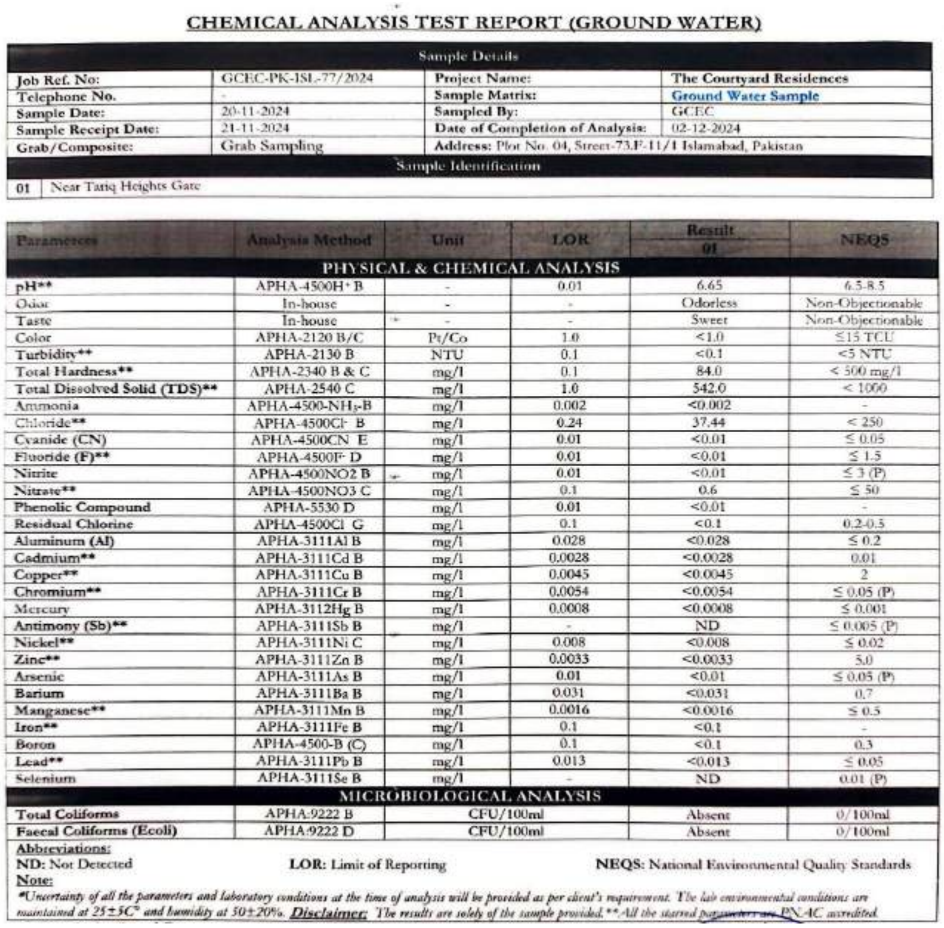
Groundwater

The observations regarding the depth of the groundwater table were taken immediately and 24 hours after the completion of boreholes and was monitored regularly throughout the period of field investigations. The observations indicated that Seepage/Perched water was encountered at a depth ranging from 9.80m to 11.50m in all boreholes. The aquifers of the area are spread over one or more layers, comprising sand, gravel, boulders and sandstone. These layers appear as lenses. The Tertiary Nimadric bedrock, consisting of clay stone, sandstone and conglomerate, make up the secondary aquifers of the Leh-Soan area to which ICT belongs. These aquifers provide a limited supply of water for open dug-wells and are not important for groundwater recharge. The alluvial sediment thickness is about 300 m in the middle of the Leh-Soan Basin. The consolidated sediments and rocks are of limestone (Eocene age), conglomerates and sandstone bedrock. Groundwater movement in these layers is through secondary porosity, which has developed through fractures and joints. Loess is widely spread at the surface along the western and southern part the Leh-Soan Basin including the ICT area. Loess is known to store large amounts of water and it releases it slowly, even in the dry period, as springs.

Depth of groundwater table in the project area ranges is around 60 feet. The aquifer layers lying under the thick and impermeable layers of limestone store a huge amount of groundwater. These important areas of recharge are however, being rapidly lost as a result of their being sealed by the forces of urbanization and emergence of residential colonies and building of streets, houses and industries.

For establishing baseline conditions, groundwater samples were collected and analyzed for microbiological and chemical parameters through EPA certified Environmental Laboratory. The results are shown in Table 4.3 and compared with the NEQS limits as prescribed by the EPA. The results show that each parameter is well within the NEQS limits as per prescribed by the EPA.

Table 4.3: Results of groundwater quality analysis



CHEMICAL ANALYSIS TEST REPORT (GROUND WATER)

Sample Details

Job Ref. No:	GCEC-PK-ISL-77/2024	**Project Name:**	**The Courtyard Residences**
Telephone No.	-	**Sample Matrix:**	**Ground Water Sample**
Sample Date:	20-11-2024	**Sampled By:**	GCEC
Sample Receipt Date:	21-11-2024	**Date of Completion of Analysis:**	02-12-2024
Grab/Composite:	Grab Sampling	**Address:** Plot No. 04, Street-73.F-11/1 Islamabad, Pakistan	

Sample Identification

01	Near Tariq Heights Gate

Parameters	Analysis Method	Unit	LOR	Result 01	NEQS
PHYSICAL & CHEMICAL ANALYSIS					
pH**	APHA-4500H$^+$ B	-	0.01	6.65	6.5-8.5
Odor	In-house	-	-	Odorless	Non-Objectionable
Taste	In-house	-	-	Sweet	Non-Objectionable
Color	APHA-2120 B/C	Pt/Co	1.0	<1.0	≤15 TCU
Turbidity**	APHA-2130 B	NTU	0.1	<0.1	<5 NTU
Total Hardness**	APHA-2340 B & C	mg/l	0.1	84.0	< 500 mg/l
Total Dissolved Solid (TDS)**	APHA-2540 C	mg/l	1.0	542.0	< 1000
Ammonia	APHA-4500-NH$_3$-B	mg/l	0.002	<0.002	-
Chloride**	APHA-4500Cl$^-$ B	mg/l	0.24	37.44	< 250
Cyanide (CN)	APHA-4500CN E	mg/l	0.01	<0.01	≤ 0.05
Fluoride (F)**	APHA-4500F$^-$ D	mg/l	0.01	<0.01	≤ 1.5
Nitrite	APHA-4500NO2 B	mg/l	0.01	<0.01	≤ 3 (P)
Nitrate**	APHA-4500NO3 C	mg/l	0.1	0.6	≤ 50
Phenolic Compound	APHA-5530 D	mg/l	0.01	<0.01	-
Residual Chlorine	APHA-4500Cl G	mg/l	0.1	<0.1	0.2-0.5
Aluminum (Al)	APHA-3111Al B	mg/l	0.028	<0.028	≤ 0.2
Cadmium**	APHA-3111Cd B	mg/l	0.0028	<0.0028	0.01
Copper**	APHA-3111Cu B	mg/l	0.0045	<0.0045	2
Chromium**	APHA-3111Cr B	mg/l	0.0054	<0.0054	≤ 0.05 (P)
Mercury	APHA-3112Hg B	mg/l	0.0008	<0.0008	≤ 0.001
Antimony (Sb)**	APHA-3111Sb B	mg/l	-	ND	≤ 0.005 (P)
Nickel**	APHA-3111Ni C	mg/l	0.008	<0.008	≤ 0.02
Zinc**	APHA-3111Zn B	mg/l	0.0033	<0.0033	5.0
Arsenic	APHA-3111As B	mg/l	0.01	<0.01	≤ 0.05 (P)
Barium	APHA-3111Ba B	mg/l	0.031	<0.031	0.7
Manganese**	APHA-3111Mn B	mg/l	0.0016	<0.0016	≤ 0.5
Iron**	APHA-3111Fe B	mg/l	0.1	<0.1	-
Boron	APHA-4500-B (C)	mg/l	0.1	<0.1	0.3
Lead**	APHA-3111Pb B	mg/l	0.013	<0.013	≤ 0.05
Selenium	APHA-3111Se B	mg/l	-	ND	0.01 (P)
MICROBIOLOGICAL ANALYSIS					
Total Coliforms	APHA:9222 B	CFU/100ml		Absent	0/100ml
Faecal Coliforms (Ecoli)	APHA:9222 D	CFU/100ml		Absent	0/100ml

Abbreviations:

ND: Not Detected **LOR:** Limit of Reporting **NEQS:** National Environmental Quality Standards

Note:

Uncertainty of all the parameters and laboratory conditions at the time of analysis will be provided as per client's requirement. The lab environmental conditions are maintained at 25±5C° and humidity at 50±20%.* ***Disclaimer:* *The results are solely of the sample provided. **All the starred parameters are PNAC accredited.*

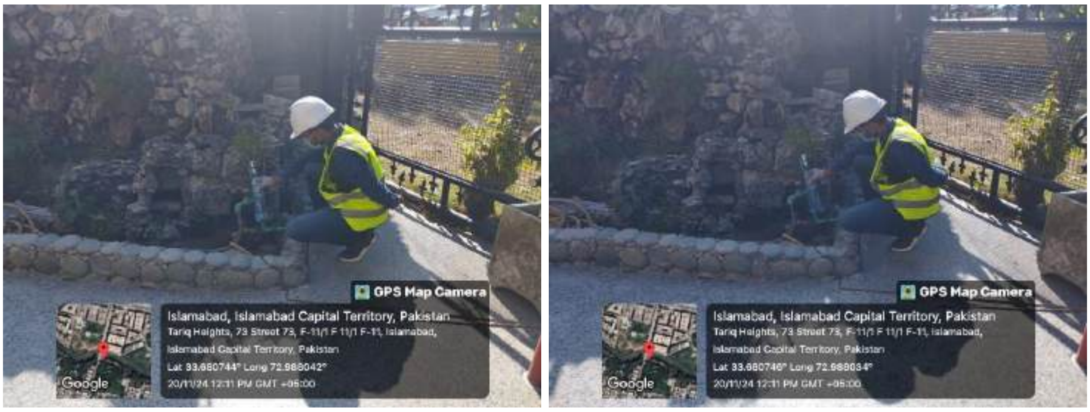


Figure 4.8: Water sampling near proposed Courtyard Residence Apartment Complex site
(Left: Sample from Tap and right: Sample from Tap)

4.2.7 Climate

Pakistan Meteorological Department (PMD) has meteorological station in Islamabad and the climate data recorded at this station represent the climatic conditions of the project area adequately.

The climate of the Project Area is semi-arid characterized by four district seasons in a year, that is, winter from Mid-November to February, spring during March and April summer from May to Mid-September and autumn from Mid-September to Mid- November.

Temperature

Islamabad has distinct seasons marked by wide variation in Temperature, hot summer and cold winters. The coldest month is January when the mean maximum temperature is 17.7°C and the mean minimum temperature is 2.6°C. June is the hottest month with mean maximum temperature around 40°C and mean minimum temperature 24°C.

Table 4.4: Mean Monthly Maximum Temperature ºC

Year	**Average Temperature**
Jan	17.7
Feb	24.7
Mar	25.0
Apr	32.6
May	39.1
Jun	37.8
Jul	34.5
Aug	33.0
Sep	33.5
Oct	31.3
Nov	24.1
Dec	18.1

Source: Pakistan Meteorological Department

Table 4.5: Mean Monthly Minimum Temperature ºC

Year	**Average Temperature**
Jan	**3.8**
Feb	9.9
Mar	11.4
Apr	16.2
May	23.7
Jun	23.8
Jul	24.9
Aug	24.2
Sep	21.0
Oct	16.6
Nov	10.7
Dec	5.5

Source: Pakistan Meteorological Department

Precipitation

The project area has two distinct rainfall seasons, the summer season from July to September and winter season from December to April. The bulk of monsoon precipitation occurs in July and August, with monthly average of 267 and 309 mm respectively. One day maximum annual rainfall per year is given in the Table 4.6.

Table 4.6: Mean Monthly Precipitation (mm)

Year	**Average Temperature**
Jan	70
Feb	27
Mar	61
Apr	19
May	76
Jun	126
Jul	504
Aug	418
Sep	52
Oct	92
Nov	20
Dec	133

Source: Pakistan Meteorological Department

Wind Speed and Wind Direction

In Islamabad, throughout the year, the winds blow predominantly from north to southeast, but in summer there are short spells of wind from north or south-east. Morning breeze is mostly from the west and the wind throughout the year is from southwest. Table 4.2 summarizes month-wise temperature, precipitation, and relative humidity while Figure 4.3 and Figure 4.4show the graphical presentation of humidity and precipitation in the study area.

The wind direction of Islamabad is mostly southeasterly and follows the 115° to 135° direction during summer. The normal wind direction during the 1961-1990 periods was westerly but southerly or southeasterly during June, July and August. The low wind velocity of 1 to 3 knots and the mostly westerly direction in Islamabad suggests that the emissions from the point sources including vehicular traffic and industries would be adequately diluted and dispersed in the atmospheric air. Thus the impact of emissions from industries or vehicular traffic would not be significant on the ambient air quality of locations near or at far off distances of the Project Area.

Table 4.7: Wind Velocity & Direction at Islamabad

Month	Direction in Degrees	Velocity in Knots	Steadiness %
January	283	1.4 to 1.7	49
February	290	2.3 to 2.7	59
March	306	2.7	48
April	304	2.4 to 2.5	36
May	321	2.7 to 3.1	18
June	159	2.5 to 3.0	32
July	150	2.2 to 2.4	67
August	148	1.4 to 1.7	40
September	191	1.1 to 1.3	20
October	303	0.8 to 1.1	22
November	292	0.6 to 1.0	49
December	296	0.7 to 1.3	56
30 Years Average	266	1.8 to 2.0	41

Relative Humidity

The mean relative humidity in summer is 60 - 80% while the mean relative humidity during winter is 70 - 90%. The average rain fall in the Islamabad city is 1,150 mm (approx.) last five years. Table-4.8 shows the average monthly relative humidity for Islamabad.

Table 4.8: Relative humidity in Islamabad

Month	Relative Humidity
January	28%
February	36%
March	34%
April	32%
May	23%
June	37%
July	54%
August	45%
September	37%
October	22%
November	25%
December	27%

Source: worldweatheronline.com

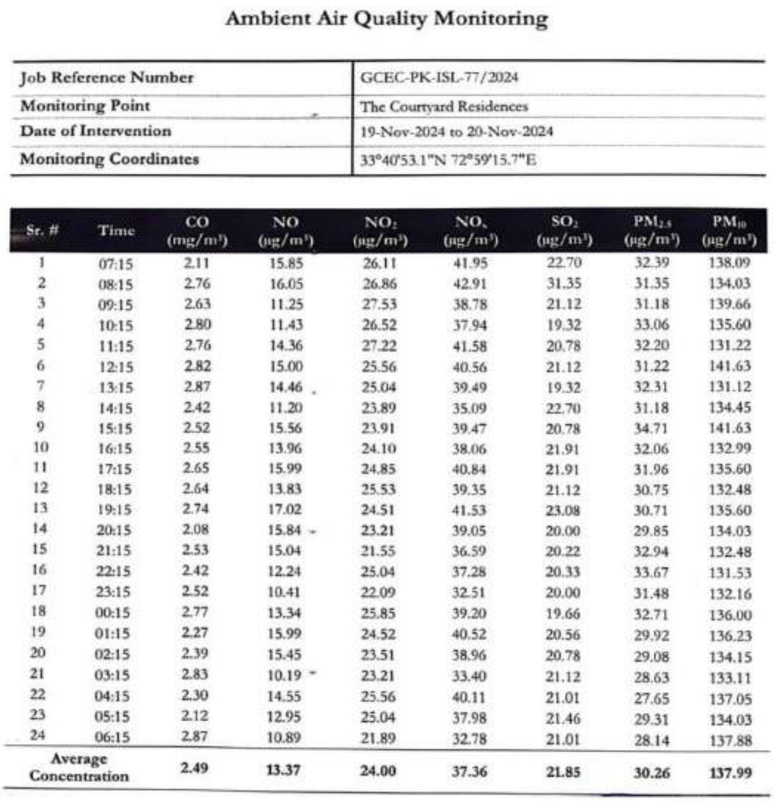
4.2.8 Ambient Air Quality and Noise

The prime objective of the baseline air quality study was to establish the existing ambient air quality of the project area. Ambient Air Monitoring was conducted by Green Crescent Laboratory in project area through Pak EPA certified laboratory in November 20th 2024 at the project site. The ambient air quality was monitored for the priority pollutants such as carbon monoxide (CO), Sulphur dioxide (SO_2), ozone (O_3), nitrogen oxide (NO), nitrogen dioxide (NO_2), suspended particular matter and particulate matter (PM_{10} and $PM_{2.5}$).

Figure 4.9: Ambient Air Quality monitoring at site

The ambient air quality monitoring results are summarized in the table below:

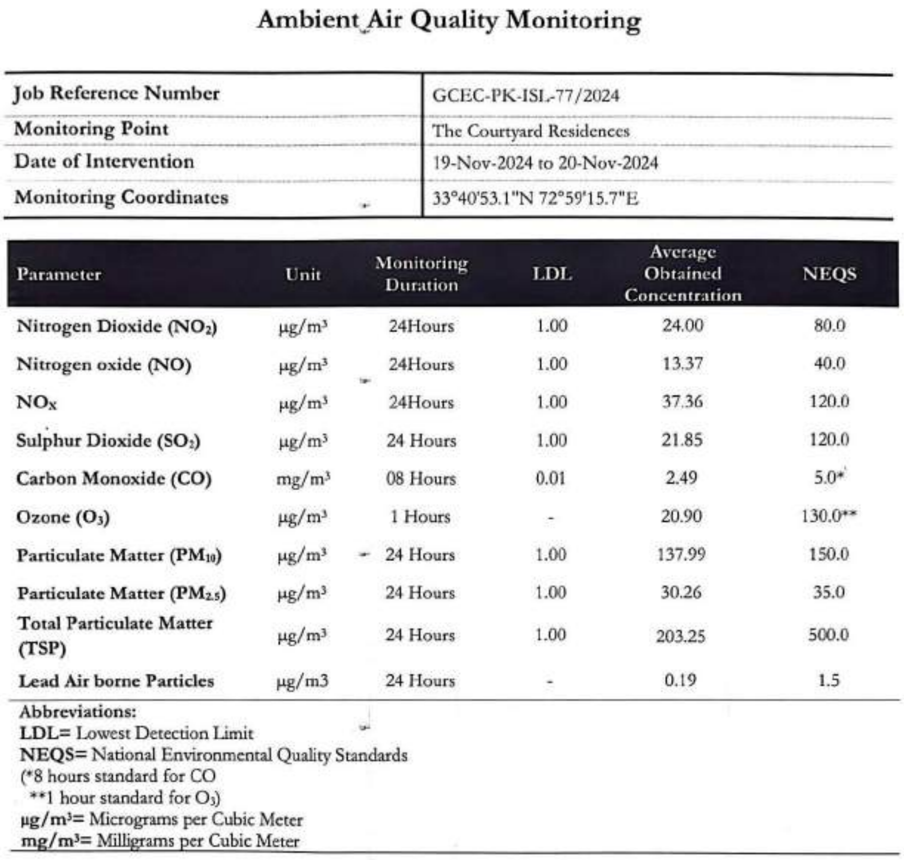
Table 4.9: Ambient Air Monitoring conducted at project site



Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-ISL-77/2024
Monitoring Point	The Courtyard Residences
Date of Intervention	19-Nov-2024 to 20-Nov-2024
Monitoring Coordinates	33°40'53.1"N 72°59'15.7"E

Sr. #	Time	CO (mg/m³)	NO (µg/m³)	NO_2 (µg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)
1	07:15	2.11	15.85	26.11	41.95	22.70	32.39	138.09
2	08:15	2.76	16.05	26.86	42.91	31.35	31.35	134.03
3	09:15	2.63	11.25	27.53	38.78	21.12	31.18	139.66
4	10:15	2.80	11.43	26.52	37.94	19.32	33.06	135.60
5	11:15	2.76	14.36	27.22	41.58	20.78	32.20	131.22
6	12:15	2.82	15.00	25.56	40.56	21.12	31.22	141.63
7	13:15	2.87	14.46	25.04	39.49	19.32	32.31	131.12
8	14:15	2.42	11.20	23.89	35.09	22.70	31.18	134.45
9	15:15	2.52	15.56	23.91	39.47	20.78	34.71	141.63
10	16:15	2.55	13.96	24.10	38.06	21.91	32.06	132.99
11	17:15	2.65	15.99	24.85	40.84	21.91	31.96	135.60
12	18:15	2.64	13.83	25.53	39.35	21.12	30.75	132.48
13	19:15	2.74	17.02	24.51	41.53	23.08	30.71	135.60
14	20:15	2.08	15.84	23.21	39.05	20.00	29.85	134.03
15	21:15	2.53	15.04	21.55	36.59	20.22	32.94	132.48
16	22:15	2.42	12.24	25.04	37.28	20.33	33.67	131.53
17	23:15	2.52	10.41	22.09	32.51	20.00	31.48	132.16
18	00:15	2.77	13.34	25.85	39.20	19.66	32.71	136.00
19	01:15	2.27	15.99	24.52	40.52	20.56	29.92	136.23
20	02:15	2.39	15.45	23.51	38.96	20.78	29.08	134.15
21	03:15	2.83	10.19	23.21	33.40	21.12	28.63	133.11
22	04:15	2.30	14.55	25.56	40.11	21.01	27.65	137.05
23	05:15	2.12	12.95	25.04	37.98	21.46	29.31	134.03
24	06:15	2.87	10.89	21.89	32.78	21.01	28.14	137.88
Average Concentration		**2.49**	**13.37**	**24.00**	**37.36**	**21.85**	**30.26**	**137.99**



Ambient Air Quality Monitoring

Job Reference Number	GCEC-PK-ISL-77/2024
Monitoring Point	The Courtyard Residences
Date of Intervention	19-Nov-2024 to 20-Nov-2024
Monitoring Coordinates	33°40'53.1"N 72°59'15.7"E

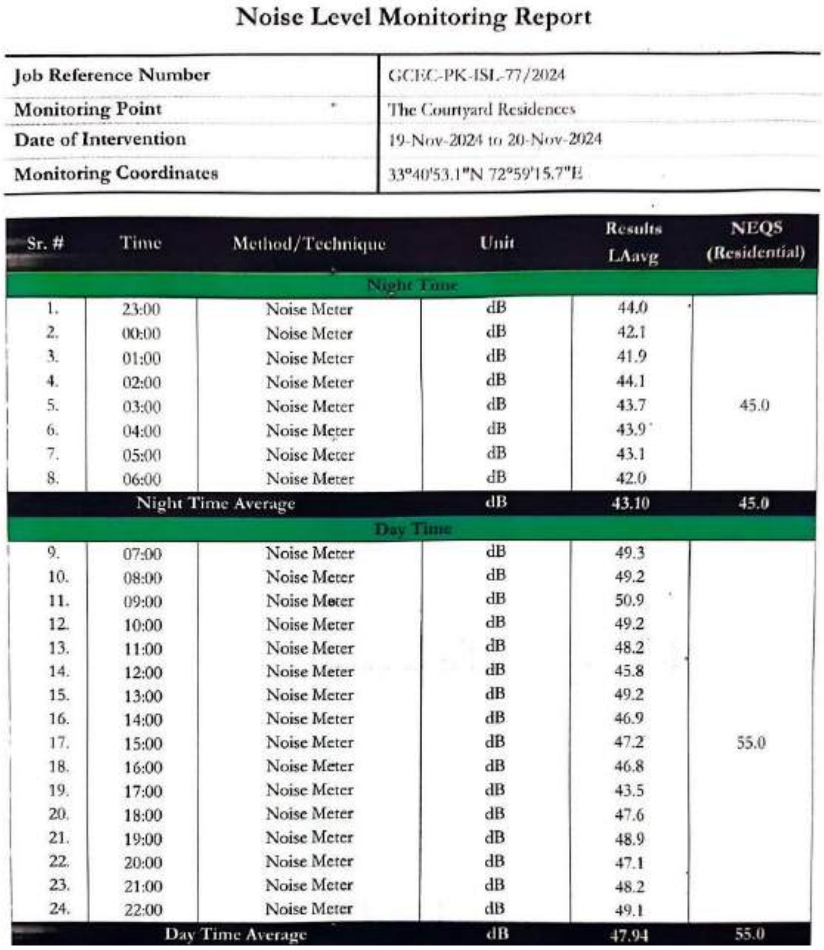
Parameter	Unit	Monitoring Duration	LDL	Average Obtained Concentration	NEQS
Nitrogen Dioxide (NO_2)	µg/m³	24Hours	1.00	24.00	80.0
Nitrogen oxide (NO)	µg/m³	24Hours	1.00	13.37	40.0
NO_X	µg/m³	24Hours	1.00	37.36	120.0
Sulphur Dioxide (SO_2)	µg/m³	24 Hours	1.00	21.85	120.0
Carbon Monoxide (CO)	mg/m³	08 Hours	0.01	2.49	5.0*
Ozone (O_3)	µg/m³	1 Hours	-	20.90	130.0**
Particulate Matter (PM_{10})	µg/m³	24 Hours	1.00	137.99	150.0
Particulate Matter ($PM_{2.5}$)	µg/m³	24 Hours	1.00	30.26	35.0
Total Particulate Matter (TSP)	µg/m³	24 Hours	1.00	203.25	500.0
Lead Air borne Particles	µg/m3	24 Hours	-	0.19	1.5

Abbreviations:
LDL= Lowest Detection Limit
NEQS= National Environmental Quality Standards
(*8 hours standard for CO
**1 hour standard for O_3)
µg/m³= Micrograms per Cubic Meter
mg/m³= Milligrams per Cubic Meter

The above results show that the parameters are within NEQS limits. The ambient air quality can be mainly affected by vehicular traffic and traffic congestion. There is moderate traffic near the project site at Plot No.04, Street No. 73, Sector F-11/1, Islamabad.

The prevailing noise levels have also been monitored at the project for 24 hours to determine noise levels during peak and off hours. The results indicate that noise levels at the Project Site are within NEQS limits for day and night time. Table 4.10 shows the results of ambient noise at the subproject area.

Table 4.10: Average Noise Level dB (A) at project site



Noise Level Monitoring Report

Job Reference Number	GCEC-PK-ISL-77/2024
Monitoring Point	The Courtyard Residences
Date of Intervention	19-Nov-2024 to 20-Nov-2024
Monitoring Coordinates	33°40'53.1"N 72°59'15.7"E

Sr. #	Time	Method/Technique	Unit	Results LAavg	NEQS (Residential)
Night Time					
1.	23:00	Noise Meter	dB	44.0	45.0
2.	00:00	Noise Meter	dB	42.1	
3.	01:00	Noise Meter	dB	41.9	
4.	02:00	Noise Meter	dB	44.1	
5.	03:00	Noise Meter	dB	43.7	
6.	04:00	Noise Meter	dB	43.9	
7.	05:00	Noise Meter	dB	43.1	
8.	06:00	Noise Meter	dB	42.0	
Night Time Average			**dB**	**43.10**	**45.0**
Day Time					
9.	07:00	Noise Meter	dB	49.3	55.0
10.	08:00	Noise Meter	dB	49.2	
11.	09:00	Noise Meter	dB	50.9	
12.	10:00	Noise Meter	dB	49.2	
13.	11:00	Noise Meter	dB	48.2	
14.	12:00	Noise Meter	dB	45.8	
15.	13:00	Noise Meter	dB	49.2	
16.	14:00	Noise Meter	dB	46.9	
17.	15:00	Noise Meter	dB	47.2	
18.	16:00	Noise Meter	dB	46.8	
19.	17:00	Noise Meter	dB	43.5	
20.	18:00	Noise Meter	dB	47.6	
21.	19:00	Noise Meter	dB	48.9	
22.	20:00	Noise Meter	dB	47.1	
23.	21:00	Noise Meter	dB	48.2	
24.	22:00	Noise Meter	dB	49.1	
Day Time Average			**dB**	**47.94**	**55.0**

Figure 4.10: Noise monitoring at project site (left) Hilal road F-11/1 Markaz (right)

Table 4.11: Average Noise Level dB(A) around project site

Location Coordinates: 33°41'31.8"N and 73°00'55.1"E
Date of Monitoring: 20-06-2018 to 20-06-2018

S.#	Monitoring location	Noise Level dB(A)	NEQS Limits
1	Project site	62 dB(A)	55dB(A)
2	At Markaz road	69-73 dB(A)	

The noise level at the project site on the average is 68.0 dB(A), shows that the average noise measurements of the survey are within the limits of NEQS which is 85dB(A) from 7.5 m from the source as per vehicular noise standards. While considering the ambient noise for the commercial area, it is higher than the NEQS limits of 65dB(A) due to the traffic problems and heavy mass of traffic flow.

4.2.9 Water Supply system

The municipal water supply is the main source of water supply in the project area. The residential areas as well as commercial buildings generally receive water supply from CDA. To compensate for water shortage, water demand is also met through installation bore water and to some areas via private tanker service at fixed rates.

4.2.10 Wastewater Drainage System

The wastewater disposal system in project area comprises a network of sewers that collects and discharges the sewerage into main municipal sewerage lines.

4.2.11 Solid Waste Management

Solid waste management in Islamabad is done through Municipal Corporation which collects waste from different areas of Islamabad through designated transportation system. However, due to mismanagement, not all of the generated waste get collected and only part of the solid waste is transported to an unorganized dumping site at Golra Mor.

4.3 Biological Environment

In this section, the baseline environmental conditions pertaining to biological environment have been described on the basis of primary and the secondary data. A reconnaissance of the project area was carried out followed by desktop study regarding the ecology of project area.

The proposed site is located in an already developed area of Islamabad. As climate of Islamabad is humid sub-tropical climate, the vegetation of the area falls under scrub, dry, tropical thorn forest type as per phyto-geographical classification of the area.

4.3.1 Flora

Islamabad is a representative of dry Subtropical Scrub Forest which is dominated by Acacia modesta (Phulai), Ziziphus mauritiana (Ber); Ziziphus nummularia (Mullah), etc. Other associates existing in varying proportions include Prosopis cineraria (Jand), Melia azadirachta (Dharek); Morus alba (Mulberry-Shahtoot); Dalbergia sissoo (Tahli-Shisham); Acacia nilotica

(Kikar). In the undergrowth Cannabis sativa (Bhang), Calotropis procera (Desi Ak), Parthenium hysterophorous (Gandi Booti) and Ocimum bacilicum (Niazbo), are predominant.

As the area is part of Pothohar Plateau, the vegetation is characteristic of the tract. Kau (Olea cuspidate) is the climax species. It grows almost in pure form on northern slopes and in cool and sheltered situations on the southern slopes. Elsewhere Phulahi (Acacia modesta) dominates. Sanatha (Deodonia viscosa), Granda (Carissa spinatum) and Pataki (Gymnosporea royaleana) grow as secondary species.With the shifting of Capital to Islamabad and urbanization of the tract, the majority of original vegetation of the tract was removed and replaced by commercial and residential hubs. The project site, due to part of a highly urbanized environment, does not have any vegetation of significance. The areas is mainly covered with wild grass, shrubs and nascent wild trees. Strenuous efforts have been made during the past to make the Islamabad green by planting trees all along the roads and in open spaces. These efforts were successful in increasing the vegetational cover of Islamabad and especially the surrounding hills. However during the past, a fast growing evergreen tree species Paper Mulberry (Broussanatia papyrifera) was also introduced in the city, which now occupies most of the vacant land and green belts, along the Kashmir Highway and its surrounding area has not only altered the edaphic characteristics but has also caused dust allergies and asthma among Islamabad residents. This species is most common along the streams and nullahs of Islamabad, including the study area. Another undesirable tree species planted along the roads and in open places was Eucalyptus (Eucalyptus camaldulensis). At present this plant is being discouraged on account of its higher water suction capabilities and for causing setback to soil fertility. At present no tree exists in the project site.

Among shrubs, Parthenium heterophorous is an exotic species and has spread in Islamabad's open places at an alarming rate. At present, it has formed thick pockets along roads, in open fields and along streams; it is perennial weed and also causes severe allergy and breathing problems.

Parthenium heterophorous

Dalbergia sissu (tree)

Phoenix, Bauhinia variegata & Dalbergia sissu *Ficus carica*

Azadirachta indica *Bauhinia variegata*

Figure 4.11: Vegetation features of the project area.

4.3.2 Fauna

Due to the extensive urbanization of the area and development of concrete structures, wild animals of the area have migrated to the surrounding Margallah hills and other areas of the city where there is no human intervention and enough green cover to serve them as habitat. Wildlife reported in the area includes wild boar, jackals, fox, rats, hare and porcupines which are present in the extensive and densely wooded areas and in the Margallah Hills. Wild boars sometimes come on the roads during the night. They also get killed sometimes by fast moving traffic on these roads.

Margallah hills are the abode of several species of wildlife including monkeys, exotic birds and carnivorous such as rare and presently endangered Margallah Leopards. Commonly found animals in Margallah hills include Rhesus monkeys, Jackals, Wild boars, porcupine and mongoose.

Wild boars generally stay, close to hills, occasionally particularly in winter, when the hills are cold, they can be seen quite far from Margallah hills. Often the boars will have small hideouts in the green belts in and around the city.

Due to proximity to Margallah Hills, Rawal Lake and overall green cover of the city, there is significant variety of bird species in the area. Commonly reported birds in the area include Hoopoe, common Mynah, sparrow and crow, White Checked Bulbul, Parrot, Little Grebe, Great Cormorant, Night Heron, Little Egret, Eurasian Wigeon, Common teal, Common Pochard, Black Shoulder Kite, Sparrow Hawk, Grey Patridge, Black Partridge, Common Sand Piper, Pigeon etc. The project site does not have any significant fauna except for few common birds including sparrow, common crow, common Mynah, pigeon etc.

4.4 Socio-Economic Baseline

Socioeconomic baseline has been developed for the project through a review of secondary data as well as primary data collected using questionnaires and discussion with the locals in project area. Secondary data used included census reports and previous research work /studies done in Islamabad by government as well as research institutes.

Figure 4.11: Social survey conducted in project area. Both residents and shop owners were included in the survey

4.4.1 Site Location and accessibility

The project will be located on Street No.73 Plot No. 04, prime location of Sector F-11/1, Islamabad. The site is readily approachable by all the primary roads of Islamabad i.e. Margalla Hills just 10 km away, visit the iconic Faisal Mosque within 9 km, and reach Islamabad Airport in just 20 mins. With F-10/2 Park only 2 km and McDonald's 4.2 km from your doorstep, everything you need is in your easy access.

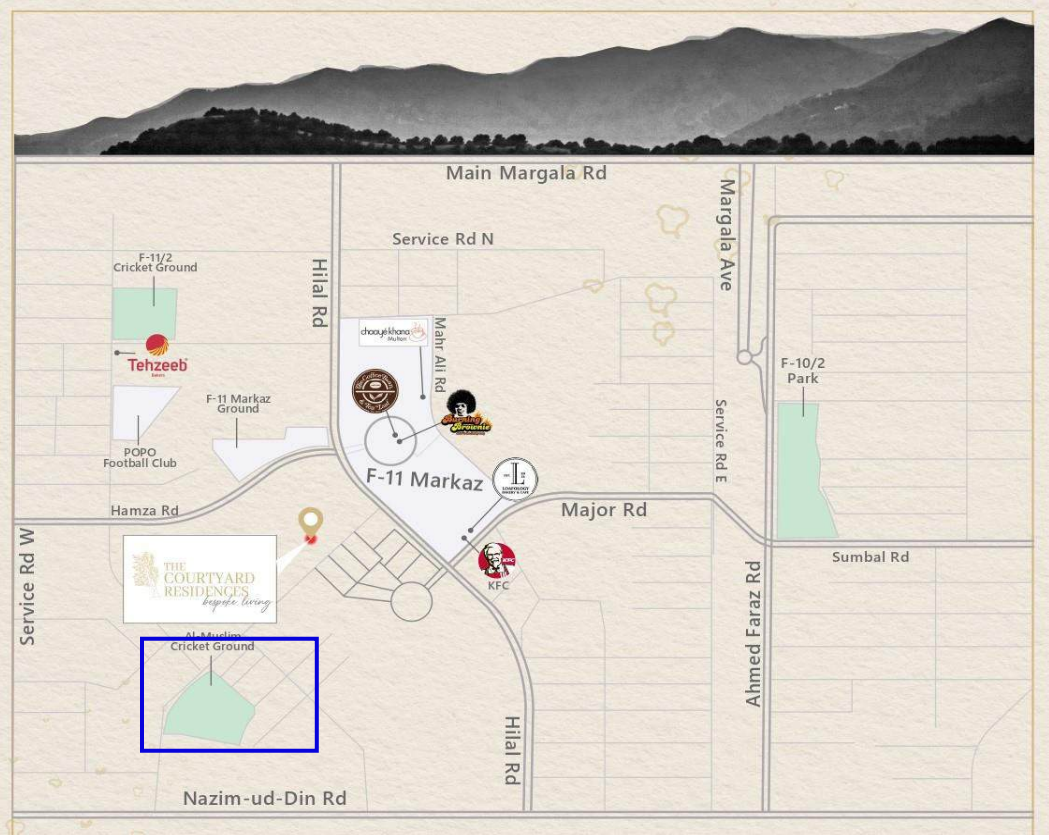


Figure 4.12: Site accessibility

4.4.2 Cultural Values and Ethnicity

Islamabad symbolizes and exhibits the true culture of Pakistan. People live in Islamabad, move to this city from the different areas and belong to different wake of life. At present, this is city of aristocratic class people and hosting the headquarters of government, private companies and different embassies. All famous Pakistani educational institutes are also located within the city and serving the educational facilities to local communities. Around 99% population is Muslim belonging to either Sunni or Shiya sect. Other minority groups include Christians and Hindus etc.

4.4.3 Population

Islamabad has an estimated population of 2,006,572 persons million as per recent census results. Annual growth rate of the city has been significant at 4.9%. The city is estimated to have around 336,182 households. Most of the houses are well constructed. The average household size is 6 persons as per the census results.

4.4.4 Occupation

The project area comprises mainly Federal Government offices, and offices of national and international firms. Most of the population in Islamabad is either employed in Federal Government offices or in private organizations. Remaining portion of population is self-employed and businesses of different magnitude. Over the years, Islamabad has become a very important financial and business city with lots of local and foreign banks and ever expending private business. In the last decade there has been vast change in the city’s traditional reputation.

4.4.5 Tourist attractions

The city is an attraction for the tourists from all across the country particularly the southern part due to its scenic landscapes. It has become livelier with lots of international food chains opening businesses and shopping mall open till late. It also serve as a base camp for people from the south and coastal areas like Karachi, visiting valleys like Swat and Kaghan and northern areas like Gilgit, Skardu and Chitral located in the Hindu Kush Mountains.

4.4.6 Social Infrastructure

A. Education

The literacy ratio in Islamabad Capital Territory has increased from 47.8 per cent in 1981, to 77.3 per cent in 1998. The literacy ratio for males is 83.2 per cent against 69.7 per cent for females. The ratio is much higher in urban areas when compared with rural areas both for male and female.

B. Health

There are six hospitals with 1,660 beds available to meet the growing health needs of the growing population of Islamabad Capital Territory. The hospitals are namely, Federal Government Service hospital with 337 beds, Capital Hospital with 261 beds, Pakistan Institute of Medical Sciences (PIMS) with 745 beds, Children Hospital with 230 beds, National Institute of Health with 50 beds and Shifa International Hospital (Private) with 37 beds.

C. Agriculture

The land in rural areas of Islamabad is rain-fed and the agricultural production is high. Crops include wheat, maize, millet, and oats. Several vegetables are also cultivated in the area. Orchards are not common.

D. Drinking water Supply

The F-11/1 Sector is facilitated by Society water Supply System. Moreover there are bore wells at the houses for household and drinking purposes. Water depth ranges from 60-633 ft.

E. Lifestyle

Almost all population of the project area has access to higher education, medical facilities, electricity, water, communication, infrastructure, transport etc.

4.4.7 Religious and Archaeological Sites

There are no religious or cultural site around the project site to be affected by the project. One mosque by the name of Jamia Masjid Ali-ul-Murtaza is located at the Main Hilal Road.

5. PUBLIC CONSULTATION & PARTICIPATION

This chapter provides the details of the consultation process involving the stakeholders as part of the Environmental Impact Assessment (EIA) process requiring information disclosure and sharing. For this purpose, consultation meetings were held with relevant government departments at the outset for scoping the EIA study, followed by consultations at grass-root level.

Public Participation in the inception stages of every development project is a mandatory requirement of the Environmental Impact Assessment exercise under the Pakistan Environmental Assessment Procedures, Pakistan Environmental Assessment Protection Act 1997 and the rules & regulations framed thereunder.

Public consultation and participation process provides an opportunity for those directly and indirectly affected by the project to express their concerns before the feasibility of the project is ascertained. It is meant to ensure that the EIA process is open, transparent and robust, characterized by defensible analysis to attain sustainability in the design, implementation, operation & management of development proposals.

The key objectives of public involvement are to:

☐ Share information with the stakeholders about the proposed project

☐ Inform the stakeholders of the project features and relevant details and the environmental issues likely to emerge while the Project is in the pre-construction, construction and operation stages.

☐ Interact with the stakeholders to share information on significant physical, biological and socioeconomic environment that must be taken into consideration during the different stages of the Project, and measures to be adopted to minimize the severity of impact;

☐ Acquire the feedback of the stakeholders regarding the project including any concerns /suggestions that may need to be addressed/incorporated in the project plans.

5.1 Consultation Framework

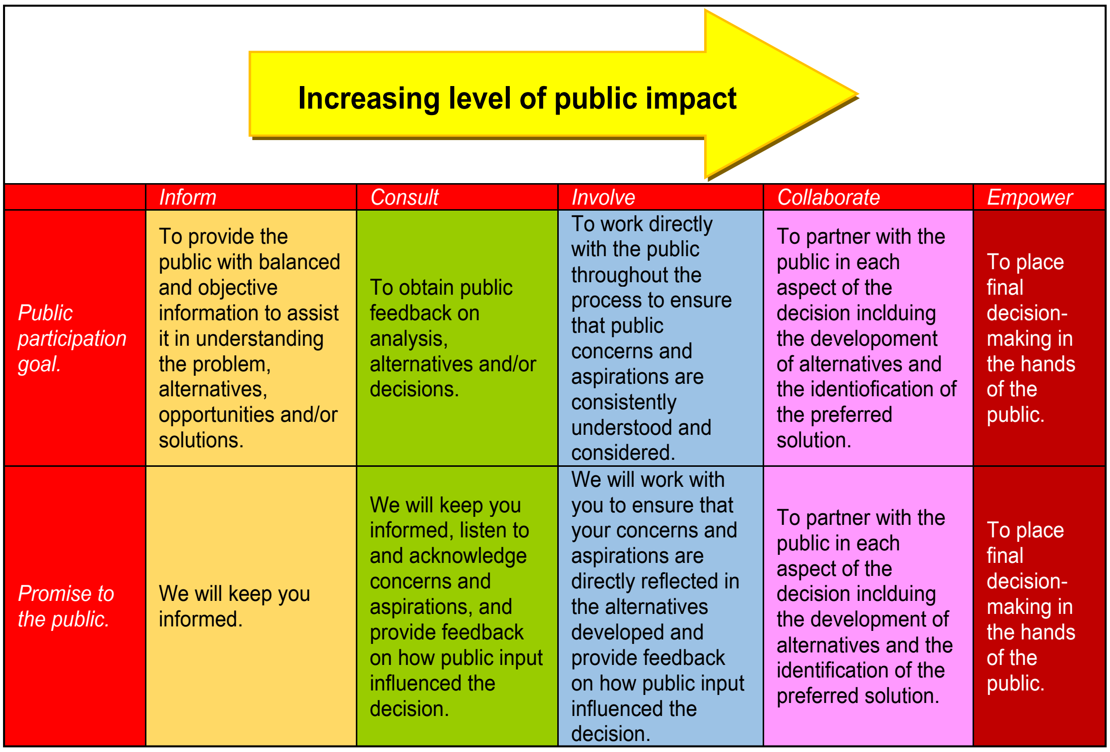
The consultation being a continuous process needs to be maintained throughout the project (Social Analysis Sourcebook: Incorporating Social Dimensions into Bank-Supported Projects: The World Bank. December 2003). The consultation framework adopted for the Project is elaborated in the Table 5.1:

Table 5.1: Consultation Framework

Project Phase	Proposed Tool	Stakeholders Consulted/to be Consulted	Responsibility
Pre-Construction	Formal and informal meetings with stakeholders	Institutional stakeholders; Grass root stakeholders, including communities in neighborhood likely to be involved during the Project Implementation Stage	Proponent
Construction	i. Formal and informal contact and liaison with the community and other	i. Institutional stakeholders ii. Grass root stakeholders, including communities in	IMC, Proponent

Table 5.1: Consultation Framework

Project Phase	Proposed Tool	Stakeholders Consulted/to be Consulted	Responsibility
	relevant stakeholders (e.g. EPA)	neighborhood involved during Project Implementation Stage	
	ii. Grievance Redress iii. Consultations with communities during environmental compliance & Impacts monitoring iv. during external monitoring/ site visits by EPA	Communities in neighborhood involved during Project Implementation Stage	IMC, Proponent
Operation	Liaison with communities in neighborhood	Communities in neighborhood Involved during the Project Operation Stage	IMC, Proponent



Increasing level of public impact

	Inform	*Consult*	*Involve*	*Collaborate*	*Empower*
Public participation goal.	To provide the public with balanced and objective information to assist it in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision inclduing the developoment of alternatives and the identiofication of the preferred solution.	To place final decision-making in the hands of the public.
Promise to the public.	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	To partner with the public in each aspect of the decision inclduing the development of alternatives and the identification of the preferred solution.	To place final decision-making in the hands of the public.

Figure 5.2: Public Participation Approach

5.2 Identification of Stakeholders

The range of stakeholders involved in an EIA typically includes the following groups:

1. Local people: Individuals or groups in the affected community get informed on what is proposed; what the likely impacts are; and how their concerns will be understood and taken cognizance thereof. The local population is assured that its views are being keenly listened

and given consideration on their merits. They would be kept informed of the local environment and changes that may occur when the construction and operation of project commences.

2. Proponent: The main aim of involving the project proponent is to ensure they are part of the consultation process and that any concerns/feedbacks are directly shared with the proponents. This helps creating transparency and also increases public understanding and acceptance of the project through provision of basic information directly from the proponent.

3. Government agencies: Involvement of government agencies /departments during the EIA process serves two purposes, (1) it ensures that their policy and regulatory requirements are addressed in the EIA (inception stages of the project) for impact analysis and mitigation measures, and (2) it enables their involvement to avoid the probability of the project becoming controversial in the later stages of the process.

4. Other interested groups: Other interested groups include those who are experts in particular fields and can make a significant contribution to the EIA study. The advice and knowledge of government agencies and the industry sector most directly concerned with the proposal are often sought. In many cases, substantive information about the environmental setting and effects do come from some such intellectuals.

Scoping meetings were conducted with Institutional stakeholders and grassroots stakeholders, including communities near site while conducting the EIA. Following stakeholders have been engaged during consultation for the project:

- Environmental Protection Agency
- Municipal Corporation Islamabad (Sanitation wing)
- Ministry of Planning Islamabad (Environment wing)
- Local Residents and shop keepers near the project site

5.3 Consultation Approach & Methodology

Consultation is generally conducted in two stages during an EIA. First, at the EIA preparation stage, the background information about the project design is shared with the relevant stakeholders to get feedback on aspects related to design, construction and completion and during the subsequent stages of operation of the project. The comments solicited from stakeholders are helpful in the screening of the potential environmental and social aspects of the project. In the second stage, consultation is done during the EIA review by EPA, to identify the concerns in the area that may face direct impacts from the proposed development. The social survey team interact with the local residents and business operators of the area to obtain their view regarding the project.

5.4 Consultation Process

The stakeholders were briefed during scoping meetings about the objectives of the project and the brief overview of the project activities including project area, location, construction activities, project duration, arrangements made by the proponent for utilities etc. Concerns and suggestions of the participants were noted and have been incorporated into the EIA document.

5.5 Outcome of Consultation

Table below provides summary of the entire consultation process initiated for the project.

Stakeholder	**Summary of discussion and key issues raised**
Pakistan EPA Director (EIA)	Director (EIA) suggested that the EIA study should encompass the following key issues: ▪ Site specific data should be available. ▪ Lab reports of environmental monitoring be provided in the report. ▪ Noise survey of the site should be conducted. ▪ Impacts on immediate receptors should be assessed. ▪ The impact due to project related traffic should be assessed and addressed in the report. ▪ Social surveys should be carried out involving the immediate residents. ▪ Water source for the project should be identified. It is recommended that study may be conducted to assess the draw down effect. ▪ Sewerage collection system should be adequate to cater to the project's requirements. ▪ The project should incorporate water conservation practices. ▪ Generators should be operated with provision of canopies and in well ventilated areas. ▪ Waste segregation at source should be done to enable waste reduction at source.
Municipal Corporation Islamabad (Sanitation wing) Mr. Salah-ud-dIn, Deputy Director-Sanitation	▪ Waste collection system should be adequate. Hazardous waste should be collected through approved contractor (if any).
Ministry Of Planning (Environment Wing) Islamabad Mr. Yasir Gul Khan, Deputy Director-Environmental Directorate Islamabad	▪ Daily consumption estimate of water should be given in the report. ▪ The building should have controlled heating system ▪ Post construction activities should include tree plantation plan also. The Sukh Chayn plant which is evergreen may be planted at the site. ▪ The project should have one point sewerage system. ▪ Sewerage from the project should be treated and reused where possible.
Local residents in the project site's vicinity	▪ The local residents had positive response to the project and none of the residents consulted objected to the project's construction. ▪ The shop owners hoped that the project will attract more business (for the local shop keepers) and will generate

	economic activity in the area as new residents will depend upon the local markets and shops. ▪ The local respondents also emphasized on the earthquake safety of the building. ▪ Noise and dust issues were also pointed out by residents who commented that the management should ensure measures to prevent any impact on the nearby areas during construction particularly from dust and noise. ▪ Car parking issues should be thoroughly addressed in the project design to avoid road side parking. ▪ For transport of Construction vehicles should transport materials during non-peak hours.

Figure 5.3: Consultation with local residents and shop owners

Figure 5.4: Consultation with MoP (Environment Wing and MCI officials (Environment and Sanitation wing)

6. ANALYSIS OF PROJECT ALTERNATIVES AND SCREENING POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS OF THE PROJECT, AND APPROPRIATE MITIGATION MEASURES

This chapter examines alternatives analysis with respect to site and technology for the proposed project activities and evaluation of the screening process and identifies the existence, if any, of significant environmental impacts during different phases of the proposed project and provides necessary mitigation measures that may have to be adopted in order to reduce or otherwise compensate for the negative impacts.

Impact assessment was conducted in detail covering each single project activity while simultaneously focusing on the nature and extent of activities proposed during the different stages of the project. Nature and strength of the impacts described below depends on the duration and frequency of constructional activities and operations which will be carried out during the course of the project.

The assessment of impacts and risk assessment was followed by identification and suggestion of suitable and workable mitigation and control measures to reduce the severity of the impact. The mitigation measures proposed here will be adopted by the Proponent to reduce, minimize and compensate for the negative impact as far as possible. The phases of the project covered in the impact assessment include:

- Design phase (siting aspects)
- Construction
- Operation

6.0 Analysis of Alternatives

Consideration of alternatives to a project proposal is a requirement of the EIA process. During the scoping process, alternatives to a proposal can be considered or refined, either directly or by reference to the key issues identified. A comparison of alternatives helps to determine the best method of achieving the project objectives with minimum environmental impacts or indicate the most environment friendly and cost-effective options. The consideration of alternatives is most useful when the EIA is undertaken early in the projects cycle. The type and range of alternatives open for consideration include:

- Site alternatives (e.g. advantage of proposed site, details of any other sites, if explored, etc.)
- Input or supply alternatives (e.g. use of raw materials, sourcing, etc.)
- Technology alternatives (e.g. feasibility of different technologies available and advantage of proposed technology, etc.)

After analysis of the various factors the most environmentally compatible alternative is selected.

This section provides an analysis of alternatives in relation to the conception and planning phase of the project. This includes the following:

No Project Scenario

The no project scenario has been analyzed to understand what would be reasonably expected to occur in the near future if the proposed project is not conducted in the area. In such a scenario, there would not be any pressure on agricultural land for urbanization, i.e. as the concept of vertical construction is viable then horizontal construction, and no adverse effect on local ecology or incremental pollution to baseline environmental components (air, water and noise levels). At the same time, there would not be any positive impact on socioeconomic status of the area resulting from direct/ indirect employment and economic benefits that such a project can provide. With no project scenario, dependence of the country on horizontal urbanization will grow.

Alternative Location of the project site

The planned project is to build residential service apartments that will give a lifestyle distinguished by high quality and intelligent design, with every detail contributing to an inspiring and delightful home. The project site is perfect for its location owing to the residential service apartments, and important landmarks nearby include the Abu Dhabi Towers, Tariq Heights, Al-Safa Heights, F-11 Markaz, and Al-Fateh Building. As a result, the project ranks as the zero alternative in terms of location.

6.1 Impact Assessment Methodology

The methodology adopted for carrying out the impact assessment of the proposed Project included a combination of tools to encompass each project component while also ensuring that the assessment has been carried out in an effective way covering all areas. The environmental aspects of the project were identified in relation to the present land use, damage to vegetation, air pollution due to fugitive dust emission, hydrology of the area and other issues during construction at site.

The entire assessment process was designed in a way so as to provide a complete assessment of the impacts on the ambient environment. The methodology included identification of risks and hazards associated with the project activities by:

- Review of Applicable Guidelines and use of Checklist matrix;
- Analysis of information obtained from site surveys and stakeholder consultation;
- Professional Judgment to assess the intensity and significance of potential impacts and obtaining expert opinion during environmental and social impact analysis;
- Defining mitigation measures to reduce impacts to as low as practicable;
- Predicting any residual impacts, including all long-term and short-term, direct and indirect, and beneficial and adverse impacts;

National Environmental Quality Standards (NEQS) were referred for determining the permissible levels of environmental parameters during project operation and classification of the site with respect to its pollution status. Guidelines were also reviewed in order to determine compliance conditions for the proponent in terms of ecology (fauna, flora, habitats and natural ecosystems), historical and archaeological sites. Impacts assessment strategy at different stages of the project are summarized as per Fig. 6.1 below:

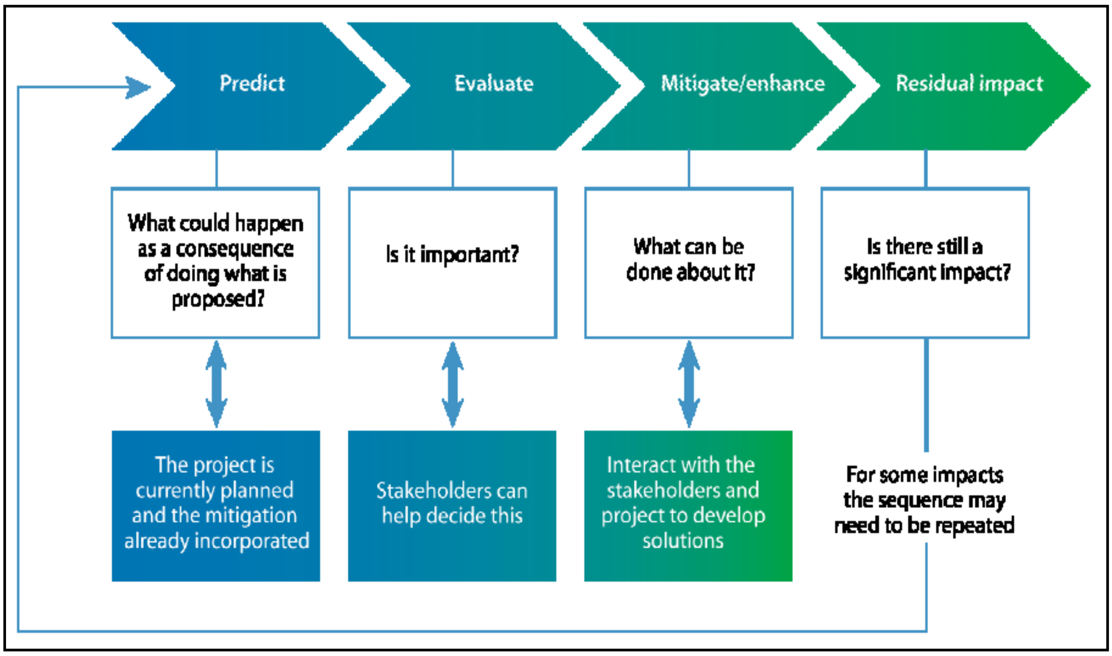


Figure 6.3: Impact Assessment Strategy

6.1.1 Review of General Guidelines and use of Checklist matrix

Guidelines for classification of site with respect to its air-shed, watershed, soil, ecology including fauna, flora, archaeological sites etc. have been reviewed. The following Checklist provides the screening of potential environmental impacts on different components of ecosystem of the proposed project.

Table 6.1: Checklist provides the screening of potential environmental impact

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting **Is the project area**			
Densely populated?	X		The immediate environs of the project are densely populated. Land uses includes both residential and commercial activities.
Heavy with development activities?	X		The microenvironment of the site is planned for a residential scheme. There are also other residential projects already in operation in the vicinity.
Adjacent to or within any environmentally sensitive areas?			
Cultural heritage site		X	No heritage site is found close to project site.
Protected area		X	No protected area is found within or immediate environs the project site.
Estuarine		X	Not Applicable
Buffer zone of protected area		X	Not Applicable
Special area for protecting biodiversity		X	Not Applicable. Margalla hills are far from the project site.
B. Potential environmental impacts			

Will the project cause…			
Impacts on the sustainability of associated sanitation and solid waste disposal systems and their interactions with other urban services.		X	The project will have dedicated sewerage collection and treatment system and provisions for treated water reuse are also part of the project plan.
Deterioration of environmental conditions of surrounding of project site during construction.	X		Environmental conditions may deteriorate during the construction stage if due mitigation measures are not implemented.
Degradation of land and ecosystems (e.g. loss of forests)?		X	Not envisaged. Temporary disturbance may last till the completion of construction work.
Dislocation or involuntary resettlement of people.		X	Not expected.
Degradation of cultural property, and loss of cultural heritage and tourism revenues?		X	Not envisaged. No such sites are found within the proximity of the site.
Water resource problems (e.g. depletion / degradation of available water supply, deterioration for surface and ground water quality, and pollution of receiving waters)?	X		Water conservation practices will be implemented during construction and operation phases including rainwater harvesting and water treatment for reuse.
Air pollution due to dust and gaseous emissions?	X		The existing air quality is within NEQS as observed during site monitoring. changes to air quality may occur as a result of construction work and management of construction activities as per EMMP will be required.
Social conflicts between construction workers from other areas and local workers?		X	Not expected. Local workers will be hired for the job.
Road blocking and temporary flooding due to land excavation during rainy season?	X		It will be mitigated if such situation emerges through good construction practices and traffic management onsite.
Noise from construction activities?	X		Nearest sensitive receptors include residents and shopkeepers in the vicinity. Noise from construction work may become nuisance for them.
Traffic disturbances due to construction material transport and wastes?		X	Construction material transportation to the site will be managed through the use of access roads and adoption of good management practices.
Temporary silt runoff from site due to construction?	X		Wastewater and storm water from construction site may lead to soil erosion. It will be mitigated if such situation emerges through better management practices and installation of silt traps.

Water depletion and/or quality degradation?		X	The project has incorporated in its design wastewater treatment during project operation to prevent discharge without treatment.
Contamination of surface and ground water due to improper waste disposal?		X	Solid and Liquid waste disposal system will be in place to prevent possible contamination of water resources. Contamination of groundwater is unlikely.

6.2 Screening of Impacts at different stages of project development

Following environmental and social impacts will need to be addressed during the siting, construction and operation of the project:

- Land use
- Building stability and liquefaction
- Earthquake safety
- Aesthetics
- Soil erosion
- Ambient air quality
- Traffic flow and noise
- Solid waste
- Wastewater
- ecological impacts
- Social conflicts
- resource consumption mainly water
- other impacts during construction
- other impacts during operation

6.3 Siting Considerations-Impacts at design stage

- The Project will be undertaken in a residential area and does not impact the ongoing land uses of the project area. Land has been acquired for the project and the approval from CDA for the building plan obtained.
- Availability of infrastructure facilities for the project and its location in F-11/1 sector suits the project requirements with respect to utilities, road accessibility, and connection with other areas of Islamabad.
- The local population seeks and prefers residence in the core areas near their offices which creates more demand for residential facilities. Building of high risers in the form of residential and commercial buildings responds just to sustain the equilibrium between the demand and supply.
- The project area (F-11/1) already has a number of residential and commercial centers. Siting of the project would not act as an intrusion to the existing landscape and skyline.
- Temporary disturbance due to construction may impact the nearby receptors mainly the residents in the vicinity. This will be need to be controlled through careful management of construction activities.

- The project has provision for parking of up to 594 cars excluding parking requirement for guest which is separately provided in guest parking. Peak traffic hours for the project are expected to be from 9-10 am and 6-7pm.
- The project site does not fall in any sensitive areas (national park, wildlife sanctuaries, game reserves, archaeological, historical or cultural heritage sites); as such its siting would have no sensitivity in this regard.
- Average daily water requirement is estimated to be 107,000 US gallons/persons/day which will sourced from local water supply network of CDA. The project has kept provisions for water treatment and reuse.
- The air quality of the project area, according to the results of ambient air quality monitoring conducted at the site, is fairly unpolluted and within the limits of NEQS. There will be temporary disturbance during construction work which will need to be trolled particularly with respect to dust emissions.
- Tree plantation will be carried out upon completion of construction work using native plant species.

6.3.1 Structural Stability

Most earthquake deaths are related to building collapse or damage (World Bank, Policy Research Working Paper 4823 January 2009). The vertical structures are vulnerable to seismic shocks if the structure does not comply with recommended seismic codes and standards. Similarly deficiency in construction materials also makes the structure weak and prone to collapse due to any seismic events as has been evidenced in Islamabad where the 19 storey building Margallah Towers had collapsed with 75 more buildings damaged in Islamabad during the 2005 earthquake. Arif Masud and AS Elnashai of the Mid-America Earthquake Centre have shown that the collapse of the structure was due to some major deficiencies in the construction of Margalla Tower, which was the only building affected by the massive earthquake. It had, for example, stronger axis of all building columns aligned in one direction. This left the structure laterally weaker and was responsible for the collapse. They have also identified deficiencies in the amount of reinforcements and approximate sizes of reinforcing bars at the base of one of the interior columns.

The design of structure which blindly follows some seismic code regulation is not likely to assure the survivability from serious damage or collapse (Gotz, Karl-Heinz et al. MCGraw-Hall, 1989). The poor seismic design of building structure may lead to collapse or destruction. In accordance to building codes, building structures are designed in such a way to prevent collapse and to with stand the earthquakes likely to occur at the location of construction. Seismic design provides the building with suitable stiffness, strength, configuration and ductility (Arnold, Christopher, reitherman, Robert, 1982). The basic requirements of seismic design are depending on the structure type, the location of the structure and application of seismic design and criteria (Omori, F. 1900). The stability of ground is also need before the starting the construction. Earthquake resistant construction refers to the implementation of the seismic design and building codes for assuring that the building structures survive through earthquakes.

Mitigation Measures

In view of the seismic zoning for Islamabad (Zone 2B), the project has been designed with respect to seismic zone 3 which adequately addresses the building safety requirements of Zone 2B. In addition, the recommendations made in the geotechnical study for the project have been incorporated into the project design. The proponent will further ensure that:

- Foundation system must be such that the pressure imposed by the installations is within allowable bearing capacity of soil without overstressing it and must fulfill the following criteria:
    - It must rest below zone of seasonal charges;
    - It must be safe from shear failure recommendations;
    - The expected settlement must be within tolerable limits for the proposed structures.

6.3.2 Aesthetic Value degradation

Vertical Development of Residential Neighborhoods: Driven by a strong real estate market, residential neighborhoods are rapidly being developed across the capital. Along main arterials, intersections and other land with high potential commercial value, offices and shops are replacing residences on the ground floor. In some cases, houses are being demolished and replaced by multi-storied buildings, with commercial uses on the ground floor and apartments above. In other cases, the G+1 height limit is being ignored and floors are being added to existing houses. This growth results in increasing the burden on the infrastructure networks, without any associated investment to increase capacity.

The proposed project site is categorized as residential land. The Project falls into the respective category that permits the designated land-use by the Development Authority. Number of residential projects are sited in the microenvironment of proposed project site.

The project will stand as a remarkable landmark and will subtly fit into the urban skyline. The associated development in the project would have aesthetically positive impact on the urban environmental.

Mitigation Measures

Not required.

6.3.3 Liquefaction Hazard

There are basically three possibilities to reduce liquefaction hazards when designing and constructing new buildings.

Avoid Liquefaction Susceptible Soils

The first possibility is to avoid construction on liquefaction susceptible soils. There are various criteria to determine the liquefaction susceptibility of a soil. By characterizing the soil at a particular building site according to these criteria one can decide if the site is susceptible to liquefaction and therefore unsuitable for the desired structure.

There are a number of different ways to evaluate the liquefaction susceptibility of a soil deposit.

Historical Criteria

Observations from earlier earthquakes provide a great deal of information about the liquefaction susceptibility of certain types of soils and sites. Soils that have liquefied in the past can liquefy again in future earthquakes. First, investigation would be required for previous earthquakes to see if they caused liquefaction at the site.

Geological Criteria

The type of geologic process that created a soil deposit has a strong influence on its liquefaction susceptibility. Saturated soil deposits that have been created by sedimentation in rivers and lakes (fluvial or alluvial deposits), deposition of debris or eroded material (colluvial deposits), or deposits formed by wind action (aeolian deposits) can be very liquefaction susceptible. These processes sort particles into uniform grain sizes and deposit them in loose state which tends to densify when shaken by earthquakes. The tendency for densification leads to increasing pore water pressure and decreasing strength. Man-made soil deposits, particularly those created by the process of hydraulic filling, may also be susceptible to liquefaction as in case of reclaimed project site.

Compositional Criteria

Liquefaction susceptibility depends on the soil type. Clayey soil, particularly sensitive soils, may exhibit strain-softening behavior similar to that of liquefied soil, but do not liquefy in the same manner as sandy soils are.

Soils composed of particles that are all about the same size are more susceptible to liquefaction than soils with a wide range of particle sizes. In a soil with many different size particles, the small particles tend to fill in the voids between the bigger particles thereby reducing the tendency for densification and pore-water pressure development when shaken.

The geologic process described above produce rounded particles. The friction between angular particles is higher than between rounded particles, hence a soil deposit with angular particles is normally stronger and less susceptible to liquefaction.

State Criteria

The initial "state" of a soil is defined by its density and effective stress at the time it is subjected to rapid loading. At a given effective stress level, looser soils are more susceptible to liquefaction than dense soils. For a given density, soils at high effective stresses are generally more susceptible to liquefaction than soils at low effective stresses.

Build Liquefaction Resistant Structures

If it is necessary to construct on liquefaction susceptible soil because of space restrictions, favorable location, or other reasons, it may be possible to make the structure liquefaction resistant by designing the foundation elements to resist the effects of liquefaction.

A structure that possesses ductility, has the ability to accommodate large deformations, adjustable supports for correction of differential settlements, and having foundation design that can span soft spots can decrease the amount of damage a structure may suffer in case of liquefaction (Committee on Earthquake Engineering, NRC, 1985). To achieve these features in a building there are various aspects to consider:

Shallow foundation Aspects

It is important that all foundation elements in a shallow foundation is tied together to make the foundation move or settle uniformly, thus decreasing the amount of shear forces induced in the structural elements resting upon the foundation. The well-reinforced perimeter and interior wall footings are tied together to enable them to bridge over areas of local settlement and provide better resistance against soil movements. A stiff foundation mat is a good type of shallow foundation, which can transfer loads from locally liquefied zones to adjacent stronger ground.

Buried utilities, such as sewage and water pipes, should have ductile connections to the structure to accommodate the large movements and settlements that can occur due to liquefaction.

Deep foundation Aspects

Liquefaction can cause large lateral loads on pile foundations. Piles driven through a weak, potentially liquefiable, soil layer to a stronger layer not only have to carry vertical loads from the superstructure, but must also be able to resist horizontal loads and bending moment induced deep foundation by lateral movements if the weak layer liquefies. Sufficient resistance can be achieved by piles of larger dimensions and/or more reinforcement. It is important that the piles are connected to the cap in a ductile manner that allows some rotation to occur without a failure of the connection. If the pile connections fail, the cap cannot resist overturning moments from the superstructure by developing vertical loads in the piles.

Improve the Soil

The third option involves mitigation of the liquefaction hazards by improving the strength, density, and/or drainage characteristics of the soil. This can be done using a variety of soil improvement techniques.

The main goal of most soil improvement techniques used for reducing liquefaction hazards is to avoid large increases in pore water pressure during earthquake shaking. This can be achieved by densification of the soil and/or improvement of its drainage capacity.

Vibro-flotation

Vibro-flotation involves the use of a vibrating probe that can penetrate granular soil to depths of over 100 feet. The vibrations of the probe cause the grain structure to collapse thereby densifying the soil surrounding the probe. To treat an area of potentially liquefiable soil, the vibro-flot is raised and lowered in a grid pattern. Vibro Replacement is a combination of vibro-flotation with a gravel backfill resulting in stone columns, which not only increases the amount of densification, but provides a degree of reinforcement and a potentially effective means of drainage.

Dynamic Compaction

Densification by dynamic compaction is performed by dropping a heavy weight of steel or concrete in a grid pattern from heights of 30 to 100 ft. It provides an economical way of improving soil for mitigation of liquefaction hazards. Local liquefaction can be initiated beneath the drop point making it easier for the sand grains to densify. When the excess pore water pressure from the dynamic loading dissipates, additional densification occurs

Stone Columns

Stone columns are columns of gravel constructed in the ground. Stone columns can be constructed by the vibroflotation method. They can also be installed in other ways, for example, with help of a steel casing and a drop hammer as in the Franki Method. In this approach the steel casing is driven in to the soil and gravel is filled in from the top and tamped with a drop hammer as the steel casing is successively withdrawn.

Compaction Piles

Installing compaction piles is a very effective way of improving soil. Compaction piles are usually made of pre stressed concrete or timber. Installation of compaction piles both densify and reinforce the soil. The piles are generally installed in a grid pattern and are generally driven to depth of up to 60 ft.

Compaction Grouting

Compaction grouting is a technique whereby a slow-flowing water/sand/cement mix is injected under pressure into a granular soil. The grout forms a bulb that displaces and hence densifies, the surrounding soil. Compaction grouting is a good option if the foundation of an existing building requires improvement, since it is possible to inject the grout from the side or at an inclined angle to reach beneath the building.

Drainage techniques

Liquefaction hazards can be reduced by increasing the drainage ability of the soil. If the pore water within the soil can drain freely, the build-up of excess pore water pressure will be reduced. Drainage techniques include installation of drains of gravel, sand or synthetic materials. Synthetic wick drains can be installed at various angles, in contrast to gravel or sand drains that are usually installed vertically. Drainage techniques are often used in combination with other types of soil improvement techniques for more effective liquefaction hazard reduction.

Mitigation Measures (Recommendations of the Geotechnical Investigation Report)

- Subsurface investigation has revealed that the top 10ft mainly comprise of firm to stiff, silty CLAY/ clayey SILT followed by stiff to very stiff, silty CLAY Clayey SILT up to a depth of 90.0ft. This is underlain by hard, silty CLAY/clayey SILT that continues up to the investigated depth 0f 120.0ft. Major subsurface deposits can be described as follows:
    - Brown, firm to stiff, CLAY/clayey SILT
    - Brown, stiff to very stiff, stiff CLAY/clayey SILT
    - Brown, hard, silty CLAY/clayey SILT

- According to the information provided by the Client, the building will have a provision of three basements whose base will be placed at about 34-36ft depth below the existing ground level. Hence it is recommended that the proposed structure be supported on raft foundation placed at 34-36ft below the exiting ground level.
- Ground water table was encountered at a depth of 63.0-66.0ft below existing ground level. Excavations for foundation trenches, extending deeper than the groundwater level will encounter groundwater. Seepage of groundwater into excavations deeper than or around the groundwater level, may be excessive and some positive measures of effectively controlling groundwater level should be provided to enable construction of foundation in the dry. For the construction of foundation around ground water table, proper dewatering system may be required.

6.3.4 Positive impacts

Employment & Business opportunities

The design phase of the project will create employment and business opportunities for various professionals/consultants who will be involved in the planning stages of the project. They will include: project managers, engineers, architects, building economists, land surveyors, environmentalists, economists, urban planners among others. These professionals may be employed directly in the project or be consultants whose services will be procured.

In addition to jobs, opportunities for suppliers will be created for purchase of building materials such as bricks, stones, metals, glass, wiring, furniture, electronics and water pumps, plumbing etc. which at present market. All these businesses activities will be taxed and generate revenue for the central government in addition to providing a market for their supply and value chains.

Environmental Opportunities

The design phase of the project will also present opportunities for green/sustainable designing of the project, which support the minimization of environmental impacts whilst fortifying the project to achieve its intended objectives. It’s at this stage that the opportunities which will enable the project achieve a sustainable development are discovered, explored and integrated into the project.

The recycling of the waste to be used as raw materials in other construction process reduces the demand for raw materials. This in turn reduces the potential impact to the environment that would have been felt if the demand of the raw materials hadn’t reduced. For instance leaving the land derelict and destroying the habitat as a result of mining activities.

Mitigation Measures

Careful implementation of project activities with focus on enhancing the project benefits and its distribution to the local population can significantly improve the public perception and acceptability of the project.

6.4 Potential Environmental Impacts at Construction Phase

6.4.1 Impacts on Physical Environment

Geophysical impacts would arise from site preparation work (surface leveling, vegetation removal etc.) excavation and filling operations during construction activities related to the proposed facilities and campsite activities at Mela and Nahspa. The likely impacts due these activities include:

- Physical scarring of the landscape
- Increased risk of land slippage
- Loss of vegetation
- Accelerated soil erosion
- Alteration of soil quality by loss of top soil
- Blockage of natural drainage

Impact Assessment

The construction activities will not require extensive ground leveling or topsoil removal, although geomorphological impacts may result from construction and campsite preparation. However, since the entire project area has got nearly flat topography, construction and campsite preparation will not result in significant alteration of geomorphology of the area.

Scarring caused by these pre-construction activities would be limited to the construction site. For this affected part of land, mitigation measures proposed later in this section would be adopted. Soil erosion might occur during the construction stage such as clearing of vegetation, movement of construction vehicles and machinery and excavation. However the impact will be fairly localized and temporary as the soils will be re-used for backfilling. The impacts will be further reduced by adopting the mitigation measures.

Mitigation Measures

- The pre-construction and construction activities will be undertaken in accordance with good housekeeping practices to prevent soil erosion, land scarring and other geophysical impacts from these activities.
- Surface will be sprinkled with water to reduce the extent of dust emissions.
- Construction may be scheduled to prevent activity in days with high wind speeds.
- Piles of excavated soil will be kept covered with tarpaulin sheets or other materials available.

6.4.2 Dust and gaseous emissions

6.4.2.1 Ambient Air Quality

According to the ambient air quality assessment at the site, the site is generally unpolluted. The major source of air pollution during the construction phase will be dust emission due to earth works and gaseous emissions from construction equipment. Impacts from each source and proposed mitigation measures are as follows:

Dust Emissions:

Dust emission from construction site is a concern particularly if the site is near residential areas. The main health hazards are the particles smaller than 10 microns (designated as PM10) as they are respirable. In cases where they reach the receptors, the dust is considered a nuisance as it may spoil property and affect visibility. Particulate matter emitted during construction activities may result in deterioration of ambient air quality in the vicinity of the source, and is usually a nuisance to the neighborhood besides the construction workers. The impact on the environment would be considered significant if there is an increase in suspended particulate matter within and beyond the boundaries of the project site due to activities at the site, or if the dust affects local property or results in complaints from the community. Potential sources of particulate matter emission during construction activities include earthworks (dirt or debris pushing and grading), exposed surfaces, exposed storage piles, truck dumping, hauling, vehicle movement on unpaved roads, and concrete mixing and batching. The quantity of dust that is generated on a particular day depends on the magnitude and nature of activity and the atmospheric conditions prevailing on the day.

Mitigation Measures

The following mitigation measures will be adopted during the earthwork and construction phase:

- Water will be sprinkled daily or when there is an obvious dust problem on all exposed surfaces to suppress emission of dust.
- Service road in front of houses will be kept clean on daily basis and water will be sprinkled to suppress dust.
- Dust emission from soil piles and aggregate storage stockpiles will be reduced by appropriate measures. These include:
    i. Keeping the material moist by sprinkling of water at appropriate frequency
    ii. Erecting windshield walls on three sides of the piles such that the wall project 0.5 m above the pile, and covering the pile, for example with tarpaulin or thick plastic sheets, to prevent emissions.
- Construction materials that are fragile and vulnerable to raising visible dust will be transported only in securely covered trucks to prevent dust emission during transportation.
- The exposure of construction workers to dust will be minimized by provision of dust masks.

Vehicle and Equipment Exhaust:

Combustion exhaust from vehicles and construction equipment can affect the ambient air quality of the site surroundings. The impact would be potentially significant when the ambient air quality deteriorates due to emissions from construction equipment and machinery or the construction generators etc. beyond the guidelines especially at the environmental receptors in the neighborhood. The exhaust emissions will include particulate matter (PM), hydrocarbons, Oxides of Nitrogen, Sulphur, and Carbon (NOx, SO2, CO).

Mitigation Measures

The emissions from operation of construction equipment and machinery as well as generators is not expected to have been significant as to affect the ambient air quality of the area. The small amount of exhaust emissions from the operation of generators and equipment are expected to be dispersed with the prevailing wind and may not have any significant impact on the local air quality. Adoption of following mitigation measures will result in further reduction / prevention of these emissions.

- All vehicles, generators and other equipment used during the construction will be properly tuned and maintained in good working condition in order to minimize emission of pollutants.
- The stack height of the generators during operation phase will be vented through vertical stacks to minimize exposure at ground level.

6.4.3 Site Runoff and Drainage

The effluents from the construction activity and campsite can cause a latent impact on the quality of receiving water bodies if the discharge remains uncontrolled. It may also cause disturbance to the ecology of the receiving water body. The possible impacts can be due to effluent discharge from:

1) Construction runoff and drainage including dewatering operations
2) Runoff from general construction activities and
3) Sewage effluents

The runoff from construction site may contain high amount of suspended particulate matter which can deteriorate water quality of surface channels passing close to the site. These impacts will be however, localized as the volume of runoff and drainage and the type and concentration of pollutants will not be significant.

Mitigation Measures

- Temporary dykes and ditches will be constructed to prevent flow of construction site runoff to the surface water channels in the project area.
- Provided that the runoff does not contain oil content, the run off can be used for watering purpose. High suspended solids can be removed through sedimentation in small ponds. The same can be reused in construction if it meets the required quality.

6.4.4 Impact from Noise

The ambient noise levels will increase at the construction sites due to operation of earth moving and excavation equipment, activities at campsites, concrete mixers, cranes and movement of vehicles across sites and human activity. Noise levels from some commonly used construction equipment are shown in table 6.2. Noise levels measured at and also reported from noise producing activities at construction sites (such as piling, earthworks etc.) generally range in the order of 100-110 dB (A) at source. These noise levels generally attenuate to less than 70dB (A) within 200m from the source.

The receptors to the high noise levels is construction crew engaged in construction work onsite and the residents in the vicinity.

Table 6.2: Noise Emission Levels for some commonly used construction equipment

Equipment	Typical Noise Level dB (A) 50 ft. from Source	Equipment	Typical Noise Level dB (A) 50 ft. from Source
Compressor	81	Generator	81
Backhoe	80	Grader	85
Compactor	82	Loader	85
Concrete Mixer	85	Pump	76
Concrete Pump	82	Roller	74
Crane, Derrick	88	Scarifier	83
Crane, Mobile	83	Scraper	89
Dozer	85	Shovel	82
Truck	88		

Source: U.S. Environmental Protection Agency, "Noise from Construction Equipment and Operations, Building Equipment and Home Appliances," NTID300.1, December 31, 1971.

Mitigation Measures

- Noise emission from the vehicles and equipment will exceed 85 dB (A) but the same would be reduced to less than 85 dB (A) at 7.5 m from the source. Workers will be provided ear plugs and other safety equipment as safeguard against the hazards in the 'high noise zones', which will be clearly defined.
- Equipment such as generators which is supposed to be used for longer periods will be isolated and located away from main activity area if possible.
- Noise barriers, such as temporary walls or piles of excavated material, between noisy activities and noise-sensitive receivers may be constructed.

Vibration Impact

Operation of different equipment during construction phase causes varying degree of vibration depending upon the type of equipment and operation. Protecting workers from the effects of vibration is essential otherwise it may lead to an increased risk of hand-arm vibration syndrome (HAVS). Protection from vibration associated effects usually requires a combination of appropriate tool selection, the use of appropriate vibration-absorbing materials (in gloves, for example), good work practices, and education programs.

Mitigation Measures

Along with using anti-vibration tools and gloves, workers can reduce the risk of hand-arm vibration syndrome (HAVS) by adopting following work practices:

- Employ a minimum hand grip consistent with safe operation of the tool or process.
- Wear sufficient clothing, including gloves, to keep warm.
- Avoid continuous exposure by taking rest periods.
- Rest the tool on the work piece whenever practical.
- Refrain from using faulty tools.
- Maintain properly sharpened cutting tools.
- Consult a doctor at the first sign of vibration disease and ask about the possibility of changing to a job with less exposure.

Some construction activities also produce ground vibrations that spread through the ground and gets diminished in strength with distance. Ground vibrations from the construction activities may not often reach the levels that can damage structures, but they can achieve the audible and perceivable ranges in buildings very close to the site.

A quantitative analysis should be made in cases where construction vibration may result in prolonged annoyance or structure damage and appropriate protective measures like site insulation, use of trenches to interrupt vibration transmission etc. should be adopted to eliminate the vibration related impacts. Mitigation for vibration impacts can take place at the source, sensitive receiver, or along the propagation path from the source to the sensitive receiver.

Construction Waste

Construction waste will be generated as a result of land clearing activities, campsite activities, preparation of material used in construction such as concrete etc. along with other construction work. Construction waste may include excavated soil, removed vegetation, excess masonry, debris, paper, glass, timber, plastics and kitchen wastes, packaging, recovered items. No significant environmental threats are associated with generation and handling of the construction waste except for the fact that improper disposal can contaminate the surface water channels and affect the aquatic life.

Mitigation Measures

- Management of construction waste will be the responsibility of the construction contractor who will arrange to handle and dispose of the waste generated during construction work.
- The waste will be removed on daily basis from the construction site, usually at the end of each day and disposed of at nearby waste collection facility.
- The activities of waste collection, handling and disposal will be monitored by the contractor and those involved in disposal of the waste will be clearly advised not to dump the waste in or close to a water body.
- Contamination of surface water channel from disposal of waste is least likely because in the vicinity of the proposed construction sites, there is no surface water body located.

Blocked Access

The project site will be fenced and activities onsite will be confined within the project site including all project related vehicles and construction materials storage. As per the instructions of CDA, the construction work will not impact to the extent possible, the ongoing activities in the area including movements around the site.

The movement of heavy plant and construction equipment along the roads leading to the site may require temporary adjustment and would not block the low volume of local traffic even for short periods of time.

6.5 Impact on Ecological environment

1. Impact on flora

Construction work involves land clearing for excavation work and ground levelling work etc. for this purpose, onsite vegetation needs to be cleared. The project site before start of pre-construction work, did not have extensive and significant vegetation. Mature trees were very few and site was mostly covered with shrubs, grasses and medium height plants.

Mitigation Measures

- After completion of construction and installation work, site restoration activities will also include growing plants on alternate areas. Indigenous species will be planted during site restoration.
- Dedicated routes /paved roads will be used to avoid damage to the local flora along road sides.

2. Impact on fauna

Project site is part of a highly urbanized and developed environment where animal density has significantly reduced due to anthropogenic activities. Any impact from construction activities on the fauna of the project site is therefore not anticipated. The small animals may get affected due to damage to their habitats (burrows etc.).

Mitigation Measures

- The construction site will be demarcated to prevent uncontrolled mobilization across the site. This will also keep animals away from site thereby reducing the chances of any animal injury.
- The staff onsite will be advised to care for the animals and move them away if one is sighted close to a risk zone (i.e. construction site).
- Soft start strategy may be adopted for construction to push the animals out and away from their habitats to prevent any direct harm to them.

6.5.1 Occupational Health and Safety Hazards during construction work

1. Cranes and Lifting Operations

For all Crane & Lifting Operations Contractor shall ensure full compliance with standard operating procedures. Contractor shall develop a site specific pre-lift checklist which includes the following at minimum,

- Condition of slings
- Rigging condition adequate for load
- Area of swing or travel unobstructed
- Multiple crane use
- Power line approach distance maintained
- Stability and footing
- Taglines and spotters
- Illumination and weather
- Signal operator
- Job hazard analysis and other permits

All lifting and rigging activities shall be supervised and conducted by a competent person or team, Contractor shall maintain a lifting gear registry for all lifting gear on-site inclusive of a listing of all lifting gear, copies of equipment certificates (manufacturer, safe working load, serial number), and the inspection/recertification frequency.

