VIEW–1

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	NAEEM
C			DESIGNED	H S HUSSAIN
B			CHECKED	M.YASIN
A			APPROVED	M.YASIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE
TOLL PLA□A
VIEWS

SCALE
N.T.S.

DATE
SEP.,20

DWG. No.
P–38035/P2/50Z/PD/01BG01

REVISION
0

VIEW–2

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	NAEEM
C			DESIGNED	H S HUSSAIN
B			CHECKED	M.YASIN
A			APPROVED	M.YASIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE
TOLL PLA□A
VIEWS

SCALE
N.T.S.

DATE	DWG. No.	REVISION
SEP.,20	P–38035/P2/50Z/PD/01BG02	0

VIEW–3

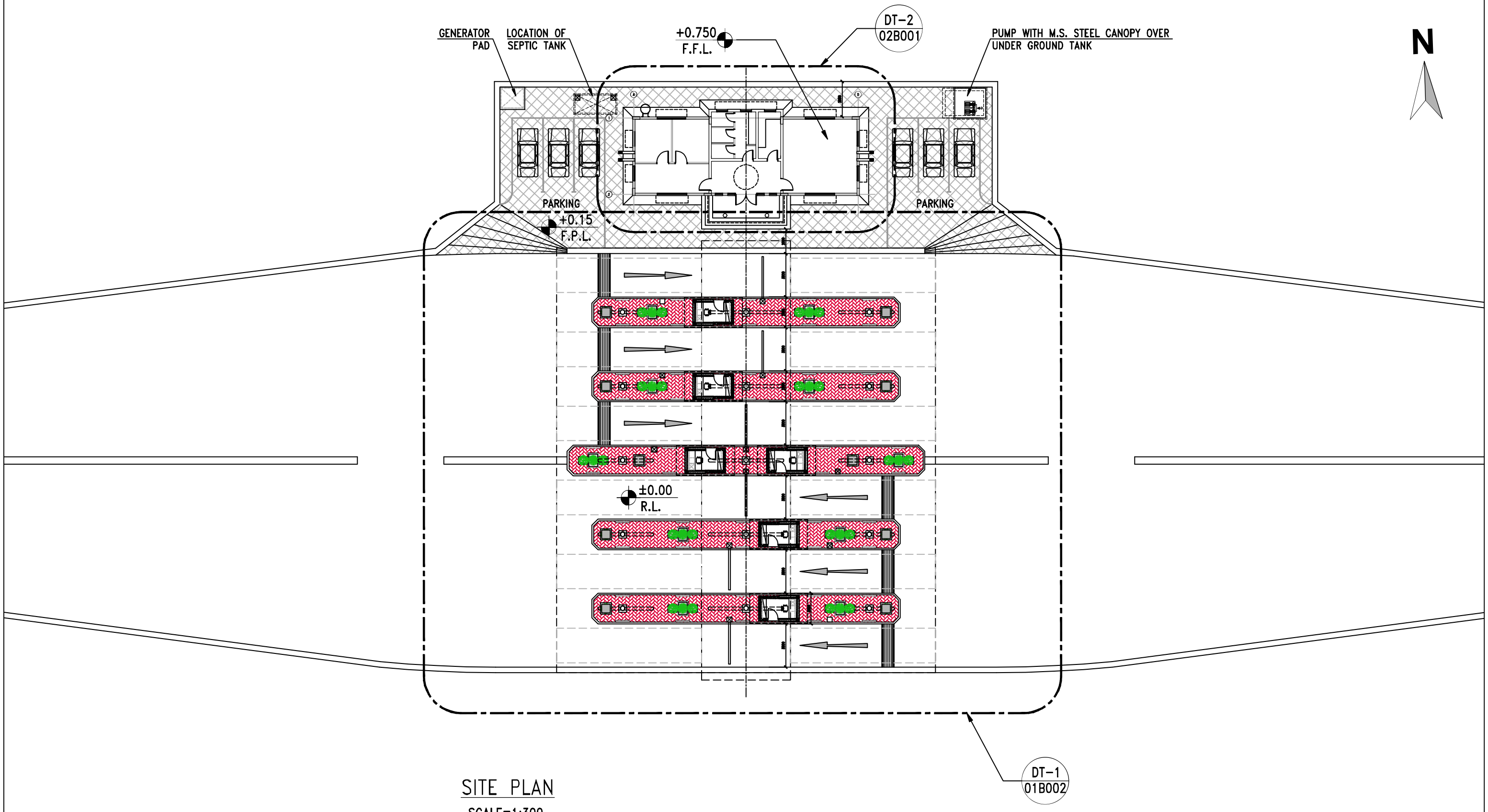
LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

D			DRAWN	NAEEM
C			DESIGNED	H S HUSSAIN
B			CHECKED	M.YASIN
A			APPROVED	M.YASIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE		SCALE
TOLL PLA□A VIEWS		N.T.S.
DATE	DWG. No.	REVISION
SEP.,20	P–38035/P2/50Z/PD/01BG03	0



SITE PLAN

SCALE=1:300

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

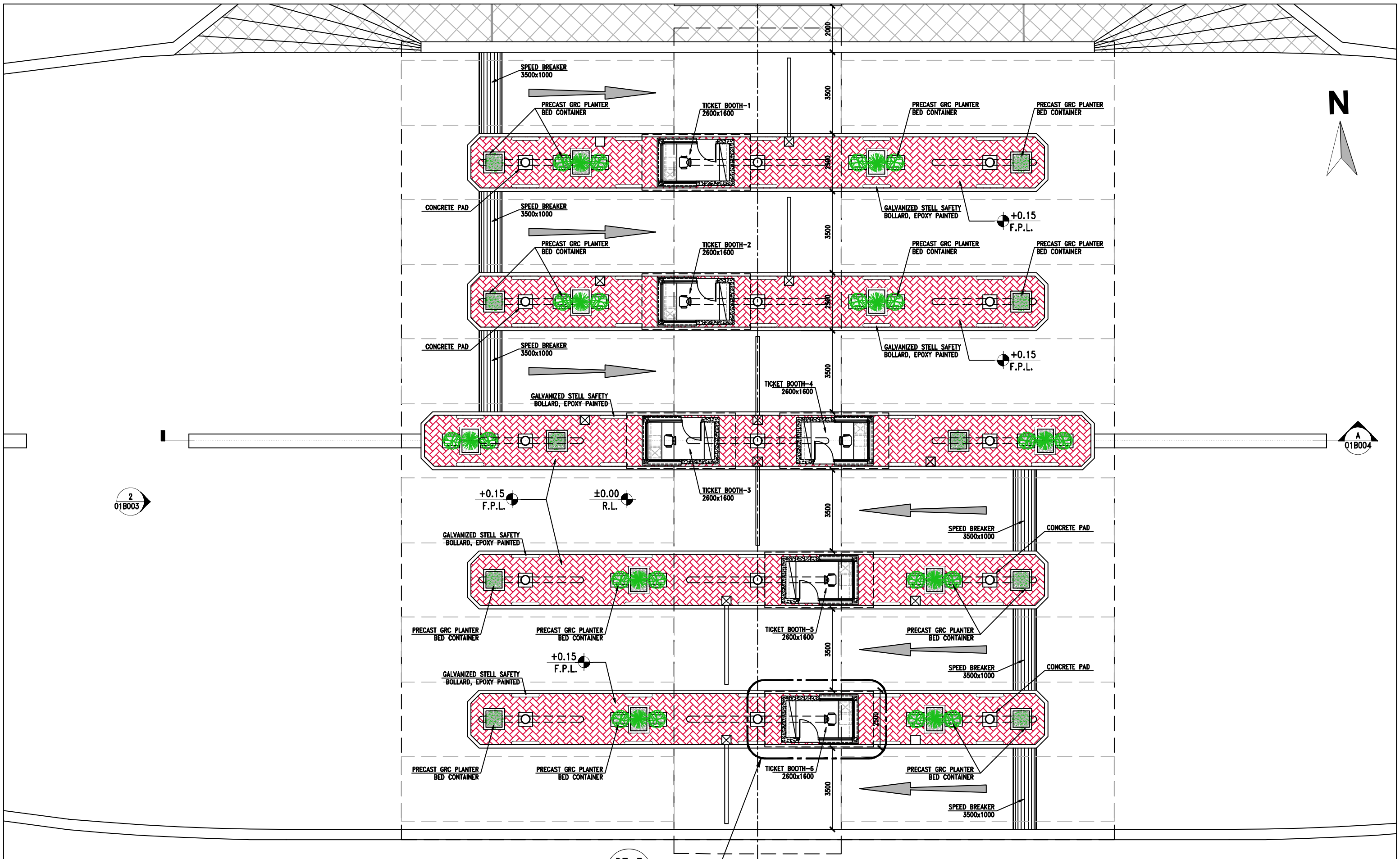
NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

REV.	DATE	DESCRIPTION
D		
C		
B		
A		
0	SEP.,2020	PRELIMINARY DESIGN

DRAWN	M.KASHIF
DESIGNED	H S HUSSAIN
CHECKED	M.YASIN
APPROVED	M.YASIN

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE		SCALE
TOLL PLA□A SITE PLAN		1:300
DATE	DWG. No.	REVISION
SEP.,20	P-38035/P2/50Z/PD/01B001	0



GROUND FLOOR PLAN (DT-1)

SCALE=1:150

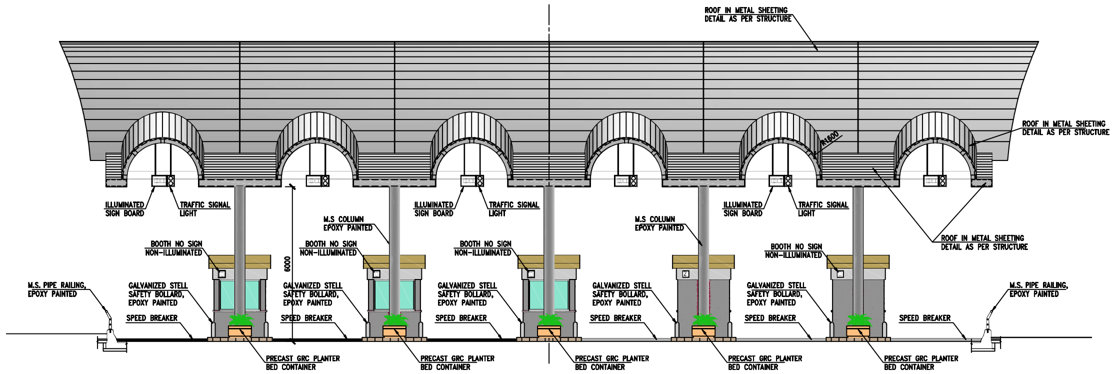
LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

D			DRAWN	M.KASHIF
C			DESIGNED	H S HUSSAIN
B			CHECKED	M.YASIN
A			APPROVED	M.YASIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

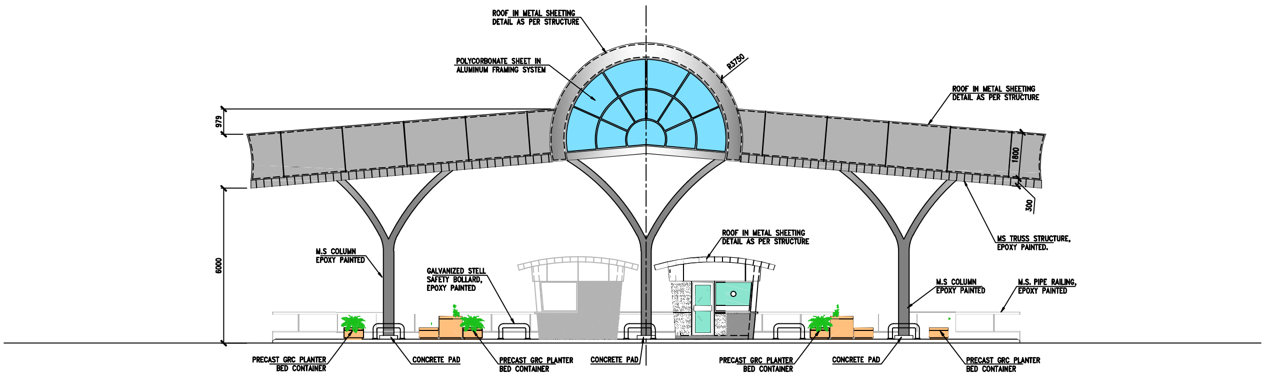
URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE	TOLL PLA□A GROUND FLOOR PLAN	SCALE 1:150
DATE SEP.,20	DWG. No. P-38035/P2/50Z/PD/01B002	REVISION 0



ELEVATION-2

SCALE=1:150



ELEVATION-1

SCALE=1:150

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NESPAK NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	M.KASHIF
C			DESIGNED	H S HUSSAIN
B			CHECKED	M.YASIN
A			APPROVED	M.YASIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

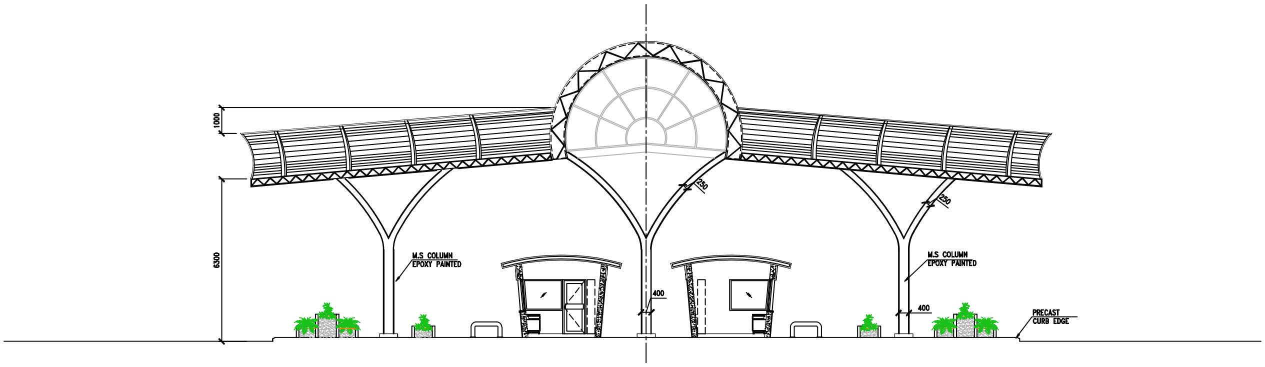
TITLE
TOLL PLA□A
ELEVATIONS

SCALE
1:150

DATE
SEP.,20

DWG. No.
P-38035/P2/50Z/PD/01B003

REVISION
0



SECTION–A

SCALE=1:150

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	M.KASHIF
C			DESIGNED	H S HUSSAIN
B			CHECKED	M.YASIN
A			APPROVED	M.YASIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

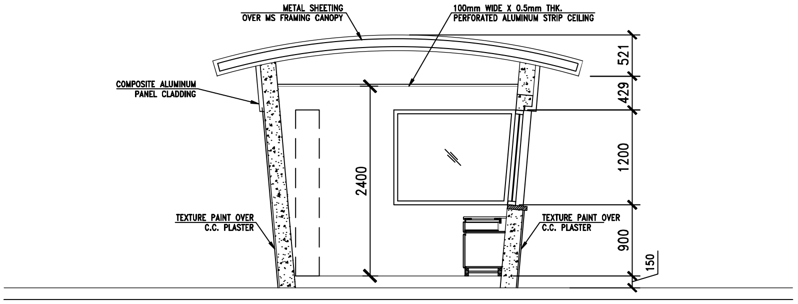
TITLE
TOLL PLA□A
SECTION

SCALE
1:150

DATE
SEP.,20

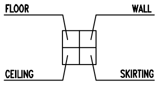
DWG. No.
P–38035/P2/50Z/PD/01B004

REVISION
0



SECTION-1

SCALE=1:50



SCHEDULE OF FINISHES

FLOOR

A- 300X300x10mm THK. (FULL BODY) FULLY VITRIFIED
PORCELAIN TILES IN APPROVED COLOR/SHADE AND TEXTURE ETC.

SKIRTING

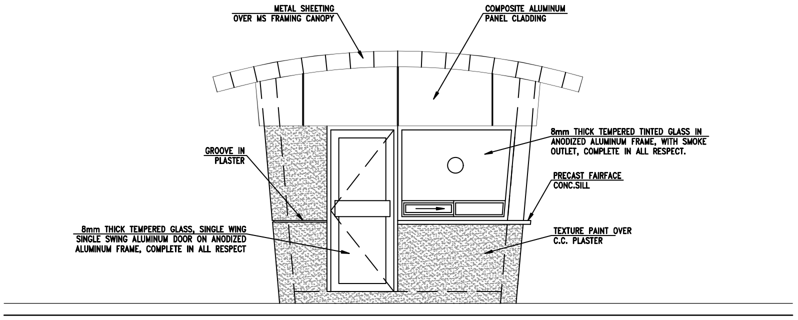
1- 100mm HIGH PORCELAIN TILE SKIRTING (MATCH WITH FLOOR)

WALL

a- PLASTIC EMULSION PAINT ON TO C.C. PLASTER.

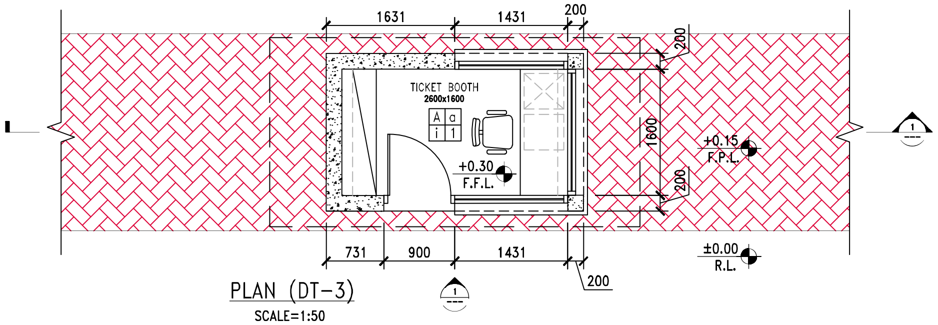
CEILING

i- 100mm WIDE X 0.5mm THK. PERFORATED ALUMINUM STRIP CEILING



ELEVATION-1

SCALE=1:50



PLAN (DT-3)

SCALE=1:50

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

D			DRAWN	M.KASHIF
C			DESIGNED	H S HUSSAIN
B			CHECKED	M.YASIN
A			APPROVED	M.YASIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE
TICKET BOOTH
PLAN□ELEVATION & SECTION

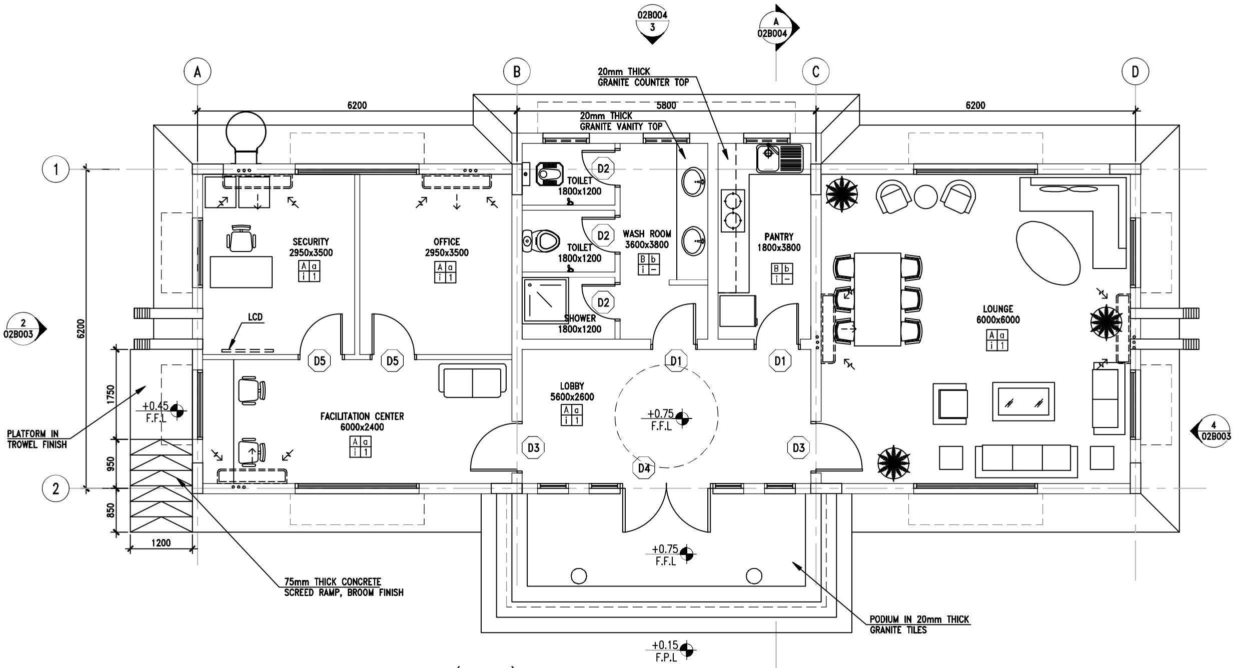
SCALE
1:50

DATE
SEP.,20

DWG. No.
P-38035/P2/50Z/PD/01B005

REVISION
0

N



GROUND FLOOR PLAN (DT-2)

SCALE=1:75

1
02B003

NOTE:

1– FURNITURE IS JUST FOR INFORMATION AND
LAYOUT PURPOSE ONLY AND NOT IN CONTRACT.

FLOOR WALL
CEILING SKIRTING

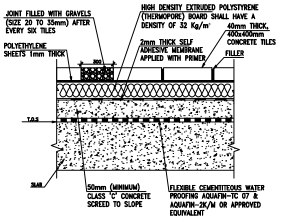
SCHEDULE OF FINISHES

FLOOR

A– 600X600x10mm THK. (FULL BODY) FULLY VITRIFIED PORCELAIN TILES IN APPROVED COLOR/SHADE AND TEXTURE ETC.

B– 300X300x8mm THK. FULLY VITRIFIED SEMI GLAZED PORCELAIN TILES IN APPROVED COLOR/SHADE AND TEXTURE ETC,

C– BUILT UP ROOFING TYPE-I



SKIRTING

1– 100mm HIGH PORCELAIN TILE SKIRTING (MATCH WITH FLOOR)

WALL

a– PLASTIC EMULSION PAINT ON TO C.C. PLASTER/DRY WALL SURFACE.

b– 300X300x8mm THK. GLAZED PORCELAIN TILES (UPTO 2400 HIGH) IN APPROVED COLOR/SHADE.

CEILING

i– PLASTIC EMULSION PAINT ONTO SOFFIT/EXPOSED SURFACE

DOOR SCHEDULE

D1 900x2400x55mm SINGLE LEAF, SINGLE SWING, SOLID CORE DOOR FILLED WITH ROUGH WOOD, BOTH SIDE PLASTIC LAMINATED WITH TEAKWOOD LIPPING FINISHED, ALL AROUND WOODEN FLUSH DOOR IN LACQUERED FINISH. COMPLETE IN ALL RESPECT.

D2 750x2100x35mm SINGLE LEAF, SINGLE SWING, HOLLOW CORE FLUSH DOOR, BOTH SIDE PLASTIC LAMINATED OF TEAKWOOD FRAME IN LACQUER FINISHED COMPLETE IN ALL RESPECT.

D3 1000x2400x44mm HOLLOW METAL DOOR, EPOXY PAINTED, FILLED WITH POLYURETHANE BY INJECTION METHOD. COMPLETE IN ALL RESPECT.

D4 8mm THICK TEMPERED GLASS DOOR, ON ANODIZED ALUMINUM FRAMES WITH COMPATIBLE HARDWARE SET COMPLETE.
NOTE : PART OF GLAZED SCREEN.

D5 35mm THICK SINGLE LEAF,SINGLE SWING, HOLLOW CORE FLUSH DOOR PLASTIC LAMINATED IN TEAKWOOD FRAME IN LACQUER FINISHED COMPLETE IN ALL RESPECT.

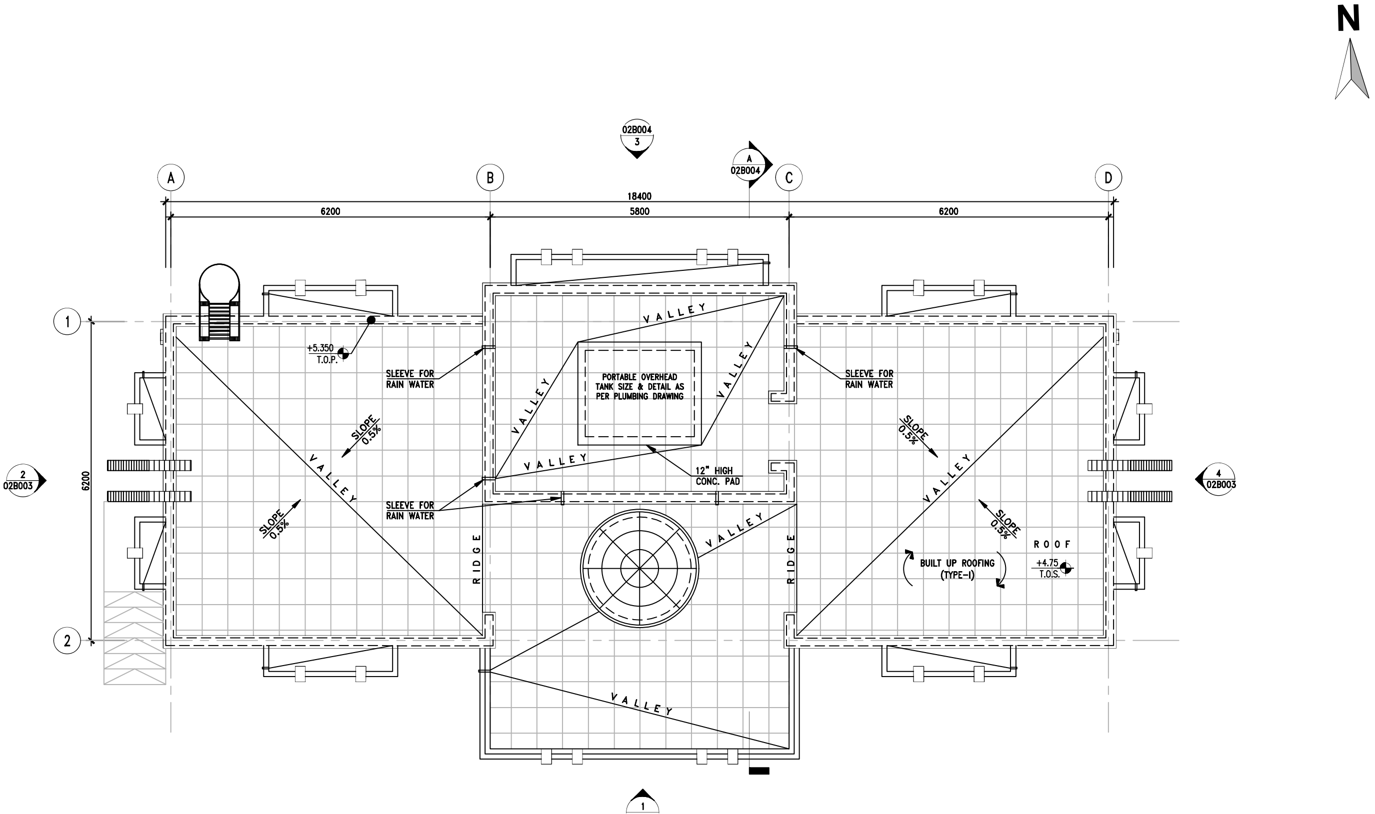
LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	M.KASHIF
C			DESIGNED	H S HUSSAIN
B			CHECKED	M.YASIN
A			APPROVED	M.YASIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE	ADMIN BUILDING GROUND FLOOR PLAN	SCALE 1:75
DATE SEP.,20	DWG. No. P–38035/P2/50Z/PD/02B001	REVISION 0



ROOF PLAN

SCALE=1:75

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

REV.	DATE	DESCRIPTION
D		
C		
B		
A		
0	SEP.,2020	PRELIMINARY DESIGN

DRAWN M.KASHIF
DESIGNED H S HUSSAIN
CHECKED M.YASIN
APPROVED M.YASIN

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

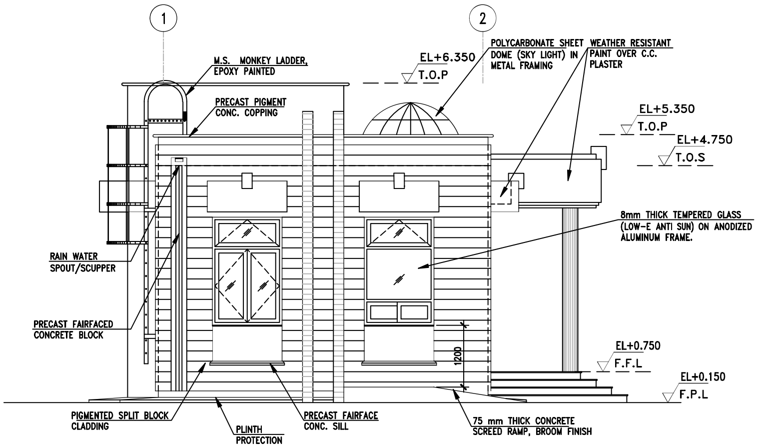
TITLE
ADMIN BUILDING
ROOF PLAN

SCALE 1:75

DATE SEP.,20

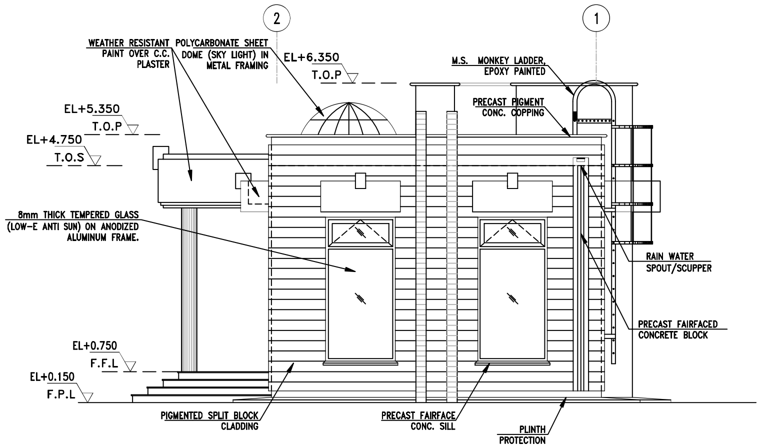
DWG. No. P-38035/P2/50Z/PD/02B002

REVISION 0



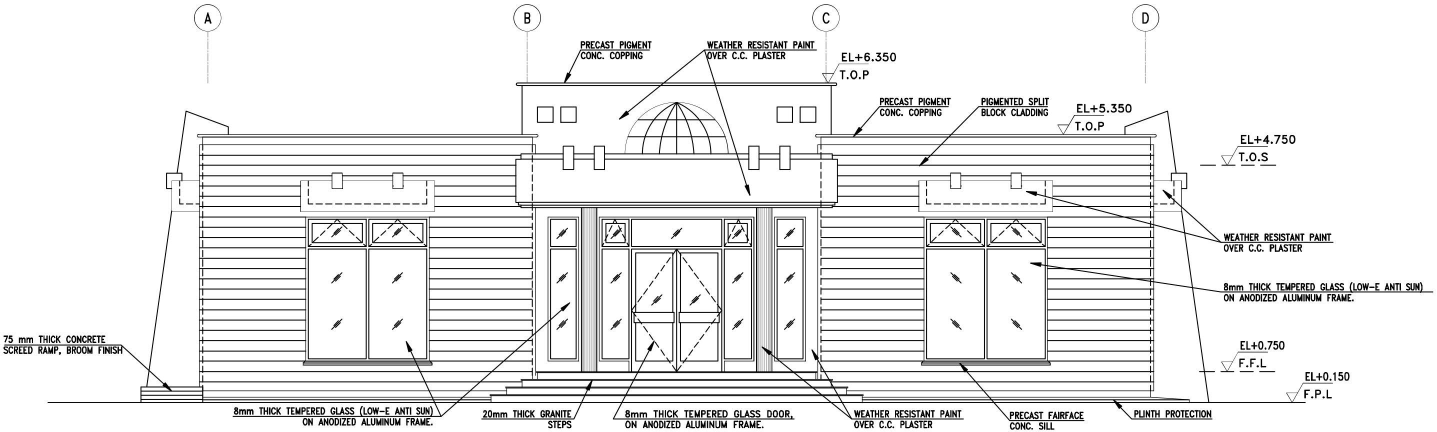
ELEVATION-2

SCALE=1:75



ELEVATION-4

SCALE=1:75



ELEVATION-1

SCALE=1:75

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	M.KASHIF
C			DESIGNED	H S HUSSAIN
B			CHECKED	M.YASIN
A			APPROVED	M.YASIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

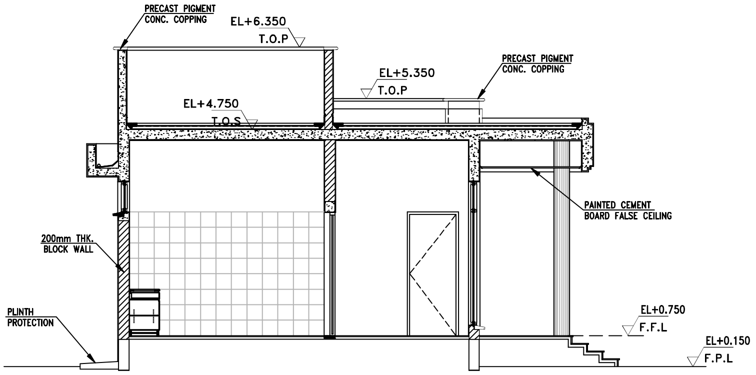
TITLE
ADMIN BUILDING
ELEVATIONS

SCALE
1:75

DATE
SEP.,20

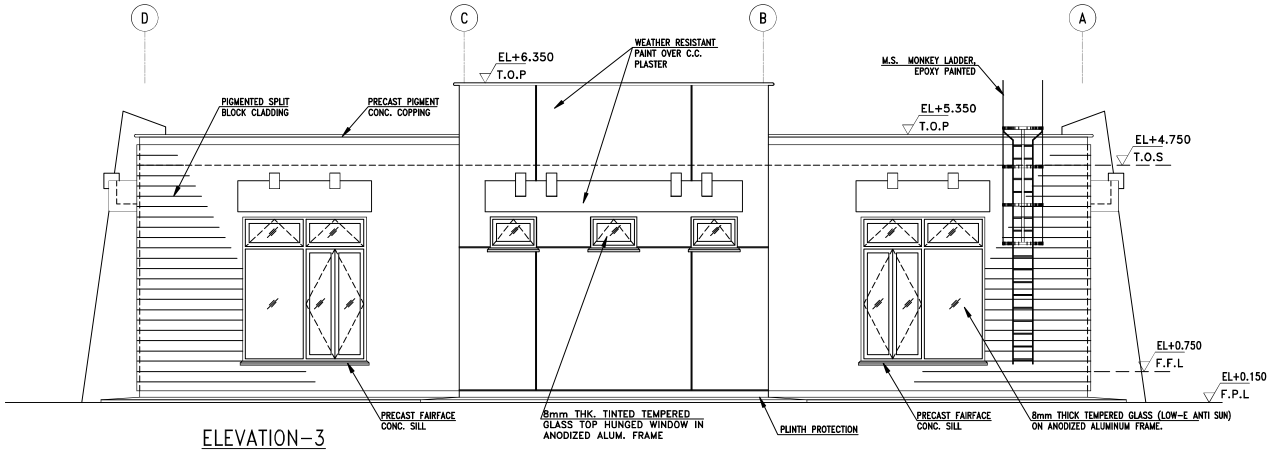
DWG. No.
P-38035/P2/50Z/PD/02B003

REVISION
0



SECTION–A

SCALE=1:75



ELEVATION–3

SCALE=1:75

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

D			DRAWN	M.KASHIF
C			DESIGNED	H S HUSSAIN
B			CHECKED	M.YASIN
A			APPROVED	M.YASIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE	ADMIN BUILDING ELEVATION & SECTION	SCALE 1:75
DATE SEP.,20	DWG. No. P-38035/P2/50Z/PD/02B004	REVISION 0

TELECOMMUNICATION DRAWINGS

GENERAL NOTES:

1– TELECOMMUNICATION SYSTEMS COMPRISES OF STRUCTURED CABLING NETWORK, CLOSED CIRCUIT TELEVISION (CCTV) & ACCESS CONTROL SYSTEM.

2– CO–ORDINATE AT SITE WITH OTHER SERVICES FOR EXACT LOCATION AND POSITION OF CONDUITS AND TELECOMMUNICATION EQUIPMENT/DEVICES.

3– ALL TELECOMMUNICATION DRAWINGS SHALL BE READ IN CONJUNCTION WITH SPECIFICATIONS, ARCHITECTURE, ELECTRICAL, STRUCTURE, HVAC, PLUMBING DRAWINGS AND ALL OTHER RELEVANT DETAILS.

4– DIMENSIONS/MEASUREMENTS GIVEN IN LAYOUTS ARE APPROXIMATE. THE CONTRACTOR SHALL BE RESPONSIBLE TO CALCULATE ACTUAL DIMENSIONS/MEASUREMENTS ACCORDING TO STRUCTURE AND ARCHITECTURE DRAWINGS.

5– THE ROUTES OF EXTERNAL CABLE AND PIPES SHALL BE FOLLOWED AS SHOWN ON THE DRAWING, ANY CHANGE IN ROUTES REQUIRED DUE TO SITE CONDITIONS SHALL BE MADE IN CO–ORDINATION WITH OTHER SERVICES, AFTER OBTAINING INDEPENDENT ENGINEER / GOS APPROVAL

6– WHERE CABLES ENTER BUILDINGS, THESE SHALL BE LAID IN PROTECTIVE PIPES. MANHOLE SHALL BE PROVIDED OUTSIDE THE BUILDING / TICKET BOOTH.

7– ALL UNDERGROUND PIPES SHALL BE LAID MINIMUM 450mm BELOW THE TOP OF PAVEMENT THE DEPTH MAY BE INCREASED / DECREASED DUE TO THE SITE CONDITIONS AFTER OBTAINING INDEPENDENT ENGINEER / GOS APPROVAL

8– ALL UNDERGROUND PIPES & MANHOLES SHALL BE PROPERLY SEALED WATER TIGHT AT ENDS/JOINTS AFTER INSTALLATION.

9– SPARE PIPES SHALL HAVE THEIR ENDS PROPERLY PLUGGED WITH CAP AND MADE WATER TIGHT. BOTH ENDS OF PIPES SHALL BE MARKED BY PIPE END MARKERS FOR IDENTIFICATION.

10– CABLE MARKERS SHALL BE PROVIDED AT 30 METER INTERVALS ALONG STRAIGHT RUNS OF CABLE DUCT / ROUTE AND AT EACH BEND.

11– ALL ROUTING OF PIPES, PIPE DUCTS & CONNECTION DETAILS SHALL BE CARRIED OUT WITH THE APPROVAL OF THE INDEPENDENT ENGINEER / GOS.

12– MANUFACTURER'S RECOMMENDATION SHALL BE FOLLOWED FOR SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF ALL TELECOMMUNICATION SYSTEMS.