2. Forklifts and Non-Road Vehicles

Contractor should ensure forklift and non-road vehicles are fit for purpose and operated according to manufacturer's requirements. Only competent operators are permitted to operate forklifts and non-road vehicles.

At minimum, all forklifts and non-road vehicles shall be equipped with following equipment;

- Seat belts
- Horn
- Emergency Brake
- Wheel chock
- Labeled Controls
- Fire Extinguishers
- First Aid Kit
- Back-up Alarm

Annual inspection shall be completed by a qualified third party, records of which shall be readily available at site.

3. Fall protection

Contractor is responsible to provide suitable and sufficient fall protection system to workers. It shall be ensured that workers assigned to work at elevated levels; 4 feet (1.2m) in height or more above lower level, active fall protection shall be used.

For active fall protection system, anchorage point can withstand an impact of 5000lbs (22kN). Anchorage point and or lifeline shall be kept as short as directly overhead as possible.

4. Hazardous Substance Handling and Storage

Contractor should ensure that chemicals such as paints, thinners etc. are handled and stored in accordance with the manufacturer recommendations found in the MSDS. Chemicals should be stored in a manner which will minimize releases to soil, groundwater, or the atmosphere. Containers and tanks which are used to store hazardous substances shall be,

- In good conditions
- Compatible with the material stored inside
- Closed when material is not being transferred into or withdrawn from them
- Flammable or combustible liquids shall not be stored in areas used for exits, stairways, or normally used for safe passages.
- Flammable chemicals shall be stored in flammable storage cabinets, room or building when the volume stored exceeds 25 gallons (95 liters).

Electrical pumps: Electrical pumps shall not be used to transfer flammable or combustible liquids. Toxic chemicals shall be stored and handled as defined in the chemical MSDS. Explosive products should be handled and stored according to applicable regulations. Explosive storage shall be located away from corrosives, flammable, oxidizers, or acids.

Welding, Cutting & Brazing

All welding, Cutting and Brazing jobs are considered as Hot Work and should only commence after proper authorization. Welding shield is specific PPE requirements in addition to mandatory PPEs.

Fire watch is required whenever welding, cutting or brazing is performed outside the designated safe hot work area; Fire watch should have following minimum skills,

- Use of fire extinguishers
- Know how to activate emergency alarm or notification system
- Able to visibly see all exposed areas or potential fire areas.

Scaffolding

Contractor is responsible to establish periodic inspection, certification, and re-certification program for scaffold works. Only qualified worker is authorized to erect, inspect and certify, scaffold. All scaffolds should have a guardrail system on each open side, up to the access point. It should be equipped with toe boards having suitable access ladder.

5. First Aid

The contractor is responsible to ensure that suitable and sufficient quantity of first aid boxes available at site. Contractor shall maintain and publish a list of trained first aid providers and provide identification for ease of recognition by the general worker. First Aid providers shall be capable performing first aid, CPR (Cardiopulmonary Resuscitation) and other methods of first response.

6. Job hazard Analysis (JHA)

Contractor shall ensure that JHA is performed prior to commencing jobs. It shall also be ensured that the JHA is reviewed after the following:

- Every time work conditions or the job scope changes
- Persons working or visiting the job shall review and acknowledge the JHA by their signature

6.5.2 Water Consumption

Water will be required during the construction activity for human consumption at the construction stage as well as for the construction activities including sprinkling of water for dust suppression. Since water has become scares commodity, following measures will be adopted to ensure water conservation.

Mitigation Measures

- A complete record of water consumption during the construction phase will be maintained.
- Water conservation practices will be adopted to prevent wastage of water.
- Use of water efficient sanitary fittings such as low flush toilets, water efficient shower heads, and aerators on faucets will be ensured throughout the Project cycle.

6.6 Screening of Potential Impacts in Operation Phase

6.6.1 Increased pressure on utilities

The influx of people due to the project coming into operation would place pressure on infrastructure, utilities and social amenities in the area. This may mainly be at the early stages of the project since they may not be capable to handle the extra demand created especially during rush hours. These services also encompass security as the project may attract people with different motives to the area. Although not all of the increased demand will be placed on the existing system and the project will use other options including conservation and re-use strategies. Additionally the roads in the area will experience more traffic due this increased in population and this can cause more or increase the duration of traffic jams as well as increase the probability of traffic hazards.

6.6.2 Increase in Land values

The project area already has higher land value as it is considered as one of the posh localities of Islamabad. With the project coming into operation and other projects being carried out in the area, it is further predicted that the values of land in the area may increase at rates significantly more than normal. This is because the increase in population will increase demand for land and since its supply can't be increased, the value of land will increase. Also these projects will cumulatively turn the area into a higher value residential area.

This increase of land values and attraction of businesses to the area will cause land use changes in the region both in terms of uses of land (residential to commercial) and changing its character (vegetated areas to built-up areas). This will have impacts of loss of vegetation and emissions of GHGs on top of increasing the cost of living in the region, which may socially push the residents of the region further away if their econometric capacities are not improved in commensurate.

It is important to note that the project in its self can't lead to this impact since it will only involve land use change at the site but its combination with other projects in the area can possibly cause this impact.

6.6.3 Micro-Climate Modification

Though the project area is quite small to cause any considerable microclimate change it bears the potential of adding to cumulative effects of other infrastructural development that together emit GHGs. Change in land surface from natural vegetation to manmade built landscape will have an effect on the area microclimate by reducing the amount of evapotranspiration from the vegetation in the area which are also a GHG sink.

The microclimate will also be modified by the project activities that produce waste heat (emitted heat) and this will result in the area producing more heat than originally emitted without the project. Waste heat will be produced from vehicles, electronics, generators, water pump, air conditioning etc.

6.6.4 Social Conflicts due to socio-cultural differences

The proposed project will attract people from different ethnic, and socioeconomic backgrounds to the area including foreigners to the site. Social cohesion and blending with the existing communities may pose a conflict of interests in the short term since the influx population will come with their differing cultural and social practices. The locals may also be forced to move from the area if the land values increase and they end being bought out to pave way for more commercial developments that are predicted to occur in the region. Thus they would face a loss of social control and ownership to the region if this happens and economic segregation may occur on the basis of richer middle and upper class moving into the area and displacing the local middle class.

However this may be treated as a minor impact since the local residents/ communities in the project area are welcoming in nature. Also since project area is a predominantly urban and developed area that has a higher level of social permissiveness than most other urban areas in the country.

6.6.5 Solid Waste Generation & Disposal

Solid waste during project operation will mainly include food waste, paper, packaging material, plastic bottles and glass and other domestic waste (table below). If not properly managed and disposed of, these wastes can pose environmental and public health hazards.

Waste	Source	Risks
Municipal Waste | Solid Waste Garbage, Kitchen & Office Wastes	Kitchen, restaurants, departmental store, residential area, offices, repair works, plants, plastics (tubes, binders, , wrappings, metals (from clips, pins, lids), paper, cloth etc.	Water pollution, nuisances, air pollution on decomposition, soil contamination, water borne diseases, respiratory illnesses
Municipal Waste | Liquid Waste Grey water, Sewerage	Kitchen, shops, offices, recreational areas, residential area, washings, cooking oils, adhesives, fuel, chemicals, toilets, soaps and detergents	Water pollution (surface & subsurface), air pollution, soil contamination, water borne diseases

Mitigation Measures

The following mitigation measures would be adopted to address the impact imposed from the solid waste generation activities in the operational phase:

- All solid waste shall be segregated into organic and recyclable waste at source and then collected, stored, and transported for recycling/sold to vendors or ultimate safe disposal.
- Handling and disposal of such waste shall be managed by a dedicated waste management contractor.
- Covered waste bins (different colors) will be provided to every floor that will be ultimately collected in a storage area. This storage area will be covered so that pollutants and smell from the waste would not affect the surrounding.

- Waste segregation will be implemented through provision of colored bins for different categories of waste.
- Storage facility for collecting waste bins will be created and established by taking into account quantities of waste generation.
- Any hazardous waste will be managed by a dedicated waste managing contractor e.g. oily rags, chemical containers, empty cans etc.

6.6.6 Wastewater Generation & Disposal

The project on becoming functional will generate wastewater which will be mainly sewage. Small quantities of hazardous waste will also be produced during the maintenance activities in the building (such as oily waste etc.). All type of wastewater generated (i.e. drainage of sewage, showers and kitchen effluent etc.) will be directed to the wastewater treatment plant prior to disposal into a nearby out fall sewer. This will ensure the specifications stipulated in NEQS will comply.

Mitigation Measures

- Wastewater from the building will be treated.
- The Grey water after collection from wash basin and showers is collected and stored in a grey water tank. The filtration and pumping equipment treats the collected grey water and stores it into the treated water tank after chlorination.
- The chlorinated grey water may be used for irrigation.
- Black Water (Soil) will be being discharged into city sewer.
- Grease interceptor and/ or oil skimmer may be installed on kitchen effluent to maintain oil levels within NEQS limits.
- Water conservation strategies will be employed to avoid wastage of water.
- Periodic preventive maintenance of pumps, diffusers and other ancillary equipment.
- Periodic monitoring of wastewater to ensure compliance with NEQS.
- Provision of sedimentation tank or holding tank, so that the effluent is primary treated and then disposed of to the main sewer line.
- The cleaning agents used will be non-hazardous.

6.6.7 Energy Consumption

During operation phase, power supply from IESCO will be made available. A back up diesel operated generator will also be installed in case of emergency or suspension of power supply from the mains.

Mitigation Measures

- Energy saving techniques such as Energy efficient mechanical systems and Passive ventilation/cooling by provision of natural lighting and ventilation have been incorporated into project design.
- The energy-efficient lighting system will be installed for the project.

- The project design has ensured maximum use of daylight and natural ventilation.
- The energy-efficient lighting system installed for the project will contribute immensely to energy saving during the operational phase of the project.

6.6.8 Air Emissions & Noise Impact

During operation phase, air emissions will mainly come from generators. If vented at lower heights, the exhaust gases are likely to disperse locally and cause localized pollution. Other emissions coming from this project will be from the vehicle exhausts. Similarly, noise sources during operation include mainly the human activity within the building and backup generators which will be operated on need basis.

Mitigation Measures

- The backup generators will be installed in open air at ground floor at the backside of the project.
- All exhausts will be monitored at regular frequency to check compliance with NEQS. It is recommended that generator stack height be adjusted to ensure efficient dispersion of gases.
- Regular tuning / maintenance of generators is recommended.
- For noise control from generators, Critical Sound Proof Canopies will be used and additional sound barriers as plantation between the Generators and the Apartments will also be done.
- The project will use sound proof windows and doors to attenuate noise.

6.6.9 Traffic Flow and Congestion

The project is located along F-11/1Markaz road. The site has residential Apartments in the vicinity. Land use in the macro environment is a mix of residential and commercial. From the assessment of traffic flow for the project, it is expected that there would be some level of increase in the traffic volume due to the project. Peak traffic hours are expected to be 9-10 am and 6-7pm. Traffic management during project operation will be required to prevent traffic jams on the Markaz road. However it has been noted that person trips are presently generated by nearby residential projects. Also, as per the prevailing Building Regulations, the builders and developers of residential and commercial projects are mandated to reserve sufficient car parking space for the residents and their visitors within the project building.

Mitigation Measures

- In order to avoid road side parking, the project has reserved three basements to accommodate around 594 cars allotting two spots per apartment. There will be separate parking for guests.
- Vehicles will be parked at designated parking areas / underground parking space provided in each building during operational phase.
- Parking of vehicles alongside the road would be prohibited at all times.

6.6.10 Fire safety

Fire is one major hazard for buildings. It may result from short circuiting or improper storage of fuel, carelessness by the residents leading to fire etc. Fires can cause loss of life and property.

Mitigation Measures

Fire Protection Systems

Stand pipes, hose reels and automatic sprinklers / extinguisher are used in compliance with relevant NFPA standards for the total covered area of the building. (Building Code of Pakistan – Fire Safety Provisions 2016).

Fire Detection and Alarm Services

The fire alarm system will provide monitoring and standby power complying with UL, NFPA and local civil defence requirements. The system shall be configured as a Fire Alarm System with capability of being fully integrated with Voice Alarm and Public Address System.

The fire alarm system will facilitate accurate identification of the source of heat/smoke/fire in their early stages to minimize occurrence of false alarms. All Smoke detectors shall be smoke and heat combined units and heat detectors shall be rate-of-rise detectors.

UPS for the Fire Alarm System will be provided.

Life Safety Plan

All travel distances and location of exits are provided based on NFPA and Building Code of Pakistan - Fire Safety Provisions 2016. Risks involve with the fire hazard can be reduced by adopting following mitigation measures:

- For all engineering designs, IBC (International Building Control), EN 54 & NFPA (National Fire Protection Authority) codes will be followed.
- Standard fire and smoke detection and protection devices such as alarms, fire hoses and hydrants to be provided in the building.
- The facility will possess a detailed emergency and evacuation plan that will be regularly drilled to make sure that the responsible staff remains trained at all times.
- Firefighting equipment such as fire extinguishers and hydrant systems will be maintained at strategic locations within the residential area.
- Regular inspection and servicing of the extinguishers will be undertaken by a reputable service provider and record of such inspections should be maintained.
- Fire safety signs will be prominently displayed within the blocks.

6.6.11 Visual Impacts and Aesthetics

The project design pays particular attention to the visuals and aesthetic values and has been skillfully developed to become a landmark to the skyline of Islamabad and produce positive impact on the aesthetics of the urban environment.

6.6.12 Bird-Building collisions

Bird-window collisions are an unfortunate side-effect of urban environments and are a proven problem. Bird accidents due to collision with manmade structures account for hundreds of thousands of deaths annually[5]. Daytime strikes occur when birds cannot perceive glass as a solid object and are unable to distinguish the images reflected in glass from sky, trees or potted indoor plants. Lights within high-rise buildings, which actively lure birds, cause nighttime collisions. According to the Fatal Light Awareness Program (FLAP), a single tall building in Chicago checked daily during spring and fall migration caused an average of 1,478 bird deaths annually and over a period of 14 consecutive years, the cumulative kill amounted to 20,697 birds.

Birds have two basic problems with buildings: One relates to lighting, the other to glass. Lighting is an attractant – especially for migrating birds who often fly at night. Brightly lit buildings can draw birds in where they can hit windows or other obstacles. Glass is a problem because it is confusing for birds as an invisible obstacle and as a reflective surface. Birds use the habitat and airspace around buildings as they forage and migrate. They fly into glass that reflects the habitat or the sky or try to fly through glass when they can see habitat or sky on the other side. As a rule, collisions occur just about anywhere birds and glass coexist and collisions increase 19 percent for every 10 percent increase in glass area.[6]

Buildings that have both extensive glass and attractive habitat are the most dangerous for birds. Other features such as skyways or passageways, mirroring and bright lighting can cause additional problems.

Due to Margalla Hills and large green cover, there is significantly large bird population in the Federal Capital and thus high probability of bird-building collisions. The proposed project therefore needs to undertake solid measures to prevent the impact on birds due to these collisions.

Mitigation Measures

The solution to the bird-building collision problem lies in integrating bird-safe design elements into new architecture for buildings. Designers and architects who are aware of these factors can use creative techniques and materials to reduce or eliminate collisions. These choices are best incorporated into the original design of a building. Retrofitting a building that proves to be a problem is more difficult with fewer options and choices that may not be consistent with the overall vision for the building.

Windows – Breaking up the image birds see is key to alerting them to an object in their way. Thus, covering windows with a pattern every four inches is helpful. Patterns can be applied on the inside or outside of glass, but are more effective when applied on the outside of the window when possible, especially on reflective glass. Curtains and shades can be closed so the glass is not so see-through. Blinds should be down and slightly slanted

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[5] *The National Audubon Society*

[6] Urban Conservation Treaty for Migratory Birds

so there is the perception that something is in the window and therefore not passable by the birds.

Bird feeders should be placed at least 30 ft. from building glass or as close as possible. A closer distance decreases the possible buildup of momentum when a bird flees a feeder and helps to reduce the impact of a collision.

Plants in windows - Indoor plants should be moved away from clear glass windows far enough that they cannot be seen from outside or break up the image with non-plant objects. If spot lighting or outdoor lighting is used, extinguish exterior vanity lighting and spot lighting by a certain time each night especially during bird migration and periods of inclement weather. When possible, exterior vanity and spot lighting altogether should be avoided. The key is to reduce the total light emitted from the building from 11pm until sunrise during migratory seasons (mid-March to early June and late August to mid-November). In addition to saving migratory birds, there are direct benefits including decreased energy and maintenance costs. Also, exterior or decorative lighting on the building should be extinguished or mad dim particularly the spotlights, logos, lighted clock faces, greenhouses, antennae lighting, etc.

6.6.13 Socioeconomic Impacts

Employment Opportunities

The labor force whether skilled or unskilled is the inhabitants of Islamabad will be deployed at the project. This will not only provide them with the employment opportunities but they will now be having easy excess to the basic necessities of life by earning their both ends meet through the learning of skills. Some people will be employed by the project as management agents, caretakers, cleaners, security personnel and technicians.

Provision of Market for the Supply of Building Materials

The project will require the supply of large quantities of building materials which will be sourced locally. This provides ready market for building material suppliers such as quarrying companies, hardware shops and individuals with such materials.

Increased Business Opportunities

The large number of project staff required will provide ready market for various goods and services, leading to several business opportunities for small scale traders such as food vendors around the construction site.

Revenue to National and Local Government

Through payment of relevant taxes, rates and fees of the government and the local authority, the proposed project will contribute towards the national and local revenue earning.

7. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.1 Introduction

This Chapter presents an environmental management plan (EMP) as the implementation mechanism to manage environmental and social issues and mitigation measures identified in earlier chapter (Screening potential environmental impacts and mitigation measures) of this EIA report.

The EMP is meant to provide an overall approach for managing and monitoring environment-related issues and to describe the institutional framework for implementing the EMP. The rationale of this EMP is to propose environmental protection commitments to protect the environmental values that may be affected by the development of the project and to assist the administering authorities to decide the appropriate approval conditions for the project.

7.2 Objectives of Environmental Management Plan

The EMP will help the Proponent in addressing the adverse environmental and social impacts of the project, enhancing project benefits, and introducing standards of good environmental practice. The primary objectives of the EMP are to:

- Outline measures to be taken during the implementation and operation of the Project to eliminate the adverse environmental impacts or reduce them to acceptable levels.
- Taking actions such as defining roles and responsibilities of the project proponent for implementation of EMP and identification of areas where these roles and responsibilities can be shared with other stakeholders.
- Defining the requirements for communication, documentation, training and management and implementation of mitigation measures.
- Taking actions required for assessing the effectiveness of mitigation measures employing the monitoring mechanism and identifying related parameters to confirm the effective implementation of these measures.

7.3 Scope of EMMP

This Environmental Management Plan has provided detailed strategy to be implemented for achieving improved environmental performance in the following areas:

1. Pollution Prevention/Environmental Management
2. Recycling and Waste Management
3. Occupational health safety risks and hazards
4. Community constraints/ social issues from land acquisition and others
5. Contingency Planning

The EMMP has been developed in view of the potential environmental and social impacts as identified during the impact assessment exercise and intends to provide a workable mechanism to ensure sustainable construction and operation of the project.

7.4 Construction Activities requiring Environmental Management

The following three phases in the Project will need to be environmentally managed:

a) Pre-Construction (Planning and Designing),
b) Construction and
c) Operation

There is already an incinerator installed at the site but it has reached the end of its operational life and is obsolete. The new incinerator will be installed in place of the old one. Minor civil construction will be done in order to renovate the room. The side walls will be raised to cater for the height of the incinerator, whilst the roof will be fabricated.

Environmental Performance Monitoring will be an essential component of the Project and will be governed through Environmental Monitoring Plan.

Site restoration work will include removal of construction materials and equipment.

7.5 Health, Safety & Environmental Management System (HSEMS)

Health, Safety and Environment Management System is essential and integral component of the environmental management system for the safe and secure working environment assuring sustained development. HSE issues and aspects are outlined in EMP with mitigation measures based on principles of best management practices. HSE management system undertakes carrying out a complete assessment, evaluating, monitoring, identifying and control measures (mitigation) of all potential hazards and risks arising during the construction and operation phases of the proposed project. It needs to ensure that the Health and Safety Plan (HSP) along with the Health and Safety Rules is established, documented and enforced. The plan also outlines roles, responsibilities and expected outcomes of proper implementation with respect to the environment, health and safety management of various phases of the project. These measures should be implemented to ensure that no significant adverse, health and safety impacts occur due to proposed activities associated with the project.

7.6 Implementation of EMP & Supervision

Environmental management will be the integral part of the project. Therefore, committing to reduce the environmental impacts will reflect the management approach and believe that good performance in this area is synonymous with running a well-managed efficient proposed project operation.

During the construction phase, main responsibility of environmental performance will reside with the construction manager, who in turn will be assisted in daily activity monitoring by site HSE officer of the project. In case of normal operational phase, main responsibility for environmental performance will be supervised by Top Management Operations of the project while the daily management will be performed under the Manager Operations and supervised by EHS Officer. Under their surveillance, environmental management during operations will be performed as per the mitigation and monitoring plans outlined in this EIA.

The specific roles of key functionaries are described as follows:

7.6.1 Top Management of Project

Environmental management plan (EMP) will be regulated by the Project top management; therefore, will play an important role. Some of the key role & responsibilities are given below.

- To cooperate and consult with relevant environmental agency in order to perform in better way.
- To evaluate the progress of development and implementation of this management plan.
- To approve any change in decision making with the consultation of respective managers, if appropriate.
- The review the environmental performance and suggest and approve changes for better implementation.

7.6.2 Project Manager

The role of Project Manager is very important. The success of an EMP will mainly depend upon effective management of the EMP by this person. Following are some of the roles and responsibilities given to the Construction Manager.

- To ensure that the EMMP has been communicated to the staff, contractors and HSE officers are considered and placed in the EMP accordingly.
- To identify issues and where possible propose solutions for inclusion in the management plan review process.
- To undertake and implement good construction practices in coordination with HSE officer during construction.
- To improve coordination and exchange of information between top management, employees, contractors, etc.
- To monitor the progress of development and implementation of this management plan.

7.6.3 EHS Officer

The role of EHS officer will be vital during the construction phase. He will be the key advisor on environmental issues to the construction manager of the project.

- To develop HSEMS and monitor its implementation during construction and operation.
- To integrate, as far as possible, the aims and objectives of different users within an agreed plan.
- To maintain a balanced, holistic approach to the solution of concerned issues in accordance with the compliance to the legislative requirements.
- To provide professional guidance on questions relating to the environmental management and issues raised by contractors/relevant personals.
- To discuss and review the project progress with project manager.

7.6.4 Contractor

The role and responsibilities of the contractor will consist of the following basic points:

- To carry out construction activities in environmentally sound manner.
- To coordinate with the HSE officer to resolve issues if any arise during construction phase.

- To manage and implement environmental management practices and construction work as per the recommendations of EMMP.
- To manage construction crew and reduce the environmental impacts.

7.7 Regulatory Requirements

7.7.1 Approvals, Authorizations and Permits

Proponent will, besides obtaining NOC from EPA, will need to obtain other clearance / approval from the government and other agencies prior to commencing construction and operation. Furthermore, issuance of NOC will require the project to plan for undertaking continuous monitoring through an Independent Monitoring Consultant (IMC).

The approval from EPA shall not absolve the proponent of the obligation to obtain any other approval or consent that may be required under any law in force.

Contractual Provisions: The requirements of environmental impact assessment with respect to mitigation measures shall be incorporated in the construction and operations plans and procedures. This will make it mandatory for the contractor to follow procedures and comply with environmental regulations.

7.7.2 Environmental Quality Objectives

This section outlines the criteria for management's quality objectives with respect to pollution control, management of waste streams from project including solid waste, wastewater quality, air and noise quality. The management of the project will review Environmental Objectives once a year and try to achieve them in a timely manner. This will also include any applicable treatment criteria meeting the National Environmental Quality Standards (NEQS) as per the Act 1997.

7.7.3 Compliance Monitoring

The management of the project shall monitor compliance by implementing the Environmental Monitoring Plan outlined in the subsequent section. The compliance will be reported in form of periodic reporting and the report may be submitted to the EPA. During the construction phase, it will be on monthly basis and during the operation phase it will be done on quarterly basis or as per the frequency defined by EPA.

7.8 Environmental Management Framework

The proponent will undertake overall responsibility for compliance with the EMP. It will ensure that all activities it executes with contractors comply with positive environmental sensitivities as well as it will cooperate with the concerned regulatory agencies such as the EPA. The contractors will be subjected to certain liabilities under the environmental laws of the country which will be mentioned in the contract with the proponent.

Key approach to implementing the EMMP at different stages will be:

- Complying with the relevant legislation and regulations.
- Regularly reviewing of the impacts on the environment.

- Developing appropriate indicators in order to monitor core impacts.
- Setting appropriate annual objective, targets and publicly reporting on progress.
- Communicating openly with internal and external stakeholders on environmental issues.

7.8.1 Construction and Operation Phase Management

In order to implement EMMP successfully during construction and operation phase, it is required to follow mitigation measures, monitoring plan and emergency procedures strictly. Training will be required at each step and phase, also if necessary to change management processes, will be documented and available to the employees.

Mitigation Plan

It defines all the impacts and their remedial with highlighting the responsible personals to work on those mitigations. A mitigation plan is basically a mitigation matrix which is given as Table 8.6 for construction & operational phase respectively. All these impacts and mitigations have already been given in previous section of this report. The proponent and construction contractor will be required to adhere to these mitigation measures throughout the project.

Training

This is another major step for the implementation of EMMP. All the employees will be require to be trained appropriately to work on EMMP effectively. Employees training can provide workers to minimize waste generation, conserve resources such as water and natural gas etc. The HSE Officer will determine the training requirements in consultation with contractor among the staff of both construction contractor and developer's staff with the advice of Construction Manager.

Monitoring and Review

Monitoring of all the activities will be required to analyze the impacts of construction and operation on the environment and detailed Monitoring plan is given in Table 7.4. Project Manager will coordinate with Construction Manager and contractor site representative to monitor environmental parameters during the construction phase.

During operations, the Project Manager will follow the monitoring plan as mentioned in the EIA. He will keep record of all environmental non-compliances and report them along with the corrective actions in meetings with the top management.

Meetings

Meetings are an important source of information exchange and will be held periodically during the project to discuss any hang-up in the project. Environmental monitoring and performance will also be taken up in such meetings to evaluate the extent the EMP requirements are being met. The following meetings will take place during the project in addition to other meetings:

- Project initiation meetings (once for each of the contractors).
- Fortnightly meetings

The purpose of the project progress meetings will be to discuss the progress of EMMP, and ensure full understanding and commitment from concerned parties for its implementation. Meetings will be held periodically during the construction phase. The purpose of the meetings will be to discuss the progress of construction, any non-compliance observed, and any EHS / social issues identified at the project site. The remedial measures will also be discussed and agreed during these meetings. The meetings will be recorded in the form of a report prepared by the EHS Officer.

7.8.2 Traffic Management Plan

The project design provides sufficient parking capacity within the building design to accommodate the project related vehicles. There is separate parking space for the vehicles of visitors. In case of an accident, the building management shall:

- Contact the appropriate emergency response agencies immediately.
- Remove the vehicle in order to overcome the problem of traffic congestion on the main road.
- Record details of the incident and the appropriate mitigation measures taken at the time of incident.
- Identify the cause of accident and report it to senior management.

7.9 Management Approach

Management will undertake overall responsibility for compliance with the EMP. It will ensure that all the activities that the management executes comply with positive environmental sensitivities as well as it will cooperate with the concerned regulatory agencies such as Environmental Protection Agency.

On the other hand, contractor will carry out field activities as part of the proposed project that includes relevant and subsidiary construction work. The contractor will be subjected to certain liabilities under the environmental laws of the country, which will be mentioned in the contract with the project site. The dynamic approaches that are followed towards successful implementation of the environmental management plan listed below:

- Compliance with the relevant legislative and regulatory requirements of the project.
- Developing appropriate monitoring indicators in order to assess the performance as well as magnitude of impact on the ecosystem (core impacts).
- Regular review of the project activities and assessing their impacts on the environment.
- Communicating broadly with internal and external stakeholders on issue of environmental concerns.

7.10 Environmental Monitoring Plan

The EIA identifies and assesses the impacts of the proposed project on the basis of information available at the time of conducting the assessment and the natural processes that link various environmental parameters. Based on this prediction, mitigation measures are proposed such that the predicted residual effects do not exceed acceptable levels. However, there is always an element of uncertainty in such predictions due to an insufficient grasp of the processes, limitations in prediction techniques, or inadequate data on the environment/social aspects.

Consequently, it is possible that even if the mitigation measures are implemented fully, the negative impacts of the project might exceed acceptable limits.

In order to address the above concerns, environmental monitoring will be undertaken during the project activities, with the overall objective of proper management of environmental and social risks and uncertainties. Broadly, monitoring will be undertaken with the following objectives:

- To verify that the impacts of the proposed project are within acceptable limits, thus establishing credibility (public assurance).
- To immediately warn the project proponents (and the regulatory agencies, if required) of unanticipated adverse impact or sudden changes in impact trends so that corrective actions can be undertaken, which may include modifications in the proposed activities, or the inclusion of modified or additional mitigation measures.
- To provide information to plan and control the timing, location, and level of certain project activities so that the effects are minimized.

The following environmental parameters will be monitored at locations identified during the construction phase:

- Ambient Air Quality (NOx, SOx, CO, O3, Lead, SPM, PM10, and PM2.5 etc.)
- Wastewater quality (BOD, COD, TSS, TDS, pH, Temp, Oil & Grease)
- Drinking water quality according to NEQS
- Noise levels (dBA)
- Stack emissions (generators) (NOx, SOx, CO, VOC, Lead, PM10, and PM2.5 etc.)

A detailed environmental monitoring programme/plan is provided in proceeding subsection to assist the proponent in evaluating and monitoring the project performance against the EIA requirements.

7.10.1 Compliance Monitoring

The compliance monitoring of the project activities is principally a tool to ensure that the environmental control measures identified in the EIA are strictly adhered to during the project construction and operation. Compliance monitoring will be the responsibility of the proponent and the contractors. It will be carried out by the following:

- EHS Officer
- Independent Monitoring Consultant (IMC)

The compliance monitoring will be done at agreed frequency to:

- Systematically observe the activities undertaken by the contractors (and subcontractors) or any other person associated with the project.
- Verify that the activities are undertaken in compliance with the EIA and EMP.
- Document and communicate the observations to the concerned person(s) of the contractors and proponent’s EHS Officer, so that any corrective measures, if required, can be taken in a timely manner.

- Maintain a record of all incidents of environmental and social significance, related actions and corrective measures.
- Maintain contact with the stakeholders, solicit their views and concerns, and discuss them during the regular meetings.
- Prepare periodic reports of the environmental, health and safety performance of project.
- The mitigation plan discussed in Table 8.2 will be used as a management and monitoring tool for compliance monitoring. Inspection will be done using checklists prepared by the respective contractors, on the basis of Table 8.2, during the construction phase.

7.11 Change Management

The present EIA has been carried out on the basis of the project information available at this stage. This is however possible that the changes are made in some components of the project, during the design and construction phases. In order to address the environmental and social implications of these changes, a simple framework has been devised, which is described below:

- No modification will be made to the Project without authorization from the proponent top management or. Any modification will be carried out in accordance with the procedures approved by the proponent.
- Proposed modifications must be evaluated for safety, health and environmental impact and a signed document should be available before the change can be implemented. The document should be signed for a second time before the change is made.

7.12 Emergency Response Plan (ERP)

The Emergency Response Plan during the construction and operation periods will be managed and monitored by the management. The Response team will ensure that the operations are carried out in time avoiding any fire, safety and security hazard and those affecting the environment. The team will be in readiness to adopt the following procedure:

- Evaluation of the situation to identify the most important steps, which must be taken first and can have an important bearing on the overall action to be taken.
- Deployment of required manpower and equipment.
- Organizing required logistical support so that there are no bottlenecks hampering the construction work.
- See to it that injured persons are cared for.
- One dedicated ambulance should be placed at site or;
- Respond to calls for ambulances for shifting the injured persons to neighborhood hospitals/healthcare units.
- Isolate all sources of ignition and environmental hazard.
- Evacuation of people who are in immediate or imminent danger. Response Team and/or in-charge of the Campsite will exert positive leadership and give instructions calmly, firmly, explicitly, and courteously and obtain help of law enforcement agencies, if necessary.
- Block approach roads if necessary for safety of operations.
- Surveillance and monitoring operations.
- Retrieval and disposal of earth/debris and resources affected by the hazard at appropriate site.

7.13 Waste Management

Waste management during construction will be responsibility of contractor. The domestic and construction waste will be separately handled by the contractor to ensure the recyclable waste is segregated and reused where possible. The hazardous waste including oily rags, containers, chemicals bottles/cans etc. are recommended to be handled through EPA approved waste contractor as they are better aware of the nature of hazardous waste and their disposal requirements.

Waste management during operational phase of new installed incinerator will be managed in a way that it will be regularly disposed off in the incinerator under the supervision of community constituted for this purpose.

NIRM follows the WM Rules 2005 for proper handling and disposal of hospital waste. Institute has its proper sanitation department which consists of 12 sanitary workers, 2 ward masters and one sanitary inspector under supervision of matron. The waste generated is categorized and collected in separate bins. Red bins are allocated for the collection of sharp needle cut syringes, blood bags and solid bandages and any other items contaminated by the blood and other fluids of patients, urinary/drainage bags soiled dressings. Moreover, Blue bins are allocated for the collection of used gloves and IV drips. Additionally, yellow bins are in place for the collection of ordinary garbage such as wrappers, fruit peels and waste papers. The waste collected in red and blue bins are of sensitive nature, therefore, it is safely disposed of in the incinerator installed in the hospital premises. The waste collected in yellow bins is of non-infectious nature, so it is disposed of in the dumpers provided by CDA.

A waste management committee has been constituted to supervise the waste management of the hospital regularly. The hospital waste is being regularly disposed off in the incinerator under the supervision of the committee.

As, incineration is not a final disposal method since it produces a solid residue or ash which may be landfilled or otherwise disposed off safely.

7.14 Maintenance of the EMMP

EMP needs to be revised on periodic basis to maintain up-to-date environmental management requirements with the changing physical and regulatory constraints. Therefore, outlining and defining the responsibilities of personnel and activities under the project's operation execution, implementation, operation and monitoring and decommissioning phase are integral part of maintenance of the EMMP. Dissemination of reviewed and revised EMMP need to be notified to all stakeholders particularly, relevant government and municipal agencies so that their modified role is also redefined and re-established in the overall environmental management process.

Table 7.1: Mitigation Matrix for Design and Construction Phase

S. No	Affected Areas	Possible Mitigation Measures	Responsibility
1	Structural Stability	During the construction of basement it will be important to maintain the stability of excavated walls.	Site Management
		During monsoons or in the case of ingress of ground water (due to inadequate dewatering) it will be essential to protect the excavation walls with shoring/bracing.	Site Management/ Construction Contractor
2	Liquefaction Hazard	Avoid construction on liquefaction susceptible soil.	Construction Manager
		If it is necessary to construct on liquefaction susceptible soil because of space restrictions, lack of favorable location, or other reasons, it may be possible to make the structure liquefaction resistant by designing the foundation elements to restrict the effects of liquefaction by improving the strength, density, and/or drainage characteristics of the soil.	Site Management
3	Soil Erosion	The project will be scheduled to avoid heavy rainfall periods (i.e., during the dry season) to the extent practical.	Site Management
		After constructional activities, the site which is cleared temporarily will be re-vegetated promptly.	Construction Contractor
		Off-site sediment transport will be reduced or prevented by the use of settlement ponds, silt fences, water treatment, as well as modifying or suspending activities during extreme rainfall and high winds to the extent practical.	Site Management
		The environmental impact of soil erosion can best be mitigated by removing vegetative cover only from the specific site on which construction is to take place and by disturbing the vegetation in adjacent areas as little as possible.	Site Management
		Disturbing the existing vegetation and natural contour of the land as little as possible can mitigate surface runoff.	Site Management
		Construction activities that result in the soil being laid bare could be scheduled in such a way that some type of vegetative cover appropriate to the site could be established prior to the onset of intense rain or windstorms.	Site Management
		If grass is to be seeded, mulch of straw will help to protect the soil from less extreme erosive forces until vegetative and root development begins.	Site Management
		Exposed surface was regularly wetted to effectively keep airborne dust levels to minimum.	Construction Contractor
		During the windy weather situation, the stockpiles of fine materials will be covered with tarpaulin.	Construction Contractor
		Site workers are mandated to wear dust masks especially during dry and windy weather conditions.	Construction Contractor
4	Contaminated Land	Fuel oils, lubricants, and chemicals will be stored in covered dyked areas, underlain with impervious lining.	Site Management
		Maintenance of vehicles and equipment will be carried out in designated areas.	Construction Contractor
		Washing of vehicles will be carried out in the designated areas.	Construction Contractor
		Construction vehicles and machinery will be examined on a regular basis for leakage prevention.	Construction Contractor
		Removal of oil and contaminated soil around the fuel storage areas will be through appropriate tools i.e. shovels, plastic bags and absorbent materials.	Construction Contractor
		Contaminated media will be managed with the objective of protecting the safety and health of laborer at the site, the surrounding residents, and the environment.	Site Management

Table 7.1: Mitigation Matrix for Design and Construction Phase

		Plans and procedures will be prepared, to respond to the discovery of contaminated media to minimize or reduce the risk to health, safety, and the environment consistent with the approach for Contaminated Land.	Site Management
		The historical use of the land will be understood with regard to the potential presence of hazardous materials or oil prior to initiation of construction activities.	Site Management
5	Construction Waste	The construction waste which will be sent for recycling like damaged pipes, left over steel, wooden and plastic pieces. While, the rest of the left over waste will then be taken away to the dumping sites for disposal.	Site Management
		The construction material will be kept in a covered place, especially during the precipitation season.	Contractor
		The excavated soil will be re-used by adopting different methods, which will be used as a filling material for the construction of the project.	Contractor
		Various waste containers for different types of waste will be deployed, in order to treat the waste in accordance with its nature.	Contractor
		The waste bins will be properly marked for each type of waste produced during the constructional activities.	Contractor
		The project area will contain the sewage and litter facility to overcome the problem of unchecked dumping of waste.	Site Management
		Use of building materials that have minimal packaging to avoid the generation of excessive packaging waste.	Site Management
		Use of durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time.	Site Management
6	Ambient Air Quality	Minimizing dust from open area sources by using control measures such as installing enclosures and covers, and increasing the moisture content.	Contractor
		Dust suppression techniques will be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements.	Site Management
		PPE, such as dusk masks, will be used where dust levels are excessive.	Contractor
		Sprinkling of water and fine spray from nozzles to suppress the dust.	Site Management
		On-Road- Inspection will be done for black smoke generating machinery	Site Management
		Only those vehicles having certificate with respect to exhaust emission quality and noise will be allowed to supply the construction material to the project site	Site Management
		Sand and other materials transported by trucks shall be kept covered to prevent dust dispersion.	Contractor
		Speed bumps are commonly used to ensure speed reduction. In cases where speed reduction cannot effectively reduce fugitive dust, it may be necessary to divert traffic to nearby paved areas.	Site Management
		Fabrics and plastics for covering piles of soils and debris is an effective means to reduce fugitive dust.	Contractor
		Care will be taken to keep all the material storages adequately covered and contained so that they are not exposed to situations where winds on the site could lead to dust / particulate emissions.	Site Management
		Ensure that the vent of generator exhaust is at adequate height so it will not be a cause of localized dispersion	Site Management
7	Water Consumption	A complete record of water consumption during the construction phase will be maintained.	Site Management
		Construction workers will be trained to use water efficiently in way to reduce the wastage of water during different activities occurring in the construction phase.	Site Management /Contractor

Table 7.1: Mitigation Matrix for Design and Construction Phase

8	Wastewater Generation and Disposal	Maintenance of vehicles and equipment used in the construction phase of the proposed project, in order to overcome the generation of wastewater at large scale.	Contractor
		Washing of vehicles and construction machinery will be restricted to a designated area.	Contractor
		Wastewater will not be disposed of directly into the sewers/open areas. rather it will be first treated through primary treatment and may be reused onsite for dust suppression, gardening etc.	Site Management
		Septic tanks at the site will be setup for sewage disposal.	Site Management
		Regular monitoring of the wastewater generation and handling onsite should be done.	Site Management
		Wastewater generation will be minimized by controlling the pollutants at the source through primary treatment which may include sedimentation tanks.	Contractor
		Adequate portable or permanent sanitation facilities serving all workers will be provided at all construction sites.	Site Management
		Sewage will not be mixed with any other waste.	Site Management
9	Solid Waste Generation and Disposal	Separate bins will be placed for different type of wastes - plastic, paper, metal, glass, wood, and cotton.	Site Management
		Recyclable material will be separated at source. The recyclable waste will be sold to waste contractors for recycling.	Site Management
		Non-hazardous non-recyclable wastes such as construction camp kitchen wastes will be disposed of in landfill site through municipal administration or approved waste manager/contractor.	Contractor
		No wastes will be dumped at any location outside the site boundary.	Contractor
		All hazardous waste will be separated from other wastes. Hazardous wastes will be stored in designated areas with restricted access and proper marking.	Contractor
		Hazardous wastes will be disposed of through approved waste manager/contractor.	Site Management
		Surplus construction materials including partially filled chemical and paint containers will be returned to suppliers. Inert construction wastes will be disposed of onsite as fill material or sold as scrap to contractors.	Contractor
		Records of all waste generated during the construction period will be maintained. Quantities of waste disposed, recycled, or reused will be logged on a Waste Tracking Register.	Contractor
		Training will be provided to personnel for identification, segregation, and management of waste.	Site Management/ Contractor
10	Noise and Vibration	Transport associated with the construction of the project will be avoided or minimized through already existing residential areas.	Contractor
		Noise control devices will be used such as temporary noise barriers and deflectors for constructional activities.	Contractor
		The residential area will be separated from traffic noise zones and the protection of schools and hospitals by green belts.	Site Management
		The activities associated with greatest potential to generate noise will be planned during the day period that will result in least disturbance to the nearby residents at night.	Site Management
		Truck drivers will be instructed to avoid gunning of vehicle engines or hooting especially when passing through sensitive areas such as mosques, schools and hospitals.	Contractor

Table 7.1: Mitigation Matrix for Design and Construction Phase

		Noise and vibration will be minimized in the projects site and surrounding areas through sensitization of the truck drivers to switch off vehicle engines while offloading material.	Site Management
		Construction machinery will be kept in good condition to reduce noise generation.	Site management/ Contractor
		All generators and heavy duty equipment will be installed and placed in enclosures to minimize ambient noise levels.	Contractor
11	Vehicular Traffic	The proponent will put in place measures to address such concerns by ensuring that construction vehicles preferably deliver materials during off-peak hours when traffic volume is low.	Site management
		There will also be provision for caution signs on the access road to alert users on construction activities in progress in order to prevent occurrence of accidents.	Site Management
		Heavy traffic during construction phase will come to the project site during late night hours.	Site Management
		Speed of vehicles will be regulated during construction phase.	Site Management/ Contractor
		Impacts from the traffic flow will be minimized through proper planning of the transportation of materials to ensure that vehicle fills are increased, in order, to reduce the number of trips done or the number of vehicles on the road.	Site management
		Truck drivers will be sensitized to avoid unnecessary racing of vehicle engines at loading/offloading areas and to switch off or keep vehicle engines at construction site.	Contractor
12	Materials Selection	The structures and materials will, in the subsequent construction stage, conform to recommended standards and follow standard practice of civil works.	Site Management
		Materials including paving stones, crush, gravel and sand will be brought from commercial quarries located in the area. Environmentally sound materials and goods will be selected, with priority being accorded to products meeting national and international standards.	Site Management
		Traditionally well-tried materials and components will be selected and selection of construction materials would be based on sustainable source.	Site Management
		Construction site will be adequately isolated to prevent entry of public and general safety measures will be evocatively imposed throughout the construction period.	Site Management
		The production, use and disposal of building materials during the construction stage of the project will utilize considerable amount of energy and resources; all attempts will be made towards efficient consumption and minimization of wastage of water, energy and materials.	Site Management
		Best practice of energy efficiency will be adopted in the building design. The Project building would be constructed with high level of thermal insulation.	Site Management
		The environmental impacts arising from selection of building materials and components would take account of the environmental issues during the materials selection process, and introduce Recycling strategies such as Reuse and Reduction of wastewater.	Site Management

Table 7.1: Mitigation Matrix for Design and Construction Phase

13	Occupational Health and Safety	Workers will be trained with lifting and materials handling techniques before the construction of the project, including the placement of weight limits above which mechanical assists or two-person lifts are necessary. Work site layout will be planned to minimize the need for manual transfer of heavy loads	Site Management
		Tools will be selected and work stations would be designed to reduce force requirements and holding times, which promote improved postures, including, where applicable, user adjustable work stations.	Site Management
		Administrative controls, such as job rotations and rest or stretch breaks will be implemented into the work processes.	Site Management
		Good house-keeping practices, such as the sorting and placing loose construction materials in established areas away from foot paths, will be implemented.	Site Management
		Excessive waste debris and liquid spills will be cleaned up regularly.	Site Management
		Electrical cords and ropes will be located in common areas and marked corridors.	
		Use of control zones and safety monitoring systems to warn workers of their proximity to fall hazard zones, as well as securing, marking, and labeling covers for openings in floors, roofs, or walking surfaces.	Site Management
		Training and use of temporary fall prevention devices, such as rails or other barriers able to support a weight of 200 pounds, when working at heights equal or greater than two meters or at any height if the risk includes falling into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface.	Site Management
		Training and use of personal fall arrest systems, such as full body harnesses and energy absorbing lanyards as well as fall rescue procedures to deal with workers whose fall has been successfully arrested.	Site Management
		The location of vehicle traffic, machine operation, walking areas, and controlling vehicle traffic will be planned and segregated through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic	Site Management
		Appropriate PPE such as safety glasses with side shields, face shields, hard hats, and safety shoes, would be wore.	Site Management
		The visibility of personnel would be ensured through the use of high visibility vests when working in or walking through heavy equipment operating areas as well as training of workers to verify eye contact with equipment operators before approaching the operating vehicle	Site Management
		Inspected and well-maintained lifting devices will be used that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.	Site Management
14	Community Health and Safety	Access to the site will be restricted through a combination of engineering and administrative controls.	Site Management
		Removing hazardous conditions on construction sites that cannot be controlled effectively with site access restrictions, such as covering openings to small confined spaces, ensuring means of escape for larger openings such as trenches or excavations, or locked storage of hazardous materials.	Site Management
		The mobility of the community living in the area would be restricted from the project site in order to prevent from catching any type of communicable diseases.	Site Management
		Any laborer found to catch any type of disease will leave the site immediately; and would be given proper medical facilities.	Site Management

Table 7.1: Mitigation Matrix for Design and Construction Phase

		The incidence of road accidents involving project vehicles during construction would be minimized through a combination of education and awareness-raising, and the adoption of procedures.	Site Management

Table 7.2: Mitigation Matrix during Operation Phase of the Project

S. No.	Affected Areas	Possible Mitigation Measures	Responsibility
1	Solid Waste	Storage facilities will be setup taking into account quantities of waste generation in the building and the population densities.	Operation Manager
		All solid waste will be segregated at source and then collected, stored and transported for ultimate disposal.	Operation Manager
		Handling and disposal of such waste will be managed by a dedicated waste managing contractor.	Operation Manager
		Adequate provisions in the building will be made for storage of solid waste.	Operation Manager
		There will be bulk dustbin type container.	Operation Manager
		A storage facility will be so placed that it is accessible to resident, employees and visitors of the project.	Operation Manager
		A storage area will be allocated for storage and pre- treatment of the waste. This storage area will be covered and the pollutants from the waste would not affect the surrounding.	Operation Manager
		Local authorities will provide different colored bins for different categories of waste.	Proponent
2	Wastewater Generation & Disposal	Grease interceptor and/ or oil skimmer to be installed on kitchen effluent to maintain oil levels within NEQS limits.	Operation Manager
		Water conservation strategies will be employed to avoid wastage of water.	Operation Manager
		Grey water will be treated and stored for reuse in gardening and other non-potable uses.	Operation Manager
		Periodic preventive maintenance of pumps, diffusers and other ancillary equipment's.	Operation Manager
		Periodic monitoring of wastewater to ensure compliance with NEQS.	Operation Manager
3	Water Consumption	A complete record of water consumption during the operation phase will be maintained.	Operation Manager
		Water conservation practices will be adopted to prevent wastage of water.	Operation Manager
		The water supply lines will be checked and repaired for leaks, if any, in order to reduce wastage of water.	Operation Manager
		Use of water efficient sanitary fittings such as low flush toilets, water efficient shower heads, and aerators on faucets will be ensured throughout the Project cycle.	Operation Manager
4	Energy Consumption	The energy usage during the operational phase will be monitored and targets would be set for efficient use of energy.	Operation Manager
		The occupants of the apartments and employees of the offices will be sensitized to ensure energy efficiency in their domestic operations.	Proponent
		The energy-efficient lighting system installed for the project will contribute immensely to energy saving during the operational phase of the project.	Operation Manager
		Double glazed windows should be used which prevent heat inflow and outflow.	Proponent
5	Air Emission	Regularly carry out ambient air quality monitoring at various points on the access road and immediately outside the proposed project premises.	Operation Manager
		Carbon monoxide detectors are to be provided in car parking which would be interlocked with the ventilation system.	Operation Manager
		Monitor all exhausts at regular frequency.	Operation Manager
		Carry out regular maintenance of generators.	Operation Manager
6		Designated parking areas will be provided for the type of project vehicles within and around the project site.	Operation Manager

Table 7.2: Mitigation Matrix during Operation Phase of the Project

S. No.	Affected Areas	Possible Mitigation Measures	Responsibility
	Traffic Flow & Congestion	Traffic management through site staff may be carried out to manage smooth flow of vehicular traffic and to avoid traffic jam and long queues.	Operation Manager
		Engineering design to examine vehicles exit and entry strategy so that it aligns with the traffic flow to cause minimum hindrance.	Operation Manager
		Vehicles will be parked at designated parking areas during operational phase.	Operation Manager
		Parking of vehicles alongside the road would be prohibited at all times.	Operation Manager
7	Illumination	Evaluation of minimum illumination requirement would be carried out in MEP Services Concept Report, for individual areas.	Operation Manager
8	Fire	Standard fire and smoke detection and protection devices such as alarms, fire hoses and hydrants to be provided in all critical areas.	Operation Manager
		The facility would possess a detailed emergency and evacuation plan that must be regularly drilled to make sure that the responsible staff remains trained at all times.	Operation Manager
		Firefighting equipment such as fire extinguishers and hydrant systems would be maintained at strategic locations within the premises.	Operation Manager
		Regular inspection and servicing of the extinguishers will be undertaken by a reputable service provider and record of such inspections should be maintained.	Operation Manager
		Signs such as “NO SMOKING” will be prominently displayed within the premises, especially in parts where inflammable material are handled.	Operation Manager
9	Socioeconomic Impacts	Grievance redress mechanism to be followed.	Proponent

7.15 Environmental Monitoring Plan

This section provides a monitoring plan that identifies the roles and responsibilities of project staff involved in environmental monitoring, and lists the parameters that will be used in the monitoring process.

7.15.1 Objectives

The main objectives of the construction and operation phase monitoring plan will be to:

- Monitor the actual project impact on physical, biological and socio-economic receptors. This will indicate the adequacy of the EIA and effectiveness of the mitigation measures proposed therein.
- Recommend mitigation measures for any residual impact as well as unexpected impact or where the impact level exceeds that anticipated in the EIA.
- Ensure compliance with the legal and community obligations including plantation /replantation to compensate for lost trees, compensate for lost business through a relocation plan, and provision of safety and security at construction sites.
- Monitor the rehabilitation and restoration of construction sites/campsites as described in the EMP.
- Ensure the safe disposal of excess construction materials.
- The main objectives of monitoring during the operation phase will be to:
- Appraise the adequacy of EIA with respect to the predicted long-term impact of the project on the physical, biological and socio-economic environment.
- Evaluate the effectiveness of the mitigation measures proposed in the EMP, and recommend improvements in the EMP, if necessary.
- Compile periodic accident data to support analyses that will help minimize future risks.

7.15.2 Monitoring Roles and Responsibilities

Internal Monitoring

The Project management will have the overall responsibility for environmental monitoring and evaluation (M&E). This includes the following:

- Ensuring the availability of human and material resources required for environmental monitoring
- Generating periodic monitoring reports and disseminating these among the members of Project management and appropriate staff members
- Ensuring that the required environmental training is provided to the staff concerned
- Contracting out external monitoring to independent firms and ensuring that periodic environmental audits are carried out.

At the end of each month /quarter of project implementation, the Project management will review the efficacy of the M&E arrangements and refine the arrangements if necessary.

Contractor

The Contractor will be responsible for carrying out periodic routine monitoring. Environmental monitoring methods and parameters will include:

- A weekly check of noise levels using a portable noise meter operated near major construction equipment and machinery
- Visual checks of exhaust emissions from equipment and vehicles on a daily basis
- Systematically observe the activities carried out by the contractors or any other organization or individual associated with the project
- Verify that the activities carried out comply with the EIA/EMMP and other conditions identified by the Project management
- Maintain a record of all incidents of environmental significance as well as related actions and corrective measures.

Independent Environmental Monitoring

Project management will engage an independent monitoring firm on the basis of clearly defined criteria including their experience and resources, to ensure monitoring of the project's compliance with the EMMP, and to document the status of the project environment at least once during the lifetime of the project. These monitoring records will be used for compliance purposes as legal records of environmental performance on construction sites. The Monitoring firm's terms of reference will define a clear work plan, including monitoring indicators, and reporting structures and timelines. Project Implementation Committee will provide the necessary logistical support to facilitate the selected firm in the monitoring process. The firm engaged for independent monitoring will report its findings directly to the Project Implementation Committee.

7.15.3 Environmental Monitoring Parameters

The following environmental parameters will be monitored at different sites during the construction phase:

Table 7.4: Environmental Monitoring Plan for the project (Construction and Operation Phase)

Monitoring Areas	Location of monitoring	Parameters and Techniques to Monitor	Monitoring Frequency	Reason to Monitor	Responsibility
Air quality	• Generator area • Any potential site of air emissions (particularly dust emissions during site preparation, excavation)	• Parameters to monitor include: Pb, PM10, PM2.5, SPM, SO_2, NOX and CO, O_3 etc, • Monitor adequacy of dust suppression measures undertaken.	• Quarterly monitoring during construction • Biannually during operation • Daily during construction and then regular during monitoring	Legal obligations, Occupational and local safety	• IMC • Contractor
	• Storage and transportation of construction materials, excavated soil and silt;	• Monitor adequacy of measures undertaken to prevent fugitive dust; • monitor disposal of excavated soil and silt to see they are disposed of at approved site	• Daily during construction		
Flooding/ Water Logging/ storm water drainage	• Drainage Points	• Monitor construction activities to ensure that they do not result in blockage of drainage and cause flooding or water logging at the project site	• Weekly during construction • During Monsoon period in all phases	Legal obligations and maintenance of sanitary conditions	• Contractor • Building Management during regular Operation
Surface and Groundwater quality	• Surface runoff management; • At likely contamination points	• Monitor surface runoff management measures; • Monitor measures taken to prevent contamination of ground/ and or surface water from waste and sewage generated from construction activities.	• Weekly during construction	Protection of water resources	• IMC

Table 7.4: Environmental Monitoring Plan for the project (Construction and Operation Phase)

Discharge of Effluents (Discharge of sewage into the sewer)	• At discharge points	Monitor sewage quality (priority parameters with NEQS) at discharge points after treatment.	• Monthly during construction • Monthly during operation	Protection of water resources / sea	• IMC
Solid Waste	• Collection, handling, storage areas and disposal	• Excavated soil and other construction waste • Solid waste generated from households during operation	• All time activity	Requirement of environmental Management	• Construction Contractor during construction and Building Management during regular Operation
Occupational Risks / Health & Safety	• Construction machinery/equipment and construction activities	• Monitor adherence to all occupational health safety requirements	• Weekly during construction	Occupational safety and legal obligations	• Contractor
Traffic management	• The access roads to the project area	• Monitor movement of construction vehicles across site • Monitor and check for any hindrance caused by construction vehicles • Monitor the traffic management plan during operation	• Regular during construction phase • Regular during operation phase	To avoid inconvenience to the general public and to facilitate smooth flow of traffic	• Construction Contractor during construction and Building Management during regular Operation
Noise	• Construction machinery • Generators operation	• Noise intensity measurement	• Monthly during operation • Monthly during construction	Occupational safety / nuisance to neighboring community	• IMC
Emergency Preparedness	• Fuel storage area • process /control rooms • generator area • other critical area	Visual observation on arrangements for fire safety	• weekly and detailed during quarterly	Building and occupant's Safety	Proponent and IMC

8. GRIEVANCE REDRESS MECHANISM

The Community Grievance Procedure is outlined below, which requires interaction, consultation, targeted information and timely resolution of legitimate grievances of the communities in vicinity who form an important stakeholder. This approach is aimed at building a reputation of responsiveness, concern and responsibility among the community, with a view to building and sustaining acceptance and support for the construction and operation of the project.

The proponent and its Contractor(s) shall foster a sense of working with the local community and demonstrate that the Project takes a proactive stance to grievances. The grievance management system and database will comply with and has the flexibility to feed information into the Community Grievance Procedure. The proponent will also provide all Contractor(s) teams with training in Community Grievance Procedures.

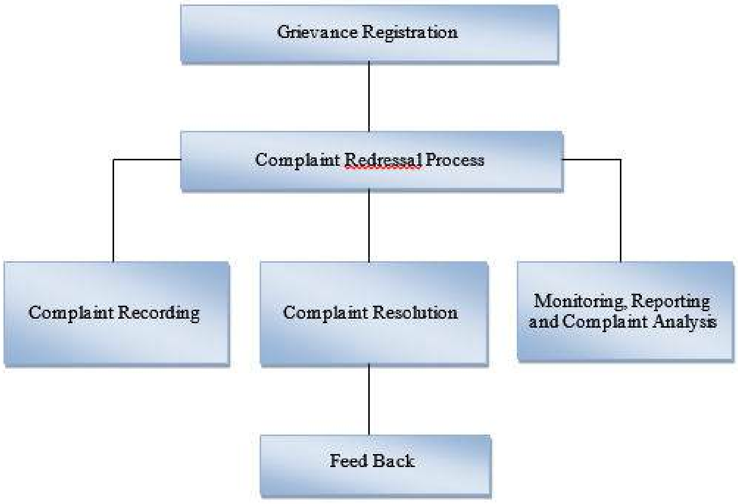

Figure 8.1: Overview of Grievance Redress Approach

In implementing the Community Grievance Procedure, the Contractor(s) shall:

- Record all grievances;
- Assess and advise the resolution of the grievance in the time frame required by the assessment.

All grievances will be investigated and a response (outlining a resolution) provided by the proponent /Contractor(s) as soon as possible and not more than 30 days after receiving the grievance. If more time is required for resolution, the person raising the grievance shall be kept informed.

While the Contractor(s) is not prevented from initiating the grievance resolution, any corrective action taken must be in coordination with the proponent. The proponent will ensure that the details of the Community Grievance Procedure are publicized at community meetings and via posters and other means to all communities in the vicinity of the project.

In addition, the proponent and its Contractor(s) shall ensure that the local populations working/residing in the local area receive necessary information for contacting and initiating a grievance through meetings, pamphlets and similar community outreach programs.

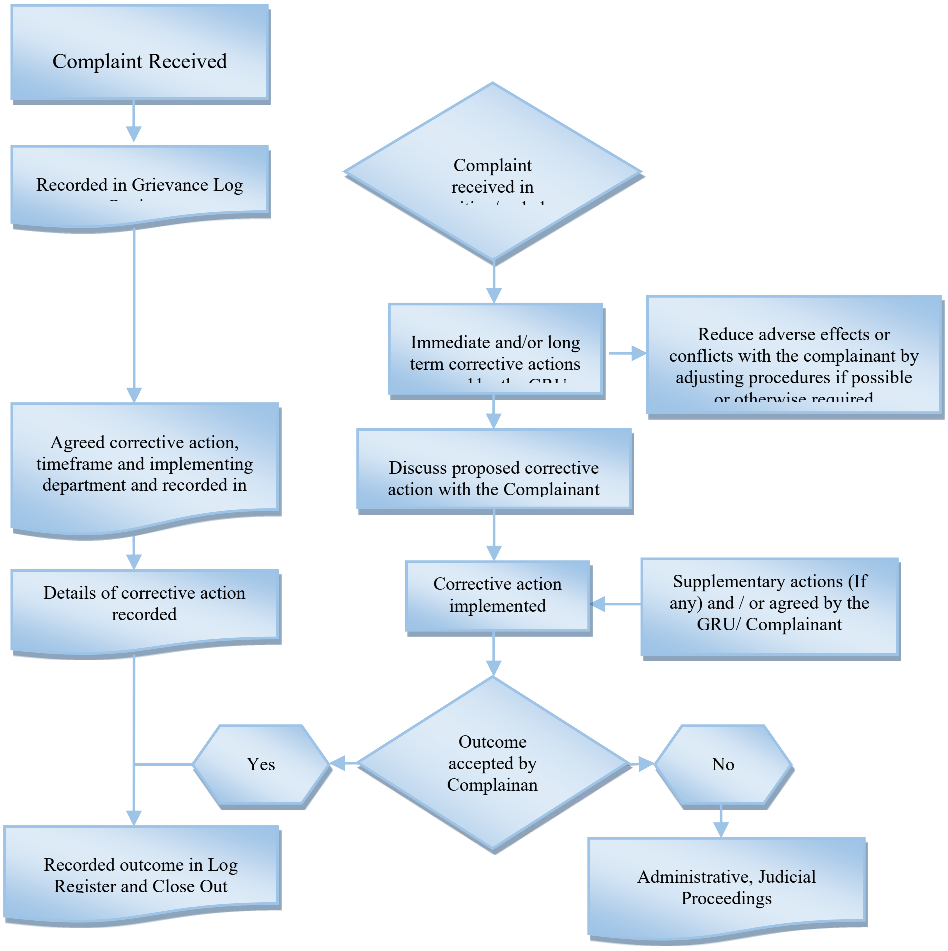

Figure 8.2: Overview of Grievance Redress Procedure

9. FINDINGS AND CONCLUSION

9.1 Summary of Findings

The EIA study for the Courtyard Residence Project has been conducted to fulfill the legislative requirements as stipulated in section 12 of Pakistan Environmental Protection Act, 1997. Key findings of the EIA study, based on review of project activities, project area and screening of impacts are given below:

- The project site comprises approximately 15.8 Kanals of land in F-11/1 just beside the Abdu Dhabi Towers apartments and ideally suits project objectives of creating residential facility in the prime location of Islamabad.
- The site has mostly flat topography with very little variation. Slope cutting /stabilization is therefore not involved.
- Project does not lie inside or adjacent to protected area or buffer zone of protected area.
- Also no special area for protecting biodiversity is found. No Ramsar sites are found within study area. No areas of primary forest are found within or adjacent to the project site.
- There are no gazetted archaeological sites located within the close vicinity of proposed project.
- Land acquisition for the project is not involved as the land has already been acquired.
- Proposed project would require 107,000 US gallons /person/day of water for domestic use and 17,000 US gallons for firefighting for three (03) towers.
- Water conservation practices will be implemented to ensure sensible water use by the project. Also, the project will treat the wastewater for use in other non-potable uses like gardening etc.
- The air quality of the site according to the ambient air monitoring results has been classified as unpolluted. Air quality of the air shed of macro-environment as well as that of the site itself will have no significant impact due to location of the project. Temporary disturbance during construction will need to be managed effectively to avoid impact due to dust and other emissions on nearby residents.
- Water analysis of the groundwater being used at project site also indicates good water quality and within NEQS limits. The results of water quality analysis are annexed with the report.
- The construction activities will have to be carefully scheduled to avoid hindrance to ongoing activities in the surrounding like traffic which may get affected from vehicles moving in and out of the site for transportation of construction material.
- A peak ground acceleration of 0.25g 0.32g has been taken as design basis for earthquake for construction of the building.
- The project site is not close to any industrial units and therefore does not receive any impact from the emissions and discharges from the industrial units.

Assessment of impact of activities during construction and operation stages of project shows that the impacts will be of temporary nature and small order. They are not expected to have any significant adverse impacts on the microenvironment and macro environment of the Project. The minor impacts resulting from said activities or operation of facilities would be mitigated.

9.2 Recommendations

Based on the findings of the EIA study and screening of potential environmental and social impacts, it is recommended that:

- The structures and materials conform to recommended standards and follow standard practice of civil works.
- Environmentally sound materials and goods are selected, with priority being accorded to products meeting national and international standards.
- Traditionally well-tried materials are chosen for provision of utilities services in the Project.
- Temporary inconveniences due to construction works are minimized through planning and coordination with local population and organizations in the neighborhood.
- The foundations be of concrete on bearing soil. Bearing capacity, settlement, static and dynamic loading conditions should be determined in view of seismic conditions pertaining zone 2B (Moderate to High hazards) and taken into account in the working designs.
- The stability of soil be verified before laying the foundations.
- Environmental Performance Monitoring to be an integral part of the Project to ensure environmental safeguards.
- Wastewater treatment plant should be operated efficiently and periodically monitored. Record of water conservation activities may be maintained for evaluation purpose. Also, periodic monitoring of water conservation arrangements such as rainwater harvesting system etc. should be done to ensure system is working properly.
- Constant and transparent liaison should be maintained with community and other stakeholders in the vicinity to address any concerns they may have during construction and operation phase of the project.
- Record of bird collisions and injuries/death should be maintained for evaluation purposes and improvement where required.
- Provisions for renewable energy should be considered in the building design. For this purpose, solar panels of adequate capacity may be installed at roof top.
- Energy conservation designs should be considered such as automatic lighting systems which detect daytime and human presence and shut off automatically.
- Constant liaison should be maintained with nearby communities to address their concerns/complaints during construction and operation. For this purpose, a grievance register may be developed and maintained to document any complaints received and address them in a systematic manner.
- Biannual/annual environmental performance review to evaluate the project’s environmental performance, progress on conservation measures adopted may be undertaken for improvement purposes.

9.3 Conclusion

The nature of Project, it’s siting; adoption of adequate measures to minimize waste and control pollution and traffic congestion during construction as well as operation stages of the project will have residual impact of low significance on the microenvironment and macro environment.

Construction and operation of the project is not expected to have unacceptable/significant impact on the aesthetics of the microenvironment and macro environment. Nevertheless, the impact will be mitigated through careful planning, suitable landscaping, waste management, traffic management and adopting appropriate mitigation measures.

Mitigation measures have been suggested and management plan is provided along with a program of environmental monitoring to ensure that all measures are adopted as intended, and to determine whether the environment is protected as envisaged.

The EIA study, based on the findings and recommendations given above as well as the screening of impacts, suggests that the Construction and operation of the project will, on adoption of the suggested mitigation measures, be an environmentally acceptable proposition.

The consultant therefore recommends that the EIA Report may be approved with the provision that the suggested mitigation measures and EMMP will be adopted in letter and spirit.

Annex – I: Allotment Letter from CDA

Annex – II: Geotechnical Investigation Report

Annex – III: Environmental monitoring Report

Annex – IV: Layout Plans of the Project

THE COURTYARD RESIDENCES APARTMENT COMPLEX,

STREET NO. 73, SECTOR F-11/1, ISLAMABAD.

Geotechnical Investigation Report

Prepared for

Client:

M/s The Courtyard

Consultant:

M/s SMK Associates

DECEMBER, 2024

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Document History

Document details

Project No.	AJK/GT/101-3645
Document title	Geotechnical Investigation Report – The Courtyard Residences Apartment Complex
Site address	Street No. 73, Sector F-11/1, Islamabad.
Report prepared for	M/s The Courtyard

Document status

Revision	Comment	Prepared by	Date issued
0	Initial Issue	Muhammad Jawad Hassan	05-12-2024

Distribution of copies

Revision	Electronic	Paper	Issued to
0	Yes	No	M/s The Courtyard

The undersigned, on behalf of AJK Engineers (Pvt.) Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		05-12-2024

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Appendix A : Layout Plan of the Area

Appendix B : Seismicity / Geological Map of the Area

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Appendix F : Summary of Laboratory Test Results / Detailed Test Result Sheets

Appendix G : Site Photographs

EXECUTIVE SUMMARY

This report summarizes the results of field and laboratory testing for the geotechnical investigations carried out for the Courtyard Residences Apartment Complex, Street No. 73, Sector F-11/1, Islamabad.

The scope of geotechnical investigations mainly includes execution of two (02) boreholes of 76.0m depth, two (02) boreholes of 28.0m & one (01) borehole upto 91.5m & 106m depth respectively below existing ground level (EGL), performance of field testing (i.e. SPTs) and collection of disturbed/undisturbed soil samples for necessary laboratory testing. A general layout plan indicating the locations of investigation points is attached in ***Appendix-A.***

Based on the information gathered through the boreholes, following lithology was encountered;

- Filling Material mainly consists of Silty Clay, Sand, Gravel, Cloth Pieces, Brick Pieces & Aggregates etc. is present from top of the ground to a depth of 8.53m – 12.0m below EGL.
- Poorly Graded Gravel with Silt / Silty Gravel in Medium Dense to Very Dense state was present from 8.53-12.0m to 15.0m depth below EGL.
- Lean Clay / Lean Clay with Sand / Silty Clay in Stiff to Very Hard state was present from 15.0m to 74.0-76.0m depth below EGL.
- Silty Gravel in Very Dense state was present from 76.0m to 106.0m depth below EGL.
- Seepage/Perched water was encountered at a depth ranging from 9.80m to 11.50m in all boreholes during the execution of field geotechnical investigations.

As per “Seismic Provisions-2007” of the Building Code of Pakistan (BCP: SP, 2007), Zone **2B** has been assigned to the project site with peak ground acceleration (PGA) of 0.16g to 0.24g.

Based on our evaluations, the seismic site class ***CD (Dense Sand or Very Stiff Clay)*** can be used for the design of the foundation.

Liquefaction analysis has been carried out for the project area which indicated that the project area is not likely to liquefy during earthquakes.

Chemical test results indicated that the subsurface soil within the project area consists of a low proportion of harmful salts as per ACI-318 Building Code Requirements. It is therefore recommended to use Ordinary Portland Cement (OPC) for all concrete works of the foundation.

Considering, the sub-surface ground conditions and the type of loads of the proposed structure, Mat and Pile foundation may be appropriate to safely transfer loads of the proposed building to the underneath soil stratum. Recommended Pile Capacity curves have been provided in Appendix – D of this report.

Geotechnical Investigation Report –

The Courtyard Residences Apartment Complex,

Street No. 73, Sector F-11/1, Islamabad.

1. INTRODUCTION

1.1 Brief Introduction

The client plans to construct an apartment complex comprising three towers in Sector F-11/1, Islamabad. The proposed towers will have 34, 30, and 22 storeys, with three basements. This report outlines the details of the geotechnical investigations conducted for the project. M/s SMK Associates serves as the consultant, while M/s AJK Engineers (Pvt.) Ltd. carried out the geotechnical investigations. The fieldwork was conducted from October 13 to November 25, 2024.

The geotechnical investigations mainly consist of execution of boreholes, performance of standard penetration tests (SPTs) in the boreholes, collection of disturbed/undisturbed soil samples, measurement of groundwater table encountered in boreholes, performance of laboratory testing on selected soil samples and preparation & submission of geotechnical investigations report based on field and laboratory investigations.

1.2 Objectives of Geotechnical Investigations

The Geotechnical Investigations have been conducted at the site to achieve the following objectives:

i. To establish the presence and extent of various lithological units prevailing at the proposed project site.

ii. To ascertain the presence and location of groundwater from a geotechnical point of view and to determine its quality from the construction perspective.

iii. To explore the zones of soft / weak soil stratum within the project area.

iv. To determine the geotechnical design parameters for carrying out the design of foundations to be constructed for the proposed buildings / structures.

v. To furnish the considerations which are to be considered for the construction of foundations and other geotechnical structures.

1.3 Scope of Field Activities

Following geotechnical investigations were carried out to fulfil the above listed objectives and structural requirements:

i. Execution of six (06) boreholes, including two (02) boreholes to a depth of 76.0 m, two (02) boreholes to a depth of 28.0 m, one (01) borehole to a depth of 91.5 m, and one (01) borehole to a depth of 106.0 m below the existing ground level (EGL), using the hydraulic-feed straight rotary drilling technique.

ii. Carrying out Standard Penetration Tests (SPTs) in the Boreholes, at specified depth intervals.

iii. Collection of undisturbed and disturbed soil samples from each Borehole where deemed necessary.

iv. Obtaining information about the groundwater table.

v. Laboratory testing of selected soil and water samples.

vi. Preparation of detailed borehole logs as per field and laboratory investigations.

vii. Preparation of foundation design recommendations for different soil stratum encountered during geotechnical investigations.

viii. Preparation of Detailed Geotechnical Investigations Report.

1.4 Project Overview

The project site is located in Sector F-11/1, Islamabad, near F-11 Markaz, and is accessible via Street No. 73. It is surrounded by multi-storey apartment buildings on the north, west, and east sides, while a water body passes near the southern boundary of the plot.

The proposed apartment complex comprises three structures: (3B+G+21F), (3B+G+29F), and (3B+G+33F). Addition of 4th basement is also under consideration. A layout plan of the project site, along with borehole locations, is provided in ***Appendix-A***.

1.5 Geology of the Project Area

The dominant factor controlling the geology of the project area is the convergence of the Pakistan- India and Eurasian tectonic plates and the collision between the plates that began about 20 million years ago. This process produced complex structures and stratigraphy in the Islamabad-Rawalpindi area. The regional geology of the Islamabad-Rawalpindi area will be best understood by reference to the geologic map of Pakistan by GSP.

The sedimentary rocks of the Islamabad area record a long period of gentle geologic fluctuations and slow deposition while the Pakistan-India tectonic plate drifted northward across the Indian Ocean, followed by much more vigorous tectonic processes and rapid deposition in the shorter period since the Pakistan-India and Eurasian plates converged. Consequently, the 150-million-year (m.y.) period from the deposition of the Samana Suk Formation (Middle Jurassic) to the beginning of deposition of the Murree Formation (lower Miocene) is represented by only about 675 m of primarily marine sedimentary rocks, whereas the last 20 m.y. are represented by more than 7,572 m of continental sedimentary rock. The geological plan of the project area is attached to the report as Appendix-B.

2. FIELD INVESTIGATION

2.1 General

This chapter mainly deals with the activities performed in the field to acquire the subsurface information of existing soils present at the proposed project site. Field activities conducted during these investigations are summarized hereunder:

- Execution of boreholes using Straight Rotart drilling method
- Performance of in-situ tests (i.e. SPTs) in boreholes, where possible
- Soil sampling for subsequent laboratory testing
- Taking observation of the groundwater table

The following sections provide the details of all the executed field activities:

2.2 Exploratory Borehole

A total of Six (06) boreholes up to the maximum depth of 106.0m below Existing Ground Level were drilled at the proposed locations. The straight rotary drilling method was used to drill in soil strata (overburden soils). The diameter of the boreholes was 96 mm. The details of boreholes drilled at the project site below the existing ground level are given below in the table:

S. No.	Borehole No.	Depth (m)	Coordinates		Drilling Method
			Easting	Northing	
1	BH-01	28.0	33.681336	72.98763	Hydraulic Feed Straight Rotary Drilling Rig
2	BH-02	76.0	33.681232	72.987439	
3	BH-03	76.0	33.681513	72.987523	
4	BH-04	91.0	33.681353	72.987203	
5	BH-05	28.0	33.681664	72.987839	
6	BH-06	106.0	33.681706	73.987479	

A careful record of drilling, in the form of borehole logs, was prepared by qualified Engineers. The logs present a summary of encountered subsoil strata, in-situ test results (i.e. SPTs), location of groundwater table / seepage water and other anomalies that have been observed during the drilling operation. Plan indicating the location of boreholes and detailed borehole logs are appended with the report as ***Appendix – A*** and ***Appendix – E*** respectively.

2.3 Standard Penetration Tests (SPTs)

Standard Penetration Tests (SPTs) were conducted in the soils encountered in boreholes at planned interval i.e. @ 1.0-3.0m depth interval. These tests were conducted as per the procedures described in the latest version of ASTM D-1586. A donut type hammer, weighing 63.5 kg was used for the testing which was lifted and dropped through a pulley attached to a tripod. Results of SPTs are presented on their respective borehole logs ***Appendix – E***.

2.4 Disturbed Soil Sampling

From boreholes, disturbed soil samples were obtained using split spoon sampler while performing the SPTs in the boreholes where possible. The specimens collected from boreholes were carefully placed in polythene bags which were stored in plastic jars.

All samples were clearly labelled identifying the following details;

- Project name
- Project ID
- Borehole designation in which sampling is being performed
- Sample designation
- Depth of collection
- Date of collection

All the soil samples were carefully transported for subsequent laboratory testing.

2.5 Undisturbed Soil Sampling

Undisturbed soil samples (UDS) were collected from the boreholes using thin-walled tube samplers at designated depths. These tube samples were carefully preserved by waxing both ends of the tubes and wrapping polythene bags at the edges of the tubes thereafter. Each specimen was labelled to identify the following details:

- Project name
- Project ID

- Borehole designation in which sampling is being performed
- Sample designation
- Depth of collection
- Date of collection

2.6 Groundwater Observations

Observations regarding the depth of the groundwater table were taken immediately and 24 hours after the completion of boreholes and was monitored regularly throughout the period of field investigations. The observations indicated that Seepage/Perched water was encountered at a depth ranging from 9.80m to 11.50m in all boreholes.

3. LABORATORY TESTING

3.1 General

After completion of field investigations, laboratory testing program for selected soil samples was prepared in the light of various types of sub-soils encountered at various depths. The laboratory testing program was prepared in such a way as to acquire the maximum details required for the classification and evaluation of the index & other engineering characteristics of sub-soils present underneath the proposed project site. The following laboratory tests were carried out on selected soil samples as per laboratory testing program:

- Sieve Analysis (ASTM D-421)
- Natural Moisture Content (ASTM D-2216)
- Atterberg Limits (ASTM D-4318)
- Bulk & Dry Density (ASTM D-7263)
- Unconfined Compression Test (ASTM D-2166)
- Chemical Analysis of Soil and Water Samples (BS 1377 part 3)

The laboratory tests were performed as per the latest version of the relevant ASTM Standard as mentioned above. Summary of laboratory test results and detailed test result sheets are appended with the report as ***Appendix – F.***

3.2 Findings on Laboratory Tests

3.2.1 Sieve Analysis (ASTM D-421)

A total of Forty-one (41) Sieve analyses were performed as per ASTM D-421 for soil classification. The classification test results indicate fine- and coarse-grained soils mostly comprised of Lean Clay with Sand / Lean Clay / Silty Clay / Sandy Silty Clay, Poorly Graded Gravel / Poorly Graded Gravel with Silt & Sand / Silty Gravel soil groups according to the Unified Soil Classification System (USCS). Test results indicated that soils consist of gravel content ranging from 0.0 % to 90.18%, sand content ranging from 2.14% to 63.69% and fine particles passing sieve no. 200 ranging from 1.39% to 97.49%.

3.2.2 Atterberg Limits (ASTM D-4318)

For estimating the consistency characteristics of cohesive soil samples, Atterberg limit tests were performed as per ASTM D-4318. Test results for thirty-four (34) soil samples indicated that soils have a liquid Limit (LL) ranging from 26% to 44% with plastic index (PI) ranging from 6% to 21%.

3.2.3 Natural Moisture Content (ASTM D-2216)

The natural water content also called the natural moisture content is the ratio of the weight of water to the weight of the solids in a given mass of soil. The laboratory tests performed on forty-five (45) soil samples have yielded natural moisture content ranging from 1.66 to 29.06%.

3.2.4 Bulk and Dry Density (ASTM D-7263)

Four (04) soil samples were tested for density determination as per ASTM D-7263. Test results indicated bulk density is 1.90 to 1.98 gm/cm^3 and dry density is 1.60 to 1.69 gm/cm^3.

3.2.5 Unconfined Compression Test (ASTM D-2166)

For determining the compressive strength of cohesive soil samples, selected Four (04) soil samples were tested as per ASTM D-2166. The unconfined compressive strength of the tested soil samples is 0.31 to 1.50 kg/cm^2.

3.2.6 Chemical Analysis of Soil/Water (BS 1377 part 3)

Chemical test results for Three (03) soil samples are summarized below:

• Sulphate Content:	0.03% – 0.05%
• Chloride Content:	0.02% – 0.04%
• Organic Matter Content:	0.41% – 0.54%

Chemical test results for Six (06) water samples and Three (03) soil samples are awaited and shall pe provided on completion of these tests.

4. SITE GEOTECHNICS

Geotechnical investigations were planned in such a manner as to effectively explore the site geotechnics of the project area. This chapter mainly discusses our evaluations for sub-soil lithology / stratigraphy, seismicity, soil seismic profile, liquefaction potential and other geotechnical characteristics of the soils prevailing at the project site.

4.1 Stratigraphy

At the time of these investigations, the maximum depth of drilled borehole was 106.0m below the existing ground level (EGL). General stratigraphy of the project area, as deduced from the site investigations duly corrected in the light of laboratory test results (wherever required), indicates the presence of the following general stratigraphic units;

Borehole No.	Depth below E.G.L (m)	Lithology
BH-01	0 – 8.53	Brown **Filling Material** (Silty Sand with Gravel, Silty Clay, Plastic Bags, Tiles Pieces, etc.)
	8.53 – 16.0	Grey, Medium Dense to Very Dense, Poorly Graded, **Gravel with Sand**
	16.0 – 28.0	Brown, Hard to Very Hard, **Lean Clay / Lean Clay with Sand**
BH-02	0 – 9.0	Brown **Filling Material** (Gravel/ Boulder, Silty Clay with Sand, Concretions)
	9.0 – 15.5	Grey, Very Dense, **Silty Gravel**
	15.5 – 76.0	Brown, Very Stiff to Very Hard, **Lean Clay / Lean Clay with Sand**
BH-03	0 – 12.0	Brown **Filling Material** (Sand with Silt and Clay, Gravel, Grass roots, etc.)
	12.0 – 14.5	Grey, Very Dense, **Silty Gravel**
	14.5 – 34.5	Brown, Stiff to Very Hard, **Lean Clay / Lean Clay with Sand / Sandy Silty Clay**
	34.5 – 37.5	Grey, Very Dense, **Silty Gravel**

	37.5 – 76.0	Brown, Hard to Very Hard, **Lean Clay / Silty Clay**
BH-04	0 – 9.0	Brown **Filling Material** (Sand with Silt and Clay, Gravels)
	9.0 – 10.0	Dark Brown, Medium Stiff, **Lean Clay**
	10.0 – 14.5	Grey, Very Dense, **Silty Gravel**
	14.5 – 75.0	Brown, Very Stiff to Very Hard, **Lean Clay / Lean Clay with Sand**
	75.0 – 90.0	Grey, Very Dense, **Silty Gravel**
BH-05	0 – 9.2	Brown **Filling Material** (Silty Sand with Gravel, Silty Clay, Plastic Bags, Tiles Pieces, etc.)
	9.2 – 14.5	Grey, Very Dense, Poorly Graded, **Gravel with Sand**
	14.5 – 23.0	Brown, Hard to Very Hard, **Lean Clay / Lean Clay with Sand**
	23.0 – 25.0	Grey, Very Dense, Poorly Graded, **Gravel**
	25.0 – 27.0	Brown, Very Hard, **Lean Clay**
BH-06	0 – 7.0	Brown **Filling Material** (Sand with Silt and Clay, Gravel, Grass Roots, etc.)
	7.0 – 10.0	Grey, Very Dense, Poorly Graded, **Gravel with Silt**
	10.0 – 21.5	Brown, Hard to Very Hard, **Lean Clay / Lean Clay with Sand**
	21.5 – 25.5	Brown, Very Dense, Poorly Graded, **Sand with Silt & Gravel**
	25.5 – 74.0	Brown, Hard to Very Hard, **Lean Clay / Lean Clay with Sand / Gravelly Lean Clay**
	74.0 – 106.0	Grey, Very Dense, **Silty Gravel**

Based on the information gathered through the boreholes, the following general lithology was encountered;

- ***Filling Material*** mainly consists of Silty Clay, Sand, Gravel, Cloth Pieces, Brick Pieces & Aggregates etc. is present from top of the ground to a depth of 8.53m – 12.0m below EGL.
- ***Poorly Graded Gravel with Silt / Silty Gravel*** in Medium Dense to Very Dense state was present from 8.53-12.0m to 15.0m depth below EGL.
- ***Lean Clay / Lean Clay with Sand / Silty Clay*** in Stiff to Very Hard state was present from 15.0m to 74.0-76.0m depth below EGL.
- ***Silty Gravel*** in Very Dense state was present from 76.0m to 106.0m depth below EGL.
- Seepage/Perched water was encountered at a depth ranging from 9.80m to 11.50m in all boreholes during the execution of field geotechnical investigations.

Details of strata encountered in each borehole can be elucidated from digitized borehole logs presented in ***Appendix-E***. In addition, a cross-section of sub-surface soil profile is provided in ***Appendix-C.***

4.2 Seismic Soil Profile Characterization

The subsurface stratum present at the site has been characterized by using the guidelines provided in ASCE/SEI 7-22 "Minimum Design Loads and Associated Criteria for Buildings and Other Structures". Chapter – 20 "Site Classification Procedure for Seismic Design", of this code describes the procedure for determining the Site Class A to F in accordance with Table 20.2-1.

As per site conditions, site class ***CD (Dense Sand or Very Stiff Clay)*** can be used for the design of the foundation. The shear wave velocity ($\boldsymbol{v_s}$) will be *1000 to 1450 ft/sec*.

4.3 Risk Category for the Proposed Building

Considering the type of structure and its usability, the proposed project has been placed in risk category III as per Building Code of Pakistan 2021 (Section 1604.5).

4.4 Seismic Ground Motion Values

As per Building Code of Pakistan 2021 (Section 1613.2), The determined Seismic Ground motion values have been documented in the following sub-sections.

4.4.1 Mapped Acceleration Parameters

0.2-second spectral response acceleration (S_s) and 1-second spectral response acceleration (S_1) have been determined to be ranged from 1.30g and 0.38g, respectively (BCP 2021, Table C-1).

4.4.2 Maximum considered earthquake spectral response Acceleration

The maximum considered earthquake spectral response acceleration for short periods (S_{MS}) and at 1-second period (S_{M1}) were found out to be 1.43 and 0.65, respectively (BCP 2021, Section 1613.2.3).

4.4.3 Design spectral response Parameters

Five-percent damped design spectral response acceleration at short periods (S_{DS}) and at 1-second period (S_{D1}) were calculated as 0.95 and 0.43, respectively (BCP 2021, Section 1613.2.3).

4.4.4 Seismic Design Category

Based on design spectral response parameters and the risk category, a seismic design category is assigned to the proposed structure as per the guidelines provided in ASCE/SEI 7-22 (also reported in BCP 2021, section 1613.2.5). The proposed project site has been assigned "*Seismic Design Category -D*".

The above-mentioned Seismic soil profile and ground motion parameters have been summarized in the table below:

DESIGN PARAMETERS		
Site Class		D
Risk Category		III
Mapped Acceleration Parameters	S_s	1.30
	S_1	0.38
Site Coefficients	F_a	1.1
	F_v	1.7
Maximum considered Earthquake Spectral Response Acceleration	S_{MS}	1.43
	S_{M1}	0.65
Design Spectral Response Parameters	S_{DS}	0.95
	S_{D1}	0.43
Seismic Design Category	Based on 0.2 Short-Period Response Acceleration	D

4.5 Liquefaction Potential

Loose state, water-submerged, cohesionless soils are generally susceptible to liquefaction under dynamic loads caused by earthquakes. Liquefaction results in total or partial loss of shear strength thereby leading to substantial subsidence, ground heave and/or uplifting of lightweight structures.

Using sub-surface ground and groundwater conditions encountered in the project area, liquefaction of the area has been checked as per guidelines mentioned in "Proceeding of the NCEER Workshop on

Evaluation of Liquefaction Resistance of Soils" NCEER-970022. ***The analysis indicated that the onsite soil deposits are not likely to liquefy during earthquakes.***

5. FOUNDATION DESIGN

Based on the field investigations and the subsequent laboratory testing, sub-surface strata at the project site has been established and the corresponding design of foundations has been carried out. The details of foundation design recommendations are provided in the following section:

5.1 Geotechnical Soil Model and Design Parameters

To execute the design of foundations, the subsurface soil model and respective geotechnical design parameters for the project site have been established by analysing the observations made during field investigations, laboratory testing and engineering judgment. Based on these results, the critical geotechnical soil model along with the geotechnical design parameters prevailing at the proposed project site have been established and are given below:

Type of Material	Maximum Layer Thickness below Adj. Road Level (m)	Subsurface Soil Parameters	
Filling Material	0.0 –12.0	Bulk Unit Weight (γ_b)	= 16 kN/m^3
Lean Clay / Silty Clay (Very Stiff to Hard)	15.0 – 76.0	Cohesion (C_u) Bulk Unit Weight (γ_b) Modulus of Elasticity (E)	= 150 kPa = 19 kN/m^3 = 50 MPa
Silty Gravel (Very Dense)	76.0 – 106.0	Angle of Internal Friction (ϕ) Bulk Unit Weight (γ_b) Modulus of Elasticity (E)	= 34° = 19.5 kN/m^3 = 60 MPa

5.2 Foundation Type and Depth

In order to be safe, the load carrying strata must be competent to sustain the imposed loading without undergoing shear failure and at the same time settlements of the foundations must not exceed the tolerable limits. Therefore, the load carrying characteristics of the strata must be evaluated keeping in view these considerations.

Considering the sub-surface ground conditions and the type of loads of the proposed structure, ***Mat and/or Bored Cast In-Situ Pile Foundation*** will be appropriate to safely transfer loads of the proposed building to the underneath soil stratum.

5.3 Design Criteria

All the foundation design has been carried out considering the following design criteria:

- The allowable loads should not initiate the shear failure of the foundation soil/bedrock.
- The total as well as differential settlements of foundations caused by the application of allowable loads should be within specified tolerable limits i.e. maximum permissible settlement for mat foundation = 50.8 mm.
- The settlement of the individual and group of piles should be within the tolerable limits under the application of allowable loads.

5.4 Shallow Foundation

Considering the proposed structure consisting of three to four basements, the Raft foundation can be placed at depth of 12.0m (40 ft.) or below from the Adjacent Road Level.

The evaluations of allowable bearing pressures in shear have been calculated using Hansen (1970) approach and for Immediate Settlement calculations, Timoshenko and Goodier (1951) Approach has been used.

The recommended allowable bearing pressures for Mat foundation is shown below:

Depth of Foundation (m)	Foundation Width (m)	Net Allowable Bearing Pressure (kPa)	Overburden Relief (kPa)	Gross Allowable Bearing Pressure (kPa)	Tolerable Settlement (mm)
12	20	275	96	371	50.8
	30	190	96	286	50.8
	40	135	96	231	50.8
16	20	310	120	430	50.8
	30	192	120	312	50.8
	40	140	120	260	50.8

In any case, foundations should not be placed on soft / loose material. In case, soft / loose material is found at the proposed foundation level, they should be completely removed and replaced by compacted engineered fill as per specifications mentioned in Section 6.1 of this report.

5.4.1 Modulus of subgrade reaction

Modulus of subgrade reaction (K_s) is a conceptual relationship between contact pressure and foundation settlements. It is required for modelling the structure in a computer program and to account for soil-structure interaction and the settlement-induced stresses. A simplified relationship for the determination of modulus of subgrade reaction is given as;

$$K_s\ (kN/m^3) = [q_a \times F.O.S] / \text{Permissible settlement}$$

5.5 Deep Foundations

Considering the sub-surface ground conditions and availability of construction equipment in the local market, bored cast in situ pile foundation may also be appropriate to safely transfer loads of the proposed structures to the underneath soil stratum.

Pile foundations having diameters of 760mm, 900mm, 1000mm and 1200mm with lengths 20.0m ~ 50.0m below Cut-Off levels of 40ft. and 53ft. and from the Adjacent Road Level are considered as per structural requirements.

The load carrying capacity analysis of RC pile foundations (under compression and Tensile loading) has been carried out using the procedure as given in NAVFAC Design Manual 7.02.

Allowable pile capacity curves (using a safety factor of 2.5 for compression and 3.0 for tension/uplift) for single piles under Compression and Tension loading are appended with the report as Appendix – D.

Note: It is worthy to mention that preliminary allowable pile capacities are computed by static formulae which suffer from limitations. Also, the capacity of the cast-in-situ reinforced concrete piles depends on the type and method of casting, it is therefore the responsibility of the piling contractor to verify the final design values by conducting pile load tests on the pilot and / or working piles. Pile capacities should be suitably adjusted if warranted by the results of load tests. The allowable pile capacity curves provided in Appendix – D is valid only if the requirement of the pile load tests is fulfilled.

If piles will be used in a group, the selected pile capacity must be reduced by applying an appropriate group reduction factor as suggested in AASHTO LRFD Bridge Design Specifications.

5.5.1 Pile Load Test

The selected pile length & capacity must be confirmed by performing at least one full scale (i.e. 2.5 x design load/group reduction factor) pile load test. Load test should be performed as per latest relevant ASTM standard.

In addition, 1% to 2 % of the working piles, should also be subjected to proof load tests, so that the quality of construction of working piles can be verified. The proof load test may be carried out up to 1.5 x design load.

5.6 Lateral Earth Pressures

Cohesion less granular material is recommended to be used as a backfill material for buried structures and retaining walls. The magnitude of static earth pressures to be used for the design depends on the soil type, its shear strength parameters, nature of the structure, method and quality of construction, restraint conditions of the retaining system and permissible design movements. For smooth vertical retaining walls with horizontal backfill, the following simplified equations can be used for the estimation of coefficients of lateral earth pressures.

Coefficient of active earth pressure, Ka = $(1 - \sin \Phi') / (1 + \sin \Phi')$

Coefficient of earth pressure at rest, Ko = $(1 - \sin \Phi')$

Coefficient of passive earth pressure, Kp = $(1 + \sin \Phi') / (1 - \sin \Phi')$

Where,

Φ' = effective angle of internal friction of the backfill soil

The effective friction angle of backfill soil, Φ', should be determined by performing shear test on remoulded soil sample at specified density moisture content. For preliminary estimates, following earth pressures coefficients can be used considering a friction angle of 30°

$$K_a = 0.33, \quad K_o = 0.50 \quad \& \quad K_p = 3.00$$

The lateral earth pressures to be used in the design should be increased for the additional residual earth pressures to be induced by the effect of compaction, as per provisions of NAVFAC: DM7.02 (1986) (Chapter-3, Section-6).

The dynamic earth pressures for active and passive conditions should be evaluated based on Mononobe-Okabe model.

6. CONSTRUCTION CONSIDERATIONS

6.1 Foundation Material

The material encountered at the foundation placement level should be thoroughly inspected by an experienced geotechnical Engineer and should conform to the material encountered in the explored boreholes. In case, the material encountered is different, the reporting authority must be contacted before the placement of foundations.

Any loose fill material or cohesive soil encountered at the foundation placement level must be excavated and replaced with compacted select fill material (A-3 or better material as per AASHTO soil classification).

All engineered filling placed beneath footings should be placed in horizontal layers having compacted thickness not greater than 150 mm and uniformly compacted to achieve at least 95% of modified AASHTO maximum density / 75% of relative density, as appropriate.

6.2 Temporary Excavation Slopes

Temporary construction slopes in natural soil (where required) should be formed at no steeper than 1:1 (vertical: horizontal) with the maximum height limited to 10-12 ft.

6.3 Excavation Support System

A suitable excavation support system, preferably secant piling, should be designed by a qualified and experienced firm to accommodate the required excavation depth and subsoil conditions. The design should also incorporate measures to prevent seepage into the excavation. This system must be implemented before commencing any site activities.

Careful monitoring of movements during excavation and construction should be undertaken and interpreted by a qualified engineer to provide early warning of unacceptable or dangerous ground movements.

6.4 Damp Proofing Measures

All necessary damp-proofing measures should be taken to make the structure watertight. It is suggested to provide proper damp-proof mat foundation as well as basement walls on all sides, in the form of a closed box. This arrangement will inhibit the ingress of seepage into the basements. Moreover, the following measures can be taken to render the reinforced concrete works damp-proof. Moreover, The following measures must be taken to render the basement R.C work damp-proof:

- Tanking with an impermeable membrane
- Maximum water cement ratio = 0.45
- Addition of water reducing agents
- Use of rich mix
- Rubberised coating on the exterior surfaces
- Provision of damp-proof course (DPC) at finish floor level of the building

6.5 Drainage of The Area

Proper drainage around the building, including provisions for stormwater management, is essential. Additionally, suitable paving should be provided adjacent to the exterior walls of the building. These measures will prevent surface water from infiltrating the ground near the building, ensuring protection against potential structural distress.

6.6 Pile Construction

The method of constructing bored piles can have significant effects on the load carrying capacity and settlement behaviour of piles. The adopted design approach relies on the implementation of good construction techniques coupled with appropriate levels of verification.

The allowable side friction value assumes that the pile shafts are suitably rough, free of remolded material or any drilling mud deposits (particularly bentonite) which can substantially reduce the mobilized resistance. Measures to ensure cleanliness of the base of the pile from debris and cuttings should also be ensured.

With regard to the construction of bored piles, temporary support through the soil is likely to be required to maintain shaft integrity and stability during drilling and concreting operations. Stability can be provided using a drilling mud (e.g. bentonite or a biodegradable polymer etc.). The suitability of any drilling fluid for temporary support should be independently assessed by an experienced practitioner to ensure compatibility with the soil/rock conditions over the site.

Because of the anticipated variability in soil conditions, it is recommended that the bored piles material should be confirmed during drilling by an experienced geotechnical engineer by logging the shaft conditions.

6.7 Backfilling of Foundation Pit

Select surplus soils from the excavated materials, not larger than 150 mm, shall be used for backfilling the foundation trenches. Backfill materials shall be free from clods, salts, sulphates and organic or other foreign material. In no case, the backfill soil should be expansive in nature.

The backfill material should be placed in layers not exceeding 450 mm loose thickness and be rolled and / or rammed to achieve compaction to the satisfaction of the Engineer. The Contractor should prepare a detailed methodology in this regard and submit it for approval from the Client.

6.8 Type of Cement

Chemical test results indicated that the subsurface soil within the project area consists of a low proportion of harmful salts as per ACI-318 Building Code Requirements. It is therefore recommended to use Ordinary Portland Cement (OPC) for all concrete works of the foundation.

6.9 Inspections and Constructions Verifications

The comments and design recommendations presented in this report are based on descriptions of conditions at known points (i.e. boreholes). Since the subsurface conditions can vary from the inferred ground model for the site, it is pertinent that the ground behaviour should be reviewed during construction and compared with the design assumptions. Accordingly, it is recommended that provision be made for a construction review and performance monitoring program along with the inspection of foundation excavations.

7. LIMITATIONS

AJK Engineers (Pvt.) Ltd. has prepared this report for the project “Geotechnical Investigations for the Construction of The Courtyard Residences Apartment Complex, Street No. 73, Sector F-11/1, Islamabad.” as per correspondence and acceptance received from the client. This report is provided for the exclusive use of the proposed site and its appointed agents for the specific project and purpose as described in the report. It should not be used for other projects or by a third party. In preparing this report AJK Engineers (Pvt.) Ltd. has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after AJK’s field testing has been completed.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. AJK cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

M/s AJK Engineers (Pvt.) Ltd.

8. REFERENCES

1. *Building Code of Pakistan, Seismic Provisions 2007.*
2. *Building Code of Pakistan, 2021.*
3. *ASCE/SEI 7-22 Minimum Design Loads and Associated Criteria for Buildings and Other Structures.*
4. *Sowers, G. F. (1962). Shallow foundations. Foundation Engineering, McGrawHill, New York, 525 - 632.*
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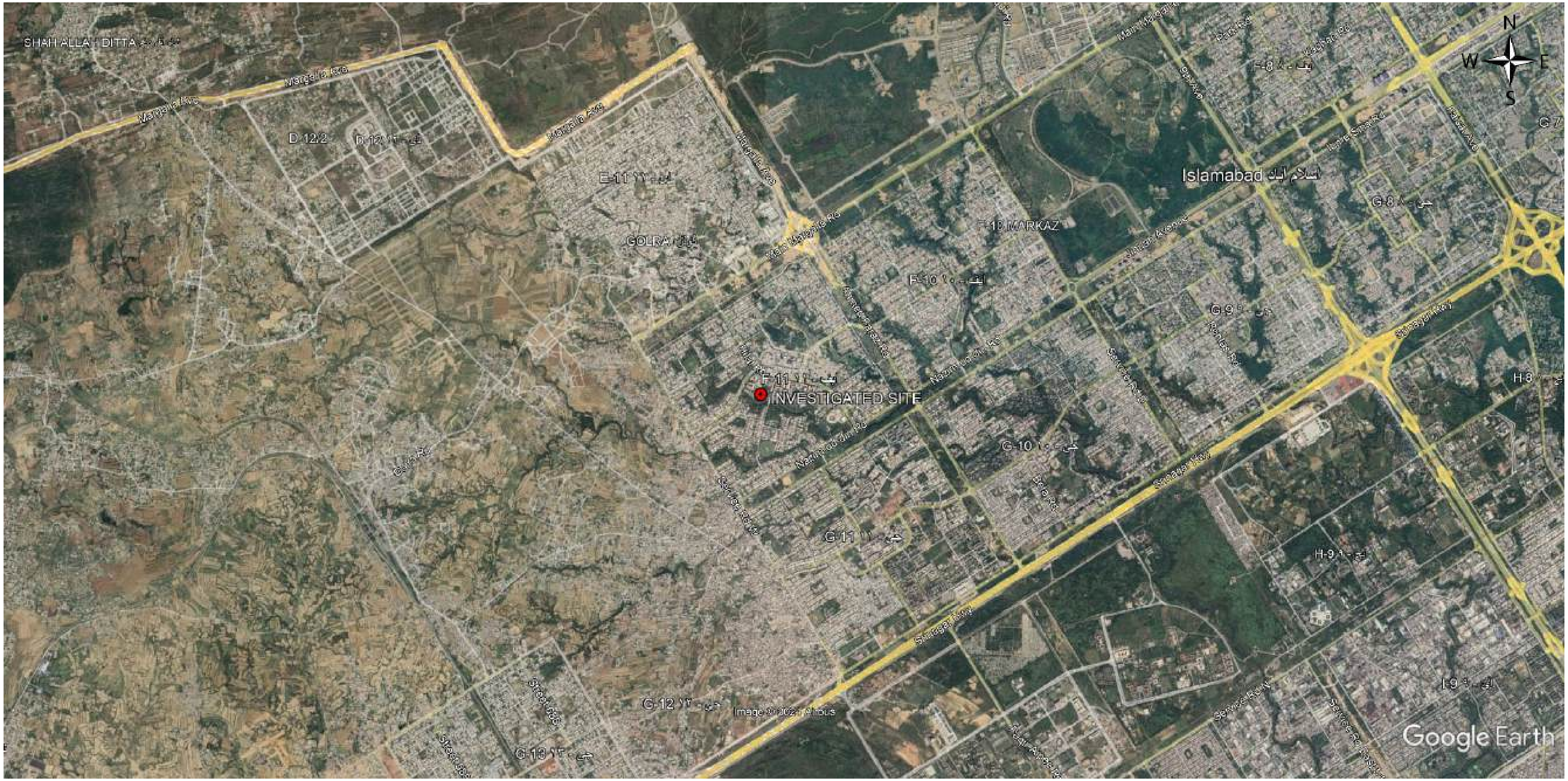
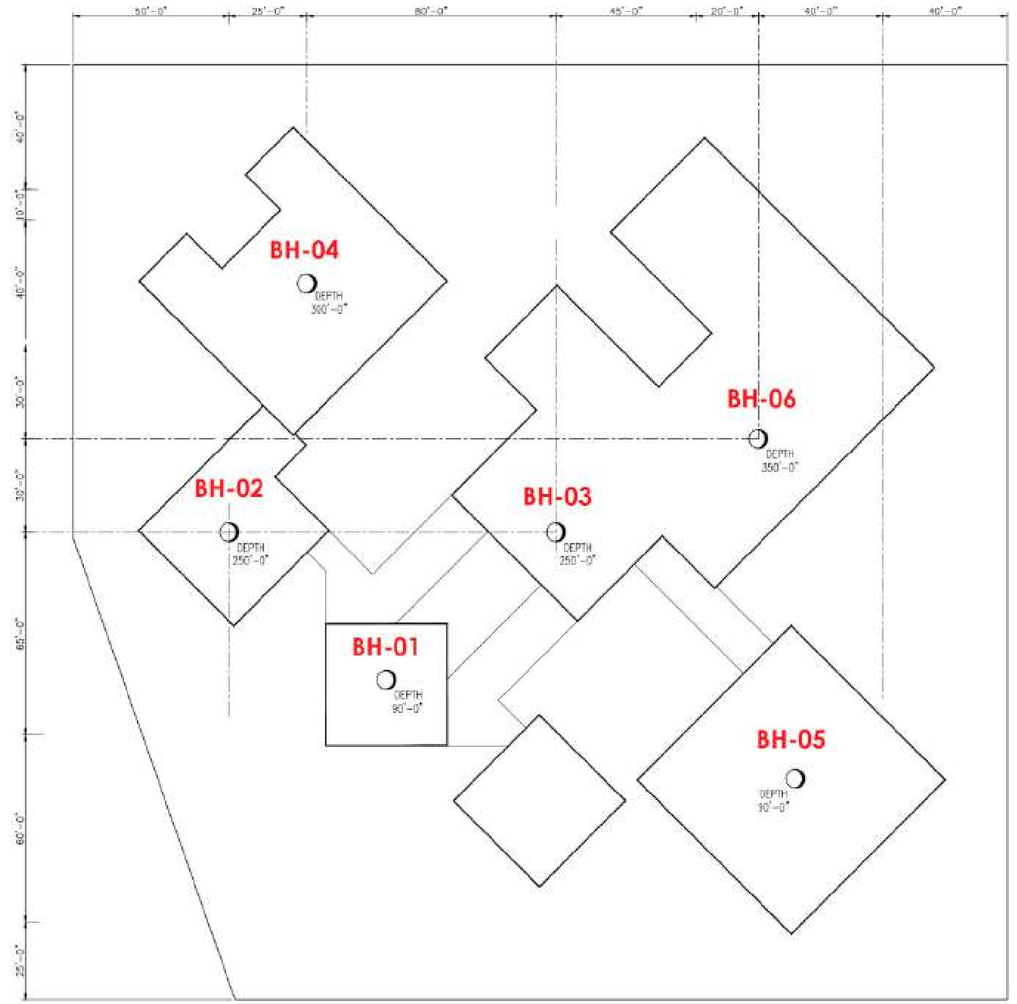
7. *Burt Look, "Handbook of Geotechnical Investigations & Design Tables"*
8. *Tomlinson, M.J., (1994), "Pile Design and Construction Practice", 4th Edition.*
9. *ACI-318 Building Code Requirements for Structural Concrete.*
10. *NAVFAC, D. M. 7.02, (1986), "Foundations & Earth Structures", Department of Naval Facilities and Engineering Command, Alexandria.*

Appendix A

Layout Plan of the Area



GEOTECHNICAL INVESTIGATION CONTRACTOR: AJK Engineers	**PROJECT:**	The Courtyard Residences Apartment Complex	**Location Plan of Site** **Street No. 73, Sector F-11/1, Islamabad.**	**FIGURE:**	A-1
	CLIENT:	The Courtyard		**REVISION:**	0
	PROJECT NO:	AJK/GT/101-3645			



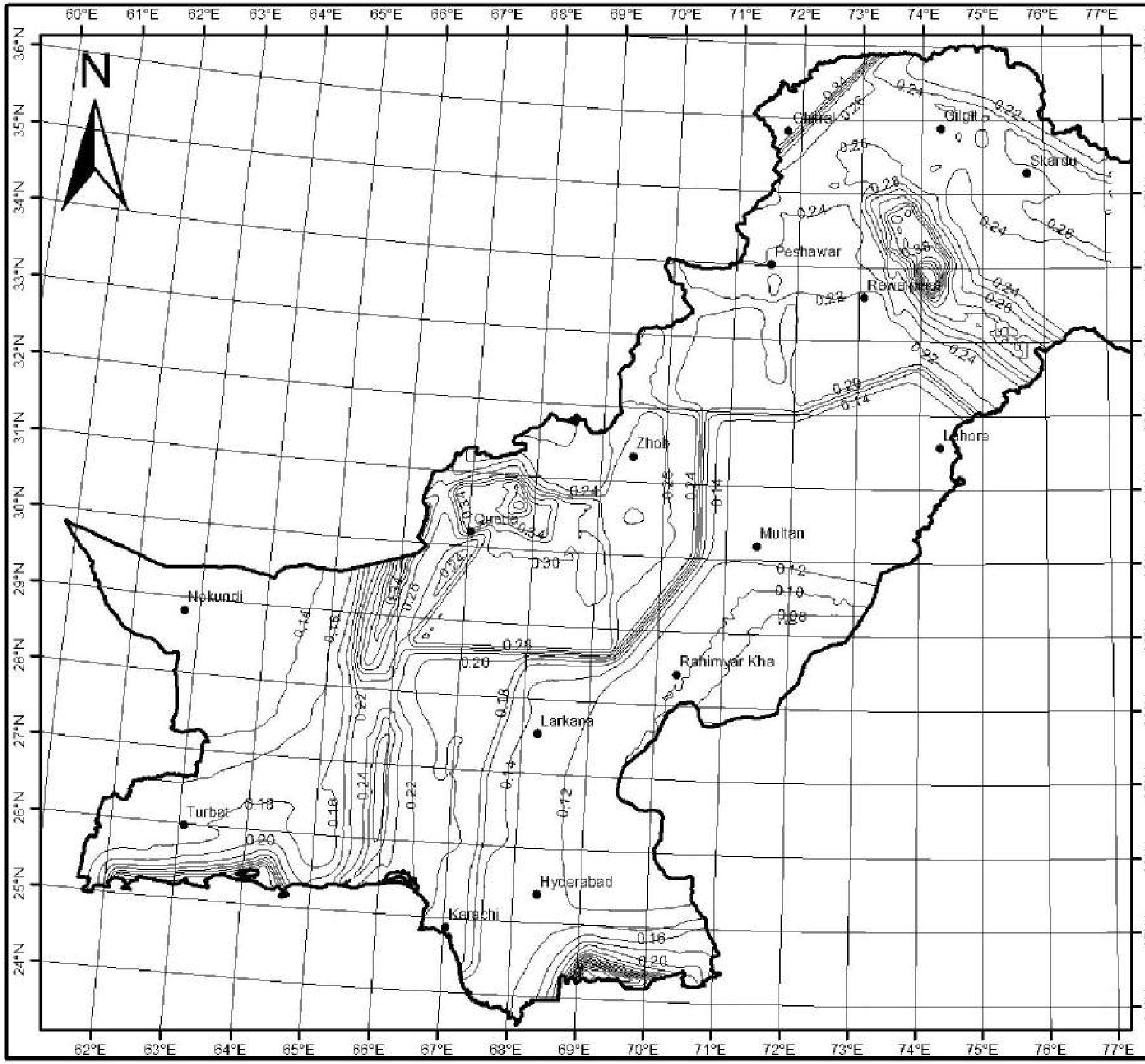
GEOTECHNICAL INVESTIGATION CONTRACTOR: AJK Engineers	**PROJECT:**	The Courtyard Residence Apartment Complex	**Location Plan of Boreholes**	**FIGURE:**	A-2
	CLIENT:	The Courtyard		**REVISION:**	0
	PROJECT NO:	AJK/GT/101-3645	**Street No. 73, Sector F-11/1, Islamabad.**		

Appendix B

Seismicity / Geological Map of the Area

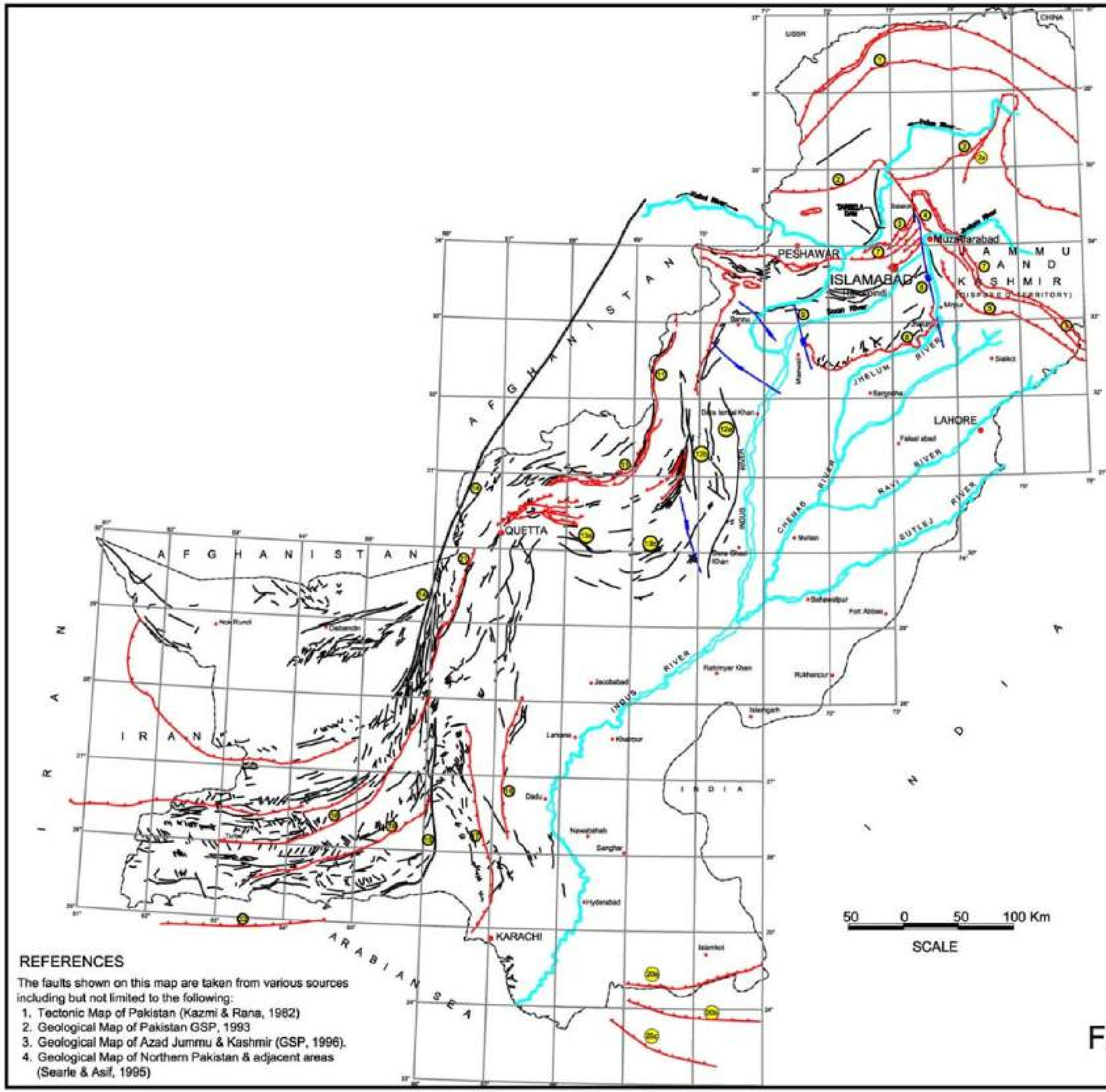
FIG. A-1

Peak Ground Acceleration (g) with 10% Probability of Exceedance in 50 years



PGA Contour Interval = 0.02g

FIG. A-2



MAJOR FAULTS

Code No.	Fault Name
1	Main Karakuram Thrust (MKT)
2	Main Mantle Thrust (MMT)
2a	Raikot Fault
3	Panjal Thrust (PT)
4	Himalayan Frontal Thrust (HFT)
5	Riasi Thrust (RT)
6	Jhelum Fault (JF)
7	Main Boundary Thrust (MBT)
8	Salt Range Thrust (SRT)
9	Kalabagh Fault (KF)
10	Bannu Fault (BF)
11	Kurram Thrust (KmT)
12a	Chaudhwan Fault (SFT N-1)
12b	Domanda Fault (SFT N-2)
13a	Harnai Fault (SFT S-1)
13b	Kohlu Fault (SFT S-2)
14	Chaman Fault (CF)
15	Ornach-Nal Fault
16	Kirthar Fault (KRF)
17	Pab Fault (PF)
18	Hoshab Fault (HF)
19	Nai Rud Fault (NRF)
20a	Nagar Parkar Fault
20b	Allah Band Fault
20c	Kutch Mainland Fault
21	Chiltan-Ghazaband Fault
22	Makran Coastal Fault

LEGEND

Faults unclassified
Strike-Slip Fault
Thrust Faults
Wrench faults
Transform faults

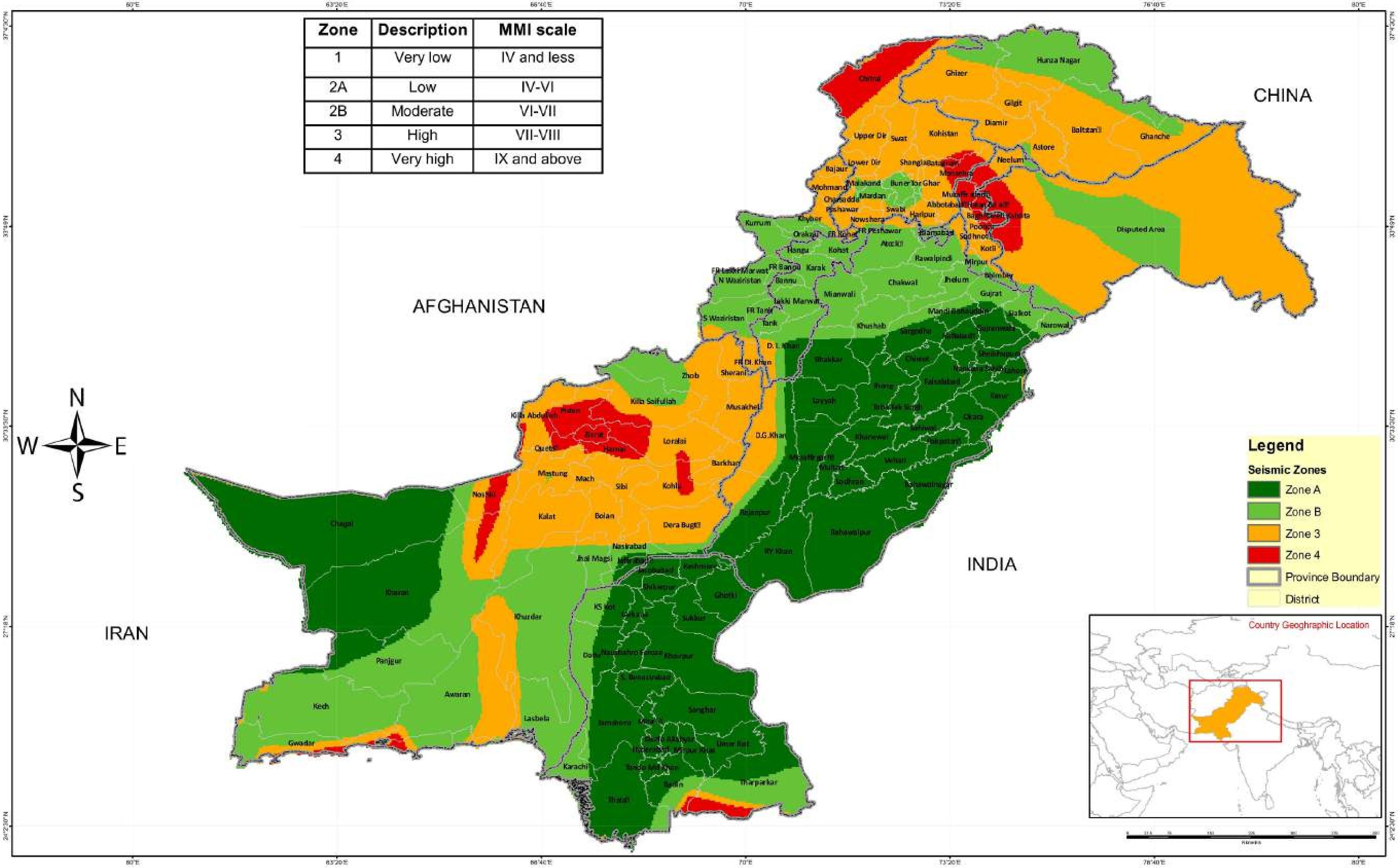
50 0 50 100 Km
SCALE

REFERENCES

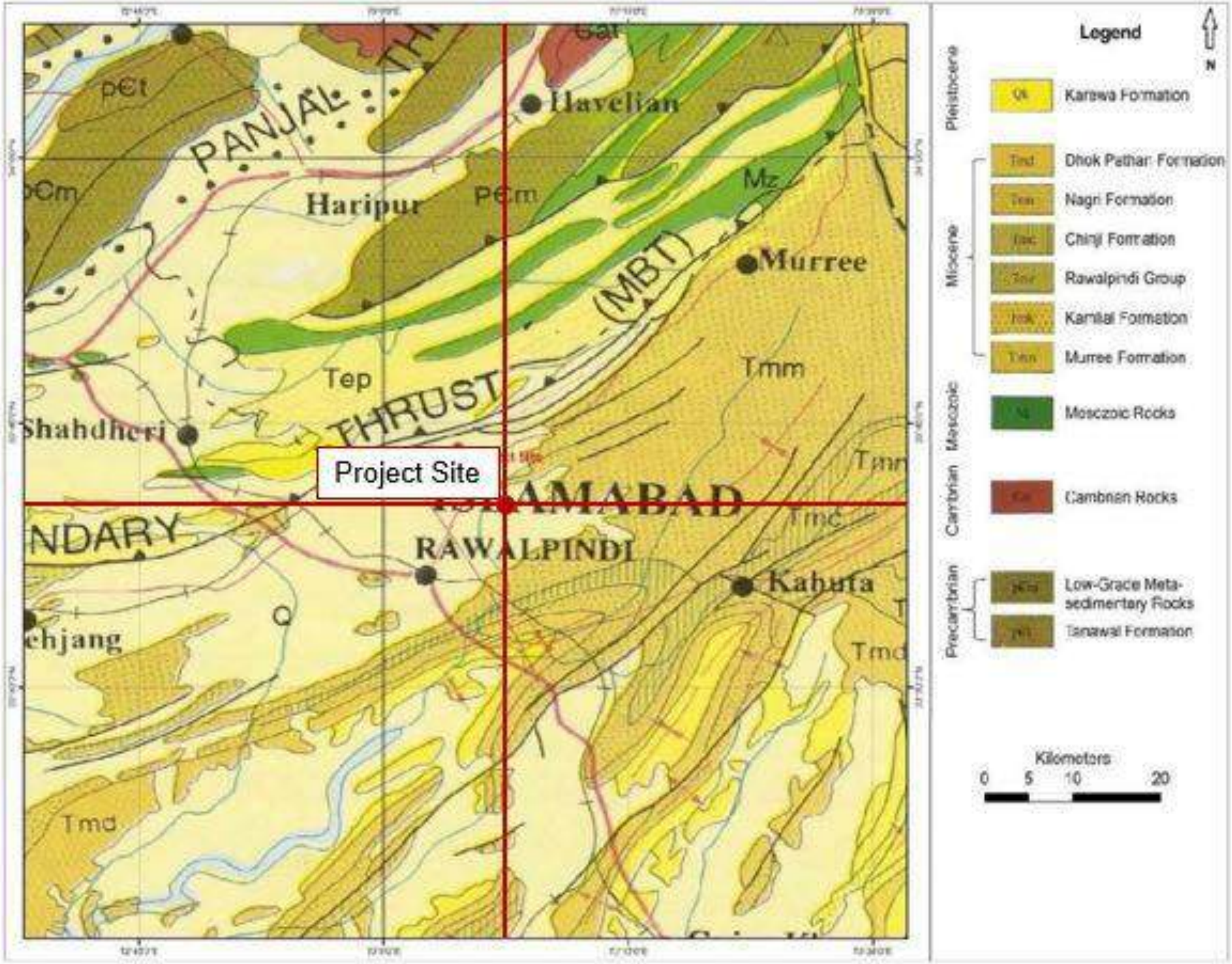
The faults shown on this map are taken from various sources including but not limited to the following:

1. Tectonic Map of Pakistan (Kazmi & Rana, 1982)
2. Geological Map of Pakistan GSP, 1993
3. Geological Map of Azad Jummu & Kashmir (GSP, 1996).
4. Geological Map of Northern Pakistan & adjacent areas (Searle & Asif, 1995)

FAULT MAP OF PAKISTAN



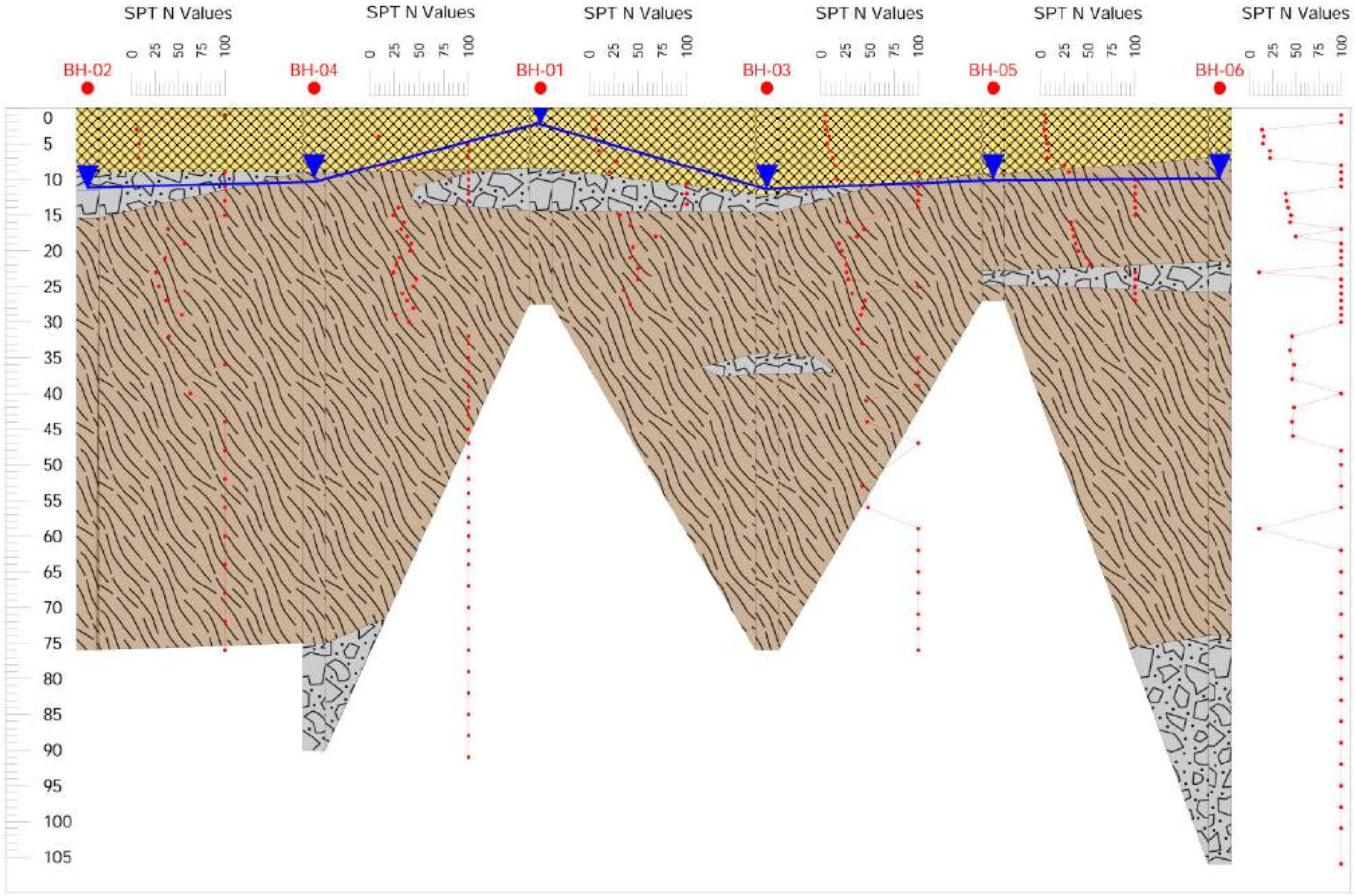
Zone	Description	MMI scale
1	Very low	IV and less
2A	Low	IV-VI
2B	Moderate	VI-VII
3	High	VII-VIII
4	Very high	IX and above



Geological Plan of the Area

Appendix - C

Subsurface Soil Profile



NOTES:

1. Subsurface Profiles Are Developed Based on Boreholes Drilled at Project Site. Slight Variation in Stratigraphy May Be Expected.

2. Legends Shown Here Represent Dominant Soil Type

Legend Title

▨ Filling Material

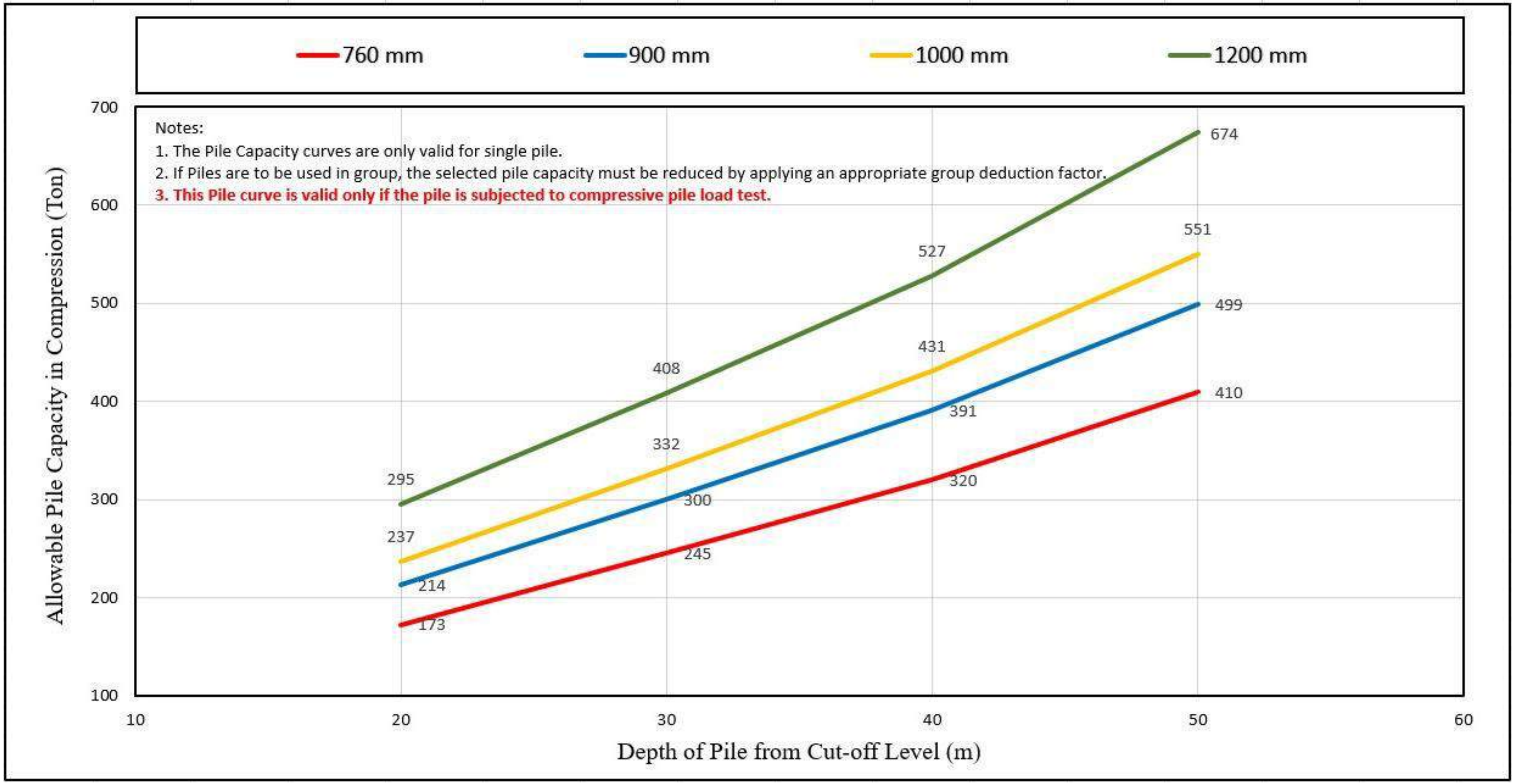
▨ Lean Clay/ Lean Clay with Sand

▨ Gravel /Gravel with Sand/ Silty Gravel

GEOTECHNICAL INVESTIGATION CONTRACTOR:	**PROJECT:**	The Courtyard Residence Apartment Complex	***Subsurface Soil Profile***	**FIGURE:**	C-1
AJK Engineers	**CLIENT:**	The Courtyard	**Street No. 73, Sector F-11/1, Islamabad.**	**REVISION:**	0
	PROJECT NO:	AJK/GT/101-3645			

Appendix - D

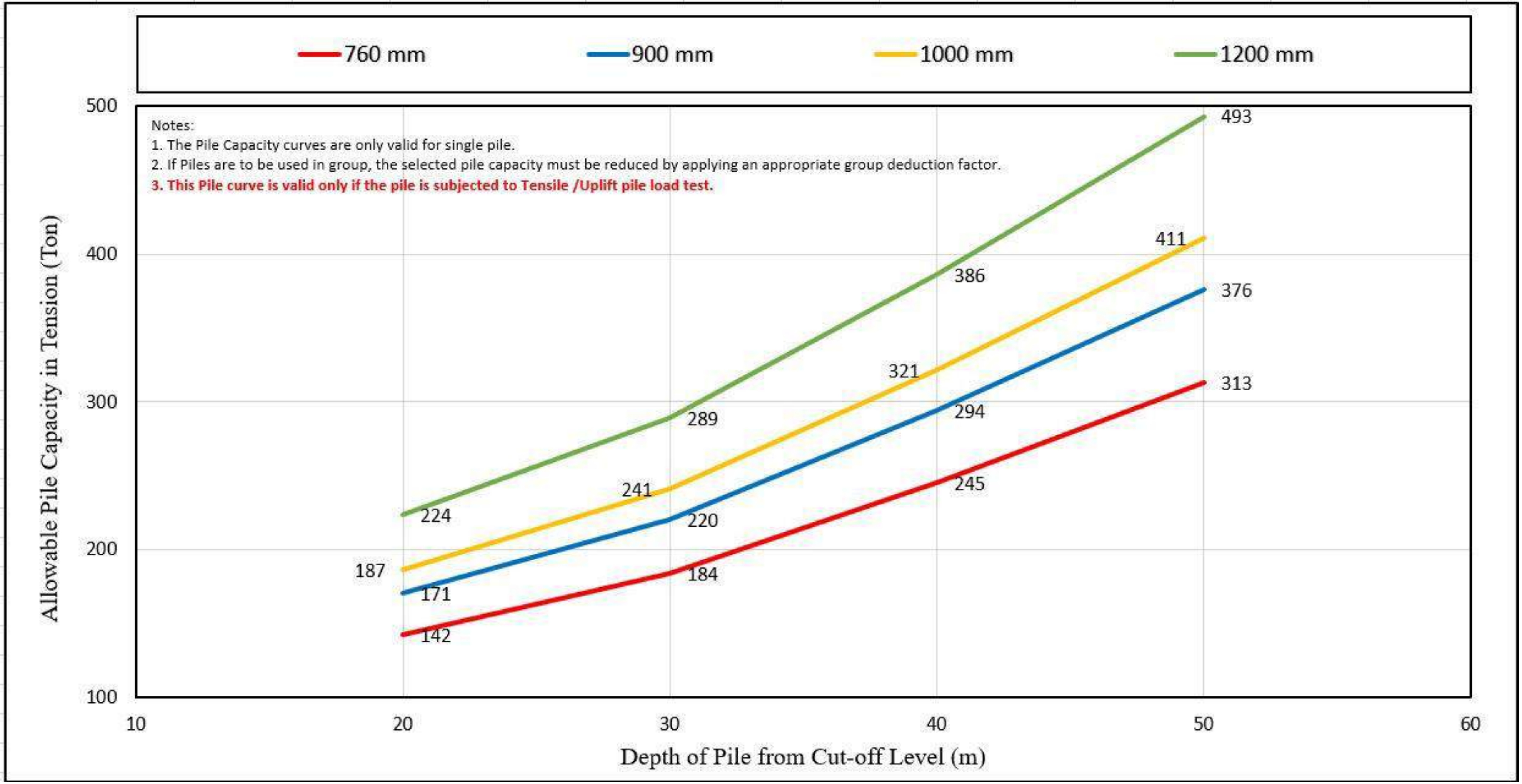
Pile Capacity Curves



Notes:

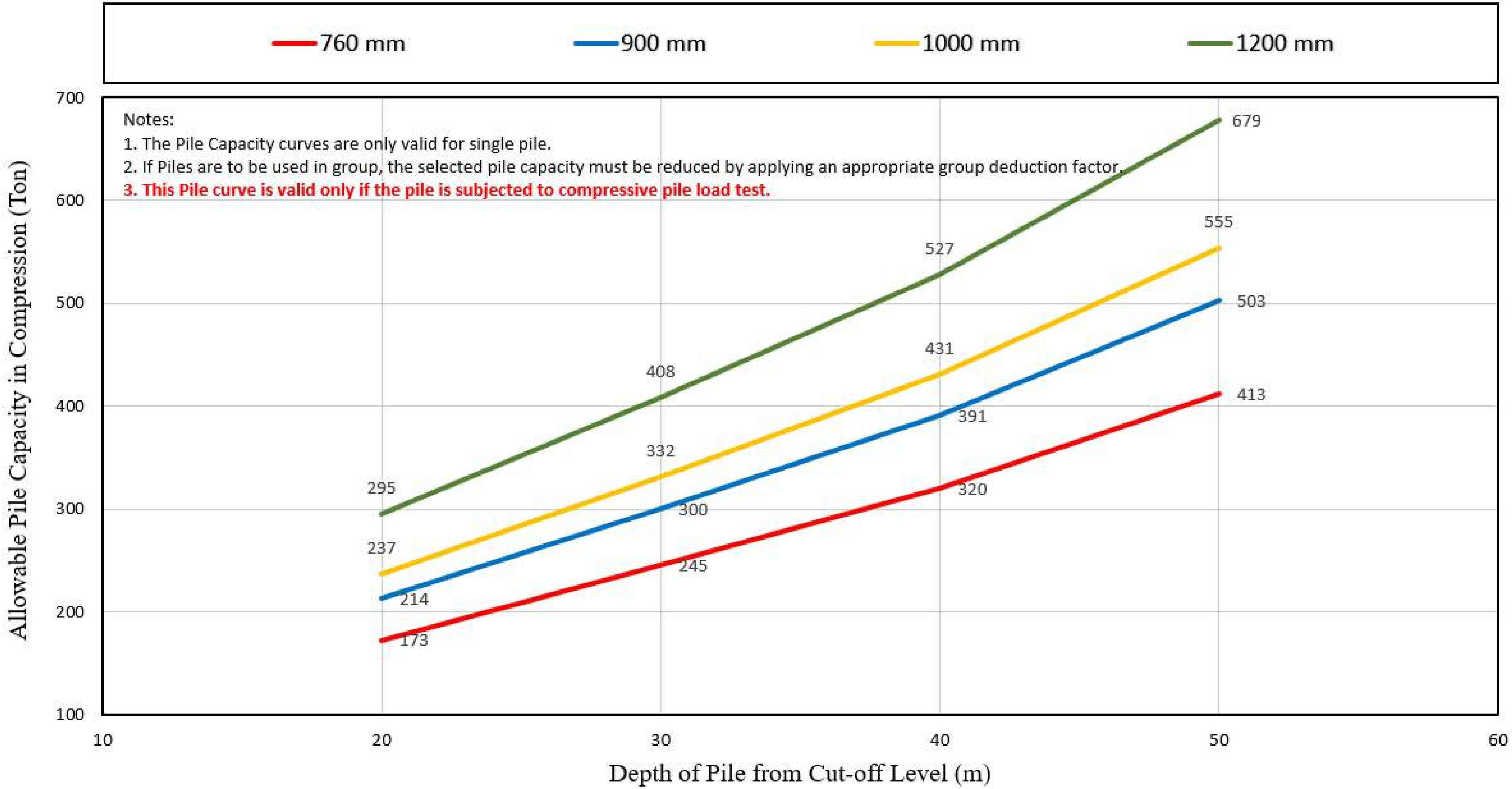
1. The Pile Capacity curves are only valid for single pile.
2. If Piles are to be used in group, the selected pile capacity must be reduced by applying an appropriate group deduction factor.
3. **This Pile curve is valid only if the pile is subjected to compressive pile load test.**

GEOTECHNICAL INVESTIGATION CONTRACTOR:	**PROJECT:**	The Courtyard Residence Apartment Complex	**Pile Capacity Curves (Compression)** ***Cut-off Level w.r.t. Road = 40.0ft***	**FIGURE:**	D-1
AJK Engineers	**CLIENT:**	The Courtyard	**Street No. 73, Sector F-11/1, Islamabad.**	**REVISION:**	0
	PROJECT NO:	AJK/GT/101-3645			



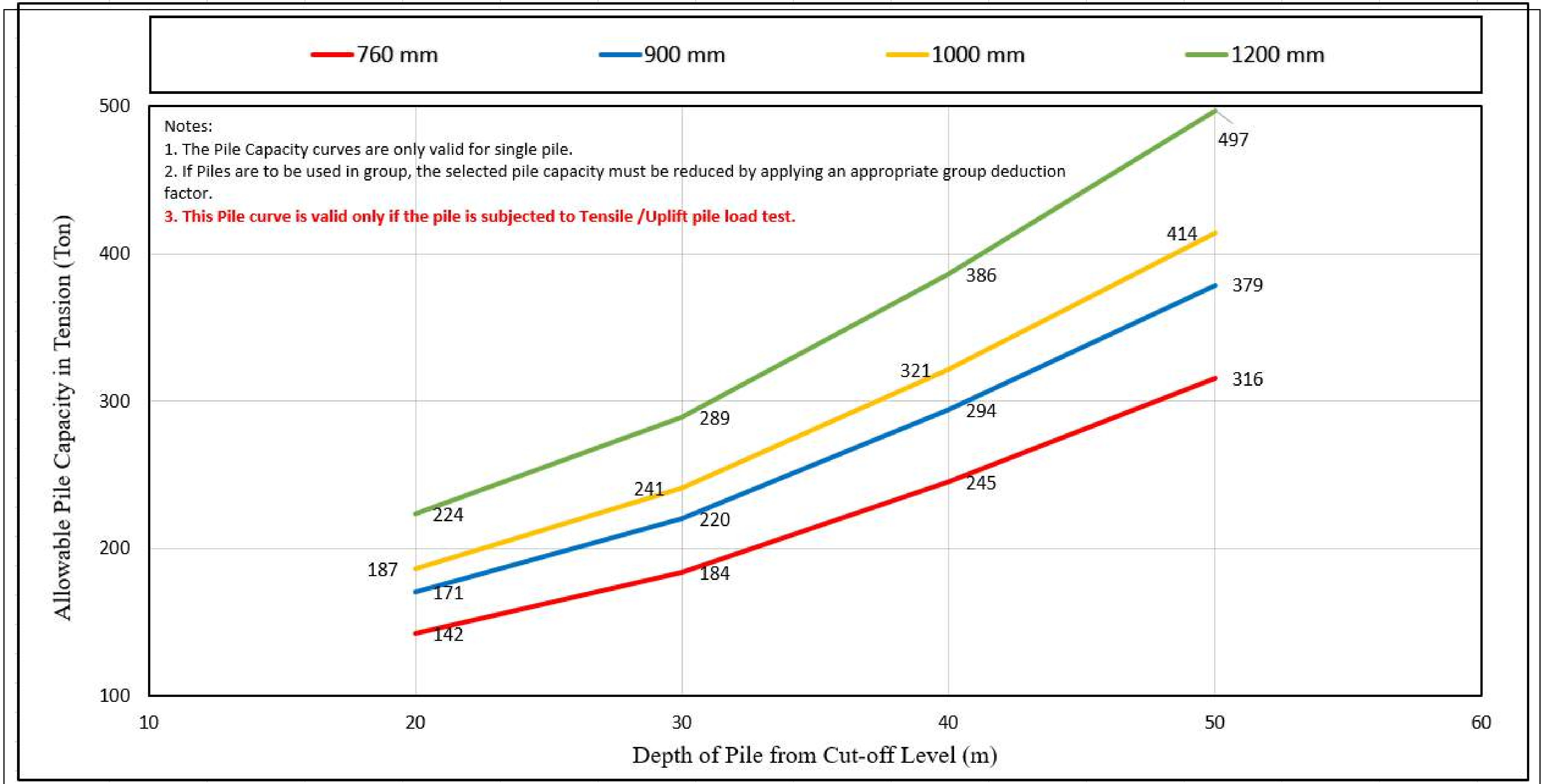
Notes:
1. The Pile Capacity curves are only valid for single pile.
2. If Piles are to be used in group, the selected pile capacity must be reduced by applying an appropriate group deduction factor.
3. **This Pile curve is valid only if the pile is subjected to Tensile /Uplift pile load test.**

GEOTECHNICAL INVESTIGATION CONTRACTOR:	**PROJECT:**	The Courtyard Residence Apartment Complex	**Pile Capacity Curves (Tension)** ***Cut-off Level w.r.t. Road = 40.0ft***	**FIGURE:**	D-2
AJK Engineers	**CLIENT:**	The Courtyard	**Street No. 73, Sector F-11/1, Islamabad.**	**REVISION:**	0
	PROJECT NO:	AJK/GT/101-3645			



Notes:
1. The Pile Capacity curves are only valid for single pile.
2. If Piles are to be used in group, the selected pile capacity must be reduced by applying an appropriate group deduction factor.
3. This Pile curve is valid only if the pile is subjected to compressive pile load test.

GEOTECHNICAL INVESTIGATION CONTRACTOR:	**PROJECT:**	The Courtyard Residence Apartment Complex	**Pile Capacity Curves (Compression)** ***Cut-off Level w.r.t. Road = 53.0ft***	**FIGURE:**	D-3
AJK Engineers	**CLIENT:**	The Courtyard		**REVISION:**	0
	PROJECT NO:	AJK/GT/101-3645	**Street No. 73, Sector F-11/1, Islamabad.**		



Notes:
1. The Pile Capacity curves are only valid for single pile.
2. If Piles are to be used in group, the selected pile capacity must be reduced by applying an appropriate group deduction factor.
3. This Pile curve is valid only if the pile is subjected to Tensile /Uplift pile load test.

GEOTECHNICAL INVESTIGATION CONTRACTOR: AJK Engineers	**PROJECT:**	The Courtyard Residence Apartment Complex	**Pile Capacity Curves (Tension)** ***Cut-off Level w.r.t. Road = 53.0ft***	**FIGURE:**	D-4
	CLIENT:	The Courtyard		**REVISION:**	0
	PROJECT NO:	AJK/GT/101-3645	**Street No. 73, Sector F-11/1, Islamabad.**		

Appendix E

Borehole Logs

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-01

PROJECT: GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE

LOCATION: STREET NO. 73, SECTOR F-11/1, ISLAMABAD.

CLIENT: THE COURTYARD

Drilling Started on: 13-10-2024

Drilling Completed on: 15-10-2024

Geologist: Inayat

Driller: Zafar

Direction / Inclination: Vertical

DRILLING INFORMATION

METHOD OF DRILLING: Straight Rotary

DIA. OF BORING: 96mm

BIT: Clay/Carbide **Rock Strike Level (m):** Nil

SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

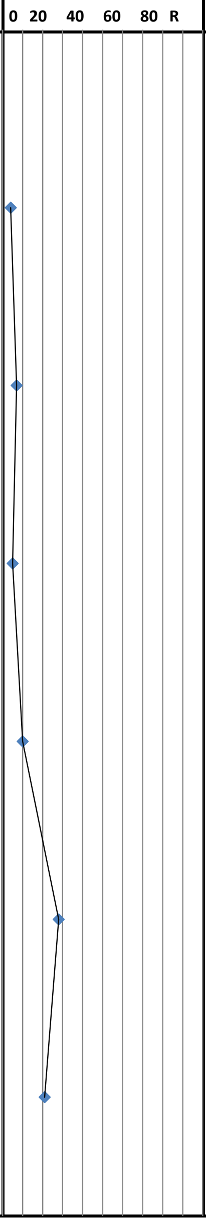
PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:

North: 33.681336 **East:** 72.987630

SEEPAGE/PERCHED WATER: Encountered at 11.10m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
0.0															*Filling Material was encountered upto 8.53m depth.*
1.0															
1.5	S-1			**FILLING MATERIAL** Brown, Medium Stiff, Silty Sand with Gravel, Plastic Bags, Tiles Pieces, etc.						2	2	2	4		
2.0															
3.0	S-2			Dark Brown, Medium Stiff, Silty Clay, Sand and Gravel, Slightly Moist,						2	2	5	7		
4.0															
4.5	S-3									2	2	3	5		
5.0															
6.0	S-4			Dark Brown, Medium Stiff, Gravelly Silty Clay, Roots, Slightly Moist,						3	4	6	10		
7.0															
7.5	S-5			Dark Brown, Very Stiff, Silty Gravel with Sand, Trace Roots, Slightly Moist,						10	16	12	28		
8.0															
9.0	S-6			**GRAVEL with SAND** Grey, Medium Dense, Poorly Graded, Trace Sand,						10	8	13	21		
10.0															



L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	F	Fracture	SW	Slightly Weathered
RUN/R	Rock Core Run and Number	SF	Slightly Fracture	MW	Moderately Weathered
RC	Rock Core Recovery	MF	Moderately Fracture	HW	Highly Weathered
RQD	Rock Quality Designation	HF	Highly Fracture	▼	Seepage/Perched Water

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

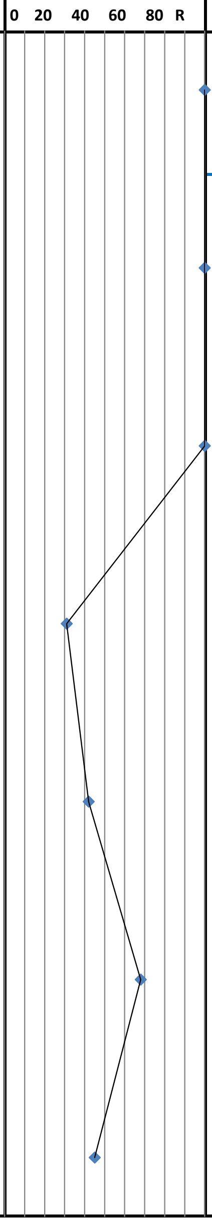
BORELOG

BOREHOLE NO.
BH-01

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	13-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	15-10-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat
DRILLING INFORMATION	**PROJECT NO: AJK/GT/101-3645**	**Driller:**	Zafar
METHOD OF DRILLING: Straight Rotary	**CO-ORDINATES:**	**Direction / Inclination:**	Vertical
DIA. OF BORING: 96mm	**North:** 33.681336 **East:** 72.987630		
BIT: Clay/Carbide **Rock Strike Level (m):** Nil	**SEEPAGE/PERCHED WATER:** Encountered at 11.10m depth.		
SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft			

1	2	3	4	5	6	7	8	9	10	11	12	13	14	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Remarks
10.0														
10.5	C-1			**GRAVEL with SAND** Grey, Medium Dense, Poorly Graded, Trace Sand and Silt,						27	R	-	R	
11.0														Seepage/Perched Water
12.0	C-2									R	-	-	R	
13.0														
13.5	C-3									39	R	-	R	
14.0														
15.0	S-7			**LEAN CLAY with SAND** Brown, Hard, Medium Plasticity, Slightly Moist,						8	12	19	31	
16.0														
16.5	S-8									10	18	24	42	
17.0														
18.0	S-9			Brown, Very Hard, Low Plasticity, Slightly Moist,						16	30	38	68	
19.0														
19.5	S-10			Brown, Hard, Low Plasticity, Moist,						10	21	24	45	
20.0														

15 Std. Penetration Test Data Blows per 6inch



L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

BORELOG

BOREHOLE NO.
BH-01

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

Drilling Started on:	13-10-2024
Drilling Completed on:	15-10-2024
Geologist:	Inayat
Driller:	Zafar
Direction / Inclination:	Vertical

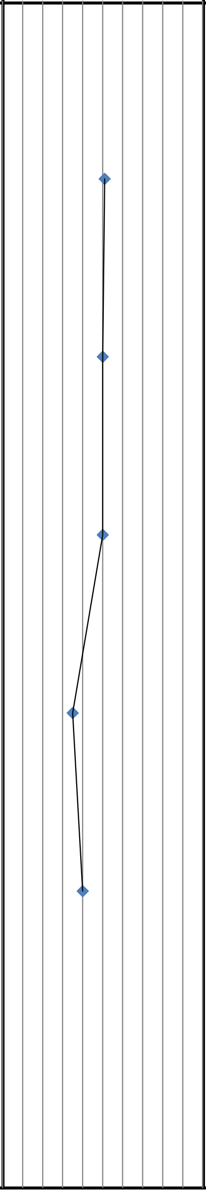
DRILLING INFORMATION

METHOD OF DRILLING: Straight Rotary
DIA. OF BORING: 96mm
BIT: Clay/Carbide **Rock Strike Level (m):** Nil
SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:
North: 33.681336 **East:** 72.987630
SEEPAGE/PERCHED WATER: Encountered at 11.10m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	**SAMPLE TYPE / NO.**	**RUN**	**PROFILE**	**Subsurface Description**	**Rock** **RC %**	**Rock** **RQD %**	**Fracture**	**Weathering**	**Drilling Fld. Loss %**	**SPT BLOWS (inches)** **6**	**SPT BLOWS (inches)** **6**	**SPT BLOWS (inches)** **6**	**N VALUES**	**Std. Penetration Test Data** **Blows per 6inch** 0 20 40 60 80 R	**Remarks**
20.0															
21.0															
21.5	S-11			**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Moist,						13	23	28	51		
22.0															
23.0	S-12									13	21	29	50		
24.0															
24.5	S-13									11	24	26	50		
25.0															
26.0	S-14			**LEAN CLAY with SAND** Brown, Hard, Medium Plasticity, Moist,						9	15	20	35		
27.0															
27.5	S-15									12	18	22	40		
28.0				***END OF BOREHOLE***											
29.0															
30.0															



L E G E N D:

SPT/S	Standard Penetration Test & Number
CPT/C	Cone Penetration Test & Number
RUN/R	Rock Core Run and Number
RC	Rock Core Recovery
RQD	Rock Quality Designation

FRACTURE:

F	Fracture
SF	Slightly Fracture
MF	Moderately Fracture
HF	Highly Fracture

WEATHERING:

SW	Slightly Weathered
MW	Moderately Weathered
HW	Highly Weathered
▽	Seepage/Perched Water

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Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

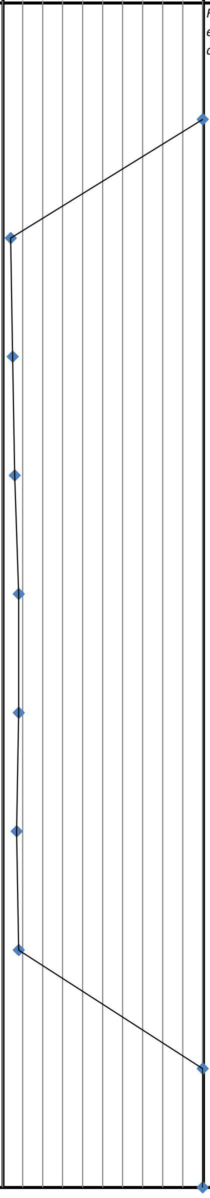
BORELOG

BOREHOLE NO.
BH-02

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	16-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	27-10-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat

DRILLING INFORMATION				**PROJECT NO: AJK/GT/101-3645**			**Driller:** Ayaz
METHOD OF DRILLING:	Straight Rotary						
DIA. OF BORING:	96mm			**CO-ORDINATES:**			
BIT: Clay/Carbide	**Rock Strike Level (m):**		Nil	**North:**	33.681232	**East:** 72.987439	**Direction / Inclination:**
SPT HAMMER WEIGHT:	63.5 kg	**Drop:**	2.5ft	**SEEPAGE/PERCHED WATER:**		Encountered at 11.50m depth.	Vertical

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
0.0															*Filling Material was encountered upto 9.0m depth.*
1.0	C-1			**FILLING MATERIAL** Grey, Very Dense, Gravel/ Boulder, Silty Clay with Sand,						R	-	-	R		
2.0	S-1			Brown, Lean Clay, Medium Stiff, Concretion, Slightly Moist,						1	2	2	4		
3.0	S-2									3	2	3	5		
4.0	S-3									2	3	3	6		
5.0	S-4			Dark Brown, Loose, Silty Clayey Sand, Slightly Moist,						5	4	4	8		
6.0	S-5									4	5	3	8		
7.0	S-6									4	4	3	7		
8.0	S-7									4	4	4	8		
9.0	S-8			**SILTY GRAVEL** Grey, Very Dense, Gravel (Limestone),						34	R	-	R		
10.0	C-2									41	R	-	R		



L E G E N D:

		FRACTURE:		**WEATHERING:**			
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered		
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered		
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered		
RC	Rock Core Recovery						
RQD	Rock Quality Designation	**HF**	Highly Fracture	▼	Seepage/Perched Water		

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.	**BH-02**
PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**
Drilling Started on:	16-10-2024
Drilling Completed on:	27-10-2024
Geologist:	Inayat
Driller:	Ayaz
Direction / Inclination:	Vertical

DRILLING INFORMATION

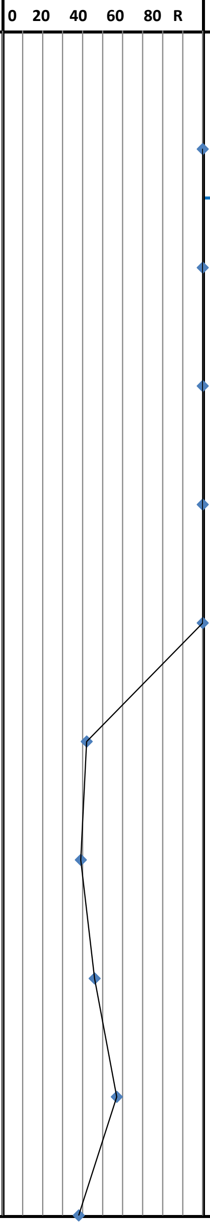
METHOD OF DRILLING:	Straight Rotary		
DIA. OF BORING:	96mm		
BIT: Clay/Carbide		**Rock Strike Level (m):**	Nil
SPT HAMMER WEIGHT:	63.5 kg	**Drop:**	2.5ft

PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:			
North:	33.681232	**East:**	72.987439
SEEPAGE/PERCHED WATER:	Encountered at 11.50m depth.		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Remarks
10.0														
11.0	C-3			**SILTY GRAVEL** Grey, Very Dense, Gravel(Limestone),						R	-	-	R	
														Seepage/Perched Water
12.0	C-4									R	-	-	R	
13.0	C-5									41	R	-	R	
14.0	C-6									R	-	-	R	
15.0	C-7									38	R	-	R	
16.0	S-9			**LEAN CLAY with SAND** Dark Brown, Hard to Very Hard, Medium Plasticity, Moist,						12	20	22	42	
17.0	S-10									14	18	21	39	
18.0	S-11									12	20	26	46	
19.0	S-12									15	25	32	57	
20.0	S-13									12	16	22	38	

15 Std. Penetration Test Data — Blows per 6inch



L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**			
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered		
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered		
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered		
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water		

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-02

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:** 16-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:** 27-10-2024
CLIENT:	**THE COURTYARD**	**Geologist:** Inayat

DRILLING INFORMATION

METHOD OF DRILLING: Straight Rotary

DIA. OF BORING: 96mm

BIT: Clay/Carbide **Rock Strike Level (m):** Nil

SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:

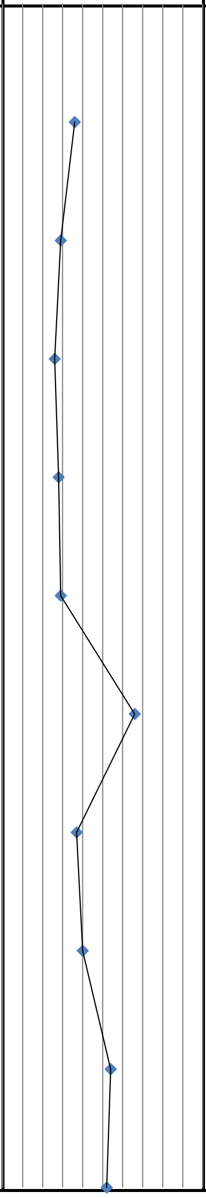
North: 33.681232 **East:** 72.9874390

SEEPAGE/PERCHED WATER: Encountered at 11.50m depth.

Driller: Ayaz

Direction / Inclination: Vertical

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
20.0															
21.0	S-14			**LEAN CLAY with SAND** Dark Brown, Very Stiff to Hard, Concretions, Slightly Moist,						13	17	19	36		
22.0	S-15									9	12	17	29		
23.0	S-16			Dark Brown, Very Stiff, Medium Plasticity, Concretions, Slightly Moist,						9	12	14	26		
24.0	S-17									10	14	14	28		
25.0	S-18									9	12	17	29		
26.0	S-19			Dark Brown, Very Hard, Medium Plasticity, Concretions, Slightly Moist,						18	30	36	66		
27.0	S-20			Dark Brown, Hard, Medium Plasticity, Concretions, Slightly Moist,						14	17	20	37		
28.0	S-21									15	16	24	40		
29.0	S-22			Dark Brown, Very Hard, Medium Plasticity, Concretions, Slightly Moist,						18	22	32	54		
30.0	S-23									17	24	28	52		



LEGEND:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**			
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered		
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered		
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered		
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water		

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

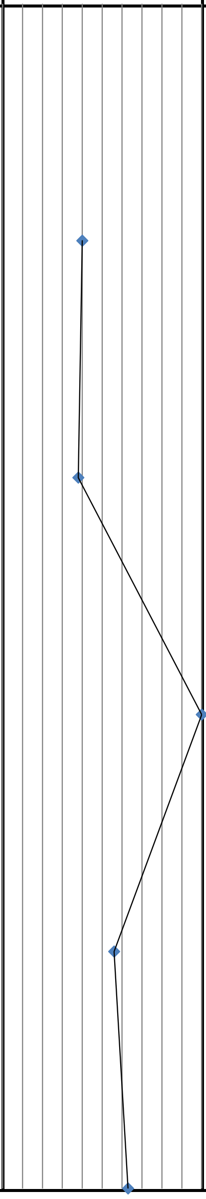
BOREHOLE NO. **BH-02**

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**
Drilling Started on:	16-10-2024
Drilling Completed on:	27-10-2024
Geologist:	Inayat
Driller:	Ayaz
Direction / Inclination:	Vertical

DRILLING INFORMATION

PROJECT NO: AJK/GT/101-3645

METHOD OF DRILLING:	Straight Rotary	**CO-ORDINATES:**	
DIA. OF BORING:	96mm	**North:** 33.681232	**East:** 72.987439
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**SEEPAGE/PERCHED WATER:**	Encountered at 11.50m depth.
SPT HAMMER WEIGHT: 63.5 kg	**Drop:** 2.5ft		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	**SAMPLE TYPE / NO.**	**RUN**	**PROFILE**	**Subsurface Description**	**Rock** RC %	**Rock** RQD %	**Fracture**	**Weathering**	**Drilling Fld. Loss %**	**SPT BLOWS (inches)** 6	6	6	**N VALUES**	**Std. Penetration Test Data** Blows per 6inch (0 20 40 60 80 R)	**Remarks**
30.0															
31.0															
32.0	S-24			**LEAN CLAY** Dark Brown, Hard, Medium Plasticity, Concretions, Moist,						15	18	22	40		
33.0															
34.0	S-25									14	18	20	38		
35.0															
36.0	S-26			Dark Brown, Very Hard, Fine Gravel (Clay Nodules), Moist,						R	-	-	R		
37.0															
38.0	S-27			Dark Brown, Very Hard, Medium Plasticity, Slightly Moist,						16	22	34	56		
39.0															
40.0	S-28									18	27	36	63		

LEGEND:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered
RC	Rock Core Recovery				
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-02

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	16-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	27-10-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat

DRILLING INFORMATION

PROJECT NO: AJK/GT/101-3645

METHOD OF DRILLING:	Straight Rotary			**Driller:**	Ayaz
DIA. OF BORING:	96mm	**CO-ORDINATES:**			
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**North:** 33.681232	**East:** 72.987439	**Direction / Inclination:**	Vertical
SPT HAMMER WEIGHT:	63.5 kg **Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 11.50m depth.		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
40.0															
41.0															
42.0	S-29			**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Clay Nodules, Slightly Moist,						15	32	R	R		
43.0															
44.0	S-30									R	-	-	R		
45.0															
46.0	S-31									R	-	-	R		
47.0															
48.0	S-32									R	-	-	R		
49.0															
50.0	S-33									R	-	-	R		

LEGEND:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.	**BH-02**
PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**
Drilling Started on:	16-10-2024
Drilling Completed on:	27-10-2024
Geologist:	Inayat
Driller:	Ayaz
Direction / Inclination:	Vertical

DRILLING INFORMATION

METHOD OF DRILLING: Straight Rotary

DIA. OF BORING: 96mm

BIT: Clay/Carbide **Rock Strike Level (m):** Nil

SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:

North: 33.681232 **East:** 72.987439

SEEPAGE/PERCHED WATER: Encountered at 11.50m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
50.0			▨												
51.0			▨												
52.0	S-33		▨	**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Slightly Moist,						R	-	-	R	◆	
53.0			▨												
54.0	S-34		▨							R	-	-	R	◆	
55.0			▨												
56.0	S-35		▨							36	R	-	R	◆	
57.0			▨												
58.0	S-36		▨							R	-	-	R	◆	
59.0			▨												
60.0	S-37		▨							R	-	-	R	◆	

LEGEND:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	F	Fracture	SW	Slightly Weathered
CPT/C	Cone Penetration Test & Number	SF	Slightly Fracture	MW	Moderately Weathered
RUN/R	Rock Core Run and Number	MF	Moderately Fracture	HW	Highly Weathered
RC	Rock Core Recovery				
RQD	Rock Quality Designation	HF	Highly Fracture	▽	Seepage/Perched Water

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO. BH-02

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

Drilling Started on: 16-10-2024
Drilling Completed on: 27-10-2024
Geologist: Inayat
Driller: Ayaz
Direction / Inclination: Vertical

DRILLING INFORMATION
METHOD OF DRILLING: Straight Rotary
DIA. OF BORING: 96mm
BIT: Clay/Carbide **Rock Strike Level (m):** Nil
SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645
CO-ORDINATES:
North: 33.681232 **East:** 72.987439
SEEPAGE/PERCHED WATER: Encountered at 11.50m depth.

1 Depth (m)	2 SAMPLE TYPE / NO.	3 RUN	4 PROFILE	5 Subsurface Description	6 Rock RC %	7 Rock RQD %	8 Fracture	9 Weathering	10 Drilling Fld. Loss %	11 SPT BLOWS (inches) 6	12 SPT BLOWS (inches) 6	13 SPT BLOWS (inches) 6	14 N VALUES	15 Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	16 Remarks
60.0															
61.0															
				LEAN CLAY											
62.0	S-38			Dark Brown, Very Hard, Medium Plasticity, Slightly Moist,						41	R	-	R		
63.0															
64.0	S-39									36	R	-	R		
65.0															
66.0	S-40									32	R	-	R		
67.0															
68.0	S-41									39	R	-	R		
69.0															
70.0	S-42									40	R	-	R		

LEGEND:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

AJK Engineers

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Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-02

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	16-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	27-10-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat

DRILLING INFORMATION

METHOD OF DRILLING: Straight Rotary

DIA. OF BORING: 96mm

BIT: Clay/Carbide **Rock Strike Level (m):** Nil

SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:

North: 33.681232 **East:** 72.987439

SEEPAGE/PERCHED WATER: Encountered at 11.50m depth.