13– THE CONTRACTOR SHALL TAKE THE RESPONSIBILITIES OF GENERAL INTEGRATOR FOR ALL THE SUB–SYSTEMS AND EQUIPMENT WITHIN THE SCOPE OF WORK INCLUDING INTERFACES WITH OTHER SYSTEMS.

14– ALL TELECOMMUNICATION SYSTEMS SHALL BE FED FROM UNINTERRUPTED POWER SUPPLY (UPS).

15– CONDUIT SHALL BE SIZED ACCORDING TO CLAUSE 4.4.2.4 OF EIA/TIA 569 STANDARD AS GIVEN BELOW.

CONDUIT TRADE SIZE		CONDUIT SIZING MAX.NUMBER OF CABLES BASED UPON ALLOWABLE FILL									
		CABLE OUTSIDE DIAMETER,mm (in)									
		3.3	4.6	5.6	6.1	7.4	7.9	9.4	13.5	15.8	17.8
mm.	inch	(.13)	(.18)	(.22)	(.24)	(.29)	(.31)	(.37)	(.53)	(.62)	(.70)
21	(3/4)	6	5	4	3	2	2	1	0	0	0
27	(1)	8	8	7	6	3	3	2	1	0	0
35	(1 1/4)	16	14	12	10	6	4	3	1	1	1
41	(1 1/2)	20	18	16	15	7	6	4	2	1	1
53	(2)	30	26	22	20	14	12	7	4	3	2

16– EN 50174–2 RECOMMENDATIONS SHALL BE FOLLOWED FOR SEPARATION DISTANCE BETWEEN POWER AND VOICE/LAN NETWORK CABLES IN GIVEN BELOW TABLE.

TYPE OF INSTALLATION	MINIMUM SEPERATION DISTANCE (mm.)		
	WITHOUT METALLIC DIVIDER	WITH METALLIC DIVIDER	WITH STEEL DIVIDER
UNSCREENED POWER CABLE AND UNSCREENED COMMUNICATION CABLE	200	100	50
UNSCREENED POWER CABLE AND SCREENED COMMUNICATION CABLE	50	20	5

17– MOUNTING HEIGHT OF FOLLOWING DEVICES SHALL BE INSTALLED AT THE INDICATED HEIGHT FROM FINISHED FLOOR LEVEL (F.F.L) TO THE BOTTOM OF DEVICE UNLESS OTHERWISE MENTIONED OR INSTRUCTED:

– TELECOMMUNICATION OUTLET FOR TELEPHONE/DATA------ 250mm/AS PER THE HEIGHT OF ELECTRICAL SOCKET
– BUILDING DISTRIBUTOR---------------------------- FLOOR STANDING
– ANPR CAMERA--------------------------------- 450mm / AS PER MANUFACTURER
– IP CAMERA---------------------------------- 1500mm / AS PER MANUFACTURER
– LONG RANGE READER---------------------------2200mm / AS PER MANUFACTURER
– TRAFFIC LIGHT ON BARRIER----------------------1800mm / AS PER MANUFACTURER

18– COLOUR, SHAPE & MOUNTING HEIGHT OF FACE PLATE OF TELECOM SOCKET OUTLETS SHALL MATCH WITH ELECTRICAL SOCKET OUTLET

19– WHERE ANPR CAMERA, IP CAMERA AND LONG RANGE READER ARE SHOWN SIDE BY SIDE THEY SHALL BE INSTALLED IN SAME VERTICAL LINE ON SAME STEEL POST.

20– AT LEAST 30 DAYS OF RECORDING CAPACITY SHALL BE PROVIDED FOR ALL CCTV CAMERAS WITH 25% EXPANSION CAPACITY.

21– ALL TELECOMMUNICATION RACKS SHALL BE FED FROM UNINTERRUPTED POWER SUPPLY (UPS) TO AVERT ANY INTERRUPTION IN SECURITY SYSTEM.

22– CONTRACTOR SHALL SUBMIT CO–ORDINATION SHOP DRAWING OF TELECOMMUNICATION LAYOUT WITH MOUNTING HEIGHTS & INSTALLATION DETAIL OF EACH EQUIPMENT AS PER THE MANUFACTURER'S RECOMMENDATION PRIOR EXECUTION OF WORK.

23– CONTRACTOR SHALL CO–ORDINATE WITH HVAC LAYOUT FOR PLACEMENT OF RACKS IN SECURITY ROOM.

LEGEND:

STRUCTURED CABLING NETWORK

TO2	TWO PORT RJ45 CAT6A UTP TELECOMMUNICATION OUTLET FOR TELEPHONE AND DATA, FLUSHED IN WALL
SR PB	PULL BOX FOR SECURITY ROOM
TB PB	PULL BOX FOR TICKET BOOTH
⏚	EARTHING
☒	BUILDING DISTRIBUTOR

BD–AB–TP
- TOLL PLAZA
- ADMIN BUILDING
- BUILDING DISTRIBUTOR

CLOSED CIRCUIT TELEVISION SYSTEM (CCTV):

▭	IP FIXED COLOR BULLET CAMERA, POLE MOUNTED
▬	AUTOMATIC NUMBER PLATE RECOGNIZATION (ANPR) CAMERA, POLE MOUNTED
●	POLE WITH BRACKETS FOR ANPR, CCTV CAMERAS LONG RANGE READER

ACCESS CONTROL SYSTEM

▯	BOOM BARRIER WITH BUILT–IN CONTROLLER
⬚	INDUCTIVE SAFETY LOOP VEHICLE DETECTOR WITH UNDERGROUND CABLE
NAC	NETWORK ACCESS CONTROLLER
■	UHF LONG RANGE RFID INTEGRATED READER
OD	OUTDOOR DISPLAY
🟩🟥	TRAFFIC SIGNAL LIGHT
⊡	MANUAL / EXIT PUSH BUTTON FOR BOOM BARRIER
🖥	TOLL STATION WORK STATION WITH SOFTWARES
P	POS PRINTER WITH PAPER RECEIPT
DRW	UHF RFID DESKTOP READER / WRITER FOR TAG

CABLE SHEDULE

Ⓐ	4 PAIR CAT6A UTP LSZH CABLE
Ⓑ	4 PAIR CAT6A UTP LSZH PATCH CORD
Ⓒ	MANUFACTURER'S RECOMMENDADED CABLE

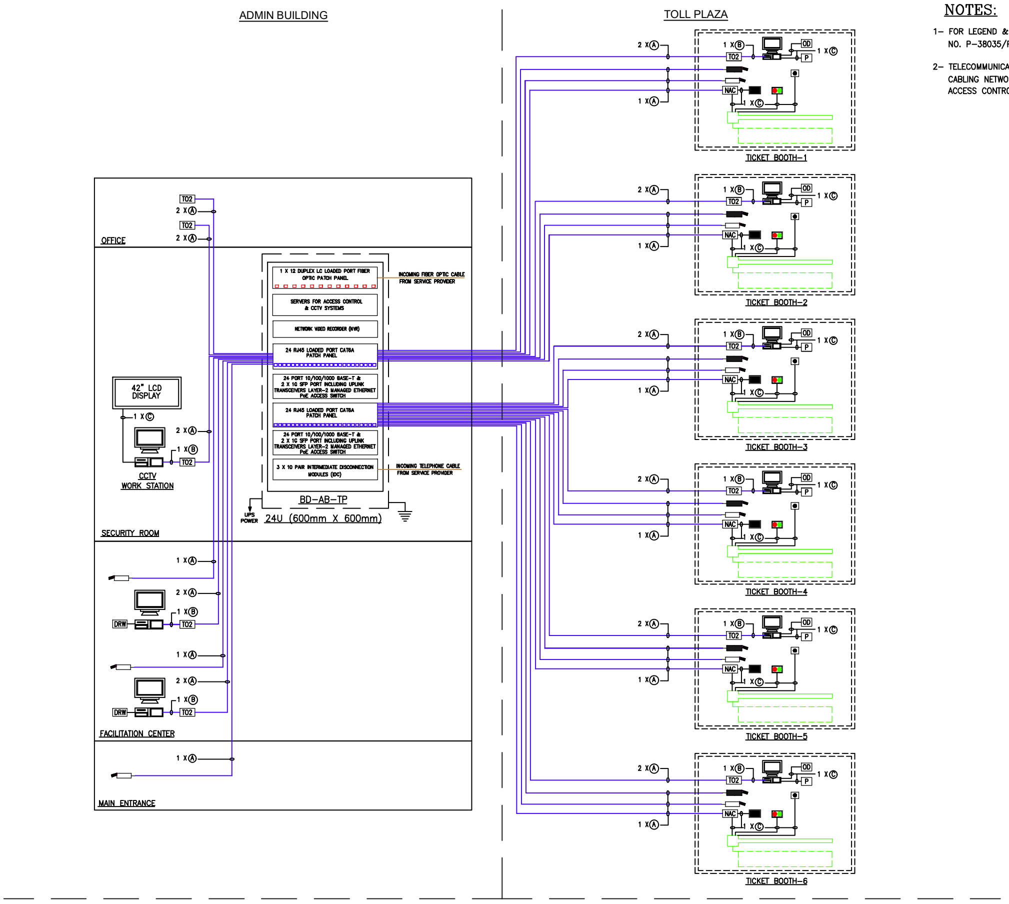
LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

D			DRAWN	
C			DESIGNED	
B			CHECKED	
A			APPROVED	
0	OCT.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE		SCALE
LEGEND & GENERAL NOTES FOR TELECOMMUNICATION SYSTEMS		NTS
DATE	DWG. No.	REVISION
OCT.,20	P–38035/P2/50B/PD/00T001	0



NOTES:

1– FOR LEGEND & GENERAL NOTES REFER DRAWING NO. P–38035/P2/50B/PD/00T001

2– TELECOMMUNICATION SYSTEMS COMPRISES OF STRUCTURED CABLING NETWORK, CLOSED CIRCUIT TELEVISION (CCTV) & ACCESS CONTROL SYSTEM.

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

REV.	DATE	DESCRIPTION
D		
C		
B		
A		
0	OCT.,2020	PRELIMINARY DESIGN

DRAWN
DESIGNED
CHECKED
APPROVED

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

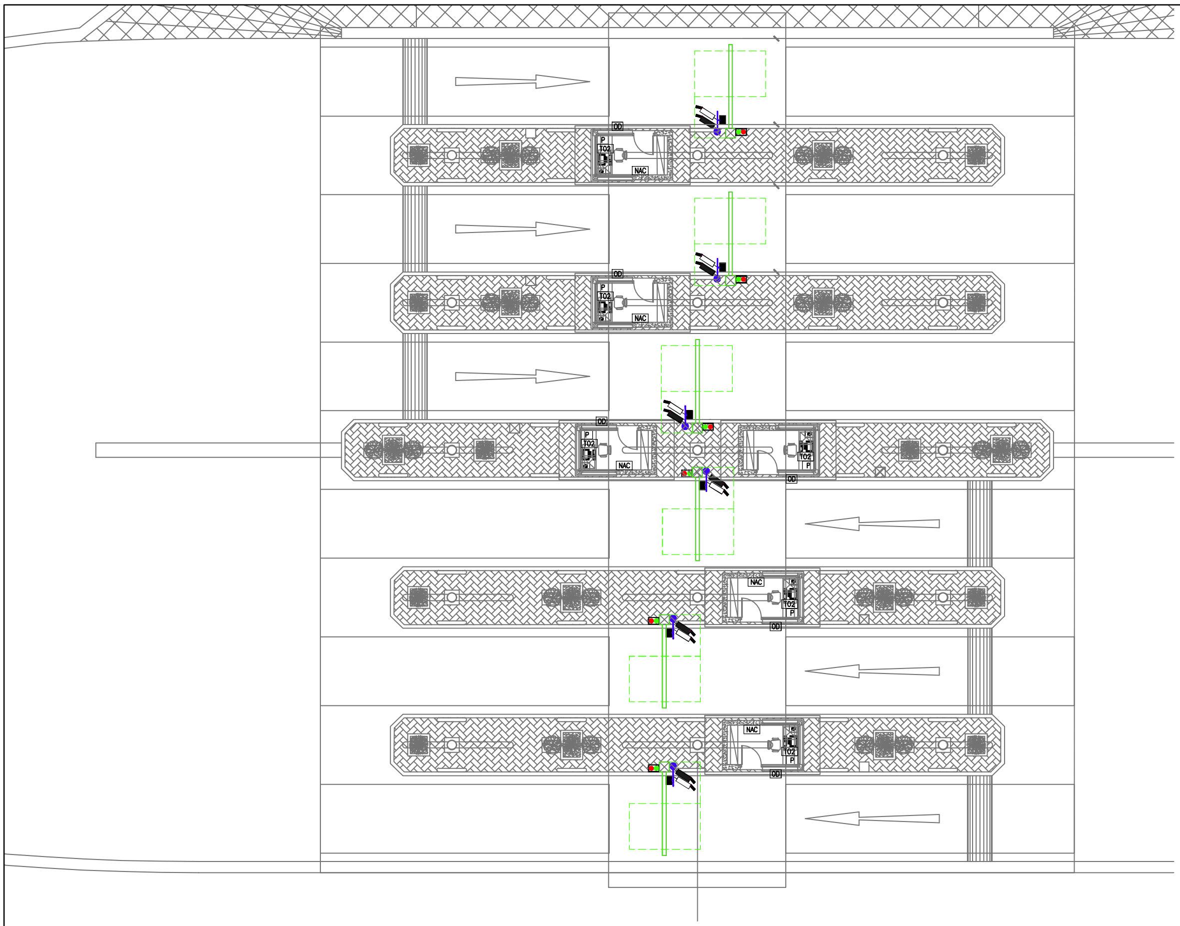
TITLE
CONCEPTUAL SCHEMATIC DIAGRAM FOR TELECOMMUNICATION SYSTEMS

SCALE
NTS

DATE
OCT.,20

DWG. No.
P–38035/P2/50B/PD/00T002

REVISION
0



NOTES:

1- FOR LEGEND & GENERAL NOTES REFER DRAWING NO. P-38035/P2/50B/PD/00T001

2- FOR CONCEPT SCHEMATIC DIAGRAM OF TELECOMMUNICATION SYSTEMS REFER DRAWING NO. P-38035/P2/50B/PD/00T002

3- TELECOMMUNICATION SYSTEMS COMPRISES OF STRUCTURED CABLING NETWORK, CLOSED CIRCUIT TELEVISION (CCTV) & ACCESS CONTROL SYSTEM.

4- FOR EXTERNAL TELECOMMUNICATION SYSTEMS LAYOUT REFER DRAWING NO. P-38035/P2/50V/PD/01E003 AND P-38035/P2/50V/PD/01E004

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NESPAK
NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	
C			DESIGNED	
B			CHECKED	
A			APPROVED	
0	OCT.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE
TOLL PLAZA
TELECOMMUNICATION SYSTEMS
LAYOUT

SCALE
1:150

DATE
OCT.,20

DWG. No.
P-38035/P2/50B/PD/01T001

REVISION
0

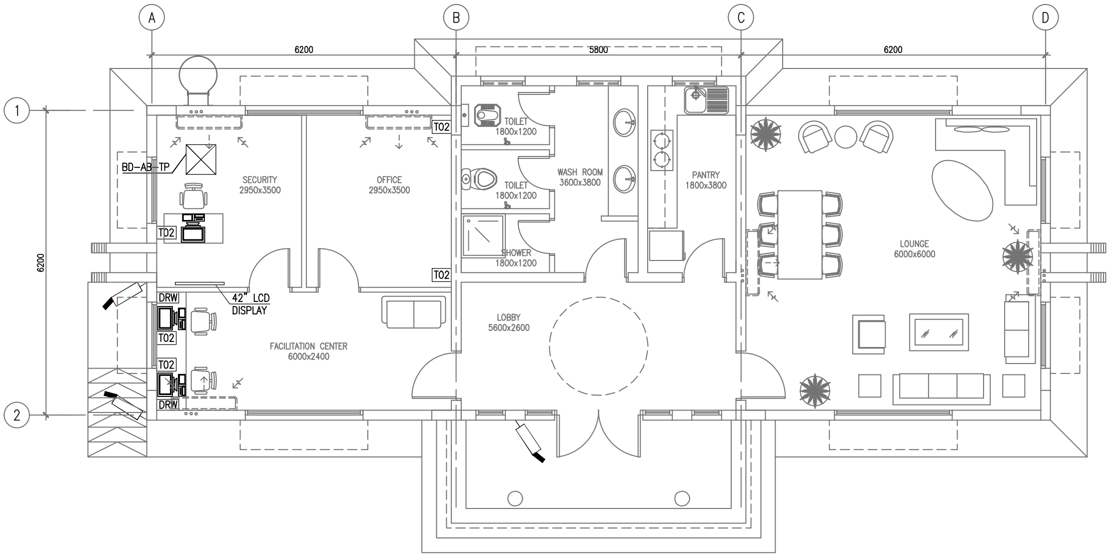
N

NOTES:

1- FOR LEGEND & GENERAL NOTES REFER DRAWING NO. P-38035/P2/50B/PD/00T001

2- FOR CONCEPT SCHEMATIC DIAGRAM OF TELECOMMUNICATION SYSTEMS REFER DRAWING NO. P-38035/P2/50B/PD/00T002

3- TELECOMMUNICATION SYSTEMS COMPRISES OF STRUCTURED CABLING NETWORK, CLOSED CIRCUIT TELEVISION (CCTV) & ACCESS CONTROL SYSTEM.



LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

D			DRAWN	
C			DESIGNED	
B			CHECKED	
A			APPROVED	
0	OCT.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE		SCALE
ADMIN BUILDING GROUND FLOOR TELECOMMUNICATION SYSTEMS LAYOUT		1:75
DATE	DWG. No.	REVISION
OCT.,20	P-38035/P2/50B/PD/02T001	0

PLUMBING DRAWINGS

1 - GENERAL NOTES (PLUMBING):

1 – PLUMBING WORKS SHALL BE CO–ORDINATED WITH OTHER SERVICES SUCH AS ELECTRICAL, HVAC ETC.TO AVOID CONFLICT OR INTERFERENCE BEFORE EXECUTION.

2 – PIPE PASSING THROUGH WALLS, SLABS OR ROOF SHALL PASS THROUGH SLEEVES AS SPECIFIED

3 – PROVIDE WALL CLEAN OUT (WCO) ON ALL VERTICAL STACKS OF WASTE, SOIL & ROOF DRAINAGE ON EACH FLOOR.

4 – DRAINAGE STACKS SHALL BE CONNECTED TO UNDERGROUND DRAIN PIPE BY 90° LARGE/LONG RADIUS BEND OR TWO 45° BENDS AS PER SITE CONDITIONS.

5 – PIPE SIZES ARE IN MILLIMETERS.

6 – SIZE OF FLOOR DRAIN UNLESS OTHERWISE SPECIFIED SHALL BE SAME AS THE SIZE OF OUTLET DRAIN PIPE.

7 – WHEREVER FLOOR DRAIN/TRAP IS SHOWN,SLOPE FLOOR TOWARDS DRAIN, AFTER COORDINATING WITH ARCH/ENGINEER.

8 – VENT PIPES THROUGH ROOF SHALL BE TERMINATED AT LEAST 600mm ABOVE FINISHED ROOF LEVEL & NOT LESS THAN 300mm. FROM VERTICAL SURFACE EACH VENT TERMINAL SHALL BE MADE WATER TIGHT WITH THE ROOF BY PROPER FLASHING CLAMPING AS PER ARCH DETAILS.

9 – WHERE THE CHANGE OF DIRECTION IS 45° OR LESS,IT IS NOT NECESSARY TO PROVIDE A CLEAN OUT.BUT WHEN THE CHANGE IN DIRECTION IS MORE THAN 45°,A CLEAN OUT SHOULD BE REQUIRED.

10 – CLEAN OUTS SHALL BE PROVIDED FLUSH WITH FLOORS.

11 – ALL TRAPS AND FLOOR DRAINS SHALL HAVE A WATER SEAL NOT LESS THAN 50mm.

12 – PROVIDE PRESSURE RELIEF VALVES OR ENERGY SHUT OFF DEVICES FOR ALL EQUIPMENT USED FOR THE HEATING OR STORAGE OF HOT WATER.

13 – PROVIDE GATE VALVES ON EACH ENTRY TO TOILETS AND ON THE LONG RUNS IN TOILETS WHETHER SHOWN ON DRAWING OR NOT.

14 – SEWER LINE SHALL BE LAID AND MANHOLES SHALL BE CONSTRUCTED AFTER CHECKING AND COORDINATING WITH EXISTING MANHOLE.

15 – PIPE SLOPE OF WASTE & DRAIN SHALL BE AS PER INTERNATIONAL PLUMBING CODE.

2 - LEGEND:

SYMBOL	DESCRIPTION
	ASIAN WATER CLOSET
	BIB TAP
—·—·—·—	COLD WATER PIPE
	CHECK VALVE OR NON–RETURN VALVE
——‖	CLEANOUT PLUG
◉	CARBONDIOXIDE PORTABLE EXTINGUISHER
——▷——	DIRECTION OF FLOW
⊖	DRY CHEMICAL POWDER PORTABLE EXTINGUISHER
————	DRAIN PIPE
	EUROPEAN WATER CLOSET
——▨	FLOOR DRAIN
——●	FLOOR TRAP
	FLOAT VALVE
————	FLOOR CLEANOUT
⊗	FOAM PORTABLE EXTINGUISHER
	ELECTRIC WATER HEATER
——☒——	GATE VALVE IN CHAMBER
	GATE VALVE ON HORIZONTAL PIPE
	GATE VALVE IN VERTICAL PIPE
——▣——	GULLY TRAP
——☒——	GREASE TRAP
—··—··—	HOT WATER PIPE
	KITCHEN SINK
– – –(MH)– – –	MANHOLE
————⊃	PIPE RISER WITH BEND
————	RAIN WATER PIPE
– – – – – –	SEWER PIPE
————	SOIL PIPE
	STRAINER
————	WASTE PIPE
	WASH BASIN

3 - ABBREVATIONS:

SYMBOL	DESCRIPTION
B/G	BELOW GROUND
CW	COLD WATER PIPE
CWAC	COLD WATER PIPE ABOVE CEILING
C/HWAC	COLD & HOT WATER ABOVE CELLING
CWR	COLD WATER RISER
CV	CHECK VALVE
CO	CLEANOUT PLUG
ø	DIAMETER OF PIPE
EWC	ELECTRIC WATER COOLER
EWH	ELECTRIC WATER HEATER
F/B	FROM BELOW
F/A	FROM ABOVE
FCO	FLOOR CLEANOUT
FD	FLOOR DRAIN
FT	FLOOR TRAP
GV	GATE VALVE
HW	HOT WATER PIPE
HWAC	HOT WATER PIPE ABOVE CEILING
HWR	HOT WATER RISER
RWP	RAIN WATER PIPE
RWO	RAIN WATER OUTLET
SP	SOIL PIPE
S/S	SOIL STACK
SP@C/L	SOIL PIPE AT CEILING LEVEL
T/B	TO BELOW
T/A	TO ABOVE
VAC	VENT ABOVE CEILING
VP	VENT PIPE
V/S	VENT STACK
VAC	VENT PIPE ABOVE FALSE CEILING
WP	WASTE PIPE
W/S	WASTE STACK
WP@C/L	WASTE PIPE AT CEILING LEVEL

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

REV.	DATE	DESCRIPTION
D		
C		
B		
A		
0	SEP.,2020	PRELIMINARY DESIGN

DRAWN	UMAIR
DESIGNED	MOAZZAM
CHECKED	M.ADNAN
APPROVED	REHAN ZAMIN

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

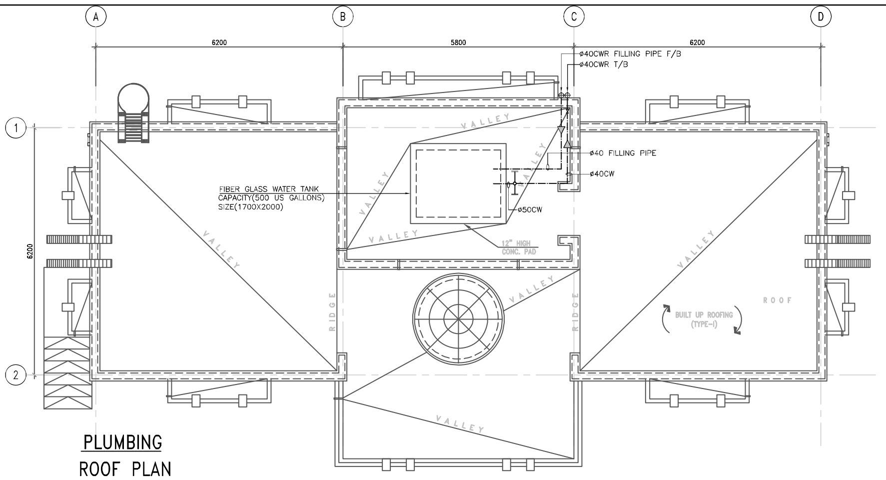
TITLE
ADMIN BUILDING
PLUMBING & FIREFIGHTING
NOTES LEGEND & ABBREVATION

SCALE
NTS

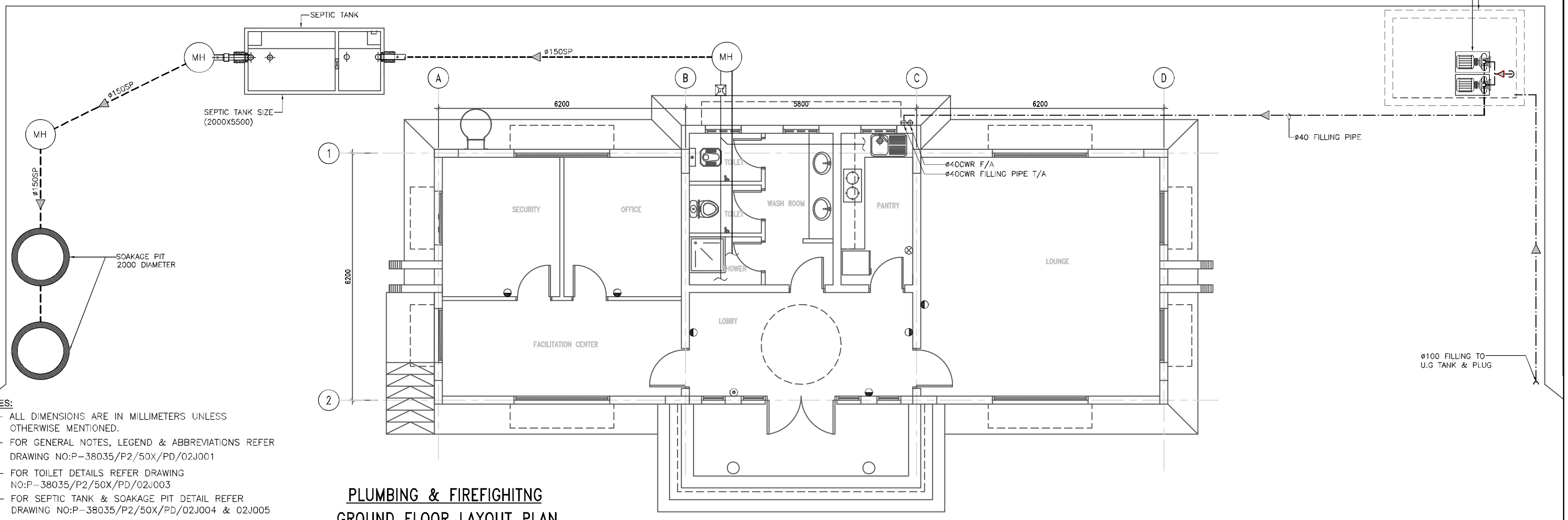
DATE
SEP.,20

DWG. No.
P–38035/P2/50X/PD/02J001

REVISION
0



PLUMBING
ROOF PLAN



NOTES:

1- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.
2- FOR GENERAL NOTES, LEGEND & ABBREVIATIONS REFER DRAWING NO:P-38035/P2/50X/PD/02J001
3- FOR TOILET DETAILS REFER DRAWING NO:P-38035/P2/50X/PD/02J003
4- FOR SEPTIC TANK & SOAKAGE PIT DETAIL REFER DRAWING NO:P-38035/P2/50X/PD/02J004 & 02J005
5- FOR MISCELLANEOUS DETAILS REFER DRAWING NO:P-38035/P2/50X/PD/02J006 &02J007

PLUMBING & FIREFIGHITNG
GROUND FLOOR LAYOUT PLAN

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

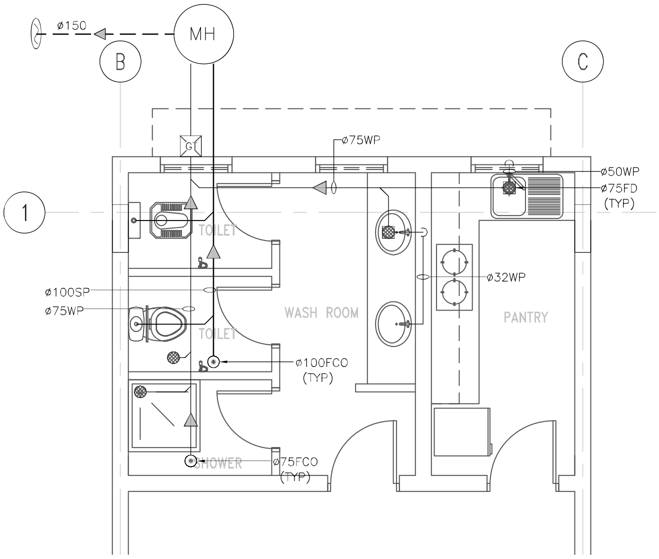
NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D		
C		
B		
A		
0	SEP.,2020	PRELIMINARY DESIGN
REV.	DATE	DESCRIPTION

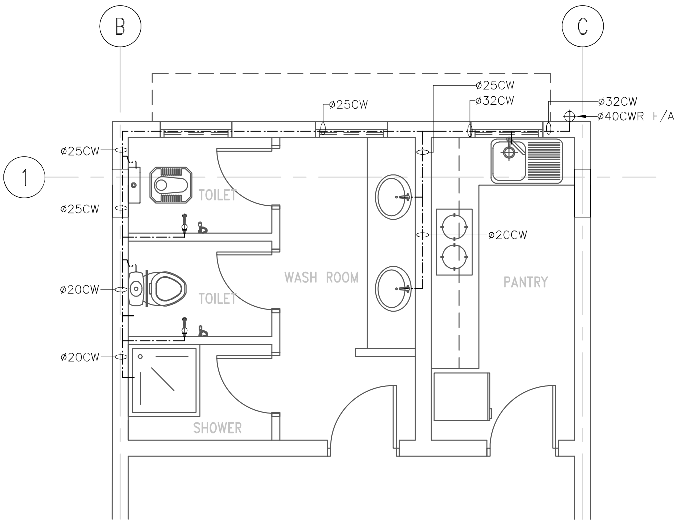
DRAWN	UMAIR
DESIGNED	MOAZZAM
CHECKED	M.ADNAN
APPROVED	REHAN ZAMIN

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE	ADMIN BUILDING GROUND FLOOR PLAN GROUND FLOOR & ROOF LAYOUT PLAN	SCALE 1:100 1:75
DATE SEP.,20	DWG. No. P-38035/P2/50X/PD/02J002	REVISION 0



TOILET DETAIL
SANITARY DRAINAGE



TOILET DETAIL
WATER SUPPLY

NOTES:

1– ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE MENTIONED.

2– FOR GENERAL NOTES, LEGEND & ABBREVIATIONS REFER DRAWING NO:P–38035/P2/50X/PD/02J001

3– FOR SEPTIC TANK & SOAKAGE PIT DETAIL REFER DRAWING NO:P–38035/P2/50X/PD/02J004 & 02J005

4– FOR MISCELLANEOUS DETAILS REFER DRAWING NO:P–38035/P2/50X/PD/02J006 &02J007

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D		
C		
B		
A		
0	SEP.,2020	PRELIMINARY DESIGN
REV.	DATE	DESCRIPTION

DRAWN	UMAIR
DESIGNED	MOAZZAM
CHECKED	M.ADNAN
APPROVED	REHAN ZAMIN

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

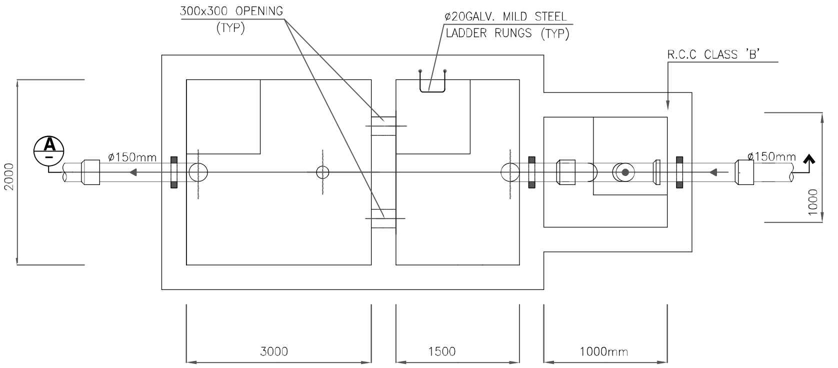
TITLE
ADMIN BUILDING
PLUMBING TOILET DETAILS
SANITARY DRAINAGE & WATER SUPPLY

SCALE
1:50

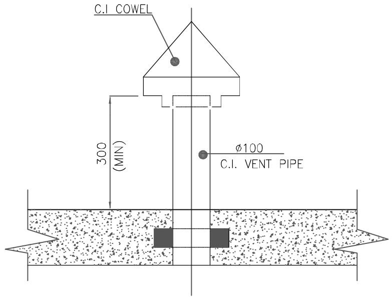
DATE
SEP.,20

DWG. No.
P–38035/P2/50X/PD/02J003

REVISION
0

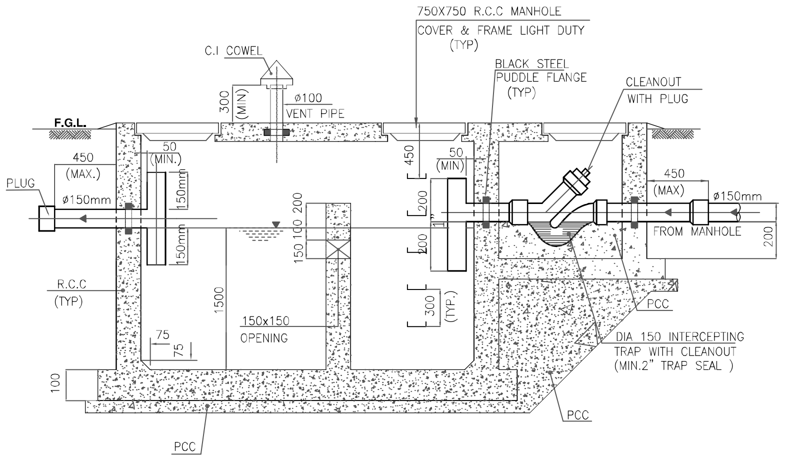


PLAN - SEPTIC TANK



TYP.VENT DETAIL

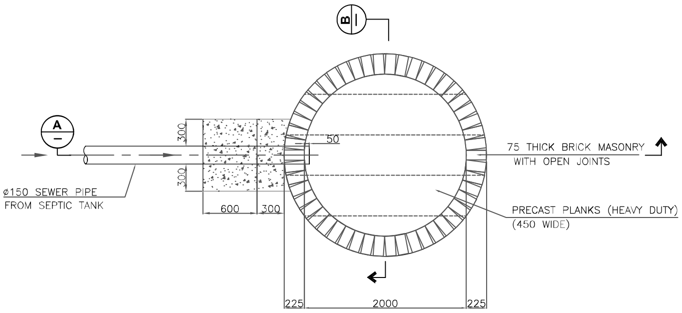
N.T.S.



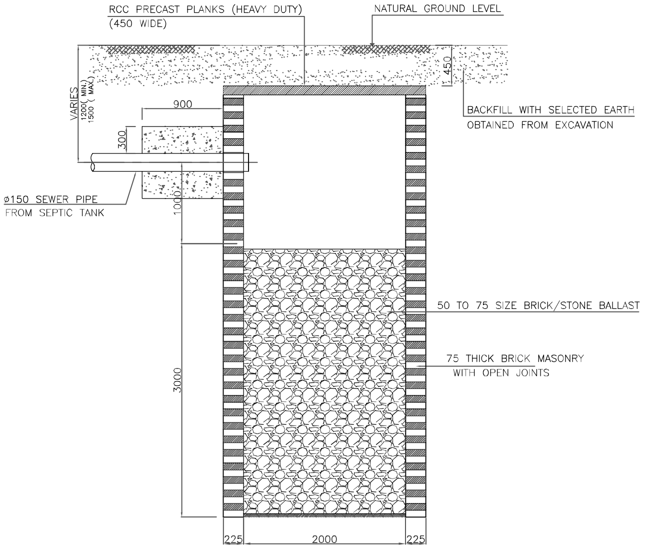
SECTION A-A

LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED	D			DRAWN	UMAIR	URBAN ROAD INITIATIVES IN KARACHI SUB-PROJECT 2 : EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUCTION
		C			DESIGNED	MOAZZAM	
		B			CHECKED	M.ADNAN	
		A			APPROVED	REHAN ZAMIN	
		0	SEP.,2020	PRELIMINARY DESIGN			
		REV.	DATE	DESCRIPTION			

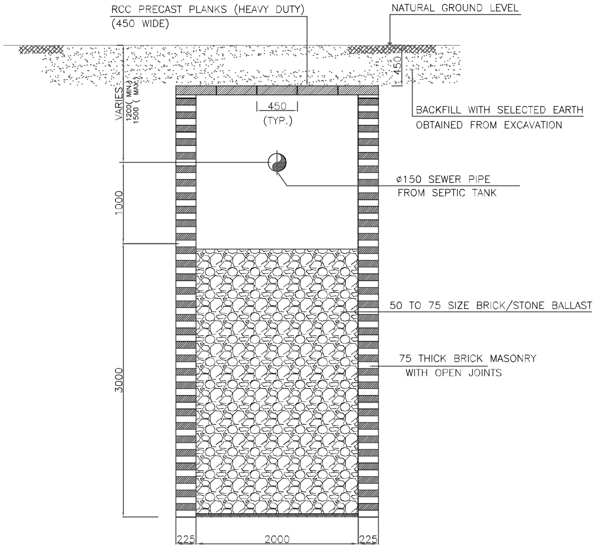
TITLE	ADMIN BUILDING SEPTIC TANK DETAILS	SCALE NTS
DATE SEP.,20	DWG. No. P-38035/P2/50X/PD/02J004	REVISION 0



PLAN
SOAKAGE PIT



SECTION A
SOAKAGE PIT



SECTION B
SOAKAGE PIT

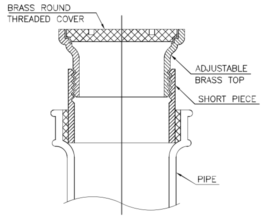
LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NESPAK
NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	UMAIR
C			DESIGNED	MOAZZAM
B			CHECKED	M.ADNAN
A			APPROVED	REHAN ZAMIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

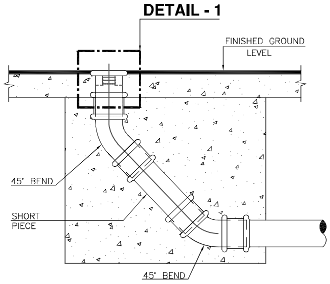
URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE		SCALE
ADMIN BUILDING SOAKAGE PIT SECTION & DETAILS		NTS
DATE SEP.,20	DWG. No. P-38035/P2/50X/PD/02J005	REVISION 0

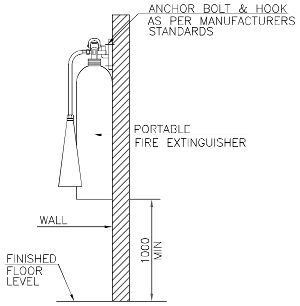


1 DETAIL

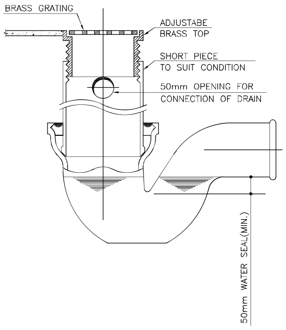
-



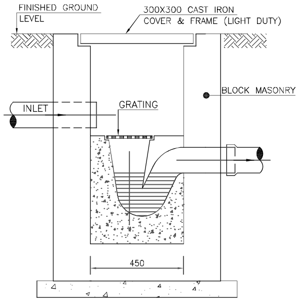
FLOOR CLEANOUT DETAILS



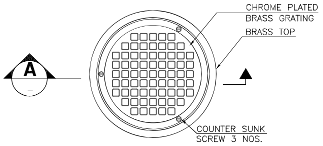
PORTABLE FIRE EXTINGUISHER MOUNTING DETAIL



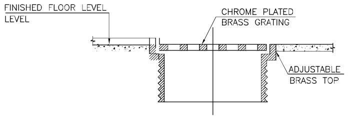
DETAIL-FLOOR DRAIN WITH TRAP



SECTIONAL DETAILS OF GULLY TRAP



PLAN CHROME PLATED BRASS GRATING COVER



A SECTION

-

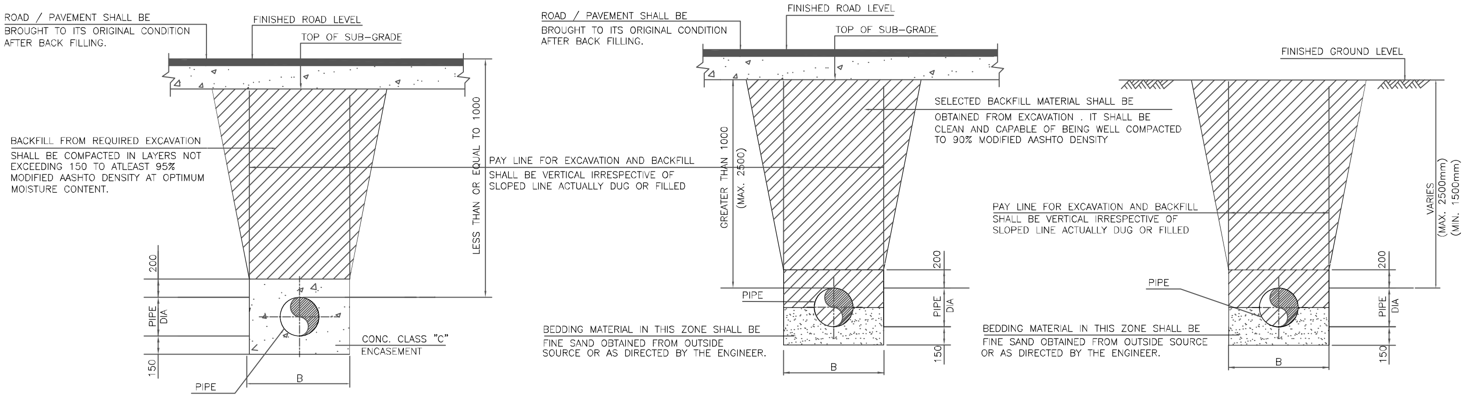
LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	UMAIR
C			DESIGNED	MOAZZAM
B			CHECKED	M.ADNAN
A			APPROVED	REHAN ZAMIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE	ADMIN BUILDING PLUMBING & FIREFIGHTING MISCELLANEOUS DETAILS (SHEET-1)		SCALE NTS
DATE SEP.,20	DWG. No. P-38035/P2/50X/PD/02J006		REVISION 0

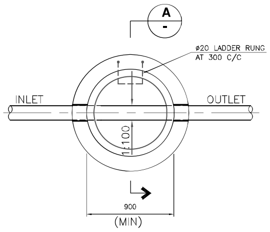


IN TRAFFIC AREA

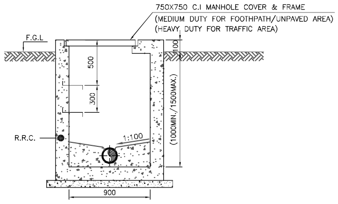
IN TRAFFIC AREA

IN NON TRAFFIC AREA

DETAILS OF TRENCH & PIPE BEDDING



PLAN
SEWER MANHOLE



A
-
SECTION

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

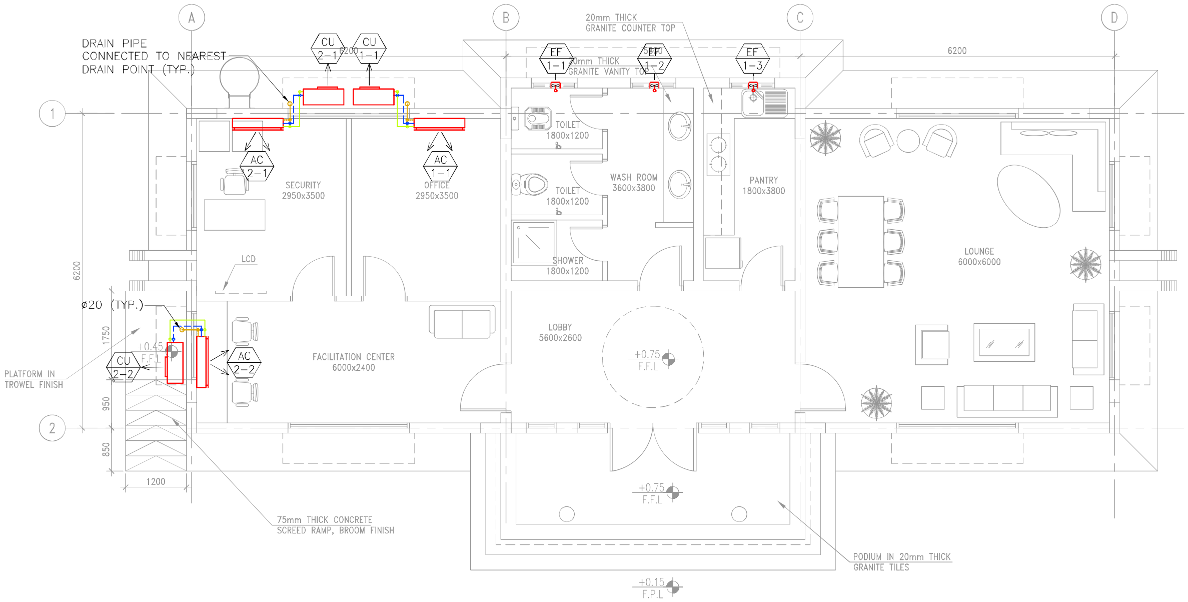
NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

D			DRAWN	UMAIR
C			DESIGNED	MOAZZAM
B			CHECKED	M.ADNAN
A			APPROVED	REHAN ZAMIN
0	SEP.,2020	PRELIMINARY DESIGN		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE	ADMIN BUILDING PLUMBING & FIREFIGHTING MISCELLANEOUS DETAILS (SHEET - 2)	SCALE 1:75
DATE SEP.,20	DWG. No. P-38035/P2/50X/PD/02J007	REVISION 00

HVAC DRAWINGS



GROUND FLOOR PLAN

SCALE=1:75

HVAC LEGEND

SYMBOL	DESCRIPTION
—D—	CONDENSATE DRAIN
—R/S—	REFRIGERANT SUCTION
- - R/D - -	REFRIGERANT DISCHARGE
EF 1-1	EXHAUST FAN CAPACITY CODE 1,QUANTITY 1
AC 1-1	INDOOR AC UNIT CAPACITY CODE 1,QUANTITY 1
CU 1-1	OUTDOOR CONDENSING UNIT CAPACITY CODE 1,QUANTITY 1

IMPORTANT NOTES

1-THIS DRAWINGS SHALL BE READ IN CONJUNCTION WITH NOTES, SPECIFICATIONS DETAILS, MANUFACTURER RECOMMENDATIONS, ALL OTHER CONCERNED SPECIALITY DRAWINGS INCLUDING BUT NOT LIMITED TO ARCHITECTURAL, ELECTRICAL, PLUMBING, MECHANICAL, STRUCTURAL, INFRASTRUCTURE & OTHER SERVICES FINAL DRAWINGS. COORDINATE HVAC WORKS WITH ALL OTHER CONCERNED TRADE'S WORKS PRIOR TO COMMENCEMENT OF WORKS. THIS DRAWING IS NOT VALID FOR FABRICATION, ERECTION, INSTALLATION AND THE LIKE BUT SHALL ONLY BE USED FOR ESTIMATION FOR BIDDING PURPOSE ONLY

2-ANY DISCREPANCIES IF NOTICED SHALL BE IMMEDIATELY BROUGHT IN TO THE NOTICE OF THE DESIGNER PRIOR TO COMMENCEMENT OF WORK.

3-COORDINATE THE ROUTING OF CONDENSATE DRAIN PIPES WITH OTHER SERVICES SO AS TO MAINTAIN MINIMUM SPECIFIED SLOPE (1:96) AND FREE FLOW.

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NESPAK NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

REV.	DATE	DESCRIPTION
D		
C		
B		
A		
0	SEP.,2020	PRELIMINARY DESIGN

DRAWN	K.A.MALIK
DESIGNED	UBAID
CHECKED	GHOUS
APPROVED	ATIF

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE		SCALE
ADMIN BUILDING HVAC SYSTEM GROUND FLOOR PLAN		1:75
DATE	DWG. No.	REVISION
SEP.,20	P-38035/P2/500/PD/02K001	0

URBAN ROAD INITIATIVES IN KARACHI

LOCAL GOVERNMENT & HTP DEPARTMENT

EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION

Technical Feasibility Study

FINAL REPORT

April, 2021

National Engineering Services Pakistan (Pvt.) Ltd.
13th Floor, N.I.C. Building, Abbasi Shaheed Road, Off. Shahrah-e-Faisal, Karachi
Phone: (0092 21) 99207277-84
Fax: (0092 21) 35651994
E-mail: karachi@nespak.com.pk
Web: http://www.nespak.com.pk

Clearance Code	4188/50W/M/24(21)	Doc No.	P-38035/50P/P2/FR/05	Rev No.	01

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

ADB	Asian Development Bank
AMC	Antecedent Moisture Condition
CBR	California Bearing Ratio
CSR	Composite Schedule of Rates
EIA	Environmental Impact Assessment
ESAL	Equivalent Standard Axle Load
FHWA	Federal Highway Administration
GoS	Government of Sindh
GCF	Green Climate Fund
GNSS	Global Navigation Satellite System
HCM	Highway Capacity Manual
JICA	Japan International Cooperation Agency
KCR	Karachi Circular Railway
KE	Karachi Electric Company
KMC	Karachi Metropolitan Corporation
KPT	Karachi Port Trust
KTIP	Karachi Transportation Improvement Project
KWSB	Karachi Water & Sewerage Board
LOS	Level of Service
NHA	National Highway Authority
NTRC	National Transport Research Center
PCPHPL	Passenger Cars per hour per lane
PCU	Passenger Car Unit
PMD	Pakistan Meteorological Department
PN	Pakistan Navy
PPP	Public Private Partnership
PTCL	Pakistan Telecommunication Corporation Ltd.
RFP	Request for Proposal
ROW	Right-of-Way
SRB	Sindh Revenue Board
SSGC	Sui Southern Gas Company Ltd.
SST	Sindh Sales Tax
TOR	Terms of Reference
UTM	Universal Transverse Mercator
WGS	World Geographic System

LIST OF ANNEXURES

Annexure-1	Topographic Survey Report
Annexure-4	Geotechnical Investigation Report
Annexure-5	Letter from Official Assignee of the High Court of Sindh
Annexure-6	Design Criteria
Annexure-7	Hydrology Study Report

1.0 INTRODUCTION

Karachi is the largest city, main seaport and the financial center of Pakistan, as well as the capital of the province of Sindh. According to Karachi Metropolitan Corporation (KMC), the metropolitan area of Karachi is spread over 3,530 sq km and, has an estimated population of over 15 million as per Census 2017. It is one of the world's largest cities in terms of population. It is Pakistan's premier center for banking, industry, economic activity and trade and is home to Pakistan's largest corporations, including those involved in textiles, shipping, automotive, entertainment, the arts, fashion, advertising, publishing, software development and medical research.

The commercial activities generate large volume of traffic within the city. Considerable volume of heavy freight traffic is generated to and from the Karachi Port and industrial areas to the rest of the country.

In 1947, Karachi was populated on an area of 83 sq. km. which has presently expanded to 3,530 sq. km (Karachi Metropolitan Corporation website). Due to the growth in population and the size of the city, the developments led to increase in the number of vehicles on the road network.

The increase in population, industrialization and commercial activities in the city has resulted in rapid increase in all kinds of motorized traffic, and it has become imperative to avert further aggravation of the problems of the residents.

As per Japan International Cooperation Agency (JICA) funded Karachi Transportation Improvement Project (KTIP), 2030, Karachi roughly maintains a 10,000 km road network. This road space combined with poor maintenance, delayed repair work, poor quality construction, and absence of essential support functions creates problems in satisfying the traffic demand. There are many places where large numbers of commuters move at the same time from one location to another, however, the access roads and links offer very few choices and hence there is considerable congestion on the roads specially during the peak hours.

The urban transport needs of a city are cyclic in nature and largely depend on the travel behavior of the citizens. Although the trips made by private and para transit vehicles are increasing, the public transport system (buses / minibuses) caters to over 34% of the modal share in 2018 (Green Climate Fund (GCF) Funding Proposal document by the Asian Development Bank (ADB), 2018), down from 53.5% in 2008 (JICA, KTIP, 2030). Due to reduction in public transport services in

Karachi, the modal share of motorcycles has increased significantly from 16% in 2008 (JICA, KTIP, 2030) to 33% (GCF, ADB, 2018).

To mitigate the traffic congestion problems and provide quick and safe access to the commuters of Karachi, the Government of Sindh (GoS) through its Local Government & HTP Department, has initiated three urban road projects under Public Private Partnership (PPP) mode under the Urban Road Initiatives (URI). These three (03) sub-projects are:

1. **Sub-project 1:** Link Road from Korangi (from KPT Interchange to PAF Airmen Academy),
2. **Sub-project 2:** Expressway from Mauripur Road (end of Lyari Expressway) to Y Junction (Kakapir Road / Mauripur Rd Intersection), and
3. **Sub-project 3:** Interchange at ICI Bridge Intersection.

This report discusses the technical feasibility of **Sub-project 2 (Expressway from Mauripur Road)**.

1.1 Project Description

Mauripur Road is one of the busiest roads with heavy traffic plying (to / from Karachi Port). Cargo traffic from the East and West wharves of Karachi Port use this road for onward journey to up-country via Northern Bypass or Hub Road. The construction of Lyari Expressway (which terminates at Mauripur Road) has increased the traffic load on this road since Lyari Expressway provides fast and convenient access from Mauripur Road to Garden, Sohrab Goth and beyond.

Mauripur Road is also the only direct connection available to Northern Bypass and recreational facilities like Hawksebay, Sandspit, Manora and other beach resorts. There are also many industrial units located on Mauripur Road between Kakapir Road and PAF Base Masroor, which carry a large number of heavy vehicles. The presence of heavy industrial units along this stretch of the road contributes to significant delays for all modes of traffic.

To alleviate traffic congestion on this stretch of the road, a bypass road for mostly light / private vehicles from the junction of Mauripur Road / Kakapir Road up to Lyari Expressway has been planned, which will significantly reduce the traffic on Mauripur Road and provide direct connectivity with Lyari Expressway.

The proposed improvement aims to boost economic activity / tourism and improve the traffic management in Mauripur and surrounding areas. The construction of this corridor will alleviate traffic congestion as the proposed expressway will also have its connectivity with Lyari Expressway. Once the proposed expressway is constructed and connected with Mauripur Road and Lyari Expressway, the overall traffic load in Mauripur area will be streamlined and people of Karachi and business community will be the overall beneficiary.

Figure 1-1 below shows the project location map.

1.2 Project Objectives

The GoS thru the Local Government & HTP Department has planned to construct this project to alleviate the congestion issues along this corridor by providing an alternate access to traffic traveling to / from Hawkesbay, Manora and adjacent areas. The project objective is to facilitate traffic coming from and going to Lyari Expressway and provide relief to traffic generated due to the presence of recreational areas around Mauripur.

1.3 Scope of Work

The scope of works for technical study cover, but are not be limited to the following:

- Reconnaissance Survey,
- Data Collection / Coordination with local agencies and stakeholders,
- Alignment Study and Preparation of Inception report,
- Detailed Topographic Survey,
- Bathymetry Survey,
- Traffic Survey,
- Geotechnical / Soil Investigation Survey,
- Preliminary Design of Roads and allied civil works,
- Preliminary Structural designs,
- Preliminary Electrical designs,
- Preliminary Communication and HVAC designs (Administration Building of Toll Plaza),
- Preliminary Cost Estimates,
- Technical Feasibility Study Report, and
- Environmental and Social Impact Assessment (separate document).

Figure 1-1: Project Location Map

1.4 Project Deliverables

The contract agreement was signed on October 15, 2020, while the letter of award was issued in June 2020. The project deliverables from the contract signing date and as per the Terms of Reference (TOR), comprise of the following:

Table 1-1: Project Deliverables (from signing of Agreement)

Phase	Timeline	Date
Phase-1: Feasibility		
Inception Report	One week	22-Oct-20
Technical Feasibility Study	4 months	12-Feb-21
Environment and Social Impact Assessment	5.5 months	29-Mar-21
Financial Viability Assessment Report	6 months	13-Apr-21
PPP Options Analysis Report	6 months	13-Apr-21
Legal and Regulatory Assessment Report	8 months	12-Jun-21
Phase-2: Transaction Advisory		
Marketing & Submission of Procurement Package	9 months	12-Jul-21
Submission of Bid Evaluation Report	11 months	10-Sep-21
Issuance of Letter of Award/Acceptance	12 months	10-Oct-21
Phase-3: Transaction Negotiation and Financial Closure		
Transaction negotiation and Signing of Concession Agreement	13 months	09-Nov-21
Financial Close	18 months	08-Apr-22

1.5 Report Outline

This report outlines the technical feasibility of the proposed project and elaborates on the proposed methodology. It includes information on surveys conducted for the project as well as the current site conditions including utility locations.

- Details of surveys including Reconnaissance Survey, Topographic Survey, Bathymetry and Traffic Survey,
- Geotechnical / soil investigations,
- Identification of Existing Utilities, relocation, and estimates,
- Stakeholder consultation,
- Project Design including Preliminary Geometric, Pavement & Structural Design for Civil Works and Allied Electrical Works,
- Details about Intersection Improvements,
- Embankment / Revetment design,
- Toll plaza / administration building design,
- Electrical / Communication, HVAC systems design,
- Land Acquisition Requirement, and
- Cost estimates based on Preliminary Design.

2.0 SURVEYS

2.1 Reconnaissance Survey

A series of reconnaissance surveys were performed by Engineers and Planners from NESPAK to get information about the existing traffic and road conditions and Land-use within the Project Area. During these surveys, photographs of various features and places were captured. Important locations such as intersections, geometric layout & traffic bottlenecks were observed.

During the site visits, information regarding the flow of traffic, traffic control method, traffic mix, on-street parking and encroachments was collected. The pavement conditions & geometrical features were also observed. Presently, there are no hard encroachments within the project limit. Some soft encroachments were found near Lyari Expressway bridge as shown in **Figure 2-1** below. The data collected was preserved for the purpose of design in the form of sketches drawn on site during reconnaissance, written notes and photographs.

Figures 2-1 thru **2-4** below show some of the reconnaissance survey activities.

Figure 2-1: Area near Lyari Expressway

Figure 2-2: Area near TP-3

Figure 2-3: Marine Academy Jetty

Figure 2-4: Kakapir Road towards Y-Junction

2.2 Topographic Survey

Topographic surveys required for preliminary design were carried out using modern electronic surveying equipment, and data obtained was processed and recorded in digital form. Based on reconnaissance survey data, available maps / information and approved concept plans, a detailed topographic survey program was prepared.

The linear measurement units used in survey and mapping work are in metric system of units and the angular measurement are in degrees, minutes and second of arc.

Local control points were established prior to actual commencement of surveying and mapping of the project area. The values obtained in World Geographic System (WGS) were transferred to Universal Transverse Mercator (UTM) Systems.

The coordinates & location of established control points are presented in **Table 2-1** and **Table 2-2** below in WGS-84 and UTM coordinate system, respectively.

Table 2-1: List of Control Points Coordinates in WGS 84

S. No.	Control Point	Latitude (DMS)	Longitude (DMS)	Elevation (m)
1	P2/BM T2	24° 52' 24.920" N	66° 58' 14.677" E	6.890
2	P2/CP T1	24° 52' 15.004" N	66° 58' 35.566" E	8.212
3	P2/CP01	24° 51' 57.182" N	66° 59' 3.022" E	5.384
4	P2/CP02	24° 52' 15.121" N	66° 58' 35.376" E	8.321
5	P2/CP03	24° 52' 21.322" N	66° 58' 28.068" E	16.052
6	P2/CP04	24° 52' 31.146" N	66° 58' 4.171" E	15.491
7	P2/CP04A	24° 52' 24.480" N	66° 58' 19.743" E	7.909
8	P2/CP05	24° 52' 10.499" N	66° 58' 3.576" E	4.329
9	P2/CP06	24° 51' 34.473" N	66° 57' 2.964" E	5.810
10	P2/CP07	24° 52' 5.211" N	66° 55' 5.494" E	6.283
11	P2/CP08	24° 51' 55.108" N	66° 54' 59.165" E	5.318
12	P2/CP09	24° 51' 37.948" N	66° 54' 59.472" E	4.493
13	P2/CP10	24° 51' 28.848" N	66° 55' 32.358" E	2.853

Table 2-2: List of Control Points Coordinates in UTM Zone 42N

S. No.	Control Point	Easting (m)	Northing (m)	Elevation (m)
1	P2/BM T2	294991.422	2752477.976	6.890
2	P2/CP T1	295573.265	2752164.140	8.212
3	P2/CP01	296335.851	2751604.335	5.384
4	P2/CP02	295567.967	2752167.821	8.321
5	P2/CP03	295365.662	2752361.683	16.052
6	P2/CP04	294699.380	2752673.960	15.491
7	P2/CP04A	295133.425	2752462.330	7.909
8	P2/CP05	294673.189	2752038.914	4.329
9	P2/CP06	292955.045	2750955.879	5.810
10	P2/CP07	289671.616	2751951.704	6.283
11	P2/CP08	289489.201	2751643.541	5.318
12	P2/CP09	289489.729	2751115.393	4.493
13	P2/CP10	290408.725	2750821.297	2.853

Topographic survey was drawn on appropriate scales and contour intervals. Planning and Design of the project has been carried out considering the following objectives:

- Development of site plans of Right-Of-Way (ROW) of the roads and service corridor,
- Observe and plot cross-sections of reaches of the roads at strategic locations,
- To establish ground control for road alignment and vertical profile,
- Preparation of survey plans on appropriate horizontal and vertical scales,
- Establishment of permanent benchmarks and reference points at site.
- Identification of all above ground existing services and utilities, located in the right-of-way, and their marking in survey maps / layout.
- approximate outline of water bodies - including drains, nullahs, rivers/ streams/ ponds etc. along with direction of flow, angle of skew and locations,
- Collect field measurement and digital representation of ground levels at appropriate distances / grids, and
- Mark location, orientation and levels of all existing features and structures.

The topographic survey report is attached as **Annexure-1** to this report.

2.3 Bathymetry Survey

Bathymetry was carried out using the latest surveying equipment (Echo Sounder), and data obtained was processed and recorded in digital form. A number of runs along the accessible area were performed along the shore. Levels obtained from the sounding were tied up with the datum of topographic survey and plotted on relevant maps using appropriate scale.

Figure 2-5 below shows the Bathymetric Survey near Salt Field. Details of the same are included in the Preliminary Design Drawings.

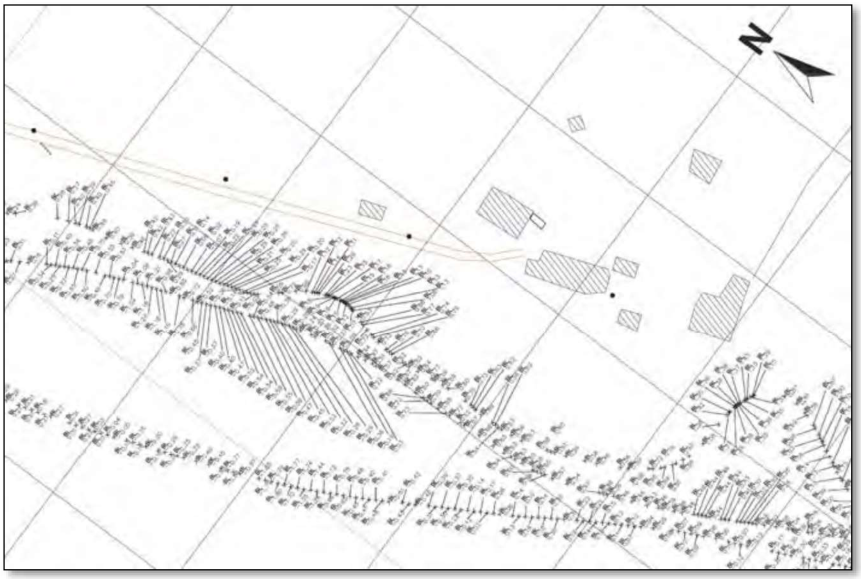


Figure 2-5: Bathymetric Survey near Salt Field

2.4 Geotechnical Investigations

2.4.1 General

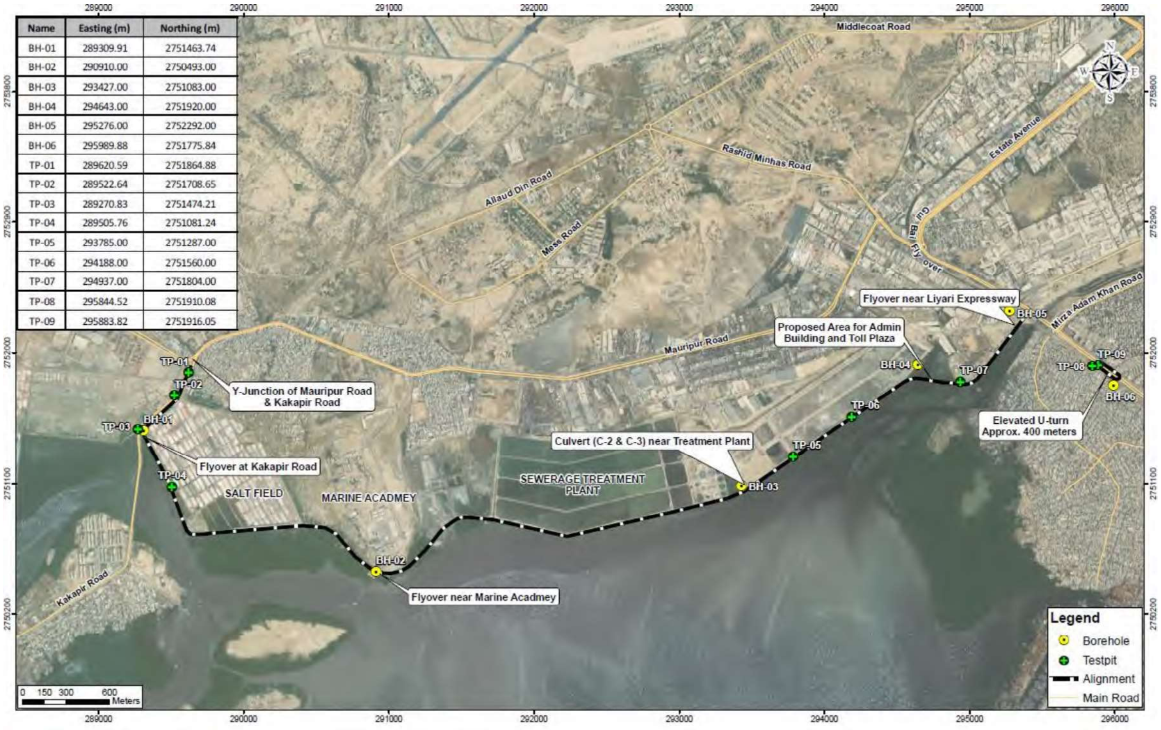
The geotechnical investigations are aimed to examine the surface and subsurface soils at the site proposed for pavements and structures. The study will summarize the core properties of the soil and its suitability for the proposed construction. The study specified an efficient and cost-effective system of foundation for structures and pavement design. Relevant ASTM/AASHTO standards were used for field and laboratory studies.

2.4.2 *Planning*

The geotechnical investigations were planned through execution of boreholes, test pits, field testing and sampling followed by appropriate laboratory testing. The investigations provided sufficient information about the condition and strength of various sub-strata. The frequency of tests was decided as per the project requirements/survey/review of available data. The laboratory testing was carried out by engaging a specialist Geotechnical Contractor on the basis of competitive bidding.

Figure 2-15 below shows the locations of bore holes and test pits.

Detailed Geotechnical Investigation Report is attached as **Annexure-4** to this report.



Name	Easting (m)	Northing (m)
BH-01	289309.91	2751463.74
BH-02	290910.00	2750493.00
BH-03	293427.00	2751083.00
BH-04	294643.00	2751920.00
BH-05	295276.00	2752292.00
BH-06	295989.88	2751775.84
TP-01	289620.59	2751864.88
TP-02	289522.64	2751708.65
TP-03	289270.83	2751474.21
TP-04	289505.76	2751081.24
TP-05	293785.00	2751287.00
TP-06	294188.00	2751560.00
TP-07	294937.00	2751804.00
TP-08	295844.52	2751910.08
TP-09	295883.82	2751916.05

Figure 2-6: Location of Boreholes and Tests-Pits

3.0 PROJECT ALIGNMENT

Mauripur Road is the only link that provides direct connection from Northern Bypass / Jinnah Bridge to the recreational facilities such as Manora, Hawkesbay, Sandspit etc. The need for an additional route was essential to provide relief to the traffic congestion problems.

As envisaged, start point of the project is junction of Lyari Expressway with Mauripur Road and end point is the Y-Junction of Mauripur Road / Kakapir Road. The alignment was aimed to link these two points through the back waters.

3.1 Alignment Options

Several options were explored regarding the alignment and connection of proposed road with the existing Mauripur Road (at the start and end points of the project). These options are as following:

3.1.1 Do-Nothing Option

Mauripur Road is one of the busiest roads in the southern parts of the city which serves heavy traffic to / from the Karachi Port. The stretch of Mauripur Road from the Gul-Bai Intersection/PAF Base Masroor up to Y-Junction of Kakapir and Mauripur Road is the only link that provides direct connectivity from the city to the Sandspit/Hawkesbay areas, and to the various Industrial and residential schemes near Hawkesbay. Moreover, there are many industrial units and a major truck stand located on this stretch of Mauripur Road (as shown in **Figure 5-1** below), which carries a large number of heavy vehicles. The loading and unloading is usually carried out near the truck stand which causes traffic congestion and contributes significant delays for all modes of traffic.

Currently, the existing Mauripur has a varied ROW of minimum width of 18 meters and maximum width of 90 meters approximately. The narrow 18m ROW (near PAF Masroor) creates heavy congestion for all modes of traffic. As the background traffic will increase over the years coupled with new developments in the newly formed Keamari District, the existing road infrastructure will not be able to handle the additional traffic. If no solution provided to the existing situation:

- Commuters will not have any alternate route,
- Considering the future growth of Hawkesbay Scheme the existing Mauripur road will not suffice to cater the future traffic demand,
- Commuters will continue to face significant delays and traffic

congestion, and

- Reduction in recreational activities at Hawkesbay/Sandspit beaches.

Figure 3-1: Truck Stand at Mauripur Road

3.1.1 Alignment Option-1: Elevated Bridge at Mauripur Road

This option considers an elevated structure at the existing Mauripur Road from the Gul-Bai Interchange to the Y-Junction, which has length of approx. 5.6 kilometers.

Some of the disadvantages of this option are as follows:

- Existing Mauripur Road has limited ROW (min. 18 meters) at various stretches of the road. The construction of flyover (2+2 lane) would approximately require 17 meters, thus not leaving any space for the at-grade traffic. This solution would only be possible after extensive land acquisition on both sides of the road (PAF Masroor Base is located on one side, while industries are located along the other side),
- There are high tension electric pylons located in the center median of the road on a stretch of about 4.7 km which would require horizontal and vertical clearances,
- The loading and unloading at truck stand are usually carried out by cranes and heavy machinery which would also require horizontal and vertical clearances,

- The cost of the elevated structure will be substantial (over PKR 10 Billion excluding the cost of utility relocation or land acquisition), and
- The need of an alternate route will not be fulfilled.

3.1.2 Alignment Option-2: Lyari Interchange (Concept-1)

This option considers connection with Lyari Expressway and Mauripur Road approx. 200m away from the Lyari Expressway interchange with Mauripur Road as shown in **Figure 5-2** below.

The only advantage of this option is direct access to the proposed expressway from existing Mauripur Road.

Some of the disadvantages of this option are as follows:

- Land will need to be acquired, and several factories / industries will be disturbed,
- This option will create conflict point and weaving issues between the exit of Mauripur Expressway and Ramp of Gul Bai Flyover, and
- One of the objectives of proposed expressway is direct access to Lyari Expressway. This option does not provide direct access to Lyari Expressway. Incoming and outgoing traffic on Lyari expressway would have to make U-turns on Mauripur road to access Mauripur Expressway and produce more congestion on existing Mauripur Road.

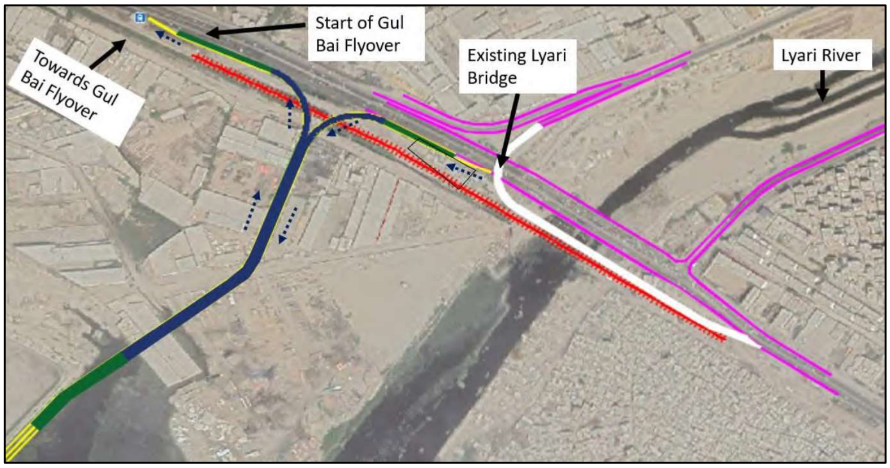


Figure 3-2: Option-2: Project Alignment thru Lyari Interchange (Concept-1)

3.1.3 Alignment Option-3: Lyari Interchange (Concept-2)

This option not only provides direct access to the commuters of Mauripur Road but also serves Lyari Expressway as shown in **Figure 5-3** below. The commuters of Lyari Expressway will have uninterrupted journey towards Hawkesbay. However, the proposed concept has some disadvantages which are as follows:

- The commuters coming from Hawkesbay do not have direct access towards Lyari Expressway, and they have to make U-turn under Gul-Bai Interchange,
- It is slightly difficult to construct the same as it would have two crossings over the river, and one crossing over the existing Lyari Expressway bridge and Railway bridge, and
- It may disturb Lyari River hydraulics.

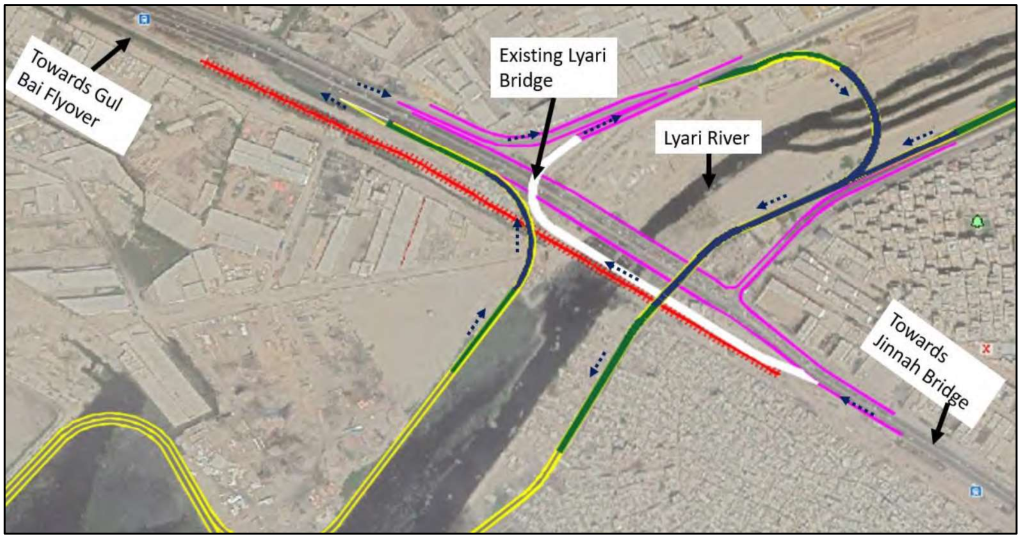


Figure 3-3: Project Alignment thru Lyari Interchange (Concept-2)

3.1.4 Alignment Option-4: Lyari Interchange (Concept-3)

Figure 5-4 below shows the layout of another option of connection with Lyari Interchange. This option will provide direct access to Mauripur Road and the existing bridge of Lyari expressway entrance will be utilized. This option will have less land acquisition impact as compared to other options detailed above. One drawback of this option was the provision of direct access to Lyari Expressway.