Driller: Ayaz

Direction / Inclination: Vertical

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock		Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches)			N VALUES	Std. Penetration Test Data Blows per 6inch	Remarks
					RC %	RQD %				6	6	6		0 20 40 60 80 R	
70.0															
71.0				**LEAN CLAY**											
72.0	S-43			Dark Brown, Very Hard, Medium Plasticity, Slightly Moist,						R	-	-	R	R	
73.0															
74.0	S-44									48	R	-	R	R	
75.0															
76.0	S-45			***END OF BOREHOLE***						R	-	-	R	R	
77.0															
78.0															
79.0															
80.0															

L E G E N D:

SPT/S	Standard Penetration Test & Number
CPT/C	Cone Penetration Test & Number
RUN/R	Rock Core Run and Number
RC	Rock Core Recovery
RQD	Rock Quality Designation

FRACTURE:

F	Fracture
SF	Slightly Fracture
MF	Moderately Fracture
HF	Highly Fracture

WEATHERING:

SW	Slightly Weathered
MW	Moderately Weathered
HW	Highly Weathered
▽	Seepage/Perched Water

SHEET 8 OF 8

AJK Engineers

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Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO. **BH-03**

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

Drilling Started on: 22-10-2024

Drilling Completed on: 29-10-2024

Geologist: Inayat

Driller: Basit

Direction / Inclination: Vertical

DRILLING INFORMATION

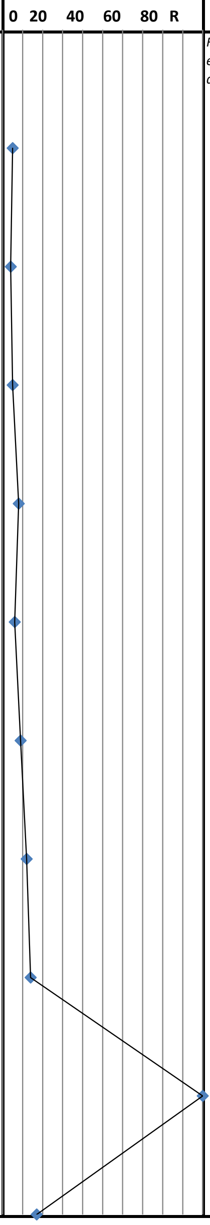
PROJECT NO: AJK/GT/101-3645

METHOD OF DRILLING:	Straight Rotary		
DIA. OF BORING:	96mm	**CO-ORDINATES:**	
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**North:** 33.681513	**East:** 72.987523
SPT HAMMER WEIGHT:	63.5 kg **Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 11.40m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	N VALUES	Remarks
0.0			▨											*Filling Material was encountered upto 12.0m depth.*
1.0	S-1		▨	**FILLING MATERIAL** Brown, Loose, Sand with Silt and Clay, Slightly Moist,						2	2	3	5	
2.0	S-2		▨							2	2	2	4	
3.0	S-3		▨							3	3	2	5	
4.0	S-4		▨							2	4	4	8	
5.0	S-5		▨	Dark Brown, Loose, Sand, Clay, Slightly Moist,						5	3	3	6	
6.0	S-6		▨							4	4	5	9	
7.0	S-7		▨	Grey, Stiff, Gravel with Sand and Silt, Moist,						5	7	5	12	
8.0	S-8		▨							4	6	8	14	
9.0	S-9		▨	Grey, Very Hard, Gravel with Sand and Silt, Moist						R	-	-	R	
10.0	S-10		▨	Grey, Medium Dense, Silty Sand with Gravel, Moist						8	10	7	17	

15 Std. Penetration Test Data

Blows per 6inch



L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

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AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-03

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

Drilling Started on:	22-10-2024
Drilling Completed on:	29-10-2024
Geologist:	Inayat
Driller:	Basit
Direction / Inclination:	Vertical

DRILLING INFORMATION

METHOD OF DRILLING:	Straight Rotary		
DIA. OF BORING:	96mm		
BIT: Clay/Carbide	**Rock Strike Level (m):**	Nil	
SPT HAMMER WEIGHT:	63.5 kg	**Drop:**	2.5ft

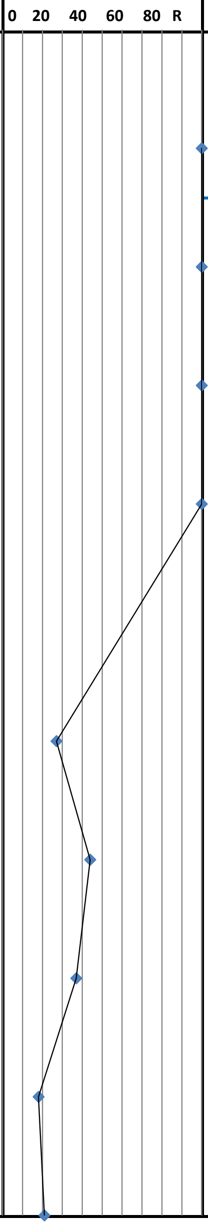
PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:			
North:	33.681513	**East:**	72.987523
SEEPAGE/PERCHED WATER:	Encountered at 11.40m depth.		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	 RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	 6	 6	N VALUES	Remarks
10.0														
11.0	C-1			Grey, Very Hard, Gravel with Sand and Silt, Moist,						R	-	-	R	▽ Seepage/Perched Water
12.0	C-2			**SILTY GRAVEL** Grey, Very Dense, Gravel (Limestone),						R	-	-	R	
13.0	C-3									R	-	-	R	
14.0	C-4									R	-	-	R	
15.0	UDS-1													
16.0	S-11			**LEAN CLAY with SAND** Dark Brown, Very Stiff, Medium Plasticity, Moist,						7	11	16	27	
17.0	S-12			Dark Brown, Hard, Medium Plasticity, Moist,						9	20	24	44	
18.0	S-13									8	17	20	37	
19.0	S-14			Dark Brown, Stiff, Medium Plasticity, Moist,						6	8	10	18	
20.0	S-15			Dark Brown, Very Stiff, Medium Plasticity, Moist,						5	9	12	21	

15 Std. Penetration Test Data

Blows per 6inch



LEGEND:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered
RC	Rock Core Recovery				
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

AJK Engineers

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-03

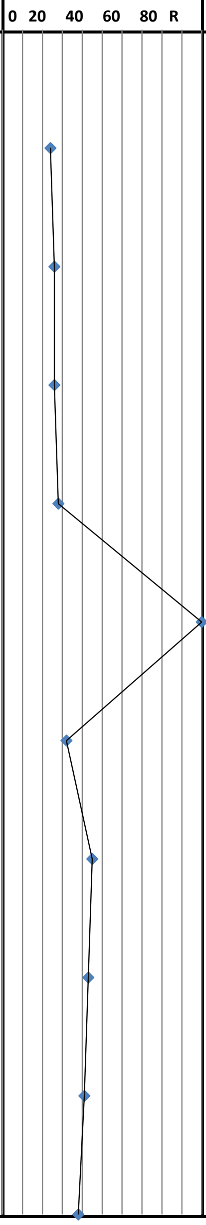
PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

Drilling Started on: 22-10-2024
Drilling Completed on: 29-10-2024
Geologist: Inayat
Driller: Basit
Direction / Inclination: Vertical

DRILLING INFORMATION
METHOD OF DRILLING: Straight Rotary
DIA. OF BORING: 96mm
BIT: Clay/Carbide **Rock Strike Level (m):** Nil
SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645
CO-ORDINATES:
North: 33.681513 **East:** 72.987523
SEEPAGE/PERCHED WATER: Encountered at 11.40m depth.

1 Depth (m)	2 SAMPLE TYPE / NO.	3 RUN	4 PROFILE	5 Subsurface Description	6 Rock RC %	7 Rock RQD %	8 Fracture	9 Weathering	10 Drilling Fld. Loss %	11 SPT BLOWS (inches) 6	12 SPT BLOWS (inches) 6	13 SPT BLOWS (inches) 6	14 N VALUES	15 Std. Penetration Test Data Blows per 6inch	16 Remarks
20.0															
21.0	S-16			**LEAN CLAY with SAND** Dark Brown, Very Stiff, Medium Plasticity, Moist,						6	10	14	24		
22.0	S-17									8	12	14	26		
23.0	S-18									10	12	14	26		
24.0	S-19									9	12	16	28		
25.0	S-20			**SANDY SILTY CLAY** Dark Brown, Very Hard, Low Plasticity, Slightly Moist,						14	26	R	R		
26.0	S-21			**LEAN CLAY** Brown, Hard, Medium Plasticity, Slightly Moist,						10	12	20	32		
27.0	S-22									15	20	25	45		
28.0	S-23									12	18	25	43		
29.0	S-24									12	19	22	41		
30.0	S-25									12	16	22	38		



L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**			
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered		
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered		
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered		
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water		

SHEET 3 OF 8

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO. **BH-03**

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**
Drilling Started on:	22-10-2024
Drilling Completed on:	29-10-2024
Geologist:	Inayat
Driller:	Basit
Direction / Inclination:	Vertical

DRILLING INFORMATION

METHOD OF DRILLING: Straight Rotary

DIA. OF BORING: 96mm

BIT: Clay/Carbide

Rock Strike Level (m): Nil

SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

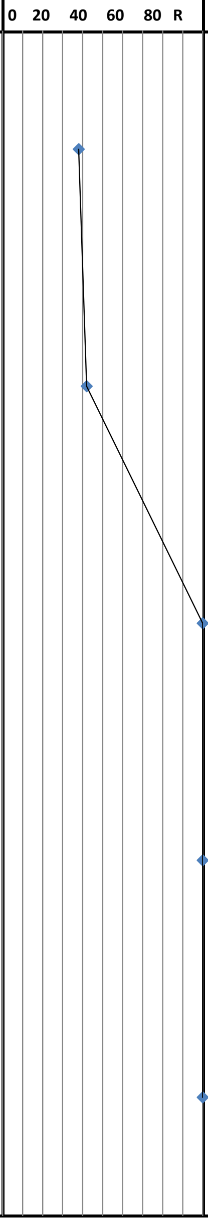
PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:

North: 33.681513 **East:** 72.987523

SEEPAGE/PERCHED WATER: Encountered at 11.40m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
30.0															
31.0	S-26			**LEAN CLAY** Brown, Hard, Concretions, Moist,						12	16	22	38		
32.0															
33.0	S-27									13	18	24	42		
34.0															
35.0	S-28			**SILTY GRAVEL** Grey, Very Dense, Gravel (Limestone),						R	-	-	R		
36.0															
37.0	C-5									R	-	-	R		
38.0															
39.0	S-29			**SILTY CLAY** Brown, Very Hard, Trace Concretion, Moist,						R	-	-	R		
40.0															



LEGEND:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered
RC	Rock Core Recovery				
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

AJK Engineers

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Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-03

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	22-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	29-10-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat

DRILLING INFORMATION

METHOD OF DRILLING: Straight Rotary

DIA. OF BORING: 96mm

BIT: Clay/Carbide **Rock Strike Level (m):** Nil

SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:

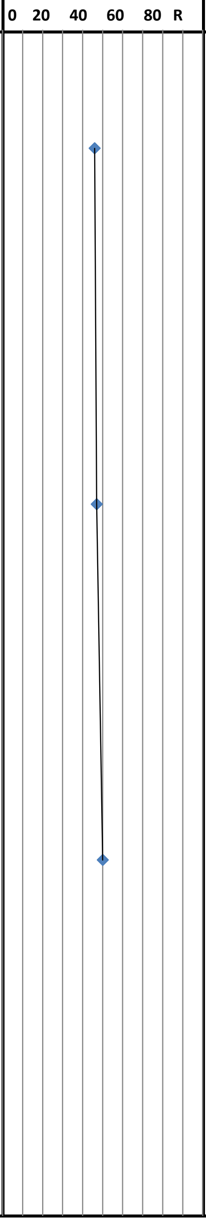
North: 33.681513 **East:** 72.987523

SEEPAGE/PERCHED WATER: Encountered at 11.40m depth.

Driller: Basit

Direction / Inclination: Vertical

1 Depth (m)	2 SAMPLE TYPE / NO.	3 RUN	4 PROFILE	5 Subsurface Description	6 Rock RC %	7 Rock RQD %	8 Fracture	9 Weathering	10 Drilling Fld. Loss %	11 SPT BLOWS (inches) 6	12 SPT BLOWS (inches) 6	13 SPT BLOWS (inches) 6	14 N VALUES	15 Std. Penetration Test Data Blows per 6inch	16 Remarks
40.0															
41.0	S-30			**LEAN CLAY** Brown, Hard, Medium Plasticity, Trace Concretion, Moist,						13	20	26	46		
42.0															
43.0															
44.0	S-31									10	25	22	47		
45.0															
46.0															
47.0	S-32									14	22	28	50		
48.0															
49.0															
50.0	UDS-2														



L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

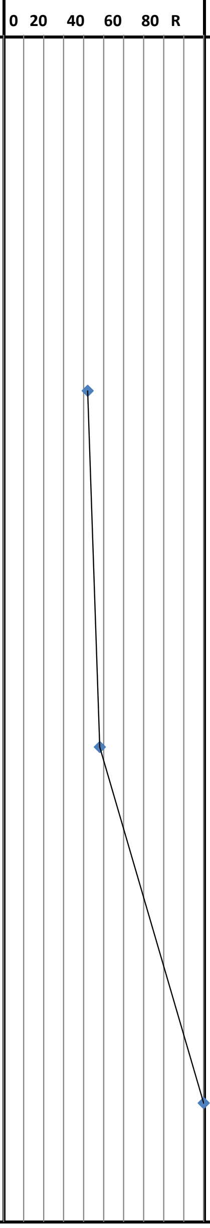
BORELOG

BOREHOLE NO.
BH-03

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:** 22-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:** 29-10-2024
CLIENT:	**THE COURTYARD**	**Geologist:** Inayat

DRILLING INFORMATION			**PROJECT NO: AJK/GT/101-3645**		**Driller:** Basit
METHOD OF DRILLING:	Straight Rotary				
DIA. OF BORING:	96mm		**CO-ORDINATES:**		
BIT: Clay/Carbide	**Rock Strike Level (m):**	Nil	**North:** 33.681513	**East:** 72.987523	**Direction / Inclination:** Vertical
SPT HAMMER WEIGHT:	63.5 kg	**Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 11.40m depth.	

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	**Subsurface Description**	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
50.0															
51.0															
52.0															
53.0	S-33			**LEAN CLAY** Brown, Hard, Medium Plasticity, Trace Concretion, Slightly Moist,						15	21	21	42		
54.0															
55.0															
56.0	S-34									17	20	28	48		
57.0															
58.0															
59.0	S-35			Brown, Very Hard, Medium Plasticity, Trace Concretion, Slightly Moist,						28	34	R	R		
60.0															



LEGEND:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO. BH-03

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

Drilling Started on: 22-10-2024
Drilling Completed on: 29-10-2024
Geologist: Inayat
Driller: Basit
Direction / Inclination: Vertical

DRILLING INFORMATION

PROJECT NO: AJK/GT/101-3645

METHOD OF DRILLING:	Straight Rotary		
DIA. OF BORING:	96mm	**CO-ORDINATES:**	
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**North:** 33.681513	**East:** 72.987523
SPT HAMMER WEIGHT:	63.5 kg **Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 11.40m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
60.0															
61.0															
				LEAN CLAY											
62.0	S-36			Dark Brown, Very Hard, Medium Plasticity, Slightly Moist,						22	29	R	R	R	
63.0															
64.0															
65.0	S-37									39	R	-	R	R	
66.0															
67.0															
68.0	S-38									39	R	-	R	R	
69.0															
70.0															

L E G E N D:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered
RC	Rock Core Recovery	**HF**	Highly Fracture	▽	Seepage/Perched Water
RQD	Rock Quality Designation				

AJK Engineers

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Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.	**BH-03**
PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**
Drilling Started on:	22-10-2024
Drilling Completed on:	29-10-2024
Geologist:	Inayat
Driller:	Basit
Direction / Inclination:	Vertical

DRILLING INFORMATION

METHOD OF DRILLING:	Straight Rotary		
DIA. OF BORING:	96mm		
BIT:	Clay/Carbide	**Rock Strike Level (m):**	Nil
SPT HAMMER WEIGHT:	63.5 kg	**Drop:**	2.5ft

PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:			
North:	33.681513	**East:**	72.987523
SEEPAGE/PERCHED WATER:	Encountered at 11.40m depth.		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
70.0															
71.0	S-43			**LEAN CLAY** Dark Brown, Very Hard, Medium Plasticity, Slightly Moist,						R	-	-	R		
72.0															
73.0	S-44									R	-	-	R		
74.0															
75.0															
76.0	S-45			*END OF BOREHOLE*						R	-	-	R		
77.0															
78.0															
79.0															
80.0															

LEGEND:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered
RC	Rock Core Recovery	**HF**	Highly Fracture	▽	Seepage/Perched Water
RQD	Rock Quality Designation				

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Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-04

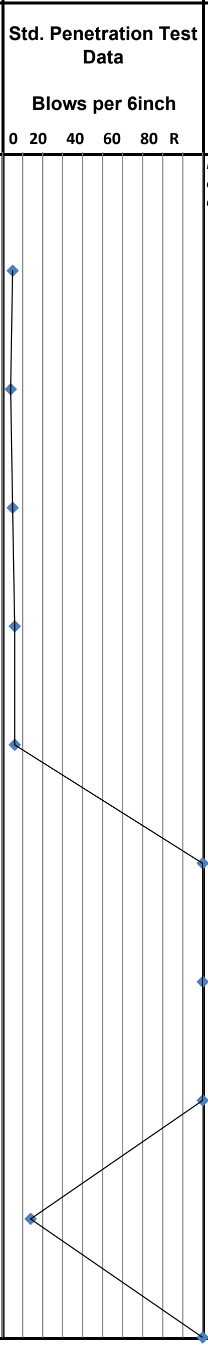
PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

Drilling Started on: 28-10-2024
Drilling Completed on: 10-11-2024
Geologist: Inayat
Driller: Ayaz
Direction / Inclination: Vertical

DRILLING INFORMATION
METHOD OF DRILLING: Straight Rotary
DIA. OF BORING: 96mm
BIT: Clay/Carbide **Rock Strike Level (m):** Nil
SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645
CO-ORDINATES:
North: 33.681353 **East:** 72.987203
SEEPAGE/PERCHED WATER: Encountered at 10.0m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Remarks
0.0														*Filling Material was encountered upto 9.0m depth.*
1.0	S-1			**FILLING MATERIAL** Brown, Loose, Sand with Silt and Clay, Slightly Moist,						2	2	3	5	
2.0	S-2									2	2	2	4	
3.0	S-3									3	2	3	5	
4.0	S-4									4	2	4	6	
5.0	S-5			Dark Brown, Loose, Sand, Clay, Slightly Moist,						3	3	3	6	
6.0	C-1			Grey, Very Dense, Gravel (Rounded to Sub-Rounded), Silty Sand, Slightly Moist,						39	R	-	R	
7.0	C-2									R	-	-	R	
8.0	C-3									R	-	-	R	
9.0	S-6			**LEAN CLAY** Brown, Medium Stiff, Low Plasticity, Moist,						5	7	7	14	
10.0	C-4		▽							R	-	-	R	Seepage/Perched



L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

AJK Engineers

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(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO. **BH-04**

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	28-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	10-11-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat

DRILLING INFORMATION

METHOD OF DRILLING: Straight Rotary

DIA. OF BORING: 96mm

BIT: Clay/Carbide **Rock Strike Level (m):** Nil

SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:

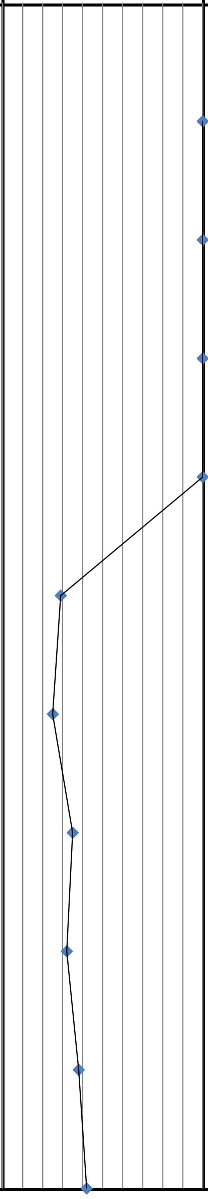
North: 33.681353 **East:** 72.987203

SEEPAGE/PERCHED WATER: Encountered at 10.0m depth.

Driller: Ayaz

Direction / Inclination: Vertical

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	**Subsurface Description**	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
10.0															
11.0	C-5			**SILTY GRAVEL** Grey, Very Dense, Gravel (Limestone),						R	-	-	R		
12.0	C-6									R	-	-	R		
13.0	C-7									R	-	-	R		
14.0	C-8									R	-	-	R		
15.0	S-7			**LEAN CLAY** Brown, Very Stiff, Low Plasticity, Highly Moist,						6	9	20	29		
16.0	S-8									6	9	16	25		
17.0	S-9			Brown, Hard, Low Plasticity, Moist,						10	15	20	35		
18.0	S-10									9	14	18	32		
19.0	S-11									10	15	23	38		
20.0	S-12									8	16	26	42		



L E G E N D:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number				
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

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(Geotechnical Engineering Department)

BORELOG

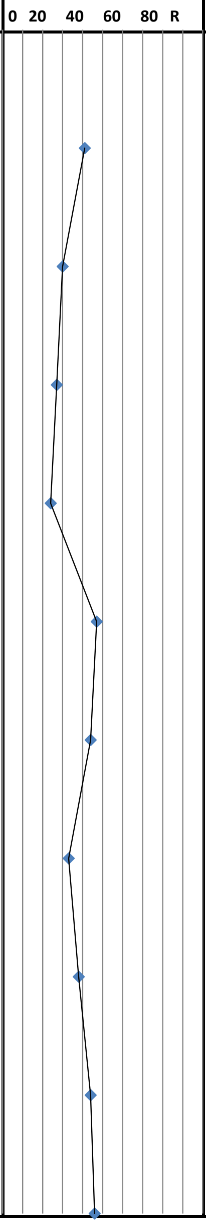
PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**BOREHOLE NO.** BH-04
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Started on:** 28-10-2024
CLIENT:	**THE COURTYARD**	**Drilling Completed on:** 10-11-2024

DRILLING INFORMATION		**PROJECT NO: AJK/GT/101-3645**		**Geologist:** Inayat
METHOD OF DRILLING:	Straight Rotary			**Driller:** Ayaz
DIA. OF BORING:	96mm	**CO-ORDINATES:**		
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**North:** 33.681353	**East:** 72.987203	**Direction / Inclination:** Vertical
SPT HAMMER WEIGHT:	63.5 kg **Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 10.0m depth.	

1	2	3	4	5	6	7	8	9	10	11	12	13	14	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	N VALUES	Remarks
20.0														
21.0	S-13			**LEAN CLAY with SAND** Dark Brown, Hard, Low Plasticity, Moist,						10	18	23	41	
22.0	S-14			Dark Brown, Very Stiff, Low Plasticity, Moist,						8	15	15	30	
23.0	S-15									8	12	15	27	
24.0	S-16									8	12	12	24	
25.0	S-27			Dark Brown, Hard, Low Plasticity, Moist,						14	19	28	47	
26.0	S-28			**LEAN CLAY** Brown, Hard, Medium Plasticity, Highly Moist,						12	18	26	44	
27.0	S-19									10	15	18	33	
28.0	S-20									12	18	20	38	
29.0	S-21									13	20	24	44	
30.0	S-22									14	22	24	46	

15 Std. Penetration Test Data

Blows per 6inch



LEGEND:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**			
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered		
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered		
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered		
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water		

AJK Engineers

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Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-04

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	28-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	10-11-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat
		Driller:	Ayaz
		Direction / Inclination:	Vertical

DRILLING INFORMATION

METHOD OF DRILLING: Straight Rotary

DIA. OF BORING: 96mm

BIT: Clay/Carbide **Rock Strike Level (m):** Nil

SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

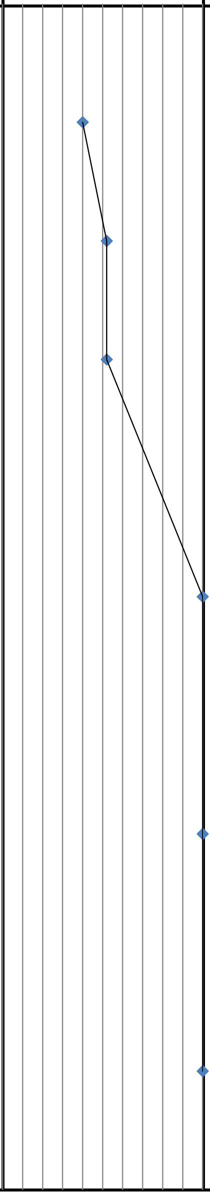
PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:

North: 33.681353 **East:** 72.987203

SEEPAGE/PERCHED WATER: Encountered at 10.0m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock		Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches)			N VALUES	Std. Penetration Test Data Blows per 6inch	Remarks
					RC %	RQD %				6	6	6		0 20 40 60 80 R	
30.0															
31.0	S-23			**LEAN CLAY with SAND** Dark Brown, Hard, Medium Plasticity, Moist,						12	18	22	40		
32.0	S-24			**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Highly Moist,						16	22	30	52		
33.0	S-25									14	20	32	52		
34.0															
35.0	S-26			Brown, Very Hard, Medium Plasticity, Moist,						R	-	-	R		
36.0															
37.0	S-27									R	-	-	R		
38.0															
39.0	S-28									10	31	R	R		
40.0															



L E G E N D:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered
RC	Rock Core Recovery	**HF**	Highly Fracture	▽	Seepage/Perched Water
RQD	Rock Quality Designation				

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.	**BH-04**
PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**
Drilling Started on:	28-10-2024
Drilling Completed on:	10-11-2024
Geologist:	Inayat
Driller:	Ayaz
Direction / Inclination:	Vertical

DRILLING INFORMATION

PROJECT NO: AJK/GT/101-3645

METHOD OF DRILLING:	Straight Rotary		
DIA. OF BORING:	96mm	**CO-ORDINATES:**	
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**North:** 33.681353	**East:** 72.987203
SPT HAMMER WEIGHT: 63.5 kg	**Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 10.0m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
40.0															
41.0	S-29			**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Moist,						30	R	-	R		
42.0															
43.0	S-30									R	-	-	R		
44.0															
45.0	S-31									R	-	-	R		
46.0															
47.0	S-32									R	-	-	R		
48.0															
49.0	S-33									R	-	-	R		
50.0															

LEGEND:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered
RC	Rock Core Recovery	**HF**	Highly Fracture	▽	Seepage/Perched Water
RQD	Rock Quality Designation				

AJK Engineers

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Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-04

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:** 28-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:** 10-11-2024
CLIENT:	**THE COURTYARD**	**Geologist:** Inayat

DRILLING INFORMATION

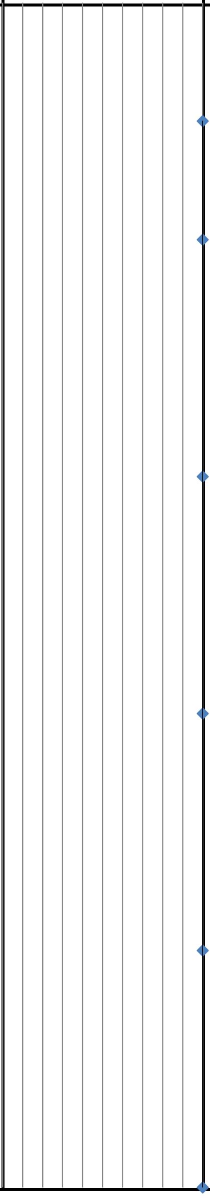
METHOD OF DRILLING: Straight Rotary
DIA. OF BORING: 96mm
BIT: Clay/Carbide **Rock Strike Level (m):** Nil
SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:
North: 33.681353 **East:** 72.987203
SEEPAGE/PERCHED WATER: Encountered at 10.0m depth.

Driller: Ayaz
Direction / Inclination: Vertical

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
50.0															
51.0	S-34			**LEAN CLAY**						45	R	-	R		
				Brown, Very Hard, Medium Plasticity, Moist,											
52.0	S-35									25	R	-	R		
53.0															
54.0	S-36									33	R	-	R		
55.0															
56.0	S-37									29	R	-	R		
57.0															
58.0	S-38									35	R	-	R		
59.0															
60.0	S-39									30	R	-	R		



L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	F	Fracture	SW	Slightly Weathered
RUN/R	Rock Core Run and Number	SF	Slightly Fracture	MW	Moderately Weathered
RC	Rock Core Recovery	MF	Moderately Fracture	HW	Highly Weathered
RQD	Rock Quality Designation	HF	Highly Fracture	▽	Seepage/Perched Water

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(Geotechnical Engineering Department)

BORELOG

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**BOREHOLE NO.**	**BH-04**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Started on:**	28-10-2024
CLIENT:	**THE COURTYARD**	**Drilling Completed on:**	10-11-2024

DRILLING INFORMATION		**PROJECT NO: AJK/GT/101-3645**	
METHOD OF DRILLING:	Straight Rotary		
DIA. OF BORING:	96mm	**CO-ORDINATES:**	
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**North:** 33.681353	**East:** 72.987203
SPT HAMMER WEIGHT:	63.5 kg **Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 10.0m depth.

Geologist: Inayat

Driller: Ayaz

Direction / Inclination: Vertical

1 Depth (m)	2 SAMPLE TYPE / NO.	3 RUN	4 PROFILE	5 Subsurface Description	6 Rock RC %	7 Rock RQD %	8 Fracture	9 Weathering	10 Drilling Fld. Loss %	11 SPT BLOWS (inches) 6	12 SPT BLOWS (inches) 6	13 SPT BLOWS (inches) 6	14 N VALUES	15 Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	16 Remarks
60.0															
61.0															
62.0	S-40			**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Moist,						31	R	-	R		
63.0															
64.0	S-41									29	R	-	R		
65.0															
66.0															
67.0	S-42									R	-	-	R		
68.0															
69.0															
70.0	S-43									R	-	-	R		

LEGEND:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered
RC	Rock Core Recovery	**HF**	Highly Fracture	▽	Seepage/Perched Water
RQD	Rock Quality Designation				

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BORELOG

BOREHOLE NO. BH-04

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

Drilling Started on: 28-10-2024

Drilling Completed on: 10-11-2024

Geologist: Inayat

Driller: Ayaz

Direction / Inclination: Vertical

DRILLING INFORMATION

METHOD OF DRILLING: Straight Rotary

DIA. OF BORING: 96mm

BIT: Clay/Carbide **Rock Strike Level (m):** Nil

SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:

North: 33.681353 **East:** 72.987203

SEEPAGE/PERCHED WATER: Encountered at 10.0m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	 6	 6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
70.0															
71.0															
72.0															
73.0	S-44			**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Moist,						22	29	R	R	◆ R	
74.0															
75.0															
76.0	S-45			**SILTY GRAVEL** Grey, Very Dense, Gravel (Limestone),						R	-	-	R	◆ R	
77.0															
78.0															
79.0	S-46									R	-	-	R	◆ R	
80.0															

LEGEND:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

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AJK Engineers

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(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-04

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	28-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	10-11-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat

DRILLING INFORMATION				**PROJECT NO: AJK/GT/101-3645**			
METHOD OF DRILLING:	Straight Rotary					**Driller:**	Ayaz
DIA. OF BORING:	96mm			**CO-ORDINATES:**			
BIT: Clay/Carbide	**Rock Strike Level (m):**	Nil		**North:** 33.681353	**East:** 72.987203	**Direction / Inclination:**	Vertical
SPT HAMMER WEIGHT:	63.5 kg	**Drop:**	2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 10.0m depth.		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	**SAMPLE TYPE / NO.**	**RUN**	**PROFILE**	**Subsurface Description**	**Rock** RC %	**Rock** RQD %	**Fracture**	**Weathering**	**Drilling Fld. Loss %**	**SPT BLOWS (inches)** 6	6	6	**N VALUES**	**Std. Penetration Test Data Blows per 6inch** 0 20 40 60 80 R	**Remarks**
80.0															
81.0															
82.0	S-47			**SILTY GRAVEL** Grey, Very Dense, Gravel (Limestone),						R	-	-	R		
83.0															
84.0															
85.0															
86.0	S-48									R	-	-	R		
87.0															
88.0															
89.0															
90.0	S-49									R	-	-	R		

END OF BOREHOLE

L E G E N D:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number				
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

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(Geotechnical Engineering Department)

BORELOG

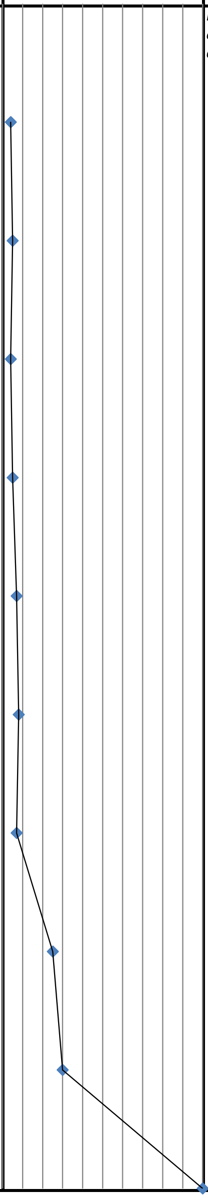
BOREHOLE NO.
BH-05

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

Drilling Started on: 30-10-2024
Drilling Completed on: 04-11-2024
Geologist: Inayat
Driller: Basit
Direction / Inclination: Vertical

DRILLING INFORMATION
METHOD OF DRILLING: Straight Rotary
DIA. OF BORING: 96mm
BIT: Clay/Carbide **Rock Strike Level (m):** Nil
SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645
CO-ORDINATES:
North: 33.681664 **East:** 72.987839
SEEPAGE/PERCHED WATER: Encountered at 10.0m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
0.0															*Filling Material was encountered upto 9.20m depth.*
1.0	S-1									2	2	2	4		
				FILLING MATERIAL Brown, Medium Stiff, Silty Sand with Gravel, Plastic Bags, Tiles Pieces, etc.											
2.0	S-2									2	3	2	5		
				Dark Brown, Medium Stiff, Silty Clay, Sand and Gravel, Slightly Moist,											
3.0	S-3									2	2	2	4		
4.0	S-4									3	3	2	5		
5.0	S-5									3	3	4	7		
				Dark Brown, Medium Stiff, Gravelly Silty Clay, Roots, Slightly Moist,											
6.0	S-6									5	5	3	8		
7.0	S-7									3	4	3	7		
				Dark Brown, Very Stiff, Silty Gravel with Sand, Trace Roots, Slightly Moist,											
8.0	S-8									8	12	13	25		
9.0	S-9									9	15	15	30		
				GRAVEL with SAND Grey, Medium Dense, Poorly Graded, Trace Sand,											
10.0	C-1		▽							R	-	-	R		Seepage/Perched

L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

SHEET 1 OF 3

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO. **BH-05**

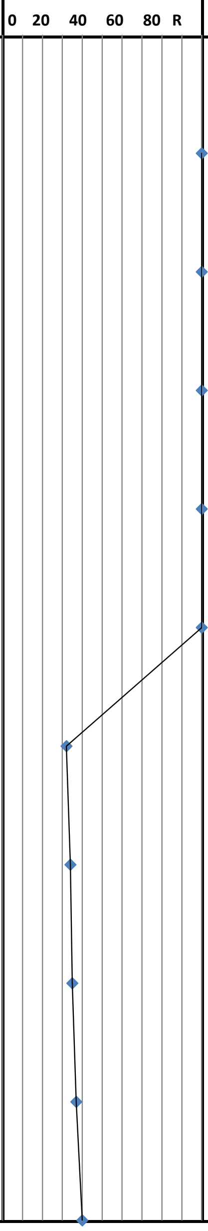
PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

Drilling Started on: 30-10-2024
Drilling Completed on: 04-11-2024
Geologist: Inayat
Driller: Basit
Direction / Inclination: Vertical

DRILLING INFORMATION
METHOD OF DRILLING: Straight Rotary
DIA. OF BORING: 96mm
BIT: Clay/Carbide **Rock Strike Level (m):** Nil
SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

PROJECT NO: AJK/GT/101-3645
CO-ORDINATES:
North: 33.681664 **East:** 72.987839
SEEPAGE/PERCHED WATER: Encountered at 10.0m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
10.0															
11.0	C-2			**GRAVEL with SAND** Grey, Medium Dense, Poorly Graded, Trace Sand and Silt,						R	-	-	R		
12.0	C-3									R	-	-	R		
13.0	C-4									R	-	-	R		
14.0	S-10									R	-	-	R		
15.0	S-11			**LEAN CLAY** Brown, Very Hard, Low Plasticity, Highly Moist,						R	-	-	R		
16.0	S-12			Brown, Hard, Low Plasticity, Highly Moist,						10	12	20	32		
17.0	S-13									12	13	21	34		
18.0	S-14									11	13	22	35		
19.0	S-15									13	16	21	37		
20.0	S-16									13	18	22	40		



L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

SHEET 2 OF 3

AJK Engineers

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-05

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	30-10-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	04-11-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat

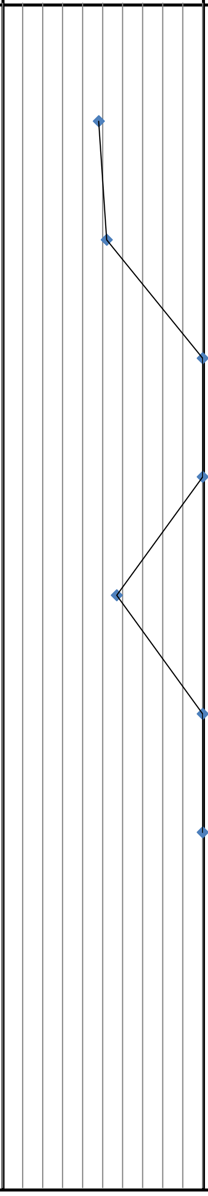
DRILLING INFORMATION

METHOD OF DRILLING:	Straight Rotary			**PROJECT NO: AJK/GT/101-3645**	
DIA. OF BORING:	96mm			**CO-ORDINATES:**	
BIT: Clay/Carbide	**Rock Strike Level (m):**	Nil		**North:** 33.681664	**East:** 72.987839
SPT HAMMER WEIGHT:	63.5 kg	**Drop:**	2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 10.0m depth.

Driller: Basit

Direction / Inclination: Vertical

1 Depth (m)	2 SAMPLE TYPE / NO.	3 RUN	4 PROFILE	5 Subsurface Description	6 Rock RC %	7 Rock RQD %	8 Fracture	9 Weathering	10 Drilling Fld. Loss %	11 SPT BLOWS (inches) 6	12 SPT BLOWS (inches) 6	13 SPT BLOWS (inches) 6	14 N VALUES	15 Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	16 Remarks
20.0															
21.0	S-17			**LEAN CLAY with SAND** Brown, Hard to Very Hard, Medium Plasticity, Highly Moist,						13	19	29	48		
22.0	S-18									14	20	32	52		
23.0	C-5			**GRAVEL** Grey, Very Dense, Poorly Graded, Moist,						25	R	-	R		
24.0	C-6									32	R	-	R		
25.0	S-19			**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Moist,						14	25	32	57		
26.0	S-20									R	-	-	R		
27.0	S-21			*END OF BOREHOLE*						R	-	-	R		
28.0															
29.0															
30.0															



LEGEND:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	F	Fracture	SW	Slightly Weathered
RUN/R	Rock Core Run and Number	SF	Slightly Fracture	MW	Moderately Weathered
RC	Rock Core Recovery	MF	Moderately Fracture	HW	Highly Weathered
RQD	Rock Quality Designation	HF	Highly Fracture	▽	Seepage/Perched Water

SHEET 3 OF 3

AJK

Ground Engineering Services & Solutions

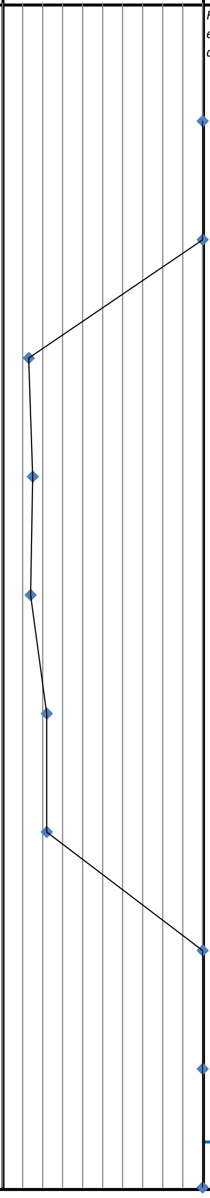
(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-06

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:** 06-11-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:** 25-11-2024
CLIENT:	**THE COURTYARD**	**Geologist:** Inayat

DRILLING INFORMATION			**PROJECT NO: AJK/GT/101-3645**		**Driller:** Ayaz
METHOD OF DRILLING: Straight Rotary					
DIA. OF BORING: 96mm			**CO-ORDINATES:**		
BIT: Clay/Carbide	**Rock Strike Level (m):**	Nil	**North:** 33.681706	**East:** 73.987479	**Direction / Inclination:** Vertical
SPT HAMMER WEIGHT: 63.5 kg	**Drop:**	2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 9.80m depth.	



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	**Subsurface Description**	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
0.0															*Filling Material was encountered upto 7.0m depth.*
1.0	C-1			**FILLING MATERIAL** Brown, Very Dense , Sand with Silt and Clay, Gravel, Slightly Moist,						33	R	-	R		
2.0	C-2									30	R	-	R		
3.0	S-1			Brown, Silty Clay, Stiff, Gravel, Grass Roots, Slightly Moist,						3	4	9	13		
4.0	S-2									6	7	8	15		
5.0	S-3									6	7	7	14		
6.0	S-4									6	9	13	22		
7.0	S-5			Brown, Medium Dense, Clayey Sand, Gravel, Moist,						7	10	12	22		
8.0	C-3			**GRAVEL with SILT** Grey, Very Dense, Poorly Graded, Slightly Moist,						R	-	-	R		
9.0	C-4									36	R	-	R		▽ Seepage/Perched
10.0	C-5									27	R	-	R		

L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

SHEET 1 OF 11

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO. **BH-06**

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

Drilling Started on: 06-11-2024

Drilling Completed on: 25-11-2024

Geologist: Inayat

Driller: Ayaz

Direction / Inclination: Vertical

DRILLING INFORMATION

METHOD OF DRILLING: Straight Rotary

DIA. OF BORING: 96mm

BIT: Clay/Carbide **Rock Strike Level (m):** Nil

SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft

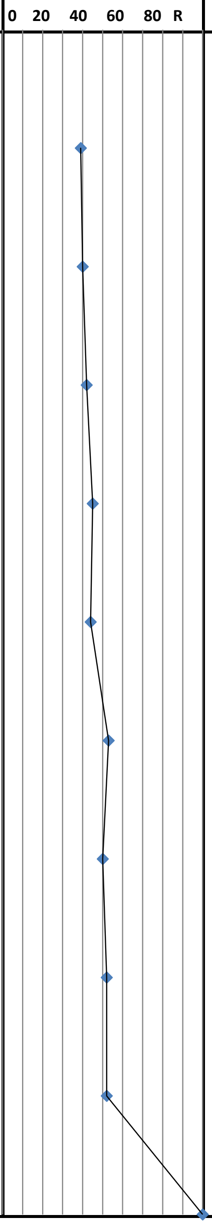
PROJECT NO: AJK/GT/101-3645

CO-ORDINATES:

North: 33.681706 **East:** 73.987479

SEEPAGE/PERCHED WATER: Encountered at 9.80m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch	Remarks
10.0															
11.0	C-6			**LEAN CLAY with SAND** Brown, Hard, Medium Plasticity, Trave Concretions, Highly Moist,						16	19	20	39		
12.0	S-6									16	20	20	40		
13.0	C-7									18	20	22	42		
14.0	C-8									18	21	24	45		
15.0	S-9			**LEAN CLAY** Brown, Hard, Medium Plasticity, Highly Moist,						16	20	24	44		
16.0	S-10			Brown, Very Hard, Medium Plasticity, Highly Moist,						18	25	28	53		
17.0	S-11									16	24	26	50		
18.0	S-12									20	25	27	52		
19.0	S-13									19	23	29	52		
20.0	S-14									22	30	R	R		



LEGEND:

SPT/S	Standard Penetration Test & Number
CPT/C	Cone Penetration Test & Number
RUN/R	Rock Core Run and Number
RC	Rock Core Recovery
RQD	Rock Quality Designation

FRACTURE:

F	Fracture
SF	Slightly Fracture
MF	Moderately Fracture
HF	Highly Fracture

WEATHERING:

SW	Slightly Weathered
MW	Moderately Weathered
HW	Highly Weathered
▽	Seepage/Perched Water

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-06

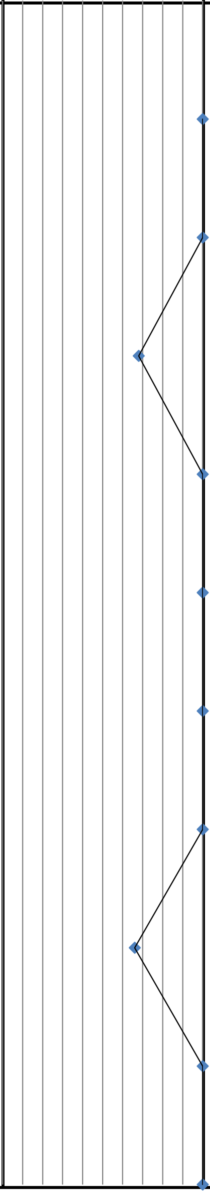
PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**
Drilling Started on:	06-11-2024
Drilling Completed on:	25-11-2024
Geologist:	Inayat
Driller:	Ayaz
Direction / Inclination:	Vertical

DRILLING INFORMATION

PROJECT NO: AJK/GT/101-3645

METHOD OF DRILLING:	Straight Rotary		
DIA. OF BORING:	96mm	**CO-ORDINATES:**	
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**North:** 33.681706	**East:** 73.987479
SPT HAMMER WEIGHT: 63.5 kg	**Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 9.80m depth.

1 Depth (m)	2 SAMPLE TYPE / NO.	3 RUN	4 PROFILE	5 Subsurface Description	6 Rock RC %	7 Rock RQD %	8 Fracture	9 Weathering	10 Drilling Fld. Loss %	11 SPT BLOWS (inches) 6	12 SPT BLOWS (inches) 6	13 SPT BLOWS (inches) 6	14 N VALUES	15 Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	16 Remarks
20.0															
21.0	S-15			**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Highly Moist,						22	30	R	R		
22.0	S-16			**SAND with SILT and GRAVEL** Brown, Very Dense, Poorly Graded, Concretions, Highly Moist,						24	21	R	R		
23.0	S-17									21	32	36	68		
24.0	S-18									26	R	-	R		
25.0	C-7									R	-	-	R		
26.0	S-19			**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Highly Moist,						36	R	-	R		
27.0	S-20									30	33	R	R		
28.0	S-21									24	32	34	66		
29.0	S-22									29	33	R	R		
30.0	S-23									24	35	R	R		



LEGEND:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

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BORELOG

BOREHOLE NO.
BH-06

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**

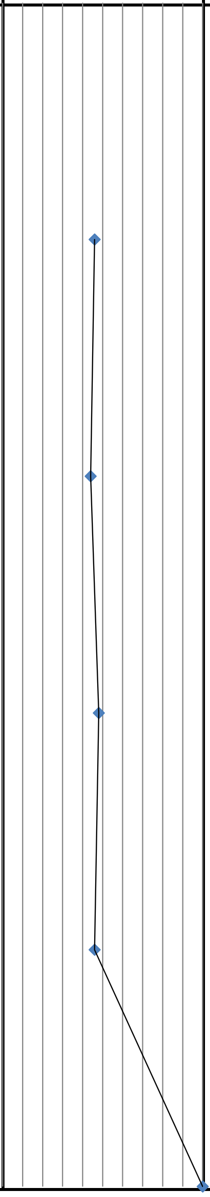
Drilling Started on: 06-11-2024
Drilling Completed on: 25-11-2024
Geologist: Inayat
Driller: Ayaz
Direction / Inclination: Vertical

DRILLING INFORMATION

PROJECT NO: AJK/GT/101-3645

METHOD OF DRILLING:	Straight Rotary			**CO-ORDINATES:**			
DIA. OF BORING:	96mm			**North:**	33.681706	**East:**	73.987479
BIT: Clay/Carbide	**Rock Strike Level (m):**	Nil		**SEEPAGE/PERCHED WATER:**	Encountered at 9.80m depth.		
SPT HAMMER WEIGHT:	63.5 kg	**Drop:**	2.5ft				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
30.0															
31.0															
32.0	S-24			**LEAN CLAY** Brown, Hard, Medium Plasticity, Highly Moist,						24	20	26	46		
33.0															
34.0	S-25									20	22	22	44		
35.0															
36.0	S-26									20	24	24	48		
37.0															
38.0	S-27									16	22	24	46		
39.0															
40.0	S-28									22	32	R	R		



L E G E N D:

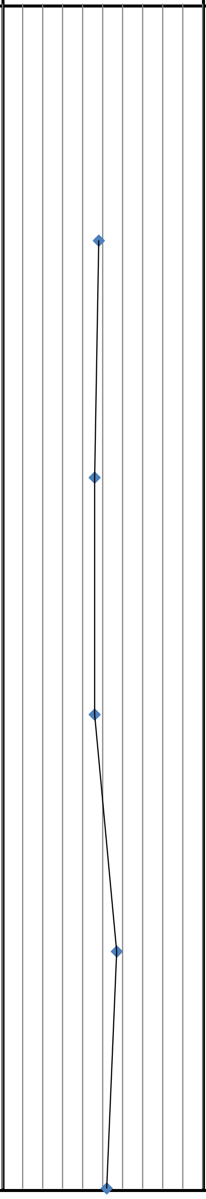
		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	F	Fracture	SW	Slightly Weathered
CPT/C	Cone Penetration Test & Number	SF	Slightly Fracture	MW	Moderately Weathered
RUN/R	Rock Core Run and Number	MF	Moderately Fracture	HW	Highly Weathered
RC	Rock Core Recovery				
RQD	Rock Quality Designation	HF	Highly Fracture	▽	Seepage/Perched Water

SHEET 4 OF 11

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**BOREHOLE NO.** **BH-06**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Started on:** 06-11-2024
CLIENT:	**THE COURTYARD**	**Drilling Completed on:** 25-11-2024

DRILLING INFORMATION			**PROJECT NO: AJK/GT/101-3645**		**Geologist:** Inayat
METHOD OF DRILLING:	Straight Rotary				
DIA. OF BORING:	96mm		**CO-ORDINATES:**		**Driller:** Ayaz
BIT: Clay/Carbide	**Rock Strike Level (m):**	Nil	**North:** 33.681706	**East:** 73.987479	**Direction / Inclination:**
SPT HAMMER WEIGHT:	63.5 kg	**Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 9.80m depth.	Vertical

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	**SAMPLE TYPE / NO.**	**RUN**	**PROFILE**	**Subsurface Description**	**Rock**		**Fracture**	**Weathering**	**Drilling Fld. Loss %**	**SPT BLOWS (inches)**			**N VALUES**	**Std. Penetration Test Data Blows per 6inch**	**Remarks**
					RC %	**RQD %**				**6**	**6**	**6**		0 20 40 60 80 R	
40.0															
41.0															
42.0	S-29			**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Moist,						17	24	24	48		
43.0															
44.0	S-30									18	24	22	46		
45.0															
46.0	S-31									12	17	29	46		
47.0															
48.0	S-32									16	26	31	57		
49.0															
50.0	S-33									18	24	28	52		



L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

BORELOG

BOREHOLE NO. **BH-06**

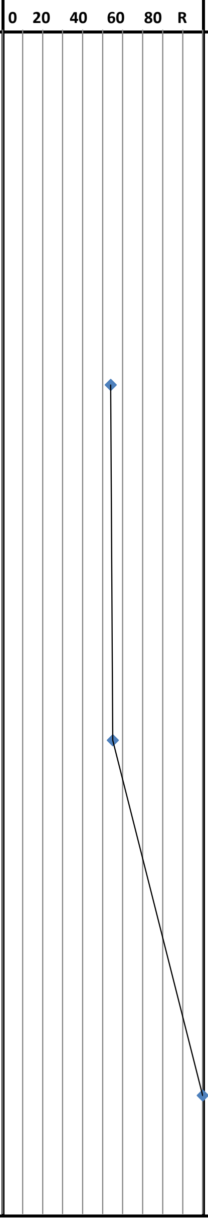
PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	06-11-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	25-11-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat
		Driller:	Ayaz
		Direction / Inclination:	Vertical

DRILLING INFORMATION

PROJECT NO: AJK/GT/101-3645

METHOD OF DRILLING:	Straight Rotary	**CO-ORDINATES:**	
DIA. OF BORING:	96mm	**North:** 33.681706	**East:** 73.987479
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**SEEPAGE/PERCHED WATER:**	Encountered at 9.80m depth.
SPT HAMMER WEIGHT: 63.5 kg	**Drop:** 2.5ft		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock		Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches)			N VALUES	Std. Penetration Test Data	Remarks
					RC %	RQD %				6	6	6		Blows per 6inch 0 20 40 60 80 R	
50.0															
51.0															
52.0															
53.0	S-34			**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Highly Moist,						19	26	28	54		
54.0															
55.0															
56.0	S-35									21	25	30	55		
57.0															
58.0															
59.0	S-36									24	36	R	R		
60.0															



L E G E N D:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.	**BH-06**
PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**
CLIENT:	**THE COURTYARD**
Drilling Started on:	06-11-2024
Drilling Completed on:	25-11-2024
Geologist:	Inayat
Driller:	Ayaz
Direction / Inclination:	Vertical

DRILLING INFORMATION

PROJECT NO: AJK/GT/101-3645

METHOD OF DRILLING:	Straight Rotary		
DIA. OF BORING:	96mm	**CO-ORDINATES:**	
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**North:** 33.681706	**East:** 73.987479
SPT HAMMER WEIGHT:	63.5 kg **Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 9.80m depth.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	**SAMPLE TYPE / NO.**	**RUN**	**PROFILE**	**Subsurface Description**	**Rock**		**Fracture**	**Weathering**	**Drilling Fld. Loss %**	**SPT BLOWS (inches)**			**N VALUES**	**Std. Penetration Test Data Blows per 6inch**	**Remarks**
					RC %	**RQD %**				**6**	**6**	**6**		**0 20 40 60 80 R**	
60.0			▨												
61.0			▨												
62.0	S-37		▨	**LEAN CLAY** Brown, Very Hard, Medium Plasticity, Moist,						20	32	R	R	◆	
63.0			▨												
64.0			▨												
65.0	S-38		▨	**GRAVELY LEAN CLAY** Brown, Very Hard, Medium Plasticity,						27	R	-	R	◆	
66.0			▨												
67.0			▨												
68.0	S-39		▨	**LEAN CLAY** Reddish Brown, Very Hard, Medium Plasticity, Moist,						25	36	R	R	◆	
69.0			▨												
70.0			▨												

LEGEND:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**			
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered		
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered		
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered		
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water		

SHEET 7 OF 11

AJK Engineers

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-06

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	06-11-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	25-11-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat

DRILLING INFORMATION

PROJECT NO: AJK/GT/101-3645

METHOD OF DRILLING: Straight Rotary		**Driller:**	Ayaz
DIA. OF BORING: 96mm	**CO-ORDINATES:**		
BIT: Clay/Carbide **Rock Strike Level (m):** Nil	**North:** 33.681706 **East:** 73.987479	**Direction / Inclination:**	Vertical
SPT HAMMER WEIGHT: 63.5 kg **Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:** Encountered at 9.80m depth.		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
70.0															
71.0	S-40			**LEAN CLAY** Reddish Brown, Very Hard, Medium Plasticity, Moist,						28	33	R	R		
72.0															
73.0															
74.0	S-41									23	32	R	R		
75.0															
76.0															
77.0	S-42			**SILTY GRAVEL** Grey, Very Dense, Gravel (Limestone),						R	-	-	R		
78.0															
79.0															
80.0	C-7									R	-	-	R		

LEGEND:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered
RC	Rock Core Recovery	**HF**	Highly Fracture	▽	Seepage/Perched Water
RQD	Rock Quality Designation				

AJK Engineers

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Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO.
BH-06

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	06-11-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	25-11-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat

DRILLING INFORMATION

PROJECT NO: AJK/GT/101-3645

METHOD OF DRILLING:	Straight Rotary	**Driller:**	Ayaz
DIA. OF BORING:	96mm	**CO-ORDINATES:**	
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**North:** 33.681706	**East:** 73.987479
SPT HAMMER WEIGHT: 63.5 kg	**Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 9.80m depth.
Direction / Inclination:	Vertical		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
80.0															
81.0															
82.0															
83.0	C-8			**SILTY GRAVEL** Grey, Very Dense, Gravel (Limestone),						R	-	-	R		
84.0															
85.0															
86.0	C-9									R	-	-	R		
87.0															
88.0															
89.0	C-10									R	-	-	R		
90.0															

LEGEND:

SPT/S	Standard Penetration Test & Number	**FRACTURE:**		**WEATHERING:**	
CPT/C	Cone Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
RUN/R	Rock Core Run and Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RC	Rock Core Recovery	**MF**	Moderately Fracture	**HW**	Highly Weathered
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

AJK

Ground Engineering Services & Solutions

(Geotechnical Engineering Department)

BORELOG

BOREHOLE NO. **BH-06**

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**Drilling Started on:**	06-11-2024
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Completed on:**	25-11-2024
CLIENT:	**THE COURTYARD**	**Geologist:**	Inayat

DRILLING INFORMATION				**PROJECT NO: AJK/GT/101-3645**			
METHOD OF DRILLING:	Straight Rotary					**Driller:**	Ayaz
DIA. OF BORING:	96mm			**CO-ORDINATES:**			
BIT: Clay/Carbide	**Rock Strike Level (m):**	Nil		**North:** 33.681706	**East:** 73.987479	**Direction / Inclination:**	Vertical
SPT HAMMER WEIGHT:	63.5 kg	**Drop:**	2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 9.80m depth.		

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	SPT BLOWS (inches) 6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
90.0															
91.0															
92.0	C-11			**SILTY GRAVEL** Grey, Very Dense, Gravel (Limestone),						R	-	-	R	◆	
93.0															
94.0															
95.0	C-12									R	-	-	R	◆	
96.0															
97.0															
98.0	C-13									R	-	-	R	◆	
99.0															
100.0	C-14									R	-	-	R	◆	

LEGEND:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered
RC	Rock Core Recovery				
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

BORELOG

PROJECT:	**GEOTECHNICAL SITE INVESTIGATIONS - THE COURTYARD RESIDENCE**	**BOREHOLE NO.** **BH-06**
LOCATION:	**STREET NO. 73, SECTOR F-11/1, ISLAMABAD.**	**Drilling Started on:** 06-11-2024
CLIENT:	**THE COURTYARD**	**Drilling Completed on:** 25-11-2024

DRILLING INFORMATION		**PROJECT NO: AJK/GT/101-3645**		**Geologist:** Inayat
METHOD OF DRILLING: Straight Rotary				**Driller:** Ayaz
DIA. OF BORING: 96mm		**CO-ORDINATES:**		
BIT: Clay/Carbide	**Rock Strike Level (m):** Nil	**North:** 33.681706	**East:** 73.987479	**Direction / Inclination:**
SPT HAMMER WEIGHT: 63.5 kg	**Drop:** 2.5ft	**SEEPAGE/PERCHED WATER:**	Encountered at 9.80m depth.	Vertical

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Depth (m)	SAMPLE TYPE / NO.	RUN	PROFILE	Subsurface Description	Rock RC %	Rock RQD %	Fracture	Weathering	Drilling Fld. Loss %	SPT BLOWS (inches) 6	6	6	N VALUES	Std. Penetration Test Data Blows per 6inch 0 20 40 60 80 R	Remarks
100.0															
101.0															
102.0															
103.0	C-15			**SILTY GRAVEL** Grey, Very Dense, Gravel (Limestone),						R	-	-	R	R	
104.0															
105.0															
106.0	C-16			***END OF BOREHOLE***						R	-	-	R	R	
107.0															
108.0															
109.0															
110.0															

L E G E N D:

		FRACTURE:		**WEATHERING:**	
SPT/S	Standard Penetration Test & Number	**F**	Fracture	**SW**	Slightly Weathered
CPT/C	Cone Penetration Test & Number	**SF**	Slightly Fracture	**MW**	Moderately Weathered
RUN/R	Rock Core Run and Number	**MF**	Moderately Fracture	**HW**	Highly Weathered
RC	Rock Core Recovery				
RQD	Rock Quality Designation	**HF**	Highly Fracture	▽	Seepage/Perched Water

Appendix F

Summary of Laboratory Test Results / Detailed Test Result Sheets

SUMMARY OF LABORATORY RESULTS

Geotechnical Investigation - The Courtyard Residence, Street No. 73, Sector F-11/1, Islamabad.

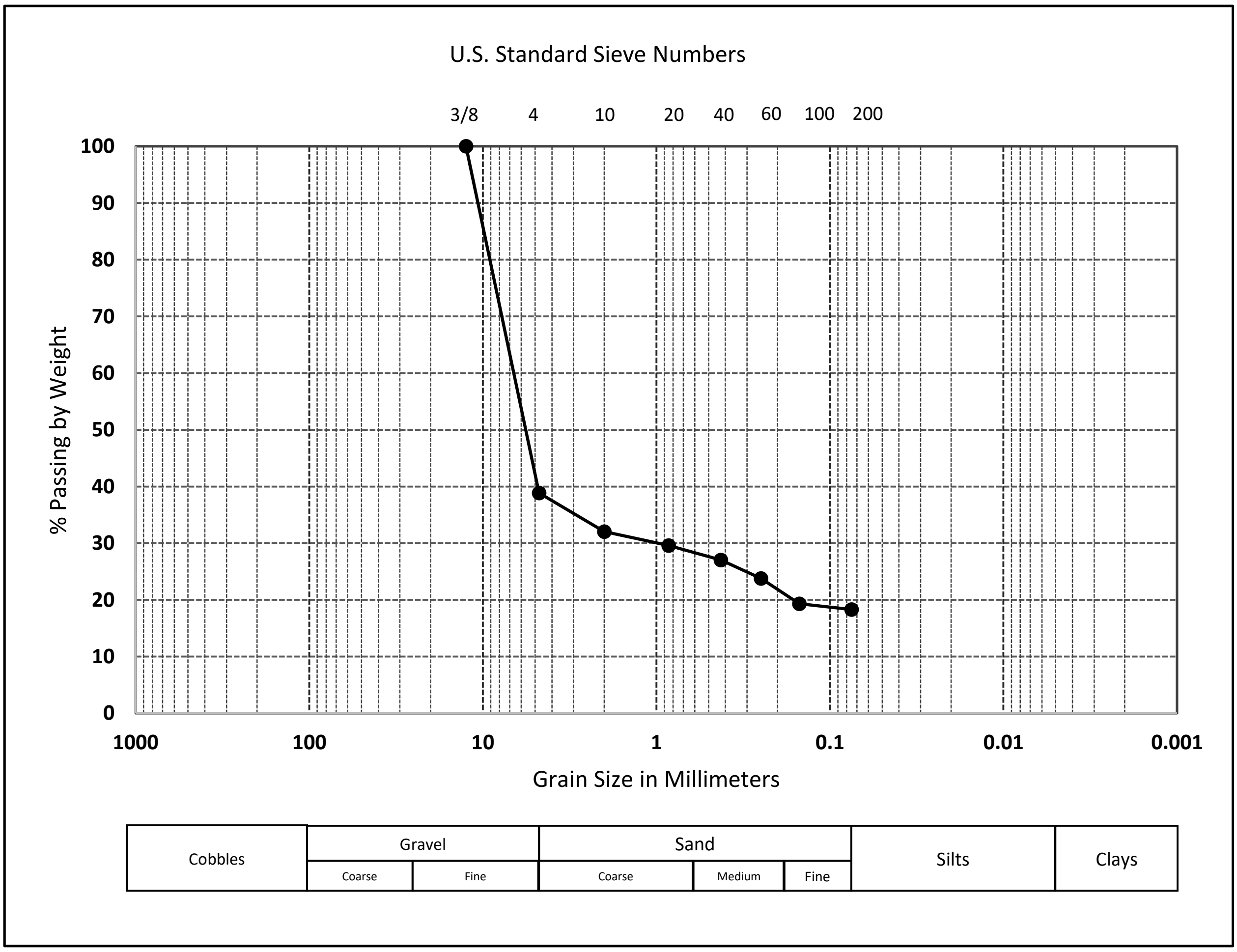
BH No.	Sample No.	Depth (m)	Atterberg Limits			NMC (%)	Sieve Analysis			Unified Soil Classification	Bulk Density	Dry Density	UCS of Soil		Chemical Analysis of Soil			Chemical Analysis of Water			
			LL	PL	PI		Gravels %	Sand %	Fines %		(gm/cm^3)	(gm/cm^3)	Compressive Strength (Kg/cm^2)	Strain (%)	SO$_4$ (%)	Cl (%)	Organic Matter (%)	SO$_4$ (ppm)	Cl (ppm)	TDS (ppm)	P.H
BH-01	S-5	7.5	NP	NP	NP	21.21	61.16	20.55	18.29	Silty Gravel with Sand (GM)											
	S-6	9.0	NP	NP	NP	10.75	74.61	24.00	1.39	Poorly Graded Gravel with Sand (GP)											
	S-7	15.0	40	25	15	26.24	0.00	15.81	84.19	Lean Clay with Sand (CL)											
	S-10	21.5	36	20	16	17.26	0.00	2.51	97.49	Lean Clay (CL)											
	S-14	26.0	39	24	15	23.27	7.35	18.92	73.73	Lean Clay with Sand (CL)											
BH-02	S-8	9.0	NP	NP	NP	1.66	77.46	10.43	12.11	Silty Gravel (GM)											
	S-9	16.0	32	18	14	11.33	4.61	24.75	70.64	Lean Clay with Sand (CL)											
	S-13	20.0	35	19	16	11.19	5.91	10.89	83.20	Lean Clay with Sand (CL)											
	S-10	17.0													0.04	0.02	0.41				
	S-25	22.0	44	26	18	10.66	6.38	14.40	79.22	Lean Clay with Sand (CL)											
	S-18	25.0	41	25	16	8.67	2.16	17.53	80.31	Lean Clay with Sand (CL)											
	S-27	38.0	38	21	17	13.34	3.91	6.88	89.21	Lean Clay (CL)											
	S-35	56.0	41	21	20	9.07	0.00	6.31	93.69	Lean Clay (CL)											
	S-40	65.0	40	22	18	7.52	0.56	5.16	94.28	Lean Clay (CL)											
BH-03	S-11	16.0	32	19	13	15.94	2.48	20.96	76.56	Lean Clay with Sand (CL)											
	UDS-1	15.0				19.30					1.91	1.60	0.31	6.75	0.05	0.04	0.44				
	S-20	25.0	26	20	6	9.81	13.36	30.75	55.89	Sandy Silty Clay (CL-ML)											
	S-23	28.0	28	16	12	11.21	2.93	7.33	89.74	Lean Clay (CL)											
	S-28	33.0	29	16	13	10.70	3.10	9.74	87.16	Lean Clay (CL)											
	S-30	41.0	39	21	18	11.12	3.16	8.09	88.75	Lean Clay (CL)											
	UDS-2	50.0				17.61					1.91	1.62	0.36	6.43							
	S-36	62.0	38	19	19	6.15	4.11	6.77	89.12	Lean Clay (CL)											
BH-04	S-6	9.0	NP	NP	NP	13.82	37.96	22.56	39.48	Silty Gravel with Sand (GM)											
	S-7	15.0	30	19	11	23.93	2.16	3.56	94.28	Lean Clay (CL)											
	S-10	18.0	30	20	10	13.33	3.14	10.21	86.65	Lean Clay (CL)											
	S-15	23.0	29	20	9	22.03	4.06	17.12	78.82	Lean Clay with Sand (CL)											
	S-21	29.0	33	16	17	15.37	1.20	10.26	88.54	Lean Clay (CL)											
	S-24	32.0	29	16	13	18.68	1.96	5.66	92.38	Lean Clay (CL)											
	UDS-1	43.0				17.36					1.98	1.69	1.50	2.00							
	S-30	52.0	39	21	18	14.46	0.00	3.98	96.02	Lean Clay (CL)											
BH-05	S-11	15.0	30	19	11	20.82	0.00	8.37	91.63	Lean Clay (CL)											
	UDS-1	14.0				15.14					1.90	1.65	0.37	3.21	0.03	0.04	0.54				
	S-13	17.0	29	20	9	24.22	0.00	11.56	88.44	Lean Clay (CL)											
	S-17	21.0	29	19	10	23.09	1.59	23.98	74.43	Lean Clay with Sand (CL)											
	C-5	23.0	NP	NP	NP	14.47	90.18	2.14	7.68	Poorly Graded Gravel with Silt (GP-GM)											
	S-19	25.0	33	15	18	17.78	0.00	13.98	86.02	Lean Clay (CL)											
BH-06	C-5	10.0	NP	NP	NP	10.10	85.81	7.47	6.72	Poorly Graded Gravel with Silt (GP-GM)											
	S-6	12.0	33	19	14	22.87	3.61	16.15	80.24	Lean Clay with Sand (CL)											
	S-11	17.0	31	16	15	23.77	1.34	8.63	90.03	Lean Clay (CL)											
	S-15	21.0	30	17	13	22.34	1.07	11.91	87.02	Lean Clay (CL)											
	S-16	22.0	NP	NP	NP	22.57	28.98	63.69	7.33	Poorly Graded Sand with Silt and Gravel (SP-SM)											
	S-21	28.0	34	21	13	24.79	1.71	11.02	87.27	Lean Clay (CL)											
	S-26	36.0	33	21	12	29.06	1.28	10.50	88.22	Lean Clay (CL)											
	S-34	53.0	41	20	21	22.28	0.00	4.74	95.26	Lean Clay (CL)											
	S-38	65.0	40	21	19	17.43	26.96	10.24	62.80	Gravelly Lean Clay (CL)											
	S-39	68.0	40	22	18	17.13	0.69	4.44	94.87	Lean Clay (CL)											

Total Number of Tests	34	34	34	45	41	41	41	41	4	4	4	4	3	3	3	0	0	0	0
Max. Value of Tests	44	26	21	29.06	90.18	63.69	97.49	-	1.98	1.69	1.50	6.75	0.05	0.04	0.54	0.00	0.00	0.00	0.00
Min. Value of Tests	26	15	6	1.66	0.00	2.14	1.39	-	1.90	1.60	0.31	2.00	0.03	0.02	0.41	0.00	0.00	0.00	0.00

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-01	**Depth (m):**	7.5
Natural Moisture Content:	21.21%	**Total Dry Weight: (gms)**	100
Gravel:	61.16%	**Sand:**	20.55%
Silt / Clay:	18.29%	**Classification Group:**	GM
Description:	Brown, **Silty Gravel with Sand.**		



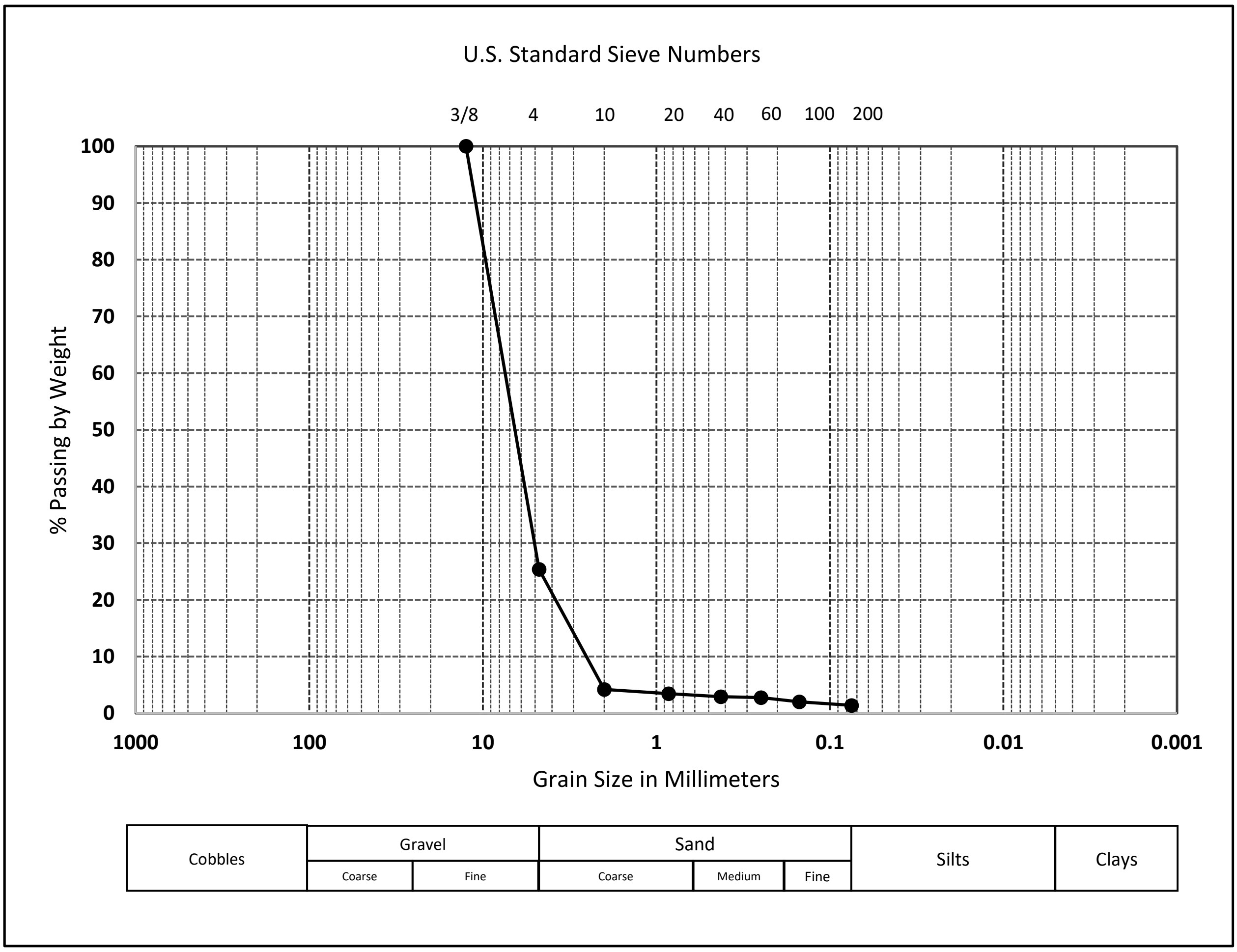
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-01	**Depth (m):**	9.0
Natural Moisture Content:	10.75%	**Total Dry Weight: (gms)**	100
Gravel:	74.61%	**Sand:**	24.00%
Silt / Clay:	1.39%	**Classification Group:**	GP
Description:	Brown, Poorly Graded **Gravel with Sand.**		



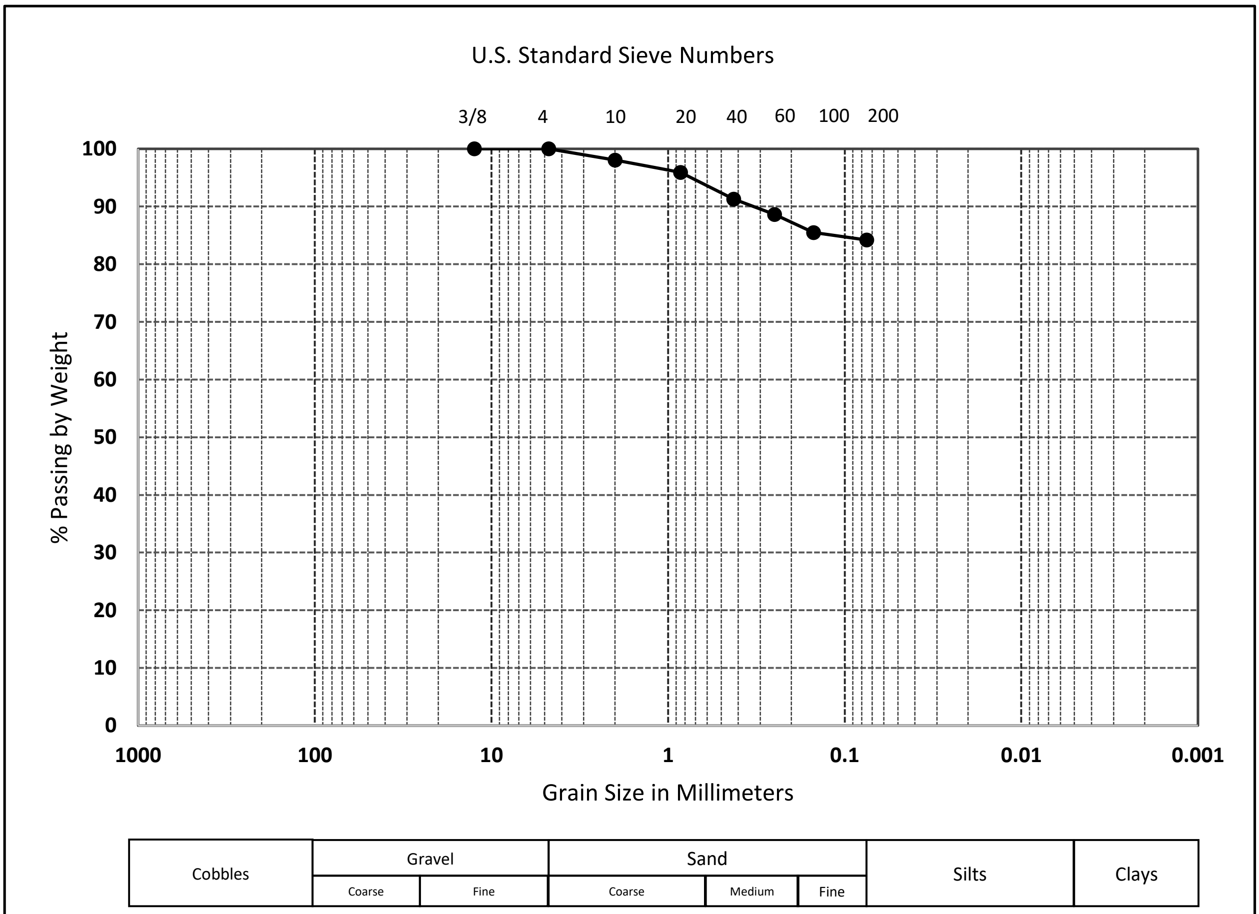
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-01	**Depth (m):**	15.0
Natural Moisture Content:	26.24%	**Total Dry Weight: (gms)**	100
Gravel:	0.00%	**Sand:**	15.81%
Silt / Clay:	84.19%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay with Sand.**		



Tested By:

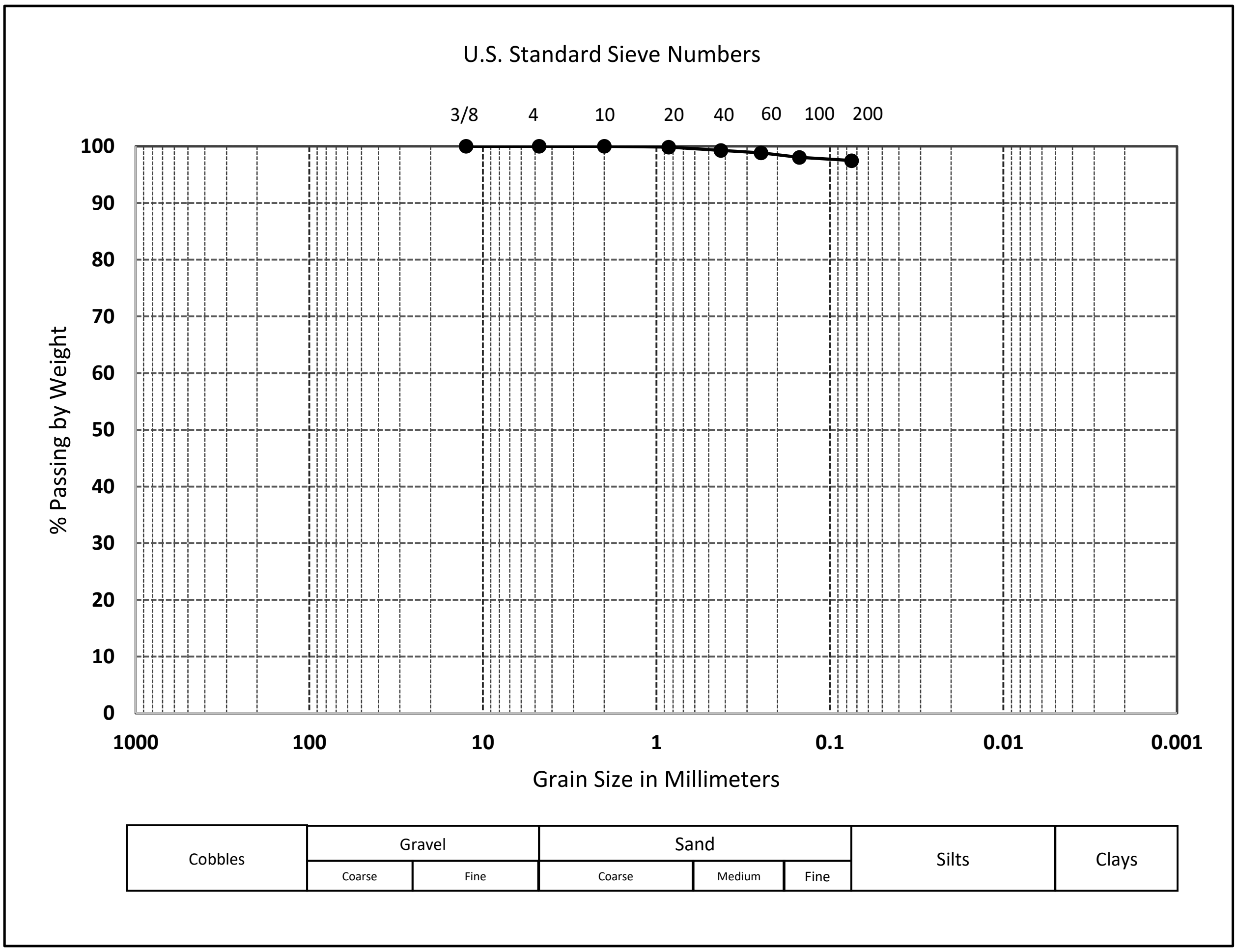
Checked By:

AJK Engineers

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-01	**Depth (m):**	21.5
Natural Moisture Content:	17.26%	**Total Dry Weight: (gms)**	100
Gravel:	0.00%	**Sand:**	2.51%
Silt / Clay:	97.49%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



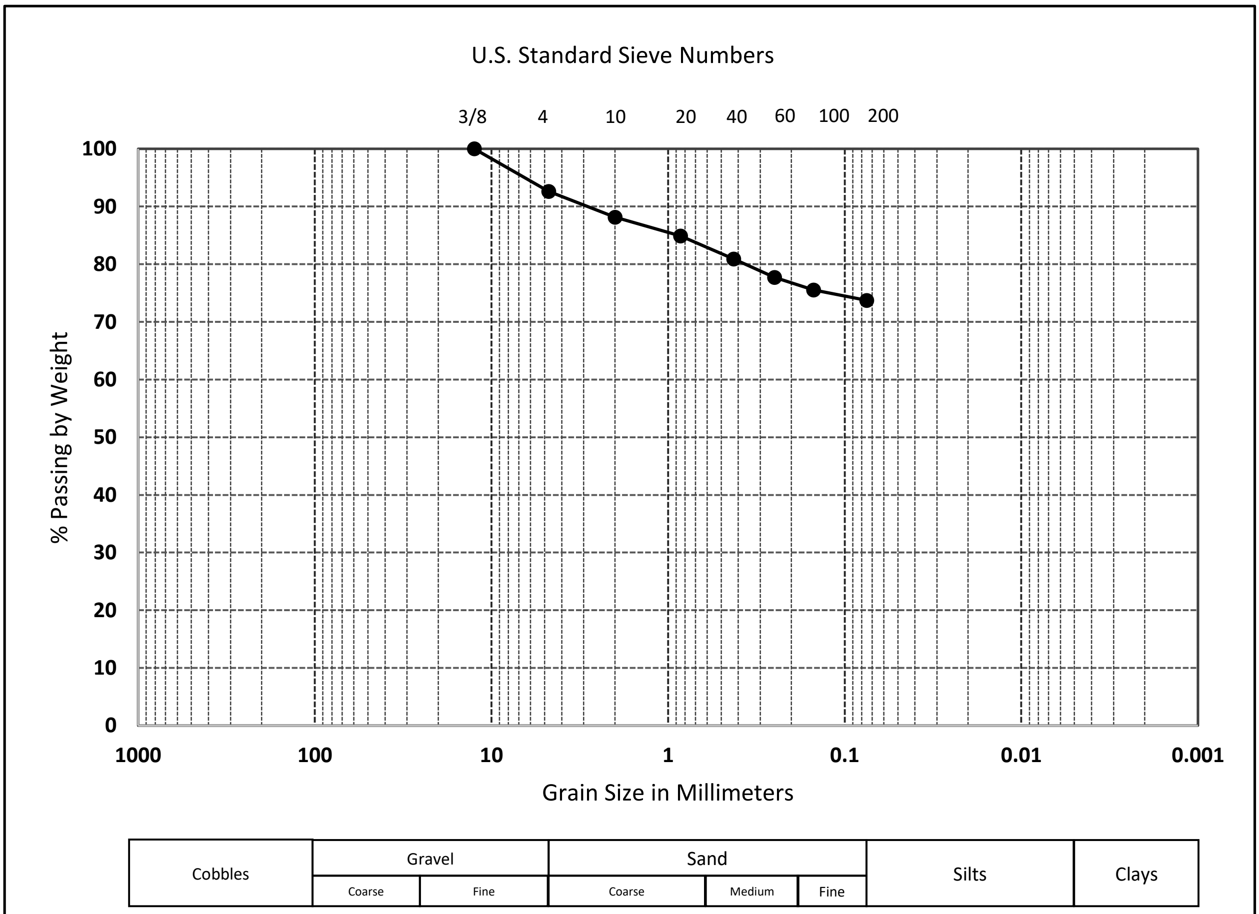
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-01	**Depth (m):**	26.0
Natural Moisture Content:	23.27%	**Total Dry Weight: (gms)**	100
Gravel:	7.35%	**Sand:**	18.92%
Silt / Clay:	73.73%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay with Sand.**		



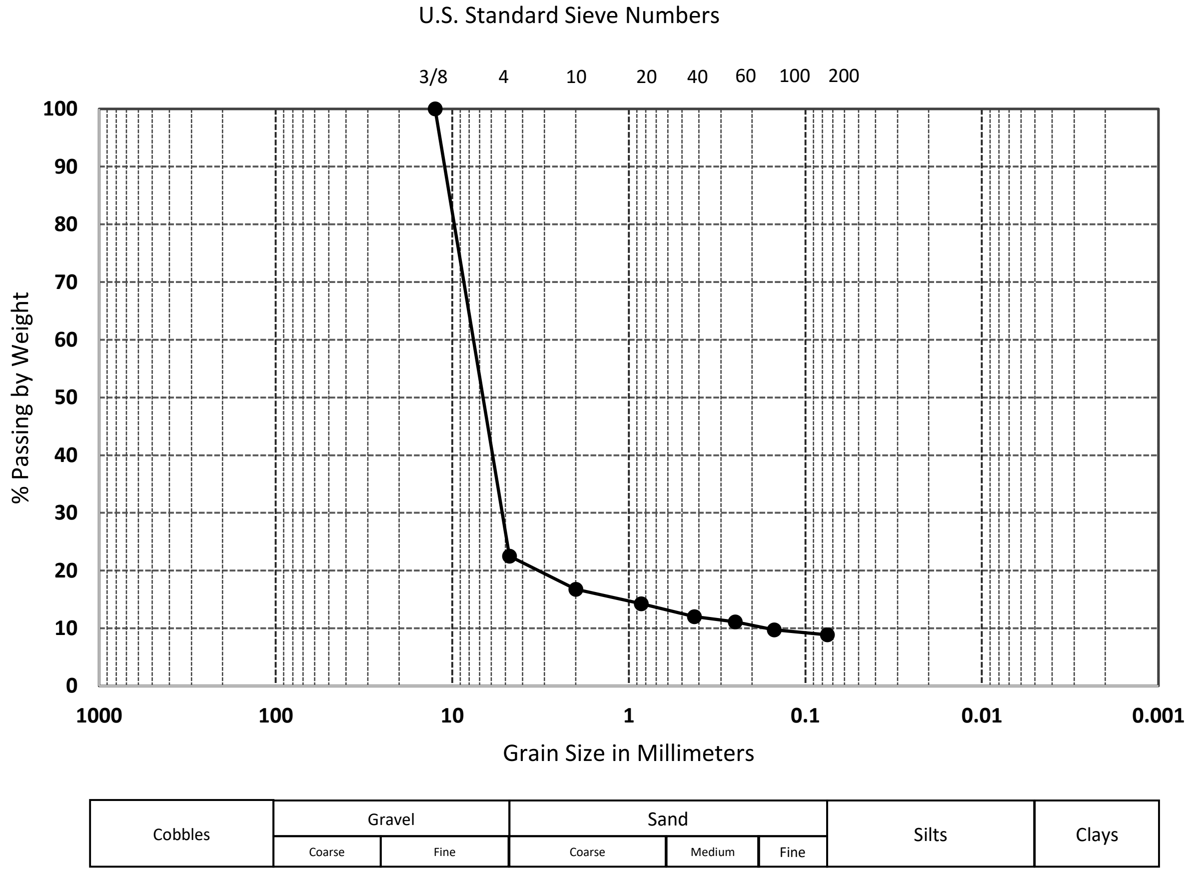
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	9.0
Natural Moisture Content:	1.66%	**Total Dry Weight: (gms)**	100
Gravel:	77.46%	**Sand:**	10.43%
Silt / Clay:	12.11%	**Classification Group:**	GM
Description:	Brown, **Silty Gravel.**		



Tested By:

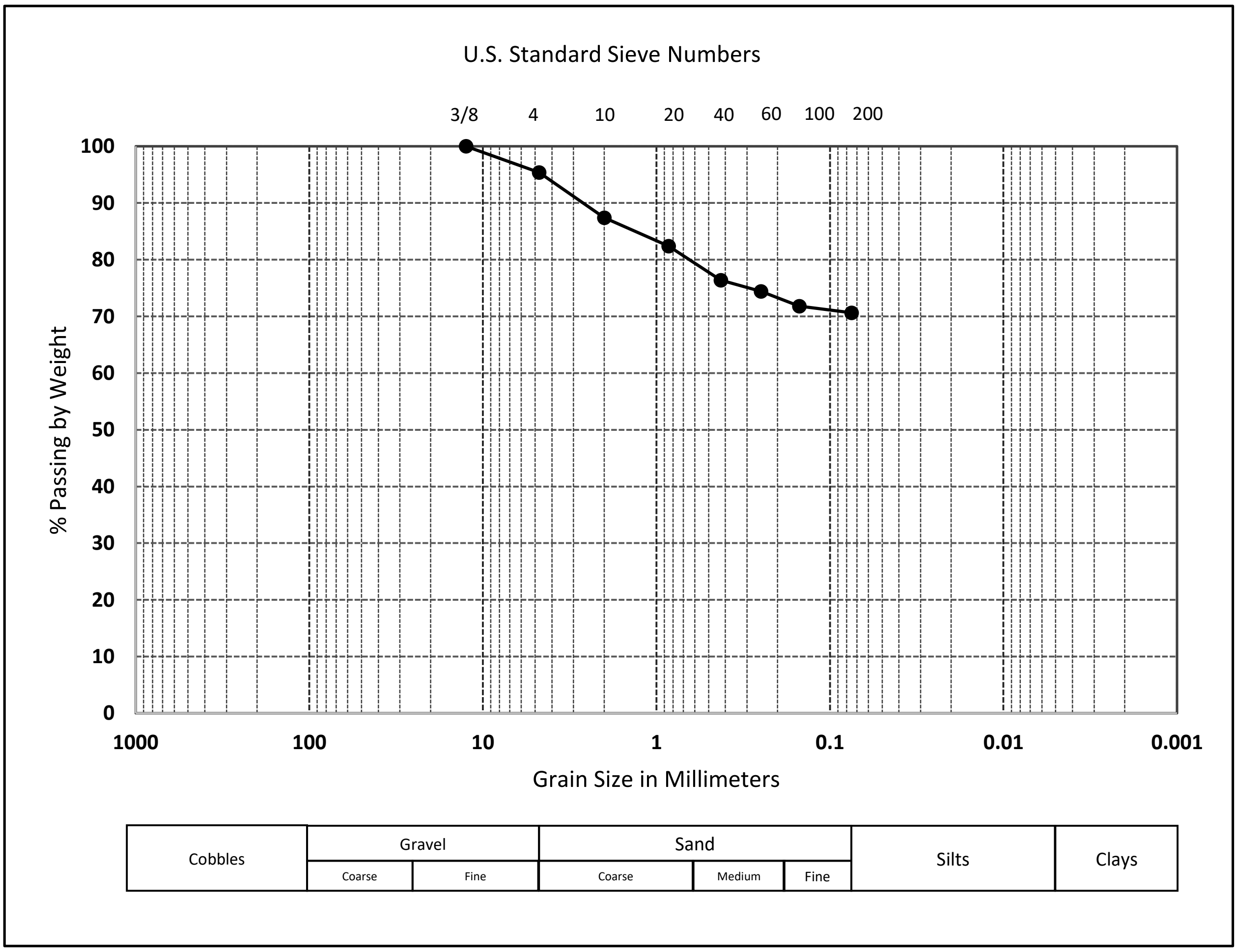
Checked By:

AJK Engineers

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	16.0
Natural Moisture Content:	11.33%	**Total Dry Weight: (gms)**	100
Gravel:	4.61%	**Sand:**	24.75%
Silt / Clay:	70.64%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay with Sand.**		



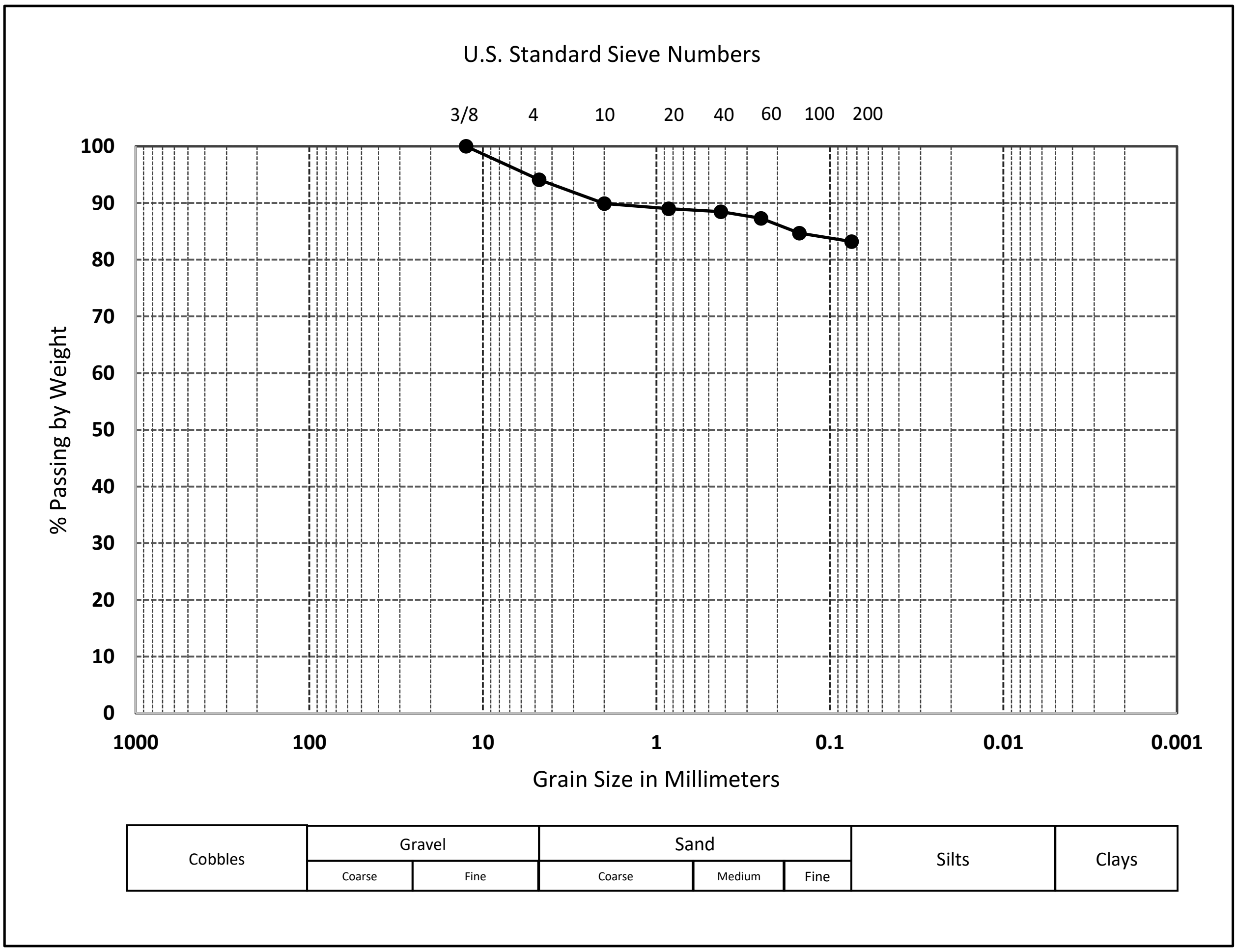
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	20.0
Natural Moisture Content:	11.19%	**Total Dry Weight: (gms)**	100
Gravel:	5.91%	**Sand:**	10.89%
Silt / Clay:	83.20%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay with Sand**.		