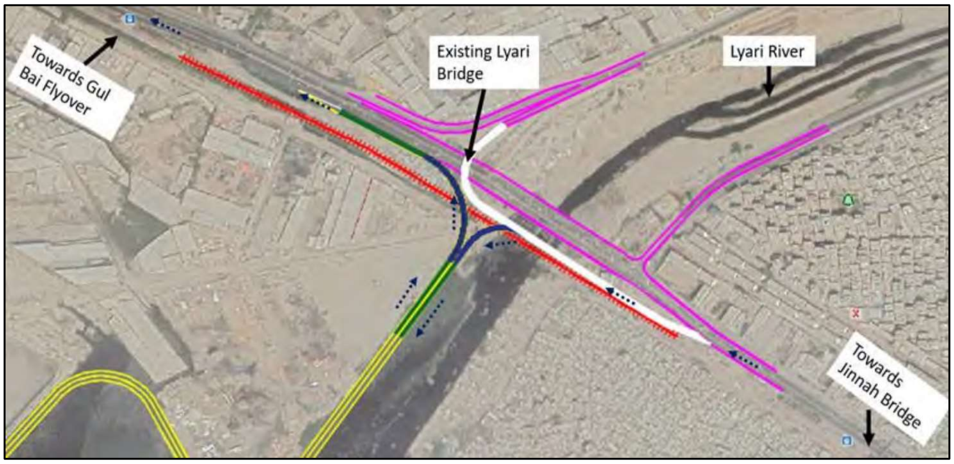


Figure 3-4: Project Alignment thru Lyari Interchange (Concept-3)

3.1.5 Alignment Option-5: Tikri Village

As shown in the **Figure 5-5** below, the alignment starts from junction of Lyari Expressway and ends at Y-Junction of Mauripur Road / Kakapir road through Tikri Village. One of the drawbacks of this alignment is extensive land acquisition. It was estimated that approximately 11 acres would be acquired near Tikri Village for the construction of this alignment option.

During the GT investigations for the subject project, it was revealed that the said area is under litigation in the High Court of Sindh (refer **Annexure-5**). Based on detailed discussion with the Client, it was decided that the alignment along the shore/backwaters should be avoided, which would result in increase in the project length by around 600 meters, however, would not require land acquisition.

Figure 3-5: Project Alignment thru Tikri Village (near End Point)

3.2 Finalized Alignment Option

After detail discussion with the Client and engineering judgement, the consultants adopted the Lyari Interchange Concept no. 3 with slight modifications for the start point alignment of the project. The start point of the project has been finalized in such a way that access to existing Lyari Expressway with the proposed Mauripur Expressway was made so that connectivity for travelers from Sohrab Goth to Hawkesbay and beyond is provided uninterrupted.

In the selected option, an elevated U-turn has been provided on Mauripur Road for right turning traffic from Lyari Expressway for access to the project expressway. This traffic has been proposed to make a left-turn on Mauripur Road and take this elevated U-turn in order to eliminate the at-grade intersection with Mauripur Expressway.

Traffic will use existing entrance ramp of Lyari Expressway to enter Mauripur Expressway. Existing barrier on Lyari Expressway will be demolished to provide this access. Karachi Circular Railway (KCR) runs parallel to the ramp. The design ensured that vertical clearance as per Pakistan Railway (PR) requirement was provided.

The proposed expressway runs along existing Lyari River / embankment and passes Karachi Water & Sewerage Board (KWSB) Treatment Plant 3, Marine Academy, Salt Range from where it connects to existing Kakapir Road.

The end point of the project (near Salt Range) would traverse around the Salt Range (an increase of approx. 600m length) as compared to Alignment Option-4 (near Tikri Village).

Since this project is envisioned as a toll road, a toll plaza along with Administration building is provided near the start point. A flyover is proposed at Marine Academy to cross the existing jetty, while a loop ramp is provided at the end point for signal free connectivity with the existing road infrastructure.

For traffic existing travelling towards Lyari Expressway, a left turn flyover is also provided for traffic to access Mauripur Road, while another flyover is proposed to provide connectivity to Lyari Expressway.

Figure 5-6 below shows the final alignment plan for the project.

Figure 3-6: Finalized Project Alignment

4.0 PROJECT DESIGN

4.1 Design Criteria

A brief Design Criteria Report has been developed for sub-project 2 (Mauripur Expressway). Design Criteria provides information related to design basis adopted / formulated by different engineering design specialties to finalize technical data, design assumptions, codes of practice, methods / procedures for sub-project 2.

Design Criteria Report is attached as **Annexure–6** to this report.

4.2 Hydrology Study

Hydrology is the study of the distribution and movement of water both on and below the Earth's surface, as well as the impact of human activity on water availability and conditions.

The proposed project will be constructed along the right bank of the Lyari river, starting from the downstream side of the existing Lyari Expressway Ramp Bridge. A portion at the start of the project is on bridge/flyover structure (to cross the existing KCR length) and then it will be on embankment which will not disturb or change the existing cross section and slope of the river. Moreover, the Lyari river has wide bed at the start of embankment structures of the project as compared to upstream side of existing Lyari Expressway Ramp bridge.

To ensure safety of the built-up areas along both banks of the Lyari River, it was essential to study the impact of proposed project components and protection of the existing infrastructure (Mauripur Road Bridge, Lyari Expressway Ramp Bridge, Karachi Circular Railway (KCR) Bridge at Lyari River and Lyari riverbanks) within the study reach.

The catchment characteristics of the area such as soil cover, land-use, soil type and extents affect the runoff generation potential. These parameters have been investigated using the public domain satellite imageries as well as from the field/catchment study.

Based on the study, the 100-year 3-Day rainfall depth has been estimated as 315 mm (12.4 inch) at Karachi Masroor rain gauge station using rainfall data for the period 1970-2020, which resulted in flood peak estimates of 2,152 m^3/s (76,000 ft^3/s), whereas rainfall runoff simulations indicate that a rainfall event like August 2020 can generate flood peak as high as 2,392 m^3/s (84,500 ft^3/s) in the Lyari catchment.

The finished levels of the project have been proposed around 3 feet above the existing ground/bank levels to make the project safe from unexpected future flooding conditions of the Lyari River. It was also noticed during the rain fall event of August 2020 (2,392 m^3/s, 84,500 ft^3/s) that the maximum water level was sufficiently below from the existing right bank of the Lyari River along the length of the proposed project.

Based on the above, it can be concluded that the project will not disturb the existing cross section and slope of the Lyari River, therefore, increase in water level at upstream side of the project due to this project is not expected, and the Hydrology of the Lyari River will remain same after the construction of Mauripur Expressway.

Detailed study is attached as **Annexure-7** to this report.

4.3 Geometric Design

Geometric design involves the elaboration of those roadway features having to do with the road geometry: lane width, shoulder width, horizontal and vertical curvature, fore-slopes and back-slopes, and various ancillary characteristics.

Guided by the applicable geometric standards and as defined in the RFP, the project was designed following generally accepted engineering practices. Preliminary alignment and earthwork calculations were made on the basis of initial surveys using GPS equipment. Once complete topographic surveys were carried out, the information was processed electronically.

In geometric design, the standards were formulated on the basis of design speed and road classification. The proposed design was based on the concept of easy maneuverability ensuring minimum conflicts and maximum road safety for passengers. Road aesthetics were also part of the criteria.

The pavement composition was kept according to the load of each road category and was designed keeping in view the strength of sub-grade and other geo-technical investigations. The period for construction phase was kept in view to allow for movement of construction vehicles.

The design was prepared showing the following:

- Optimization to determine most economic design,
- Type of pavement and foundation design,
- Width of carriageway, footpaths, services etc.,

- Type of material proposed, and
- Study the location, gradients and other details of the structure including the feasibility from construction point of view, diversion of traffic etc.

Based on the design criteria, the horizontal alignments were fixed to suit the topography and plans were prepared showing the details of road centerline geometry, the super elevations at curves, setting out data for the centerlines both for its straight and curvilinear segments. The vertical profile was designed to cater for the elevations at structures and the pavement design requirements of various road structural layers. The profile was plotted on 1:1000 scale (Horizontal) and 1:100 scale (Vertical) on the same sheets as for the plans.

Salient features of the geometric design are shown in **Table 6-1** below:

Table 4-1: Salient Features

S. No.	Salient Features	Description	Approx. Length (meters)
1	Total Alignment	2+2 Lane with shoulders	7200
2	Elevated U-turn	2 Lane	500
3	Entrance Loop Ramp at Lyari Bridge	2 Lane with shoulders	40
4	Exit Loop – 1 Towards Gul-Bai	1 Lane with shoulders	320
5	Exit Loop – 2 Towards Lyari Expressway	1 Lane with shoulders	40
6	Marine Academy Flyover	2+2 Lane with shoulders	450
7	Right Turn Flyover at Kakapir Road	1 Lane with shoulders	450
8	Widening of existing Kakapir Road	2m each side (3 + 3 Lane)	750

4.4 Pavement Design

The design period for major roads is usually taken as 10 and 20 years as per American Association of State Highways and Transportation Officials (AASHTO), primarily due to the reason that traffic / passenger projections beyond that horizon are very unreliable and un-realistic and it is also economically not feasible to invest a whole sum in a project which may not have effective longer useful life span. In fact, from an economic standpoint, for roads, for which passenger traffic is expected to increase slowly at first, best engineering practice is to propose a geometric feature adequate for the projected 20-year traffic, However, pavement design should better be analyzed for 20 years. Hence by extending the traffic analysis period to 20 years was more to benchmark against international practice as a check.

Pavement design was governed primarily by the following factors:

- Design period in years, for which the pavement should provide acceptable service, with adequate maintenance,
- Number of repetitions of vehicle wheel loads during the design period, measured as Equivalent Standard Axle Loads (ESAL),
- Support value of the material over which the pavement structure will be constructed, commonly defined by California Bearing Ratio (CBR), and
- CBR value of each component layer of the pavement structure.

Testing and surveys conducted and presented in Geotechnical report recommends using on-site material for design of subgrade and road embankment with minimum soaked CBR value as 30% at 95% modified AASHTO maximum dry density. However, if on-site material is not available in required quantity then suitable borrow areas near the project site needs to be explored prior to start of construction. The borrow areas must contain A-4 or better material as per AASHTO soil classification with minimum soaked CBR value as 7% and 5% for subgrade and road embankment, respectively. Reasonable CBR value of 10% is considered for the pavement analysis.

4.4.1 Equivalent Axle Loads

Equivalent standard axle loads (ESAL) were computed using the equivalence load factors. The pavement design analysis was carried out for 20 years design period.

4.4.2 Determination of ESALS

ESAL stands for “equivalent single axle loads” and is defined as the number of passes of an 18-kip single axle that will cause the same damage to the pavement as one pass of an axle under consideration. The ESALS for base year were computed.

4.4.3 Determination of Fatigue Life

All design parameters, such as design pavement thicknesses, layer moduli, subgrade CBR and asphalt properties will be examined by MICHPAVE computer software which were used to find out the pavement response in the form of deflections, strains and stresses. The horizontal tensile strains at the bottom of asphalt concrete layer and compressive strains at top of sub-grade were used in empirical fatigue and rut models to ascertain designed life of pavement.

4.5 Commercial Area

To facilitate the commuters on Mauripur Expressway, a commercial area has been proposed near Pakistan Marine Academy and TP-3. The commercial area is placed on the southern side of the alignment and will have space for parking in both directions.

The length of this area is approx. 300 meters with a depth / width of around 40 meters. Total parking provision of 300 vehicles is provided on both sides of the road, with pedestrian overpass to cross the road.

The commercial area will boost the development of the area and increase the tourism activities at the Hawkesbay beach and surroundings. Layout plan of the commercial area is shown in **Figure 6-1** below.

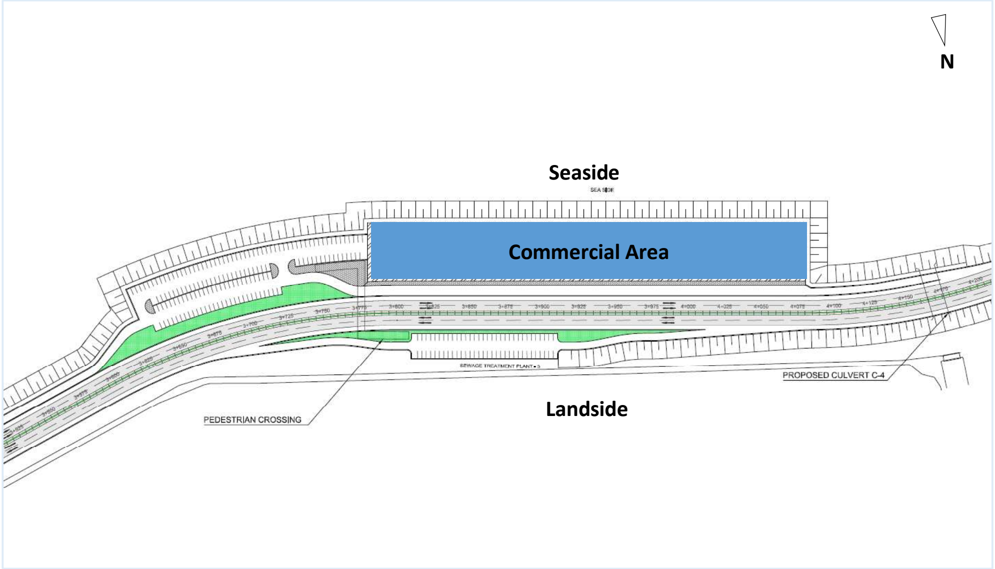


Figure 4-1: Proposed Commercial Area

5.0 STAKEHOLDER CONSULTATION

5.1 Coordination with Various Stakeholders

Several meetings were held with various stakeholders including Local Government Depart (LGD, Public Private Partnership (PPP) Unit, Karachi Port Trust (KPT), Pakistan Railways (PR), Pakistan Navy (PN), National Highway Authority (NHA), Karachi Metropolitan Corporation (KMC), and Pakistan Marine Academy to finalize the project alignment and to determine impacts on existing services. Various alternatives developed for the project were shared with the participants to obtain their feedback. The finalized option was selected after careful deliberation with the various stakeholders, sensitivity of the area, and availability of ROW.

For the Environmental Impact Assessment (EIA) and Social Assessment Report, in order to get opinion of different stakeholders and to discuss anticipated social issues of the proposed Project, consultations were held with LGD, PPP Unit, NGOs, Traffic Police Karachi, Road Users and local community as well. Their views and suggestions were recorded and incorporated in the EIA document. Overall, all the stakeholders appreciated the project. Detailed discussion on the same is presented in the EIA report (separate document).

Figure 5-1: Consultation with KPT & PN

Figure 5-2: Consultation with KPT & PN

5.2 Coordination with Utility Agencies

Requisite surveys were conducted after taking permission from relevant authorities and preliminary design drawings were prepared based on the collected data and project requirements. These preliminary drawings were sent to various government agencies including National Telecommunication Company LTD. (NTC), Sui

Southern Gas Company Ltd. (SSGC), K-Electric Company Ltd., Karachi Water & Sewerage Board (KW&SB), and Pakistan Telecommunication Corporation Ltd. (PTCL).

Information received from various agencies was incorporated in the design drawings. The cost for the utility relocation as received from various utilities agencies is Rs. 128,798,286/-, whereas utilities identified by the various utility companies are marked on the preliminary drawings.

6.0 LAND ACQUISITION REQUIREMENTS

The land acquisition plan has been identified along with the preliminary design. Approximately 50,900 sq. meter area is required for the proposed improvements. The approximate area requires are shown from **Figures 8-1 to 8-4** below highlighted in red.

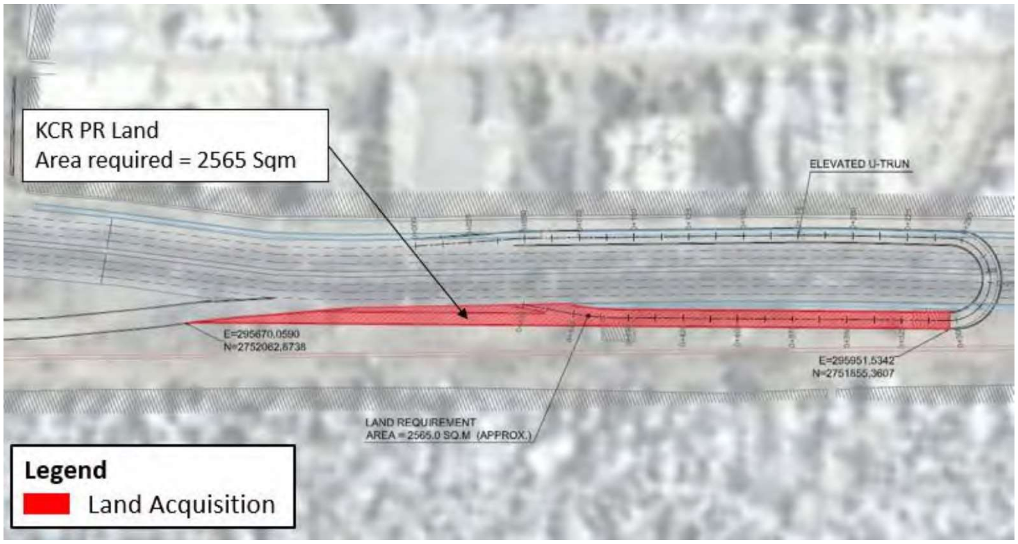


Figure 6-1: Approx. Area Requirement near Elevated U-turn

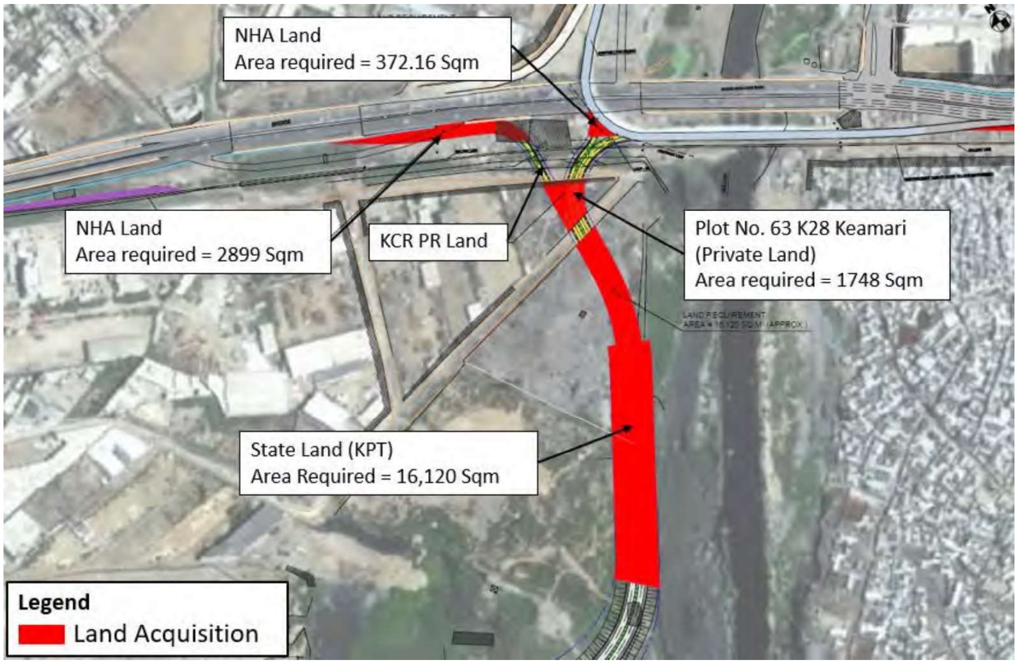


Figure 6-2: Approx. Area Requirement near Lyari Interchange

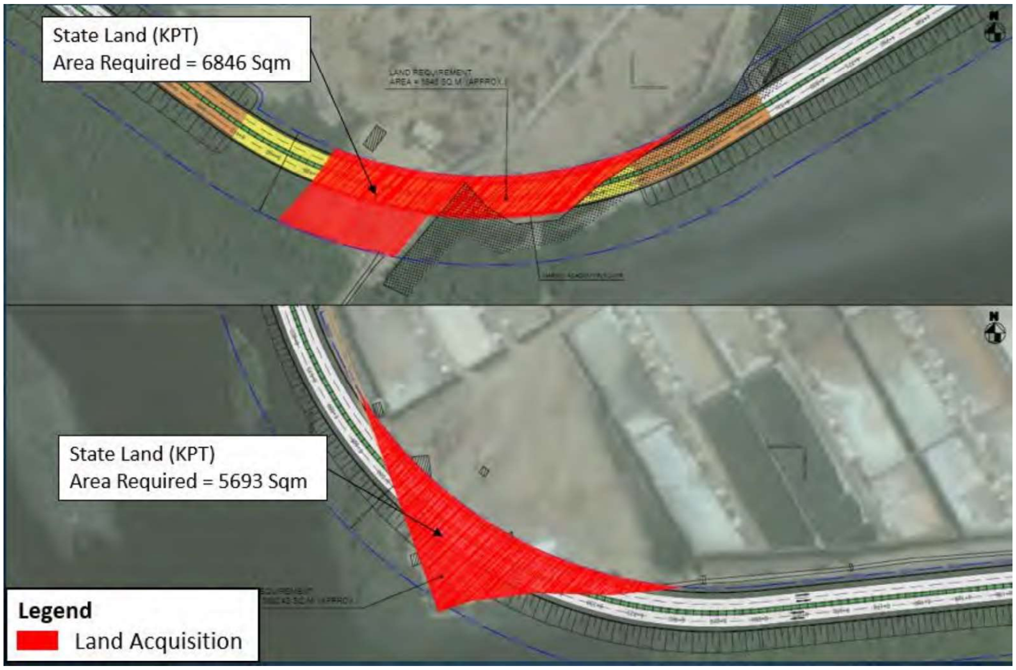


Figure 6-3: Approx. Area Requirement near Marine Academy and near Salt Field

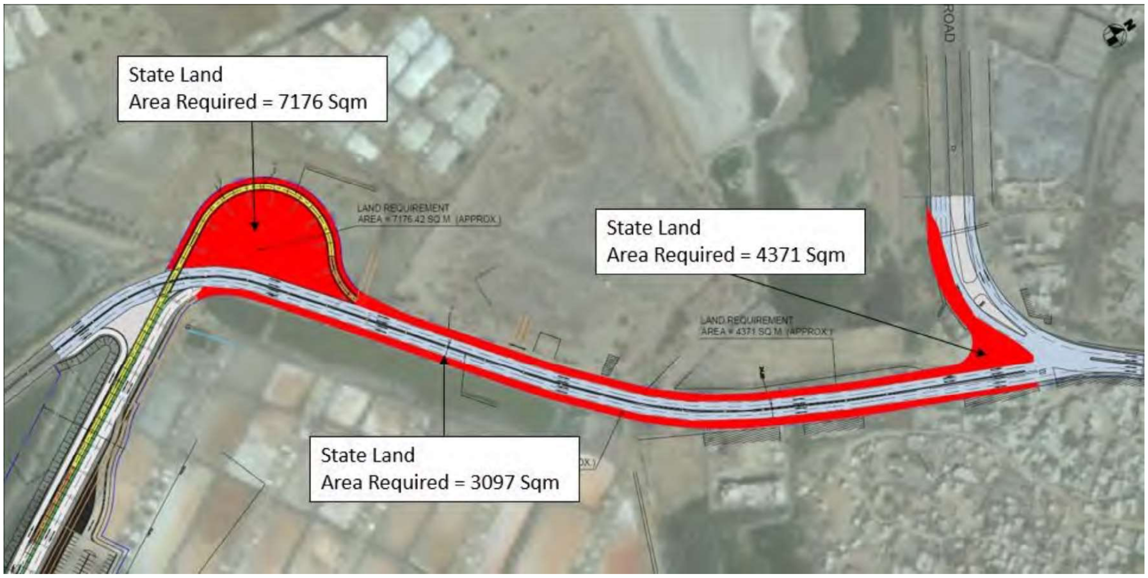


Figure 6-4: Approx. Area Requirement near Kakapir Road

7.0 CONCLUSION

The primary purpose of construction of expressway from Mauripur Expressway is to provide access for the traffic coming from and going to Lyari Expressway and to provide access to the traffic generated due to the presence of recreational spots along the way. It would also provide relief to freight traffic generated due to the industrial area on existing Mauripur Road. Due to non-availability of adequate right-of-way for construction, it may be necessary to acquire land and relocate the adjoining residents to a suitable location, if required.

Several options were studied for the construction of alternate route including construction of elevated expressway over the existing Mauripur Road. After detailed analysis, the proposed alignment was finalized as the best possible alternate access route.

The proposed Mauripur Expressway will connect the city with the newly created Keamari Division, which is home to many picnic hotspots including Hawkesbay, Sandspit, Manora beach etc. Recently, a 6-kilometer road was constructed extending from Kakapir to Y-junction (end point of this project) to attract recreational activities towards Manora beach as part of a broader initiative to improve Karachi's waterfront and establish more recreational public spots.

Many waterfront developments have been launched in the past to increase recreational activities for the residents of Karachi, whereas Hawkesbay Scheme 42, with over 50,000 plots, is in the development phase along with many other schemes.

Construction of Mauripur Expressway will provide an alternate route to commuters and provide express connectivity to all recreational facilities along the seacoast, as well as possibly result in speeding up the development activities in the district.

ANNEXURE – 1

TOPOGRAPHIC SURVEY REPORT PROJECT 02

The methodology covers details of locations of survey control network, instruments used, measurement details, position fixation and coordinates and layout of the above defined scope of works. The scope of the project is already discussed in section ---- of the report.

1. LOCATION & EXTENTS OF THE PROJECT SITE

The project area for which survey has been carried out includes Liari Express way, Mauripur road, Kakapir road and strip along coast. The Bathymetry survey data within the project area has also been collected for the study.

The location map of the subject project is shown in Figure-1.

2. SCOPE OF SURVEY WORK

Survey is required to obtain basic information regarding topography, terrain, drainage pattern, profile etc. of the project area. The survey detail is inclusive of, but not limited to the elements listed below;

- Site Reconnaissance visit of the project area.
- Establishment of survey Bench Marks (BM) in the project area.
- Topographic survey of entire project area.
- Inventory of existing structures.
- Processing of the observed data.
- Preparation of topographic survey map and related report of project area.

The above-mentioned scope of the work has been completed by using the following methodology;

3. WORK PLAN AND SITE RECONNAISSANCE VISIT

A comprehensive work plan has been established and implemented in the field by qualified survey team during execution of survey works. Site reconnaissance survey of the project area has been carried out to assess the field conditions and general topography to finalize the survey activities/ implementation plan.

4. ESTABLISHMENT OF SURVEY BENCH MARK (BM) (ADD PHOTOGRAPHS OF BENCH MARKS FOR REFERENCE)

Establishment of local control points is an essential activity which is to be carried out prior to actual commencement of surveying and mapping of the project area. New technology Global Navigation Satellite System (GNSS) makes it more efficient and effective to establish a primary control bench mark. Often National Geodetic Survey (NGS) vertical control is not readily available within the project area, thus the new procedures allow for establishing a vertical height easily, efficiently, and economically using GNSS.

Next activity is selection of a project control point and utilization of vertical data derived from GNSS observation processed through Online Positioning User Service (OPUS) as our primary control bench mark. The values obtained in World Geographic System (WGS) can easily be transferred to local or Universal Transverse Mercator (UTM) Systems.

This Bench Mark has been used as a reference point for further establishment of horizontal and vertical control network, within the project area, to carry out the topographical and cross-sectional survey work.

The coordinates & location of established control points are presented in Table-1 and Table-2 in WGS-84 and UTM coordinate system respectively and shown in Figure-2.

5. SELECTION OF CONTROL POINTS LOCATION

Quality is a characteristic of comparable things that allows us to decide that one thing is better than another. In the context of geographic data, the ultimate standard of quality is the degree to which a data set is fit for its effective use.

Selection of location for control points (Established Bench Marks) were based on three elements i.e. stability for the soil conditions encountered for each point set, safety of the established point and ample clear view to the sky, which are crucial for GNSS observations. In order to mitigate errors and to increase accuracy, the control network was planned and designed to form triangles wherever possible.

6. ESTABLISHMENT OF HORIZONTAL AND VERTICAL CONTROL NETWORKS

Horizontal and vertical project control survey has been established for the project. Whenever feasible, the horizontal and vertical control is based on high-precision GNSS observations.

In order to achieve maximum possible accuracy and minimal spatial variations in both horizontal and vertical planes, control network was established by using state of the art "GNSS" equipment encompassing the entire project area. For base line computation, three (3) GNSS instruments have been used simultaneously. To receive the signals from satellite, the receiver should have minimum obstructions like building, trees, power lines etc, around it. In case of weakening of signals due to unfavourable weather conditions like rainfall, clouds and vehicle noise, the observations have repeatedly been noted till obtaining satisfactory readings/data. For all time observations, at least four (4) satellites should be available with Geometric Dilution of Precision/Position Dilution of Precision (GDOP/PDOP) value of less than five (5). The availability of satellites and GDOP value can be known in advance with the help of computer program for given time, date and point of observations. Each instrument is set to work at least 30 minutes for simultaneous observations. Out of three (3) receivers, one acted as reference (for which coordinates of the observing point are known) and the other two (2) as rovers (coordinates to be computed). The observed point coordinates served as reference for further observing points to make a triangle or large polygon. CPs has been engraved at the permanent structures.

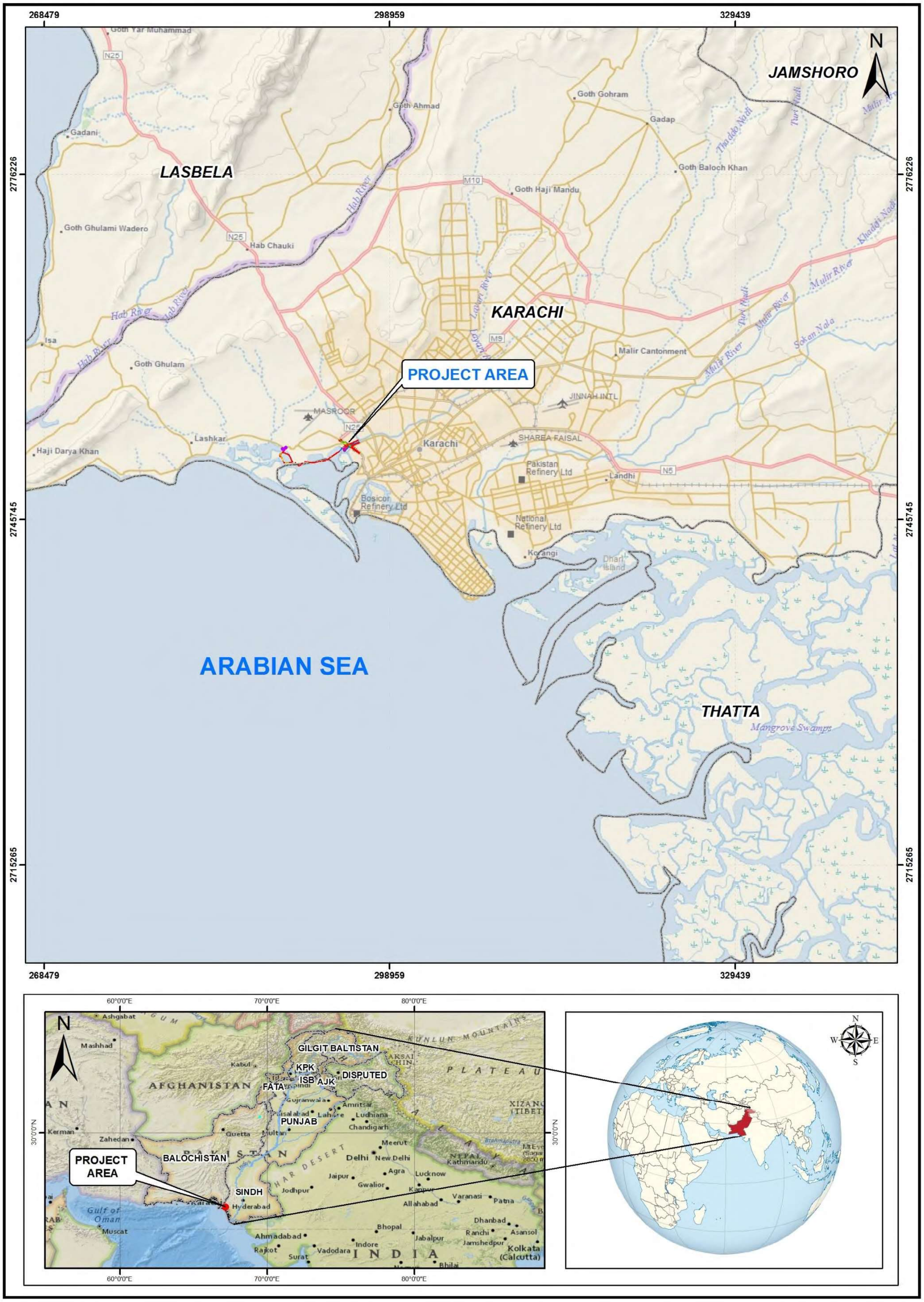


Figure-1: Location Map of Project Area

Table-1 : List of Control Points Coordinates in World Geographic System (WGS) 84

Sr. No.	Control Point	Latitude (DMS)	Longitude (DMS)	Elevation (m)
1	P2/BM T2	24° 52' 24.920" N	66° 58' 14.677" E	6.890
2	P2/CP T1	24° 52' 15.004" N	66° 58' 35.566" E	8.212
3	P2/CP01	24° 51' 57.182" N	66° 59' 3.022" E	5.384
4	P2/CP02	24° 52' 15.121" N	66° 58' 35.376" E	8.321
5	P2/CP03	24° 52' 21.322" N	66° 58' 28.068" E	16.052
6	P2/CP04	24° 52' 31.146" N	66° 58' 4.171" E	15.491
7	P2/CP04A	24° 52' 24.480" N	66° 58' 19.743" E	7.909
8	P2/CP05	24° 52' 10.499" N	66° 58' 3.576" E	4.329
9	P2/CP06	24° 51' 34.473" N	66° 57' 2.964" E	5.810
10	P2/CP07	24° 52' 5.211" N	66° 55' 5.494" E	6.283
11	P2/CP08	24° 51' 55.108" N	66° 54' 59.165" E	5.318
12	P2/CP09	24° 51' 37.948" N	66° 54' 59.472" E	4.493
13	P2/CP10	24° 51' 28.848" N	66° 55' 32.358" E	2.853

Table- 2 : List of Control Points Coordinates in Universal Transverse Mercator (UTM) Zone 42N

Sr. No.	Control Point	Easting (m)	Northing (m)	Elevation (m)
1	P2/BM T2	294991.422	2752477.976	6.890
2	P2/CP T1	295573.265	2752164.140	8.212
3	P2/CP01	296335.851	2751604.335	5.384
4	P2/CP02	295567.967	2752167.821	8.321
5	P2/CP03	295365.662	2752361.683	16.052
6	P2/CP04	294699.380	2752673.960	15.491
7	P2/CP04A	295133.425	2752462.330	7.909
8	P2/CP05	294673.189	2752038.914	4.329
9	P2/CP06	292955.045	2750955.879	5.810
10	P2/CP07	289671.616	2751951.704	6.283
11	P2/CP08	289489.201	2751643.541	5.318

12	P2/CP09	289489.729	2751115.393	4.493
13	P2/CP10	290408.725	2750821.297	2.853

The accuracy of the survey control points in static mode is as follows:

Horizontal ……………... ± 3 mm +1 ppm RMS
Vertical………..……….. ± 5 mm +1 ppm RMS

7. INSTRUMENTS USED

Leica Viva GS 10, GS 15 and Trimble R2, R9 were used to establish the control points. Also, these systems with one base and receivers (rovers) were used to collect the survey data in RTK mode.

The topographic survey has been carried out by using the GNSS in Real Time Kinematic (RTK) mode. The base station was placed on the known control point and the rover has been used for collecting the survey points. The accuracy of the GNSS equipment in RTK mode is as follows:

Horizontal ……………. ± 10 mm +1 ppm RMS
Vertical……………….. ± 20 mm + 1 ppm RMS

8. MEASUREMENT UNITS

The linear measurement units used in survey and mapping work are in metric system of units and the angular measurement are in degrees, minutes and second of arc.

9. FIELD DATA PROCESSING

The data observed was downloaded to laptop which always remain available with survey team at the survey site. The data has been processed and checked at the site for quality and gaps, if any. The GPS baselines were processed using Leica Geo Office (LGO) and Trimble Business Centre (TBC) software. The default acceptance criteria for baselines were used in LGO & TBC. Any baseline not fulfilling the acceptance criteria has been repeated. As the GNSS reading is based upon the WGS-84, the data was converted into UTM Zone 42.

10. SOFTWARE USED

All the observed data has been processed using LGO, TBC and ArcGIS software which are widely used for field data processing. AutoCAD and Eagle Point software have been used for preparation of the topographic survey layouts using the field survey data.

11. DATA POST PROCESSING AND PRODUCTION OF DRAWINGS

The observed data was digitized using AutoCAD software in the form of points, lines and polygons. The digitization of features has been done in different AutoCAD layers. The feature layers have unique style and symbols so that these can be well distinguished from other features.

Control Point	Easting (m)	Northing (m)	Elevation (m)
P2/BM T2	294991.422	2752477.976	6.890
P2/CP T1	295573.265	2752164.140	8.212
P2/CP01	296335.851	2751604.335	5.384
P2/CP02	295567.967	2752167.821	8.321
P2/CP03	295365.662	2752361.683	16.052
P2/CP04	294699.380	2752673.960	15.491
P2/CP04A	295133.425	2752462.330	7.909
P2/CP05	294673.189	2752038.914	4.329
P2/CP06	292955.045	2750955.879	5.810
P2/CP07	289671.616	2751951.704	6.283
P2/CP08	289489.201	2751643.541	5.318
P2/CP09	289489.729	2751115.393	4.493
P2/CP10	290408.725	2750821.297	2.853

Figure-2: Location Map of Established Survey Bench Marks

ANNEXURE – 4

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

GOS

Feasibility Study and Transaction Advisory Services, 'Urban Road Initiatives in Karachi'

Sub Project 2: Expressway from Mauripur Road to Y-Junction

Geotechnical Investigation Report

November 2020

National Engineering Services Pakistan (Pvt.) Ltd.
13th Floor, N.I.C. Building, Abbasi Shaheed Road, Off. Shahrah-e-Faisal, Karachi
Phone: (0092 21) 99207277-84
Fax: (0092 21) 35651994
E-mail: nespakkh@khi.wol.net.pk
Web: http://www.nespak.com.pk

Clearance Code	P-38035/024/D/27(20)	Doc No.	P-38035/024D/P2/GT/01	Rev No.	00

Consultant

National Engineering Services Pakistan (Pvt.) Ltd.
13th Floor, N.I.C. Building, Abbasi Shaheed Road, Off. Shahrah-e-Faisal, Karachi
Phone: (0092 21) 99207277-84
Fax : (0092 21) 35651994
E-mail : nespakkh@khi.wol.net.pk
Web: http://www.nespak.com.pk

Client

Local Government & HTP Department
Ground Floor, Annexe Tughluque House, Sindh Secretariat
Phone: +92-928-621123
Email: info@lgsindh.gov.pk
http://www.lgdsindh.gov.pk

DOCUMENT CONTROL

Category	Information			
Project	Feasibility Study and Transaction Advisory Services, 'Urban Road Initiatives in Karachi' (Sub Project 2: Expressway from Mauripur Road to Y Junction)			
Job / Proposal No.	P-38035	Division: Karachi Office		
Project Manager	Rehan Zamin			
Specialty Group Leader(s)	GL1 (GT&GE) : Asim Masud - Chief Engineer			
Title	Geotechnical Investigation Report			
Document No.	P-38035/024D/P2/GT/01	No. of Documents	01	
Clearance Code	P-38035/024/D/27(20)			
Date of Issue	November 24, 2020			
Document Location				

Rev No	Date	Description	Prepared by		Checked by		Approved by HOD	
			Name	Signature	Name	Signature	Name	Signature
00	24-11-20	Final	Muhammad Ali (S.E.)		Asim Masud (C.E.)	Asim	Irfan Ul Haq (G.M/ Head)	
01								
02								
03								
04								

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI
(Sub Project – 2: Expressway from Mauripur Road to Y Junction)

GEOTECHNICAL INVESTIGATION REPORT

TABLE OF CONTENTS

Page No.

APPENDICES

LIST OF TABLES

LIST OF ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
BA	Borrow Area
BH	Borehole
BS	British Standard
CBR	California Bearing Ratio
CS	Composite Sample
FDT	Field Density Test
HTP	Housing Town Planning
LL	Liquid Limit
LS	Lalji Syncline
MBT	Main Boundary Thrust
MDD	Maximum Dry Density
m.y.	Million Year
NAVFAC	Naval Facilities Engineering Command
NESPAK	National Engineering Services Pakistan (Pvt.) Ltd
NMC	Natural Moisture Content
NSL	Natural Surface Level
OMC	Optimum Moisture Content
SRC	Sulphate Resistance Cement
PI	Plasticity Index
PL	Plastic Limit
PPRA	Public Procurement Regulatory Authority
PPP	Public Private Partnership
PMA	Pir Mangho Anticline
PMF	Pir Mangho Fault
SPT	Standard Penetration Test
SRC	Sulphate Resisting Cement
TP	Test pit
UDS	Undisturbed Soil Sample
USCS	Unified Soil Classification System
w/c	Water Cement Ratio

EXECUTIVE SUMMARY

Local Government & HTP Department, Govt. of Sindh intends to conduct feasibility study and transaction advisory services for three urban road projects that will be initiated under Public Private Partnership (PPP) mode. The project consists of following parts:

Sub Project – 1:	Link Road from Korangi (from KPT Interchange to PAF Airmen Academy)
Sub Project – 2:	Expressway from Mauripur Road (End of Lyari Expressway) to Y Junction (Kakapir Rd / Mauripur Rd Intersection)
Sub Project – 3:	Interchange at ICI Bridge Intersection

National Engineering Services Pakistan (Pvt.) Ltd. (NESPAK) has been appointed as a Consultant by the Client for conducting feasibility study and transaction advisory services for the subject project. This report deals with geotechnical studies and necessary geotechnical recommendations for Sub Project – 2: Expressway from Mauripur Road to Y Junction.

The task of geotechnical investigations was awarded to M/s Soil Testing Services (STS), Karachi through competitive bidding amongst the drilling contractors as per PPRA rules. The field investigations were carried out under the full-time supervision of geotechnical engineers of NESPAK from August 15, 2020 to September 21, 2020.

The geotechnical investigations were aimed at delineating the major subsoil / bedrock conditions spread over the site area, to evolve soil / rock parameters for the feasibility level design of foundations for proposed structures, to evolve geotechnical parameters for the feasibility level design of road works & to identify any problematic ground conditions and provide remedy. Geotechnical investigations comprised drilling of boreholes, excavation of test pits, performance of field testing, collection of soil / rock / water samples and laboratory testing on selected samples followed by engineering analysis.

The geotechnical investigations indicated that the project alignment consists of overburden soils i.e. Lean Clay / Silty Clay / Silty Sand etc. up to the depth of 24.5 m below NSL. Bedrock, consists of weak to very weak Sandstone / Claystone / Mudstone, from 24.5 m to maximum investigated depth of 29 m below NSL.

Based on the subsurface ground conditions and the type of loads of the proposed structures, RC piles and strip / square / mat foundations can be opted as per structural requirements.

Chemical test results indicated that groundwater contains moderate to severe proportion of harmful salts. Therefore, sulphate resistance cement (SRC) is recommended to be used for concrete works of foundations.

Test results indicated that on-site A-1-b / A-2-4 / A-2-6 material with soaked CBR as 18 % at 95 % modified AASHTO maximum dry density can be used for the pavement design of road works.

1. INTRODUCTION

1.1 GENERAL

Local Government & HTP Department, Govt. of Sindh intends to conduct feasibility study and transaction advisory services for three urban road projects that will be initiated under Public Private Partnership (PPP) mode. The primary objective of the project is to mitigate the traffic congestion problems and provide quick & safe access to the local commuters. The project consists of following parts:

Sub Project – 1:	Link Road from Korangi (from KPT Interchange to PAF Airmen Academy)
Sub Project – 2:	Expressway from Mauripur Road (End of Lyari Expressway) to Y Junction (Kakapir Rd / Mauripur Rd Intersection)
Sub Project – 3:	Interchange at ICI Bridge Intersection

This report solely deals with geotechnical studies and necessary geotechnical recommendations for feasibility level design of roads and foundations for proposed development works on **Sub Project – 2: Expressway from Mauripur Road to Y Junction**. The proposed development works consist of:

i. Flyover at Kakapir Road
ii. Flyover near Marine Academy
iii. Culverts near Treatment Plant
iv. Admin Building and Toll Plaza
v. Flyover near Liyari Expressway
vi. Elevated U-Turn

National Engineering Services Pakistan (Pvt.) Ltd. (NESPAK) has been appointed as a Consultant by the Client for conducting feasibility study and transaction advisory services for the subject project.

In order to evaluate the subsurface conditions at project site and to arrive at a safe and economical design of foundations of the proposed structures, geotechnical investigations were considered necessary.

The task of geotechnical investigations was awarded to M/s Soil Testing Services (STS), Karachi through competitive bidding amongst the drilling contractors as per PPRA rules. These investigations were carried out under the full-time supervision of geotechnical engineers of NESPAK from August 15, 2020 to September 21, 2020.

The selected soil / rock and water samples collected during the field geotechnical investigations were tested at Geotechnical testing Laboratory of SOILCON and University of Engineering & Technology, Lahore as per laboratory testing programs prepared by NESPAK.

This report provides an account of the geotechnical activities carried out at the site, characteristics of subsurface materials, details of field & laboratory tests, selection of geotechnical parameters and geotechnical recommendations for feasibility level design of foundations and road works.

1.2 OBJECTIVES OF GEOTECHNICAL INVESTIGATIONS

The geotechnical investigations were undertaken to meet the following objectives:

- To delineate major subsurface material types spread over the site area.
- To evolve geotechnical parameters for feasibility level design of foundations for the proposed structures.
- To evolve geotechnical parameters for feasibility level design of road works.
- To furnish general geotechnical considerations for the construction of foundations and road works.

1.3 SCOPE OF WORK

Following scope of work for geotechnical investigations was executed to fulfill the above mentioned objectives:

- Execution of six (06) boreholes up to a maximum depth of 29 m below natural surface level (NSL) at the proposed structure locations using straight rotary drilling method.
- Excavation of nine (09) test pits up to a maximum depth of 2 m below NSL at road locations.
- Continuous core drilling in bedrock along with collection & preservation of rock cores.
- Performance of Standard Penetration Tests (SPTs) in overburden soils encountered in boreholes, generally at 1 m depth interval.
- Performance of Field Density Tests (FDTs) in test pits, generally at 1 to 2 tests per test pit at designated depths.
- Collection and preservation of disturbed/undisturbed soil samples from the boreholes and test pits.
- Collection and preservation of groundwater samples from the boreholes.
- Laboratory testing of selected soil / rock samples for the evaluation of classification, strength, compaction and chemical characteristics.
- Chemical analysis of groundwater samples.

- Analysis of field and laboratory data for determination of foundation design parameters including soil / rock parameters, foundation type, depth & size, allowable bearing pressures, etc.
- Formulation of geotechnical considerations for the construction of foundations and road works.
- Compilation of a Geotechnical Investigation Report on the basis of the above mentioned studies.

1.4 DESCRIPTION OF SITE

The proposed project site starts from Y Junction near Kakapir Road and ends at Mauripur Road. The length of the proposed expressway is about 8 Km. The site can be accessed through Mauripur Road and Kakapir Road.

The terrain of the site area is generally flat. Location plan of the project site is appended as Fig. A-1 (Appendix A).

2. GEOLOGY AND SEISMICITY OF AREA

2.1 GEOLOGY

2.1.1 Regional Geology

Regionally, the project area is located in the Karachi arc which is located on the southern margin of the Sulaiman Kirther fold belt. Karachi arc is an eastward arcuate feature bounded by east west oriented sinistral and dextral faults near Mancher Lake in north and near Karachi in south respectively (Sarwar and DeJong, 1979). The east verging structures in the Karachi Arc indicate an eastward tectonic transport in a thin skinned fashion as a result of India - Arabia convergence (Sarwar, 1992; Niamatullah, 1998). The Karachi arcuate feature is also bounded by the Chaman Transform Fault System to the west and the Kirthar or Kachhi Foredeep in the east. The fold belt has formed by folding and thrusting of shelf sediments at the northwestern edge of the Indian Plate. The fold belt has originated as a result of India-Eurasia convergence to the north and India-Arabia to the south (Sarwar, 1992; Niamatullah, 1998). A thin skinned deformation style has been present all along the Karachi arc as a result eastward tectonic transport. However, some thick skinned deformation has also been reported in the southern part of it (Smewing et al., 2002).

The major structures of the area are the Pir Mangho Anticline (PMA) and the Lalji Syncline (LS). The strike of the pronounced structural trend is NE-SW in the area. In the north of Pir Mangho Anticline, structural trend changes sharply to the NS. A number of sinistral strike slip faults displace the strata. The most important is the Pir Mangho Fault (PMF), which is a NW-SW trending vertical fault with subhorizontal striation and having sinistral displacement. This fault has partitioned the strain in the area.

Laji Syncline is located in the SW of the Pir Mangho Anticline which is a double syncline with a kink geometry and hinges plunging towards SW. The two synclinal hinges are separate in the NE but converge towards SW, where they join together and form a single hinge asymmetric fold facing SE in Orangi area. Where fold is double hinged, its eastern limb is dipping at a low angle towards west, while its northwestern limb is dipping at a higher angle towards SE (Structural Geometry and Tectonics of Southern Part of Karachi Arc - A Case Study of Pirmangho and Lalji Area, April 2012).

2.1.2 Site Geology

The project site lie at the foot hills of Sulaiman Kirther Mountains and is comprised of unconsolidated surficial deposits of clay, silt, sand and gravel which forms distinct piedmont plains. These piedmont plains are characterized by gentler slope comprising of softer rocks and commonly contains parallel or concentric, low, scalloped, homoclinal ridges and hogbacks.

2.2 SEISMICITY

The project area is located in the southern part of Pakistan which is seismically active. The tectonic feature most critical for the project area is the Pab Fault which is passing at a distance of about 18 km north-west from project area. Moderate to low level of seismicity is observed to be associated with this fault. Very active Kutch seismic zone is present about 200km south-east from project area. In Kuch seismic zone several damaging earthquakes (with maximum intensity upto XI on Modified Mercellic Intensity scale) have occurred including 2000 Bhoj Earthquake of magnitude 7.9.

Probabilistic seismic hazard assessment carried out as part of the revision of the Building Code of Pakistan Seismic Provisions (2007) shows that the project area falls in Zone-2B.

It is therefore recommended that the project structures should be designed to cater for the requirements of Zone-2B of Building Code of Pakistan seismic provisions (2007) after giving due consideration to the soil profile of the site area.

3. FIELD GEOTECHNICAL STUDIES

3.1 PLANNING

In order to evaluate subsurface ground conditions at the project site, boreholes and test pits of appropriate depth were planned to be executed at the selected locations, in the light of the project requirements. The location of these boreholes and test pits was fixed in such a manner so as to cover the maximum area of the project site. The geotechnical investigation plan showing locations of boreholes and test pits is appended to this report as Fig. A-2 (Appendix-A).

3.2 DRILLING OF BOREHOLES

A total of six (06) boreholes up to a maximum depth of 29 m below natural surface level (NSL) were drilled at proposed structure locations. Details of boreholes are as follows:

Borehole No.	Depth below NSL (meter)	Location
BH - 1	20	Flyover at Kakapir Road
BH - 2	12	Flyover near Marine Academy
BH - 3	25	Culverts (C-2 & C-3) near Treatment Plant
BH - 4	25	Admin Building & Toll Plaza
BH - 5	25	Flyover near Liyari Expressway
BH - 6	29	Elevated U-Turn

Straight rotary drilling method was used for execution of boreholes. Fish tail / tricon roller bit with a diameter of 100 mm was used to drill the boreholes in overburden soils. However, NX sized double tube core barrel was used for drilling in bedrock. Bentonite slurry was used as drilling fluid during execution of boreholes.

Field borehole logs were developed on the basis of material encountered at the site and later confirmed on the basis of laboratory test results. The borehole logs are appended to this report as Appendix-B. The subsurface soil / rock profile developed on the basis of borehole logs is appended with the report as Fig. A-3 (Appendix-A).

3.3 EXCAVATION OF TEST PITS

Nine (09) test pits of 1.15 – 2.0 m depth below NSL were excavated at road locations. The test pits were excavated using conventional hand digging tools like pick-axe and hand shovel.

The test pits were carefully logged during excavation and field logs were developed, which were later confirmed through laboratory testing. The test pit logs are appended to this report as Appendix-B.

3.4 STANDARD PENETRATION TESTS (SPTs)

Standard Penetration Tests (SPTs) were performed in all the boreholes according to the latest ASTM D 1586, generally at 1 m depth interval, where possible. A donut type hammer, weighing 63.5 kg, was used for the test. During performance of SPTs in boreholes, the hammer was lifted and dropped mechanically through the flywheel of drilling rig and pulley hanged to a tripod. A split spoon sampler without a liner was used for all the tests. Disturbed soil samples were obtained through the split spoon sampler. The SPT blow counts were recorded for 45 cm total penetration of split spoon sampler. The number of blows required to drive the sampler through the last 30 cm viz. 'N' values have been shown on the respective borehole logs (Appendix-B).

Plots of field and corrected SPT-N value with depth have been developed for all the boreholes and appended to this report as Fig. C-1 and Fig. C-2 (Appendix-C), respectively.

3.5 IN-SITU DENSITY TESTS

To evaluate the in-situ density of the subsurface soils, density tests were performed in the test pits at selected depths below NSL. Sand replacement method was used to perform the density tests according to the latest ASTM D 1556. Ten (10) field density tests were performed in the test pits. The results of these density tests are shown on the individual test pit logs (Appendix-B).

3.6 UNDISTURBED SAMPLING

Nine (09) relatively undisturbed soil samples were recovered from boreholes using Denison / Shelby samplers as per latest ASTM D 1587. After determining the in-situ density, the soil samples were properly waxed, labeled, preserved and transported to the approved geotechnical testing laboratory.

Thirty one (31) representative undisturbed rock samples (rock cores) were carefully recovered from boreholes. These rock samples (rock cores) were properly waxed, labeled and preserved in core boxes before transportation to the geotechnical testing laboratory.

3.7 DISTURBED SAMPLING

The SPT samples obtained from overburden soils in the boreholes and composite soil samples collected from on-site test pits were properly labeled and preserved as disturbed samples. All the disturbed samples were transported to the approved geotechnical testing laboratory.

For determination of the in-situ moisture content, small quantity of soil samples were also collected in tin cans from the depths where the density tests were carried out in test pits. These samples were weighted at the site and subsequently sealed & labeled for dispatch to the laboratory for evaluation of moisture content by oven drying method.

3.8 GROUNDWATER

Groundwater was encountered at a depth of 1.2 m to 2.4 m below NSL during field geotechnical investigations executed in the month of August - September 2020.

4. LABORATORY TESTING

4.1 GENERAL

Selected soil / rock and water samples collected from boreholes and test pits were subjected to the following tests as per laboratory testing program prepared by NESPAK in accordance with latest ASTM / BS or equivalent standard in Geotechnical Testing Laboratories of SOILCON and University of Engineering & Technology, Lahore:

- Grain Size Analysis (ASTM D – 421, 422)
- Atterberg Limits (ASTM D – 4318)
- Natural Moisture Content (ASTM D – 2216)
- Bulk & Dry Density (ASTM D – 7263)
- Unconfined Compression (ASTM D – 2166)
- Consolidation with Swell Pressure Measurement (ASTM D - 2435)
- Uniaxial Compression Test (ASTM D 7012)
- Modified AASHTO Compaction (AASHTO T-180)
- 3-Point Soaked CBR (AASHTO T-193)
- Sulphate Content (BS 1377 Part 3)
- Chloride Content (BS 1377 Part 3)
- Organic Matter Content (BS 1377 Part 3)
- Chemical Analysis of Water (BS 1377 Part 3)

Summary of laboratory test results is appended to this report as Table D-1 (Appendix-D) along with original test result sheets.

4.2 DISCUSSION ON RESULTS

4.2.1 Classification Test

Grain size analysis was performed on twenty four (24) soil samples collected from boreholes and test pits. Test results showed that the on-site soils generally comprise Lean Clay / Lean Clay with Sand / Sandy Lean Clay (CL), Silty Sand / Silty Sand with Gravel (SM), Poorly graded Sand with Silt & Gravel (SP-SM) etc. as per Unified Soil Classification System (USCS). As per AASHTO soil classification, on-site soils generally belong to A-1-b, A-2-4, A-4, A-6 & A-7-6 group.

Fourteen (14) on-site soil samples were subjected to Atterberg limit tests. Test results indicated liquid limit (LL) ranging from 28 to 51 % and the plasticity index (PI) ranging from 8 to 25 %.

4.2.2 Natural Moisture Content (NMC) and Dry Density Test

Eight (08) relatively undisturbed soil samples collected from boreholes were tested for natural moisture content (NMC) and dry density. Test results indicated NMC value as 13.16 % to 20.61 % and dry density value varies from 15.5 to 18.5 kN/m^3.

Fifteen (15) rock core samples collected from boreholes were also tested for natural moisture content (NMC) and density test. Test results indicated NMC value as 0.59 % to 8.9 % and dry density as 19.9 kN/m^3 to 27.8 kN/m^3.

4.2.3 Unconfined Compression Test

Unconfined compressive strength tests were performed on seven (07) relatively undisturbed cohesive soil samples extracted from boreholes. Test results indicated the unconfined compressive strength of soil samples as 70.6 kPa to 171.0 kPa while the failure strain was 2.74 % to 8.77 %.

4.2.4 Uniaxial Compression Test

Uniaxial compression tests were performed on fifteen (15) rock core samples collected from boreholes. Test results indicated uniaxial compressive strength as 0.20 to 1.04 Mpa for claystone and 1.08 to 10.87 Mpa for sandstone. %.

4.2.5 Consolidation Test

Consolidation test was carried out on two (02) cohesive soil samples collected from boreholes. Test results indicated initial void ratio (e_o) as 0.42 & 0.47, compression index (c_c) as 0.07 & 0.09 and swell pressure as 23.1 kPa and 76.9 kPa.

4.2.6 Modified AASHTO Compaction Test

Modified AASHTO Compaction tests were performed on six (06) composite soil samples collected from on-site test pits. Test results indicated maximum dry density (MDD) as 18.2 kN/m^3 to 21.7 kN/m^3 and optimum moisture content (OMC) as 5.8 % to 8.8 %.

4.2.7 3-Point Soaked CBR Test

California Bearing Ratio (CBR) tests were performed on six (06) composite soil samples collected from on-site test pits, which revealed CBR value as 12.4 % to 36 % at 95% Modified AASHTO maximum dry density.

4.2.8 Chemical Test

Chemical tests were carried out on five (05) soil samples, collected from boreholes from 5.5 to 12.0 m depth below NSL. Test result indicated soluble sulphate content as 0.012 % to 0.025 %, chloride content as 0.014 % to 0.554 % and organic matter as 0.133 % to 0.792 %.

Chemical tests were also carried out on six (06) water samples collected from boreholes. Test results indicated sulphate content as 692 ppm to 3567 ppm, chloride content as 12 ppm to 10330 ppm, total dissolved solids (TDS) as 1813 ppm to 3500 ppm and pH as 5.65 to 7.66.

5. SITE GEOTECHNICS

5.1 STRATIGRAPHY AND CONSISTENCY

The geotechnical investigations carried out at the site of this project have revealed the presence of the following distinct lithological units:

Location	Layer Thickness below NSL (meter)	Lithology	Reference Borehole
Flyover at Kakapir Road	0.0 – 1.0	Gravelly Silt, trace clay, dry	BH - 1
	1.0 – 3.0	Firm to stiff, Silty Clay, low plastic, moist	
	3.0 – 6.0	Medium dense to very dense, Silty Sand / Sandy Silt, trace to few gravels, moist	
	6.0 – 9.0	Very dense, Poorly graded Gravel with Silt & Sand, moist	
	9.0 – 10.0	Hard, Lean Clay, medium plastic, trace sand & gravel	
	10.0 – 20.0	Bedrock, mainly consists of Friable Sandstone with thin layers of Mudstone/Claystone	
	-	Groundwater is at a depth of 1.2 m below NSL	
Flyover near Marine Academy	0.0 – 1.0	Fill material consisting of Silty Clay, polythene bags, cloth pieces etc.	BH - 2
	1.0 – 12.0	Firm to hard, Lean Clay / Sandy Lean Clay / Silty Clay, low to medium plastic, moist	
	-	Groundwater is at a depth of 1.3 m below NSL	
Culverts (C-2 & C-3) near Treatment Plant	0.0 – 1.0	Fill material consisting of Silty Clay, polythene bags, cloth pieces etc.	BH - 3
	1.0 – 6.0	Very soft to stiff, Silty Clay / Lean Clay with Sand, low to medium plastic, moist	
	6.0 – 10.0	Very Dense, Poorly graded Sand with Silt / Poorly graded Gravels, moist	
	10.0 – 21.4	Hard, Lean Clay, medium plastic, moist	
	21.4 – 25.0	Bedrock, mainly consist of Claystone	
Admin Building & Toll Plaza	0.0 – 4.0	Alternate layers of Silty Clay / Silty Clayey Gravel / Poorly graded Gravel with Silt & Sand	BH - 4
	4.0 – 8.0	Loose to very dense, Silty Sand / Poorly graded Gravel with Sand, moist	
	8.0 – 20.0	Hard, Lean Clay, medium to high plastic, moist	
	20.0 – 25.0	Bedrock, mainly consist of Claystone	
	-	Groundwater is at a depth of 2.4 m below NSL	

Flyover near Liyari Expressway	0.0 – 11.0	Loose to very dense, Silty Sand / Silty Clayey Sand, moist	BH - 5
	11.0 – 17.5	Hard, Lean Clay, medium plastic, moist	
	17.5 – 25.0	Bedrock, mainly consist of Claystone	
	-	Groundwater is at a depth of 1.85 m below NSL	
Elevated U-Turn	0.0 – 1.0	Fill material mainly consists of Silty Sand, polythene bags & cloth pieces	BH - 6
	1.0 – 4.0	Very loose to loose, Silty Sand, trace clay & gravel, moist	
	4.0 – 10.0	Very soft to very stiff, Silty Clay / lean Clay, low to medium plastic, moist	
	10.0 – 12.5	Very dense, Silty Sand, moist	
	12.5 – 16.0	Hard, Lean Clay / Lean Clay with Sand, medium plastic, moist	
	16.0 – 24.5	Very dense, Silty Sand / Silty Clayey Sand / Clayey Gravel with Sand, moist	
	24.5 – 29.0	Bedrock mainly consists of Sandstone / Claystone	
	-	Groundwater is at a depth of 2.4 m below NSL	

5.2 SHEAR STRENGTH

The field and laboratory investigation data indicated that overburden soils and bedrock, present at the project site, generally have low to medium shear strength characteristics.

5.3 NATURAL MOISTURE CONTENT

Test results for natural moisture content indicated that the overburden soils at the project site are in moist condition while the bedrock is in dry condition.

5.4 COMPRESSIBILITY

Consolidation test results indicated that the onsite cohesive soil deposits generally have slightly to moderately compressible characteristics.

5.5 CHEMICAL CHARACTERISTICS

Chemical test results indicated that the subsurface soil consists of negligible proportion of harmful salts. However, test results for water samples indicated moderate to severe proportion of harmful salts as per ACI Building Code Requirements for Structural Concrete.

6. CONSIDERATIONS FOR DESIGN AND CONSTRUCTION OF FOUNDATIONS

6.1 GENERAL

The considerations for the foundation design have been made keeping in view the type of structure, topography of the area and the subsoil / bedrock characteristics. A safe and an economical design of foundations of the structures have to be ensured. The following sections provide guidelines regarding the geotechnical design criteria, soil / rock parameters, selection of foundation type, depth of placement, foundation size, allowable bearing pressures, foundation settlements and allowable load carrying capacity.

6.2 GEOTECHNICAL DESIGN CRITERIA

The foundation of the proposed structures should meet the following minimum design criteria:

- It should be safe against shear failure of the supporting ground. A factor of safety of 2.5 & 3 is adopted for this purpose for RC pile and square / mat foundation, respectively.
- It should not settle excessively under the service loads. A limit of 25 mm has been put on the total settlement of square foundations and 50 mm on mat foundation. Moreover, a group of piles should not settle in excess of 25 mm to 50 mm, depending upon size of group.

6.3 SUBSURFACE SOIL / ROCK PARAMETERS

Engineering analysis for the determination of bearing / load carrying capacity and settlements of foundations for encountered subsurface conditions are based on carefully selected representative subsurface parameters.

The following parameters have been defined for the subsurface on the basis of field investigations, laboratory test results, recent literature, engineering judgment and our experience with the similar ground conditions:

Table 6-1: Summary of Subsurface Parameters

Location	Material Type	Depth below NSL (m)	Subsurface Parameters
Flyover at Kakapir Road	Gravelly Silt / Silty Clay	0.0 – 3.0	Undrained Cohesion *(cu)* = 50 kPa Coefficient of Volume Compressibility *(mv)* = 0.015 cm^2/kg Adhesion *(α)* = 0.55 Bulk Unit Weight (γ_b) = 17 kN/m^3
	Silty Sand / Sandy Silt	3.0 – 6.0	Angle of Internal Friction *(Φ)* = 33^o Bulk Unit Weight (γ_b) = 18 kN/m^3 Coefficient of Lateral Earth Pressure *(K)* = 0.7

	Poorly graded Gravel with Silt & Sand	6.0 – 10.0	Angle of Internal Friction (Φ) = 36° Bulk Unit Weight (γ_b) = 20 kN/m^3 Coefficient of Lateral Earth Pressure (K) = 0.7
	Bedrock	10.0 – 20.0	Bulk Unit Weight (γ_b) = 24 kN/m^3 Uniaxial Compressive Strength (q_u) = 1 Mpa
Flyover near Marine Academy	Fill Material	0.0 – 1.0	Bulk Unit Weight (γ_b) = 16 kN/m^3
	Silty Clay	1.0 – 3.0	Undrained Cohesion (cu) = 40 kPa Coefficient of Volume Compressibility (mv) = 0.018 cm^2/kg Adhesion (α) = 0.55 Bulk Unit Weight (γ_b) = 17 kN/m^3
	Lean Clay	3.0 – 12.0	Undrained Cohesion (cu) = 150 kPa Coefficient of Volume Compressibility (mv) = 0.003 cm^2/kg Adhesion (α) = 0.55 Bulk Unit Weight (γ_b) = 19 kN/m^3
	Bedrock	12.0 – 20.0	Bulk Unit Weight (γ_b) = 22 kN/m^3 Uniaxial Compressive Strength (q_u) = 0.4 Mpa
Culvert (C – 2 & C – 3) near Treatment Plant	Fill Material	0.0 – 1.0	Bulk Unit Weight (γ_b) = 16 kN/m^3
	Silty Clay / Lean Clay	1.0 – 6.0	Undrained Cohesion (cu) = 20 kPa Coefficient of Volume Compressibility (mv) = 0.025 cm^2/kg Adhesion (α) = 0.55 Bulk Unit Weight (γ_b) = 16 kN/m^3
	Poorly graded Sand with Silt / Poorly graded Gravels	6.0 – 10.0	Angle of Internal Friction (Φ) = 36° Bulk Unit Weight (γ_b) = 20 kN/m^3 Coefficient of Lateral Earth Pressure (K) = 0.7
	Lean Clay	10.0 – 21.4	Undrained Cohesion (cu) = 150 kPa Coefficient of Volume Compressibility (mv) = 0.003 cm^2/kg Adhesion (α) = 0.55 Bulk Unit Weight (γ_b) = 19 kN/m^3
	Bedrock	21.4 – 25.0	Bulk Unit Weight (γ_b) = 26 kN/m^3 Uniaxial Compressive Strength (q_u) = 0.65 Mpa
Admin Building & Toll Plaza	Silty Clay	0.0 – 4.0	Undrained Cohesion (cu) = 25 kPa Coefficient of Volume Compressibility (mv) = 0.022 cm^2/kg Adhesion (α) = 0.55 Bulk Unit Weight (γ_b) = 16 kN/m^3
	Silty Sand / Poorly graded Gravel	4.0 – 8.0	Angle of Internal Friction (Φ) = 30° Bulk Unit Weight (γ_b) = 18 kN/m^3 Coefficient of Lateral Earth Pressure (K) = 0.7
	Lean Clay	8.0 – 20.15	Undrained Cohesion (cu) = 150 kPa Coefficient of Volume Compressibility (mv) = 0.003 cm^2/kg Adhesion (α) = 0.55 Bulk Unit Weight (γ_b) = 19 kN/m^3
	Bedrock	20.15 – 25.0	Bulk Unit Weight (γ_b) = 23 kN/m^3 Uniaxial Compressive Strength (q_u) = 1.0 Mpa
Flyover near Liyari Expressway	Silty Sand / Silty Clayey Sand	0.0 – 3.0	Angle of Internal Friction (Φ) = 30° Bulk Unit Weight (γ_b) = 17 kN/m^3 Coefficient of Lateral Earth Pressure (K) = 0.7
	Silty Sand / Silty Clayey Sand	3.0 – 11.0	Angle of Internal Friction (Φ) = 33° Bulk Unit Weight (γ_b) = 18 kN/m^3 Coefficient of Lateral Earth Pressure (K) = 0.7
	Lean Clay	11.0 – 17.45	Undrained Cohesion (cu) = 200 kPa Coefficient of Volume Compressibility (mv) = 0.002 cm^2/kg Adhesion (α) = 0.55 Bulk Unit Weight (γ_b) = 19 kN/m^3
	Bedrock	17.45 – 25.0	Bulk Unit Weight (γ_b) = 22 kN/m^3 Uniaxial Compressive Strength (q_u) = 0.5 Mpa
	Fill Material	0.0 – 1.0	Bulk Unit Weight (γ_b) = 16 kN/m^3

Elevated U-Turn	Silty Sand	1.0 – 4.0	Angle of Internal Friction (Φ) = 29° Bulk Unit Weight (γ_b) = 17 kN/m^3 Coefficient of Lateral Earth Pressure *(K)* = 0.7
	Silty Clay / Sandy Clay	4.0 – 8.0	Undrained Cohesion *(cu)* = 20 kPa Coefficient of Volume Compressibility *(mv)* = 0.025 cm^2/kg Adhesion (α) = 0.55 Bulk Unit Weight (γ_b) = 16 kN/m^3
	Lean Clay	8.0 – 10.0	Undrained Cohesion *(cu)* = 100 kPa Coefficient of Volume Compressibility *(mv)* = 0.012 cm^2/kg Adhesion (α) = 0.55 Bulk Unit Weight (γ_b) = 18 kN/m^3
	Silty Sand	10.0 – 12.5	Angle of Internal Friction (Φ) = 33° Bulk Unit Weight (γ_b) = 19 kN/m^3 Coefficient of Lateral Earth Pressure *(K)* = 0.7
	Lean Clay	12.5 – 16.0	Undrained Cohesion *(cu)* = 200 kPa Coefficient of Volume Compressibility *(mv)* = 0.002 cm^2/kg Adhesion (α) = 0.55 Bulk Unit Weight (γ_b) = 19 kN/m^3
	Silty Sand / Clayey Sand	16.0 – 23.0	Angle of Internal Friction (Φ) = 35° Bulk Unit Weight (γ_b) = 19 kN/m^3 Coefficient of Lateral Earth Pressure *(K)* = 0.7
	Lean Clay	23.0 – 24.5	Undrained Cohesion *(cu)* = 200 kPa Coefficient of Volume Compressibility *(mv)* = 0.002 cm^2/kg Adhesion (α) = 0.55 Bulk Unit Weight (γ_b) = 19 kN/m^3
	Bedrock	24.5 – 29.0	Bulk Unit Weight (γ_b) = 22 kN/m^3 Uniaxial Compressive Strength (q_u) = 0.5 Mpa

**Since, the bedrock at the project site was in very weak to weak condition, therefore, equivalent soil parameters have been used for bedrock during bearing capacity / load carrying capacity evaluation.*

6.4 FOUNDATION TYPE

Considering, the safety of the structures, anticipated structural loads and subsurface ground conditions, cast in place R.C. piles, mat and strip / square foundations can be considered for proposed development works as per structural requirements.

Foundation recommendations for light poles have been developed on the basis of available information regarding existing pole foundation types adjacent to the project site. Therefore, keeping in view of weak ground conditions at upper depths at scattered locations, design of proposed light pole foundations should be firmed-up after detailed structure specific investigations.

6.5 FOUNDATION SIZE, DEPTH AND ALLOWABLE BEARING PRESSURE

The geotechnical recommendations for feasibility level design of foundations for proposed structures are as follows:

<u>Flyover at Kakapir Road</u>

- Foundation Type = RC Piles

- Diameter of Piles = 760 mm & 900 mm
- Length of Piles = 10 m – 20 m below NSL
- Load Carrying Capacity under Compression Loading = Refer to Fig. E-1 & E-2**
- Load Carrying Capacity under Tensile Loading = Refer to Fig. E-3 & E-4**
- Soil Spring Stiffness for RC Piles = Refer to Fig. E-5
- Soil Profile Type = S_D

Light Poles & Retaining Wall for Flyover at Kakapir Road

- Foundation Type = Strip / Square
- Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL
- Width of Foundation ***(B_F)*** = 1 m – 4 m
- Net Allowable Bearing Pressure = Refer to Fig. E-6
- Tolerable Settlement = 25 mm

Flyover near Marine Academy

- Foundation Type = RC Piles
- Diameter of Piles = 760 mm, 900 mm & 1200 mm
- Length of Piles = 20 m – 40 m below NSL
- Load Carrying Capacity under Compression Loading = Refer to Fig. E-7, E-8 & E-9**
- Load Carrying Capacity under Tensile Loading = Refer to Fig. E-10, E-11 & E-12**
- Soil Spring Stiffness for RC Piles = Refer to Fig. E-13
- Soil Profile Type = S_D

Light Poles & Retaining Wall for Flyover near Marine Academy

- Foundation Type = Strip / Square
- Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL
- Width of Foundation ***(B_F)*** = 1 m – 4 m
- Net Allowable Bearing Pressure = Refer to Fig. E-14
- Tolerable Settlement = 25 mm

Culverts (C-2 & C-3) near Treatment Plant (Option –I)

- Foundation Type = RC Piles
- Diameter of Piles = 760 mm & 900 mm
- Length of Piles = 10 m – 30 m below NSL
- Load Carrying Capacity under Compression Loading = Refer to Fig. E-15 & E-16**
- Load Carrying Capacity under Tensile Loading = Refer to Fig. E-17 & E-18**
- Soil Spring Stiffness for RC Piles = Refer to Fig. E-19
- Soil Profile Type = S_D

Culverts (C-2 & C-3) near Treatment Plant (Option –II)

- Foundation Type = Mat
- Minimum Depth of Foundation ***(D_F)*** = 2.5 m below NSL***
- Width of Foundation ***(B_F)*** = 25 m & 10 m***
- Minimum Thickness of Select Fill = 2.0 m below foundation base
- Net Allowable Bearing Pressure = 90 kPa *(for B_F = 25 m)*
  = 130 kPa *(for B_F = 10 m)*
- Tolerable Settlement = 50 mm

Light Poles for Culverts (C – 2 & C – 3)

- Foundation Type = Square
- Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL
- Width of Foundation ***(B_F)*** = 1 m – 3 m
- Minimum Thickness of Select Fill = 1 m below foundation base
- Net Allowable Bearing Pressure = Refer to Fig. E-20
- Tolerable Settlement = 25 mm

Toll Plaza, Admin Building and Adjacent Light Poles

- Foundation Type = Strip / Square
- Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL
- Width of Foundation ***(B_F)*** = 1 m – 4 m
- Minimum Thickness of Select Fill = 1 m below foundation base
- Net Allowable Bearing Pressure = Refer to Fig. E-21
- Tolerable Settlement = 25 mm
- Soil Profile Type = S_D

Flyover near Liyari Expressway

- Foundation Type = RC Piles
- Diameter of Piles = 760 mm & 900 mm
- Length of Piles = 15 m – 35 m below NSL
- Load Carrying Capacity under Compression Loading = Refer to Fig. E-22 & E-23**
- Load Carrying Capacity under Tensile Loading = Refer to Fig. E-24 & E-25**
- Soil Spring Stiffness for RC Piles = Refer to Fig. E-26
- Soil Profile Type = S_D

Light Poles & Retaining Wall for Flyover near Liyari Expressway

- Foundation Type = Strip / Square
- Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL
- Width of Foundation ***(B_F)*** = 1 m – 4 m

- Net Allowable Bearing Pressure = Refer to Fig. E-27
- Tolerable Settlement = 25 mm

Elevated U-Turn and Retaining Walls

- Foundation Type = RC Piles
- Diameter of Piles = 760 mm
- Length of Piles = 20 m – 30 m below NSL
- Load Carrying Capacity under Compression Loading = Refer to Fig. E-28**
- Load Carrying Capacity under Tensile Loading = Refer to Fig. E-29**
- Soil Spring Stiffness for RC Piles = Refer to Fig. E-30
- Soil Profile Type = S_E

Light Poles at Elevated U-Turn

- Foundation Type = Square
- Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL
- Width of Foundation ***(B_F)*** = 1 m – 4 m
- Minimum Thickness of Select Fill = 1 m below foundation base
- Net Allowable Bearing Pressure = Refer to Fig. E-31
- Tolerable Settlement = 25 mm

***No scour depth has been considered during evaluation of pile load carrying capacity. Moreover, the pile capacity curves are only valid if plain water or bentonite mud under controlled conditions as per FHWA requirements will be used as drilling fluid.*

****As per provided drawings*

Detailed geotechnical investigations should be carried out prior to the finalization of foundation design for all the proposed development works during detailed design phase.

If loose soil / soft pocket / fill material encountered at the base of the square / strip / mat foundation excavation, it should be completely removed and backfilled with select fill material. Select fill should be A-3 or better material as per AASHTO soil classification. Select fill should be placed and compacted in layers appropriate to the type & size of compaction equipment to at least 95 % of modified AASHTO maximum dry density.

During construction, the excavation of shallow foundation and casting of in-situ RC piles shall be inspected by an experienced geotechnical engineer/engineering geologist for firming-up the above recommendations. For any unusual subsurface conditions, geotechnical engineer must be consulted prior to initiation of the foundation construction.