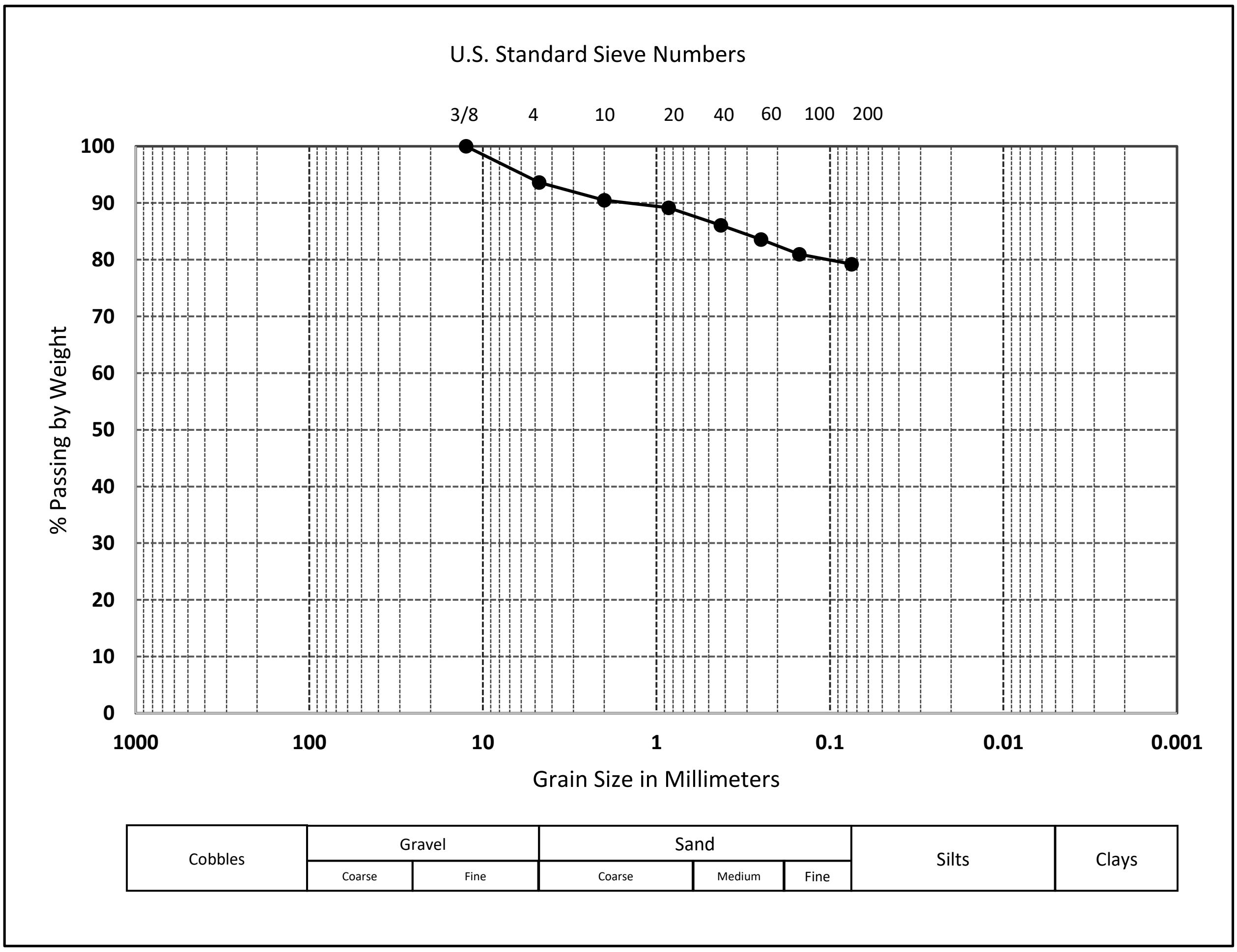
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	22.0
Natural Moisture Content:	10.66%	**Total Dry Weight: (gms)**	100
Gravel:	6.38%	**Sand:**	14.40%
Silt / Clay:	79.22%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay with Sand.**		



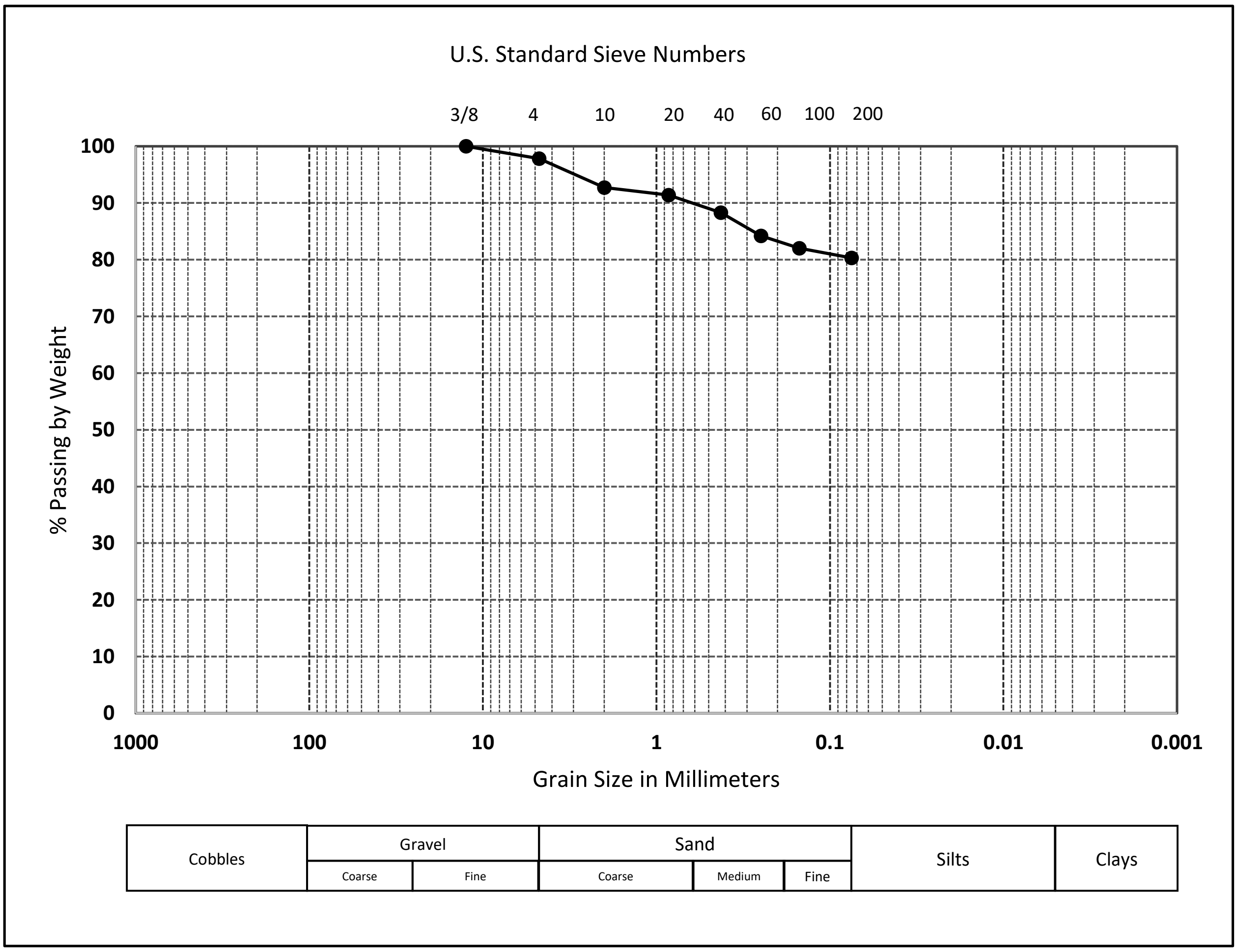
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	25.0
Natural Moisture Content:	8.67%	**Total Dry Weight: (gms)**	100
Gravel:	2.16%	**Sand:**	17.53%
Silt / Clay:	80.31%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay with Sand.**		



Tested By:

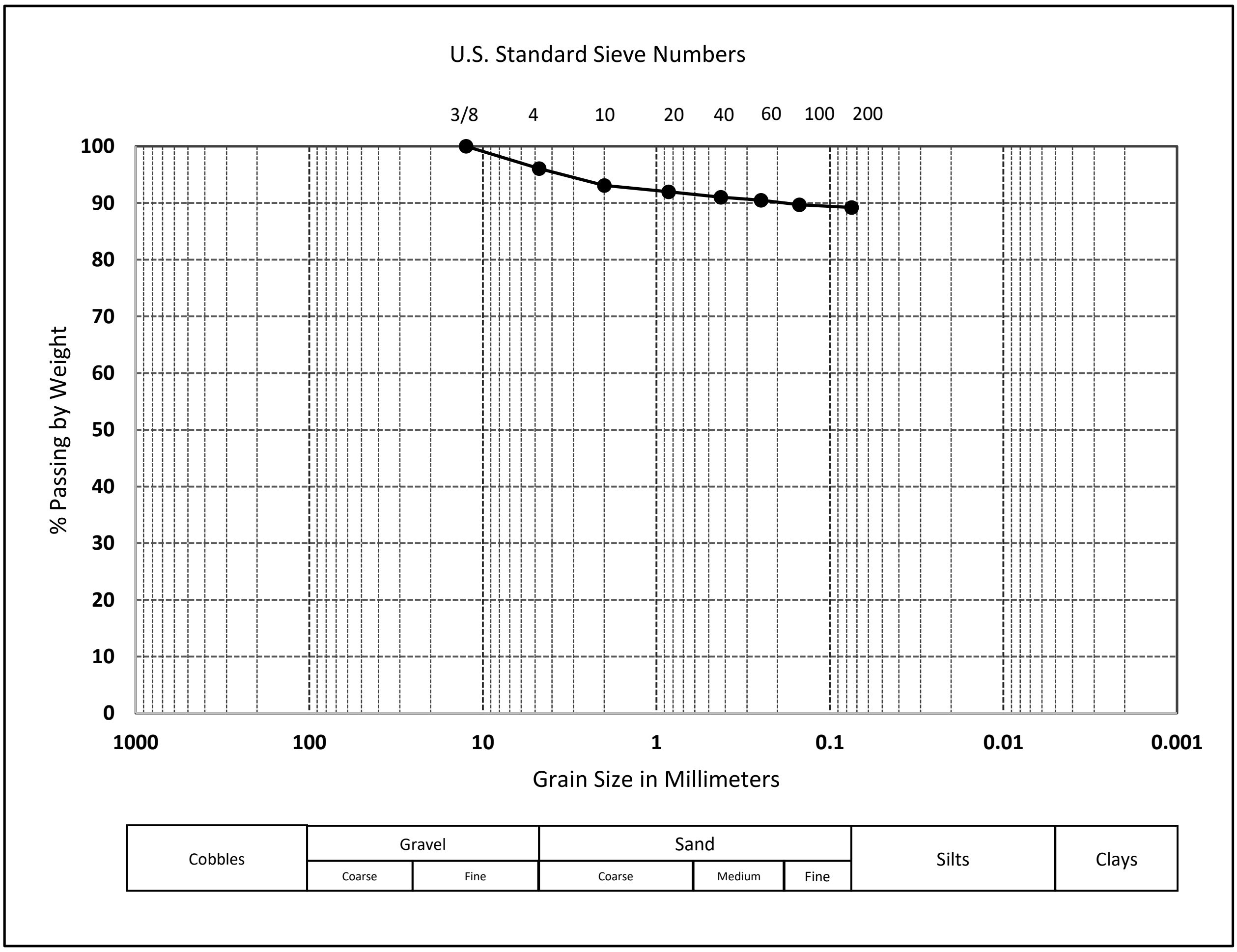
Checked By:

AJK Engineers

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	38.0
Natural Moisture Content:	13.34%	**Total Dry Weight: (gms)**	100
Gravel:	3.91%	**Sand:**	6.88%
Silt / Clay:	89.21%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



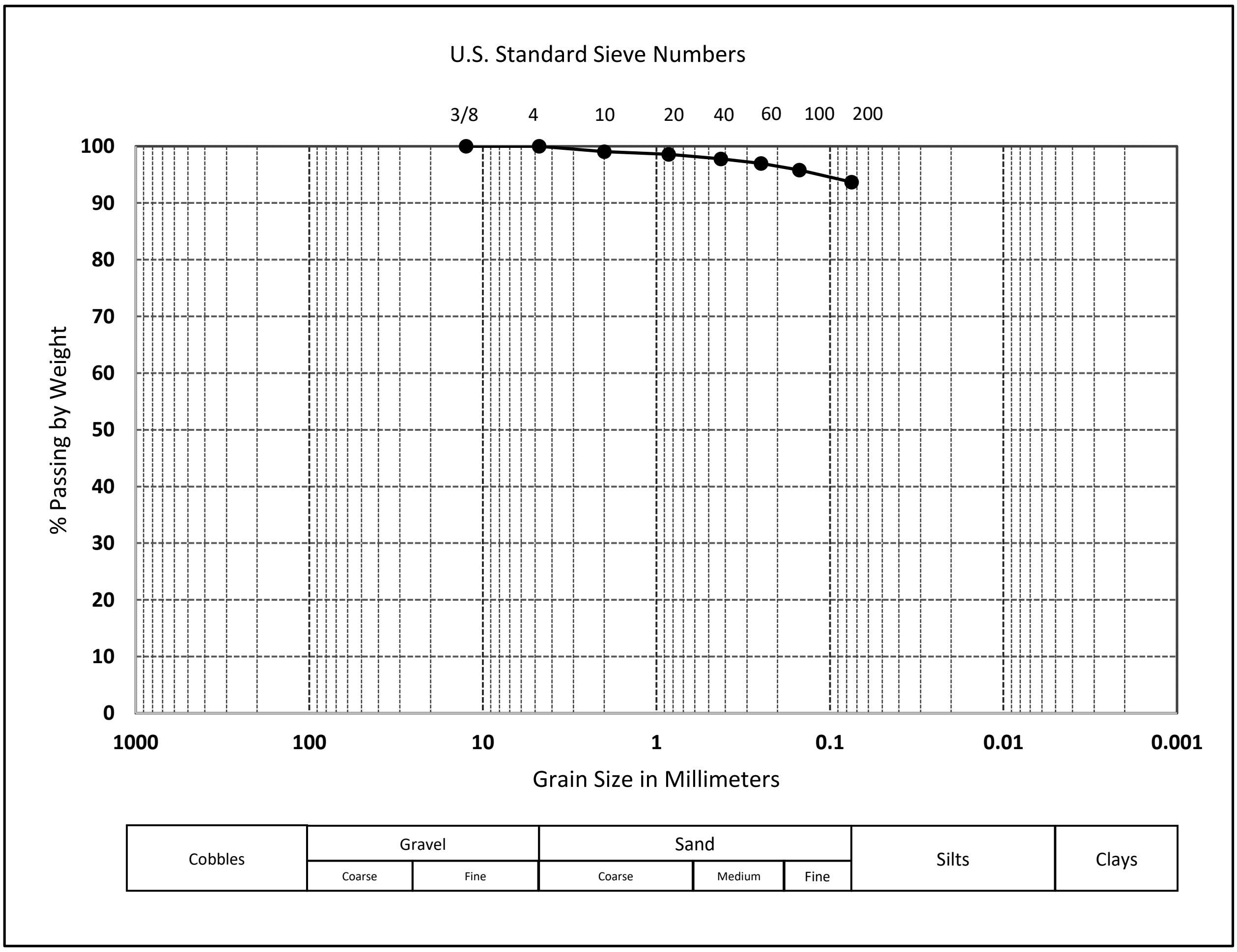
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	56.0
Natural Moisture Content:	9.07%	**Total Dry Weight: (gms)**	100
Gravel:	0.00%	**Sand:**	6.31%
Silt / Clay:	93.69%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



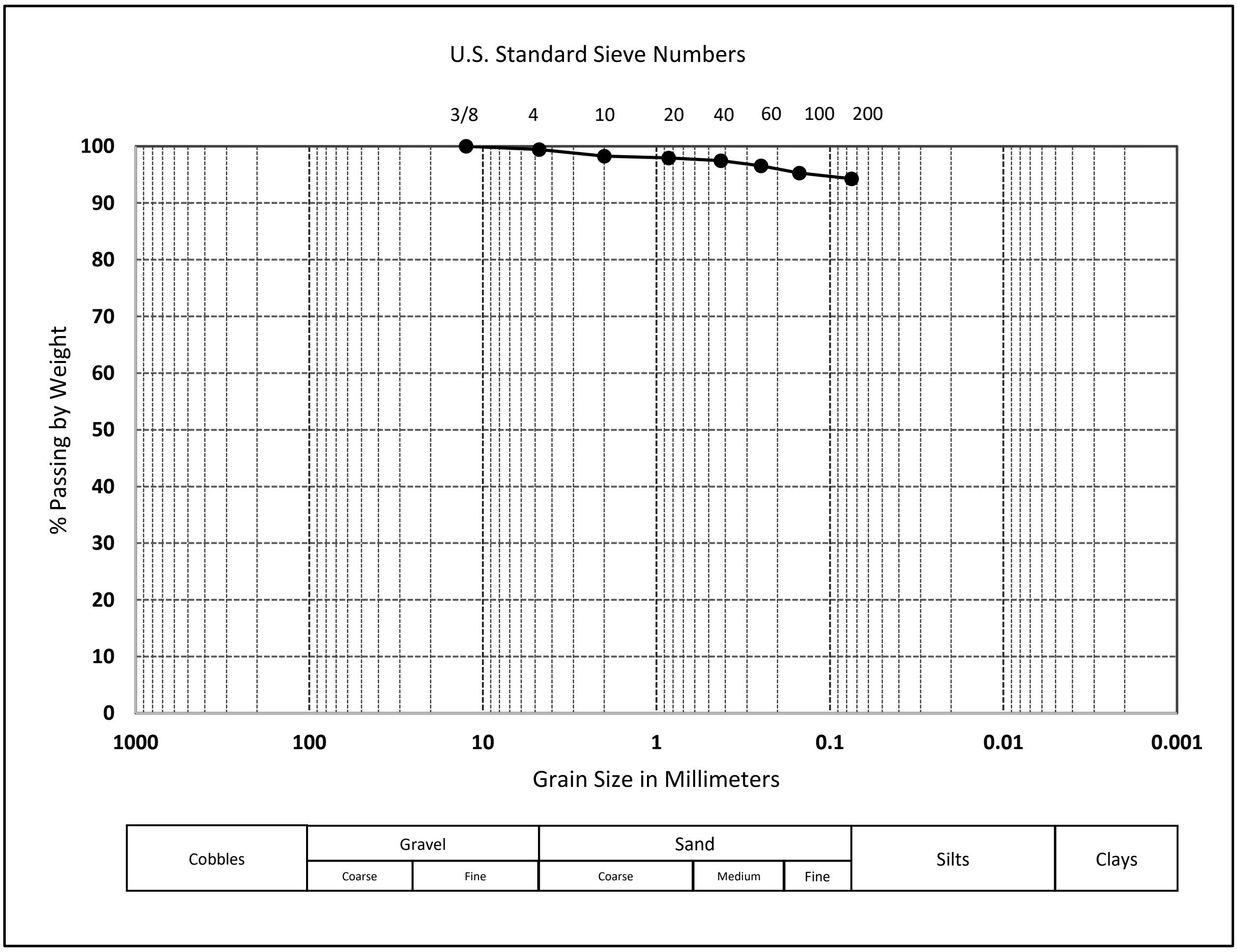
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	65.0
Natural Moisture Content:	7.52%	**Total Dry Weight: (gms)**	100
Gravel:	0.56%	**Sand:**	5.16%
Silt / Clay:	94.28%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



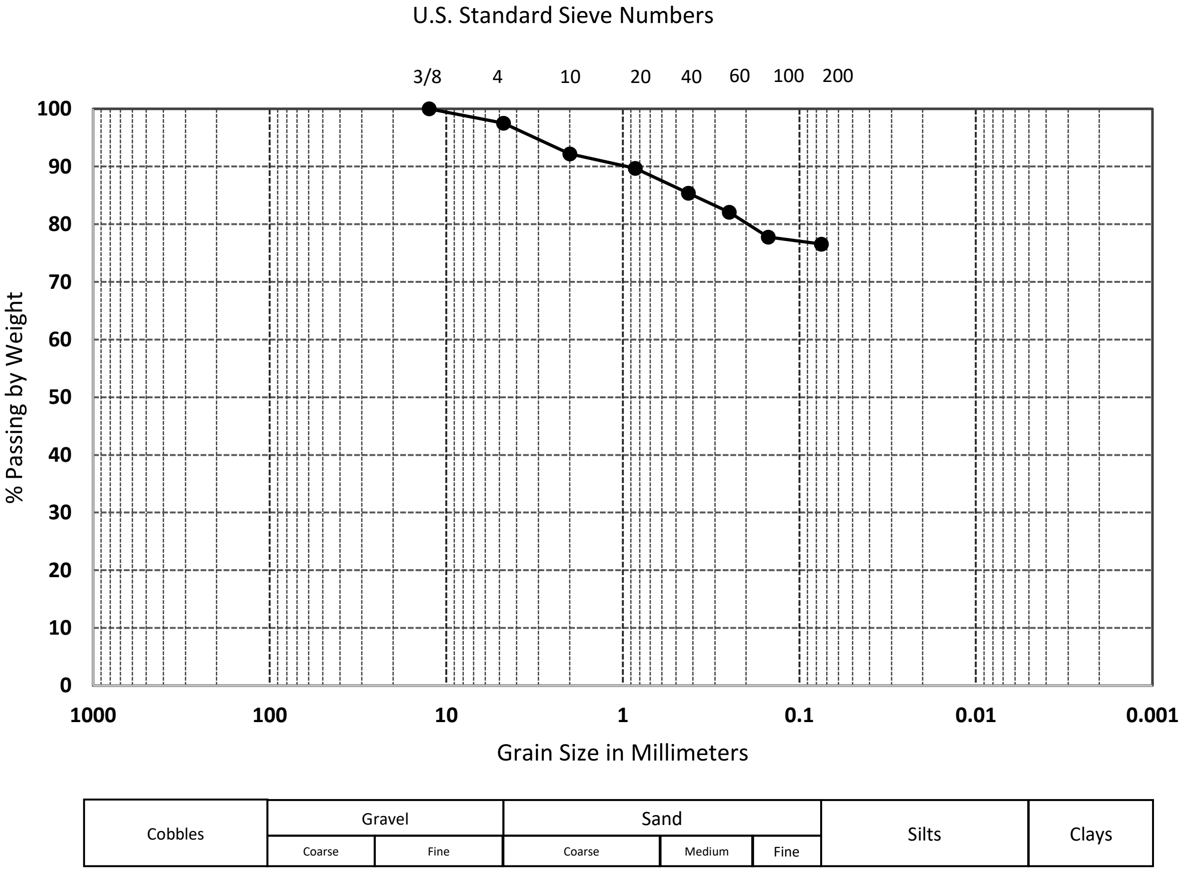
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	16.0
Natural Moisture Content:	15.94%	**Total Dry Weight: (gms)**	100
Gravel:	2.48%	**Sand:**	20.96%
Silt / Clay:	76.56%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay with Sand.**		



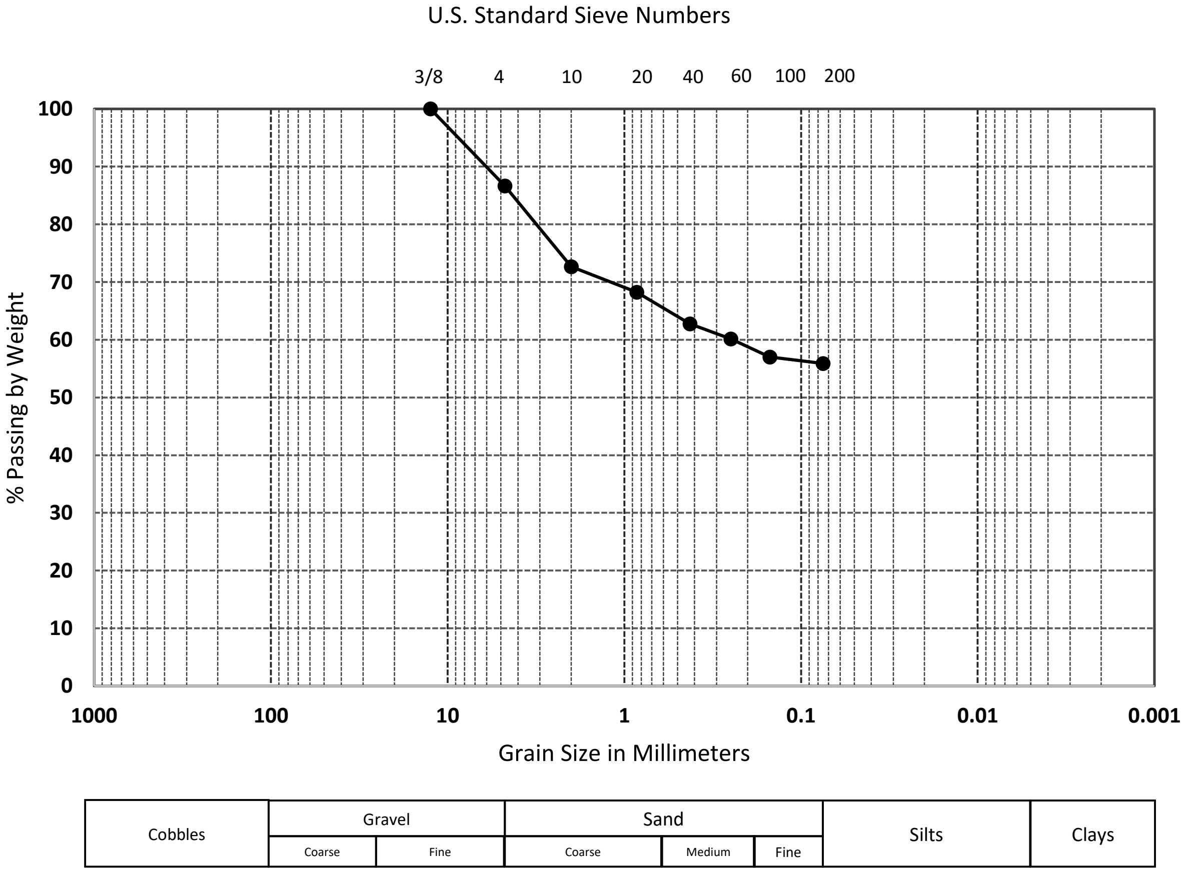
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	25.0
Natural Moisture Content:	9.81%	**Total Dry Weight: (gms)**	100
Gravel:	13.36%	**Sand:**	30.75%
Silt / Clay:	55.89%	**Classification Group:**	CL-ML
Description:	Brown, Low Plasticity, **Sandy Silty Clay.**		



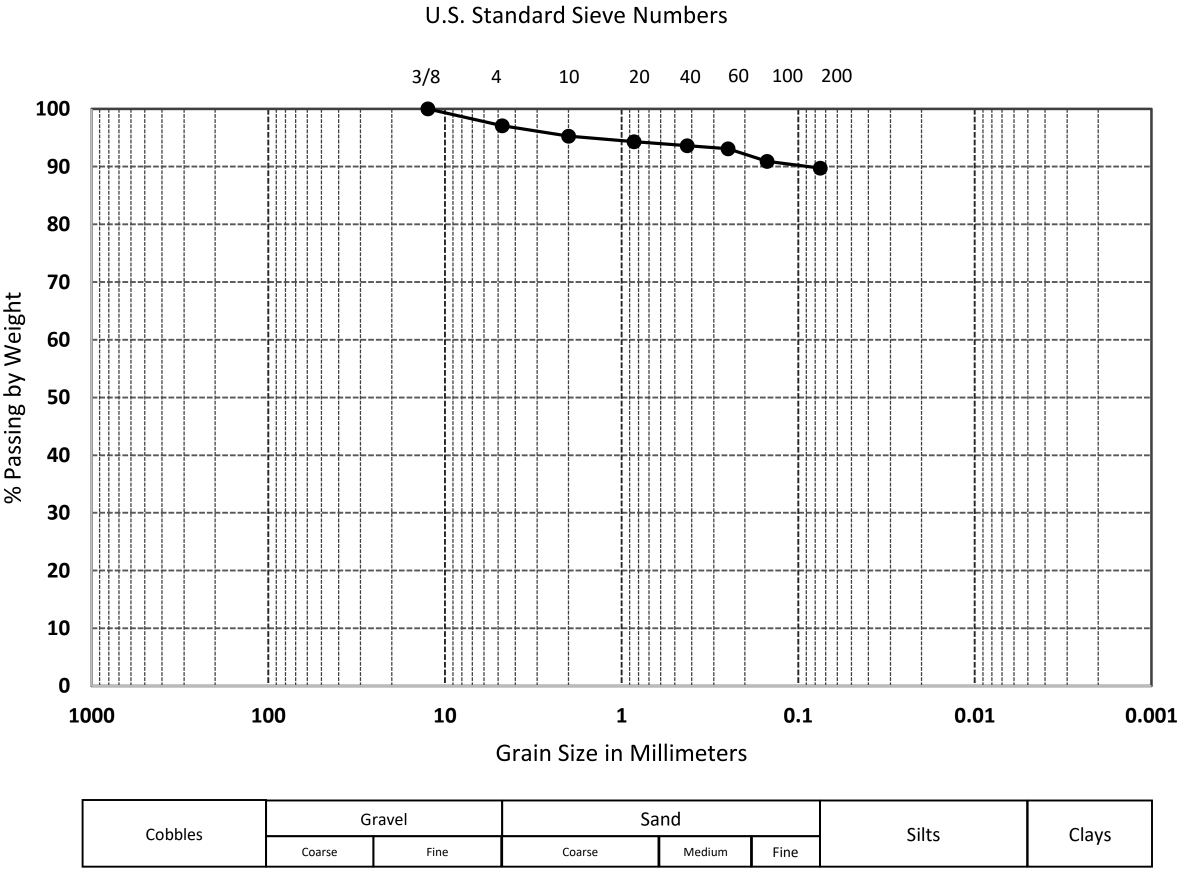
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	28.0
Natural Moisture Content:	11.21%	**Total Dry Weight: (gms)**	100
Gravel:	2.93%	**Sand:**	7.33%
Silt / Clay:	89.74%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



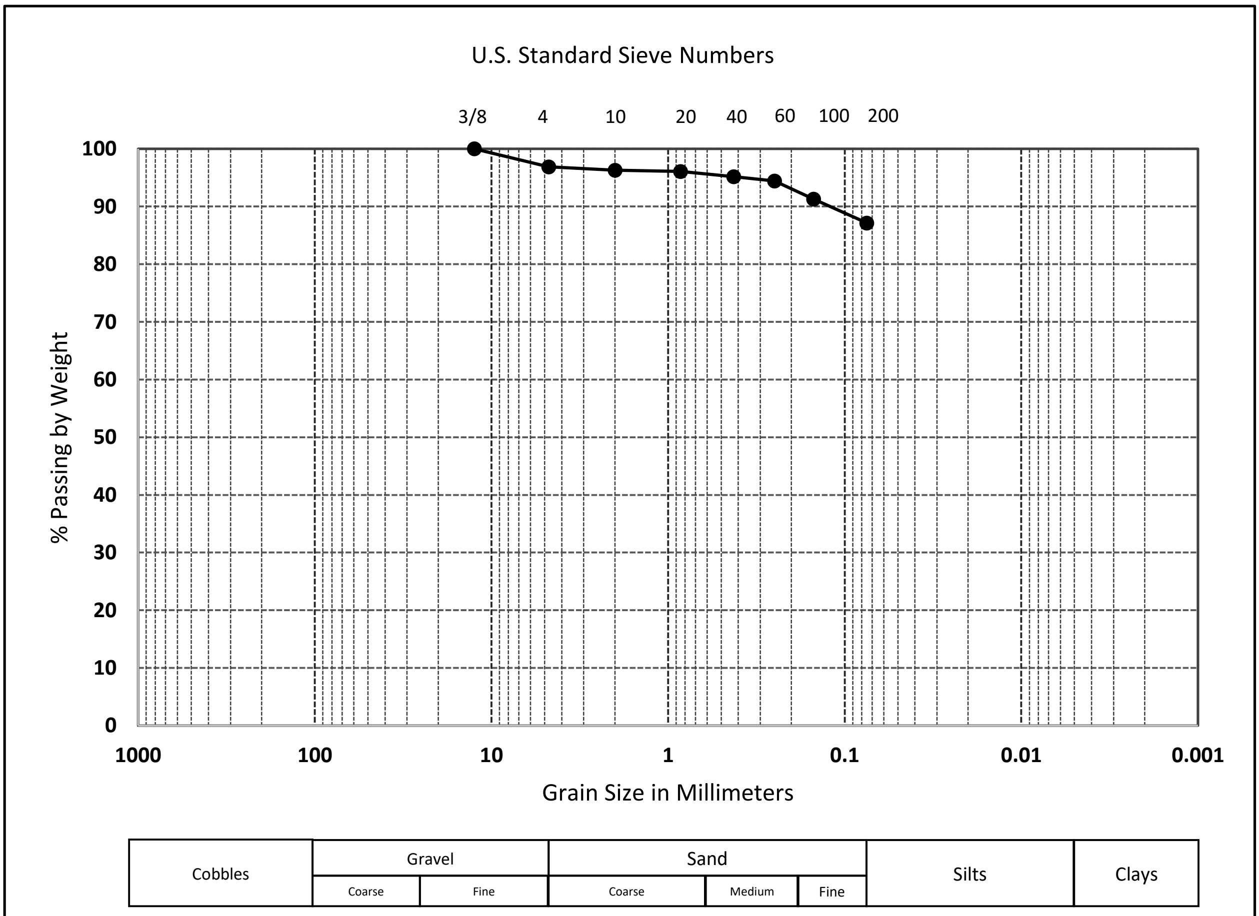
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	33.0
Natural Moisture Content:	10.70%	**Total Dry Weight: (gms)**	100
Gravel:	3.10%	**Sand:**	9.74%
Silt / Clay:	87.16%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



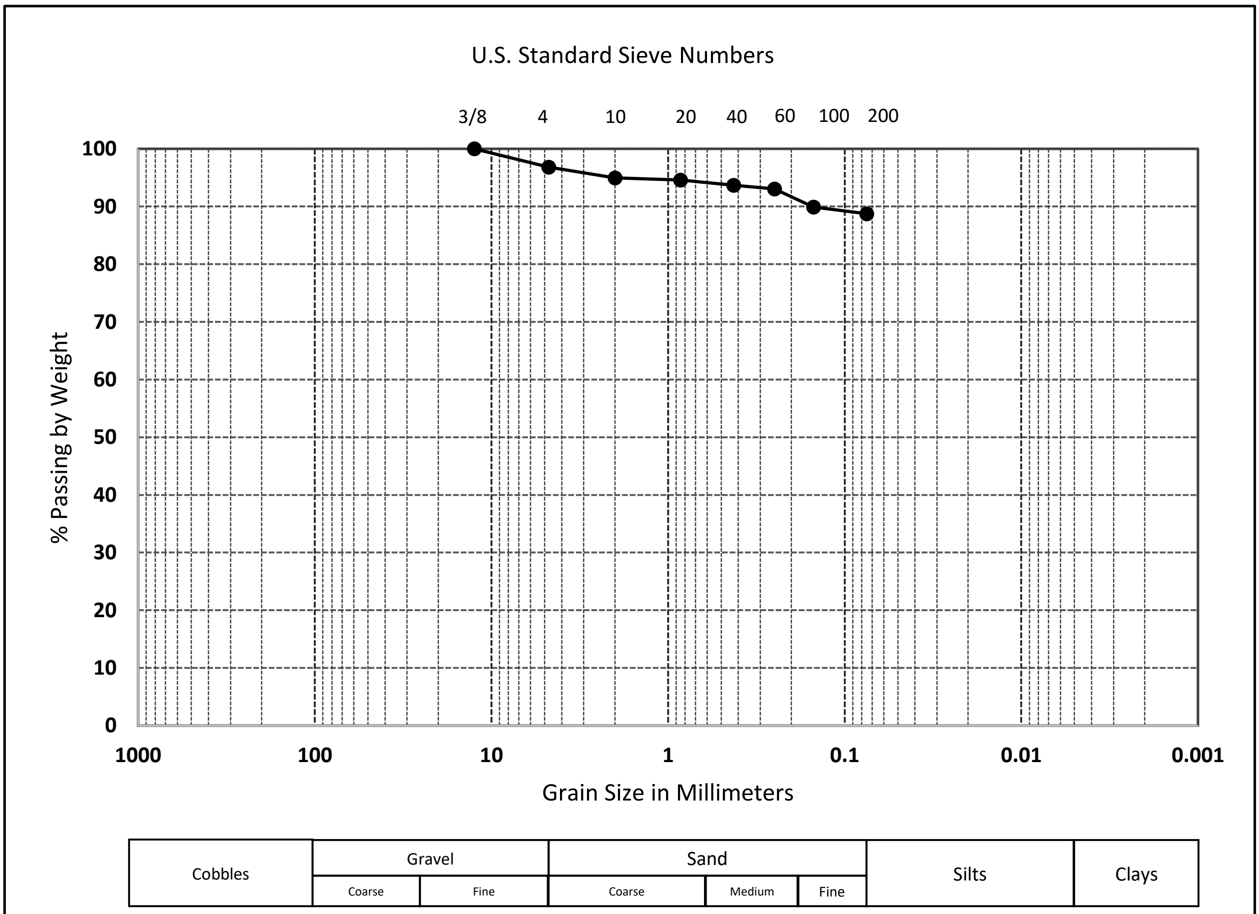
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	41.0
Natural Moisture Content:	11.12%	**Total Dry Weight: (gms)**	100
Gravel:	3.16%	**Sand:**	8.09%
Silt / Clay:	88.75%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



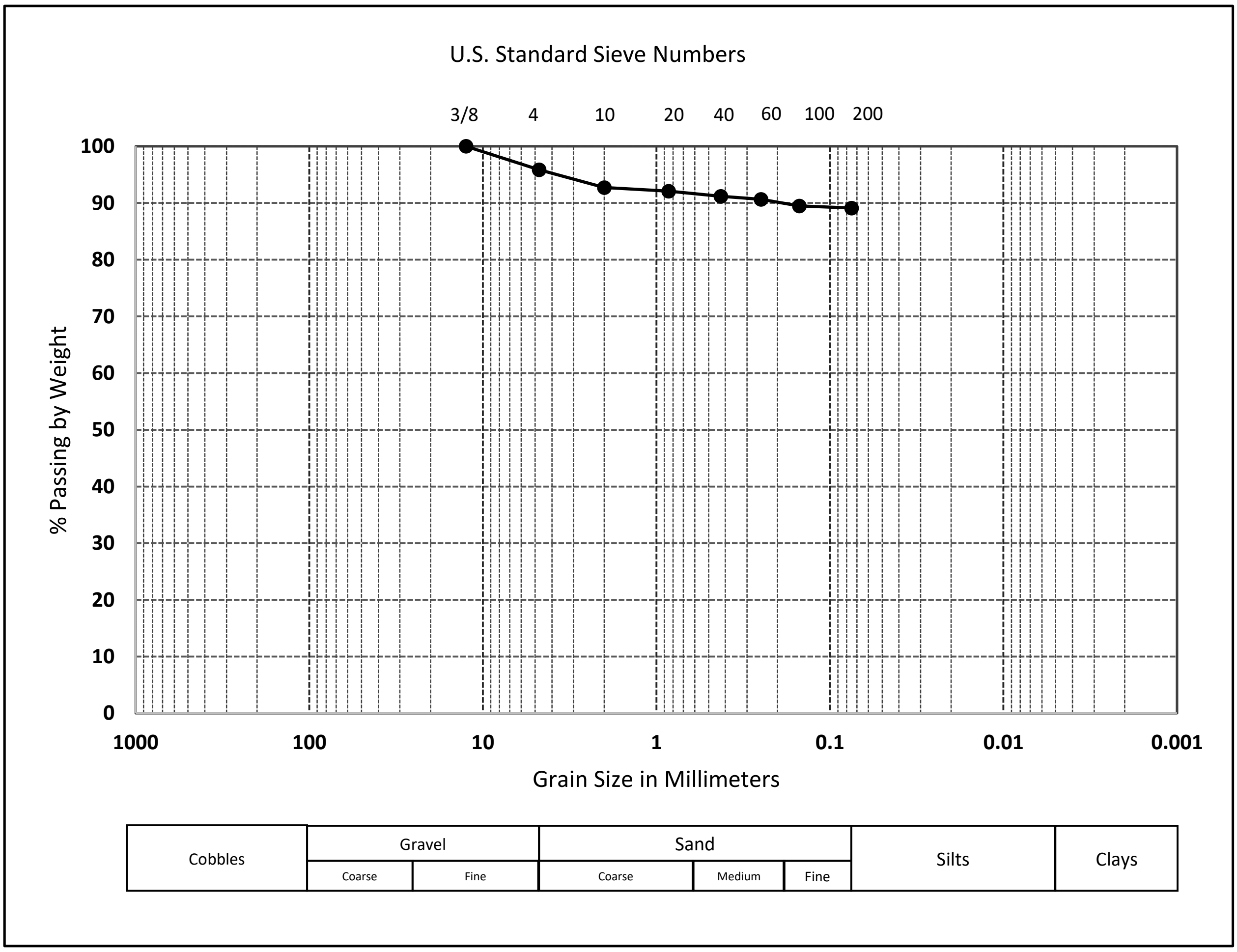
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	62.0
Natural Moisture Content:	6.15%	**Total Dry Weight: (gms)**	100
Gravel:	4.11%	**Sand:**	6.77%
Silt / Clay:	89.12%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



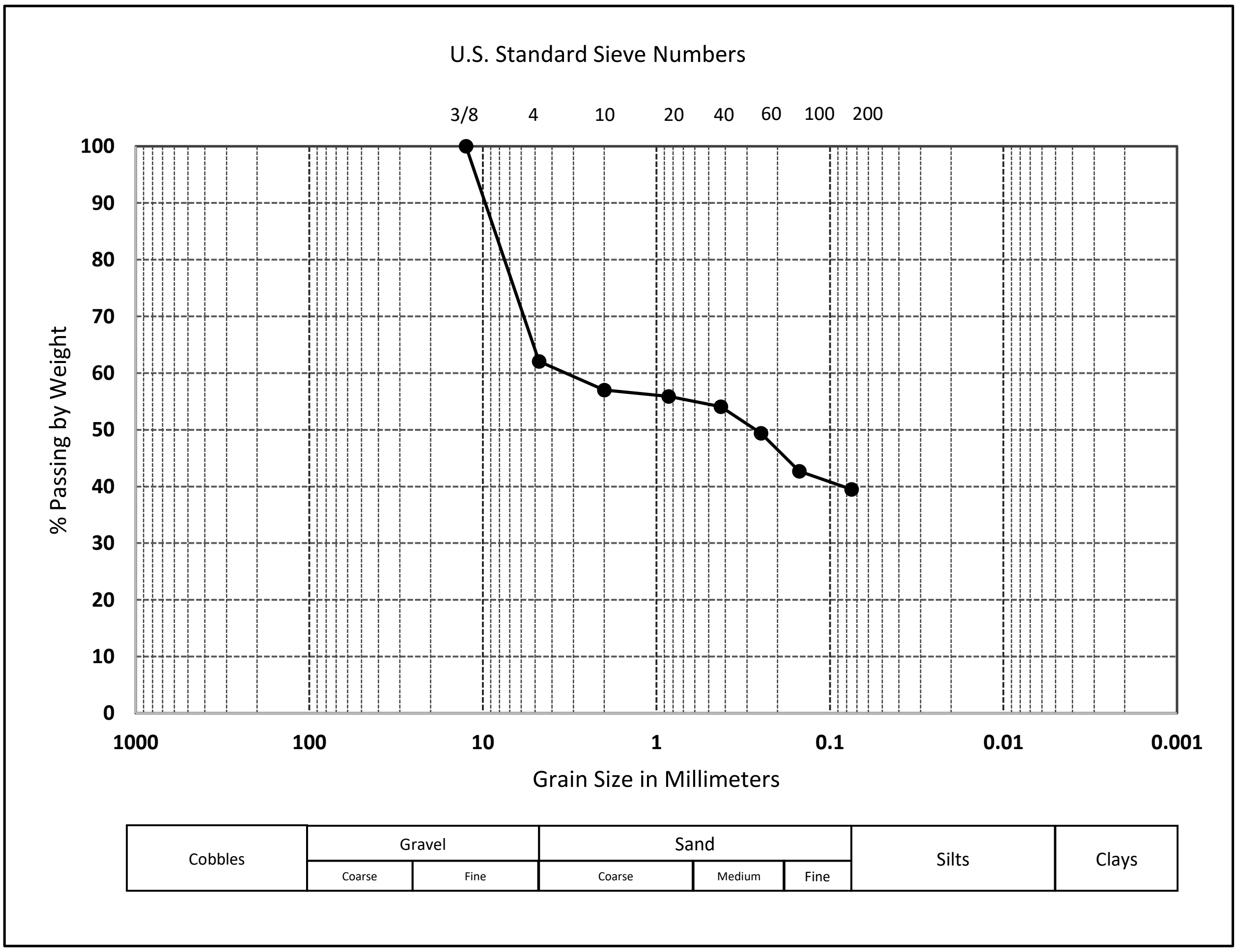
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	9.0
Natural Moisture Content:	13.82%	**Total Dry Weight: (gms)**	100
Gravel:	37.96%	**Sand:**	22.56%
Silt / Clay:	39.48%	**Classification Group:**	GM
Description:	Brown, **Silty Gravel with Sand.**		



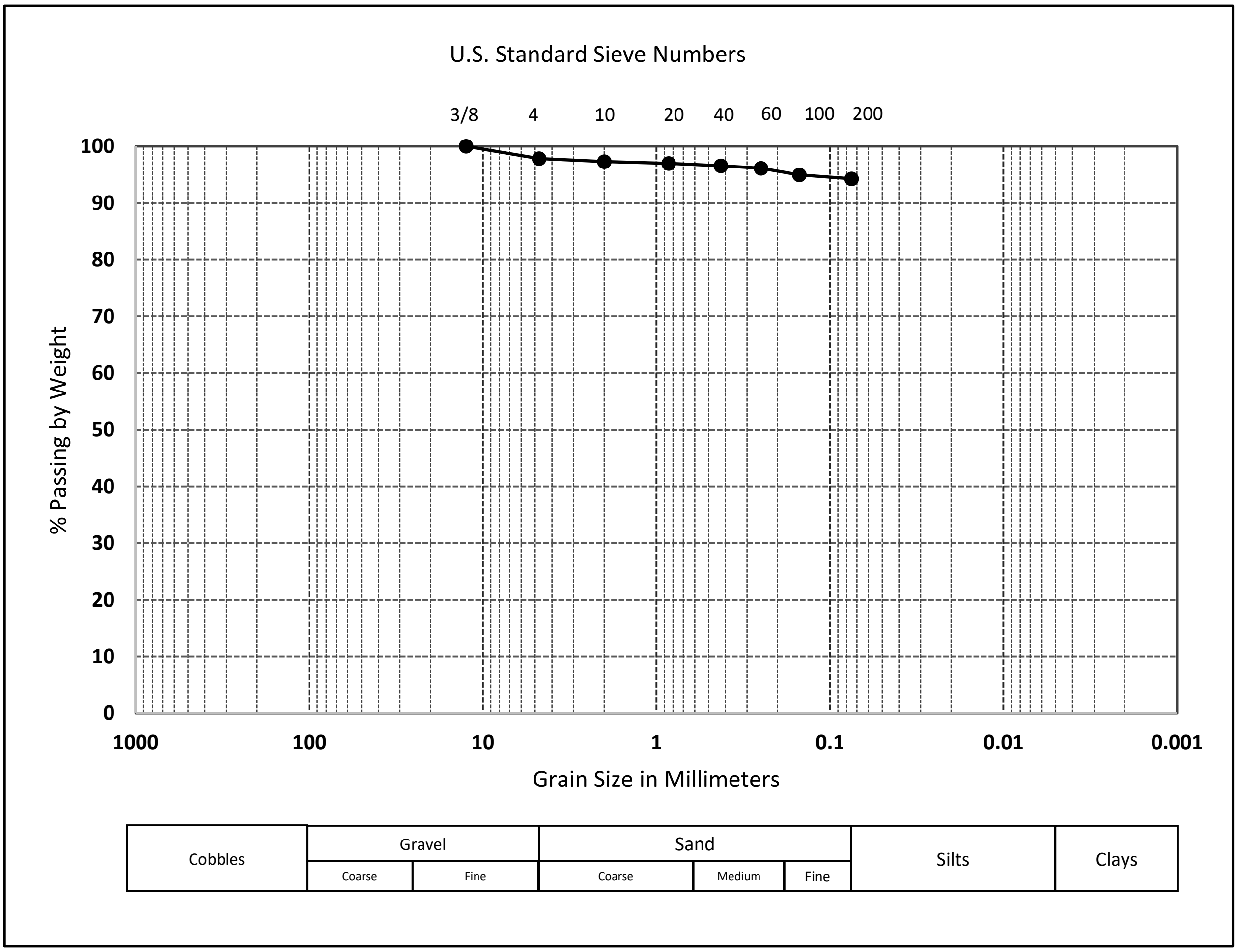
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	15.0
Natural Moisture Content:	23.93%	**Total Dry Weight: (gms)**	100
Gravel:	2.16%	**Sand:**	3.56%
Silt / Clay:	94.28%	**Classification Group:**	CL
Description:	Brown, Low Plasticity, **Lean Clay.**		



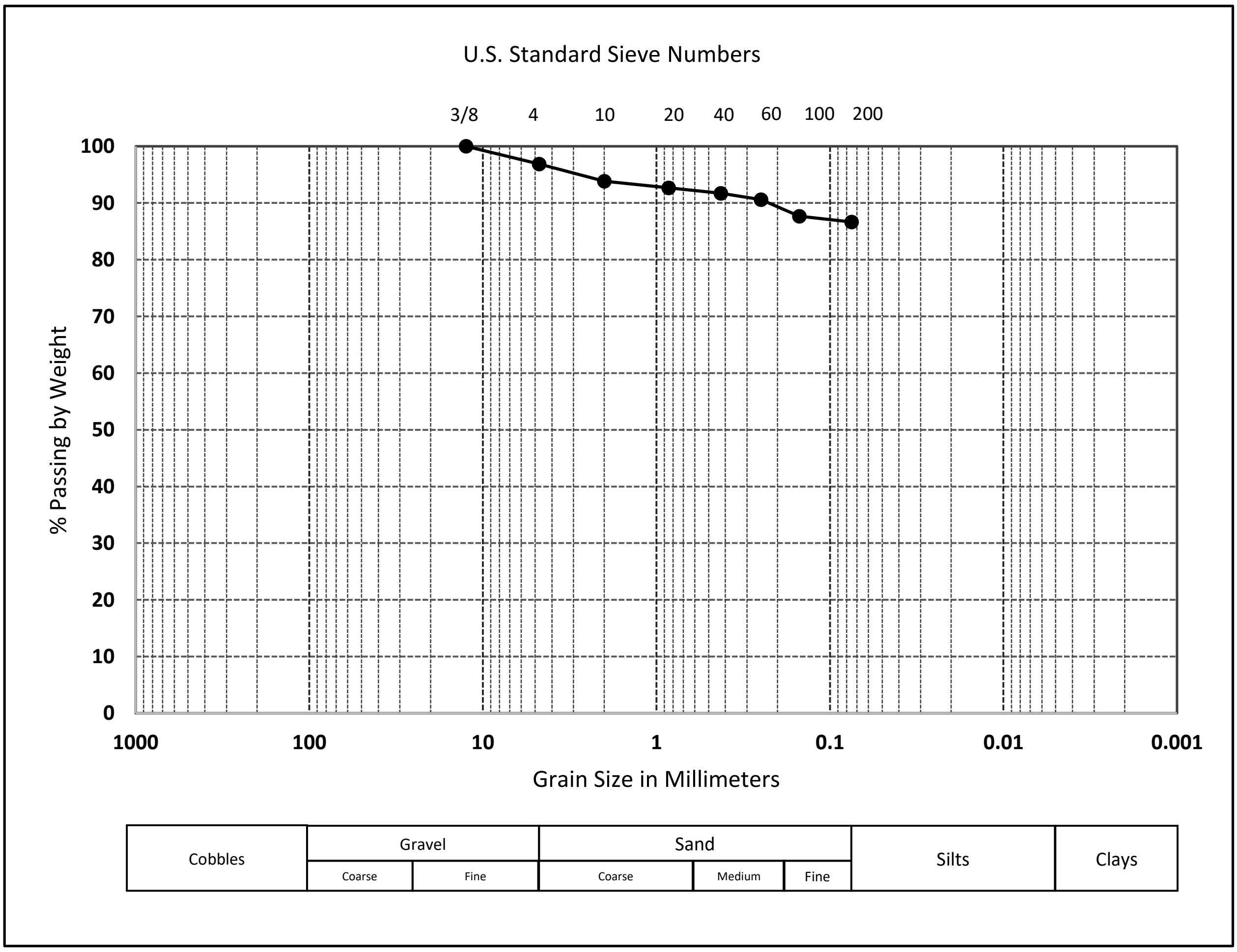
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	18.0
Natural Moisture Content:	13.33%	**Total Dry Weight: (gms)**	100
Gravel:	3.14%	**Sand:**	10.21%
Silt / Clay:	86.65%	**Classification Group:**	CL
Description:	Brown, Low Plasticity, **Lean Clay.**		



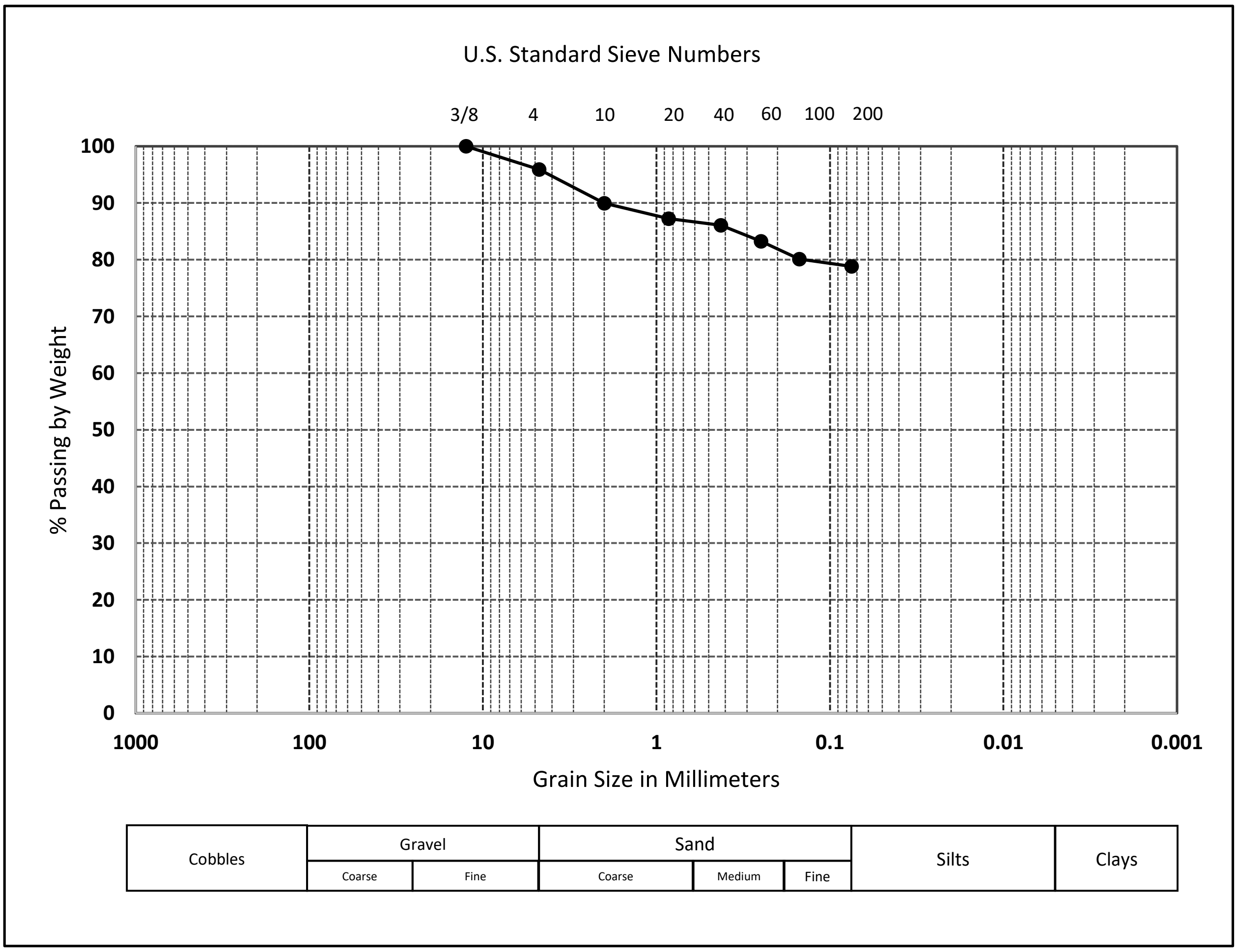
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	23.0
Natural Moisture Content:	22.03%	**Total Dry Weight: (gms)**	100
Gravel:	4.06%	**Sand:**	17.12%
Silt / Clay:	78.82%	**Classification Group:**	CL
Description:	Brown, Low Plasticity, **Lean Clay with Sand.**		



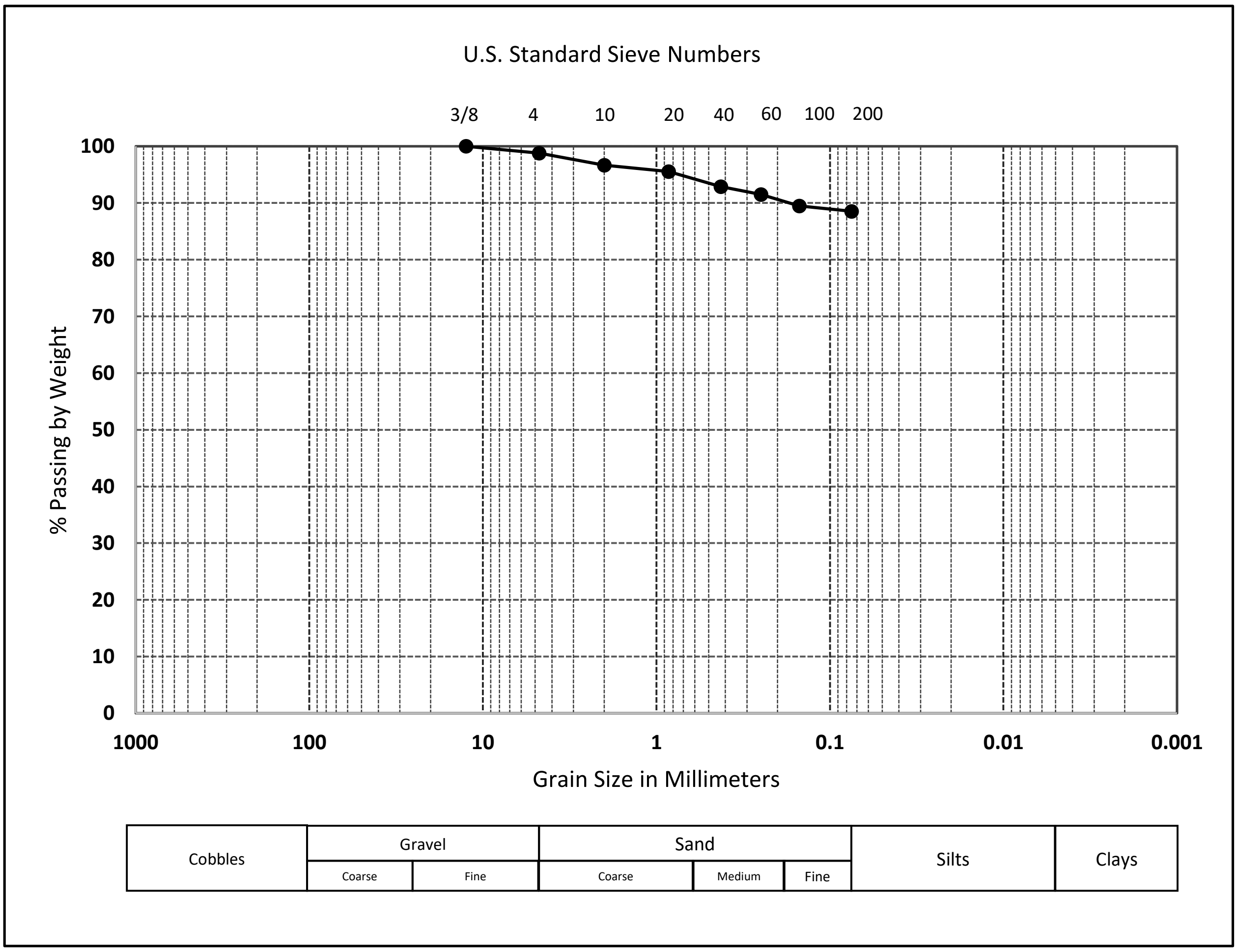
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	29.0
Natural Moisture Content:	15.37%	**Total Dry Weight: (gms)**	100
Gravel:	1.20%	**Sand:**	10.26%
Silt / Clay:	88.54%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



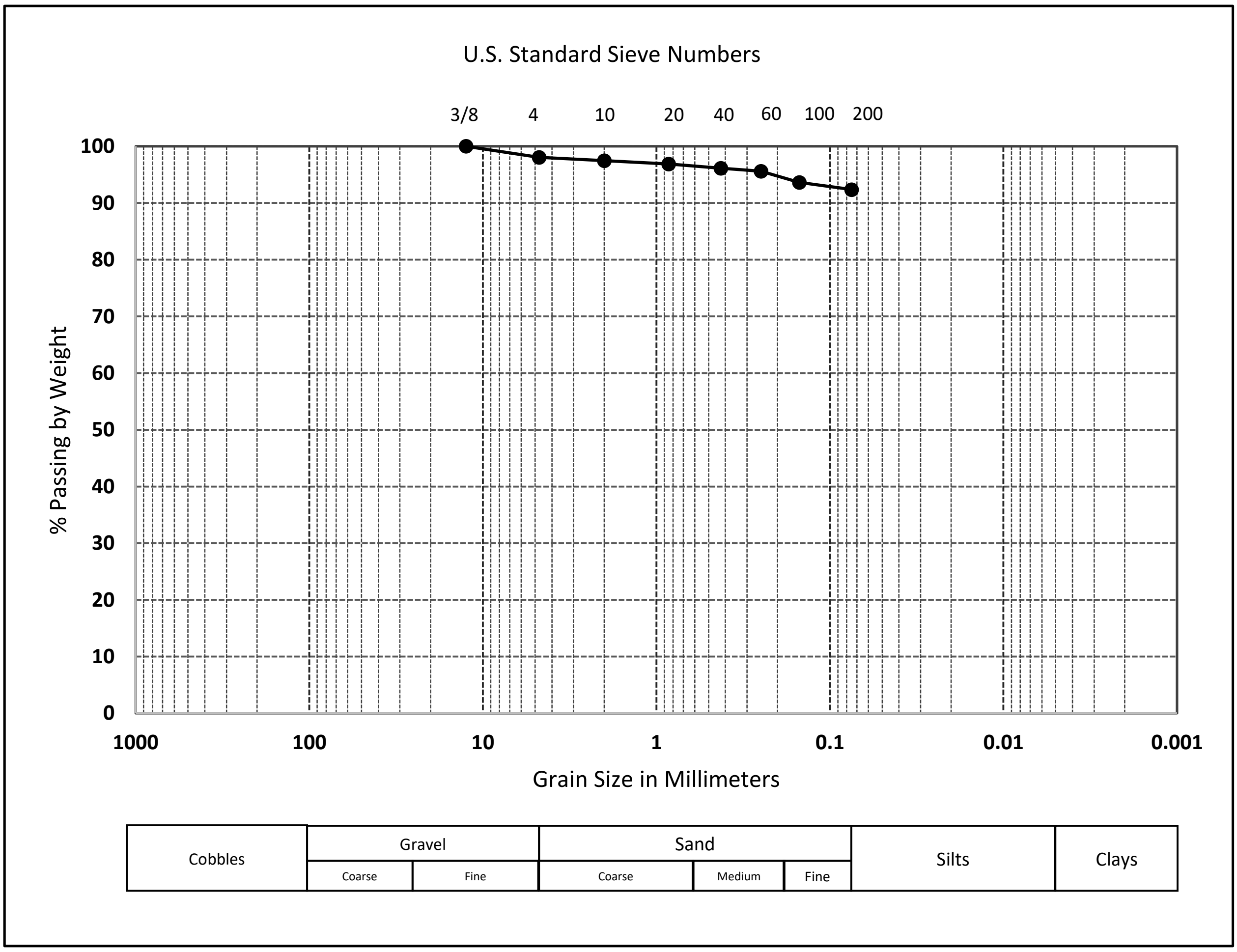
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	32.0
Natural Moisture Content:	18.68%	**Total Dry Weight: (gms)**	100
Gravel:	1.96%	**Sand:**	5.66%
Silt / Clay:	92.38%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



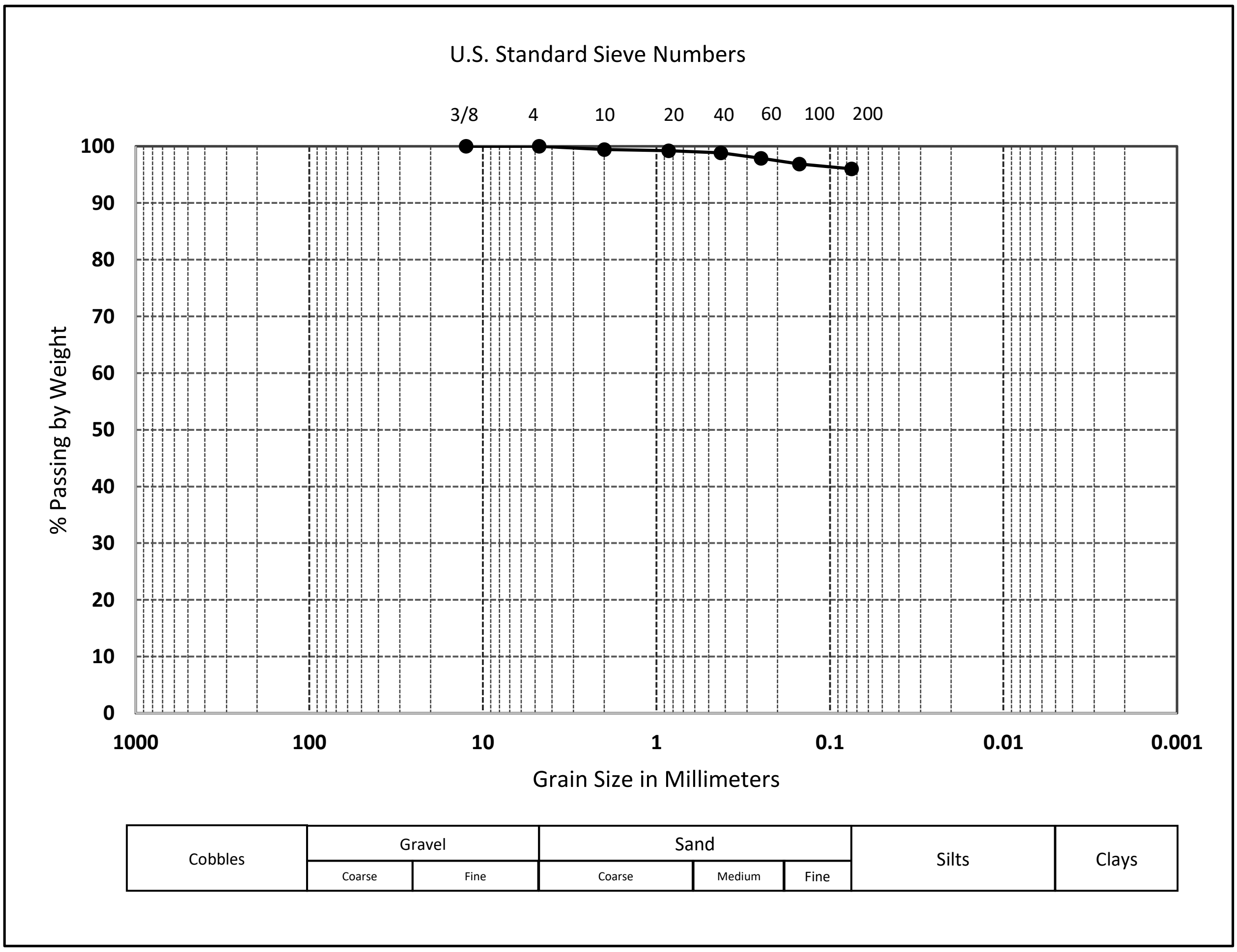
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	52.0
Natural Moisture Content:	14.46%	**Total Dry Weight: (gms)**	100
Gravel:	0.00%	**Sand:**	3.98%
Silt / Clay:	96.02%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



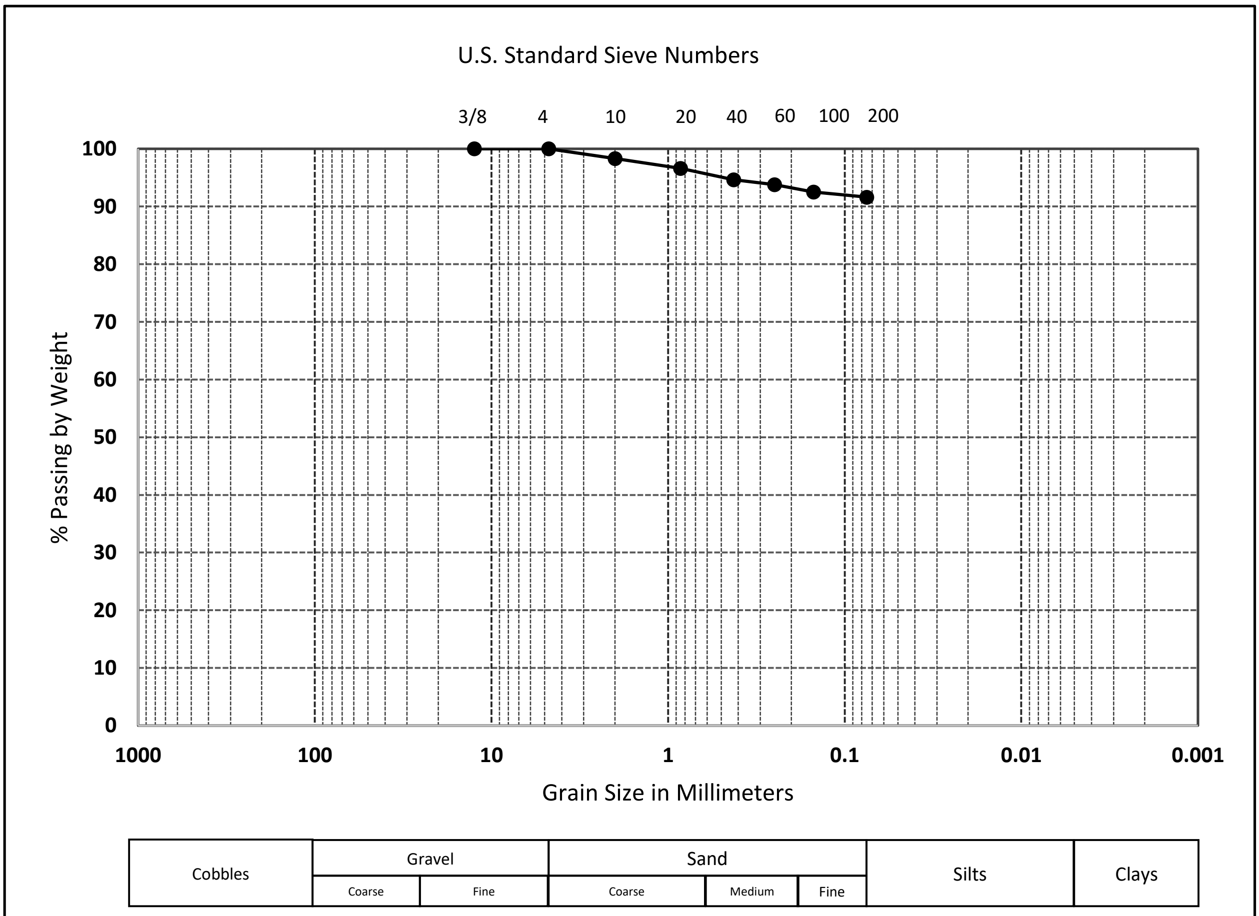
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-05	**Depth (m):**	15.0
Natural Moisture Content:	20.82%	**Total Dry Weight: (gms)**	100
Gravel:	0.00%	**Sand:**	8.37%
Silt / Clay:	91.63%	**Classification Group:**	CL
Description:	Brown, Low Plasticity, **Lean Clay.**		



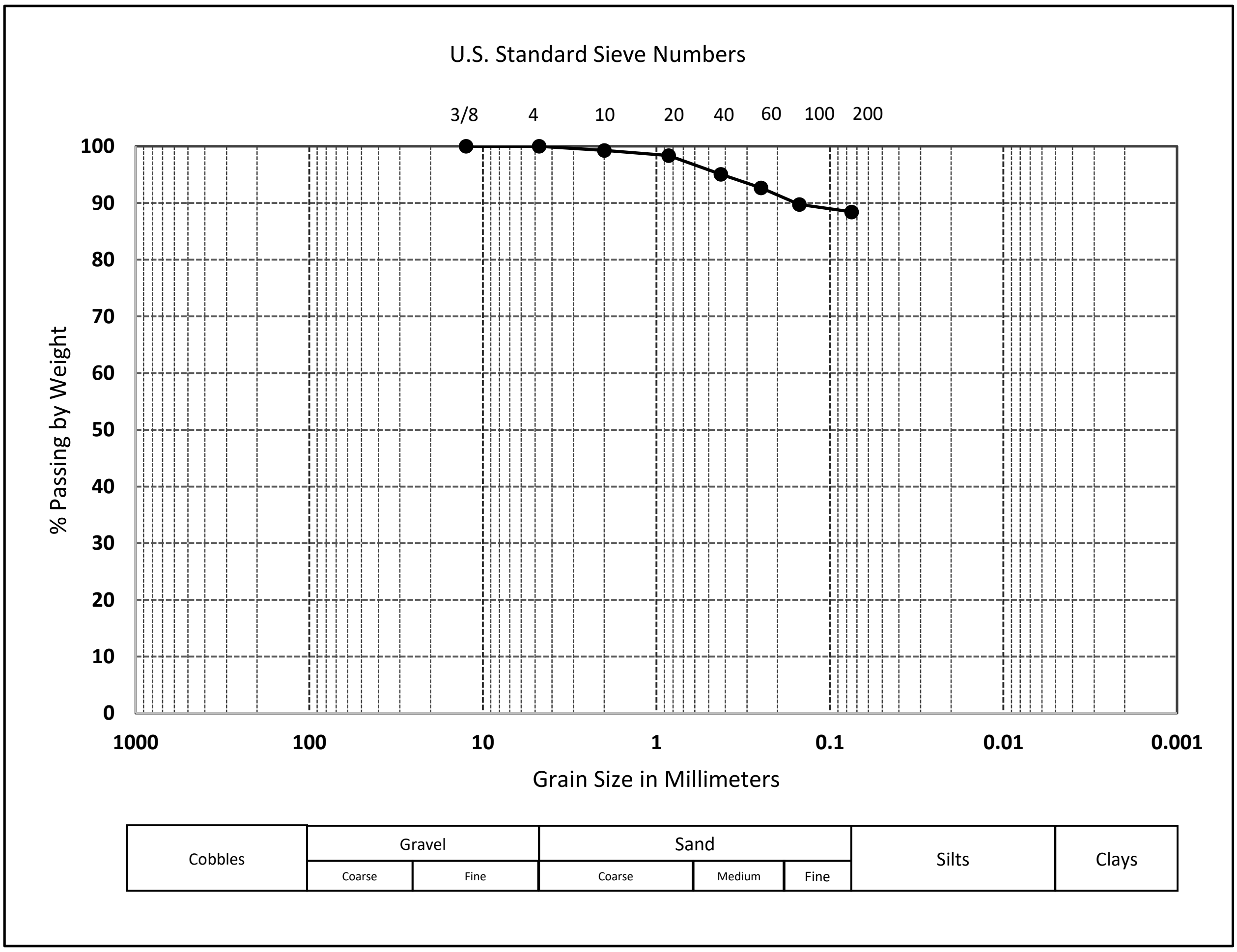
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-05	**Depth (m):**	17.0
Natural Moisture Content:	24.22%	**Total Dry Weight: (gms)**	100
Gravel:	0.00%	**Sand:**	11.56%
Silt / Clay:	88.44%	**Classification Group:**	CL
Description:	Brown, Low Plasticity, **Lean Clay.**		



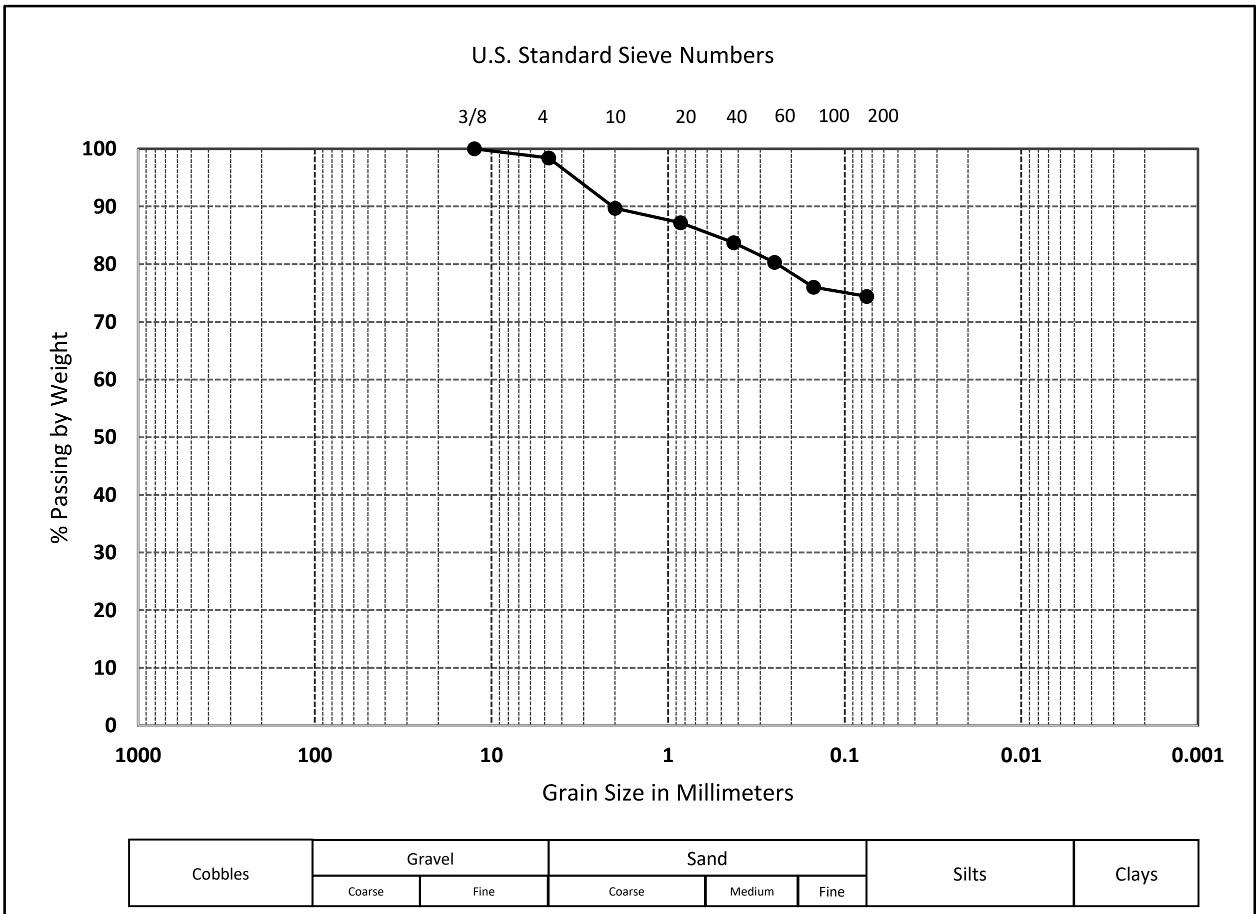
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-05	**Depth (m):**	21.0
Natural Moisture Content:	23.09%	**Total Dry Weight: (gms)**	100
Gravel:	1.59%	**Sand:**	23.98%
Silt / Clay:	74.43%	**Classification Group:**	CL
Description:	Brown, Low Plasticity, **Lean Clay with Sand.**		



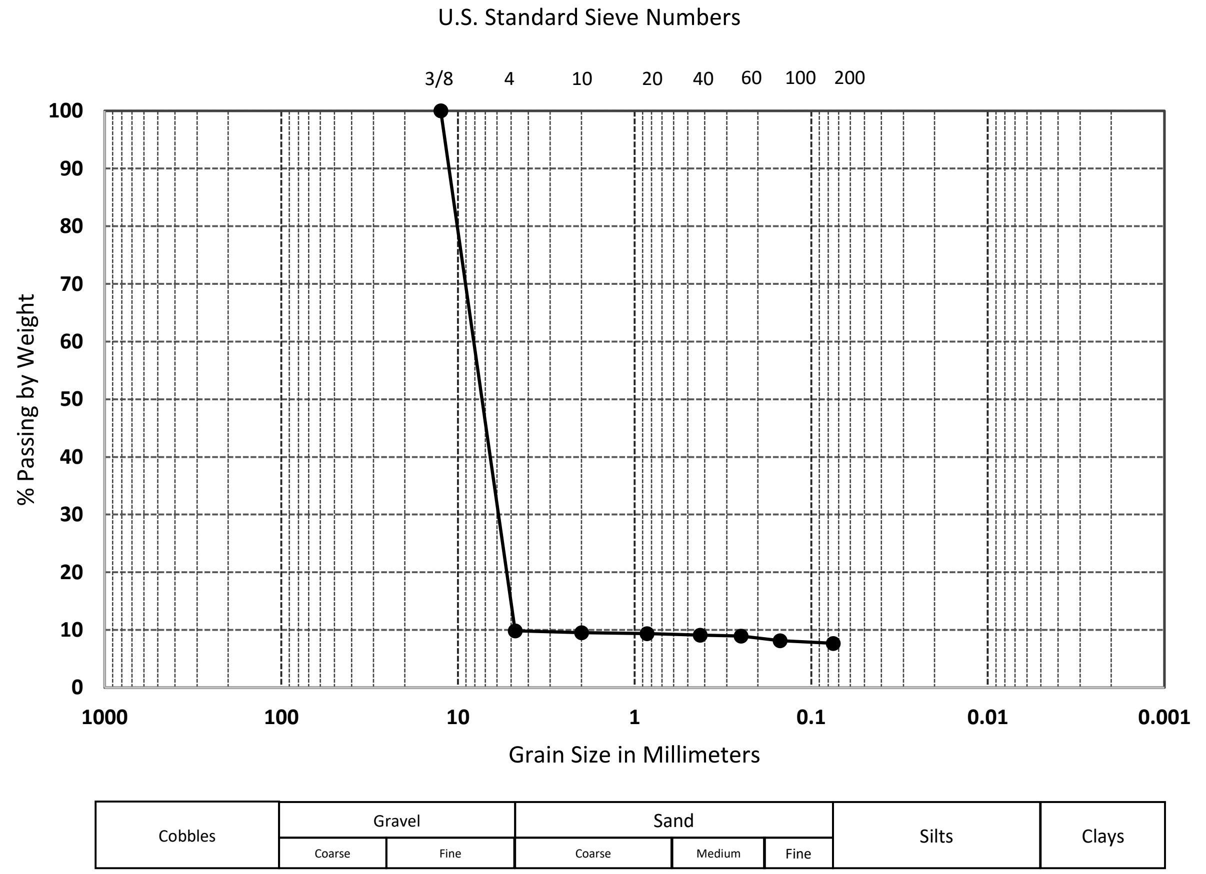
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-05	**Depth (m):**	23.0
Natural Moisture Content:	14.47%	**Total Dry Weight: (gms)**	100
Gravel:	90.18%	**Sand:**	2.14%
Silt / Clay:	7.68%	**Classification Group:**	GP-GM
Description:	Grey, Poorly Graded **GRAVEL with SILT.**		



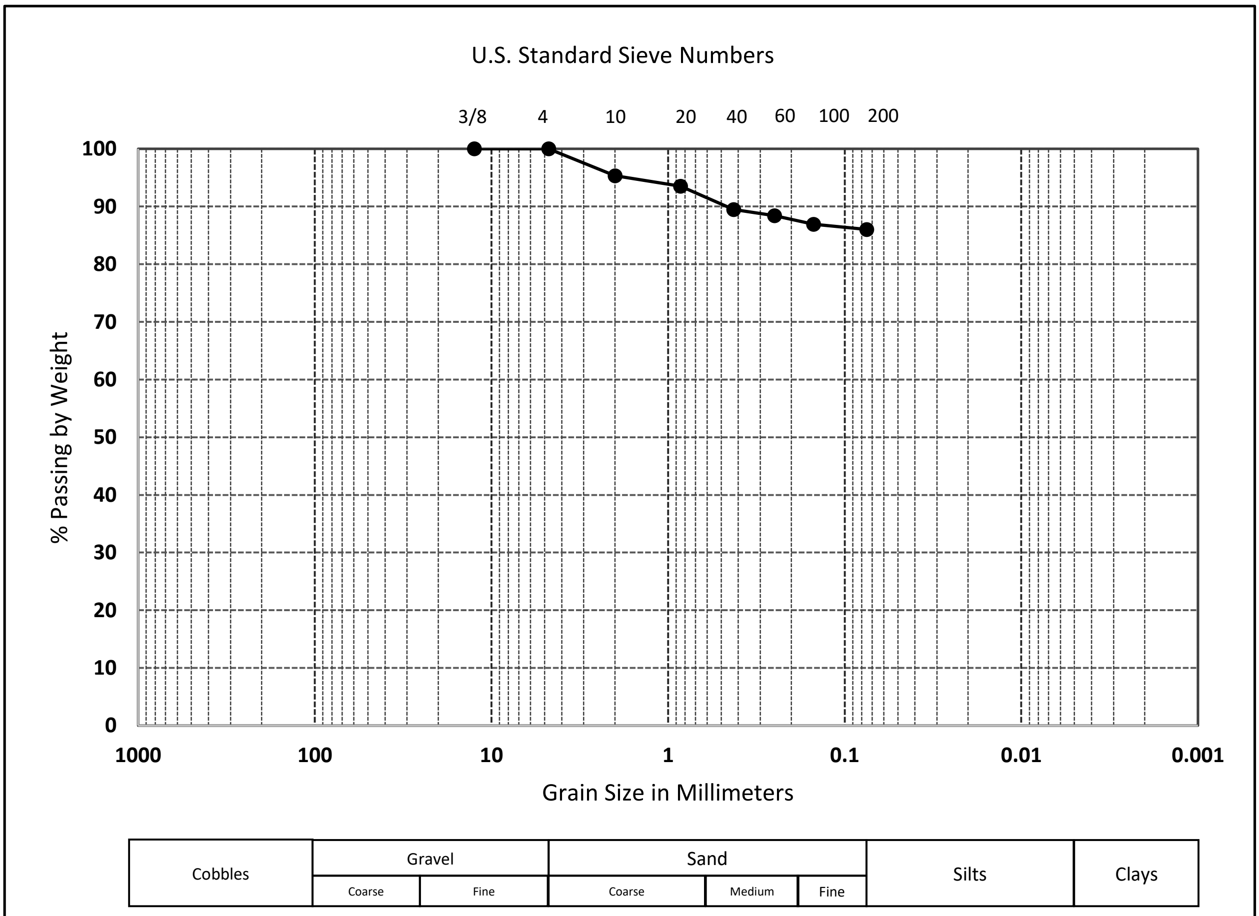
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-05	**Depth (m):**	25.0
Natural Moisture Content:	17.78%	**Total Dry Weight: (gms)**	100
Gravel:	0.00%	**Sand:**	13.98%
Silt / Clay:	86.02%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



Tested By:

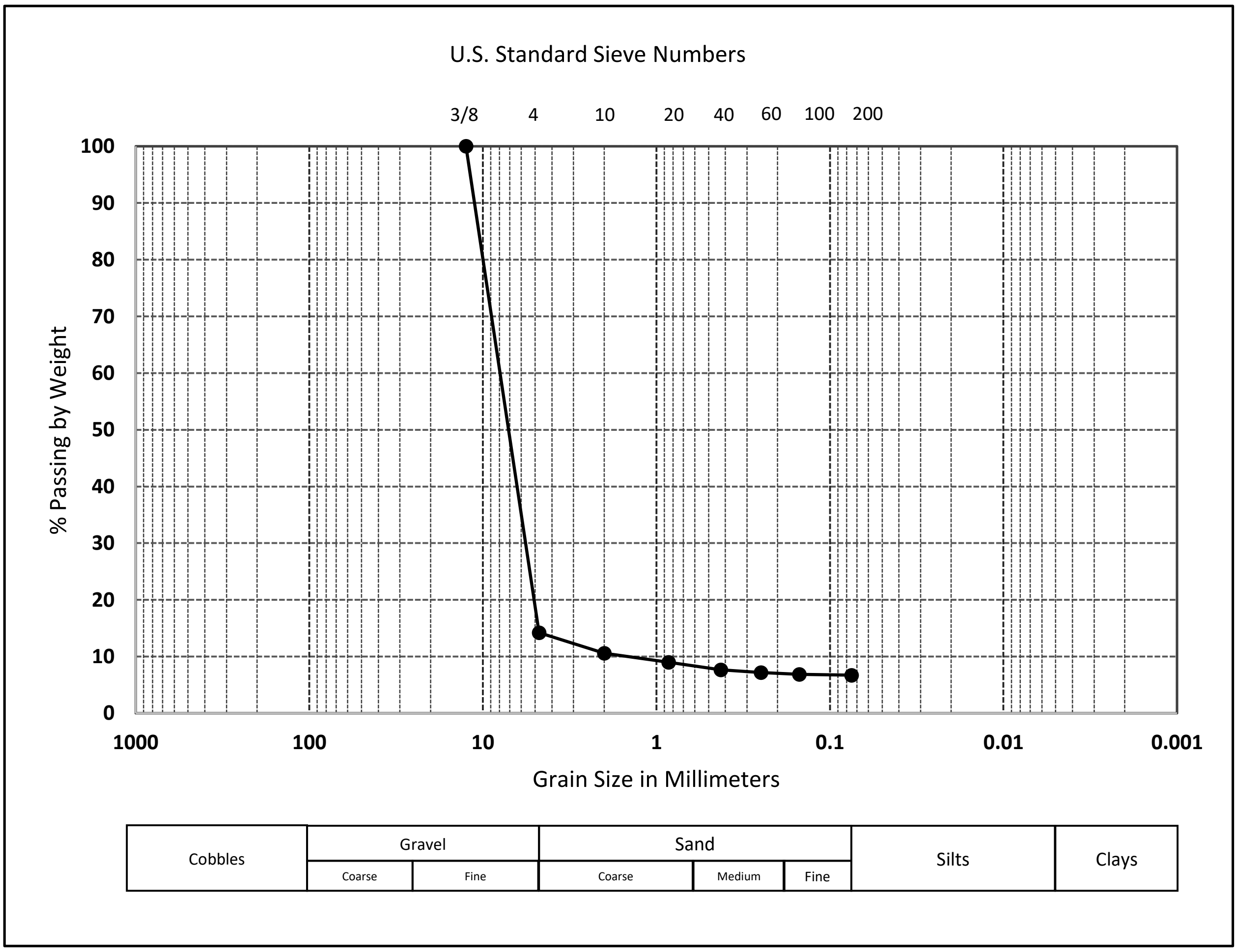
Checked By:

AJK Engineers

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	10.0
Natural Moisture Content:	10.10%	**Total Dry Weight: (gms)**	100
Gravel:	85.81%	**Sand:**	7.47%
Silt / Clay:	6.72%	**Classification Group:**	GP-GM
Description:	Brown, Poorly Graded **Gravel with Silt.**		



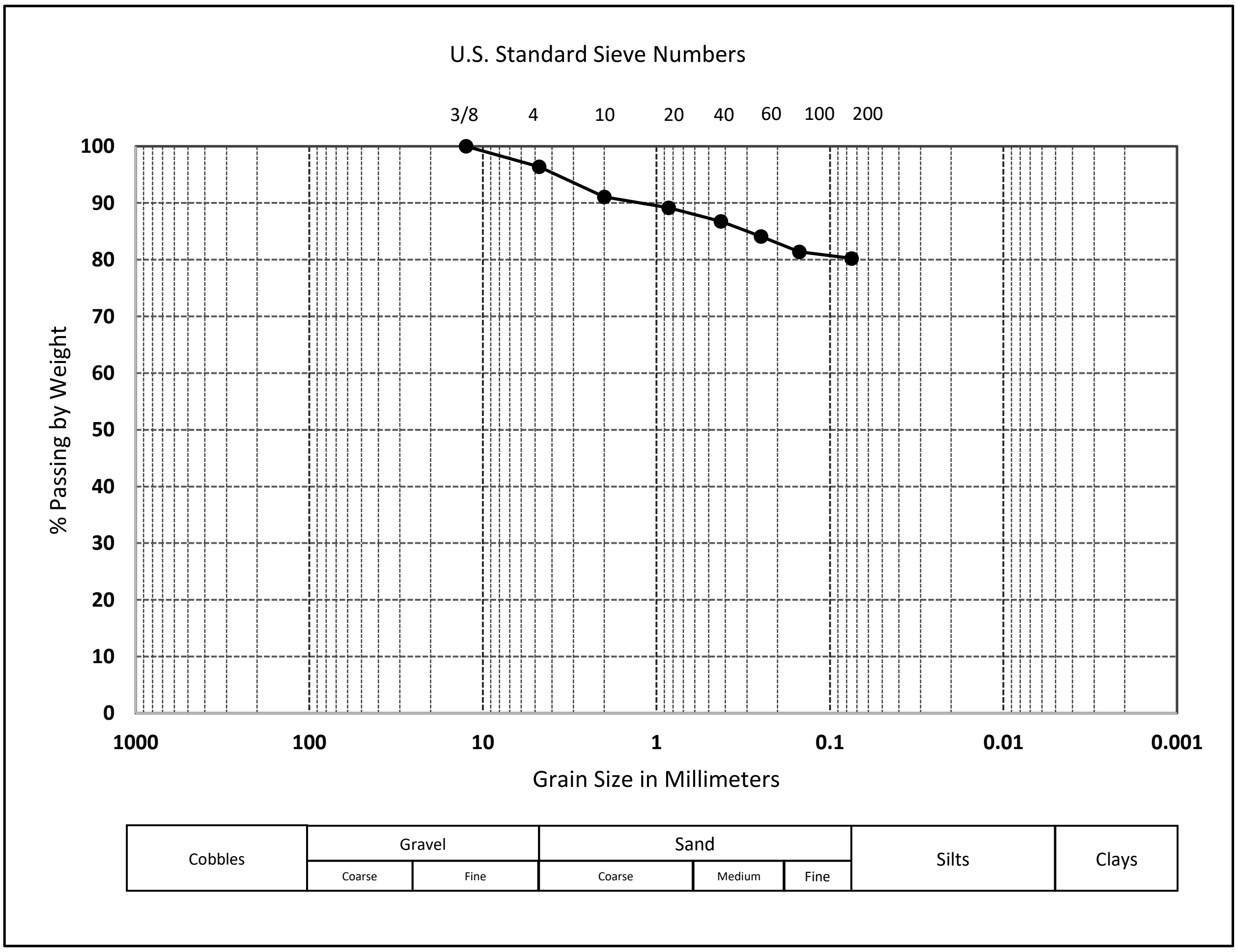
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	12.0
Natural Moisture Content:	22.87%	**Total Dry Weight: (gms)**	100
Gravel:	3.61%	**Sand:**	16.15%
Silt / Clay:	80.24%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay with Sand.**		



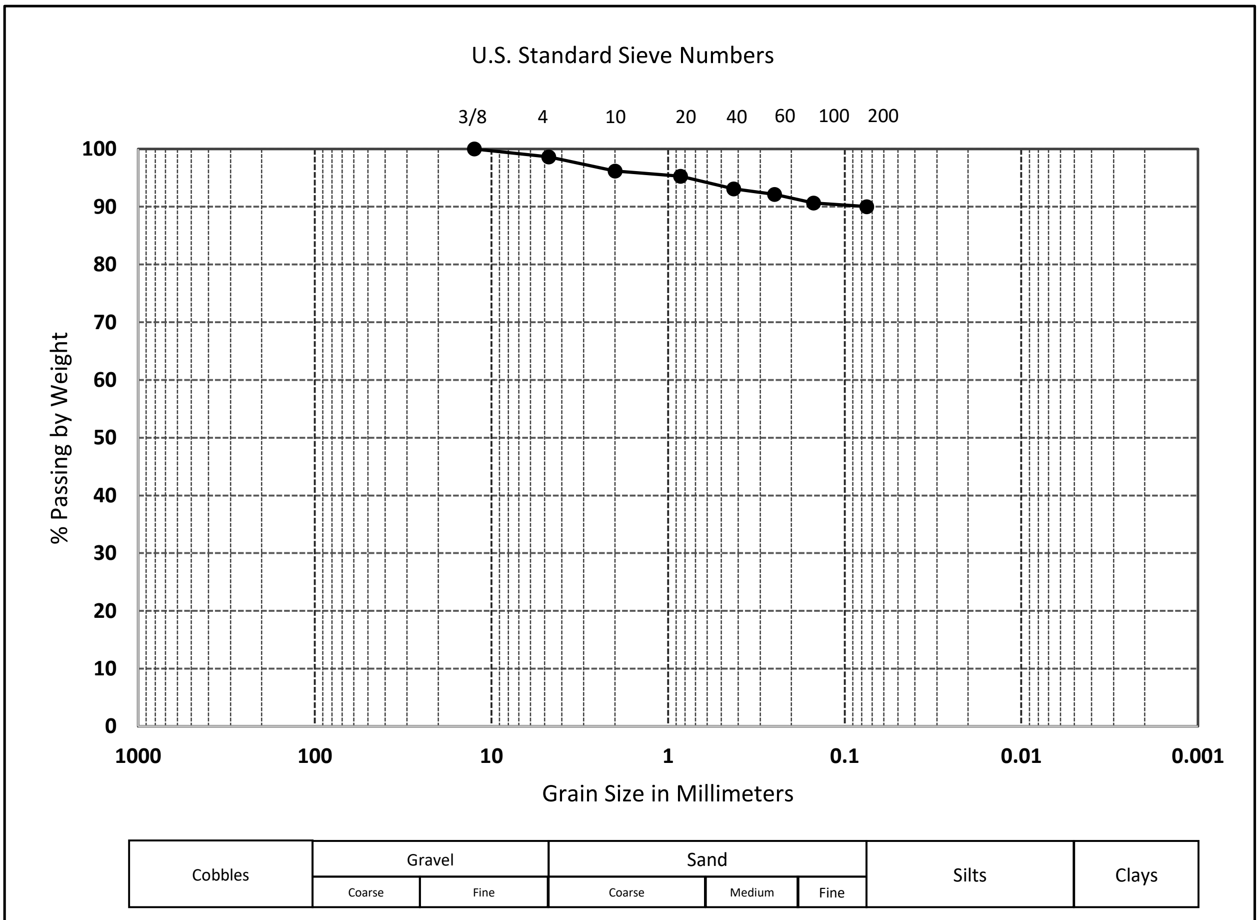
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	17.0
Natural Moisture Content:	23.77%	**Total Dry Weight: (gms)**	100
Gravel:	1.34%	**Sand:**	8.63%
Silt / Clay:	90.03%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



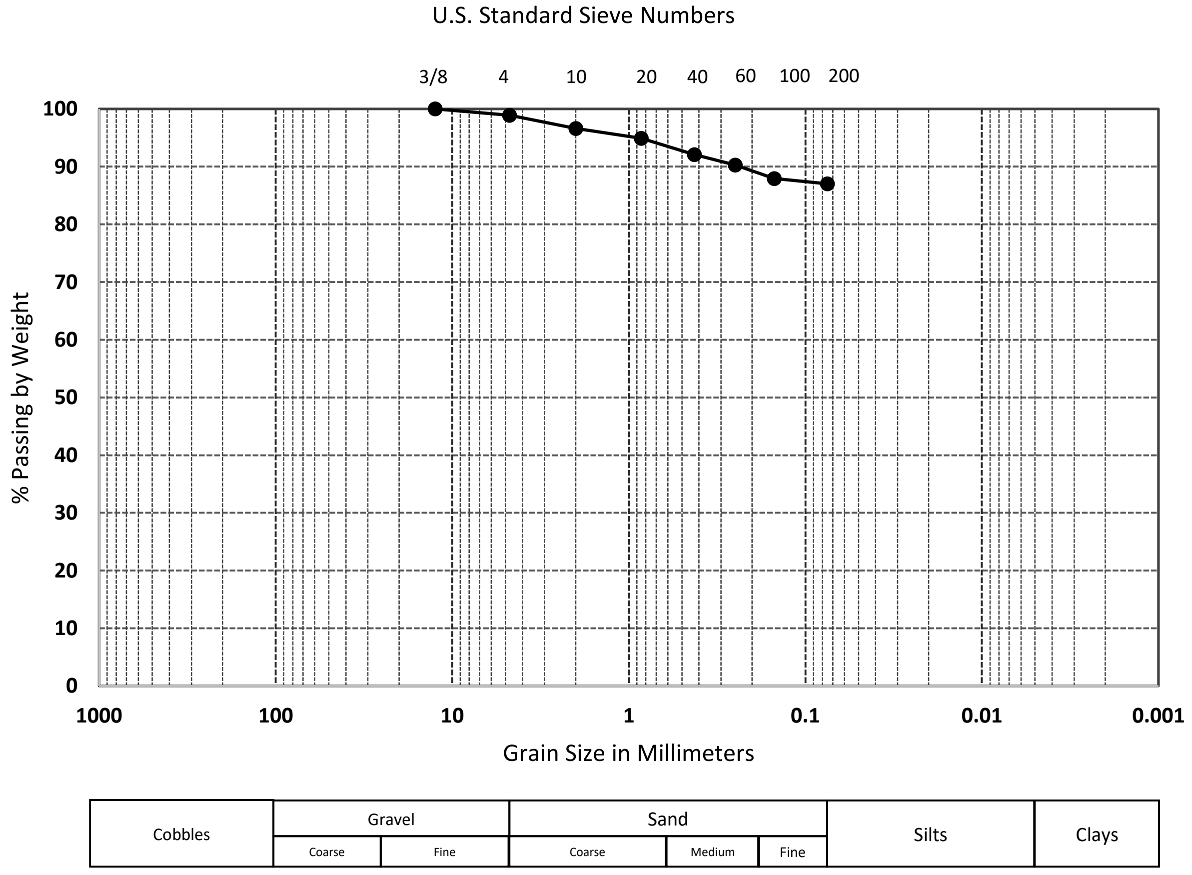
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	21.0
Natural Moisture Content:	22.34%	**Total Dry Weight: (gms)**	100
Gravel:	1.07%	**Sand:**	11.91%
Silt / Clay:	87.02%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



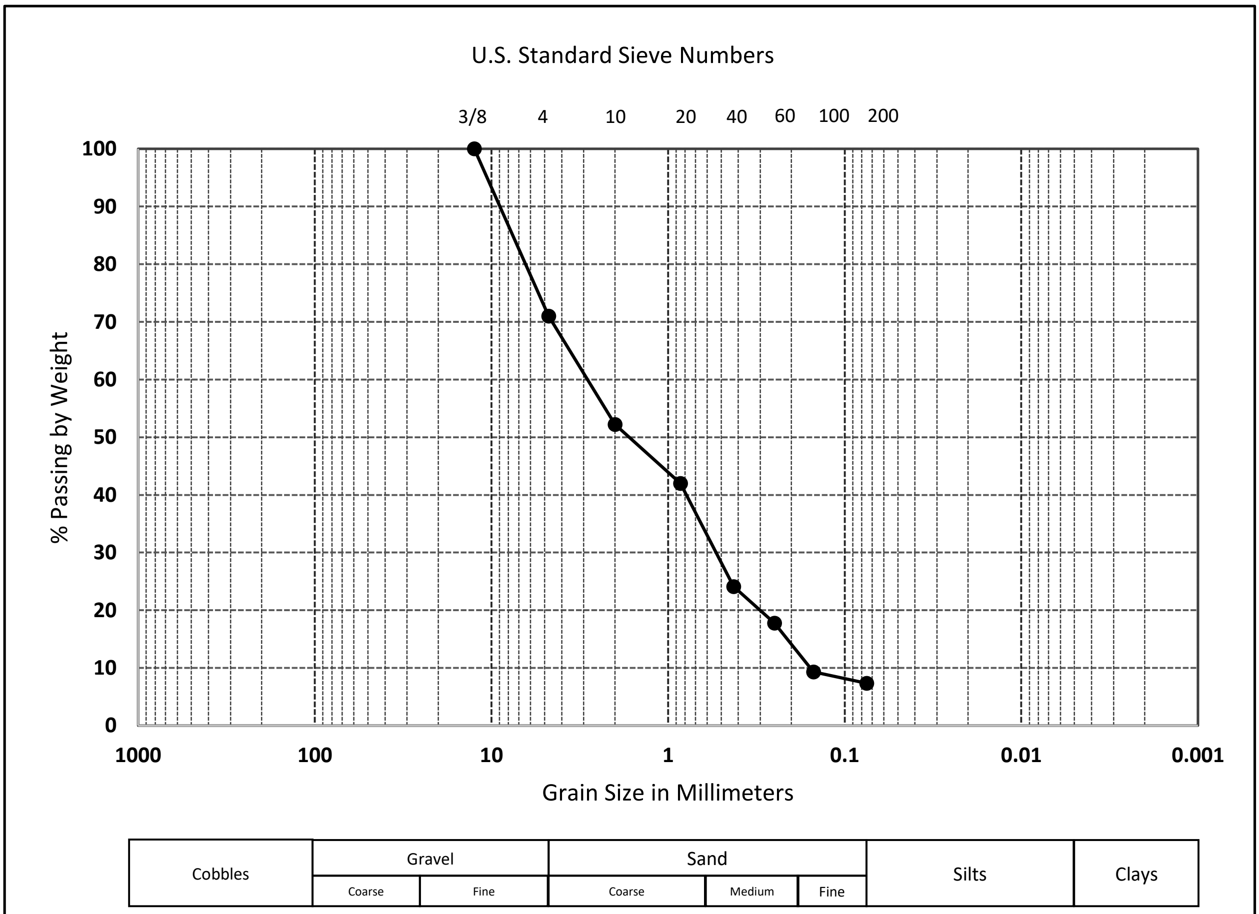
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	22.0
Natural Moisture Content:	22.57%	**Total Dry Weight: (gms)**	100
Gravel:	28.98%	**Sand:**	63.69%
Silt / Clay:	7.33%	**Classification Group:**	SP-SM
Description:	Brown, Poorly Graded **Sand with Silt and Gravel.**		



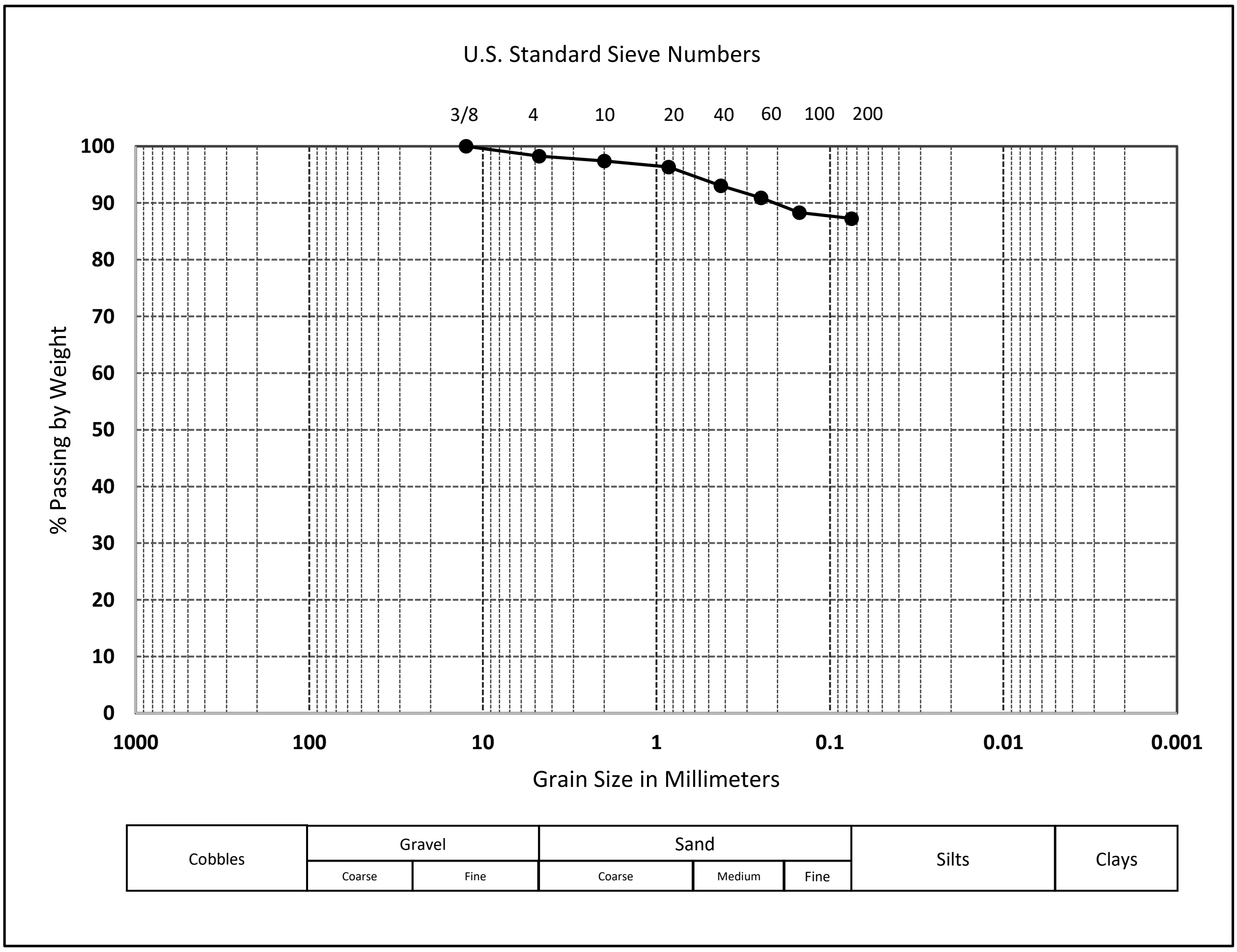
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	28.0
Natural Moisture Content:	24.79%	**Total Dry Weight: (gms)**	100
Gravel:	1.71%	**Sand:**	11.02%
Silt / Clay:	87.27%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



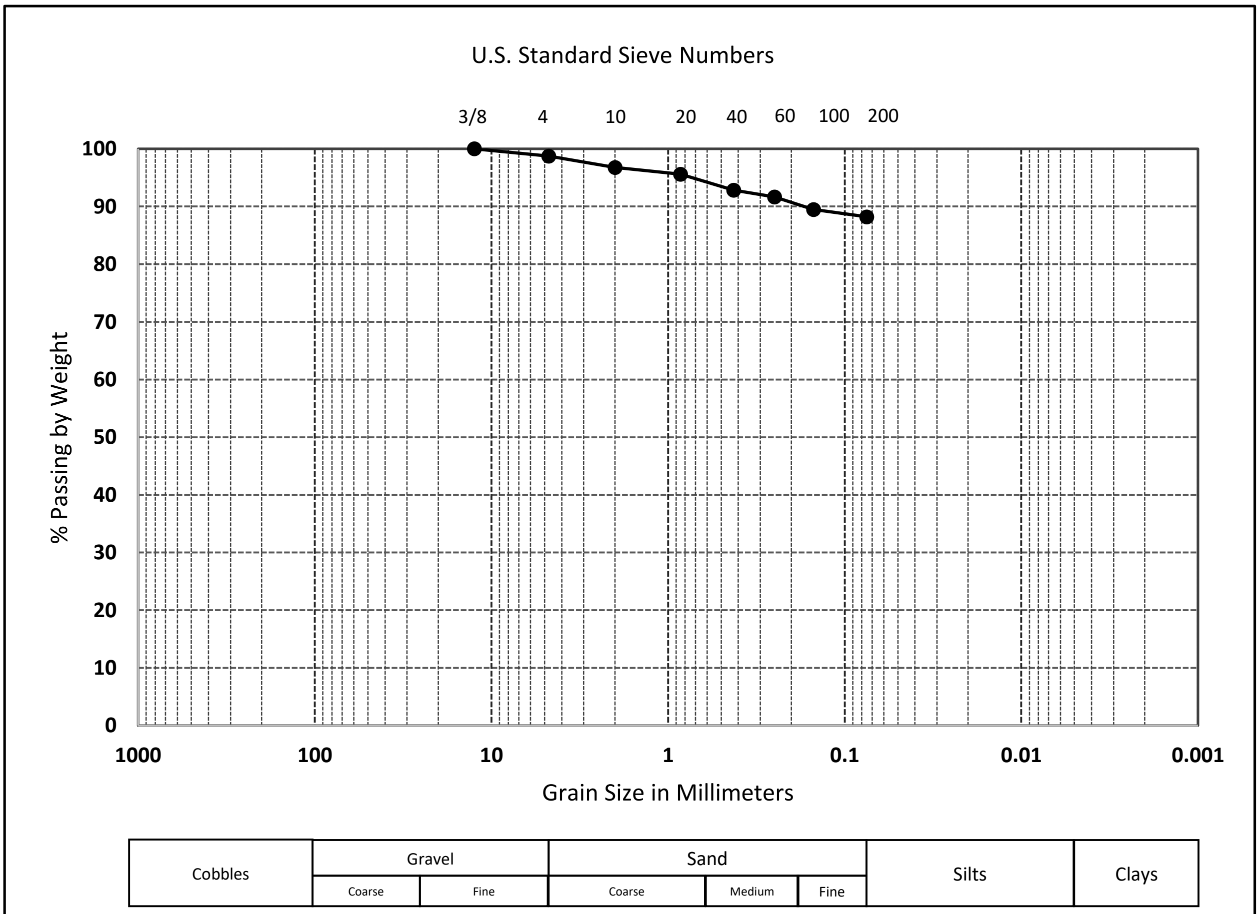
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	36.0
Natural Moisture Content:	29.06%	**Total Dry Weight: (gms)**	100
Gravel:	1.28%	**Sand:**	10.50%
Silt / Clay:	88.22%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



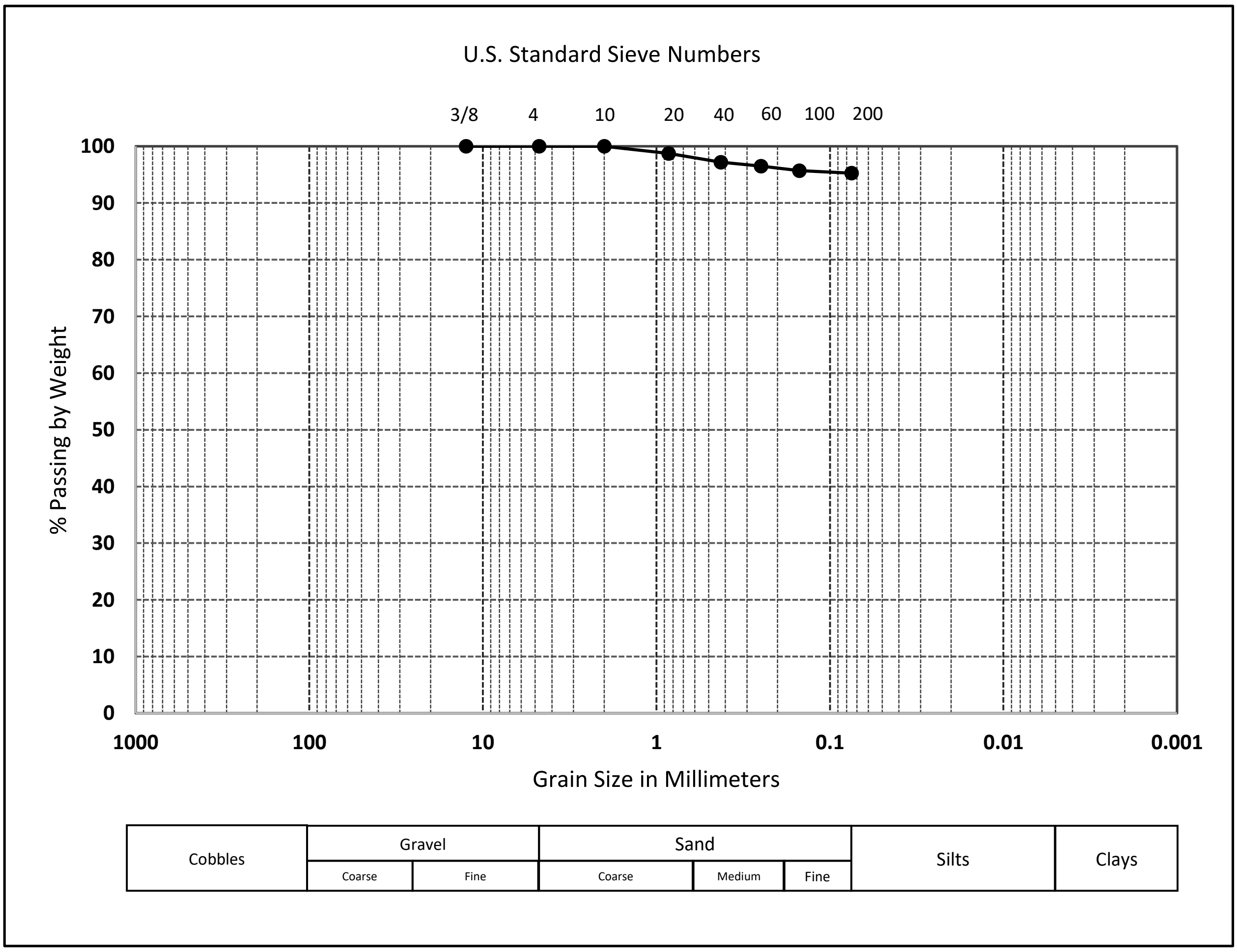
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	53.0
Natural Moisture Content:	22.28%	**Total Dry Weight: (gms)**	100
Gravel:	0.00%	**Sand:**	4.74%
Silt / Clay:	95.26%	**Classification Group:**	CL
Description:	Brown, High Plasticity, **Lean Clay.**		



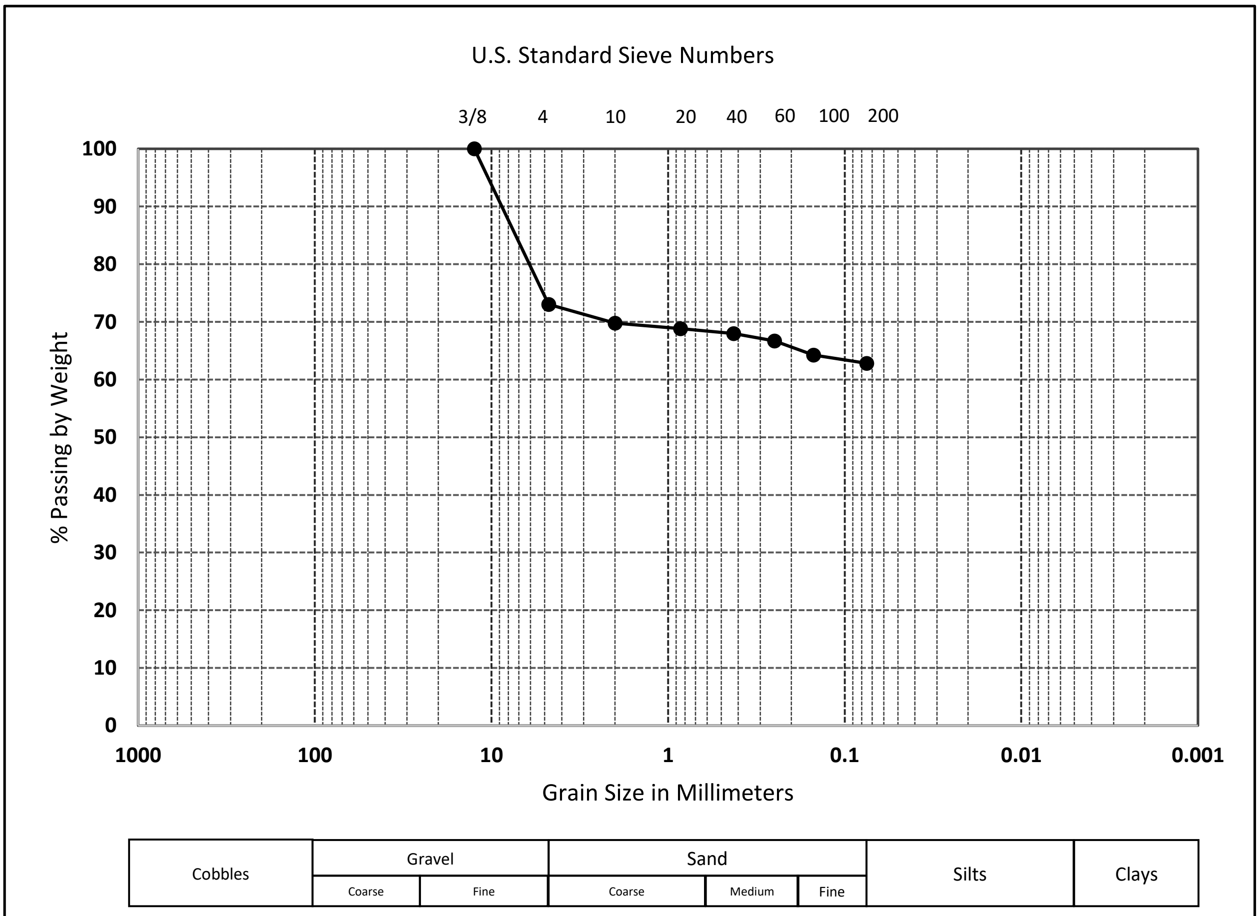
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	65.0
Natural Moisture Content:	17.43%	**Total Dry Weight: (gms)**	100
Gravel:	26.95%	**Sand:**	10.24%
Silt / Clay:	62.81%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Gravelly Lean Clay.**		



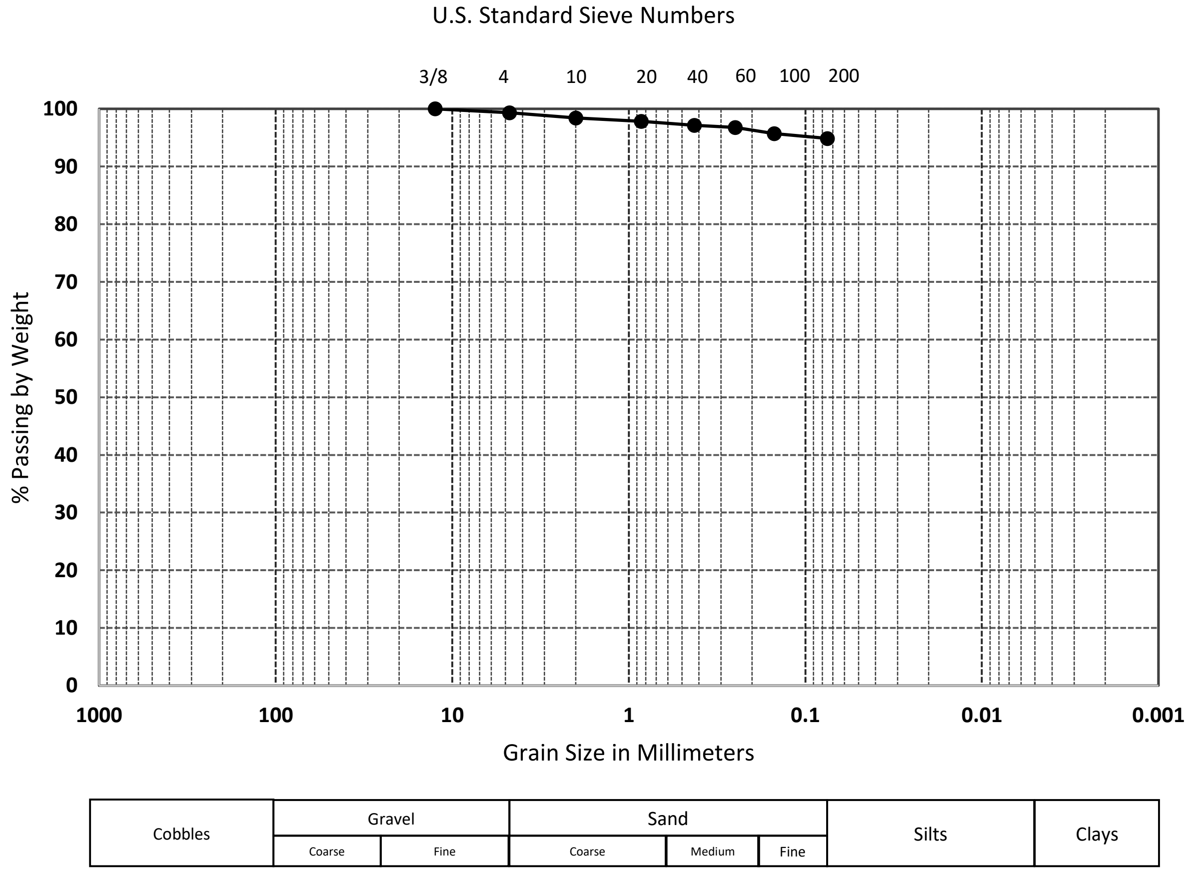
Tested By:

Checked By:

Grain Size Analysis

ASTM D-421, 422

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	68.0
Natural Moisture Content:	17.13%	**Total Dry Weight: (gms)**	100
Gravel:	0.69%	**Sand:**	4.44%
Silt / Clay:	94.87%	**Classification Group:**	CL
Description:	Brown, Medium Plasticity, **Lean Clay.**		



Tested By:

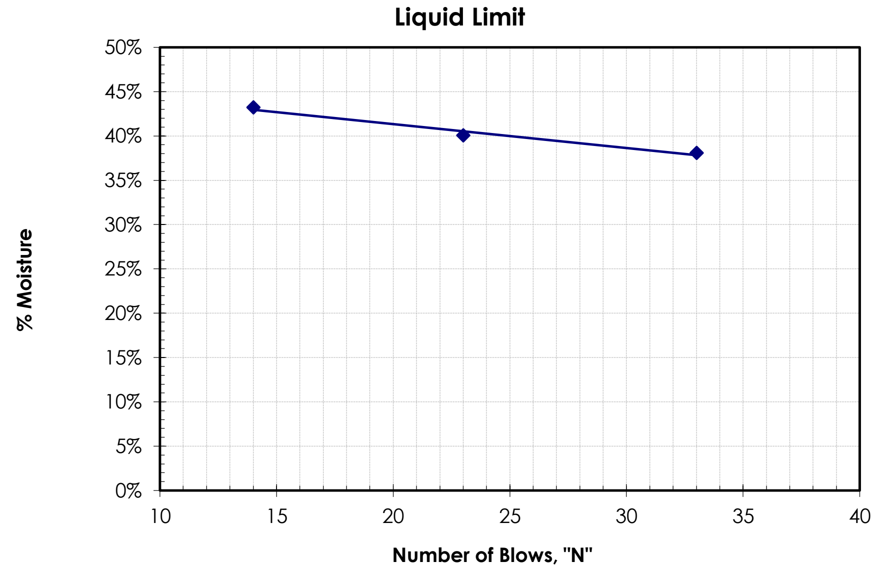
Checked By:

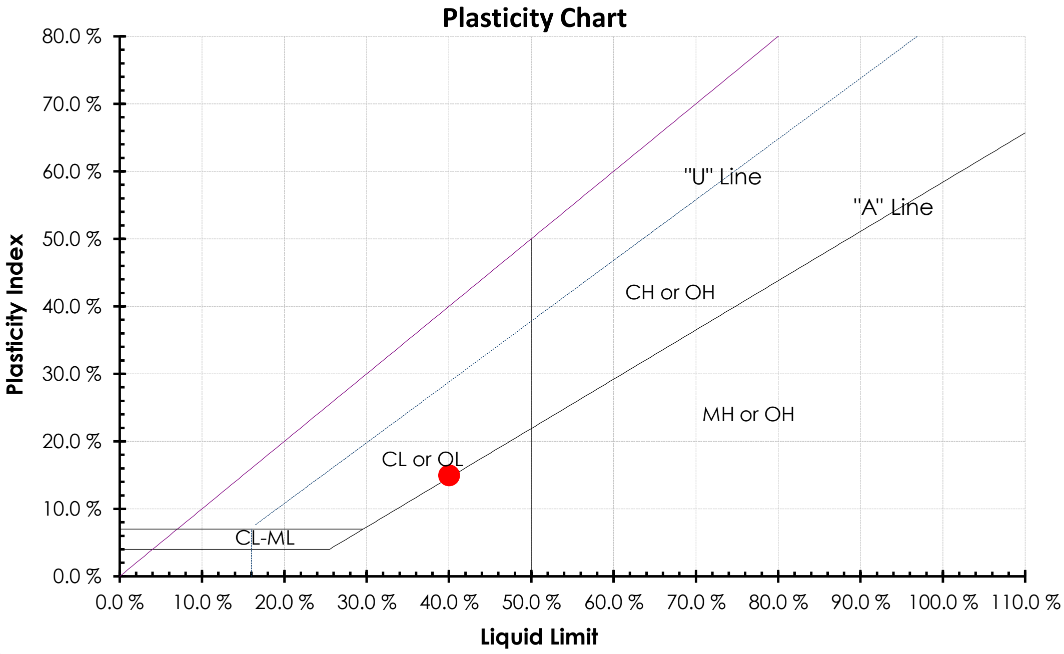
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-01	**Depth (m):**	15.0
Liquid Limit:	40%	**Plastic Limit:**	25%
Plasticity Index :	15%	**Classification Group:**	CL, Lean Clay with Sand





Tested By:

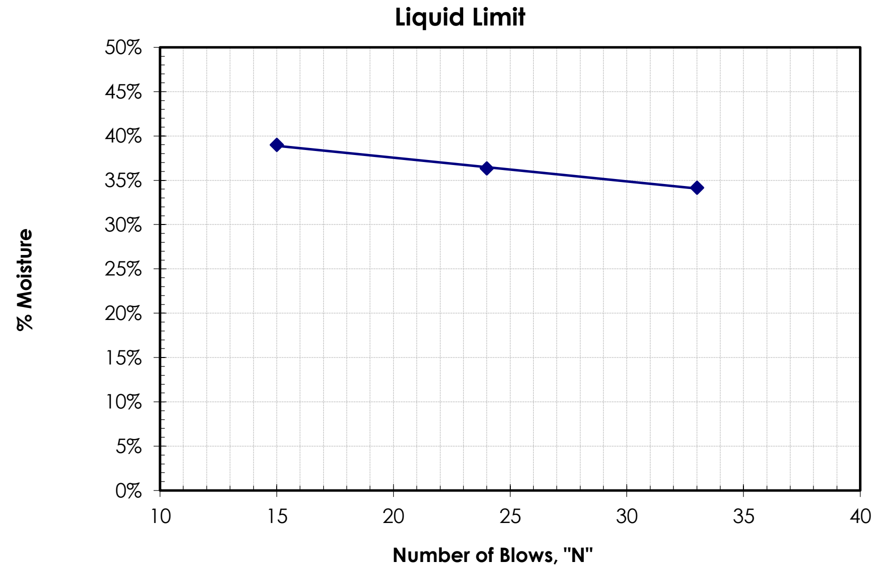
Checked By:

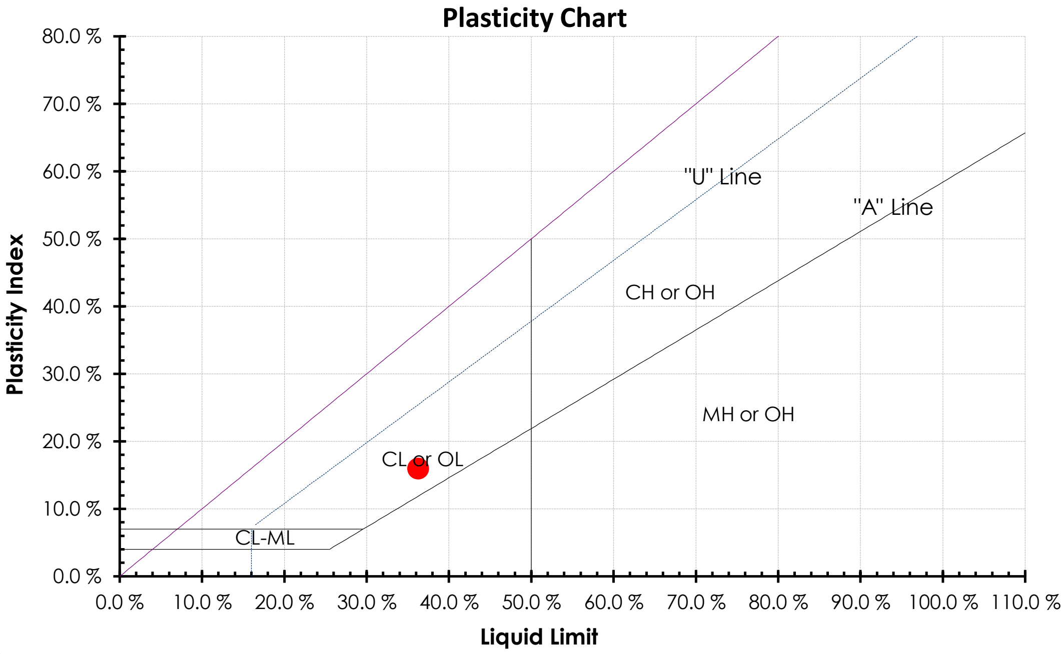
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-01	**Depth (m):**	21.5
Liquid Limit:	36%	**Plastic Limit:**	20%
Plasticity Index :	16%	**Classification Group:**	CL, Lean Clay





Tested By:

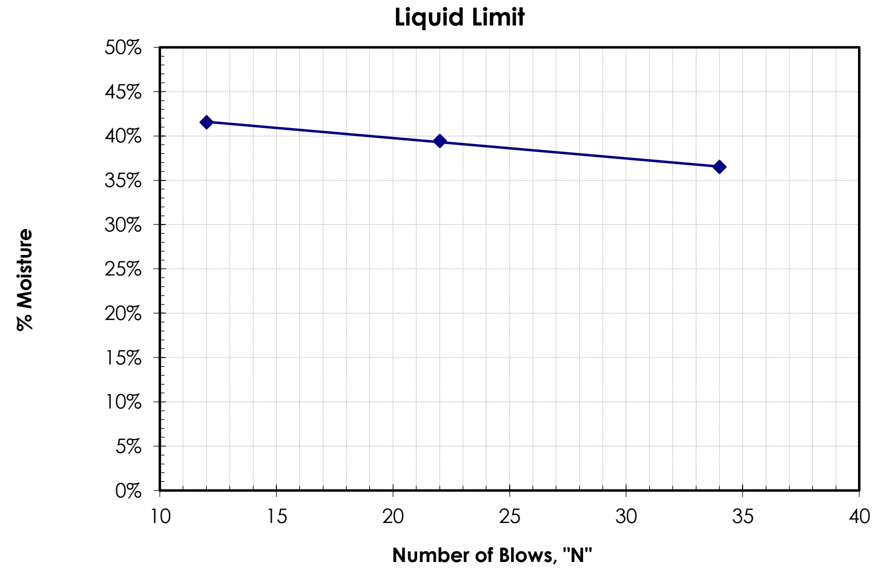
Checked By:

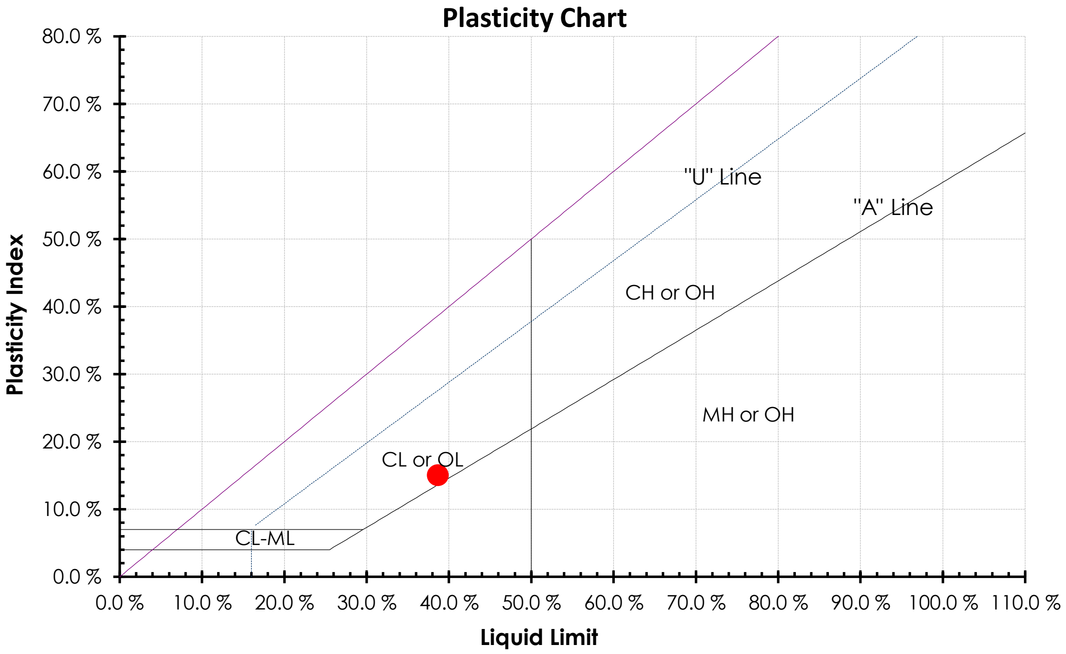
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-01	**Depth (m):**	26.0
Liquid Limit:	39%	**Plastic Limit:**	24%
Plasticity Index :	15%	**Classification Group:**	CL, Lean Clay with Sand





Tested By:

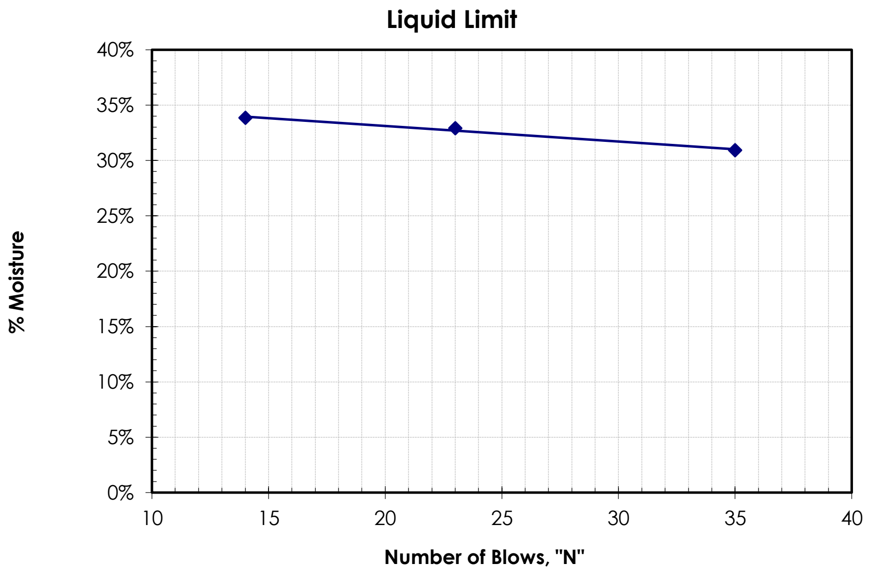
Checked By:

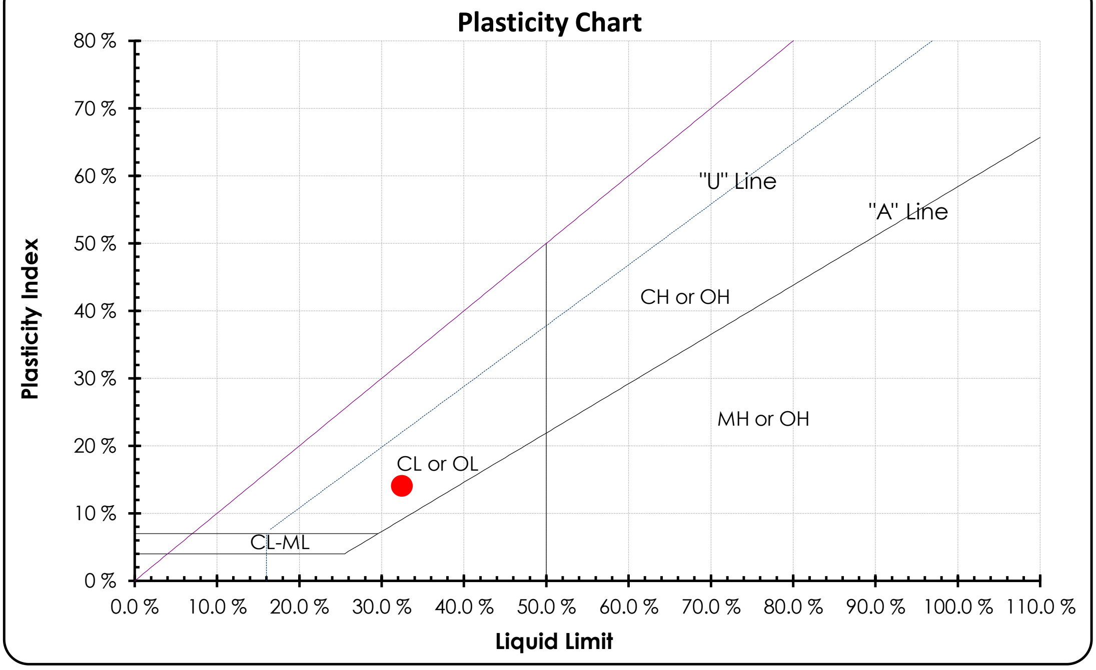
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	16.0
Liquid Limit:	32%	**Plastic Limit:**	18%
Plasticity Index :	14%	**Classification Group:**	CL, Lean Clay with Sand





Tested By:

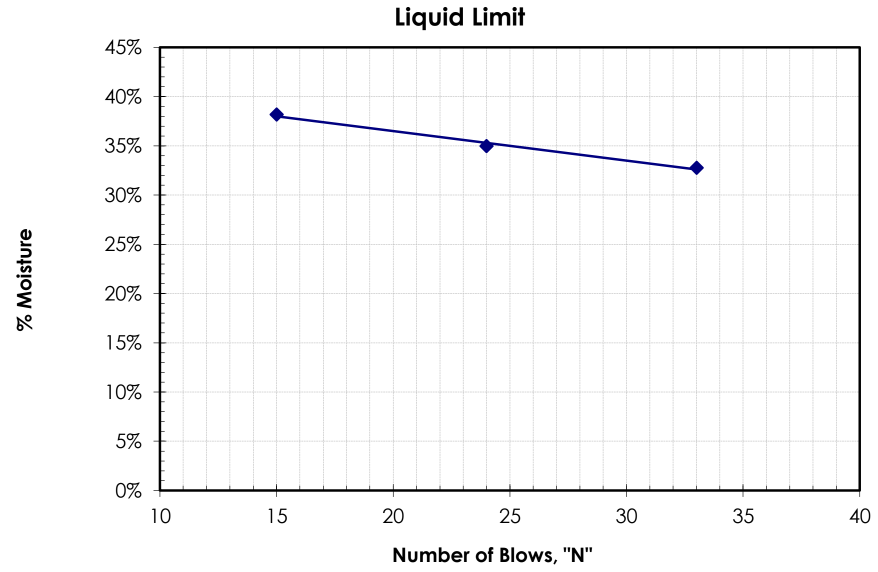
Checked By:

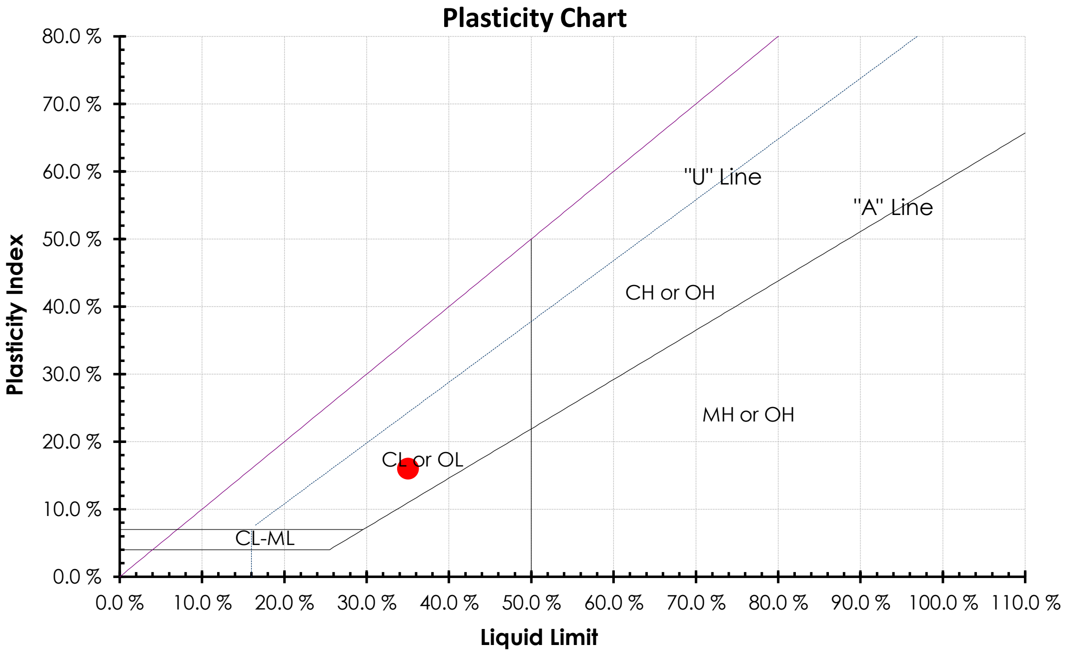
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	20.0
Liquid Limit:	35%	**Plastic Limit:**	19%
Plasticity Index :	16%	**Classification Group:**	CL, Lean Clay with Sand





Tested By:

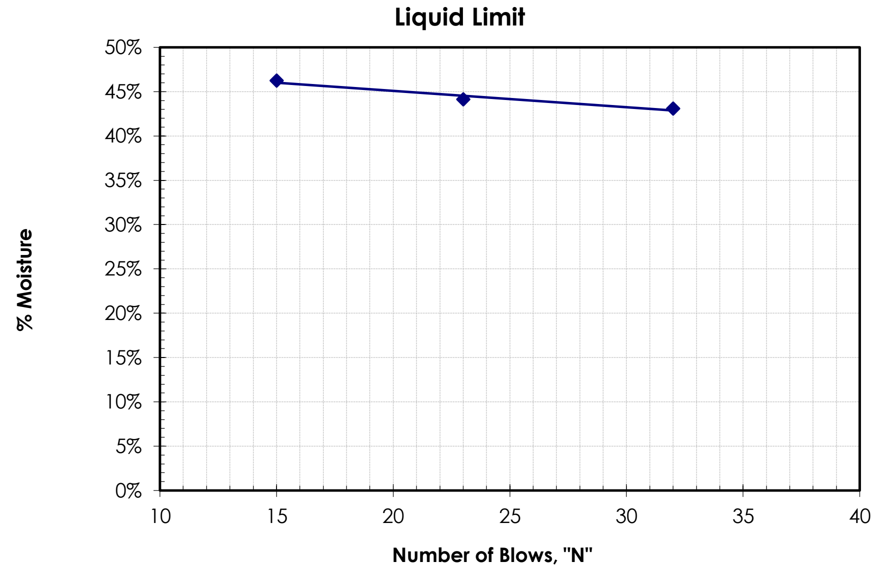
Checked By:

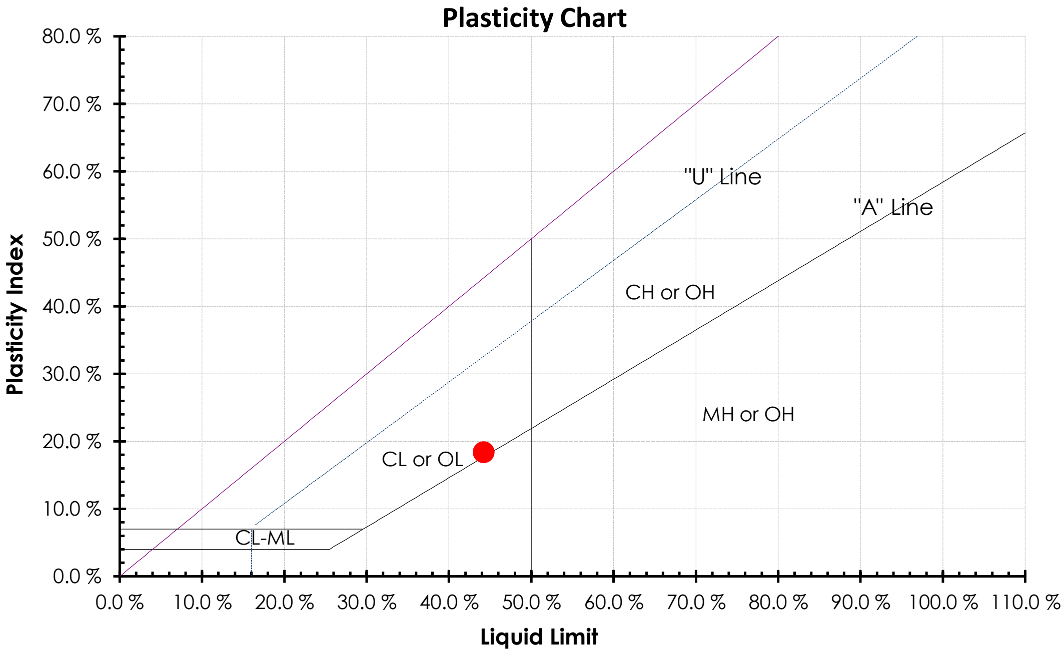
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	22.0
Liquid Limit:	44%	**Plastic Limit:**	26%
Plasticity Index :	18%	**Classification Group:**	CL, Lean Clay with Sand





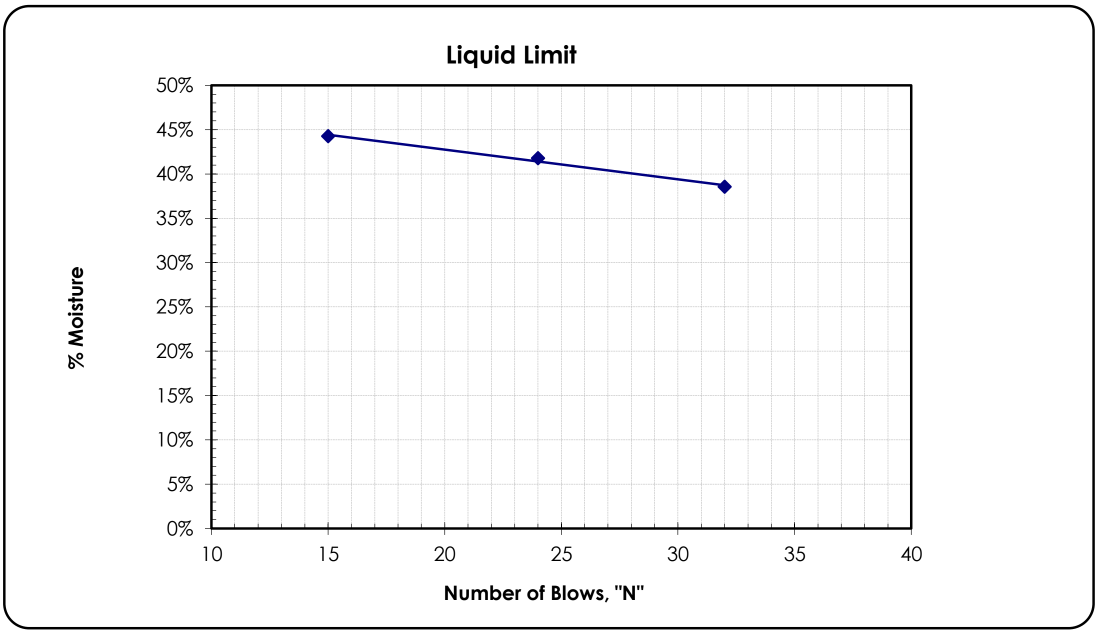
Tested By:

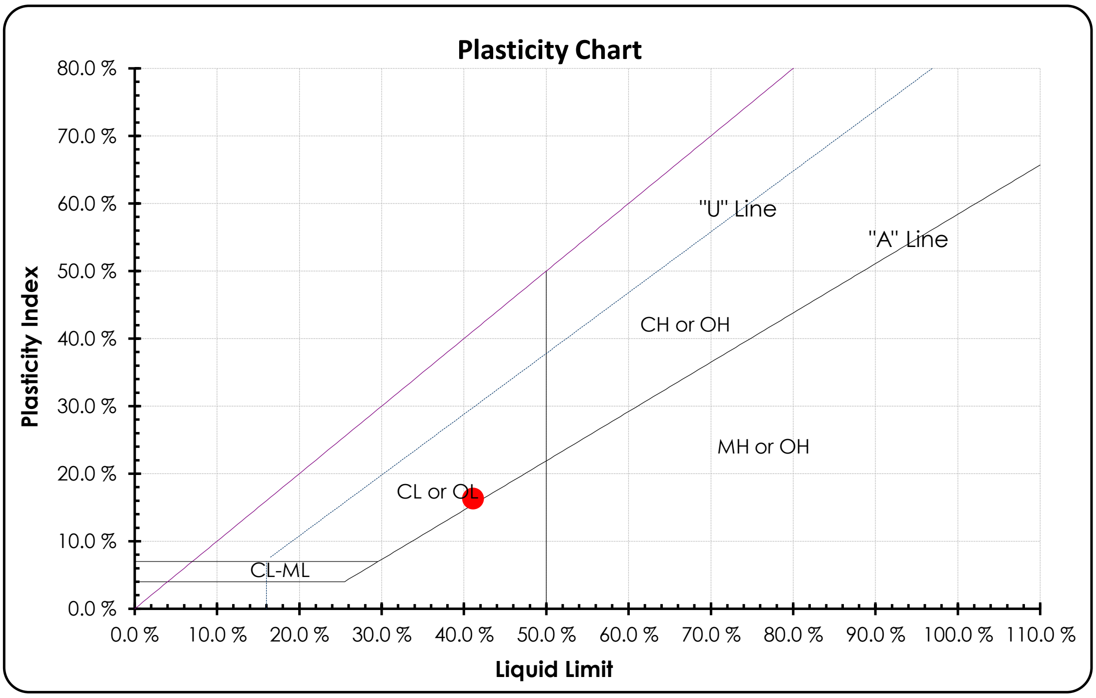
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	25.0
Liquid Limit:	41%	**Plastic Limit:**	25%
Plasticity Index :	16%	**Classification Group:**	CL, Lean Clay with Sand





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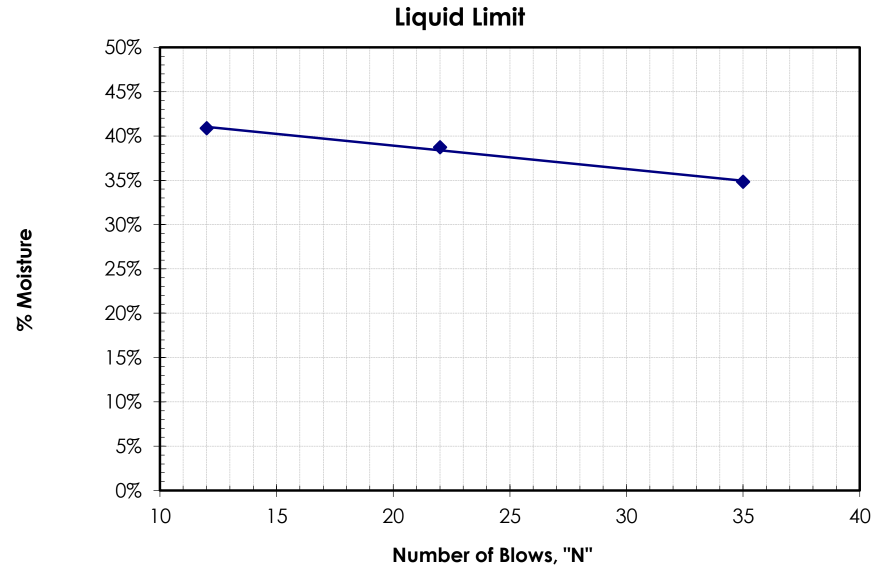
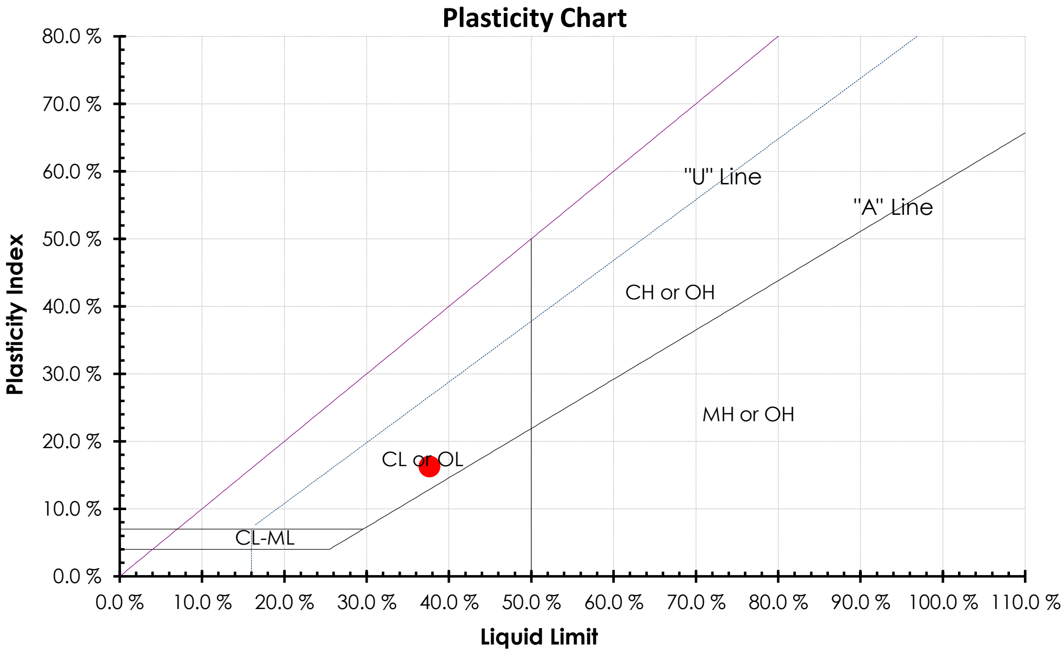
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	38.0
Liquid Limit:	38%	**Plastic Limit:**	21%
Plasticity Index :	16%	**Classification Group:**	CL, Lean Clay