6.6 FULL SCALE PILE LOAD TEST

The selected pile length/capacity must be confirmed by performing at least one (1) full scale pile load test at each structure location. The full scale pile load test must be carried out before construction of working piles to 3 times the design load (i.e. $P_{design\ load}$ x 3.0/η) to finalize the design.

Further, as per prevailing geotechnical engineering practices, proof load tests should also be carried out on the selected working piles of each structure, to a maximum of 1.5 times the design load. The quantum of proof load tests shall be decided in the light of scope of work and project specifications. The Contractor should submit his Method Statement, for carrying out the proof pile load tests, for approval of the Engineer. Moreover, sonic integrity test (SIT) should also be carried out to ascertain the integrity of all the working piles.

6.7 EXCAVATIONS

Excavations for square / strip / mat foundations will generally be made in Lean Clay / Silty Clay / Silty Sand. The experience gained during excavation of test pits at this project showed that vertical excavation of pit walls was possible for reasonable duration of time. It is therefore, established that shallow temporary excavations with light/manual equipment would be possible.

Temporary excavations may be carried out at stable slopes as determined by trials at site. In case, excavations have to be made very close to the existing foundation like roads or buildings, suitable temporary excavation support system should be designed to stop any untoward incident. The excavations may preferably not be done during rainy season or otherwise some special precautions may deem necessary to ensure drainage of the excavations. The contractor should submit his Method Statement and design for temporary excavation support system, for Engineer's approval.

6.8 COEFFICIENTS OF LATERAL EARTH PRESSURE

It is recommended to use granular material as the backfill, where required. The granular material should be compacted to around 90 % Modified Proctor density.

The static lateral earth pressure coefficients for active (K_a), at rest (K_o) and passive (K_p) conditions, using granular material as backfill having $\Phi = 30^o$ are recommended as follows:

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

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 Naval Facilities Engineering Command (NAVFAC) Design Manual 7.02 (Chapter-3, Section-6).

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

6.9 TYPE OF CEMENT

On the basis of chemical test results for soil and water samples, Sulphate Resistance Cement (SRC) is recommended to be used for concrete works of foundations.

6.10 WATER FOR MIXING AND CURING

Water will be required during the construction for mixing and curing of concrete. The water required for this purpose needs to be reasonably clean and free from the detrimental amounts of soluble salts, alkalies, oil, organic matter and other deleterious substances that are injurious to concrete. In addition to these, the suspended solids also affect the water quality.

It is therefore recommended that during the construction stage before mixing and curing, the water should also be tested against the permissible limits of salts and solids of mixing and curing water as specified in BS 3148.

6.11 CONCRETE MATERIALS

Detailed material studies have not been carried out for this project. However, fine and coarse aggregates can be obtained from local sources subject to meeting the project specifications / ASTM gradation.

7. CONSIDERATIONS FOR DESIGN AND CONSTRUCTION OF ROADWAYS

7.1 GENERAL

The project also includes rehabilitation of approach roads for the proposed flyover. The following sections provide guidelines regarding geotechnical design and certain construction considerations for roadways:

7.2 PAVEMENT MATERIAL AND DESIGN CBR

7.2.1 Embankment and Subgrade Soils

The primary soil parameter required for the pavement design is the California Bearing Ratio (CBR) or alternatively, the resilient modulus. Laboratory facilities for evaluation of the latter parameter do not exist in Pakistan at present. If a pavement design method requires the use of resilient modulus, it can readily be evaluated from CBR value, using the recent literature.

Six (06) representative soil samples were collected from on-site test pits to evaluate the characteristics of in-situ soils. Test results have revealed that the on-site soils generally belong to A-1-b, A-2-4, A-2-6 & A-7-6 groups as per ASSHTO. A-7-6 material cannot be used for road works as per NHA Specifications.

It is therefore, recommended to use on-site A-1-b / A-2-4 / A-2-6 material for design of road works with minimum soaked CBR value as 18 % at 95 % modified AASHTO maximum dry density. The recommended CBR value is evaluated using 90 percentile analysis of relevant laboratory test results. However, if on-site material is not available in requisite quantity than suitable borrow areas near the project site must be explored. The borrow areas must contain A-4 or better material as per AASHTO soil classification with minimum soaked CBR value as 7 % at 95 % modified AASHTO maximum dry density for subgrade and 5 % at 90 – 95 % modified AASHTO maximum dry density for road embankment, respectively. The suitability of on-site and / or borrow area material must be confirmed by performing appropriate laboratory testing prior to their use in road works.

7.2.2 Sub-Base and Base Course

Material from local sources can be used for the construction of sub-base and base course subject to meeting Project Specifications. The design CBR for these materials shall be governed by the project specifications. However, it would be desirable to use materials with minimum CBR values of 50 and 80, respectively, for these courses.

7.3 SITE PREPARATIONS

For a roadway to perform well, it is imperative that the subgrade of the pavement is competent to support the anticipated vehicular loads. It is therefore recommended that the subgrade should be properly prepared to meet the design CBR. In order to meet this requirement, the area that will support the pavement, should be properly cleared, grubbed by removing any topsoil containing objectionable material.

7.4 FILL PLACEMENT AND COMPACTION

Before placement of the borrow fill, in-situ soil should be proof-rolled to eliminate any soft pocket of soil. For the placement and compaction of the embankment and subgrade fill, loose lift thickness should generally not exceed 30 cm. The moisture content of the fill material should be controlled within ± 2% of the optimum moisture content.

For the sub-base and base courses, the placement should be in such a manner that the compacted thickness of 15 cm is not exceeded.

The following layer thickness and compaction levels are recommended for various pavement elements:

Table 7-1: Fill Placement and Compaction

Material Type	Maximum compacted Layer thickness (cm)	Recommended Modified AASHTO Compaction (%)
Base Course	15	100
Sub-base	15	98
Subgrade & General Fill		
Upper 30cm	20	95
30cm – 70cm	25	93
Below 70cm	30	90

The above compaction levels have to be attained by the Contractor using appropriate machinery. However, prior to construction, the Contractor should submit method statement for fill placement and compaction, for approval of the Engineer.

8. CONCLUSION AND RECOMMENDATIONS

1) The project alignment consists of overburden soils (i.e silty clay, lean clay, silty sand etc.) of depth ranging from 10 m to 24.5 m below NSL. The overburden soil underlain by bedrock (i.e. friable sandstone, claystone, mudstone) up to maximum drilled depth of 29 m below NSL. For detail, Refer to Section 5.1 and Appendix B.

2) Groundwater was encountered at a depth of 1.2 m to 2.4 m below NSL.

3) Both shallow and deep foundations can be used for proposed development works as per structural requirements. For detail, refer to Section 6.4.

4) The selected pile length / capacity must be confirmed by performing at least one (01) full scale pile load test at each structure location. Load test arrangement and execution should be as per ASTM requirements.

5) On the basis of chemical test results for soil and water samples, Sulpahet Resisting Cement (SRC) is recommended to be used for concrete works of foundations.

6) Coarse and fine aggregates for concrete can be obtained from local quarries. The fine and coarse aggregates from these quarries must meet Project specifications and requirements of ASTM C 33.

7) On-site A-1-b / A-2-4 / A-2-6 material can be used for road works with minimum soaked CBR value as 18 % at 95 % modified AASHTO maximum dry density. Alternatively, suitable borrow areas of A-4 or better material with minimum CBR value as 7 % and 5 % for subgrade and road embankment, respectively must be explored. CBR of on-site and borrow area material must be confirmed by performing appropriate laboratory testing prior to their use in subgrade and road embankment. For detail, refer to Section 7.2.

8) Detailed geotechnical investigations should be carried out prior to finalization of foundation design for the proposed development works.

9. DISCLAIMER

This report has been prepared by National Engineering Services Pakistan Pvt. Ltd (NESPAK) for proposed development works of Mauripur Expressway which is the part of the project titled as “Feasibility Study and Transaction Advisory Services for Urban Road Initiative Project. The material contained in this report reflects engineering characteristics of soils / rocks and recommendations on the basis of actual field and laboratory test results at the time of preparation of this report. The recommendations provided in the report can only be used for feasibility level design of foundations. Detailed geotechnical investigations must be carried out prior to the finalization of design of foundations.

This document and the information are solely for the use of the authorized recipient. Any use, which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such party and NESPAK accepts no responsibility for damages, if any, suffered by any third party as a result of such decisions or actions.

This document and the information are solely for the use of the authorized recipient. Any use, which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such party and NESPAK accepts no responsibility for damages, if any, suffered by any third party as a result of such decisions or actions.

During construction, the construction activity may alter the conditions from those prevailing at the time, this report was written or may reveal somewhat different conditions at places. This may require performance of additional investigations during the construction stage so as to adjust the design to safeguard against the revealed conditions. NESPAK does not accept any responsibility for the changes in the conditions and design recommendations provided in this report due to above circumstances.

APPENDICES

- **APPENDIX-A:**

  LOCATION PLAN, GEOTECHNICAL INVESTIGATION PLAN & SUBSURFACE SOIL PROFILE

- **APPENDIX-B:**

  BOREHOLE AND TESTPIT LOGS

- ***APPENDIX-C:***

  SUBSURFACE CHARACTERISTICS

- ***APPENDIX-D:***

  SUMMARY OF LABORATORY TEST RESULTS & DETAILED RESULT SHEETS

- ***APPENDIX-E:***

  FOUNDATION RECOMMENDATIONS

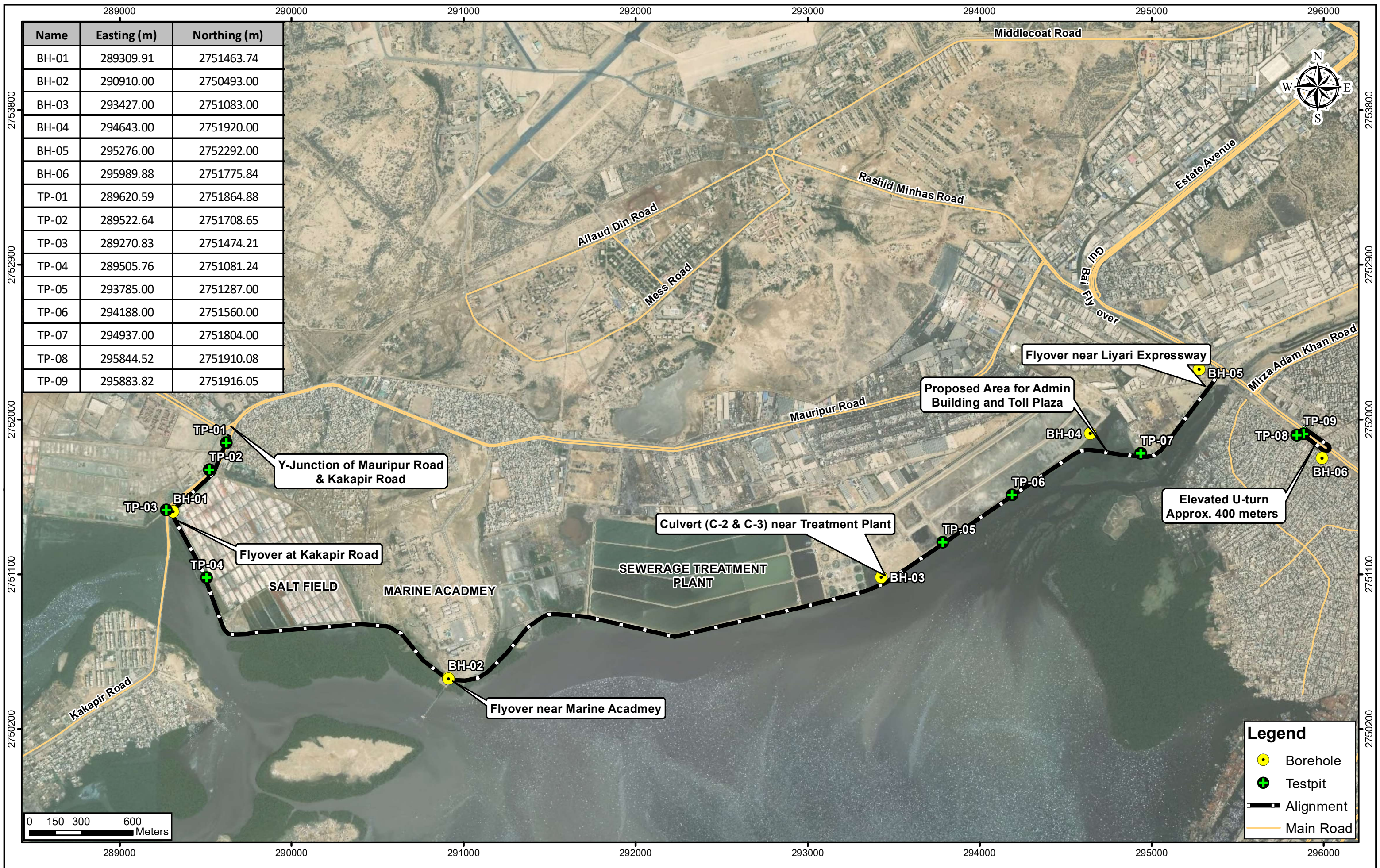
- ***APPENDIX-F:***

  SITE PHOTOGRAPHS

APPENDIX-A

LOCATION PLAN, GEOTECHNICAL INVESTIGATION PLAN & SUBSURFACE SOIL PROFILE

CLIENT	CONSULTANT							PROJECT		SCALE
LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	HASSAN	FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI'	LOCATION PLAN	1:50,000
		03				SUBMITTED				
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.	S.BADAR	SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION	DATE OCT, 2020	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	M.Ali		FIG. A-1	



Name	Easting (m)	Northing (m)
BH-01	289309.91	2751463.74
BH-02	290910.00	2750493.00
BH-03	293427.00	2751083.00
BH-04	294643.00	2751920.00
BH-05	295276.00	2752292.00
BH-06	295989.88	2751775.84
TP-01	289620.59	2751864.88
TP-02	289522.64	2751708.65
TP-03	289270.83	2751474.21
TP-04	289505.76	2751081.24
TP-05	293785.00	2751287.00
TP-06	294188.00	2751560.00
TP-07	294937.00	2751804.00
TP-08	295844.52	2751910.08
TP-09	295883.82	2751916.05

CLIENT

LOCAL GOVERNMENT
& HTP DEPARTMENT
GOVERNMENT OF SINDH

CONSULTANT

NATIONAL ENGINEERING
SERVICES PAKISTAN
(PVT.) LTD

HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N
MODEL TOWN EXTENSION, LAHORE, PAKISTAN

REV.	DATE	DESCRIPTION	APPROVED		
04				DRAWN	HASSAN
03				SUBMITTED	
02				RECOMMENDED	
01				CHD/VER.	S.BADAR
				APPROVED	M.ALI

PROJECT

FEASIBILITY STUDY AND TRANSACTION
ADVISORY SERVICES,
'URBAN ROAD INITIATIVES IN KARACHI'
SUB PROJECT 2: EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUNCTION

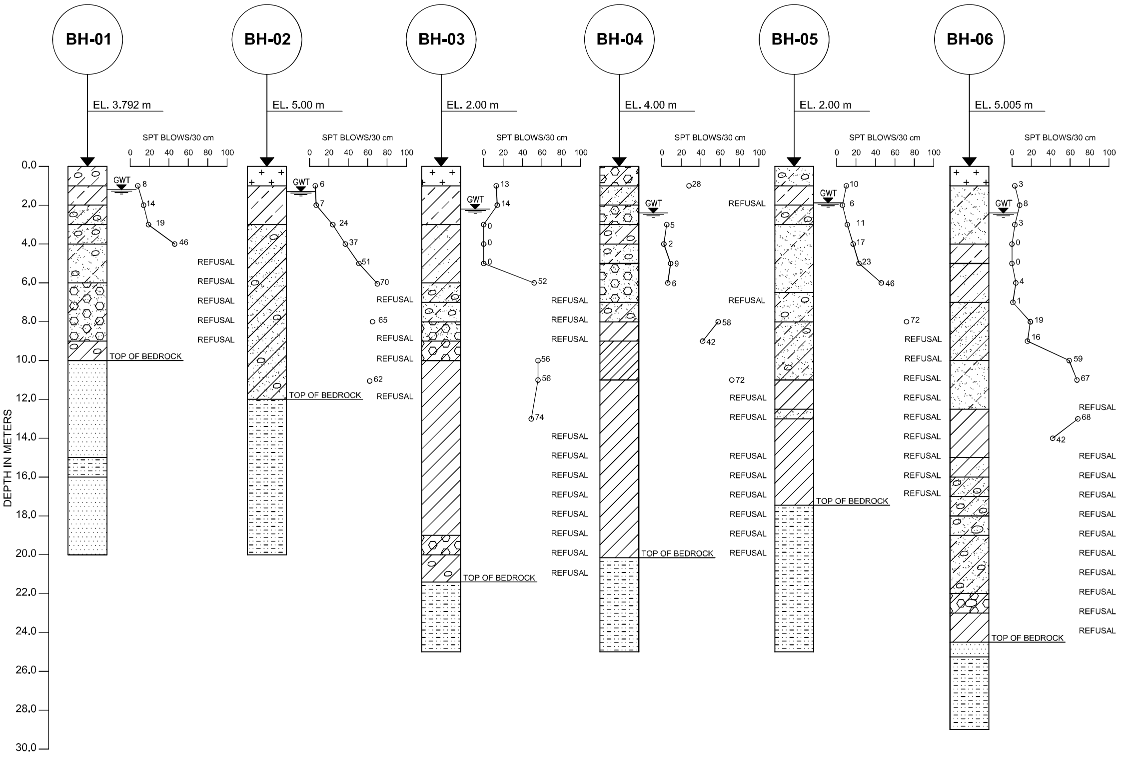
GEOTECHNICAL
INVESTIGATION PLAN

SCALE
1:20,000

DATE
OCT, 2020

FIG. A-2

REV.
0



LEGEND

- FILL MATERIAL
- LEAN CLAY
- FAT CLAY
- LEAN CLAY WITH SAND OR SANDY LEAN CLAY
- LEAN CLAY WITH GRAVELS
- LEAN CLAY WITH SAND AND FEW GRAVELS
- SILTY CLAY
- SANDY SILTY CLAY OR SILTY CLAY WITH SAND
- SANDY CLAY WITH GRAVELS
- GRAVELLY SILTY CLAY
- SILTY CLAYEY SAND WITH GRAVELS OR CLAYEY SAND WITH GRAVEL
- SILTY SAND WITH GRAVELS
- POORLY GRADED SAND WITH SILT AND FEW GRAVELS
- SANDY SILT WITH TRACE GRAVELS
- GRAVELLY SILT
- GRAVELS WITH SAND.
- POORLY GRADED GRAVELS WITH SILT AND SAND.
- CLAYEY GRAVELS
- SILTY CLAYEY GRAVEL
- SANDSTONE
- CLAYSTONE
- ○ SPT BLOWS/30 cm
- GWT GROUND WATER TABLE

NOTES

1. ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE NOTED.
2. THE WIDTH OF BOREHOLES IS NOT TO SCALE.

CLIENT
LOCAL GOVERNMENT
& HTP DEPARTMENT
GOVERNMENT OF SINDH

CONSULTANT
NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT.) LTD.
HEAD OFFICE:- NESPAK HOUSE, I-C, BLOCK-N,
MODEL TOWN EXTENSION, LAHORE, PAKISTAN.

REV.	DATE	DESCRIPTION	APPROVED		
04				DRAWN	RIAZ
03				SUBMITTED	
02				RECOMMENDED	
01				CHD./VER.	M.UMAR
				APPROVED	M.ALI

PROJECT
FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES,
'URBAN ROAD INITIATIVES IN KARACHI'
SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TOY-JUNCTION

SUBSURFACE SOIL / ROCK PROFILE

SCALE
HOR. NTS
VER. 1:200

DATE
NOVEMBER, 2020

FIG. A-3

REV.
0

APPENDIX-B

BOREHOLE AND TESTPIT LOGS

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-01
SHEET 1 OF 2

BOREHOLE LOG

Job No. P38035

Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION

Location FLYOVER AT KAKAPIR ROAD

Site Incharge JUNAID/ARIF

Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH

Contractor M/S STS KARACHI

Type of boring STRAIGHT ROTARY

Drilling Fluid BENTONITE SLURRY

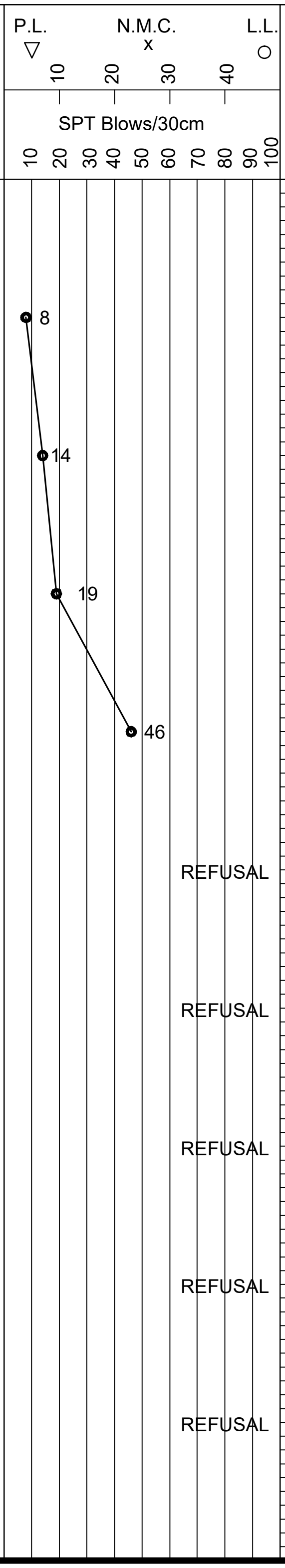
Ground Water Depth 1.20 m

Coordinates N: 2751463.74 m E: 289309.91 m

Ground Elevation 3.79 m

Date 02-09-2020 To 06-09-2020

Depth (m)	Sample No.	USCS Symbol	Description of Material	Dia of Casing/ Hole	SPT Blows/30cm	Remarks
0.0		ML	Grey to yellow, GRAVELLY SILT, trace clay, dry.	100 mm		
1.0	SPT-1	CL-ML	Grey to yellow, firm, SILTY CLAY, low to medium plastic, moist.		8	GWT
2.0	SPT-2	CL-ML	Yellow, stiff, SANDY SILTY CLAY, low plastic trace gravels (50 mm size), moist.		14	
3.0	SPT-3	ML	Grey, medium dense, SANDY SILT, moist, trace gravels.		19	
4.0	SPT-4	SM	Grey, dense to very dense, SILTY SAND, moist, few gravels.		46	
5.0	SPT-5				REFUSAL	
6.0	SPT-6(c)	GP-GM	Grey, very dense, poorly graded GRAVEL with SILT and SAND, moist.		REFUSAL	
7.0	SPT-7(c)				REFUSAL	
8.0	SPT-8(c)				REFUSAL	
9.0	SPT-9	CL	Brown, hard, LEAN CLAY, medium plastic, trace sand, few gravels, moist.		REFUSAL	
10.0			TOP OF BEDROCK			



NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

PROJECT: FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
SITE: FLYOVER AT KAKAPIR ROAD
COORDINATES: N: 2751463.74 m
E: 289309.91 m
ANGLE (with vertical): 0 BEARING: _

GROUND ELEVATION: 3.79 m
ROCK ELEVATION: 10.0 m
GROUND WATER ELEVATION: -
BACK FILLING MATERIAL: -
PEIZOMETER: –

DATE START: 02-09-2020 COMPLETE: 06-09-2020
DRILLING AGENCY: M/S STS KARACHI
DRILLING RIG: STRAIGHT ROTARY
LOGGED BY: M. ARIF
CHECKED BY: -

BOREHOLE No.

BH-01

SHEET 02 OF 02

1	2	3	4	5	6	7	8	9	10			11	12										13		14	15
Depth (m)	Run No.	Core Recovery %	R.Q.D. %	Fragmented Core	Drilling Fluid Loss %	Core Barrel / Bit	Hole Stabilization	Elevation (m)	LITHOLOGY			SAMPLE	DISCONTINUTY DATA										WPT		Point Load (Failure Pressure on Dial)	REMARKS
									Legend	Classification symbol	General Description Soil: Type, Colour, Consistency, Structure, Origin Rock: Colour, Grain Size, Texture and Fabric. State of Weathering, State of Alteration Name, Strength, Shear Zones.		Joint Set	Graphics	Type	Attitude Angle °	Aperture	Roughness	Infilling	Strength Grade	Frequency		Pressure psi	LU Value		
																					Total Joints	Frequency per meter				
10.0	1	45	Nill		5-10%	DOUBLE TUBE CORE BARREL/NX SIZE BIT	BENTONITE SLURRY				TOP OF BEDROCK SANDSTONE:(10.0-15.0) Greenish grey to yellowish grey, fine grained, friable moderately slightly weathered, very weak to weak.															
11.0	2	70	Nill																							
12.0	3	63	Nill							S.St.																
13.0	4	70	Nill																							
14.0	0	77	12																							WS-1:14.00-14.12m
15.0	0	52	25							C.St.	MUDSTONE/CLAYSTONE:(15.0-16.0) Brownish yellow/dark brown, slightly weathered very weak, fragmented, fine grained.															WS-2:15.00-15.25m
16.0	0	54	Nill								SANDSTONE(FRIABLE):(16.0-20.0) Greyish grey to yellowish grey, very weak to weak slightly to moderately weathered, fine graind layer of mudstone from (17.50m to 17.59).															
17.0	0	82	Nill																							
18.0	0	63	28							S.St.																WS-3:18.12-18.27m WS-4:18.76-18.89m
19.0	0	66	15								BOTTOM OF BOREHOLE															WS-5:19.00-19.15m
20.0																										

Key for Description of Discontinuities

Type	
J	Joint
M	Major Joint
F	Fault
B	Bedding
R	Fracture
S	Shistocity
O	Foliation

Aperture		
1	Very Tight	< 0.10 mm
2	Tight	0.10-0.25 mm
3	Partly Open	
4	Open	

Roughness								
	STATE	CODE		STATE	CODE		STATE	CODE
STEPPED	Rough	SR	UNDULATING	Rough	UR	PLANAR	Rough	PR
	Smooth	SSm		Smooth	USm		Smooth	PSm
	Slickensided	SSI		Slickensided	USI		Slickensided	PSI

Infilling			
1	Clean	6	Hydro-Thermals
2	Surface Staining	7	Oxides
3	Loam	8	Breccia
4	Calcite	9	Sheared
5	Silty Gravel/ Gravely Silt	10	Aragonite

NOTES:- 1. For Detailed Description of Discontinuity Parameters Refer to °ISRM Suggested Method for Quantitative Description of Discontinuities in Roc
2. Masses°. In Case of Clay Filled Discontinuities, the Strength of Clay Seam should be Reported as per ISRM. Depth wise Zones of Similar Discontinuity
3. Characteristics should be Recognized to fill in Column No. 11

Weathering of Rock Mass

Grade	Term
I	Fresh
II	Slightly Weathered
III	Moderately Weathered
IV	Highly Weathered
V	Verly Highy Weathered
VI	Residual Soil

Strength Grade of Discontinuity Wall

Grade	Description / MPa	Manual Index Test
R0	Extremely Weak / 0.25 - 1.0	Indented by thumbnail
R1	Very Weak / 1.0 - 5.0	Peeled easily by knife, crumbled under hammer blow
R2	Weak / 5.0 - 25	Peeled difficulty by knife, Indentation by firm hammer blows
R3	Medium Strong / 25 - 50	Cannot peel by knife, fractured with single hammer blow
R4	Strong / 50 - 100	Requires more than one hammer blow to fracture
R5	Very Strong / 100 - 250	Requires many hammer blows to fracture
R6	Extremely Strong / > 250	Specimen can only be chipped with hammer

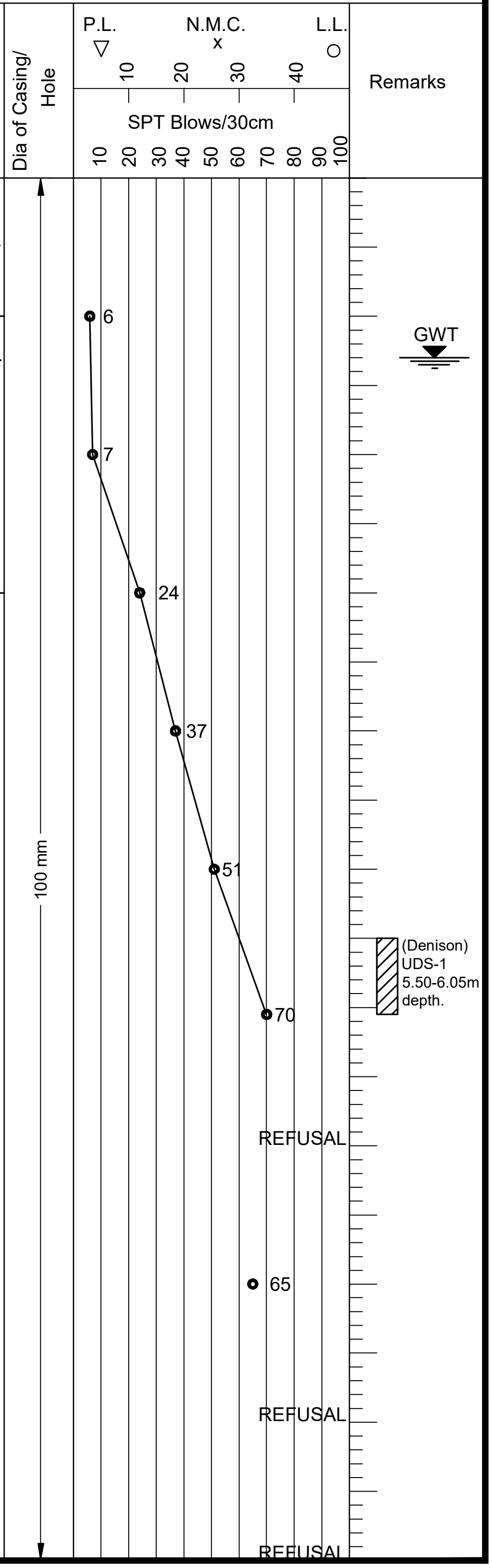
NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-02
SHEET 1 OF 3

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location FLYOVER NEAR MARINE ACADEMY
Site Incharge MUDASSAR ZAFAR
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 1.30 m
Coordinates N: 2750493.00 m E: 290910.00 m
Ground Elevation 5.00 m
Date 09-09-2020 To 12-09-2020

Depth (m)	Sample No.	USCS Symbol	Description of Material	Dia of Casing/ Hole	SPT Blows/30cm	Remarks
0.0			Fill material: Brown to grey, SILTY CLAY, low plastic, trace organic matter, trace polythene bags, trace cloth pieces, moist.	100 mm		
1.0	SPT-1		Brown, firm, SILTY CLAY, low to medium plastic, medium dry strength, little to some sand, trace gravels.		6	GWT
2.0	SPT-2	CL-ML			7	
3.0	SPT-3		Brown to greenish grey, very stiff to hard, LEAN CLAY with SAND, low to medium plastic, high dry strength, trace gravels, moist.		24	
4.0	SPT-4				37	
5.0	SPT-5				51	
	UDS-1					(Denison) UDS-1 5.50-6.05m depth.
6.0	SPT-6	CL			70	
7.0	SPT-7				REFUSAL	
8.0	SPT-8				65	
9.0	SPT-9				REFUSAL	
10.0	SPT-10				REFUSAL	



NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-02
SHEET 2 OF 3

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location FLYOVER NEAR MARINE ACADEMY
Site Incharge MUDASSAR ZAFAR
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 1.30 m
Coordinates N: 2750493.00 m E: 290910.00 m
Ground Elevation 5.00 m
Date 09-09-2020 To 12-09-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ (10 20 30 40) SPT Blows/30cm (10 20 30 40 50 60 70 80 90 100)	Remarks
10.0	SPT-10	▨		Brown, hard, SANDY LEAN CLAY, medium plastic, high dry strength, moist.	100 mm	REFUSAL	
	UDS-2	▨					▨ (Denison) UDS-2 10.50-11.05m depth.
11.0	SPT-11	▨	CL			○ 62	
12.0	SPT-12	▨		TOP OF BEDROCK		REFUSAL	

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

PROJECT: FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
SITE: FLYOVER NEAR MARINE ACADEMY
COORDINATES: N: 2750493.00 m
E: 290910.00 m
ANGLE (with vertical): 0 BEARING: _

GROUND ELEVATION: 5.00 m
ROCK ELEVATION: -
GROUND WATER ELEVATION: 1.3 m
BACK FILLING MATERIAL: -
PEIZOMETER: –

DATE START: 09-09-2020 COMPLETE: 12-09-2020
DRILLING AGENCY: M/S STS KARACHI
DRILLING RIG: STRAIGHT ROTARY
LOGGED BY: MUDASSAR ZAFAR
CHECKED BY: -

BOREHOLE No.

BH-02

SHEET 03 OF 03

1	2	3	4	5	6	7	8	9	10			11	12										13		14	15
									LITHOLOGY				DISCONTINUTY DATA										WPT			
Depth (m)	Run No.	Core Recovery %	R.Q.D. %	Fragmented Core	Drilling Fluid Loss %	Core Barrel / Bit	Hole Stabilization	Elevation (m)	Legend	Classification symbol	General Description Soil: Type, Colour, Consistency, Structure, Origin Rock: Colour, Grain Size, Texture and Fabric. State of Weathering, State of Alteration Name, Strength, Shear Zones.	SAMPLE	Joint Set	Graphics	Type	Attitude Angle °	Aperture	Roughness	Infilling	Strength Grade	Frequency Total Joints	Frequency Frequency per meter	Pressure psi	LU Value	Point Load (Failure Pressure on Dial)	REMARKS
10.0 11.0																										
12.0	SPT-12										TOP OF BEDROCK															WAX SAMPLES:
13.0	1	100	77			DOUBLE TUBE CORE BARREL/NX SIZE BIT	BENTONITE SLURRY				CLAYSTONE: Brown, fresh to slightly weathered, moderately jointed / fractured, bedded, extremely weak to very weak.															
14.0	2	86	49																							WS-1:13.14-13.30m
15.0	3	69	41																							WS-2:14.11-14.27m WS-3:14.28-14.42m
16.0	4	91	58							C.St.																WS-4:15.40-15.57m
17.0	5	100	95																							WS-5:16.81-16.97m
18.0	6	95	25																							WS-6:17.29-17.43m
19.0	7	100	61																							WS-7:18.70-18.91m
20.0	8	96	44								BOTTOM OF BOREHOLE															WS-8:19.40-19.69m

Key for Description of Discontinuities

Type	
J	Joint
M	Major Joint
F	Fault
B	Bedding
R	Fracture
S	Shistocity
O	Foliation

Aperture		
1	Very Tight	< 0.10 mm
2	Tight	0.10-0.25 mm
3	Partly Open	
4	Open	

Roughness

	STATE	CODE
STEPPED	Rough	SR
	Smooth	SSm
	Slickensided	SSI
UNDULATING	Rough	UR
	Smooth	USm
	Slickensided	USI
PLANAR	Rough	PR
	Smooth	PSm
	Slickensided	PSI

Infilling			
1	Clean	6	Hydro-Thermals
2	Surface Staining	7	Oxides
3	Loam	8	Breccia
4	Calcite	9	Sheared
5	Silty Gravel/ Gravely Silt	10	Aragonite

NOTES:- 1. For Detailed Description of Discontinuity Parameters Refer to °ISRM Suggested Method for Quantitative Description of Discontinuities in Roc
2. Masses°. In Case of Clay Filled Discontinuities, the Strength of Clay Seam should be Reported as per ISRM. Depth wise Zones of Similar Discontinuity
3. Characteristics should be Recognized to fill in Column No. 11

Weathering of Rock Mass

Grade	Term
I	Fresh
II	Slightly Weathered
III	Moderately Weathered
IV	Highly Weathered
V	Verly Highy Weathered
VI	Residual Soil

Strength Grade of Discontinuity Wall

Grade	Description / MPa	Manual Index Test
R0	Extremely Weak / 0.25 - 1.0	Indented by thumbnail
R1	Very Weak / 1.0 - 5.0	Peeled easily by knife, crumbled under hammer blow
R2	Weak / 5.0 - 25	Peeled difficulty by knife, Indentation by firm hammer blows
R3	Medium Strong / 25 - 50	Cannot peel by knife, fractured with single hammer blow
R4	Strong / 50 - 100	Requires more than one hammer blow to fracture
R5	Very Strong / 100 - 250	Requires many hammer blows to fracture
R6	Extremely Strong / > 250	Specimen can only be chipped with hammer

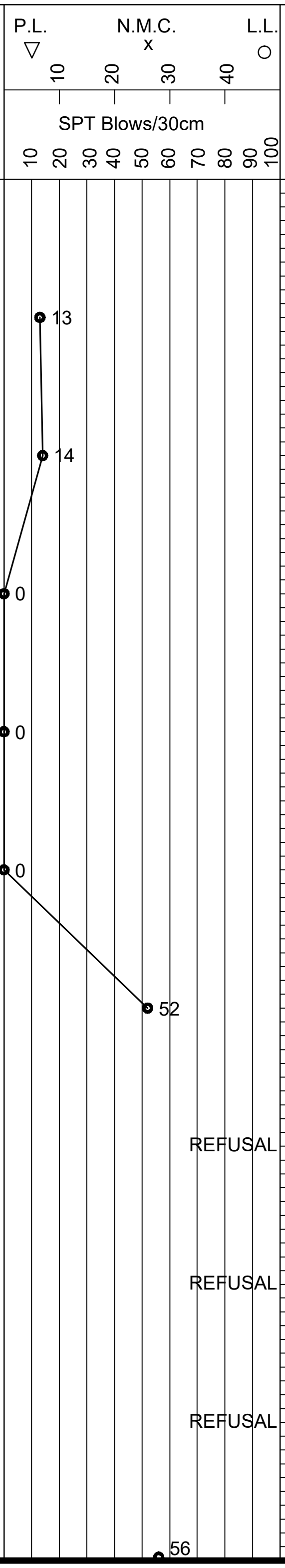
NATIONAL ENGINEERING SERVICES PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-03
SHEET 1 OF 4

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location CULVERTS (C-2 & C-3) NEAR TREATMENT PLANT
Site Incharge MUDASSAR ZAFAR/M. ARIF
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 2.2 m
Coordinates N: 2751083.00 m E: 293427.00 m
Ground Elevation 2.00 m
Date 15-08-2020 To 24-08-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	SPT Blows/30cm	Remarks
0.0				Fill material: Brown, SILTY CLAY, low plastic, trace organic matter, trace polythene bags, trace cloth pieces, moist.	100 mm		
1.0	SPT-1		CL-ML	Black to brown, stiff, SILTY CLAY, low plastic, trace to little organic matter, moist.		13	
2.0	SPT-2					14	GWT
3.0	SPT-3		CL	Black, very soft, LEAN CLAY with SAND, low to medium plastic, moist.		0	
4.0	SPT-4					0	
5.0	SPT-5					0	
6.0	SPT-6		SC-SM	Yellowish brown, very dense, SILTY CLAYEY SAND, fine to medium grained, trace fine gravels, trace to few organic matter, moist.		52	
7.0	SPT-7		SP-SM	Brown, very dense, fine to medium grained, poorly graded SAND with SILT, trace fine gravels, moist.		REFUSAL	
8.0	SPT-8 DS-1		GP-GM	Brown, very dense, poorly graded GRAVELS with SILT and SAND.		REFUSAL	
9.0	SPT-9(C) DS-2		GC	Grey to brown, very dense, sub-angular to sub-rounded, fine to coarse CLAYEY GRAVELS of size (6-50 mm), moist.		REFUSAL	
10.0	SPT-10(C)					56	



NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-03
SHEET 2 OF 4

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location CULVERTS (C-2 & C-3) NEAR TREATMENT PLANT
Site Incharge MUDASSAR ZAFAR/M. ARIF
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 2.2 m
Coordinates N: 2751083.00 m E: 293427.00 m
Ground Elevation 2.00 m
Date 15-08-2020 To 24-08-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ / SPT Blows/30cm	Remarks
10.0	SPT-10(C)	▨	CL	Brown, hard, LEAN CLAY, medium plastic, moist.	100 mm	56	
	DS-3						
11.0	SPT-11(C)					56	
	DS-4						
12.0	UDS-1						▨ (Denison) UDS-1 12.0-12.4m depth.
13.0	SPT-12					74	
14.0	SPT-13					REFUSAL	
15.0	SPT-14					REFUSAL	
16.0	SPT-15					REFUSAL	
17.0	SPT-16					REFUSAL	
18.0	SPT-17					REFUSAL	
19.0	SPT-18					REFUSAL	
	DS-5		GC	Brown, very dense, CLAYEY GRAVELS of size (100mm), moist.			
20.0	SPT-19					REFUSAL	

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-03
SHEET 3 OF 4

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location CULVERTS (C-2 & C-3) NEAR TREATMENT PLANT
Site Incharge MUDASSAR ZAFAR/M. ARIF
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 2.2 m
Coordinates N: 2751083.00 m E: 293427.00 m
Ground Elevation 2.00 m
Date 15-08-2020 To 24-08-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ 10 20 30 40 / SPT Blows/30cm 10 20 30 40 50 60 70 80 90 100	Remarks
20.0	SPT-19						
	DS-5	▨	CL	Brown, hard, LEAN CLAY, medium plastic, trace gravels, moist.	100 mm	REFUSAL	
21.0	SPT-20(C)	▨				REFUSAL	
	DS-6	▨		TOP OF BEDROCK			
21.4							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES,
'URBAN ROAD INITIATIVES IN KARACHI'
PROJECT: SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
SITE: CULVERTS (C-2 & C-3) NEAR TREATMENT PLANT
COORDINATES: N: 2751083.00 m
E: 293427.00 m
ANGLE (with vertical): 0 BEARING: _

GROUND ELEVATION: 2.00 m
ROCK ELEVATION: -14.4 m
GROUND WATER ELEVATION: 2.2 m
BACK FILLING MATERIAL: -
PEIZOMETER: –

DATE START: 15-08-2020 COMPLETE: 24-08-2020
DRILLING AGENCY: M/S STS KARACHI
DRILLING RIG: STRAIGHT ROTARY
LOGGED BY: M. ARIF
CHECKED BY: -

BOREHOLE No.

BH-03

SHEET 04 OF 04

1	2	3	4	5	6	7	8	9	10			11	12										13		14	15
									LITHOLOGY				DISCONTINUTY DATA										WPT			
Depth (m)	Run No.	Core Recovery %	R.Q.D. %	Fragmented Core	Drilling Fluid Loss %	Core Barrel / Bit	Hole Stabilization	Elevation (m)	Legend	Classification symbol	General Description Soil: Type, Colour, Consistency, Structure, Origin Rock: Colour, Grain Size, Texture and Fabric. State of Weathering, State of Alteration Name, Strength, Shear Zones.	SAMPLE	Joint Set	Graphics	Type	Attitude Angle °	Aperture	Roughness	Infilling	Strength Grade	Frequency Total Joints	Frequency Frequency per meter	Pressure psi	LU Value	Point Load (Failure Pressure on Dial)	REMARKS
20.0																										
21.0								-14.4			TOP OF BEDROCK															
21.40	1	100	40		0-5%	DOUBLE TUBE CORE BARREL/NX SIZE BIT	BENTONITE SLURRY			C.St.	CLAYSTONE: Brown, very thinly to moderately bedded, intensely fractured, slightly weathered, extremely weak to very weak.	WS-1, WS-2	3		J	10°-82°	1-2	PSm	7	R0-R1	14	14				WAX SAMPLES: WS-1:21.60-21.89m WS-2:21.89-22.00m WS-3:22.05-22.21m WS-4:22.21-22.30m WS-5:22.50-22.60m WS-6:22.60-22.70m WS-7:23.16-23.32m WS-8:23.32-23.42m WS-9:24.14-24.24m WS-10:24.60-24.85m
22.0	2	96	40.5									WS-3, WS-4, WS-5, WS-6	2		J B	1°-78°	1-2	PSm	7	R0-R1	11	11				
23.0	3	74	42									WS-7, WS-8	3		J B	1°-76°	1-2	PSm	7	R0-R1	9	9				
24.0	4	89	70									WS-9, WS-10	3		J B	1°-47°	1-2	PSm	7	R0-R1	36	36				CORE LOSSES: 22.96-23.00m 23.74-24.00m 24.89-25.00m
25.0						DOUBLE TUBE CORE BARREL BIT/HQ SIZE BIT					BOTTOM OF BOREHOLE															

Key for Description of Discontinuities

Type	
J	Joint
M	Major Joint
F	Fault
B	Bedding
R	Fracture
S	Shistocity
O	Foliation

Aperture		
1	Very Tight	< 0.10 mm
2	Tight	0.10-0.25 mm
3	Partly Open	
4	Open	

Roughness

	STATE	CODE
STEPPED	Rough	SR
	Smooth	SSm
	Slickensided	SSI
UNDULATING	Rough	UR
	Smooth	USm
	Slickensided	USI
PLANAR	Rough	PR
	Smooth	PSm
	Slickensided	PSI

Infilling			
1	Clean	6	Hydro-Thermals
2	Surface Staining	7	Oxides
3	Loam	8	Breccia
4	Calcite	9	Sheared
5	Silty Gravel/ Gravely Silt	10	Aragonite

NOTES:- 1. For Detailed Description of Discontinuity Parameters Refer to °ISRM Suggested Method for Quantitative Description of Discontinuities in Roc
2. Masses°. In Case of Clay Filled Discontinuities, the Strength of Clay Seam should be Reported as per ISRM. Depth wise Zones of Similar Discontinuity
3. Characteristics should be Recognized to fill in Column No. 11

Weathering of Rock Mass

Grade	Term
I	Fresh
II	Slightly Weathered
III	Moderately Weathered
IV	Highly Weathered
V	Verly Highy Weathered
VI	Residual Soil

Strength Grade of Discontinuity Wall

Grade	Description / MPa	Manual Index Test
R0	Extremely Weak / 0.25 - 1.0	Indented by thumbnail
R1	Very Weak / 1.0 - 5.0	Peeled easily by knife, crumbled under hammer blow
R2	Weak / 5.0 - 25	Peeled difficulty by knife, Indentation by firm hammer blows
R3	Medium Strong / 25 - 50	Cannot peel by knife, fractured with single hammer blow
R4	Strong / 50 - 100	Requires more than one hammer blow to fracture
R5	Very Strong / 100 - 250	Requires many hammer blows to fracture
R6	Extremely Strong / > 250	Specimen can only be chipped with hammer

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-04
SHEET 1 OF 4

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location ADMIN BUILDING AND TOLL PLAZA
Site Incharge MUDASSAR ZAFAR/M. ARIF
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 2.4 m
Coordinates N: 2751920.00 m E: 294643.00 m
Ground Elevation 4.00 m
Date 02-09-2020 To 06-09-2020

Depth (m)	Sample No.	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ / SPT Blows/30cm	Remarks
0.0						
1.0	SPT-1	GC	Variegated, SILTY CLAYEY GRAVEL, fine to coarse, size(4.75-60 mm), few sand, sedimentary origin, moist.	100 mm	28	
2.0	SPT-2	CL-ML	Greyish brown, very stiff, SILTY CLAY with SAND, low to medium plastic, layered (5 cm thickness), moist.		REFUSAL	
3.0	SPT-3	GP-GM	Brown, very dense, fine to coarse, poorly graded GRAVEL with SILT and SAND, sedimentary origin, size (5-39mm), moist.		5	GWT (2.4 m)
4.0	SPT-4	CL-ML	Dark grey, firm, SILTY CLAY, few organic matter, low to medium plastic, trace sand, trace gravels, moist.		2	
5.0	SPT-5	SM	Brown , very loose, SILTY SAND, non plastic, trace gravels, wet.		9	
6.0	SPT-6	GP	Grey, loose, fine to coarse, poorly graded GRAVELS with SAND, sedimentary orgin, size (4.75-39 mm), wet.		6	
7.0	SPT-7				REFUSAL	
8.0	SPT-8	SC-SM	Brown, very dense, SILTY CLAYEY SAND, trace to few gravels, moist.		58	
9.0	SPT-9	CL	Brown, hard, LEAN CLAY, medium plastic, moist.		42	
10.0	UDS-1	CH	Reddish brown, hard, FAT CLAY, high plastic, moist.			

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-04
SHEET 2 OF 4

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location ADMIN BUILDING AND TOLL PLAZA
Site Incharge MUDASSAR ZAFAR/M. ARIF
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 2.4 m
Coordinates N: 2751920.00 m E: 294643.00 m
Ground Elevation 4.00 m
Date 02-09-2020 To 06-09-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ (10 20 30 40) SPT Blows/30cm (10 20 30 40 50 60 70 80 90 100)	Remarks
10.0	UDS-1	▨	CH	Reddish brown, FAT CLAY, high plastic, moist.	100 mm		(Denison) UDS-1 10.00- 10.50m depth.
11.0	SPT-10	▨	CL	Reddish brown, hard, LEAN CLAY, medium plastic, moist.		○ 72	
12.0	SPT-11	▨				REFUSAL	
13.0	SPT-12	▨				REFUSAL	
14.0	UDS-2	▨					(Denison) UDS-2 14.00- 14.60m depth.
15.0	SPT-13	▨				REFUSAL	
16.0	SPT-14	▨				REFUSAL	
17.0	SPT-15	▨				REFUSAL	
18.0	SPT-16	▨				REFUSAL	
19.0	SPT-17	▨				REFUSAL	
20.0	SPT(C)-18	▨				REFUSAL	

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-04
SHEET 3 OF 4

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location ADMIN BUILDING AND TOLL PLAZA
Site Incharge MUDASSAR ZAFAR/M. ARIF
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 2.4 m
Coordinates N: 2751920.00 m E: 294643.00 m
Ground Elevation 4.00 m
Date 02-09-2020 To 06-09-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ (10 20 30 40) SPT Blows/30cm (10 20 30 40 50 60 70 80 90 100)	Remarks
20.0 20.15	SPT(C)-18	▨	CL	Brown, hard, LEAN CLAY, medium plastic, oxidized, moist.	100 mm	REFUSAL	
				TOP OF BEDROCK			

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES,
'URBAN ROAD INITIATIVES IN KARACHI'

PROJECT: SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
SITE: ADMIN BUILDING AND TOLL PLAZA
COORDINATES: N: 2751920.00 m
E: 294643.00 m
ANGLE (with vertical): 0 BEARING: _

GROUND ELEVATION: 4.00 m
ROCK ELEVATION: -15.15 m
GROUND WATER ELEVATION: 2.6 m
BACK FILLING MATERIAL: -
PEIZOMETER: –

DATE START: 02-09-2020 COMPLETE: 06-09-2020
DRILLING AGENCY: M/S STS KARACHI
DRILLING RIG: STRAIGHT ROTARY
LOGGED BY: M. ARIF
CHECKED BY: -

BOREHOLE No.

BH-04

SHEET 04 OF 04

1	2	3	4	5	6	7	8	9	10			11	12										13		14	15
									LITHOLOGY				DISCONTINUTY DATA										WPT			
																					Frequency					
Depth (m) 20.0	Run No.	Core Recovery %	R.Q.D. %	Fragmented Core	Drilling Fluid Loss %	Core Barrel / Bit	Hole Stabilization	Elevation (m)	Legend	Classification symbol	General Description Soil: Type, Colour, Consistency, Structure, Origin Rock: Colour, Grain Size, Texture and Fabric. State of Weathering, State of Alteration Name, Strength, Shear Zones.	SAMPLE	Joint Set	Graphics	Type	Attitude Angle °	Aperture	Roughness	Infilling	Strength Grade	Total Joints	Frequency per meter	Pressure psi	LU Value	Point Load (Failure Pressure on Dial)	REMARKS
20.15	1	100	85		0-5%	DOUBLE TUBE CORE BARREL/NX SIZE BIT	BENTONITE SLURRY	-15.5		C.St.	CLAYSTONE(20.15-21.00m): Brown, very thinly to moderately bedded, intensely fractured, fresh to slightly weathered, extremely weak to very weak.	WS-1	2		J	1°-15° 25°-38°	3	PSm Usm	1-2	R0-R1	8	8				**WAX SAMPLES:** WS-1:20.20-20.53m WS-2:21.20-21.34m WS-3:23.00-23.22m WS-4:24.56-24.73m
21.0	2	57	24									WS-2	1 1		J	1°-3° 30°	3-4	PSm Ssm	1-2	R0-R1	5	5				
22.0	3	100	35										2		J	1°-5° 37°-70°	3-4	PSm Ssm	1-2	R0-R1	12	12				
23.0	4	100	44									WS-3	1 1		J J	1°-3° 80°	3-4	Usm PSm	1-2	R0-R1	8	8				**CORE LOSSES:** 21.54-22.00m 24.90-25.00m
24.0	5	90	54									WS-4	1		J	1°-4°	3-4	UR SR	1-2	R0-R1	5	5				
25.0											BOTTOM OF BOREHOLE															

Key for Description of Discontinuities

Type	
J	Joint
M	Major Joint
F	Fault
B	Bedding
R	Fracture
S	Shistocity
O	Foliation

Aperture		
1	Very Tight	< 0.10 mm
2	Tight	0.10-0.25 mm
3	Partly Open	
4	Open	

Roughness

	STATE	CODE		STATE	CODE		STATE	CODE
STEPPED	Rough	SR	UNDULATING	Rough	UR	PLANAR	Rough	PR
	Smooth	SSm		Smooth	USm		Smooth	PSm
	Slickensided	SSI		Slickensided	USI		Slickensided	PSI

Infilling			
1	Clean	6	Hydro-Thermals
2	Surface Staining	7	Oxides
3	Loam	8	Breccia
4	Calcite	9	Sheared
5	Silty Gravel/ Gravely Silt	10	Aragonite

NOTES:- 1. For Detailed Description of Discontinuity Parameters Refer to °ISRM Suggested Method for Quantitative Description of Discontinuities in Roc
2. Masses°. In Case of Clay Filled Discontinuities, the Strength of Clay Seam should be Reported as per ISRM. Depth wise Zones of Similar Discontinuity
3. Characteristics should be Recognized to fill in Column No. 11

Weathering of Rock Mass

Grade	Term
I	Fresh
II	Slightly Weathered
III	Moderately Weathered
IV	Highly Weathered
V	Verly Highy Weathered
VI	Residual Soil

Strength Grade of Discontinuity Wall

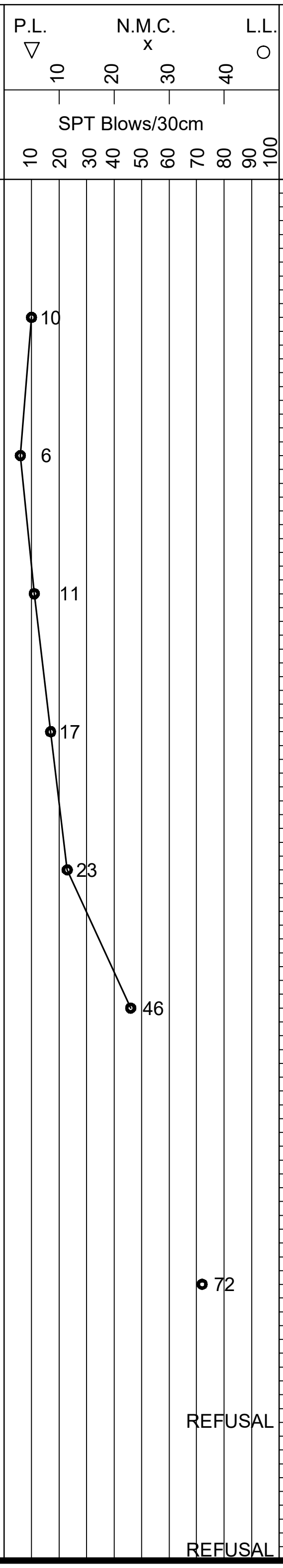
Grade	Description / MPa	Manual Index Test
R0	Extremely Weak / 0.25 - 1.0	Indented by thumbnail
R1	Very Weak / 1.0 - 5.0	Peeled easily by knife, crumbled under hammer blow
R2	Weak / 5.0 - 25	Peeled difficulty by knife, Indentation by firm hammer blows
R3	Medium Strong / 25 - 50	Cannot peel by knife, fractured with single hammer blow
R4	Strong / 50 - 100	Requires more than one hammer blow to fracture
R5	Very Strong / 100 - 250	Requires many hammer blows to fracture
R6	Extremely Strong / > 250	Specimen can only be chipped with hammer

BOREHOLE NO. BH-05
SHEET 1 OF 4

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location FLYOVER NEAR LIYARI EXPRESSWAY
Site Incharge M. ARIF
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 1.85 m
Coordinates N: 2752292.00 m
E: 295276.00 m
Ground Elevation 2.00 m
Date 04-09-2020 To 11-09-2020

Depth (m)	Sample No.	USCS Symbol	Description of Material	Dia of Casing/Hole	SPT Blows/30cm	Remarks
0.0		SM	Greyish brown, SILTY SAND with GRAVEL, trace to few cloth pieces, trace to few polythene pieces, moist.	100 mm		
1.0	SPT-1	CL-ML	Brown & black, stiff, SILTY CLAY, low to medium plastic, few sand, trace organic matter, trace polythene bags, moist.		10	
2.0	SPT-2	SC-SM	Brown, loose, SILTY CLAYEY SAND, trace gravels, trace organic matter, moist.		6	GWT
3.0	SPT-3	SM	Brown, medium dense to dense, fine grained, SILTY SAND, trace mica, wet.		11	
4.0	SPT-4				17	
5.0	SPT-5				23	
6.0	SPT-6				46	
	UDS-1	SM	Greyish brown, fine grained, SILTY SAND with GRAVELS, moist.			(Denison) UDS-1 6.50-7.40m depth.
7.0						
8.0	SPT-7	SC-SM	Brown, very dense, SILTY CLAYEY SAND, fine to coarse, trace to few fine gravels, moist.		72	
9.0	SPT-8				REFUSAL	
10.0	SPT-9				REFUSAL	



NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-05
SHEET 2 OF 4

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location FLYOVER NEAR LIYARI EXPRESSWAY
Site Incharge M. ARIF
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 1.85 m
Coordinates N: 2752292.00 m E: 295276.00 m
Ground Elevation 2.00 m
Date 04-09-2020 To 11-09-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ 10 20 30 40 / SPT Blows/30cm 10 20 30 40 50 60 70 80 90 100	Remarks
10.0	SPT-9		SC-SM	Yellowish brown, very dense,SILTY CLAYEY SAND, fine to coarse grained, trace to few fine gravels, moist.	100 mm		
11.0	SPT-10		CL	Yellowish brown, hard, LEAN CLAY, medium plastic, moist.		REFUSAL	
12.0	SPT-11					REFUSAL	
	UDS-2		SC	Brown, fine grained, CLAYEY SAND, moist.			(Denison) UDS-2 12.50-13.00m depth.
13.0	SPT-12		CL	Yellowish brown, hard, LEAN CLAY, medium plastic, moist.		REFUSAL	
14.0	SPT-13					REFUSAL	
15.0	SPT-14					REFUSAL	
16.0	SPT-15					REFUSAL	
17.0	SPT-16					REFUSAL	
17.45				TOP OF BEDROCK			

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES,
'URBAN ROAD INITIATIVES IN KARACHI'
PROJECT: SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
SITE: FLYOVER NEAR LIYARI EXPRESSWAY
COORDINATES: N: 2752292.00 m
E: 295276.00 m
ANGLE (with vertical): 0 BEARING: _
GROUND ELEVATION: 2.00 m
ROCK ELEVATION: -13.45 m
GROUND WATER ELEVATION: -
BACK FILLING MATERIAL: -
PEIZOMETER: –
DATE START: 04-09-2020 COMPLETE: 11-09-2020
DRILLING AGENCY: M/S STS KARACHI
DRILLING RIG: STRAIGHT ROTARY
LOGGED BY: M. ARIF
CHECKED BY: -

BOREHOLE No.
BH-05
SHEET 03 OF 04

1	2	3	4	5	6	7	8	9	10			11	12										13		14	15
									LITHOLOGY				DISCONTINUTY DATA										WPT			
Depth (m)	Run No.	Core Recovery %	R.Q.D. %	Fragmented Core	Drilling Fluid Loss %	Core Barrel / Bit	Hole Stabilization	Elevation (m)	Legend	Classification symbol	General Description Soil: Type, Colour, Consistency, Structure, Origin Rock: Colour, Grain Size, Texture and Fabric. State of Weathering, State of Alteration Name, Strength, Shear Zones.	SAMPLE	Joint Set	Graphics	Type	Attitude Angle °	Aperture	Roughness	Infilling	Strength Grade	Frequency Total Joints	Frequency Frequency per meter	Pressure psi	LU Value	Point Load (Failure Pressure on Dial)	REMARKS
10.0																										
11.0																										
12.0																										
13.0																										
14.0																										
15.0																										
16.0																										
17.0								-13.45																		
	1	96	65		0-5%	DOUBLE TUBE CORE BARREL/NX SIZE BIT	BENTONITE SLURRY			C.St.	CLAYSTONE(17.25-25.00m): Brown, moderately to intensely fractured/jointed, fresh to slightly weathered, extremely weak to very weak.	WS-1	2		J J	2°-12° 23°-34°	3-4	PSm	1-2	R0-R1	7	7				WAX SAMPLES: WS-1:17.64-17.86m
18.0	2	65	0										2		J J	1°-10° 75°-85°	3-4	PSm	1-2	R0-R1	24	24				CORE LOSSES: 18.65-19.00m
19.0	3	100	29										1 1		J J	1°-3° 84°	3-4	PSm	1-2	R0-R1	14	14				
20.0																										

Key for Description of Discontinuities

Type	
J	Joint
M	Major Joint
F	Fault
B	Bedding
R	Fracture
S	Shistocity
O	Foliation

Aperture		
1	Very Tight	< 0.10 mm
2	Tight	0.10-0.25 mm
3	Partly Open	
4	Open	

Roughness

	STATE	CODE		STATE	CODE		STATE	CODE
STEPPED	Rough	SR	UNDULATING	Rough	UR	PLANAR	Rough	PR
	Smooth	SSm		Smooth	USm		Smooth	PSm
	Slickensided	SSI		Slickensided	USI		Slickensided	PSI

Infilling			
1	Clean	6	Hydro-Thermals
2	Surface Staining	7	Oxides
3	Loam	8	Breccia
4	Calcite	9	Sheared
5	Silty Gravel/ Gravely Silt	10	Aragonite

NOTES:- 1. For Detailed Description of Discontinuity Parameters Refer to °ISRM Suggested Method for Quantitative Description of Discontinuities in Roc
2. Masses°. In Case of Clay Filled Discontinuities, the Strength of Clay Seam should be Reported as per ISRM. Depth wise Zones of Similar Discontinuity
3. Characteristics should be Recognized to fill in Column No. 11

Weathering of Rock Mass

Grade	Term
I	Fresh
II	Slightly Weathered
III	Moderately Weathered
IV	Highly Weathered
V	Verly Highy Weathered
VI	Residual Soil

Strength Grade of Discontinuity Wall

Grade	Description / MPa	Manual Index Test
R0	Extremely Weak / 0.25 - 1.0	Indented by thumbnail
R1	Very Weak / 1.0 - 5.0	Peeled easily by knife, crumbled under hammer blow
R2	Weak / 5.0 - 25	Peeled difficulty by knife, Indentation by firm hammer blows
R3	Medium Strong / 25 - 50	Cannot peel by knife, fractured with single hammer blow
R4	Strong / 50 - 100	Requires more than one hammer blow to fracture
R5	Very Strong / 100 - 250	Requires many hammer blows to fracture
R6	Extremely Strong / > 250	Specimen can only be chipped with hammer

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

PROJECT: FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
SITE: FLYOVER NEAR LIYARI EXPRESSWAY
COORDINATES: N: 2752292.00 m
E: 295276.00 m
ANGLE (with vertical): 0 BEARING: _

GROUND ELEVATION: 2.00 m
ROCK ELEVATION: -13.45 m
GROUND WATER ELEVATION: -
BACK FILLING MATERIAL: -
PEIZOMETER: –

DATE START: 04-09-2020 COMPLETE: 11-09-2020
DRILLING AGENCY: M/S STS KARACHI
DRILLING RIG: STRAIGHT ROTARY
LOGGED BY: M. ARIF
CHECKED BY: -

BOREHOLE No.

BH-05

SHEET 04 OF 04

1	2	3	4	5	6	7	8	9	10			11	12										13		14	15
									LITHOLOGY				DISCONTINUITY DATA										WPT			
																					Frequency					
Depth (m)	Run No.	Core Recovery %	R.Q.D. %	Fragmented Core	Drilling Fluid Loss %	Core Barrel / Bit	Hole Stabilization	Elevation (m)	Legend	Classification symbol	General Description Soil: Type, Colour, Consistency, Structure, Origin Rock: Colour, Grain Size, Texture and Fabric. State of Weathering, State of Alteration Name, Strength, Shear Zones.	SAMPLE	Joint Set	Graphics	Type	Attitude Angle °	Aperture	Roughness	Infilling	Strength Grade	Total Joints	Frequency per meter	Pressure psi	LU Value	Point Load (Failure Pressure on Dial)	REMARKS
20.0	4	82	33		0-5%	DOUBLE TUBE CORE BARREL/NX SIZE BIT	BENTONITE SLURRY			C.St.	CLAYSTONE(17.25-25.00m): Brown, moderately to intensely fractured/jointed, fresh to slightly weathered, extremely weak to very weak.	WS-2	2		J J	2°-7° 23°-39°	3-4	PSm	1-2	R0-R1	11	11				**WAX SAMPLES:** WS-2:20.52-20.64m WS-3:21.79-21.90m WS-4:23.46-23.59m WS-5:24.56-24.76m WS-6:24.78-24.80m **CORE LOSSES:** 20.64-20.82m 21.61-21.79m 23.15-23.33m 24.09-24.30m
21.0	5	27	11									WS-3														
22.0	6	100	10									WS-3	1		J	2°-10°	3-4	PSm	1-2	R0-R1	14	14				
23.0	7	82	23									WS-4	2		J J	1°-3° 50°-82°	3-4	PSm	1-2	R0-R1	15	15				
24.0	8	79	54									WS-5 WS-6	2		J J	1°-5° 40°	3-4	PSm	1-2	R0-R1	9	9				
25.0											BOTTOM OF BOREHOLE															

Key for Description of Discontinuities

Type	
J	Joint
M	Major Joint
F	Fault
B	Bedding
R	Fracture
S	Shistocity
O	Foliation

Aperture		
1	Very Tight	< 0.10 mm
2	Tight	0.10-0.25 mm
3	Partly Open	
4	Open	

Roughness

	STATE	CODE		STATE	CODE		STATE	CODE
STEPPED	Rough	SR	UNDULATING	Rough	UR	PLANAR	Rough	PR
	Smooth	SSm		Smooth	USm		Smooth	PSm
	Slickensided	SSI		Slickensided	USI		Slickensided	PSI

Infilling			
1	Clean	6	Hydro-Thermals
2	Surface Staining	7	Oxides
3	Loam	8	Breccia
4	Calcite	9	Sheared
5	Silty Gravel/ Gravely Silt	10	Aragonite

NOTES:- 1. For Detailed Description of Discontinuity Parameters Refer to °ISRM Suggested Method for Quantitative Description of Discontinuities in Roc
2. Masses°. In Case of Clay Filled Discontinuities, the Strength of Clay Seam should be Reported as per ISRM. Depth wise Zones of Similar Discontinuity
3. Characteristics should be Recognized to fill in Column No. 11

Weathering of Rock Mass

Grade	Term
I	Fresh
II	Slightly Weathered
III	Moderately Weathered
IV	Highly Weathered
V	Verly Highy Weathered
VI	Residual Soil

Strength Grade of Discontinuity Wall

Grade	Description / MPa	Manual Index Test
R0	Extremely Weak / 0.25 - 1.0	Indented by thumbnail
R1	Very Weak / 1.0 - 5.0	Peeled easily by knife, crumbled under hammer blow
R2	Weak / 5.0 - 25	Peeled difficulty by knife, Indentation by firm hammer blows
R3	Medium Strong / 25 - 50	Cannot peel by knife, fractured with single hammer blow
R4	Strong / 50 - 100	Requires more than one hammer blow to fracture
R5	Very Strong / 100 - 250	Requires many hammer blows to fracture
R6	Extremely Strong / > 250	Specimen can only be chipped with hammer

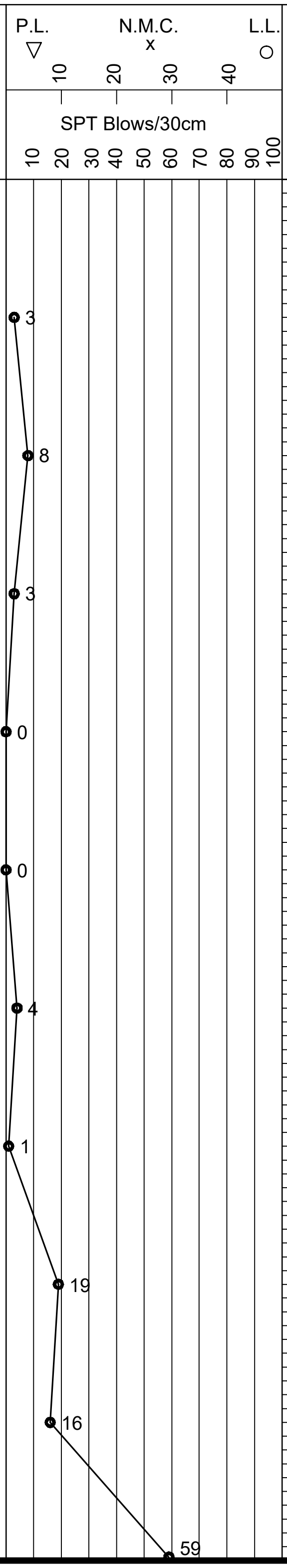
NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-06
SHEET 1 OF 4

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location ELEVATED U-TURN
Site Incharge MUDASSAR ZAFAR
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 2.40 m
Coordinates N: 2751775.84 m E: 295989.88 m
Ground Elevation 5.38 m
Date 21-08-2020 To 31-08-2020

Depth (m)	Sample No.	USCS Symbol	Description of Material	Dia of Casing/ Hole	SPT Blows/30cm	Remarks
0.0			Top kacha track beside road side nullah. Fill material: Blackish grey, SILTY SAND, trace clay, trace roots, trace polythene bags, trace cloth pieces.	100 mm		
1.0	SPT-1	SM	Brownish grey, very loose to loose, fine grained, SILTY SAND, trace clay, trace gravels, moist.		3	
2.0	SPT-2				8	GWT
3.0	SPT-3				3	
4.0	SPT-4	CL-ML	Grey to brown, very soft, SILTY CLAY, low to medium plastic, medium dry strength, trace sand, trace roots, moist.		0	
5.0	SPT-5	SC	Light grey, very soft, SANDY CLAY, low to medium plastic, medium dry strength, trace fine gravels, trace roots.		0	
6.0	SPT-6				4	
	UDS-1					(Shellby) UDS-1 6.50-7.00m depth.
7.0	SPT-7	CL	Light grey, very soft to very stiff, LEAN CLAY with SAND, low to medium plastic, medium dry strength, trace gravels, moist.		1	
8.0	SPT-8				19	
9.0	SPT-9				16	
10.0	SPT-10				59	



NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-06
SHEET 2 OF 4

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location ELEVATED U-TURN
Site Incharge MUDASSAR ZAFAR
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 2.40 m
Coordinates N: 2751775.84 m E: 295989.88 m
Ground Elevation 5.38 m
Date 21-08-2020 To 31-08-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ (10 20 30 40) / SPT Blows/30cm	Remarks
10.0	SPT-10		SM	Brown, very dense, fine grained, SILTY SAND, trace clay, moist.	100 mm	59	
11.0	SPT-11					67	
12.0							
	SPT-12					REFUSAL	
			CL	Brown, hard, LEAN CLAY, medium plastic, high dry strength, trace sand, trace fine gravels.			
13.0	SPT-13					68	
	UDS-2						(Denison) UDS-2 13.50-14.00 m depth.
14.0	SPT-14					42	
15.0	SPT-15					REFUSAL	
			CL	Brown, hard, LEAN CLAY with SAND, medium plastic, high dry strength, little to some gravels.			
16.0	SPT-16					REFUSAL	
			SC	Brown, very dense, CLAYEY SAND with GRAVELS, gravels are sub-rounded to rounded (6-30mm) size.			
17.0	CPT-1					REFUSAL	
			SC-SM	Brown, very dense, SILTY CLAYEY SAND, trace to little gravels (6-20mm) size.			
18.0	CPT-2					REFUSAL	
			SM	Brown, very dense, SILTY SAND with GRAVELS, trace to little clay, two pieces of conglomerate (35-45mm) size.			
19.0	CPT-3					REFUSAL	
			SC-SM	Brown, very dense, SILTY CLAYEY SAND, trace to little gravels (6-53mm) size.			
20.0	CPT-4					REFUSAL	

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

BOREHOLE NO. BH-06
SHEET 3 OF 4

BOREHOLE LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location ELEVATED U-TURN
Site Incharge MUDASSAR ZAFAR
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Type of boring STRAIGHT ROTARY
Drilling Fluid BENTONITE SLURRY
Ground Water Depth 2.40 m
Coordinates N: 2751775.84 m E: 295989.88 m
Ground Elevation 5.38 m
Date 21-08-2020 To 31-08-2020

Depth (m)	Sample No.	Legend	USCS Symbol	Description of Material	Dia of Casing/ Hole	P.L. ▽ N.M.C. x L.L. ○ 10 20 30 40 SPT Blows/30cm 10 20 30 40 50 60 70 80 90 100	Remarks
20.0	CPT-4		SC-SM	Brown, very dense, SILTY CLAYEY SAND, trace to little gravels (6-46mm) size.	100 mm	REFUSAL	
21.0	CPT-5					REFUSAL	
22.0	SPT-17		GC	Brown, very dense, CLAYEY GRAVELS with SAND, one piece of cobble (60mm) size.		REFUSAL	
23.0	CPT-6		CL	Grey to brown, hard, LEAN CLAY, medium plastic, high dry strength.		REFUSAL	
24.0	CPT-7					REFUSAL	
24.5				TOP OF BEDROCK			

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

PROJECT: FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
SITE: ELEVATED U-TURN
COORDINATES: N: 2751775.84 m
E: 295989.88 m
ANGLE (with vertical): 0 BEARING: _

GROUND ELEVATION: 5.38 m
ROCK ELEVATION: -9.5 m
GROUND WATER ELEVATION: 13 m
BACK FILLING MATERIAL: -
PEIZOMETER: –

DATE START: 21-08-2020 COMPLETE: 31-08-2020
DRILLING AGENCY: M/S STS KARACHI
DRILLING RIG: STRAIGHT ROTARY
LOGGED BY: MUDASSAR ZAFAR
CHECKED BY: -

BOREHOLE No. **BH-06**

SHEET 04 OF 04

1	2	3	4	5	6	7	8	9	10			11	12										13		14	15
									LITHOLOGY				DISCONTINUITY DATA										WPT			
Depth (m)	Run No.	Core Recovery %	R.Q.D. %	Fragmented Core	Drilling Fluid Loss %	Core Barrel / Bit	Hole Stabilization	Elevation (m)	Legend	Classification symbol	General Description Soil: Type, Colour, Consistency, Structure, Origin Rock: Colour, Grain Size, Texture and Fabric. State of Weathering, State of Alteration Name, Strength, Shear Zones.	SAMPLE	Joint Set	Graphics	Type	Attitude Angle °	Aperture	Roughness	Infilling	Strength Grade	Frequency Total Joints	Frequency per meter	Pressure psi	LU Value	Point Load (Failure Pressure on Dial)	REMARKS
20.0																										
21.0																										
22.0																										
23.0																										
24.0								-9.5			TOP OF BEDROCK															
24.5	1	96	0		0-5%	DOUBLE TUBE CORE BARREL/NX SIZE BIT	BENTONITE SLURRY			S.St.	<u>SANDSTONE:</u> Grey, fine to medium grained, intensely fractured/jointed, slightly to moderately weathered, weak to medium strong.		1		J	2°-16°	3	PSm-Usm	1-2	R2-R3	29					**WAX SAMPLES:**
25.0	2	70	50							C.St.	<u>CLAYSTONE:</u> Brown, slightly weathered, extremely weak to very weak.	WS-1	1		J	1°-8°	3-4	PSm-Usm	1-2	R2-R3 R0-R1	8	8				WS-1:25.06-25.20m
26.0	3	100	63									WS-2,WS-3	1		J	1°-5°	3-4	UR-Usm	1-2	R0-R1	8	8				WS-2:26.33-26.43m WS-3:26.72-27.00m
27.0	4	97	58									WS-4,WS-5	2		J J	1°-7° 31°-37°	3-4	Usm-UR	1-2	R0-R1	7	7				WS-4:27.00-27.13m WS-5:27.56-27.71m
28.0	5	75	59									WS-6	1		J	1°-4°	3-4	Usm-UR	1-2	R0-R1	5	5				WS-6:28.51-28.67m
29.0											BOTTOM OF BOREHOLE															**CORE LOSSES:** 24.98-25.00m 25.26-25.56m 27.97-28.00m 28.75-29.00m

Key for Description of Discontinuities

Type	
J	Joint
M	Major Joint
F	Fault
B	Bedding
R	Fracture
S	Shistocity
O	Foliation

Aperture		
1	Very Tight	< 0.10 mm
2	Tight	0.10-0.25 mm
3	Partly Open	
4	Open	

Roughness

	STATE	CODE
STEPPED	Rough	SR
	Smooth	SSm
	Slickensided	SSI
UNDULATING	Rough	UR
	Smooth	USm
	Slickensided	USI
PLANAR	Rough	PR
	Smooth	PSm
	Slickensided	PSI

Infilling			
1	Clean	6	Hydro-Thermals
2	Surface Staining	7	Oxides
3	Loam	8	Breccia
4	Calcite	9	Sheared
5	Silty Gravel/ Gravely Silt	10	Aragonite

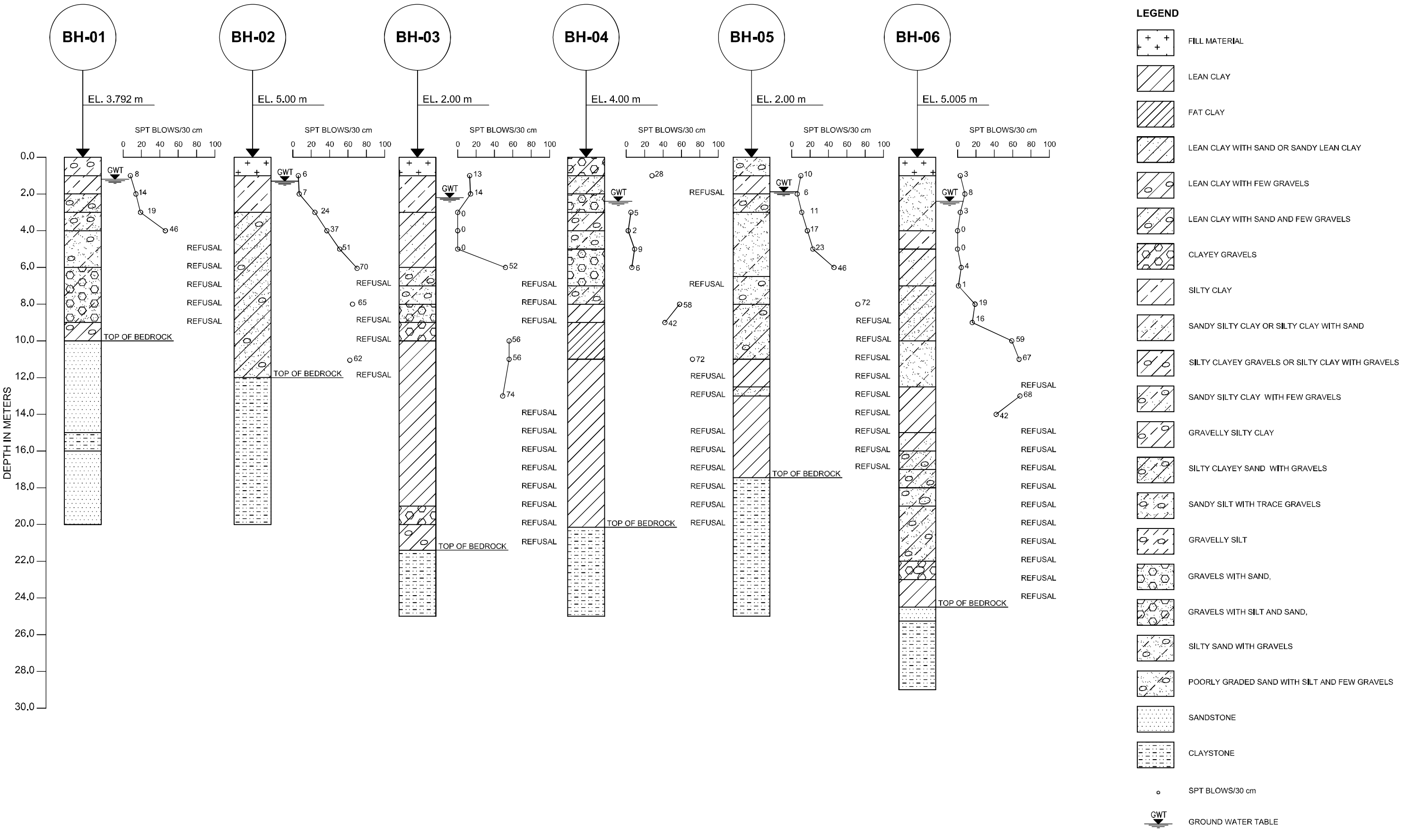
NOTES:- 1. For Detailed Description of Discontinuity Parameters Refer to °ISRM Suggested Method for Quantitative Description of Discontinuities in Roc
2. Masses°. In Case of Clay Filled Discontinuities, the Strength of Clay Seam should be Reported as per ISRM. Depth wise Zones of Similar Discontinuity
3. Characteristics should be Recognized to fill in Column No. 11

Weathering of Rock Mass

Grade	Term
I	Fresh
II	Slightly Weathered
III	Moderately Weathered
IV	Highly Weathered
V	Verly Highy Weathered
VI	Residual Soil

Strength Grade of Discontinuity Wall

Grade	Description / MPa	Manual Index Test
R0	Extremely Weak / 0.25 - 1.0	Indented by thumbnail
R1	Very Weak / 1.0 - 5.0	Peeled easily by knife, crumbled under hammer blow
R2	Weak / 5.0 - 25	Peeled difficulty by knife, Indentation by firm hammer blows
R3	Medium Strong / 25 - 50	Cannot peel by knife, fractured with single hammer blow
R4	Strong / 50 - 100	Requires more than one hammer blow to fracture
R5	Very Strong / 100 - 250	Requires many hammer blows to fracture
R6	Extremely Strong / > 250	Specimen can only be chipped with hammer



NOTES

1. ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE NOTED.
2. THE WIDTH OF BORE HOLES IS NOT TO SCALE.