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Checked By:

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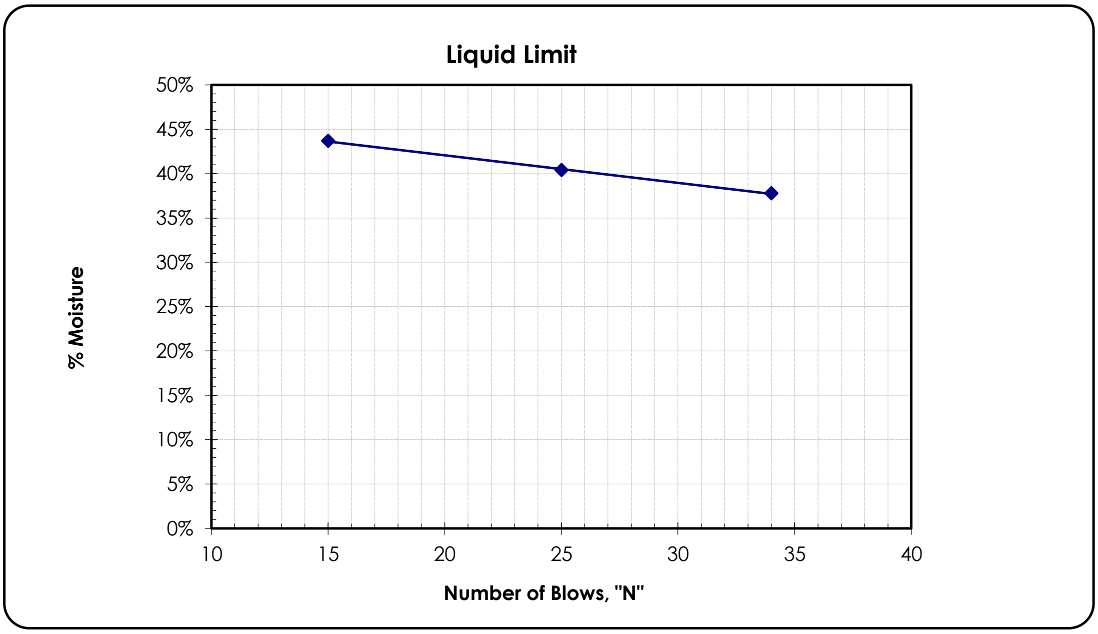
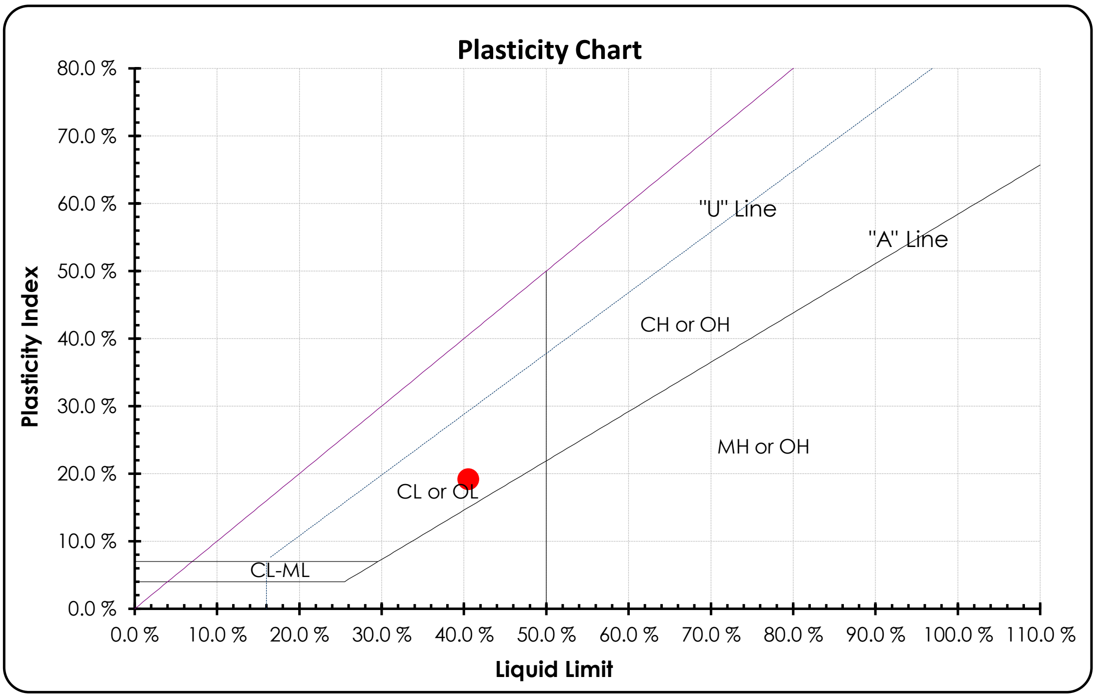
ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	56.0
Liquid Limit:	41%	**Plastic Limit:**	21%
Plasticity Index :	20%	**Classification Group:**	CL, Lean Clay





Tested By:

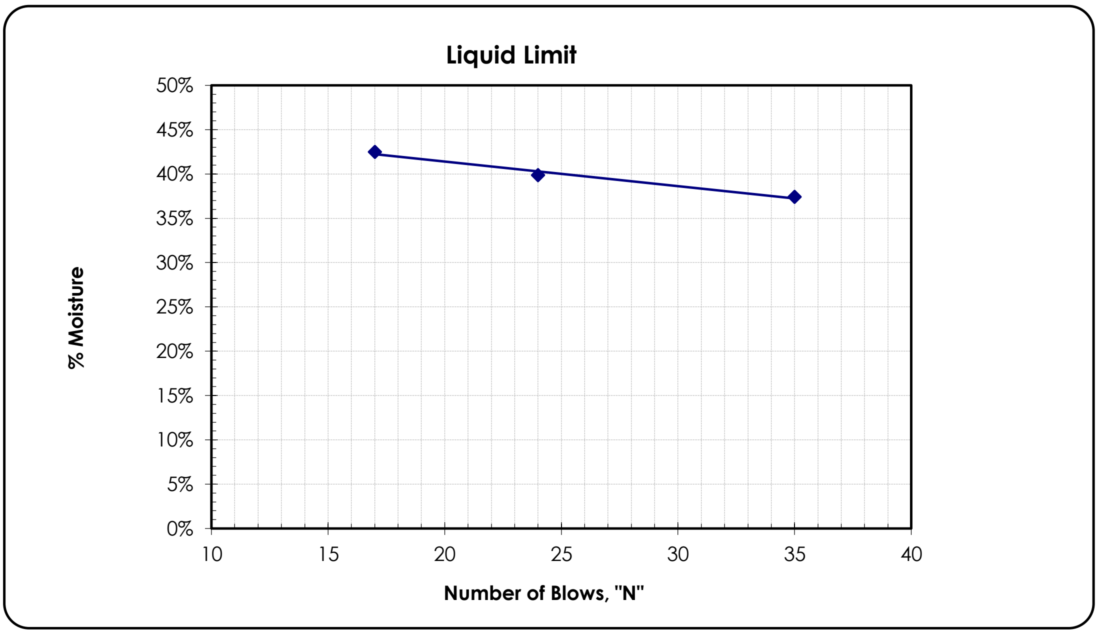
Checked By:

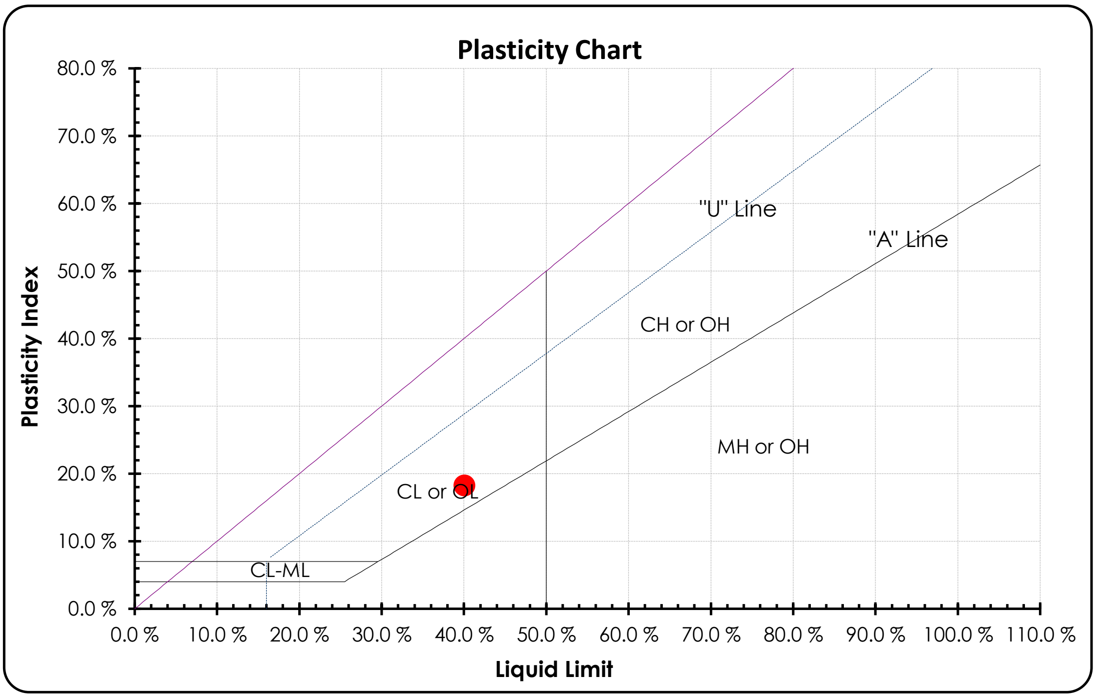
AJK
Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-02	**Depth (m):**	65.0
Liquid Limit:	40%	**Plastic Limit:**	22%
Plasticity Index :	18%	**Classification Group:**	CL, Lean Clay





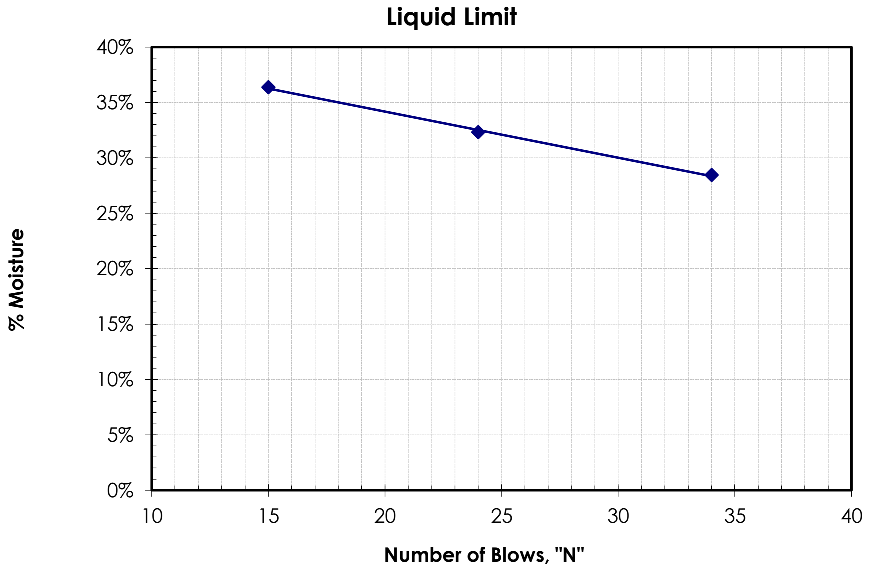
Tested By:

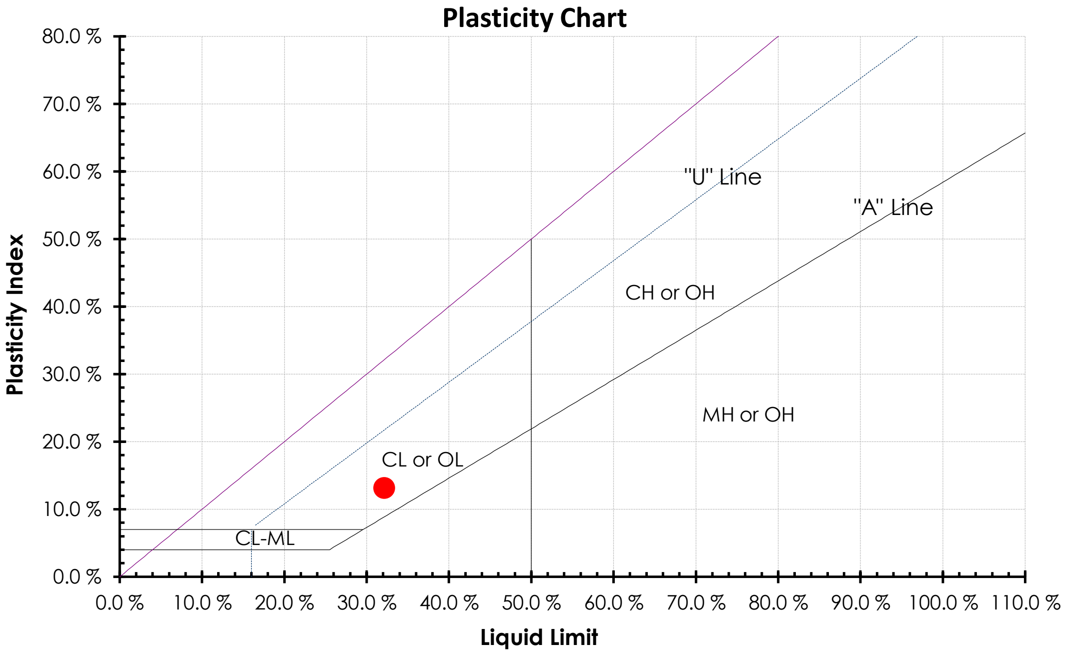
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	16.0
Liquid Limit:	32%	**Plastic Limit:**	19%
Plasticity Index :	13%	**Classification Group:**	CL, Lean Clay with Sand





Tested By:

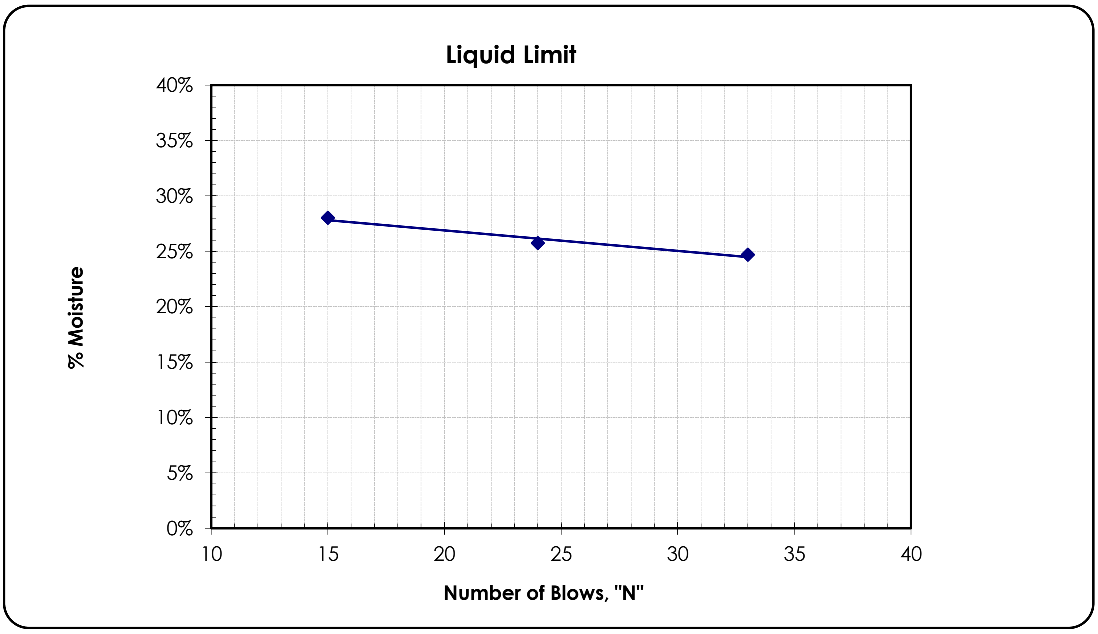
Checked By:

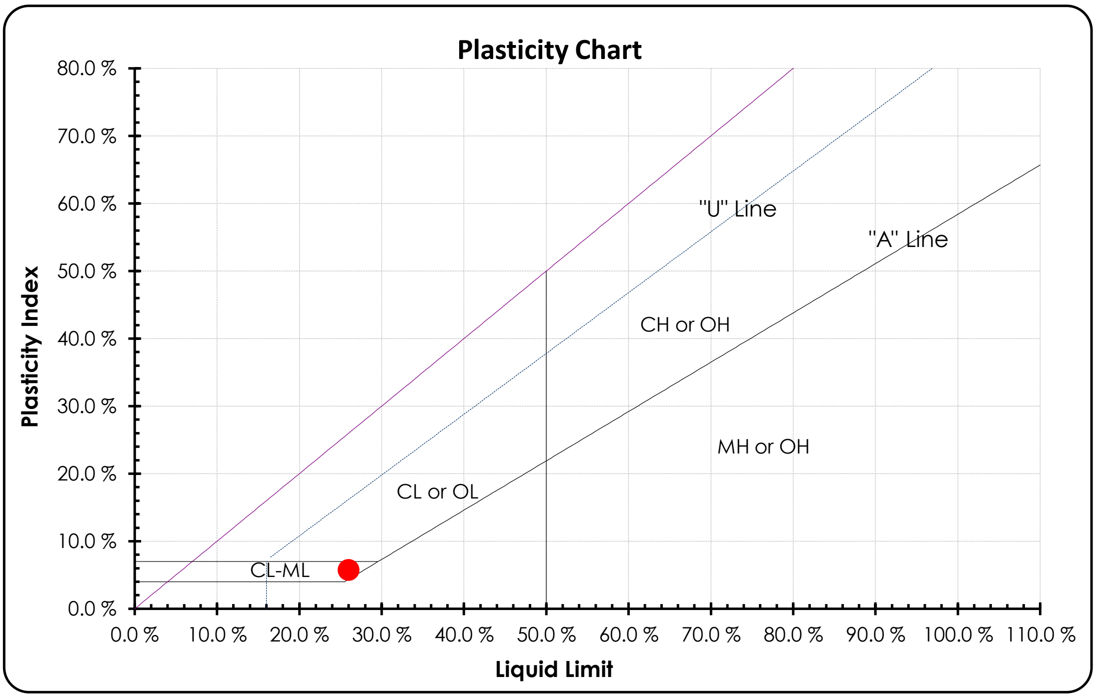
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	25.0
Liquid Limit:	26%	**Plastic Limit:**	20%
Plasticity Index :	6%	**Classification Group:**	CL-ML, Sandy Silty Clay





Tested By:

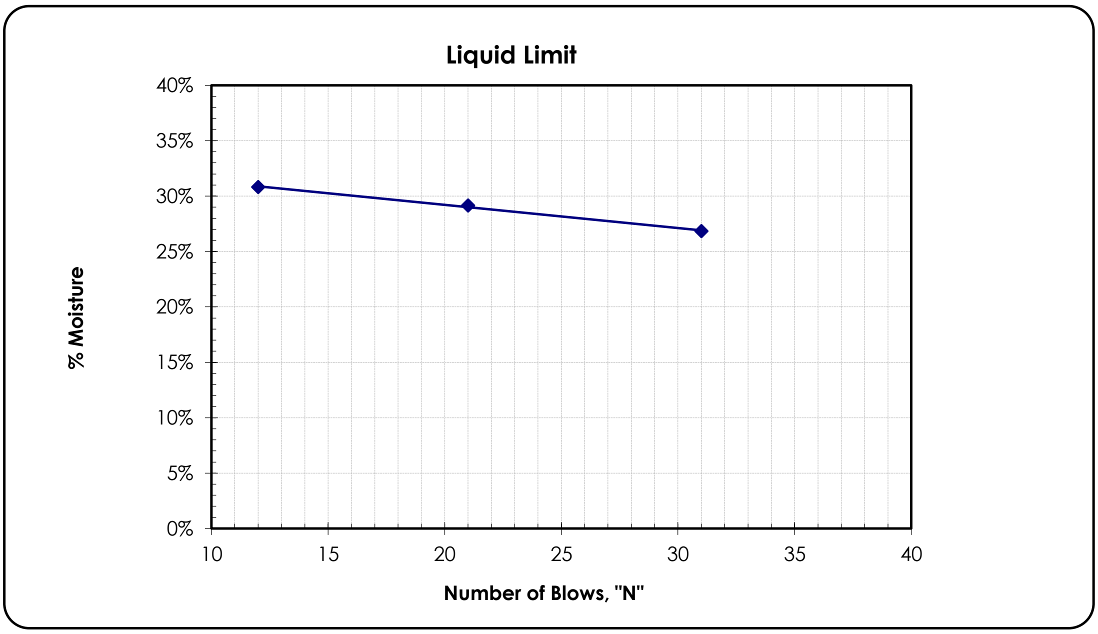
Checked By:

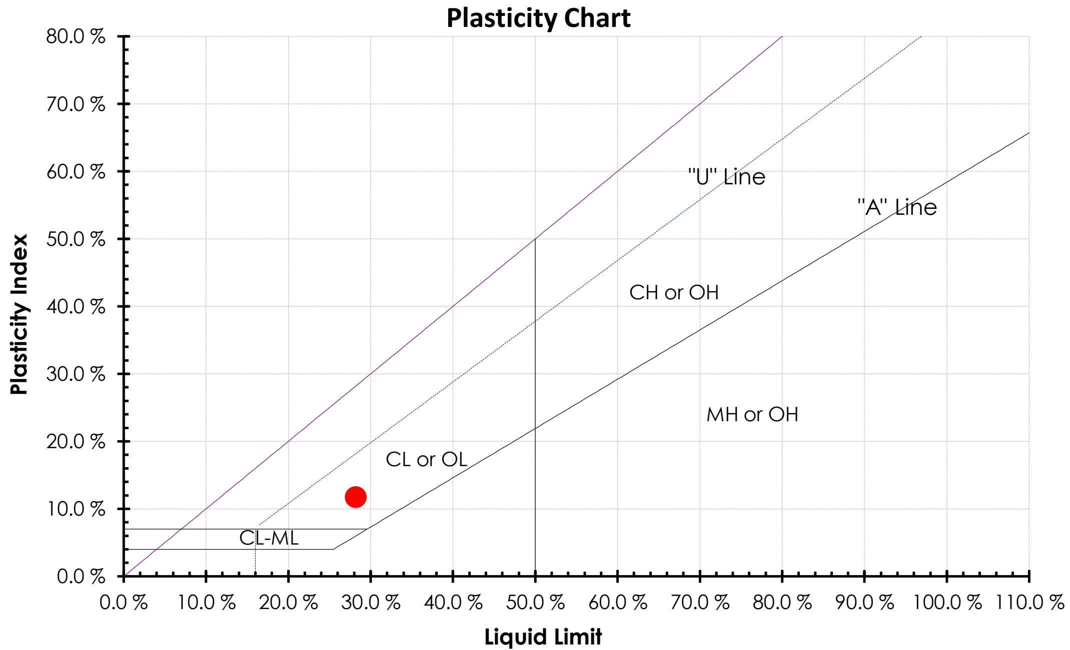
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	28.0
Liquid Limit:	28%	**Plastic Limit:**	16%
Plasticity Index :	12%	**Classification Group:**	CL, Lean Clay





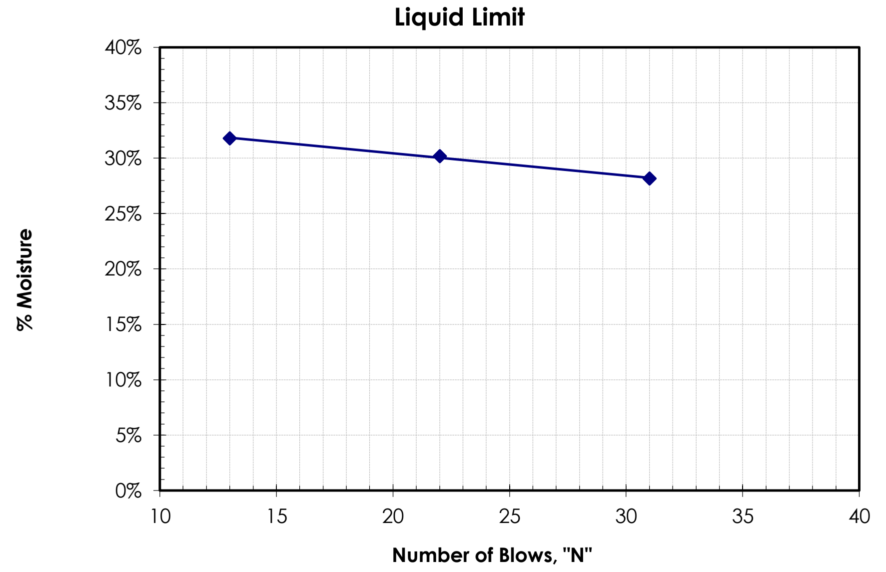
Tested By:

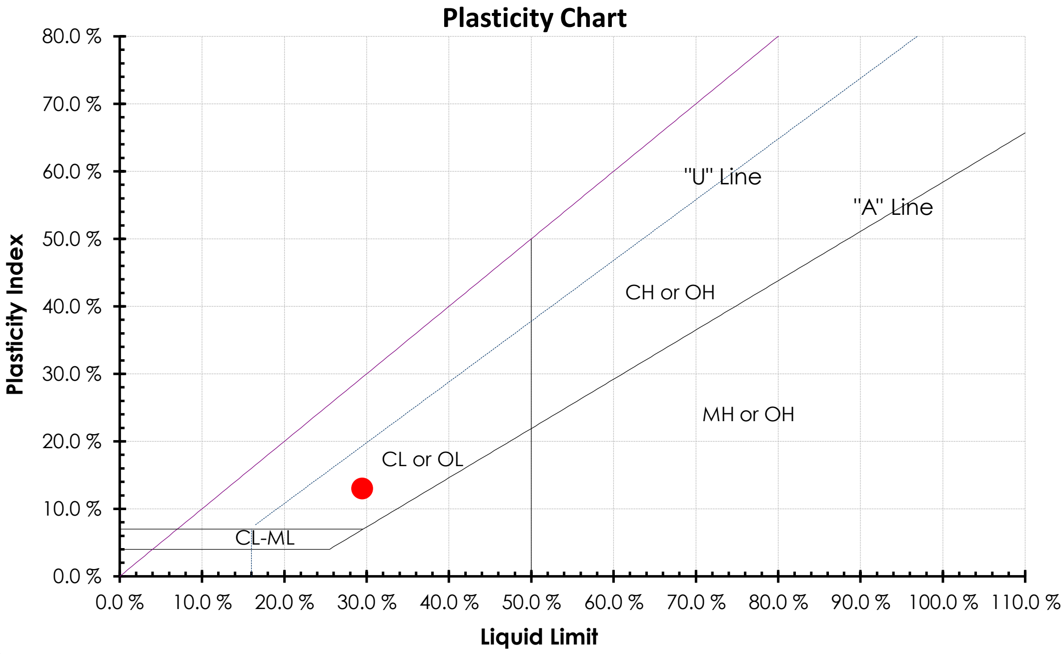
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	33.0
Liquid Limit:	29%	**Plastic Limit:**	16%
Plasticity Index :	13%	**Classification Group:**	CL, Lean Clay





Tested By:

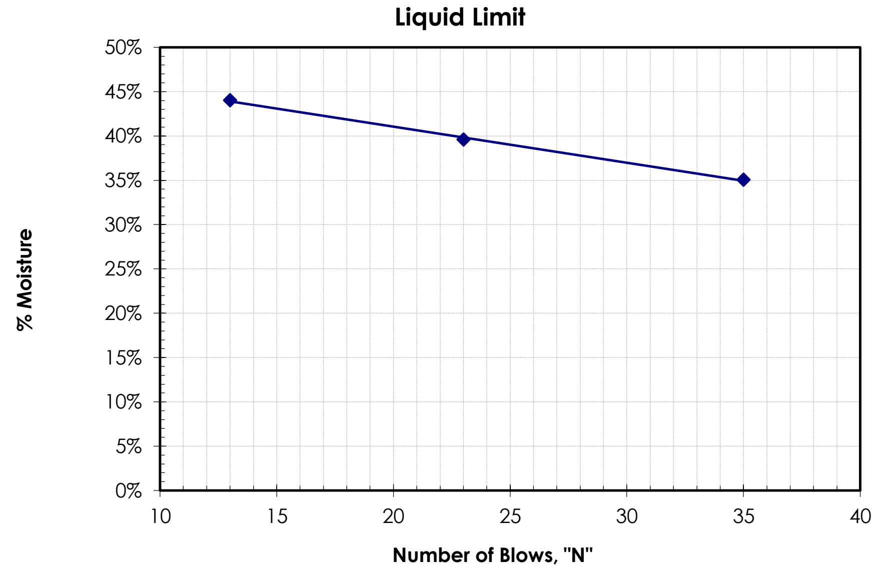
Checked By:

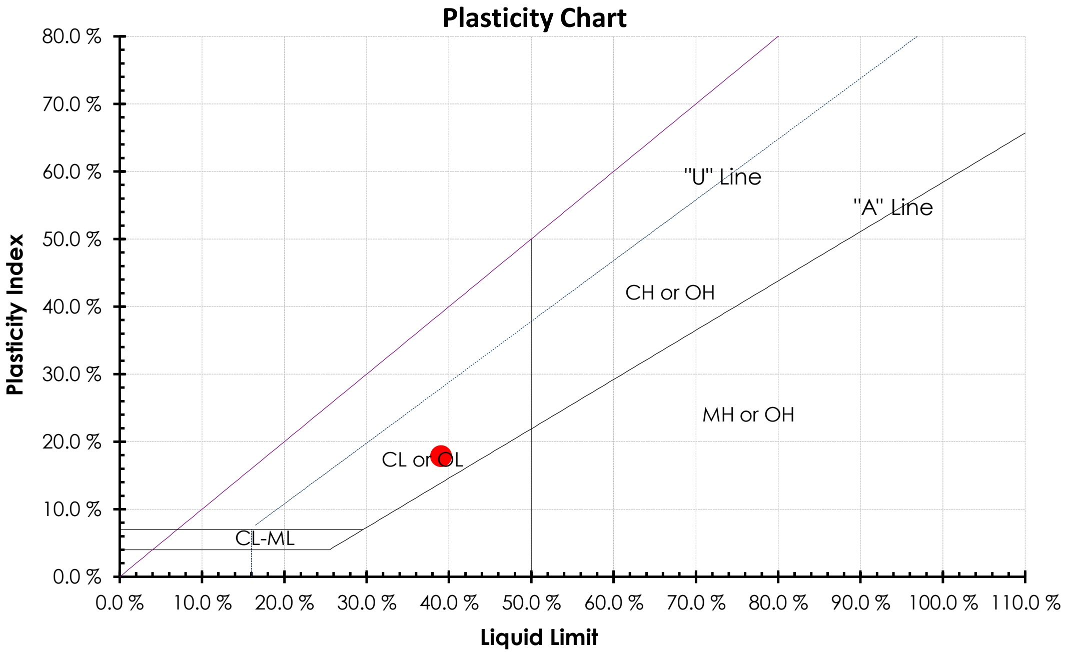
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	41.0
Liquid Limit:	39%	**Plastic Limit:**	21%
Plasticity Index :	18%	**Classification Group:**	CL, Lean Clay





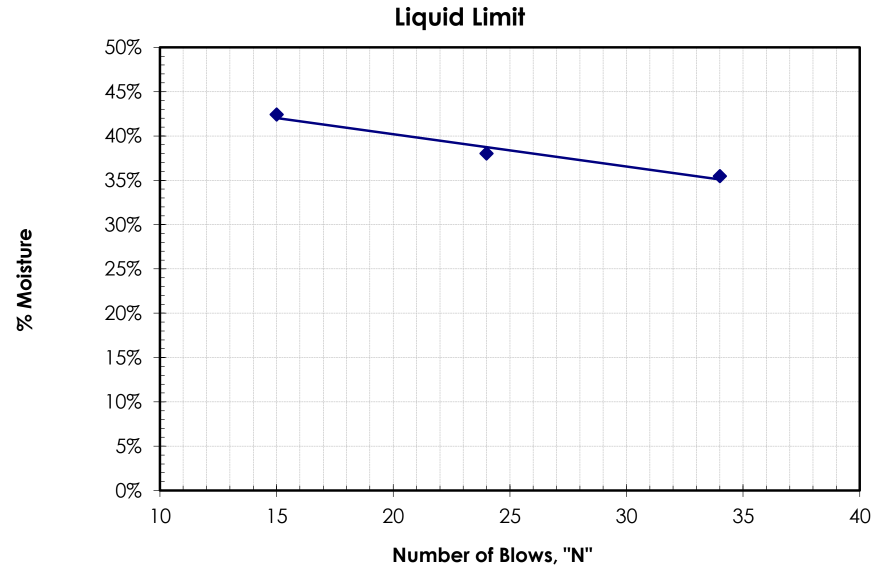
Tested By:

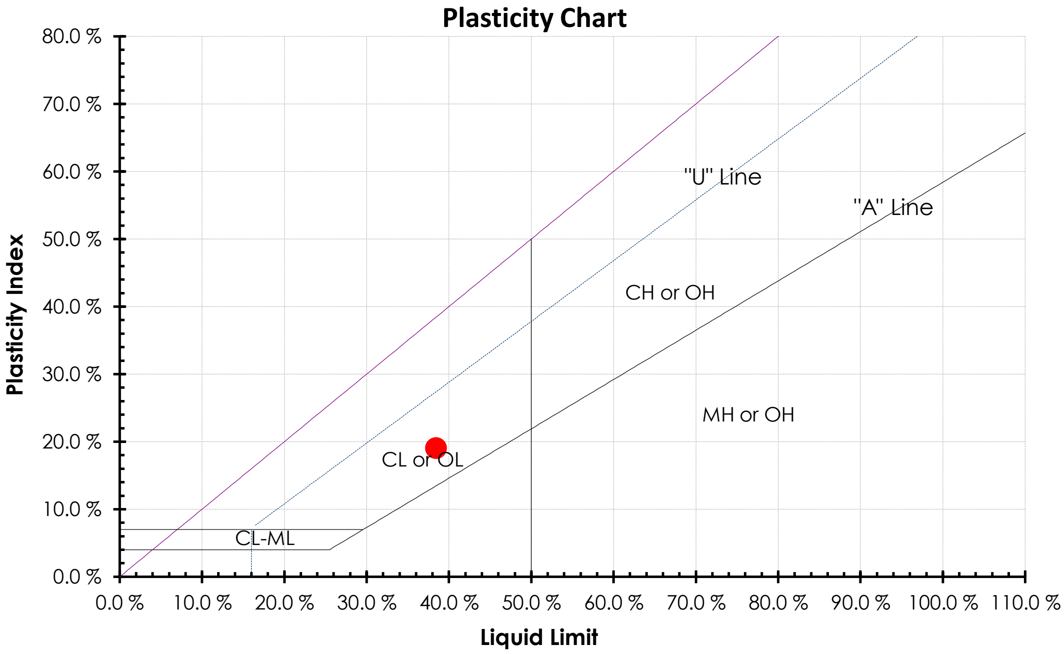
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-03	**Depth (m):**	62.0
Liquid Limit:	38%	**Plastic Limit:**	19%
Plasticity Index :	19%	**Classification Group:**	CL, Lean Clay





Tested By:

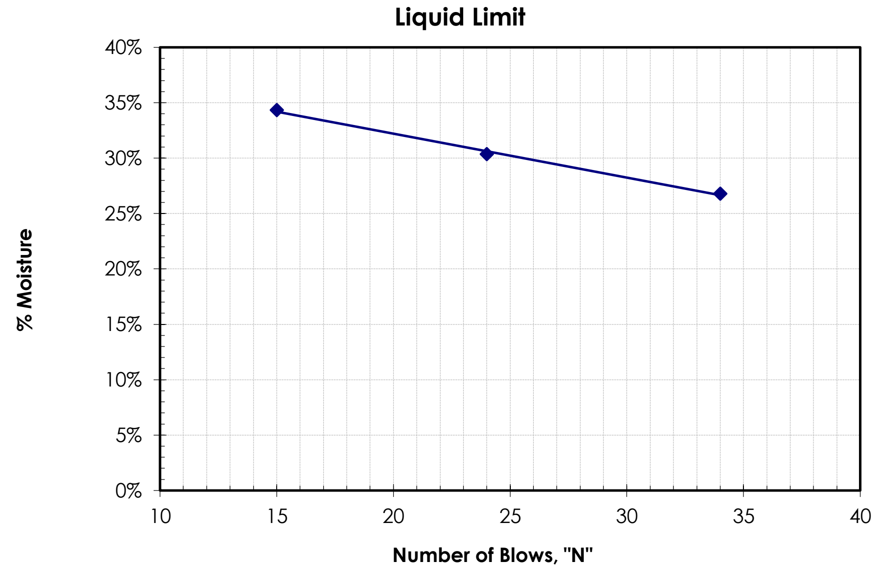
Checked By:

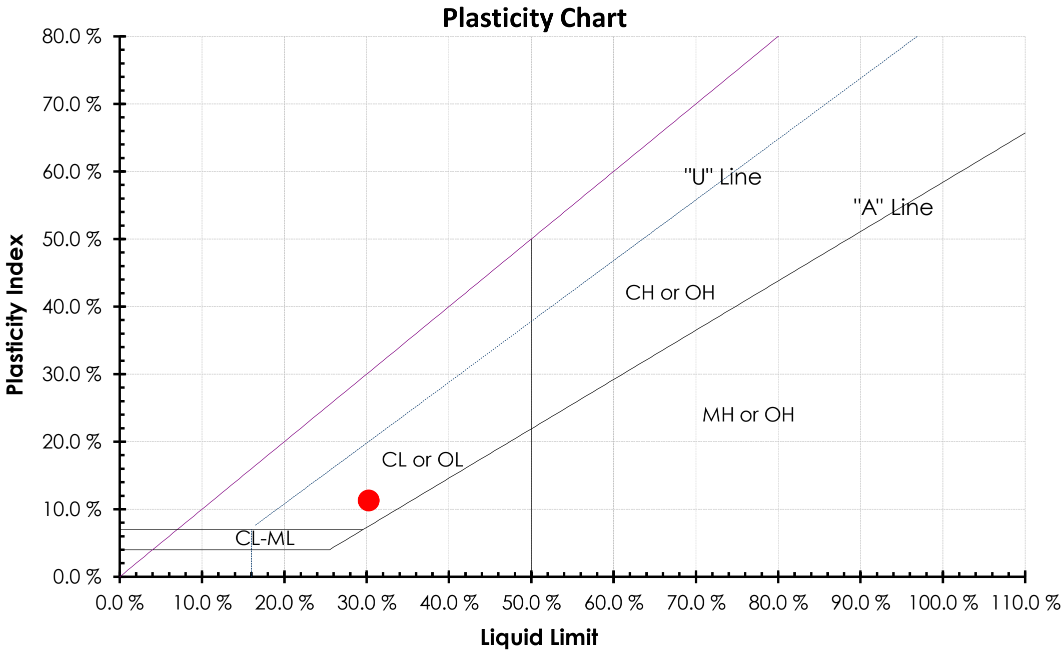
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	15.0
Liquid Limit:	30%	**Plastic Limit:**	19%
Plasticity Index :	11%	**Classification Group:**	CL, Lean Clay





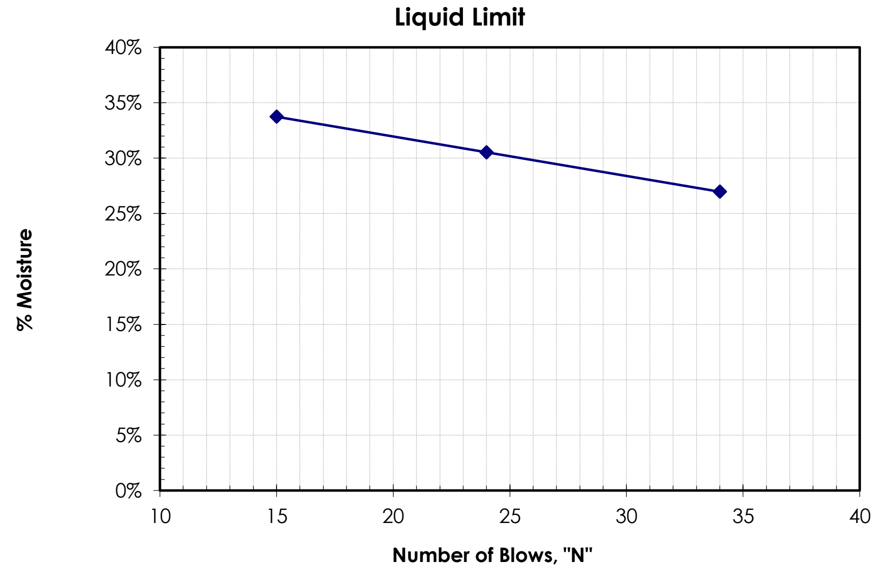
Tested By:

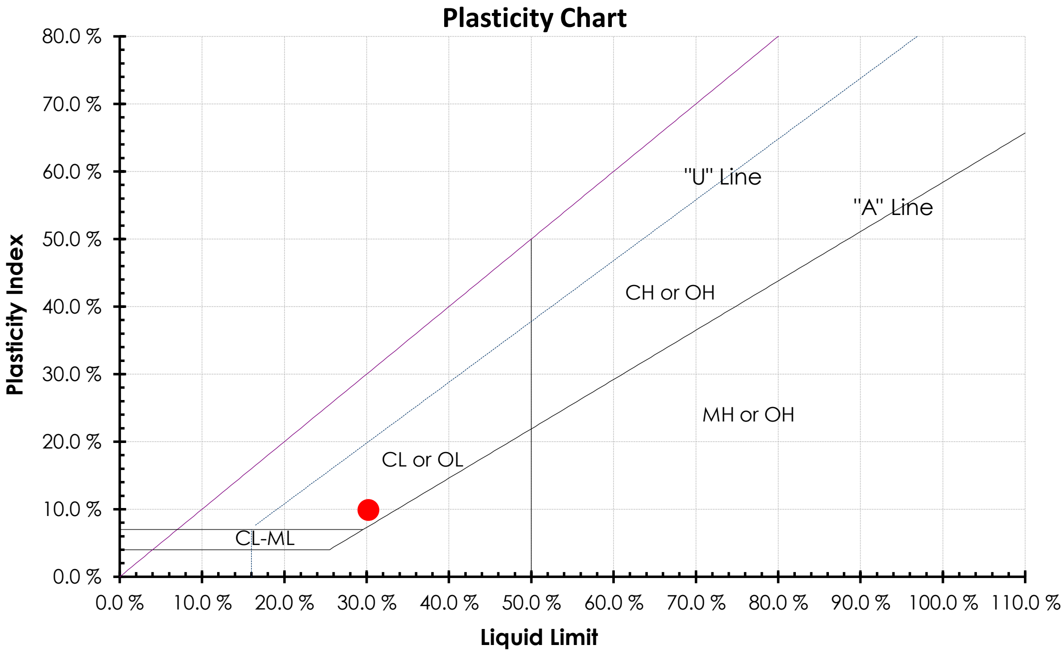
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	18.0
Liquid Limit:	30%	**Plastic Limit:**	20%
Plasticity Index :	10%	**Classification Group:**	CL, Lean Clay





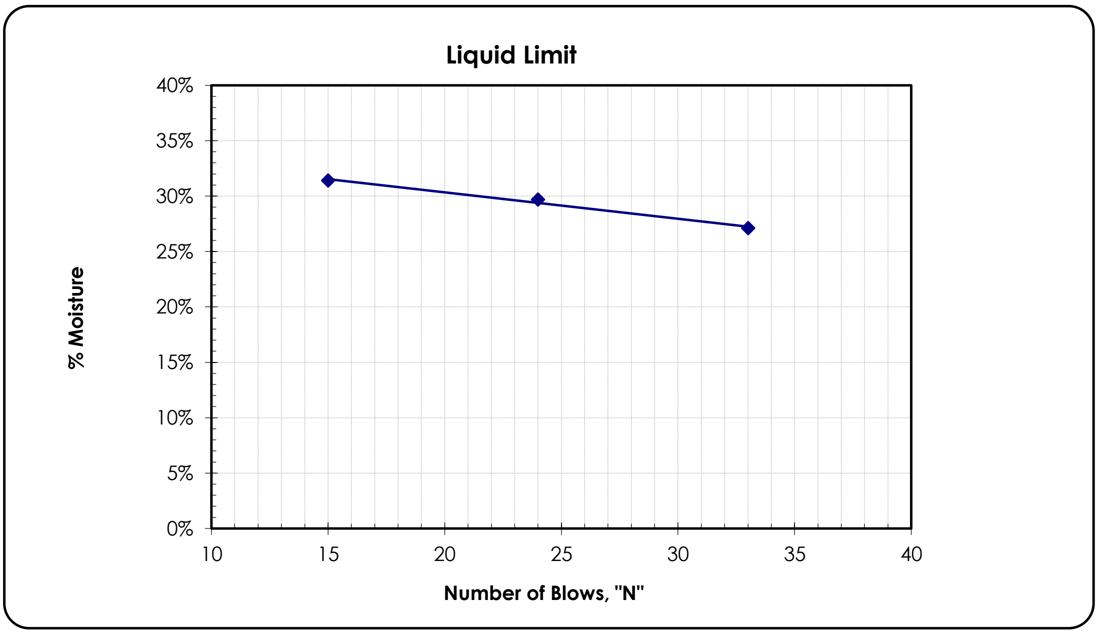
Tested By:

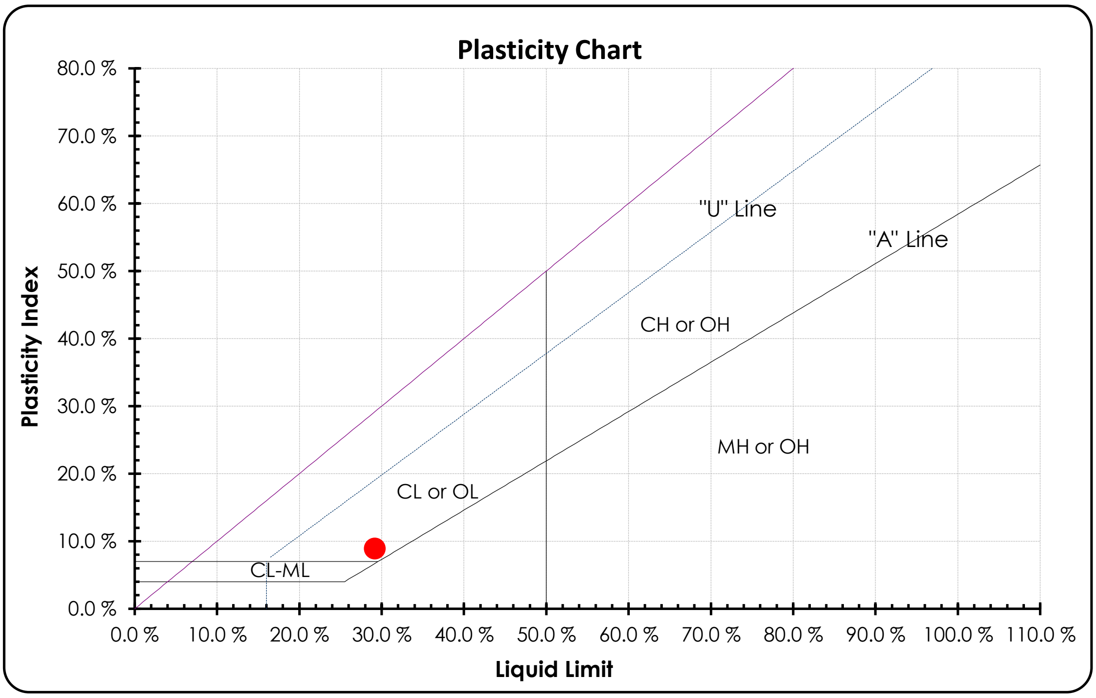
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	23.0
Liquid Limit:	29%	**Plastic Limit:**	20%
Plasticity Index :	9%	**Classification Group:**	CL, Lean Clay with Sand





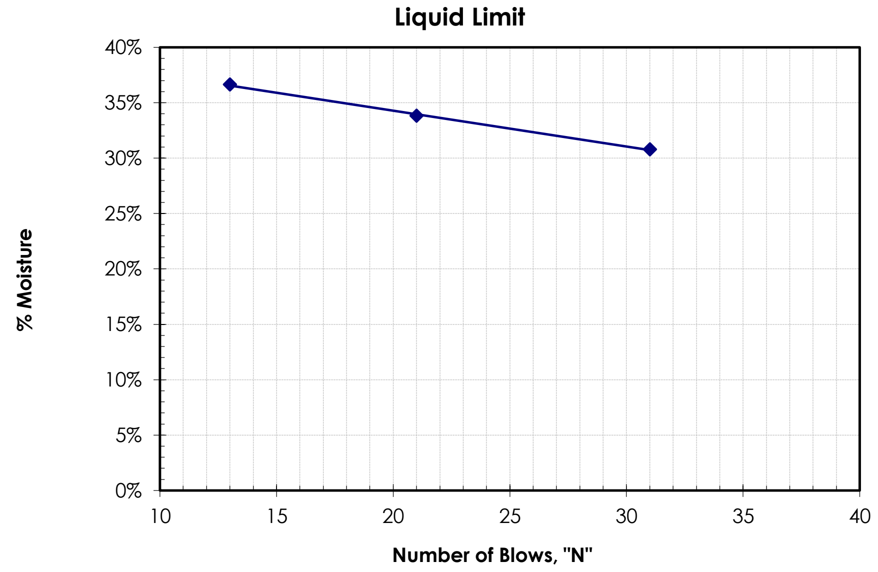
Tested By:

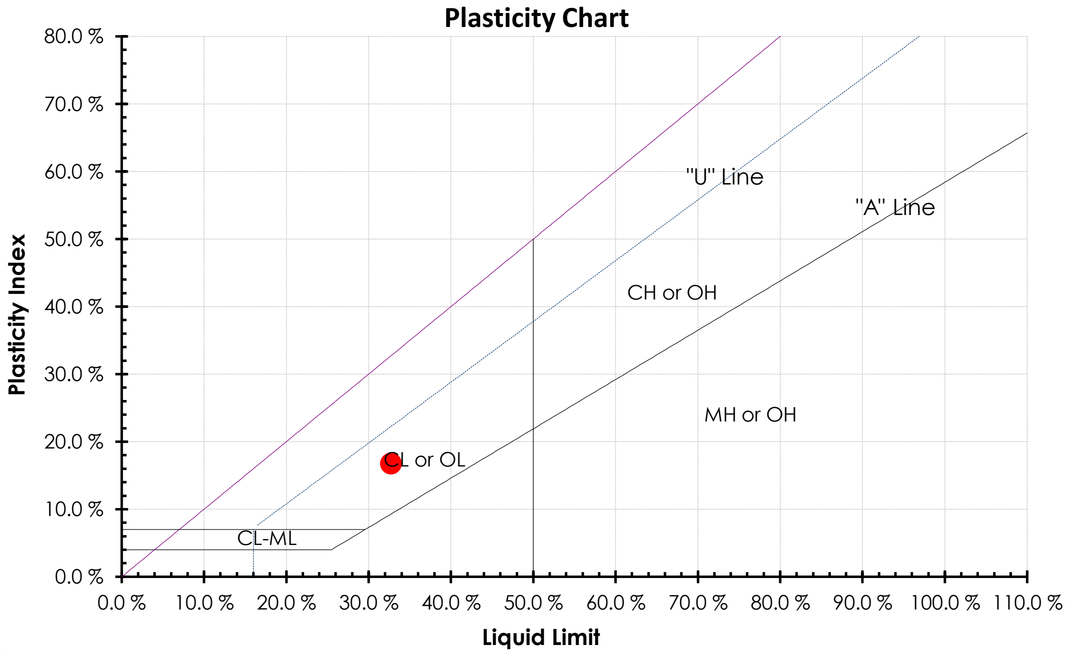
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	29.0
Liquid Limit:	33%	**Plastic Limit:**	16%
Plasticity Index :	17%	**Classification Group:**	CL, Lean Clay





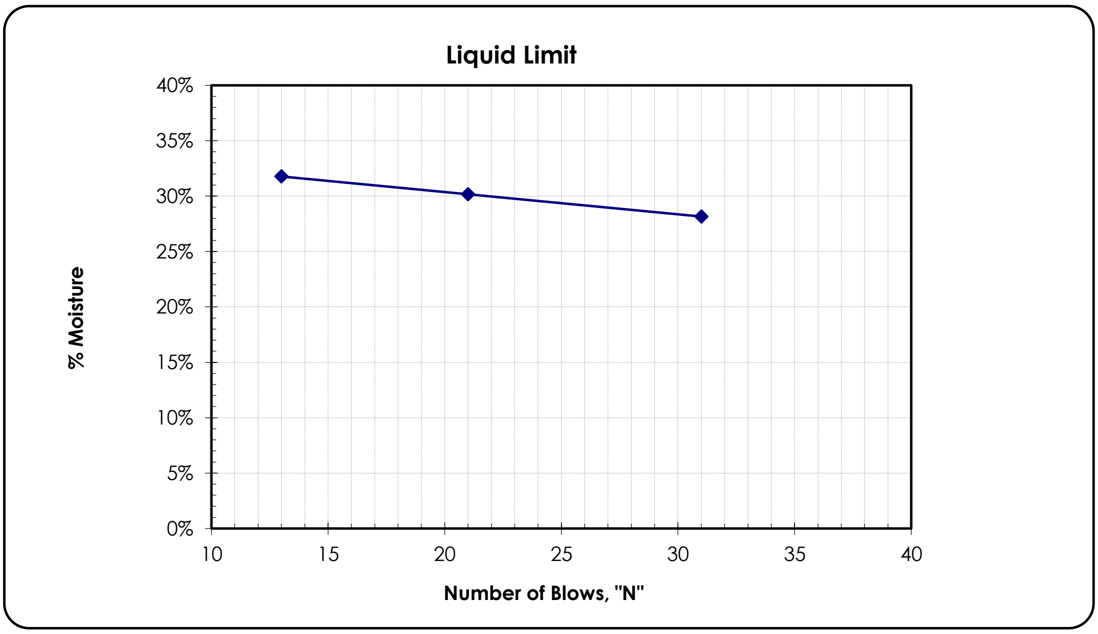
Tested By:

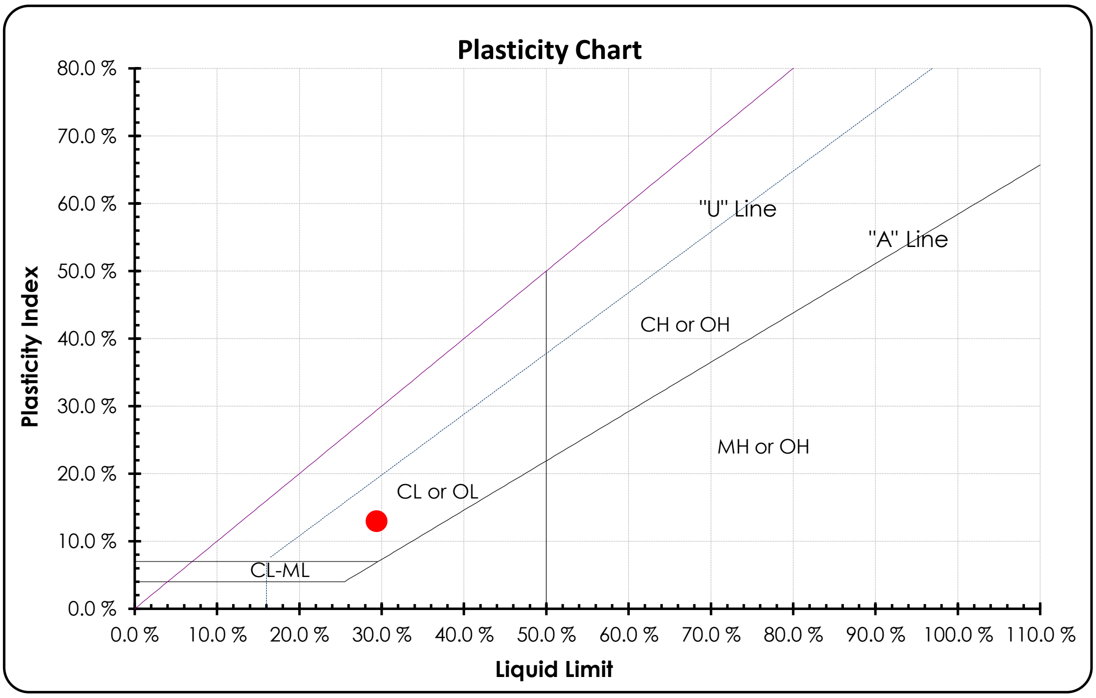
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	32.0
Liquid Limit:	29%	**Plastic Limit:**	16%
Plasticity Index :	13%	**Classification Group:**	CL, Lean Clay





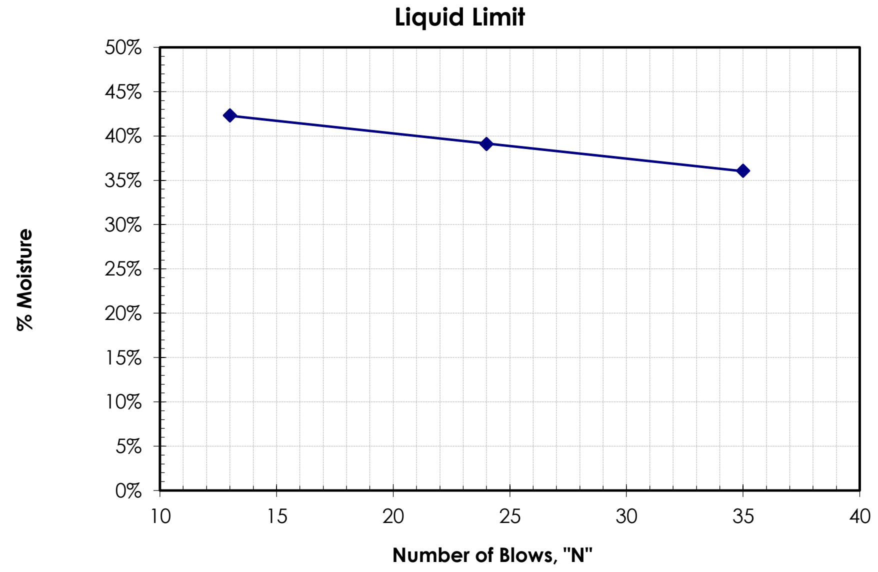
Tested By:

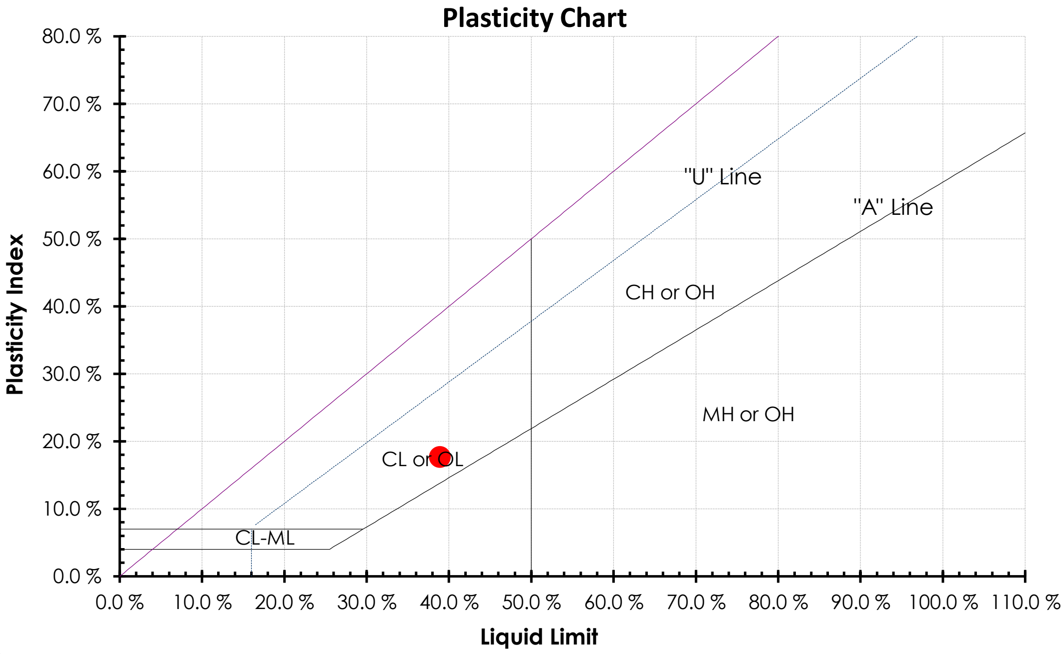
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-04	**Depth (m):**	52.0
Liquid Limit:	39%	**Plastic Limit:**	21%
Plasticity Index :	18%	**Classification Group:**	CL, Lean Clay





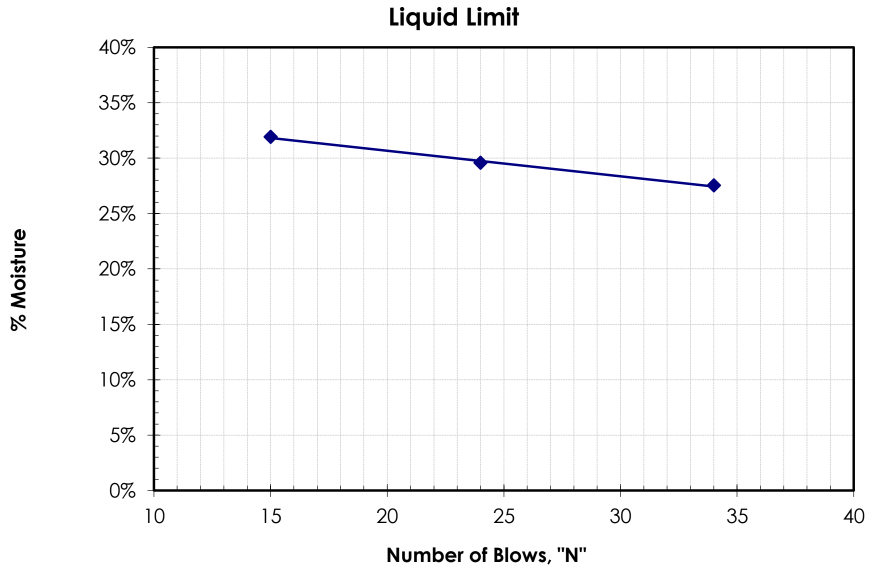
Tested By:

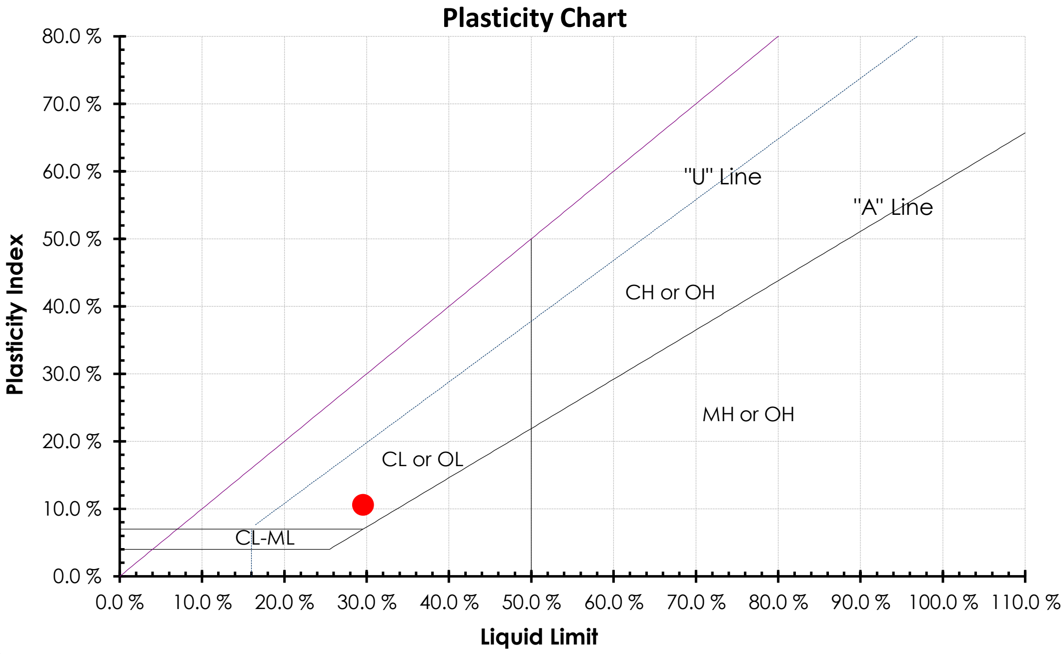
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-05	**Depth (m):**	15.0
Liquid Limit:	30%	**Plastic Limit:**	19%
Plasticity Index :	11%	**Classification Group:**	CL, Lean Clay





Tested By:

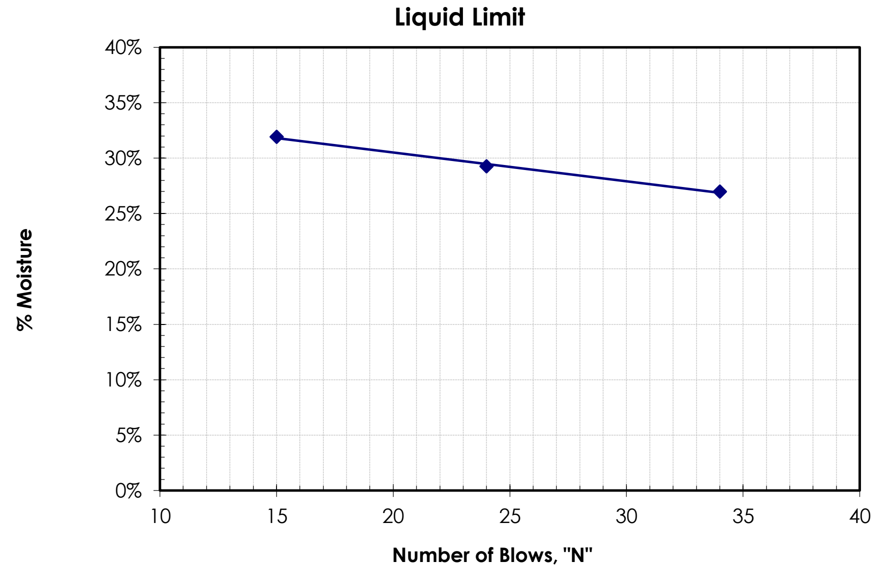
Checked By:

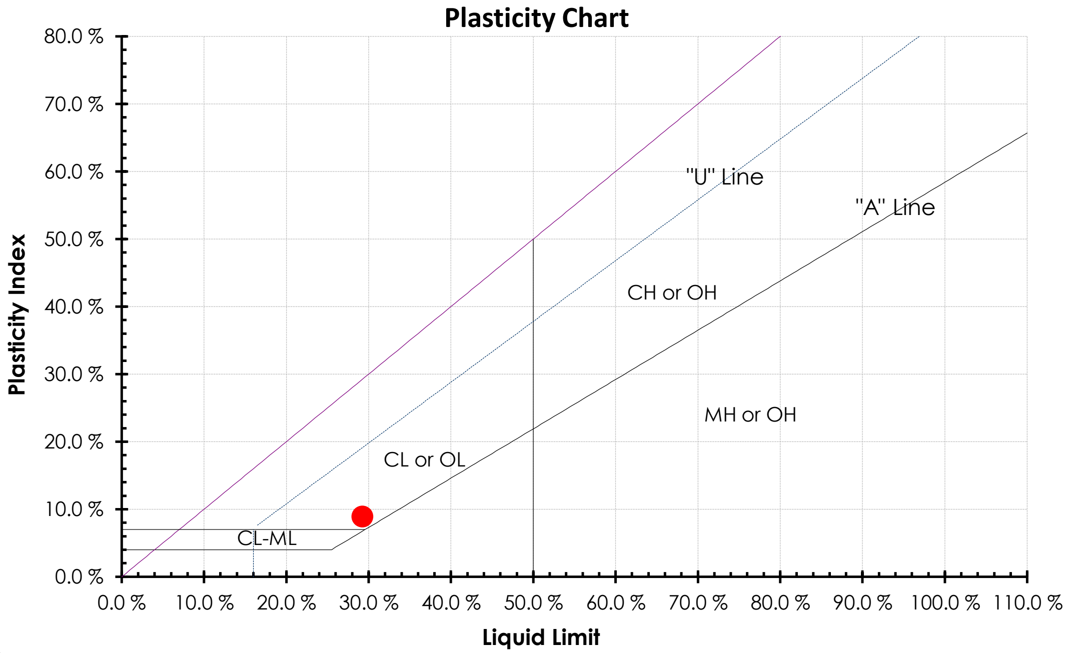
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-05	**Depth (m):**	17.0
Liquid Limit:	29%	**Plastic Limit:**	20%
Plasticity Index :	9%	**Classification Group:**	CL, Lean Clay





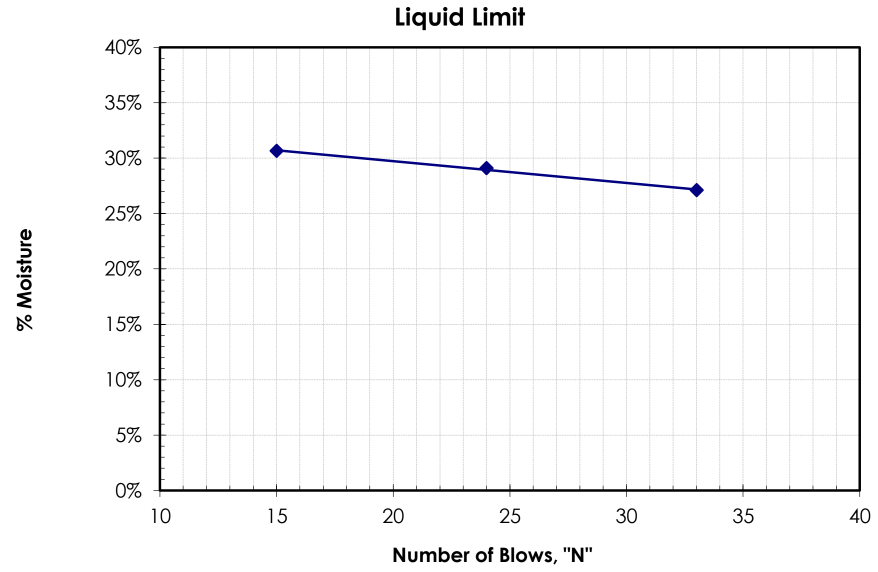
Tested By:

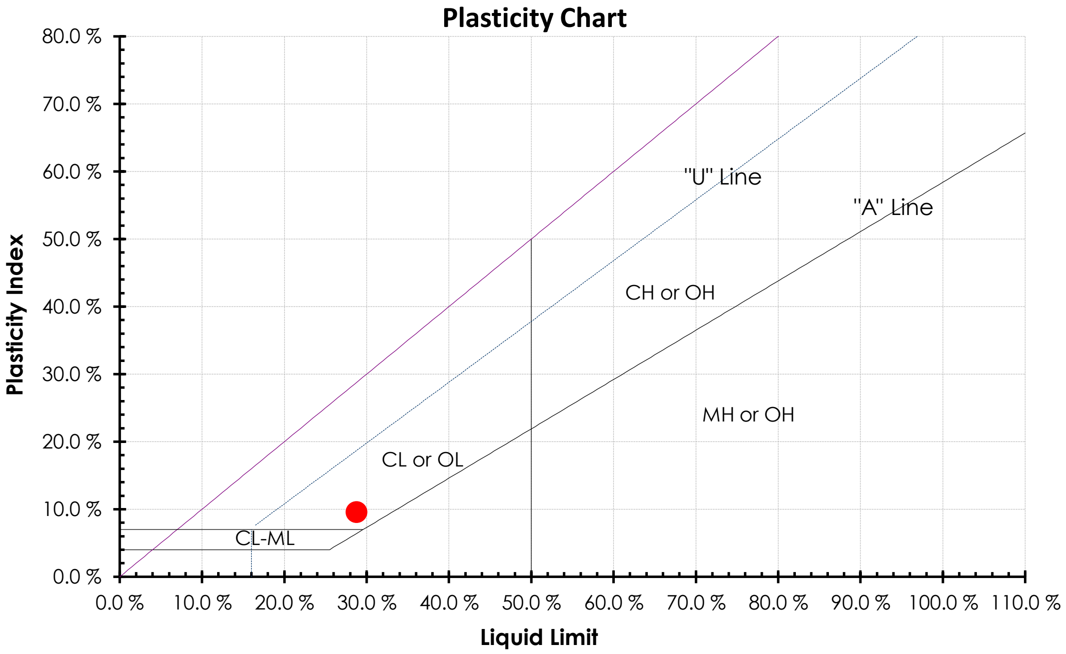
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-05	**Depth (m):**	21.0
Liquid Limit:	29%	**Plastic Limit:**	19%
Plasticity Index :	10%	**Classification Group:**	CL, Lean Clay with Sand





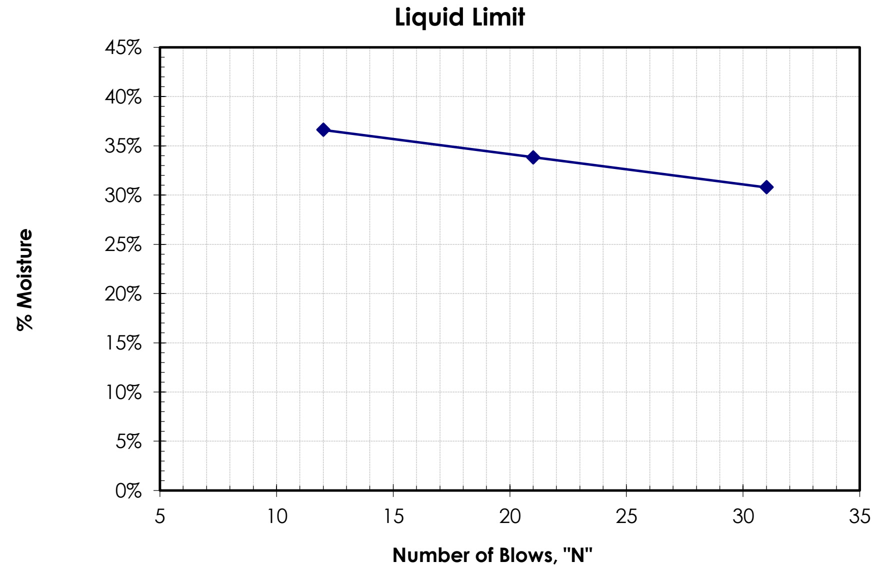
Tested By:

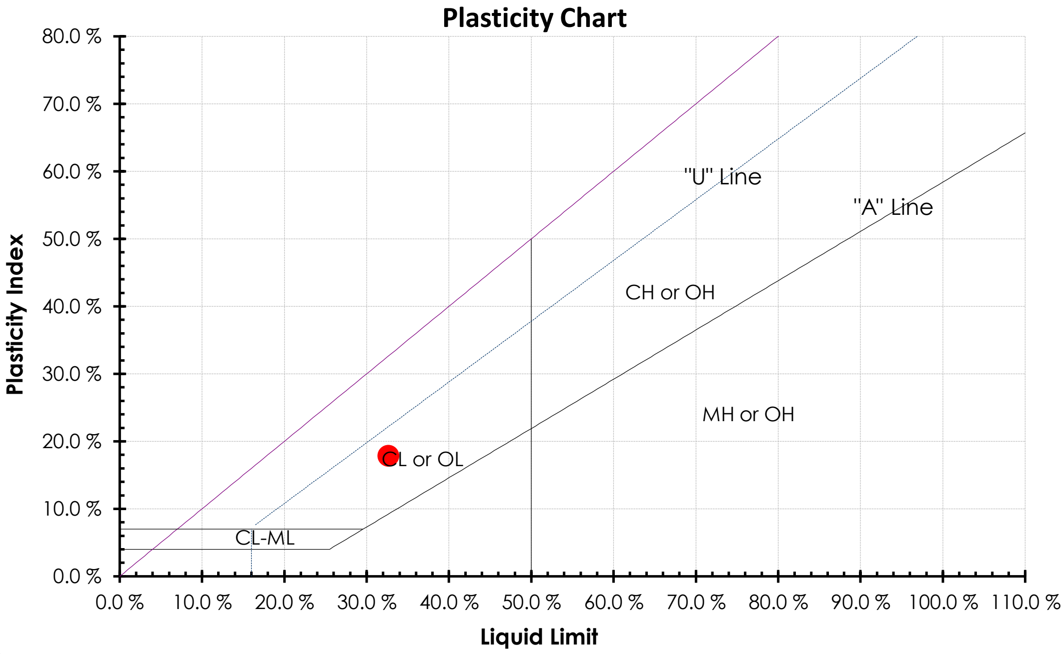
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-05	**Depth (m):**	25.0
Liquid Limit:	33%	**Plastic Limit:**	15%
Plasticity Index :	18%	**Classification Group:**	CL, Lean Clay





Tested By:

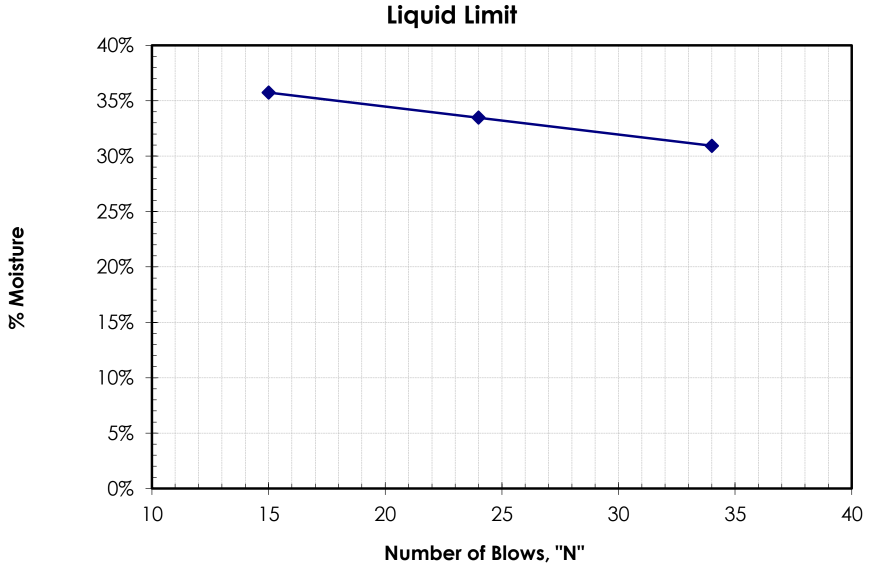
Checked By:

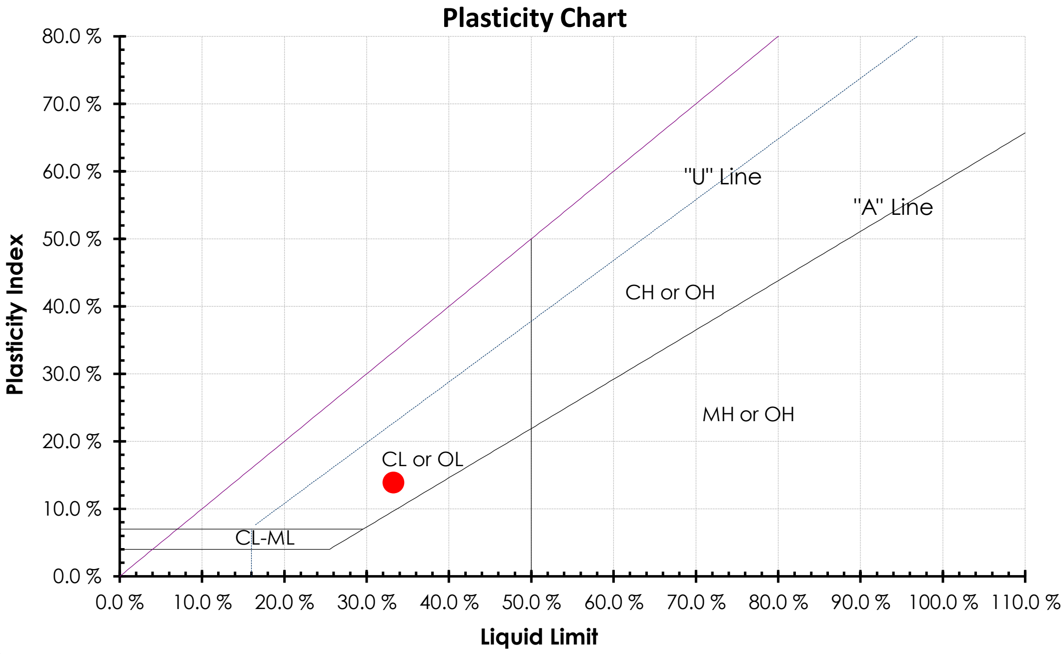
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	12.0
Liquid Limit:	33%	**Plastic Limit:**	19%
Plasticity Index :	14%	**Classification Group:**	CL, Lean Clay with Sand





Tested By:

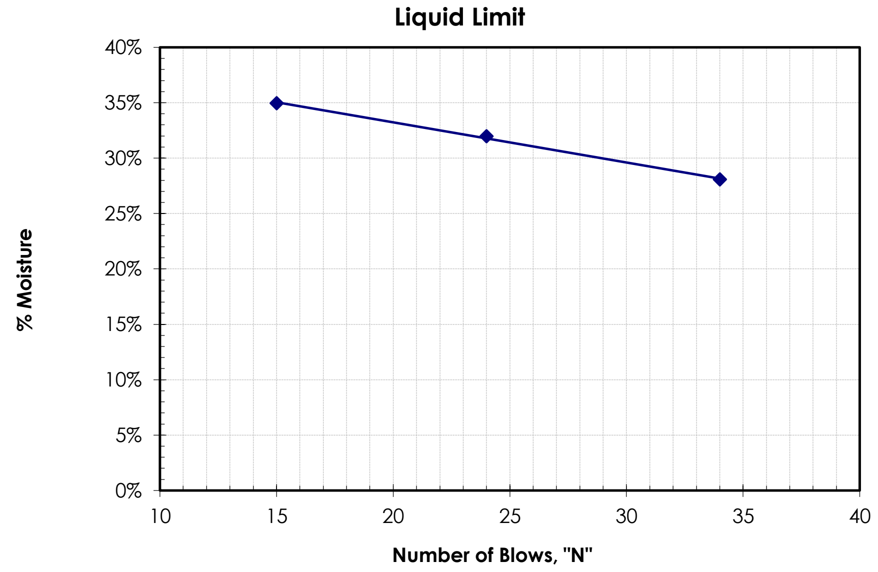
Checked By:

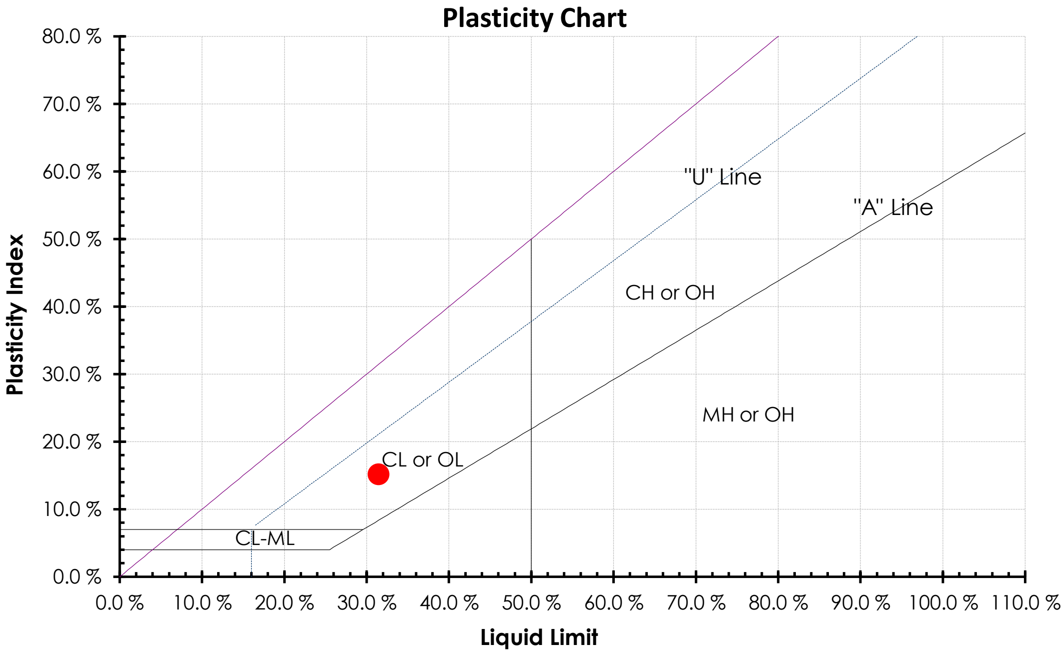
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	17.0
Liquid Limit:	31%	**Plastic Limit:**	16%
Plasticity Index :	15%	**Classification Group:**	CL, Lean Clay





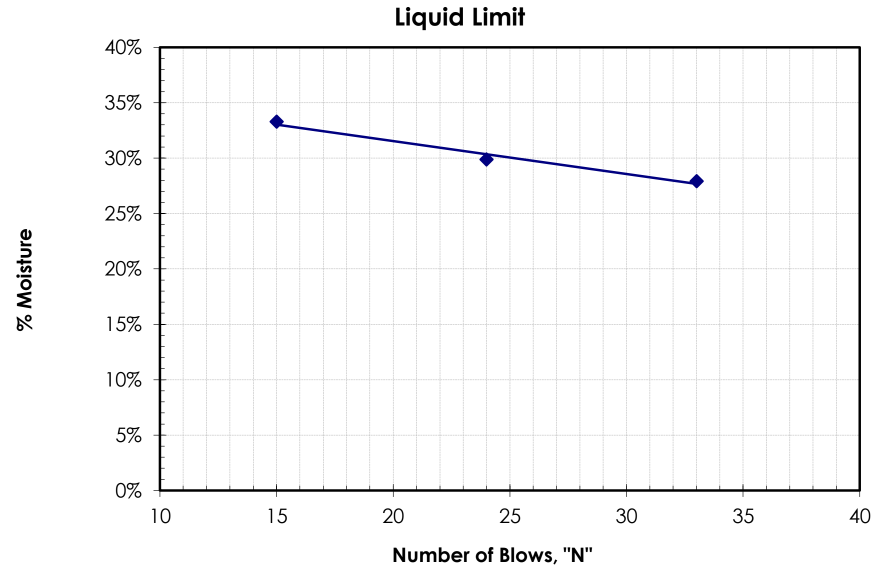
Tested By:

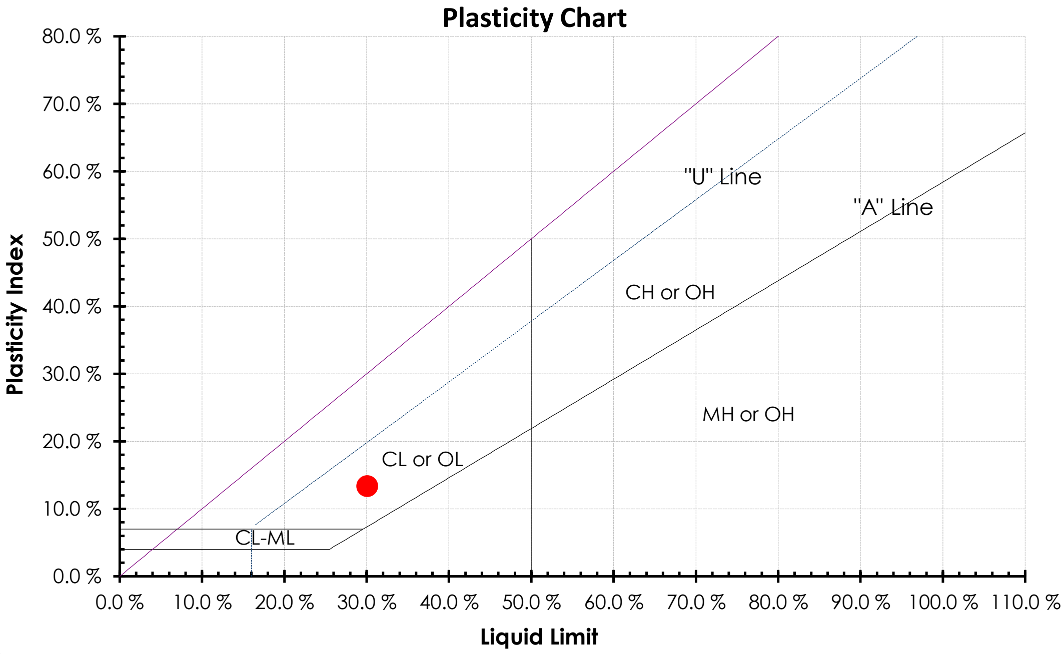
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	21.0
Liquid Limit:	30%	**Plastic Limit:**	17%
Plasticity Index :	13%	**Classification Group:**	CL, Lean Clay





Tested By:

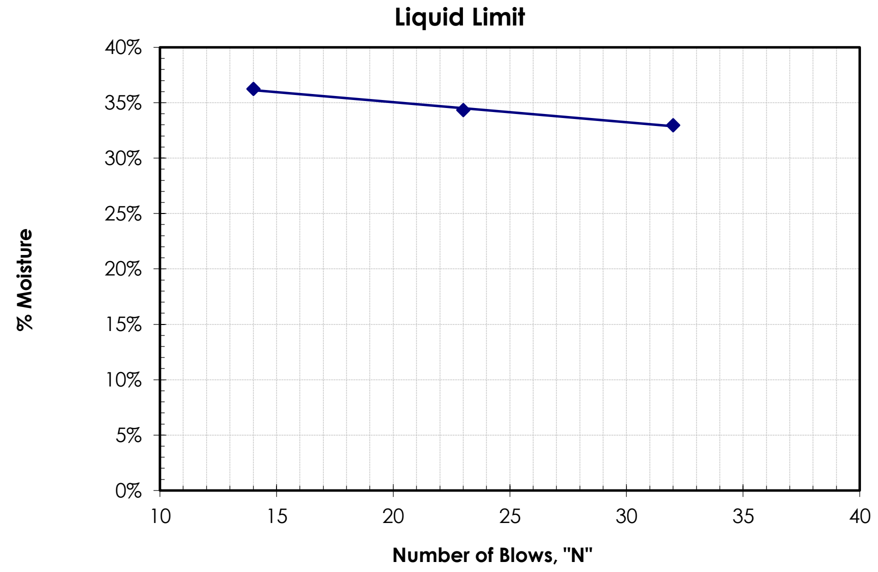
Checked By:

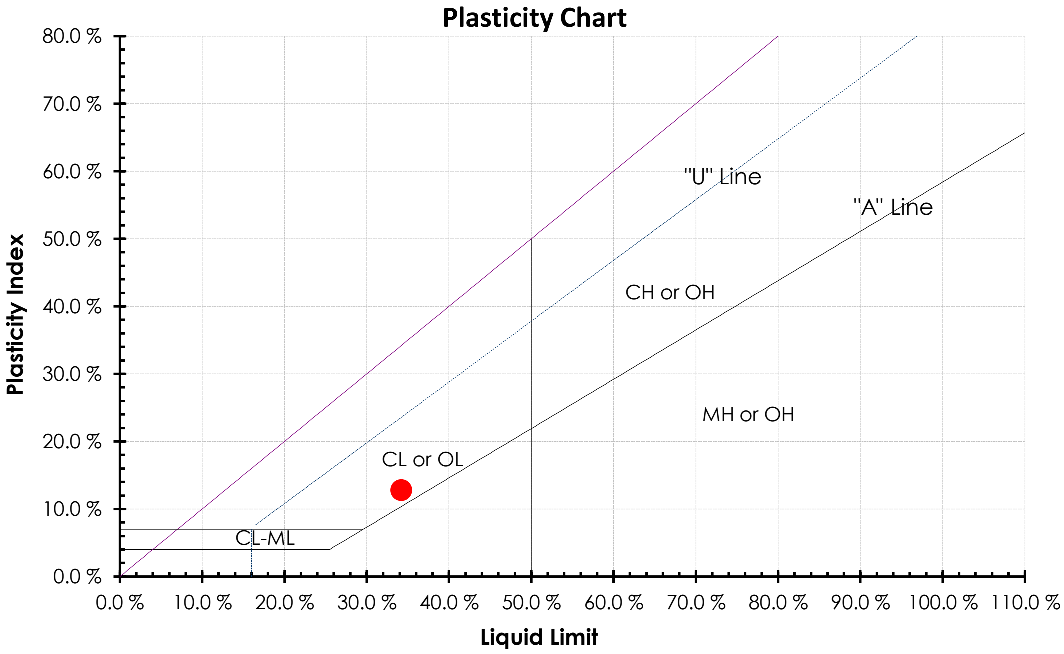
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	28.0
Liquid Limit:	34%	**Plastic Limit:**	21%
Plasticity Index :	13%	**Classification Group:**	CL, Lean Clay





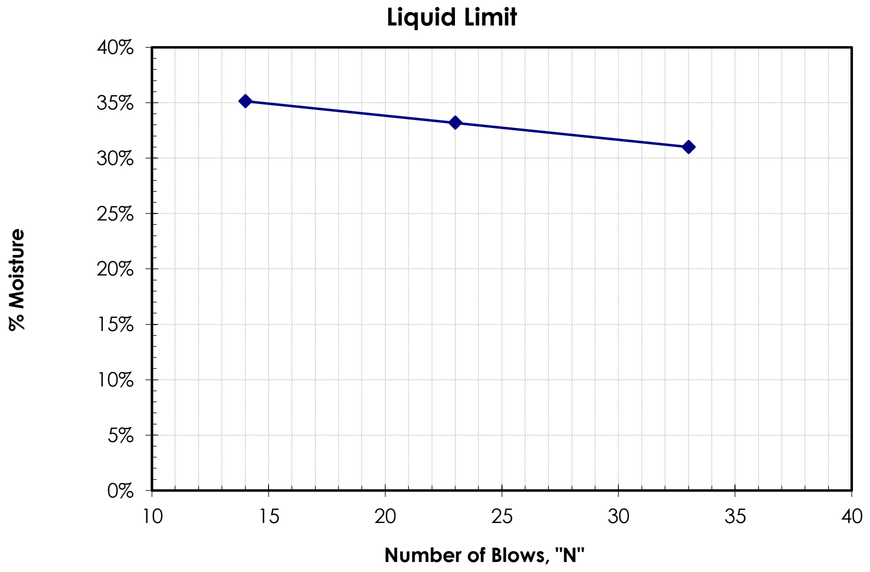
Tested By:

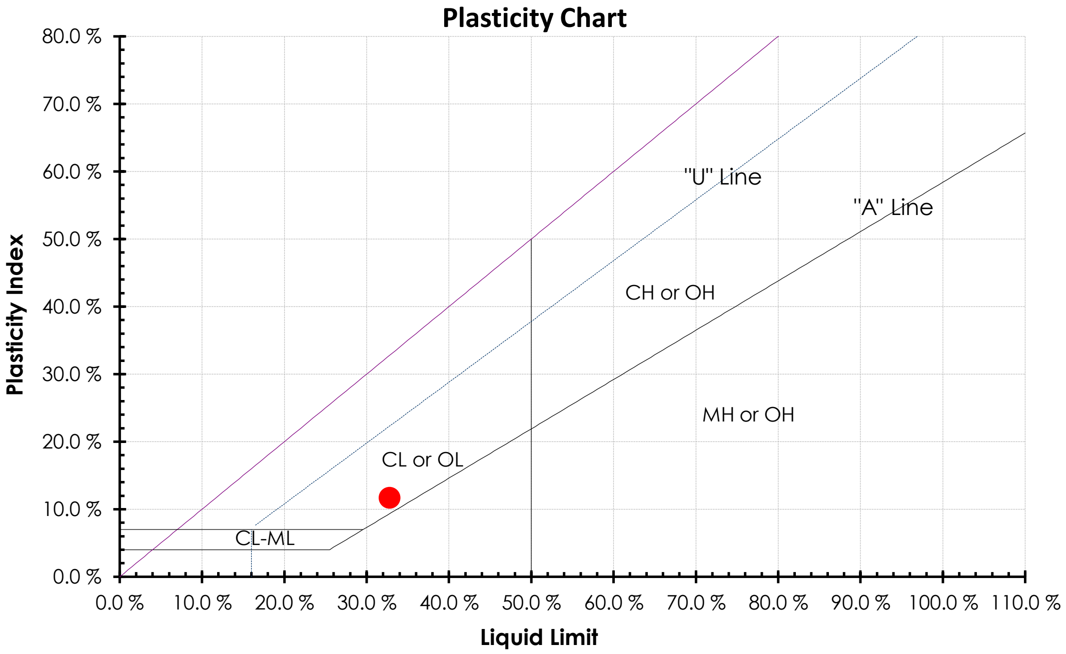
Checked By:

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	36.0
Liquid Limit:	33%	**Plastic Limit:**	21%
Plasticity Index :	12%	**Classification Group:**	CL, Lean Clay





Tested By:

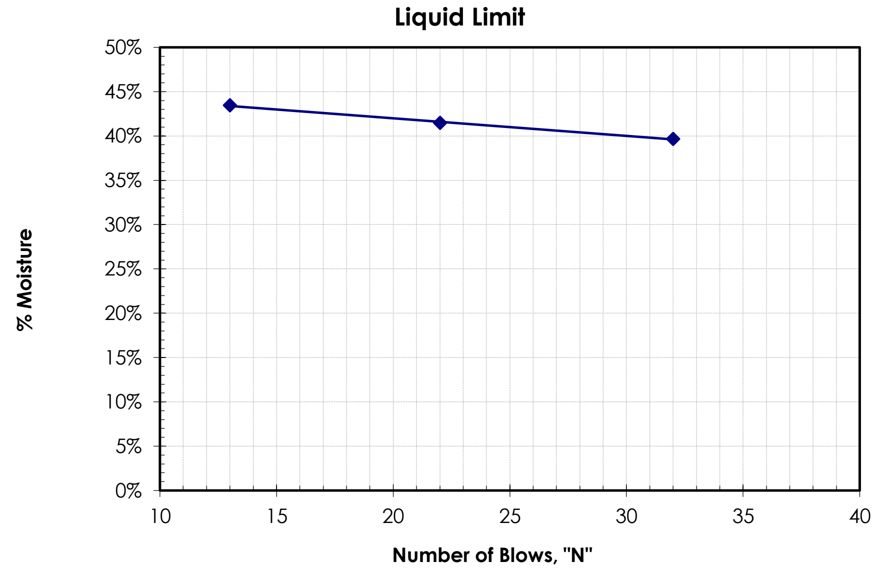
Checked By:

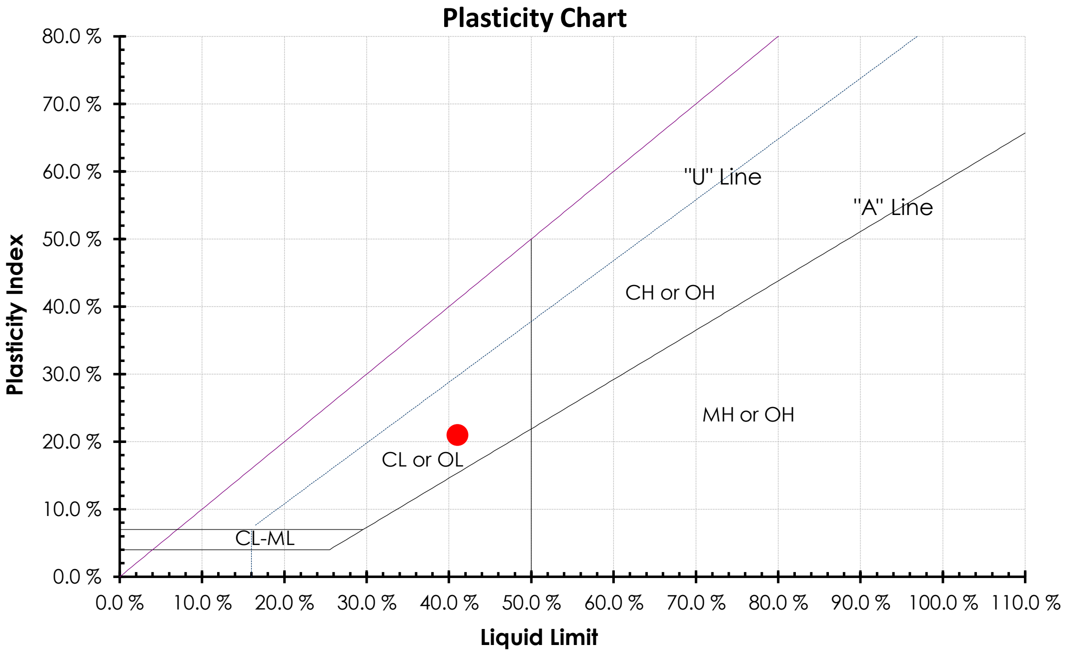
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	53.0
Liquid Limit:	41%	**Plastic Limit:**	20%
Plasticity Index :	21%	**Classification Group:**	CL, Lean Clay





Tested By:

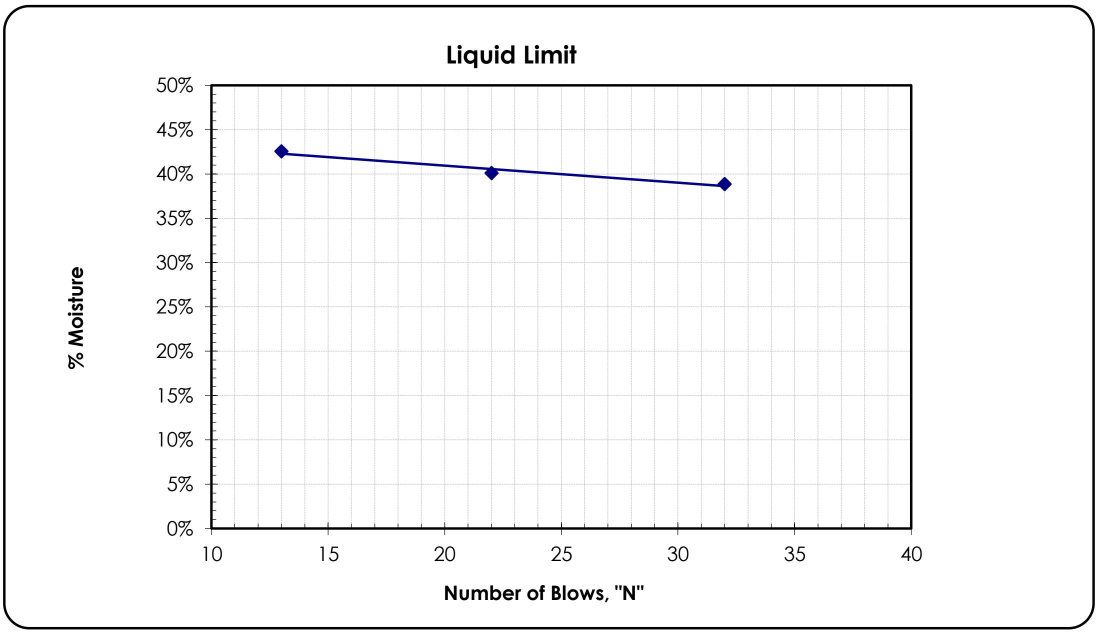
Checked By:

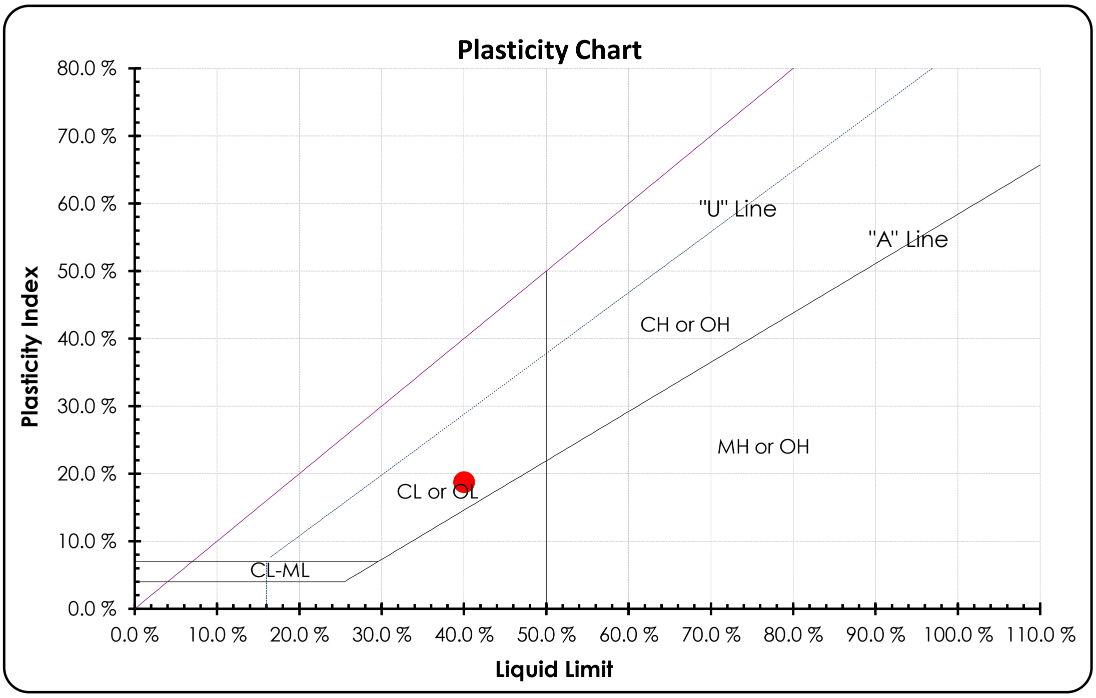
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	65.0
Liquid Limit:	40%	**Plastic Limit:**	21%
Plasticity Index :	19%	**Classification Group:**	CL, Gravelly Lean Clay





Tested By:

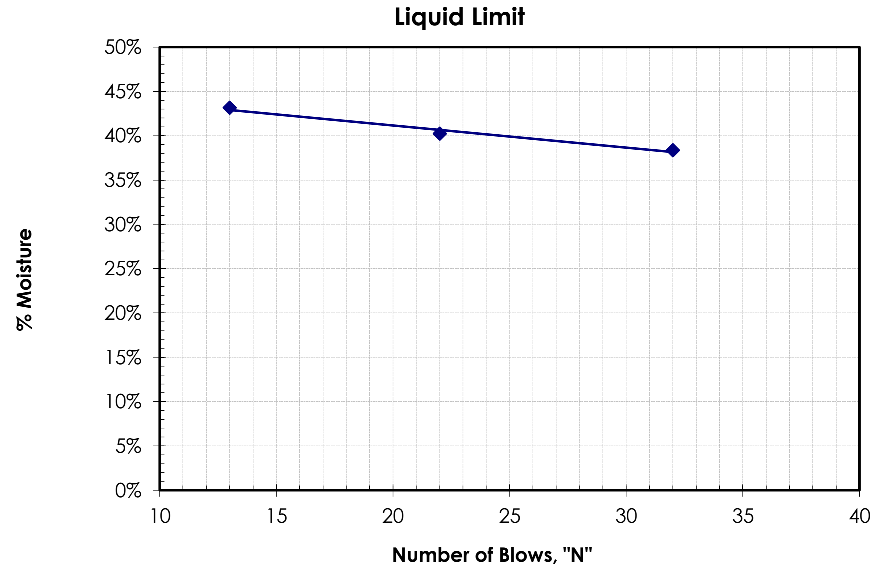
Checked By:

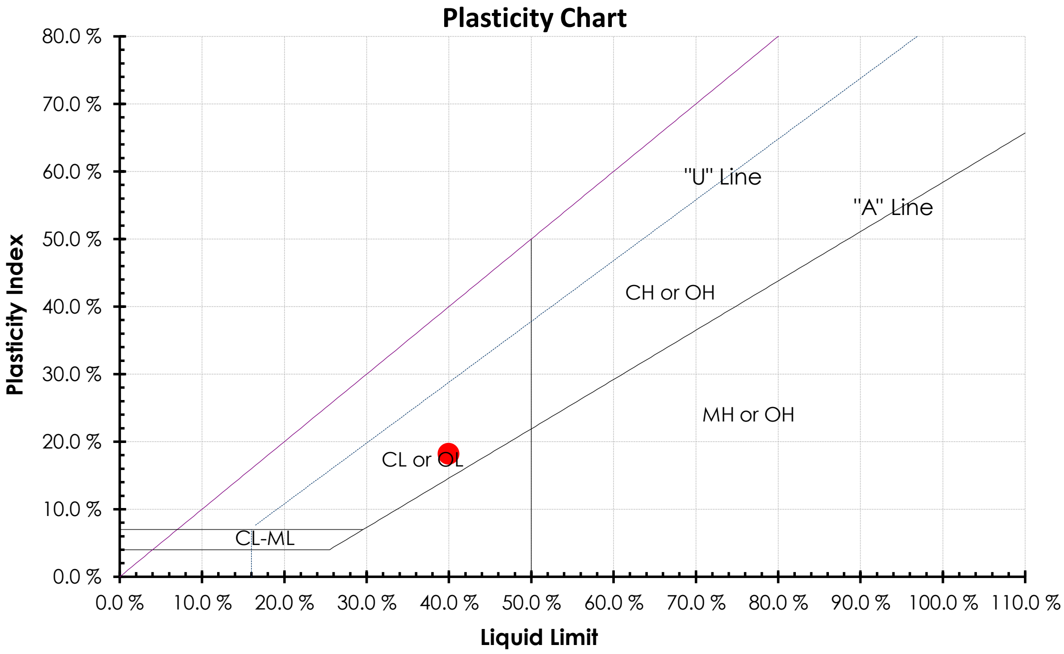
AJK Engineers

ATTERBURG LIMITS

ASTM D-4318

Project:	Geotechnical Investigation - The Courtyard Residence		
Location:	Street No. 73, Sector F-11/1, Islamabad.		
Client:	The Courtyard		
Borehole No.	BH-06	**Depth (m):**	68.0
Liquid Limit:	40%	**Plastic Limit:**	22%
Plasticity Index :	18%	**Classification Group:**	CL, Lean Clay





Tested By:

Checked By:

UNCONFINED COMPRESSION TEST

CLIENT	CONSULTANT	CONTRACTOR
The Courtyard	-	M/S AJK Engineers(Pvt) Ltd

Project	Geotechnical Investigations - The Courtyard Residence, F-11/1, Islamabad	**decon** **Geotechnical Testing Laboratory**
Location	-	

BH / TP No.	BH-03	**Job No.**	-
Sample No.	UDS-01	**Lab No.**	935
Sample Depth (m)	15.00	**Test Started**	November 5, 2024
Sampled Date	-	**Test Completed**	November 6, 2024

UNCONFINED COMPRESSION TEST (ASTM D 2166)

Details	Initial	Final	
Specimen Dia (cm)	5.00	5.18	Proving Ring No. N24887
Specimen Area (cm^2)	19.63	21.06	Proving Ring Factor 0.134
Specimen Height (cm)	10.00	9.32	
Specimen Volume (cm^3)	196.35	196.35	Average Rate of Strain 1.00 % per min
Weight of Specimen (g)	374.00		
Bulk Density of Soil (g/cm^3)	1.905		
Dry Density of Soil (g/cm^3)	1.597		

Determination of Moisture Content

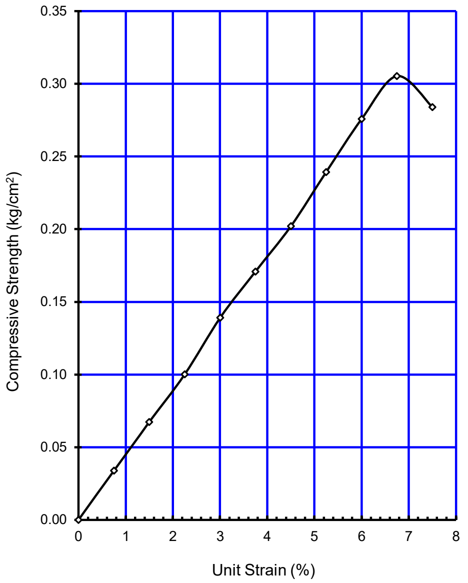
Container No.	C-149	C-18
Weight of Container (g)	22.74	26.55
Weight of Container + Wet Sample (g)	158.66	176.29
Weight of Container + Dry Sample (g)	136.71	152.02
Weight of Dry Soil (g)	113.97	125.47
Weight of Water (g)	21.95	24.27
Moisture Content (%)	19.26	19.34
Average Moisture Content (%)	19.30	

Failure Sketches

Rear **Front**

Determination of Stess and Strain

Strain Dial Reading	Unit Strain (%)	Load Dial Reading	Axial Load (kg)	Corrected Area (cm^2)	Compressive Strength (kg/cm^2)
0	0.00	0	0.00	19.63	0.00
75	0.75	5	0.67	19.78	0.03
150	1.50	10	1.34	19.93	0.07
225	2.25	15	2.01	20.09	0.10
300	3.00	21	2.81	20.24	0.14
375	3.75	26	3.48	20.40	0.17
450	4.50	31	4.15	20.56	0.20
525	5.25	37	4.96	20.72	0.24
600	6.00	43	5.76	20.89	0.28
675	6.75	48	6.43	21.06	0.31
750	7.50	45	6.03	21.23	0.28



Compressive Strength	**0.31** kg/cm^2	Strain	**6.75** %

Tested By	Checked By	Approved By
Imran Ali	-	Shahzaib Khalid

Shahzaib

FIRM decon International (Pvt) Ltd.

CLIENT	**CONSULTANT**	**CONTRACTOR**
The Courtyard	-	M/S AJK Engineers(Pvt) Ltd

Project	Geotechnical Investigations - The Courtyard Residence, F-11/1, Islamabad	**decon** **Geotechnical Testing Laboratory**
Location	-	

BH / TP No.	BH-03	**Job No.**	-
Sample No.	UDS-02	**Lab No.**	935
Sample Depth (m)	50.00	**Test Started**	November 5, 2024
Sampled Date	-	**Test Completed**	November 6, 2024

UNCONFINED COMPRESSION TEST (ASTM D 2166)

Details	**Initial**	**Final**
Specimen Dia (cm)	7.00	7.24
Specimen Area (cm^2)	38.48	41.13
Specimen Height (cm)	14.00	13.10
Specimen Volume (cm^3)	538.78	538.78
Weight of Specimen (g)	1029.00	
Bulk Density of Soil (g/cm^3)	1.910	
Dry Density of Soil (g/cm^3)	1.624	

Proving Ring No.	N24887
Proving Ring Factor	0.134
Average Rate of Strain	1.00 % per min

Determination of Moisture Content

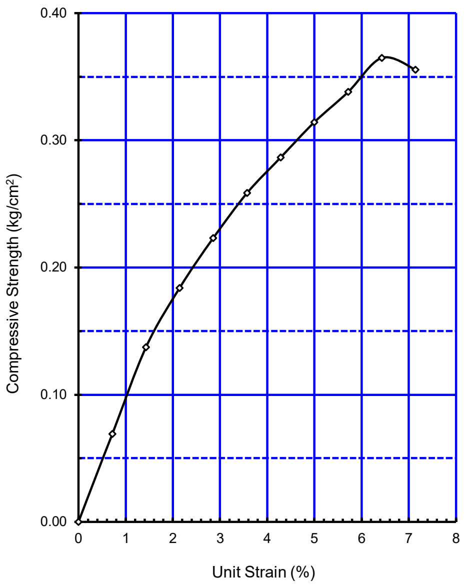
Container No.	C-253	C-172
Weight of Container (g)	24.45	31.79
Weight of Container + Wet Sample (g)	164.12	151.12
Weight of Container + Dry Sample (g)	143.18	133.27
Weight of Dry Soil (g)	118.73	101.48
Weight of Water (g)	20.94	17.85
Moisture Content (%)	17.64	17.59
Average Moisture Content (%)	17.61	

Failure Sketches

Rear **Front**

Determination of Stess and Strain

Strain Dial Reading	Unit Strain (%)	Load Dial Reading	Axial Load (kg)	Corrected Area (cm^2)	Compressive Strength (kg/cm^2)
0	0.00	0	0.00	38.48	0.00
100	0.71	20	2.68	38.76	0.07
200	1.43	40	5.36	39.04	0.14
300	2.14	54	7.24	39.33	0.18
400	2.86	66	8.84	39.62	0.22
500	3.57	77	10.32	39.91	0.26
600	4.29	86	11.52	40.21	0.29
700	5.00	95	12.73	40.51	0.31
800	5.71	103	13.80	40.82	0.34
900	6.43	112	15.01	41.13	0.36
1000	7.14	110	14.74	41.44	0.36



Compressive Strength	**0.36** kg/cm^2	Strain	**6.43** %

Tested By	**Checked By**	**Approved By**
Imran Ali	-	Shahzaib Khalid

Shahzaib

FIRM decon International (Pvt) Ltd.

CLIENT	CONSULTANT	CONTRACTOR
The Courtyard	-	M/s AJK Engineering Services

Project	Geotechnical Investigation of The Courtyard Residence	**decon** **Geotechnical Testing Laboratory**
Location	F-11/1, Islamabad	

BH / TP No.	BH-05	**Job No.**	-
Sample No.	UDS-01	**Lab No.**	935
Sample Depth (m)	14.00	**Test Started**	November 19, 2024
Sampled Date	-	**Test Completed**	November 21, 2024

UNCONFINED COMPRESSION TEST (ASTM D 2166)

Details	Initial	Final	
Specimen Dia (cm)	7.00	7.12	Proving Ring No. N24887
Specimen Area (cm^2)	38.48	39.76	Proving Ring Factor 0.134
Specimen Height (cm)	14.00	13.55	
Specimen Volume (cm^3)	538.78	538.78	Average Rate of Strain 1.00 % per min
Weight of Specimen (g)	1024.00		
Bulk Density of Soil (g/cm^3)	1.901		
Dry Density of Soil (g/cm^3)	1.651		

Determination of Moisture Content

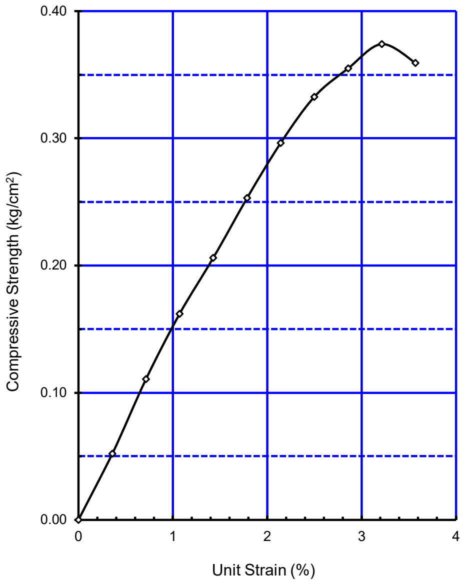
Container No.	C-222	C-189
Weight of Container (g)	28.32	30.51
Weight of Container + Wet Sample (g)	164.21	170.25
Weight of Container + Dry Sample (g)	146.43	151.79
Weight of Dry Soil (g)	118.11	121.28
Weight of Water (g)	17.78	18.46
Moisture Content (%)	15.05	15.22
Average Moisture Content (%)	15.14	

Failure Sketches

Rear **Front**

Determination of Stess and Strain

Strain Dial Reading	Unit Strain (%)	Load Dial Reading	Axial Load (kg)	Corrected Area (cm^2)	Compressive Strength (kg/cm^2)
0	0.00	0	0.00	38.48	0.00
50	0.36	15	2.01	38.62	0.05
100	0.71	32	4.29	38.76	0.11
150	1.07	47	6.30	38.90	0.16
200	1.43	60	8.04	39.04	0.21
250	1.79	74	9.92	39.18	0.25
300	2.14	87	11.66	39.33	0.30
350	2.50	98	13.13	39.47	0.33
400	2.86	105	14.07	39.62	0.36
450	3.21	111	14.87	39.76	0.37
500	3.57	107	14.34	39.91	0.36



Compressive Strength	**0.37** kg/cm^2	Strain	**3.21** %

Tested By	Checked By	Approved By
Nasrullha Khan	-	Shahzaib Khalid

Shahzaib

FIRM decon International (Pvt) Ltd.

CLIENT	CONSULTANT	CONTRACTOR
The Courtyard	-	M/s AJK Engineering Services

Project	Geotechnical Investigation of The Courtyard Residence	**decon** **Geotechnical Testing Laboratory**
Location	F-11/1, Islamabad	

BH / TP No.	BH-04	**Job No.**	-
Sample No.	UDS-01	**Lab No.**	935
Sample Depth (m)	42.00-43.00	**Test Started**	November 19, 2024
Sampled Date	-	**Test Completed**	November 21, 2024

UNCONFINED COMPRESSION TEST (ASTM D 2166)

Details	Initial	Final	Proving Ring No.
Specimen Dia (cm)	5.00	5.05	N24887
Specimen Area (cm^2)	19.63	20.04	Proving Ring Factor
Specimen Height (cm)	10.00	9.80	0.134
Specimen Volume (cm^3)	196.35	196.35	Average Rate of Strain
Weight of Specimen (g)	389.00		1.00 % per min
Bulk Density of Soil (g/cm^3)	1.981		
Dry Density of Soil (g/cm^3)	1.688		

Determination of Moisture Content

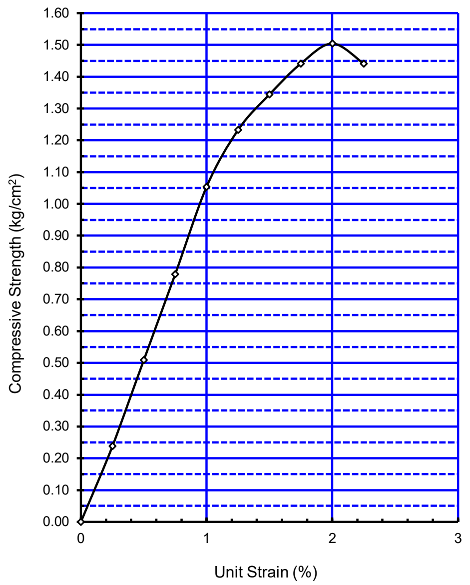
Container No.	C-09	C-187
Weight of Container (g)	23.62	30.45
Weight of Container + Wet Sample (g)	117.38	125.32
Weight of Container + Dry Sample (g)	103.68	111.11
Weight of Dry Soil (g)	80.06	80.66
Weight of Water (g)	13.70	14.21
Moisture Content (%)	17.11	17.62
Average Moisture Content (%)	17.36	

Failure Sketches

Rear **Front**

Determination of Stess and Strain

Strain Dial Reading	Unit Strain (%)	Load Dial Reading	Axial Load (kg)	Corrected Area (cm^2)	Compressive Strength (kg/cm^2)
0	0.00	0	0.00	19.63	0.00
25	0.25	35	4.69	19.68	0.24
50	0.50	75	10.05	19.73	0.51
75	0.75	115	15.41	19.78	0.78
100	1.00	156	20.90	19.83	1.05
125	1.25	183	24.52	19.88	1.23
150	1.50	200	26.80	19.93	1.34
175	1.75	215	28.81	19.98	1.44
200	2.00	225	30.15	20.04	1.50
225	2.25	216	28.94	20.09	1.44



Compressive Strength	**1.50** kg/cm^2	Strain	**2.00** %

Tested By	Checked By	Approved By
Nasrullha Khan	-	Shahzaib Khalid

Shahzaib

FIRM decon International (Pvt) Ltd.

CHEMICAL ANALYSIS OF SOIL / ROCK SAMPLE

CLIENT	CONSULTANT	CONTRACTOR
The Courtyard	-	M/S AJK Engineers(Pvt) Ltd

Project	Geotechnical Investigations - The Courtyard Residence, F-11/1, Islamabad	**decon** Geotechnical Testing Laboratory
Location	-	

Lab No	935	**Test Started**	November 6, 2024
Sampled Date	-	**Test Completed**	November 7, 2024

Chemical Analysis of Soil

Sr No	BH / TP No	Sample Detail	Sample Depth (m)		Location	Sulphates (%)	Chlorides (%)	Organic Matter (%)	TDS (ppm)	pH
			From	To						
1	BH-02	S-10	17.00		-	0.04	0.02	0.41	-	-
2	BH-03	UDS-01	15.00			0.05	0.04	0.44		

Tested By	Checked By	Approved By
Yasir Arif	-	Shahzaib Khalid

Shahzaib

FIRM
decon
International (Pvt) Ltd.

CLIENT	CONSULTANT	CONTRACTOR
The Courtyard	-	M/s AJK Engineering Services

Project	Geotechnical Investigation of The Courtyard Residence	**decon** Geotechnical Testing Laboratory
Location	F-11/1, Islamabad	

Lab No	935	**Test Started**	November 19, 2024
Sampled Date	-	**Test Completed**	November 21, 2024

Chemical Analysis of Soil

Sr No	BH / TP No	Sample Detail	Sample Depth (m)		Location	Sulphates (%)	Chlorides (%)	Organic Matter (%)	TDS (ppm)	pH
			From	To						
1	BH-05	UDS-01	14.00		-	0.03	0.04	0.54	-	-
					-				-	-

Tested By	Checked By	Approved By
Yasir Arif	-	Shahzaib Khalid

Shahzaib

FIRM
decon
International (Pvt) Ltd.

Appendix - G

Site Photographs

Site Photographs **BH-01**

Fig 01: A view of site during performing SPT

Fig 02: Another view of site during performing SPT

Site Photographs ***BH-02***

Fig 03: A view of site during performing SPT

Fig 04: Another view of site during performing SPT

Site Photographs BH-04

Fig 05: A view of site during performing SPT

Fig 06: Another view of site during performing SPT

Site Photographs **BH-05**

Fig 07: A view Drilling Operation at Site

Fig 08: Another view of site during performing SPT

Site Photographs **BH-06**

Fig 09: A view of site during performing SPT

Fig 10: Another view of site during performing SPT

Site Photographs ***SPT Samples*** ***BH-01***

BH-01 **SPT-13** **Depth = 17.0m**

BH-01 **SPT-10** **Depth = 10.0m**

BH-01 **SPT-17** **Depth = 17.0m**

BH-01 **SPT-19** **Depth = 19.0m**

BH-01 **SPT-23** **Depth = 23.0m**

BH-01 **SPT-26** **Depth = 26.0m**

Site Photographs ***SPT Samples*** ***BH-02***

BH-02 **SPT-9** **Depth = 9.0m**

BH-02 **SPT-14** **Depth = 14.0m**

BH-02 **SPT-13** **Depth = 20.0m**

BH-02 **SPT-17** **Depth = 24.0m**

BH-02 **SPT-23** **Depth = 30.0m**

BH-02 **SPT-37** **Depth = 56.0m**

Site Photographs ***SPT Samples*** ***BH-03***

BH-03 **SPT-11** **Depth = 16m**

BH-03 **SPT-23** **Depth = 28.0m**

BH-03 **SPT-30** **Depth = 44.0m**

BH-03 **SPT-32** **Depth = 53.0m**

BH-03 **SPT-36** **Depth = 65.0m**

BH-03 **SPT-39** **Depth = 73.0m**

Site Photographs *SPT Samples* *BH-04*

BH-04 **SPT-10** **Depth = 18.0m**

BH-04 **SPT-18** **Depth = 39.0m**

BH-04 **SPT-22** **Depth = 56.0m**

BH-04 **SPT-25** **Depth = 60.0m**

BH-04 **SPT-30** **Depth = 73.0m**

Site Photographs ***SPT Samples*** ***BH-05***

BH-05 **SPT-11** **Depth = 15.0m**

BH-05 **SPT-16** **Depth = 20.0m**

BH-05 **SPT-18** **Depth = 22.0m**

BH-05 **SPT-14** **Depth = 18.0m**

BH-05 **SPT-19** **Depth = 25.0m**

BH-05 **SPT-21** **Depth = 27.0m**

Site Photographs SPT Samples BH-06

BH-06 SPT-9 Depth = 15.0m

BH-06 SPT-19 Depth = 26.0m

BH-06 SPT-27 Depth = 36.0m

BH-06 SPT-33 Depth = 50.0m

BH-06 SPT-37 Depth = 62.0m

BASEMENT-02 & 03 PLAN

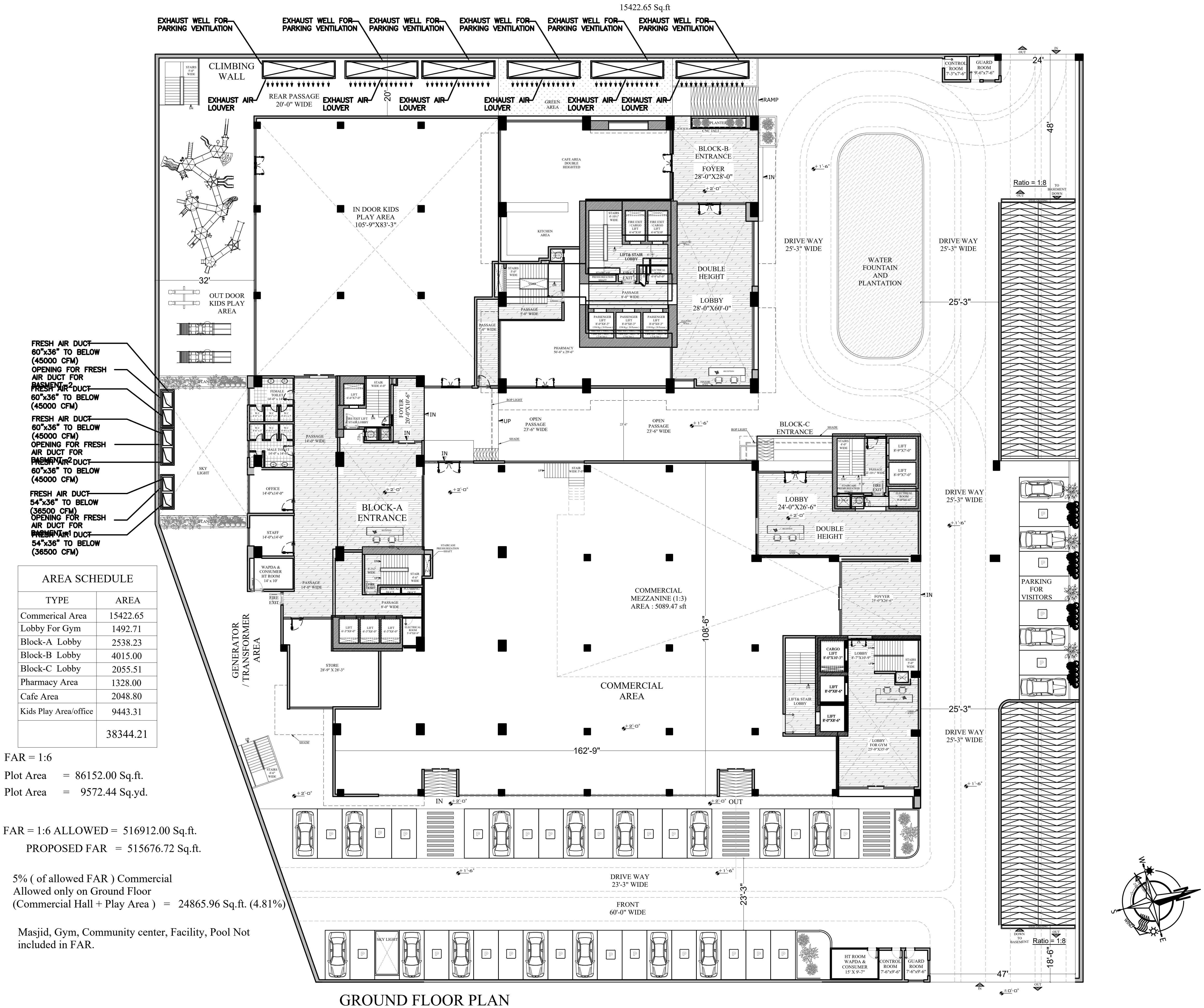
Parking = 245 Qty

Plot Area = 86152.00 Sq.ft.

BASEMENT-01 PLAN

Parking = 137Qty

Plot Area = 86152.00 Sq.ft.



AREA SCHEDULE	
TYPE	AREA
Commerical Area	15422.65
Lobby For Gym	1492.71
Block-A Lobby	2538.23
Block-B Lobby	4015.00
Block-C Lobby	2055.51
Pharmacy Area	1328.00
Cafe Area	2048.80
Kids Play Area/office	9443.31
	38344.21

FAR = 1:6

Plot Area = 86152.00 Sq.ft.

Plot Area = 9572.44 Sq.yd.

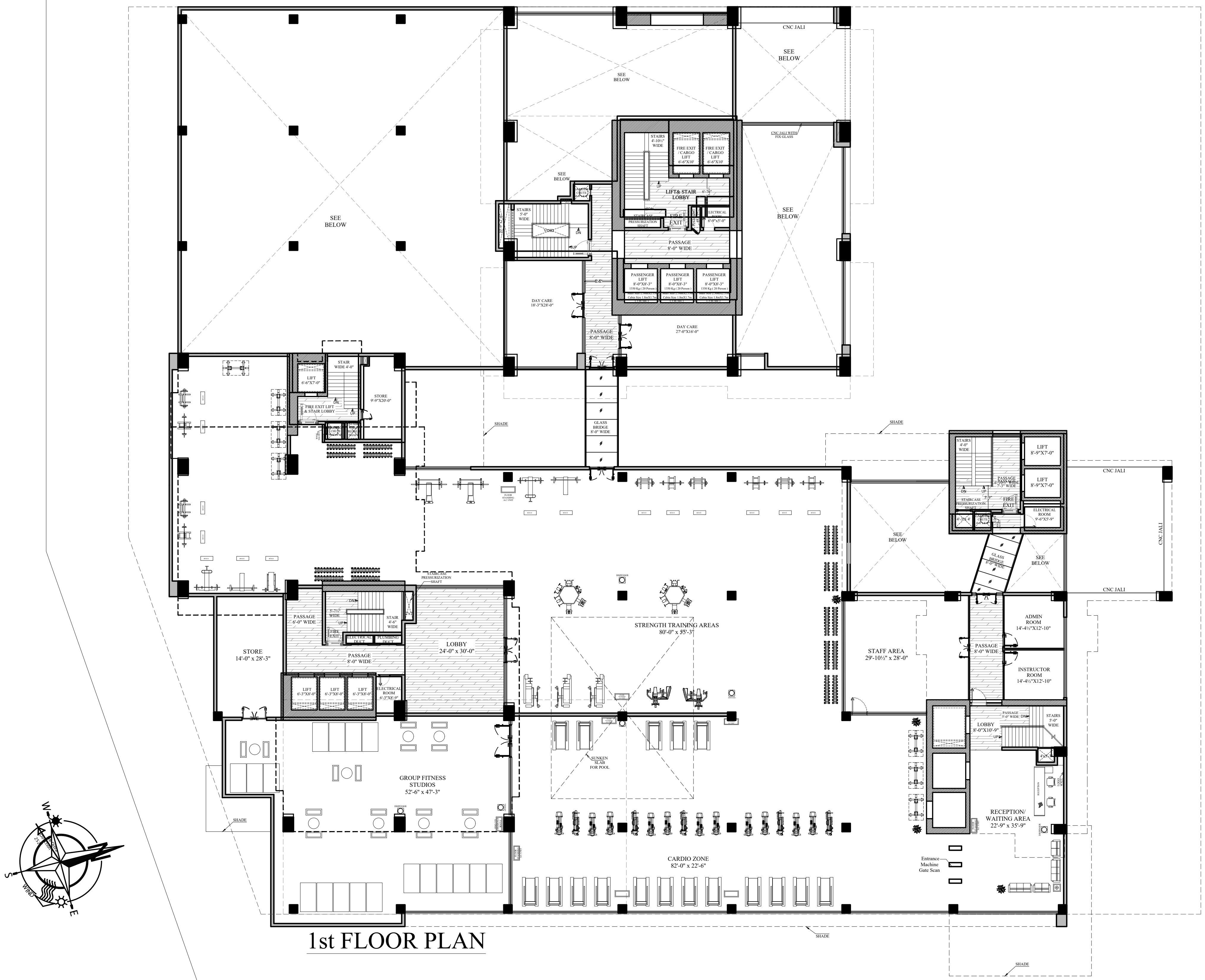
FAR = 1:6 ALLOWED = 516912.00 Sq.ft.

PROPOSED FAR = 515676.72 Sq.ft.

5% (of allowed FAR) Commercial
Allowed only on Ground Floor
(Commercial Hall + Play Area) = 24865.96 Sq.ft. (4.81%)

Masjid, Gym, Community center, Facility, Pool Not included in FAR.

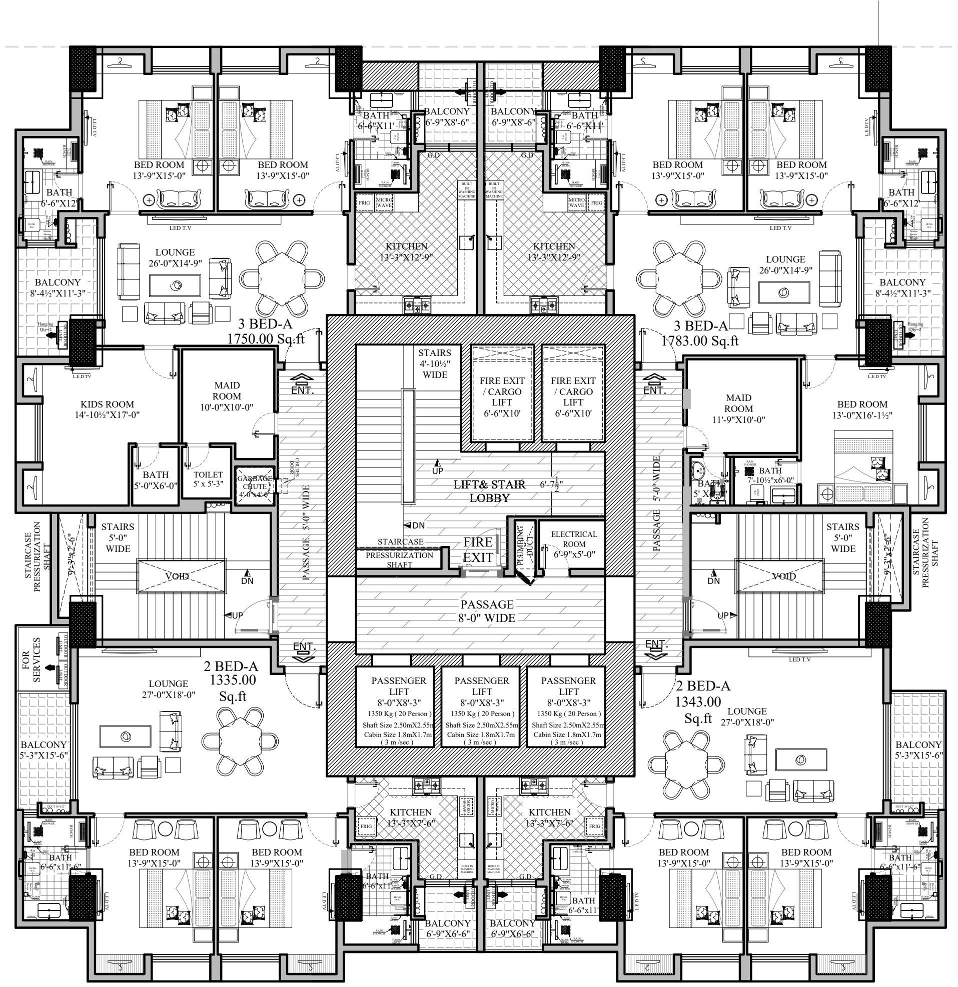
GROUND FLOOR PLAN
Parking = 46 Qty



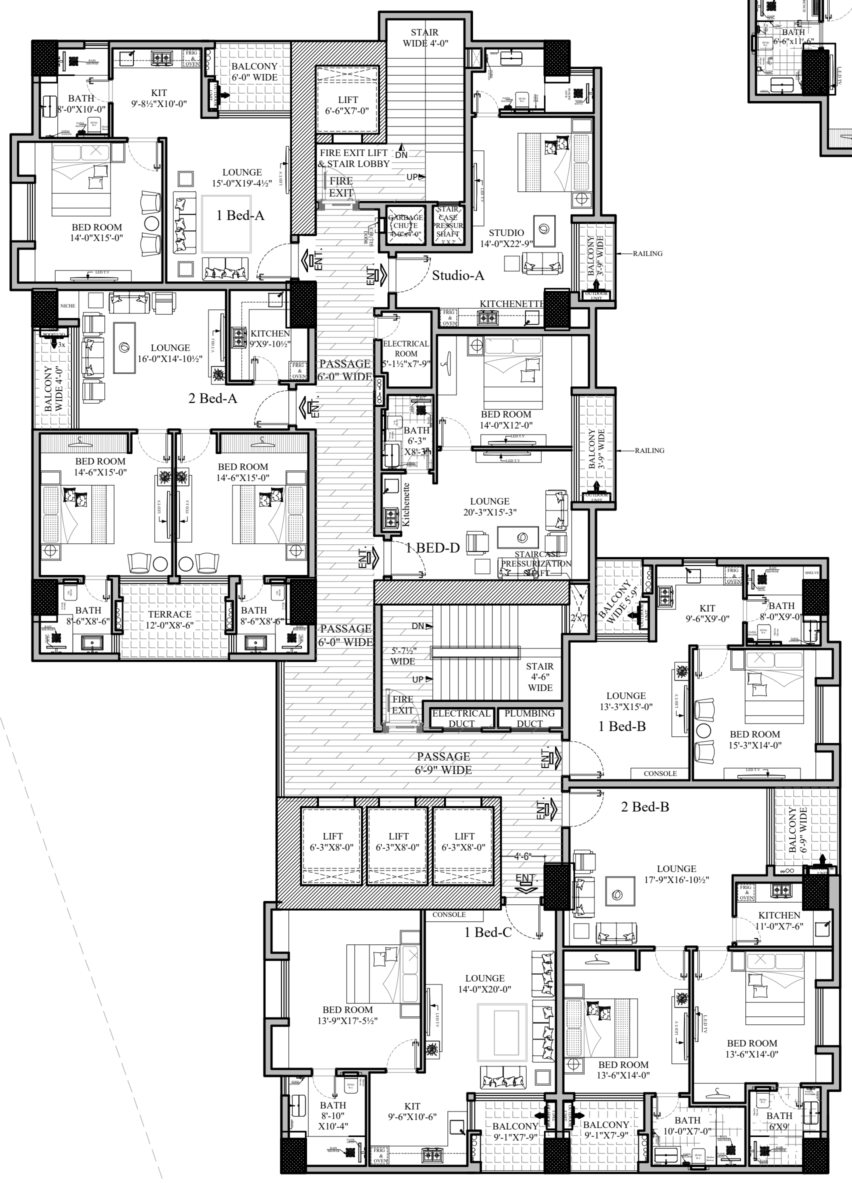
1st FLOOR PLAN

2nd FLOOR PLAN

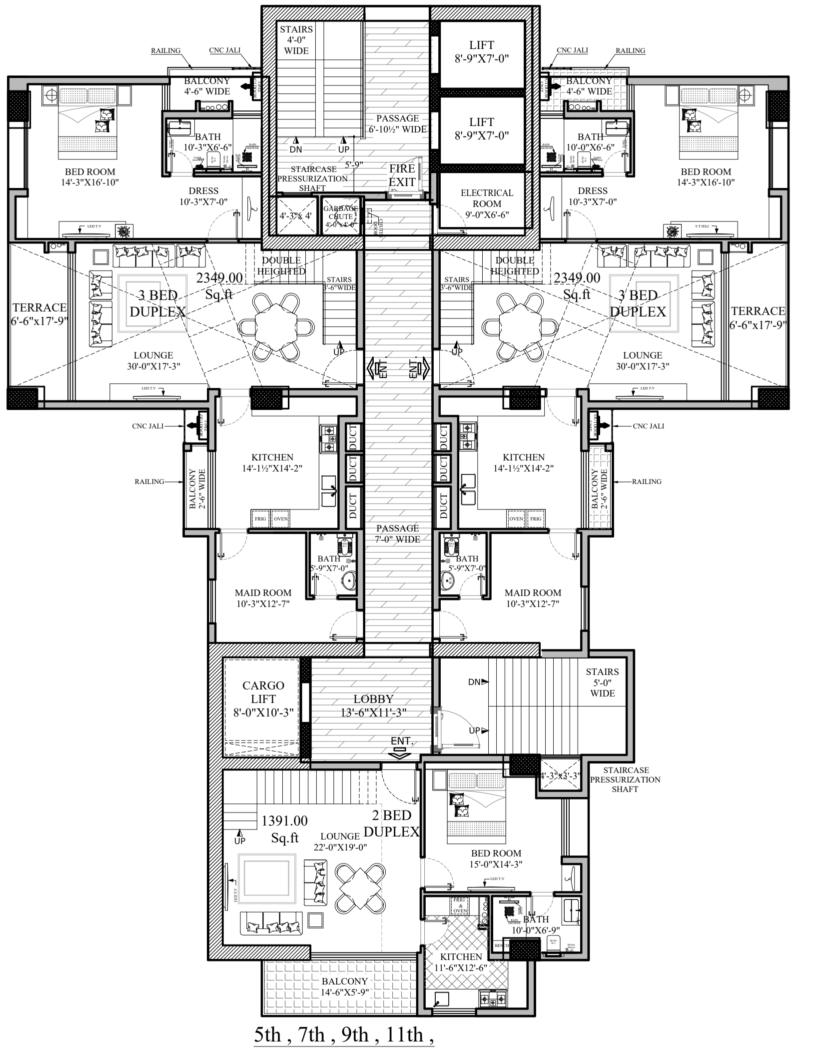
3rd FLOOR PLAN



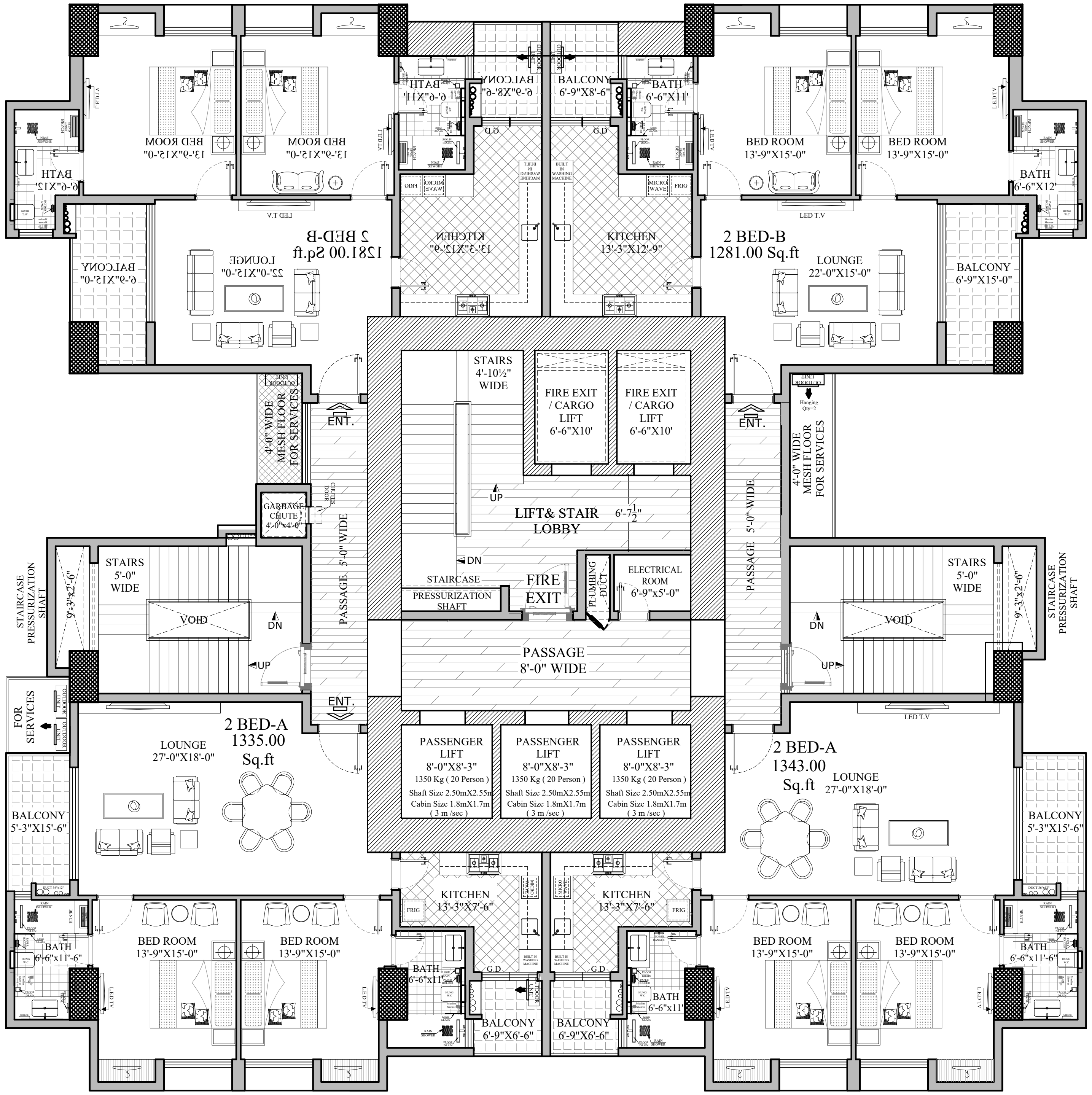
14th to 31th FLOOR PLAN
BLOCK-B



4th to 31th FLOOR PLAN
BLOCK-A

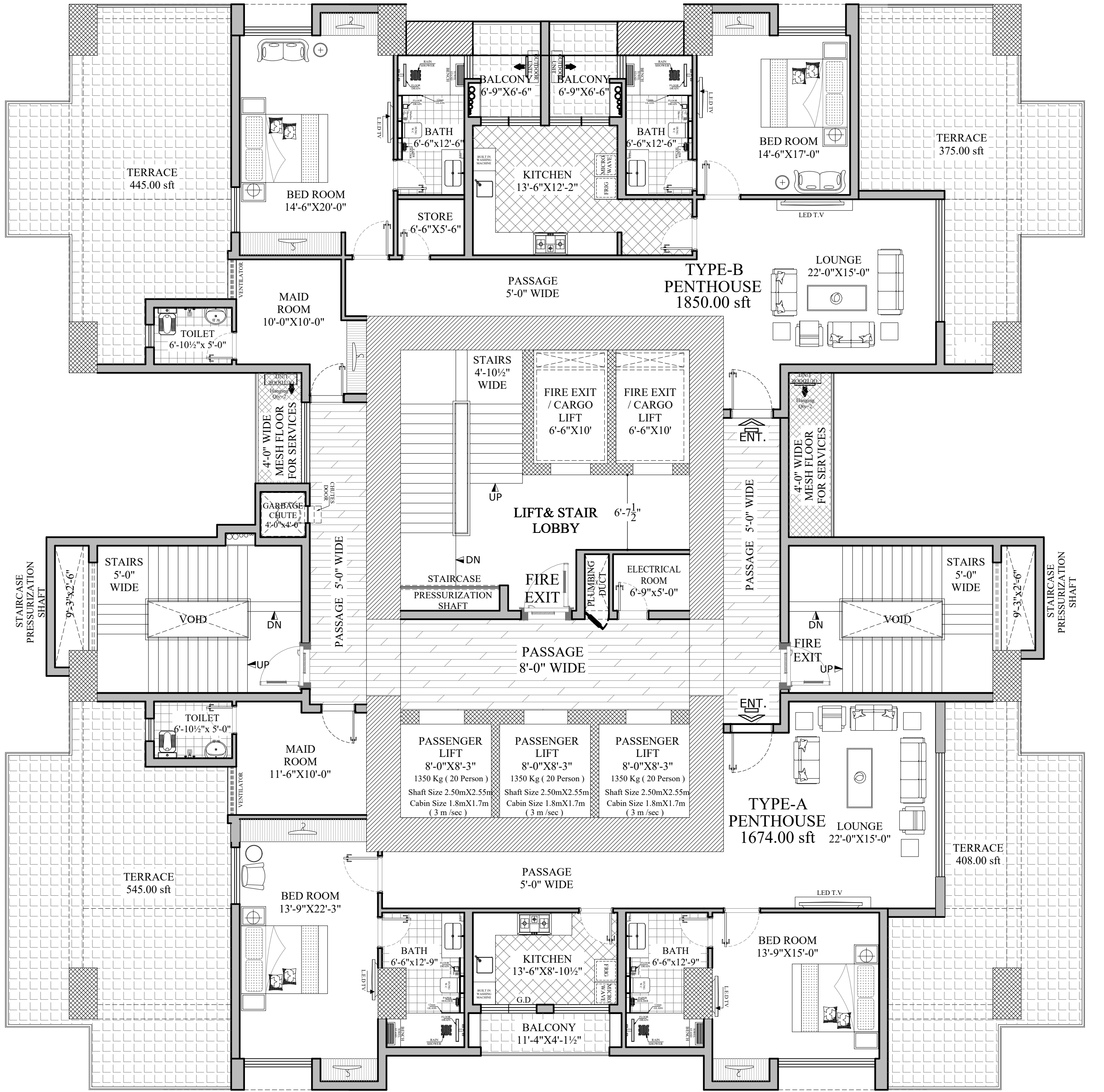


5th , 7th , 9th , 11th ,
17th ,19th FLOOR PLAN
BLOCK-C



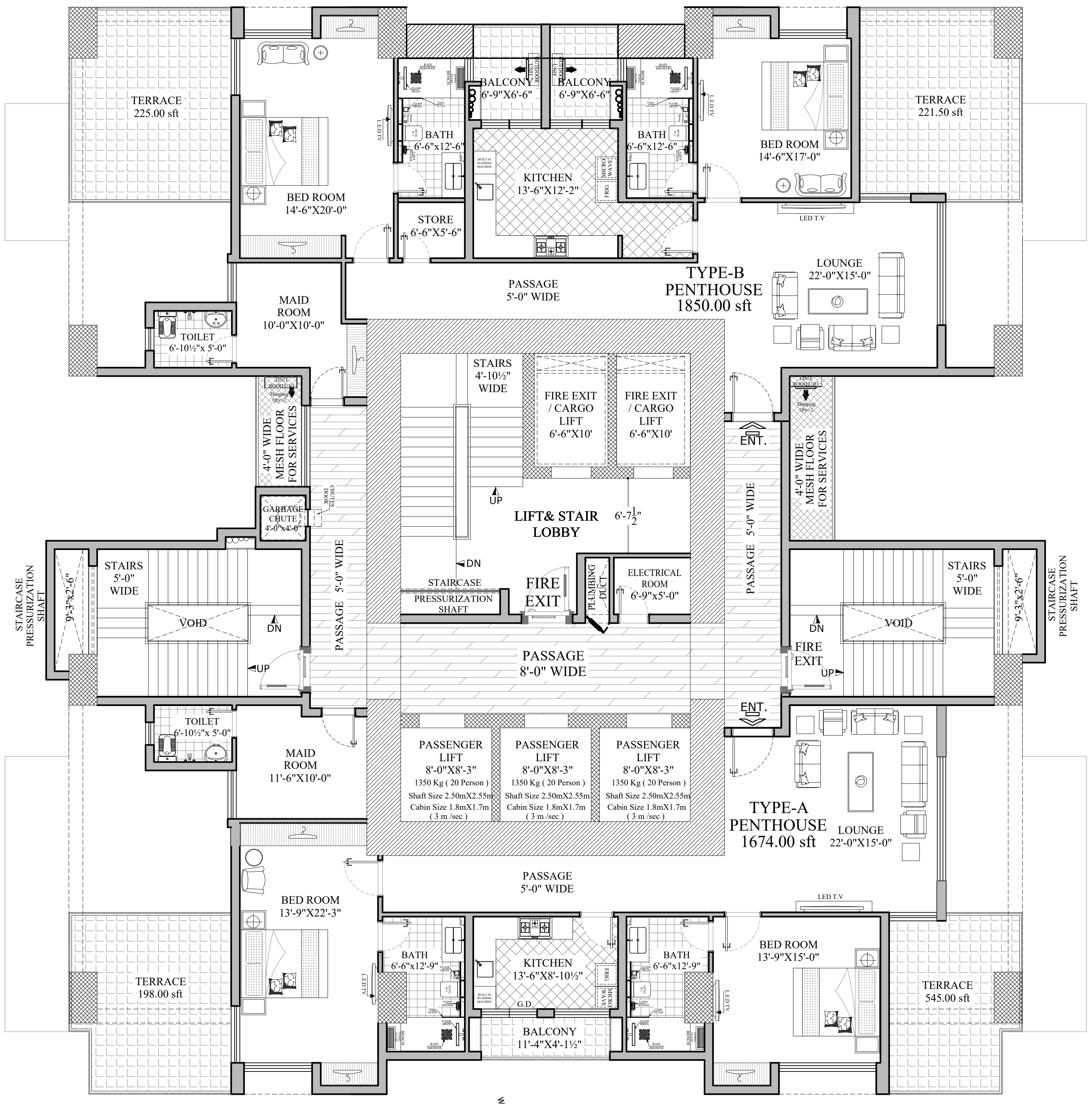
33th to 40th FLOOR PLAN

BLOCK-B

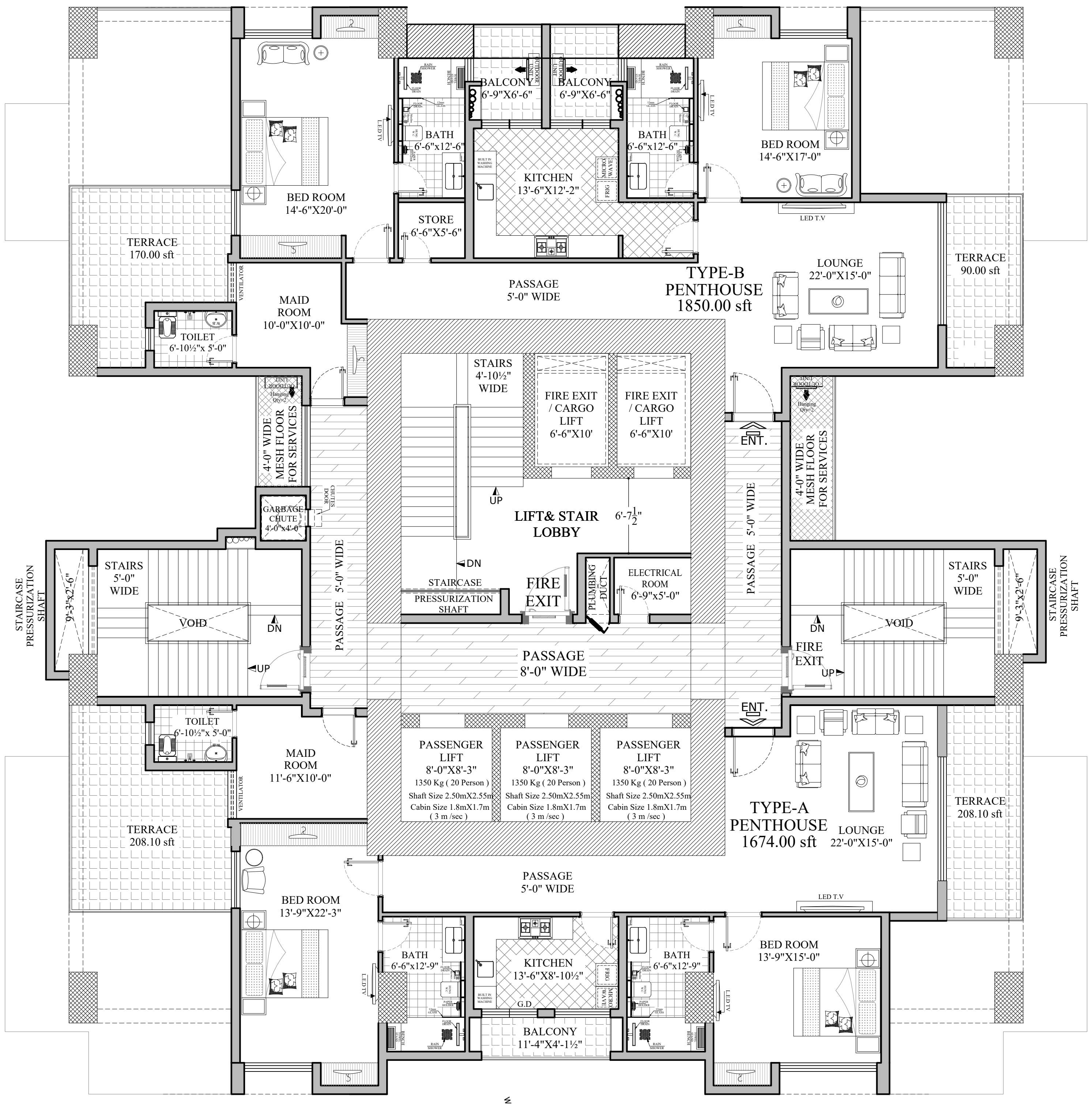


41th FLOOR PLAN

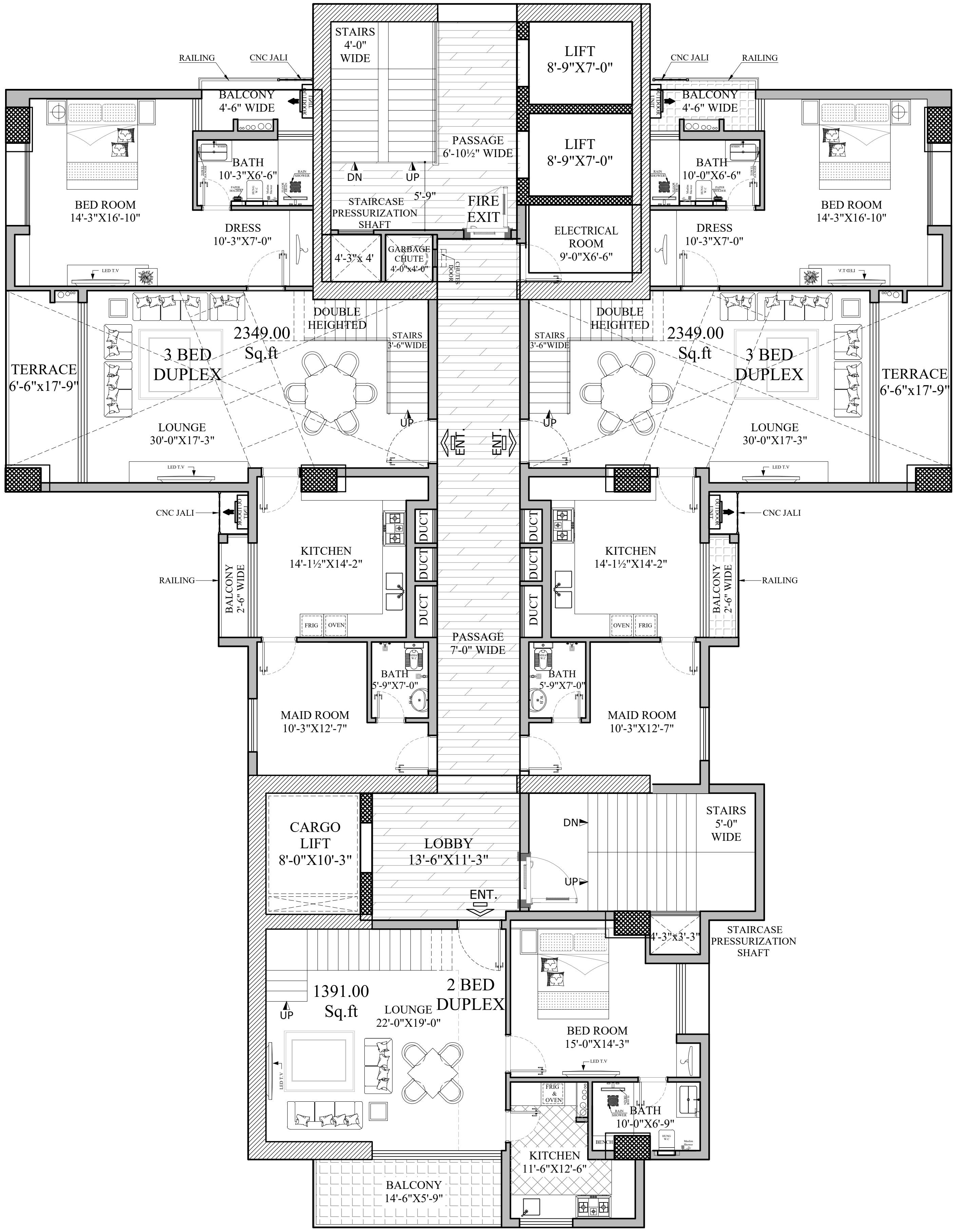
BLOCK-B



42th & 44th FLOOR PLAN
BLOCK-B

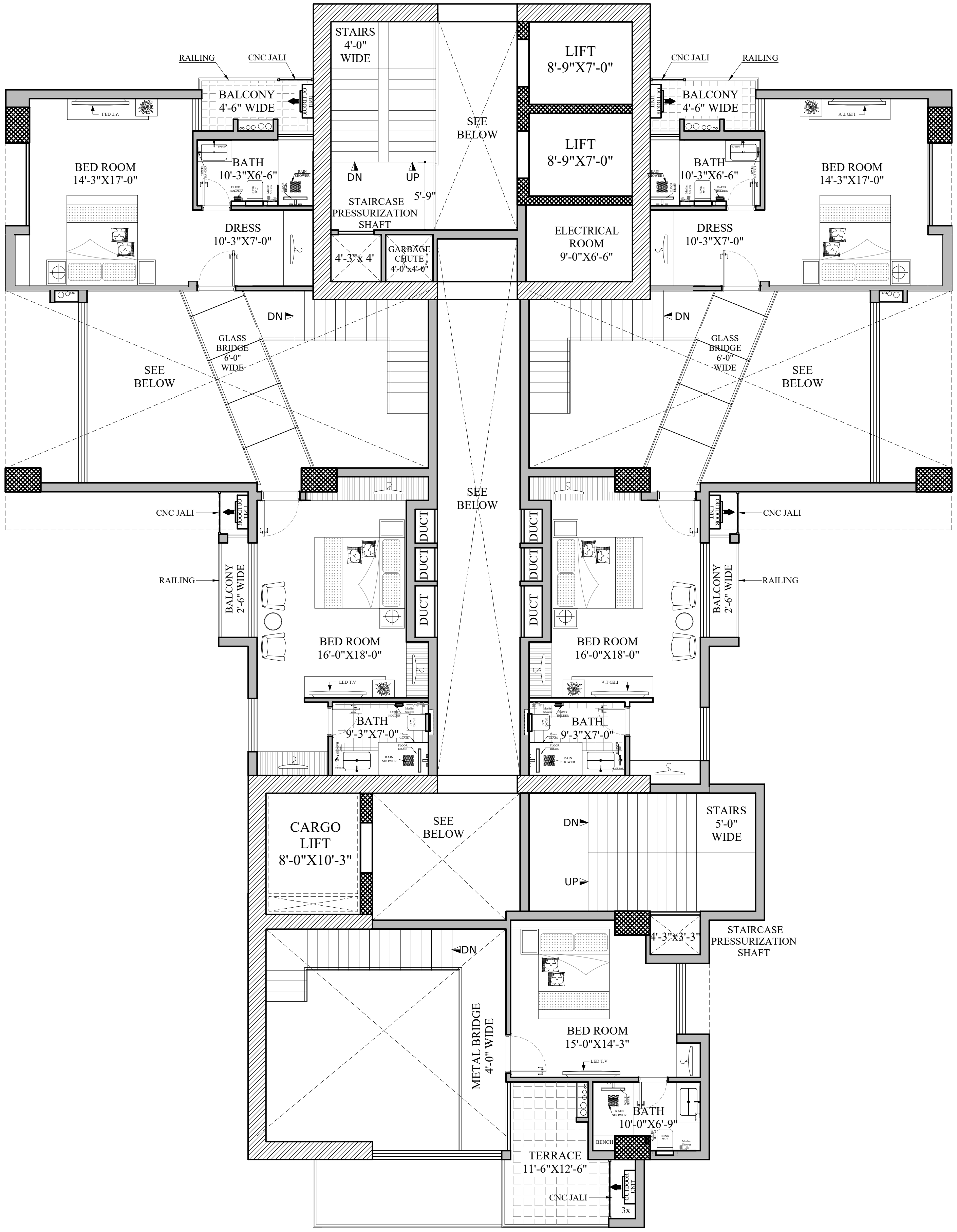


43th & 45th FLOOR PLAN
BLOCK-B



5th , 7th , 9th , 11th ,
17th ,19th FLOOR PLAN

BLOCK-C



6th , 8th , 10th , 12th , 18th , 20th
FLOOR PLAN

LOFT FLOOR BLOCK-C