CLIENT LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD. HEAD OFFICE:- NESPAK HOUSE, I-C, BLOCK-N, MODEL TOWN EXTENSION, LAHORE, PAKISTAN.	04				DRAWN	RIAZ	PROJECT FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TOY-JUNCTION	SUBSURFACE SOIL / ROCK PROFILE	SCALE HOR. NTS VER. 1:200
		03				SUBMITTED				
		02				RECOMMENDED			DATE NOVEMBER, 2020	
		01				CHD./VER.	M.UMAR		FIG. A-3	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	M.ALI			

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-01
Sheet 1 OF 1

TESTPIT LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location FLYOVER AT KAKAPIR ROAD
Site Incharge MUDASSAR
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Coordinates N: 2751864.88 m E: 289620.59 m
Ground Elevation 5.01 m
Date 16-09-2020 TO 17-09-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test: Dry Density kN/m 3	Field Density Test: Moisture Content %	Lab. Density Test: Max. Dry Density kN/m 3	Lab. Density Test: Optimum m.c. %	Inplace % Compaction	REMARKS
0.0				Asphalt layer.							
			GP	Greyish brown, poorly graded GRAVEL with SAND, gravels are sub rounded to rounded (size 6mm to 20mm).							
0.5			SM	Brown, fine to medium grained, SILTY SAND with GRAVEL, gravels are angular to sub rounded of size (6-65 mm), little to some clay.	FDT-1	19.4	6.2	21.5	7.5	90.3	
1.0					CS-1						
1.5											
1.75				BOTTOM OF TESTPIT							Seepage water encountered at 1.75 m depth.

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

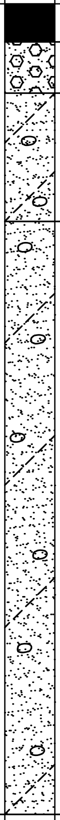
Test Pit No. TP-02
Sheet 1 OF 1

TESTPIT LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location FLYOVER AT KAKAPIR ROAD

Site Incharge MUDASSAR
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI

Coordinates N: 2751708.65 m
E: 289522.64 m
Ground Elevation 4.94 m
Date 16-09-2020 TO 17-09-2020



Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test		Lab. Density Test		Inplace % Compaction	REMARKS
						Dry Density kN/m 3	Moisture Content %	Max. Dry Density kN/m 3	Optimum m.c. %		
0.0				Asphalt layer.							
			GP	Greyish brown, poorly graded gravel with SAND, gravels are sub rounded to rounded of size (6-50 mm).							
			SM	Brown, fine to medium grained, SILTY SAND with gravel, trace clay, trace cobbles, polythene bags, fabric and rope pieces, moist.							
0.5			SM	Brown, fine to medium grained, SILTY SAND with gravel, trace clay, trace cobbles, moist.							
1.0					FDT-1	19.3	7.1	21.7	6.1	89.1	
1.5					CS-1						
1.9				BOTTOM OF TESTPIT							Seepage water encountered at 1.9 m depth.

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-03
Sheet 1 OF 1

TESTPIT LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location FLYOVER AT KAKAPIR ROAD
Site Incharge MUDASSAR
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Coordinates N: 2751474.21 m
E: 289270.83 m
Ground Elevation 5.66 m
Date 12-09-2020 TO 15-09-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test		Lab. Density Test		Inplace % Compaction	REMARKS
						Dry Density kN/m 3	Moisture Content %	Max. Dry Density kN/m 3	Optimum m.c. %		
0.0				Asphalt layer.							
0.5			GP	Water bound macadam (WBM) layer: Greyish brown, poorly graded GRAVEL with SAND, sub rounded to rounded (size 25mm)							
				Old water bound macadam layer: Greyish brown, poorly graded GRAVEL with SAND, sub rounded to rounded (size 25mm)							
1.0				Brownish grey, poorly graded GRAVEL with SAND, trace clay, gravels are sub rounded to rounded (size 6mm-70mm).							
1.5			GC	Brown, CLAYEY GRAVEL WITH SAND, gravels are sub rounded to rounded (size 6mm-75mm).	FDT-1	16.7	8.0				
2.0				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-04
Sheet 1 OF 1

TESTPIT LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location KAKAPIR (PKG-2)

Site Incharge MUDASSAR
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI

Coordinates N: 2751081.24 m E: 289505.76 m
Ground Elevation 3.91 m
Date 21-09-2020 TO 21-09-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test		Lab. Density Test		Inplace % Compaction	REMARKS
						Dry Density kN/m 3	Moisture Content %	Max. Dry Density kN/m 3	Optimum m.c. %		
0.0			GM	Brown, SILTY GRAVEL with SAND, trace to little clay, gravels are sub rounded to rounded, (size 6mm to 10mm).							
			CL	Brown, GRAVELLY LEAN CLAY, low to medium plastic, medium dry strength, gravels are sub rounded to rounded of size (20-70 mm), moist.	CS-1						
0.5											
					FDT-1	15.6	6.2	18.2	8.8	85.7	
1.0											
1.15				BOTTOM OF TESTPIT							Seepage water encountered at 1.15 m depth.

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-05
Sheet 1 OF 1

TESTPIT LOG

Job No. P38035

Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION

Location NEAR CULVERTS (C-2 & C-3) AT TREATMENT PLANT

Site Incharge M.ARIF

Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH

Contractor M/S STS KARACHI

Coordinates N: 2751287.00 m
E: 293785.00 m

Ground Elevation 1.00 m

Date 06-09-2020 TO 07-09-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test		Lab. Density Test		Inplace % Compaction	REMARKS
						Dry Density kN/m 3	Moisture Content %	Max. Dry Density kN/m 3	Optimum m.c. %		
0.0		▨	CL-ML	Brown, SILTY CLAY with GRAVEL, trace to little sand, low plastic, trace cloth pieces, moist.							
0.5 1.0		▨	SC	Grey, CLAYEY SAND with GRAVEL, trace cobbles (one pieces only of size (110mm), trace boulder (one only of size 410 mm), trace cloth pieces, trace polythene bags, moist.	CS-1						
1.5		▨	CL-ML	Grey, SILTY CLAY with SAND, low to medium plastic, few gravels, moist.	FDT-1	15.8	5.96	-	-		
		▨		Grey, SILTY CLAY with SAND, low to medium plastic, trace gravels, trace polythene bags, trace cloth pieces, moist.							
2.0				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-06
Sheet 1 OF 1

TESTPIT LOG

Job No. P38035

Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION

Location NEAR CULVERTS (C-2 & C-3) AT TREATMENT PLANT

Site Incharge MUDASSAR/M.ARIF

Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH

Contractor M/S STS KARACHI

Coordinates N: 2751560.00 m
E: 294188.00 m

Ground Elevation 3.00 m

Date 18-09-2020 TO 20-09-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test		Lab. Density Test		Inplace % Compaction	REMARKS
						Dry Density kN/m 3	Moisture Content %	Max. Dry Density kN/m 3	Optimum m.c. %		
0.0			GP-GM	Varigated colors, sub rounded, poorly graded GRAVEL with SILT and SAND, sedimentary rock origin, size (5mm-48mm.)							
		▨	CL-ML	Brown, SILTY CLAY, low to medium plastic, trace gravels, trace sand, moist.							
0.5		▨									
		▨			FDT-1	15.2	8.1				
1.0		▨									
1.5		▨									
			GP	Brown, poorly graded GRAVEL, some cobbles, sub rounded to rounded, moist.							
2.0				BOTTOM OF TESTPIT							

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-07
Sheet 1 OF 1

TESTPIT LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location NEAR ADMIN BUILDING AND TOLL PLAZA
Site Incharge MUDASSAR
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI
Coordinates N: 2751804.00 m E: 294937.00 m
Ground Elevation 1.00 m
Date 18-09-2020 TO 19-09-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test		Lab. Density Test		Inplace % Compaction	REMARKS
						Dry Density kN/m 3	Moisture Content %	Max. Dry Density kN/m 3	Optimum m.c. %		
0.0			SM	Fill Material: Grey to brown, fine grained, SILTY SAND, trace to little clay, trace fabric, polythene bags and gravel.							
0.5			SC-SM	Fill Material: Black, SILTY CLAYEY SAND, polythene bags, broken wires, roots and wood pieces, trace organic matter.							
			SM	Fill Material:- Brown,fine to medium grained, SILTY SAND, trace to little clay.							
1.0			CL-ML	Light grey, SILTY CLAY, low to medium plastic, medium dry strength, trace sand, trace polythene bags.							
1.25				BOTTOM OF TESTPIT							Seepage water encountered at 1.25 m depth.

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-08
Sheet 1 OF 1

TESTPIT LOG

Job No. P38035

Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION

Location ELEVATED U-TURN

Site Incharge MUDASSAR

Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH

Contractor M/S STS KARACHI

Coordinates N: 2751910.08 m
E: 295844.52 m

Ground Elevation 5.04 m

Date 19-09-2020 TO 20-09-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test		Lab. Density Test		Inplace % Compaction	REMARKS
						Dry Density kN/m 3	Moisture Content %	Max. Dry Density kN/m 3	Optimum m.c. %		
0.0		■		Asphalt layer.	FDT-1	20.3	7.2				
0.5				Aggregate base course							
		▨	GC	Grey to brown, CLAYEY GRAVELS with SAND, gravels are sub rounded to rounded, (size 10mm to 110mm).							
1.0		⁙	SP-SM	Brown, poorly graded SAND with SILT and GRAVEL, trace to little clay, gravels are angular, sub rounded to rounded, (size 6mm to 40mm).	FDT-2 CS-1	19.2	8.6	21.4	7.2	89.5	
1.45				BOTTOM OF TESTPIT							Seepage water encountered at 1.45 m depth.

NATIONAL ENGINEERING SERVICES
PAKISTAN (Pvt.) LIMITED, LAHORE

Test Pit No. TP-09
Sheet 1 OF 1

TESTPIT LOG

Job No. P38035
Project FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI' SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Location ELEVATED U-TURN

Site Incharge MUDASSAR
Client LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH
Contractor M/S STS KARACHI

Coordinates N: 2751916.05 m E: 295883.82 m
Ground Elevation 4.97 m
Date 19-09-2020 TO 20-09-2020

Depth in meter	Elevation in meter	Legend	USCS Symbol	DESCRIPTION OF MATERIAL	Sample Type/No.	Field Density Test		Lab. Density Test		Inplace % Compaction	REMARKS
						Dry Density kN/m 3	Moisture Content %	Max. Dry Density kN/m 3	Optimum m.c. %		
0.0		■		Asphalt layer.	FDT-1	21.8	3.99	22.4	7.5	97.5	
0.5		▨	SP-SM	Aggregate base course: Grey, poorly graded SAND with SILT and GRAVEL, gravel are sub rounded to rounded, moist.	FDT-2 CS-1	21.9	5.07	22.4	7.5	98.0	
		▨	GC	Grey to brown, CLAYEY GRAVELS with SAND, gravels are sub rounded to rounded, (size 6mm to 50mm).							
		▨	SM	Greyish Brown, fine grained, SILTY SAND, trace clay, trace gravels.							
		▨	GP	Brown, poorly graded GRAVEL, some cobbles, sub rounded to rounded, trace sand, moist.							
1.3				BOTTOM OF TESTPIT							Seepage water encountered at 1.30 m depth.

APPENDIX-C

SUBSURFACE CHARACTERISTICS

FIG. C-1 VARIATION OF FIELD SPT BLOWS WITH DEPTH

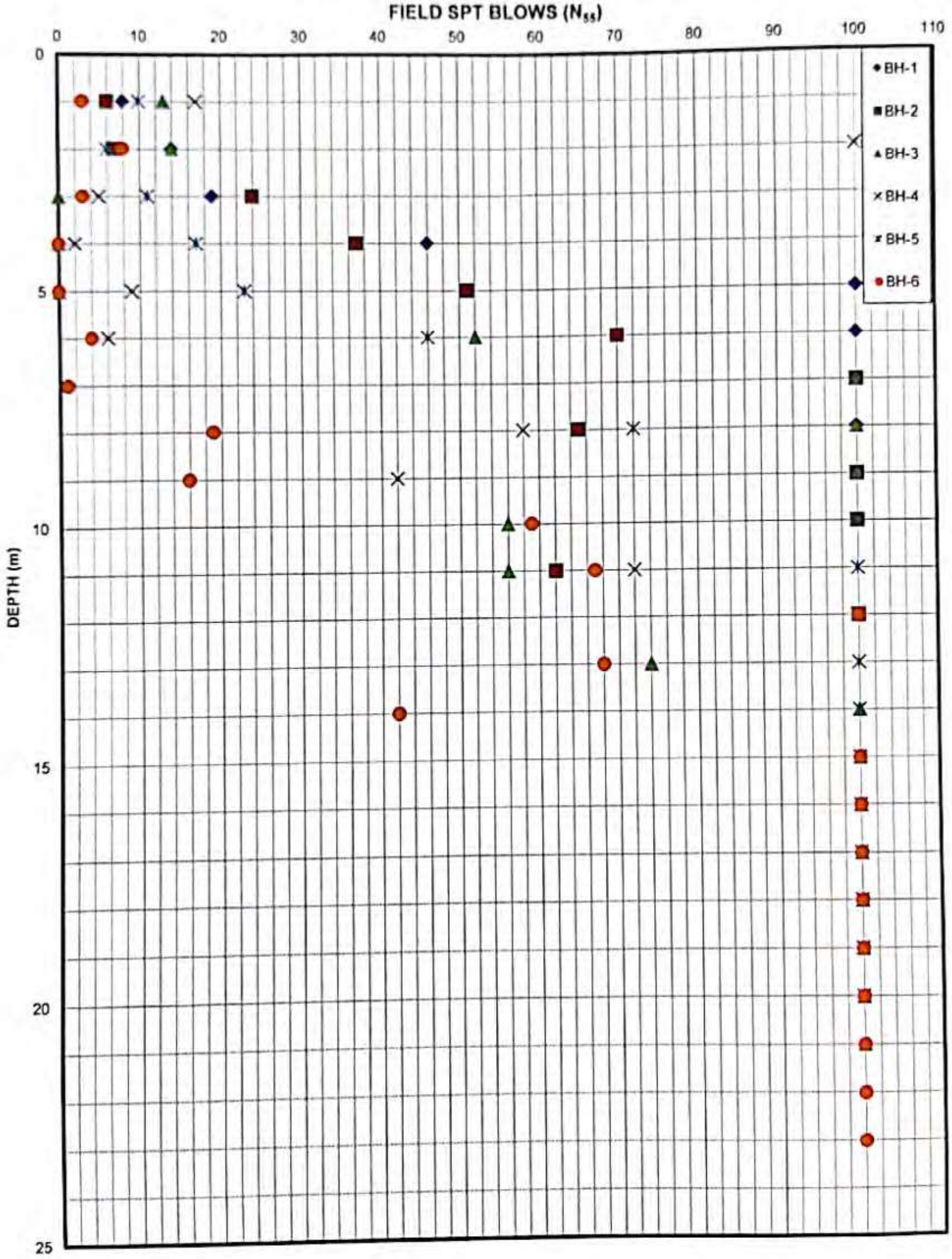
FIG. C-2 VARIATION OF CORRECTED SPT BLOWS WITH DEPTH

Fig C-1

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI'

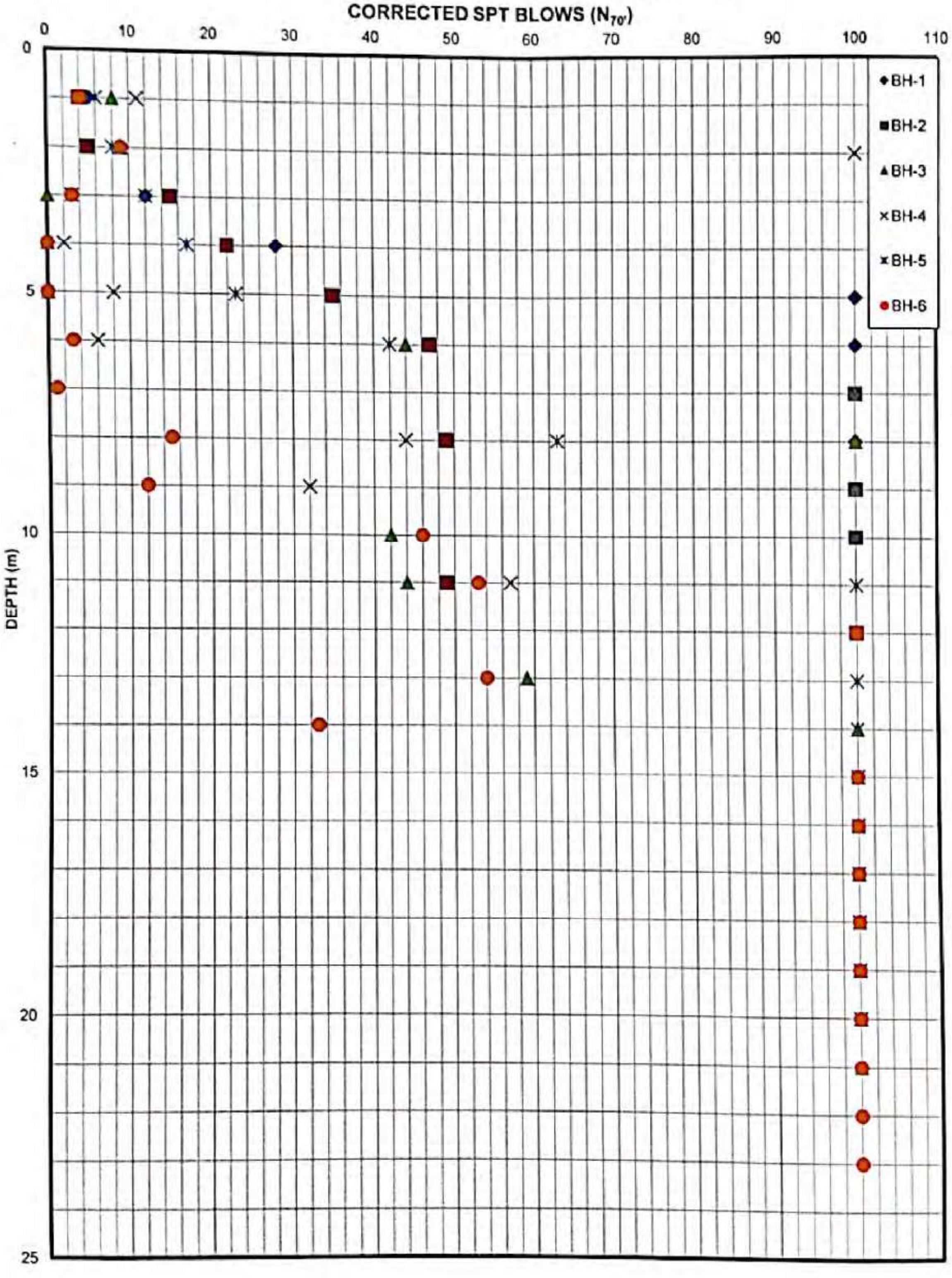
(Sub Project 2: Expressway from Mauripur Road to Y-Junction)

Variation of Field SPT Blows with Depth



17-11-202 08 PM

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI'
(Sub Project2 : Expressway from Mauripur Road to Y-Junction)
Variation of Corrected SPT Blows with Depth



APPENDIX-D

LABORATORY TEST RESULTS

Table D – 1: Summary of Laboratory Test Results

Table D – 2: Summary of Field Density Tests

Table D-1
Sheet 1 of 2

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI'
(SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y - JUNCTION)

Summary of Laboratory Test Results

Sr No.	Location	BH/TP No.	Sample No.	Depth	Natural Moisture Content (NMC)	In-situ Bulk Density	In-situ Dry Density	Grain Size Analysis (% Passing)							Atterberg Limits			Material Classification			Unconfined Compression Test (Soil)		Uniaxial Compression Test (Rock)		Direct Shear Test		Consolidation Test with swell potential Measurement			Modified AASHTO Compaction Test		3 Point Soaked CBR at 95% of MDD	Chemical Analysis of Soil			Chemical Analysis of Water			
															LL	PL	PI	Unified Soil Classification System (USCS) Symbol	AASHTO Classification Symbol	Material Description	q_u	Failure Strain	q_u	Failure Strain	c	ϕ	eo	Cc	Swell Pressure	OMC	Max. Dry Density (MDD)		Sulphate Content	Chloride Content	Organic Matter	Sulphate Content	Chloride Content	Total Dissolved Soilds	pH
-	-	-	-	(m)	(%)	(kN/m^3)	(kN/m^3)	#4	#10	#40	#100	# 200	0.02 mm	0.002 mm	(%)	(%)	(%)				(kPa)	%	(MPa)	%	(kPa)	(deg)	-	-	(kPa)	(%)	(kN/m^3)	(%)	(%)	(%)	(%)	(ppm)	(ppm)	(ppm)	-
1	Flyover at Kakapir Road	BH-01	SPT-4	4.00-4.45	-	-	-	100	46	35	24	21	-	-	-	-	-	SM	A-1-b	Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2			SPT-9	9.00-9.45	-	-	-	100	100	100	99	98	-	-	41	23	18	CL	A-7-6	Lean Clay	-	-	-	-	-	-	-	-	-	-	-	-	0.017	0.014	0.148	-	-	-	-
3			WS-1	14.0-14.12	1.46	24.3	24.0	-	-	-	-	-	-	-	-	-	-	-	-	Sandstone	-	-	1.35	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4			WS-2	15.0-15.25	6.71	22.7	21.3	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	0.23	1.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5			WS-3	18.12-18.27	1.04	23.8	23.6	-	-	-	-	-	-	-	-	-	-	-	-	Sandstone	-	-	1.08	1.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6			W/S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		3265	8310	3374	5.88
7	Flyover near Marine Academy	BH-02	UDS-1	5.50-6.05	15.59	20.8	18.0	100	79	77	75	75	47	20	41	23	18	CL	A-7-6	Lean Clay with Sand	129.5	5.45	-	-	-	-	0.47	0.09	23.1	-	-	-	0.013	0.554	0.596	-	-	-	-
8			UDS-2	10.50-11.05	20.61	21.2	17.6	100	74	68	66	64			45	25	20	CL	A-7-6	Sandy Lean Clay	70.6	4.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9			WS-1	13.14-13.30	7.94	21.9	20.3	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	0.25	3.10		-	-	-	-	-	-	-	-	-	-	-	-	-	-
10			WS-5	16.81-16.97	8.83	21.7	19.9	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	0.50	2.40		-	-	-	-	-	-	-	-	-	-	-	-	-	-
11			WS-8	19.40-19.69	7.42	23.8	22.2	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	0.33	2.60		-	-	-	-	-	-	-	-	-	-	-	-	-	-
12			W/S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	995	1029	3426	5.95
13	Culverts (C-2 & C-3) near Treatment Plant	BH-3	SPT-4	4.00-4.45	-	-	-	100	98	96	89	85	-	-	38	22	16	CL	A-6	Lean Clay with Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14			UDS-1	12.00-12.40	13.16	20.2	17.9	100	99	98	97	97	59	21	35	21	14	CL	A-6	Lean Clay	114.7	7.57	-	-	-	-	0.42	0.07	76.9	-	-	-	0.025	0.370	0.152	-	-	-	-
15			SPT-17	18.00-18.45	-	-	-	100	100	100	99	98	-	-	46	25	21	CL	A-7-6	Lean Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16			WS-1	21.60-21.89	0.99	26.0	25.7	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	0.71	1.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17			WS-10	24.60-24.85	0.93	26.3	26.1	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	0.61	0.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18			W/S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	896	83	3500	6.11
19	Admin Building & Toll Plaza	BH-04	SPT-4	4.00-4.45	-	-	-	100	91	79	39	25	-	-	-	-	-	SM	A-2-4	Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20			UDS-1	10.00-10.55	14.21	21.2	18.5	100	100	99	99	98	-	-	51	26	25	CH	A-7-6	Fat Clay	171	2.74	-	-	-	-	-	-	-	-	-	-	0.018	0.016	0.133	-	-	-	-
21			UDS-2	14.00-14.60	17.14	19.7	16.8	100	100	100	99	98	-	-	45	25	20	CL	A-7-6	Lean Clay	149	8.77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22			SPT-16	18.00-18.45	-	-	-	100	100	100	99	98	-	-	41	23	18	CL	A-7-6	Lean Clay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23			WS-1	20.20-20.53	2.46	23.3	22.7	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	1.01	1.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24			WS-4	24.56-24.73	2.38	23.1	22.6	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	1.04	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25			W/s	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3567	10330	3389	5.65

Table D-1
Sheet 2 of 2

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI'
(SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y - JUNCTION)

Summary of Laboratory Test Results

Sr No.	Location	BH/TP No.	Sample No.	Depth	Natural Moisture Content (NMC)	In-situ Bulk Density	In-situ Dry Density	Grain Size Analysis (% Passing)							Atterberg Limits			Material Classification			Unconfined Compression Test (Soil)		Uniaxial Compression Test (Rock)		Direct Shear Test		Consolidation Test with swell potential Measurement			Modified AASHTO Compaction Test		3 Point Soaked CBR at 95% of MDD	Chemical Analysis of Soil			Chemical Analysis of Water			
															LL	PL	PI	Unified Soil Classification System (USCS) Symbol	AASHTO Classification Symbol	Material Description	q_u	Failure Strain	q_u	Failure Strain	c	ϕ	eo	Cc	Swell Pressure	OMC	Max. Dry Density (MDD)		Sulphate Content	Chloride Content	Organic Matter	Sulphate Content	Chloride Content	Total Dissolved Soilds	pH
-	-	-	-	(m)	(%)	(kN/m^3)	(kN/m^3)	#4	#10	#40	#100	# 200	0.02 mm	0.002 mm	(%)	(%)	(%)				(kPa)	%	(MPa)	%	(kPa)	(deg)	-	-	(kPa)	(%)	(kN/m^3)	(%)	(%)	(%)	(%)	(ppm)	(ppm)	(ppm)	-
26	Flyover near Liyari Expressway	BH-05	SPT-3	3.00-3.45	-	-	-	100	91	83	28	21	-	-	-	-	-	SM	A-2-4	Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27			UDS-1	6.50-7.40	14.73	17.8	15.5	55	39	34	27	24	-	-	-	-	-	SM	A-1-b	Silty Sand with Gravel	-	-	-	-	Not performed due to gravelly Strata			-	-	-	-	-	-	-	-	-	-	-	-
28			UDS-2	12.60-13.00	17.09	20.5	17.5	100	60	52	47	44	-	-	28	20	8	SC	A-4	Clayey Sand	163.8	4.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29			WS-1	17.64-17.86	8.08	22.4	20.7	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	0.67	2.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30			WS-2	20.52-20.64	8.90	22.6	20.8	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	0.20	2.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31			WS-5	24.56-24.76	6.55	21.9	20.6	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	0.53	2.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32			W/S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	788	819	3376	5.75
33	Eleveated U- turn	BH-6	SPT-2	2.00-2.45	-	-	-	100	99	98	55	25	-	-	-	-	-	SM	A-2-4	Silty Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34			SPT-7	7.00-7.45	-	-	-	100	99	96	90	80	-	-	43	24	19	CL	A-7-6	Lean Clay with Sand	-	-	-	-	-	-	-	-	-	-	-	-	0.012	0.022	0.792	-	-	-	-
35			UDS-2	13.50-14.00	17.51	20.7	17.6	100	100	100	95	88	53	17	34	21	13	CL	A-6	Lean Clay	108.9	6.31	-	-	-	-	-	-	-	-	-	-				-	-	-	-
36			SPT-17	22.00-22.45	-	-	-	58	51	44	41	39	-	-	-	-	-	GC	A-4	Clayey Gravel with Sand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37			WS-1	25.06-25.20	0.59	28.0	27.8	-	-	-	-	-	-	-	-	-	-	-	-	Sandstone	-	-	10.87	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38			WS-3	26.72-27.00	2.38	21.7	21.2	-	-	-	-	-	-	-	-	-	-	-	-	Claystone	-	-	0.26	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39			W/S	_	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	692	12	1813	7.66
40	Flyover at Kakapir Road	TP-1	CS-1	0.65-1.30	-	-	-	71	60	43	27	22						SM	A-1-b	Silty Sand with Gravel	-	-	-	-	-	-	-	-	-	7.5	21.5	20.3	-	-	-	-	-	-	-
41		TP-2	CS-1	1.10-1.90	-	-	-	82	66	53	47	46						SM	A-2-4	Silty Sand with Gravel	-	-	-	-	-	-	-	-	-	6.1	21.7	28.0	-	-	-	-	-	-	-
42		TP-4	CS-1	0.18-1.15	-	-	-	60	60	59	57	55	34	12	41	27	17	CL	A-7-6	Gravelly Lean Clay	-	-	-	-	-	-	-	-	-	8.8	18.2	12.4	-	-	-	-	-	-	-
43	Culverts at Treatment plant	TP-5	CS-1	0.50-1.15	-	-	-	79	61	40	30	24	-	-	31	20	11	SC	A-2-4	Clayey Sand with Gravel	-	-	-	-	-	-	-	-	-	5.8	21.3	17.0	-	-	-	-	-	-	-
44	Eleveated U- turn	TP-8	CS-1	0.82-1.07	-	-	-	60	45	31	20	11	-	-	-	-	-	SP-SM	A-2-4	Poorly Graded Sand with Silt and Gravel	-	-	-	-	-	-	-	-	-	7.2	21.4	28.7	-	-	-	-	-	-	-
45		TP-9	CS-1	0.22-0.65	-	-	-	55	48	35	19	9	-	-	-	-	-	SP-SM	A-1-b	Poorly Graded Sand with Silt and Gravel	-	-	-	-	-	-	-	-	-	7.5	22.4	36.0	-	-	-	-	-	-	-

LEGEND:

BH	BOREHOLE	TP	TESTPIT
SPT	STANDARD PENETRATION TEST	CS	COMPOSITE SAMPLE
UDS	UNDISTURBED SOIL SAMPLE	WS	WAXED SAMPLE
W/S	WATER SAMPLE		

Table D-2
Sheet 1 of 1

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI'
(SUB PROJECT 2: EXPRESSWAY FROM MAURIPUR ROAD TO Y - JUNCTION)

Summary of Field Density Tests

Sr. No.	Location	Testpit No.	FDTs	Depth (m)	Natural Moisture Content (%)	Density		Modified AASHTO Compaction		Relative Compaction (%)
						Bulk (kN/m^3)	Dry (kN/m^3)	Max. Dry Density (kN/m^3)	OMC(%)	
1	(EXPRESSWAY FROM MAURIPUR ROAD TO Y - JUNCTION)	TP-1	FDT-1	0.85	6.15	20.6	19.4	21.5	7.5	90.3
2		TP-2	FDT-1	1.20	7.08	20.7	19.3	21.7	6.1	89.1
3		TP-3	FDT-1	0.55	8.02	18.0	16.7	-	-	-
4		TP-4	FDT-1	0.70	6.21	16.6	15.6	18.2	8.8	85.7
5		TP-5	FDT-1	1.60	5.96	16.8	15.8	-	-	-
		TP-6	FDT-1	0.60	8.11	16.4	15.2	-	-	-
6		TP-8	FDT-1	0.21	7.18	21.8	20.3	-	-	-
7			FDT-2	0.90	8.56	20.8	19.2	21.4	7.2	89.5
8		TP-9	FDT-1	0.22	3.99	22.7	21.8	22.4	7.5	97.5
9			FDT-2	0.40	5.07	23.1	21.9	22.4	7.5	98.0

SOILCON

18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF FIELD DENSITY TEST

Project: TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI
Location: PACKAGE-II
Client: STA
Lab. Ref: 64/2020

BH / TP No.	Sample No.	Depth (m)	Location	M.C.%	Field Dry Density (g/cu.cm)	Specific Gravity	Remarks
TP-1	FDT-1	0.85		6.15			
TP-2	FDT-1	1.20		7.08			
TP-3	FDT-1	0.55		8.02			
TP-4	FDT-1	0.70		6.21			
TP-5	FDT-1	1.60		5.96			
TP-6	FDT-1	0.60		8.11			
TP-8	FDT-1	0.21		7.18			
TP-8	FDT-2	0.90		8.56			
TP-9	FDT-1	0.22		3.99			
TP-9	FDT-2	0.40		5.07			

Tested By: IKRAM ULLAH
Checked By: MAHMOOD
Dated: 12.11.2020

SOILCON

GEOTECHNICAL TESTING LABORATORIES

18-Km, Multan Road, Lahore. Ph: 042-37510942-43 Fax:042-37515267

SUMMARY OF NMC BULK DENSITY TEST RESULTS

Project: TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI

Location:

Client: SOIL TESTING SERVICE

Lab. Ref: 61/2020

BH / TP No.	Sample No.	Depth (m)	Location	MC%	DENSITY (g/cu.cm)		Specific Gravity	REMARKS
					Bulk	Dry		
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]			[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]			[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]			[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]			[illegible]
BH-2	UDS-1	5.50-6.05		15.59	2.116			
BH-2	UDS-2	10.50-11.05		20.61	2.163			
BH-5	UDS-1	6.50-7.40		14.73	1.818			
BH-5	UDS-2	12.60-13.0		17.09	2.090			

Tested By: Ikram Ullah

Checked By: Mahmood

Dated: 29.09.2020

SOILCON
GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-37510942-43 Fax:042-37515267

SUMMARY OF NMC BULK DENSITY TEST RESULTS

Project: TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI
Location:
Client: SOIL TESTING SERVICES
Lab. Ref: 57/2020

BH / TP No.	Sample No.	Depth (m)	Location	MC%	DENSITY (g/cu.cm)		Specific Gravity	REMARKS
					Bulk	Dry		
BH-4	UDS-1	10.00-10.55		14.21	2.159			
BH-4	UDS-2	14.00-14.60		17.14	2.009			

Tested By: Ikram Ullah
Checked By: Mahmood
Dated: 23.09.2020

SOILCON

GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-37510942-43 Fax:042-37515267

SUMMARY OF NMC BULK DENSITY TEST RESULTS

Project: TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI
Location: PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Client: SOIL TESTING SERVICES
Lab. Ref: 57/2020

BH / TP No.	Sample No.	Depth (m)	Location	MC%	DENSITY (g/cu.cm)		Specific Gravity	REMARKS
					Bulk	Dry		
BH-3	UDS-1	12.00-12.40		13.16	2.062			
BH-6	UDS-2	13.50-14.00		17.51	2.106			

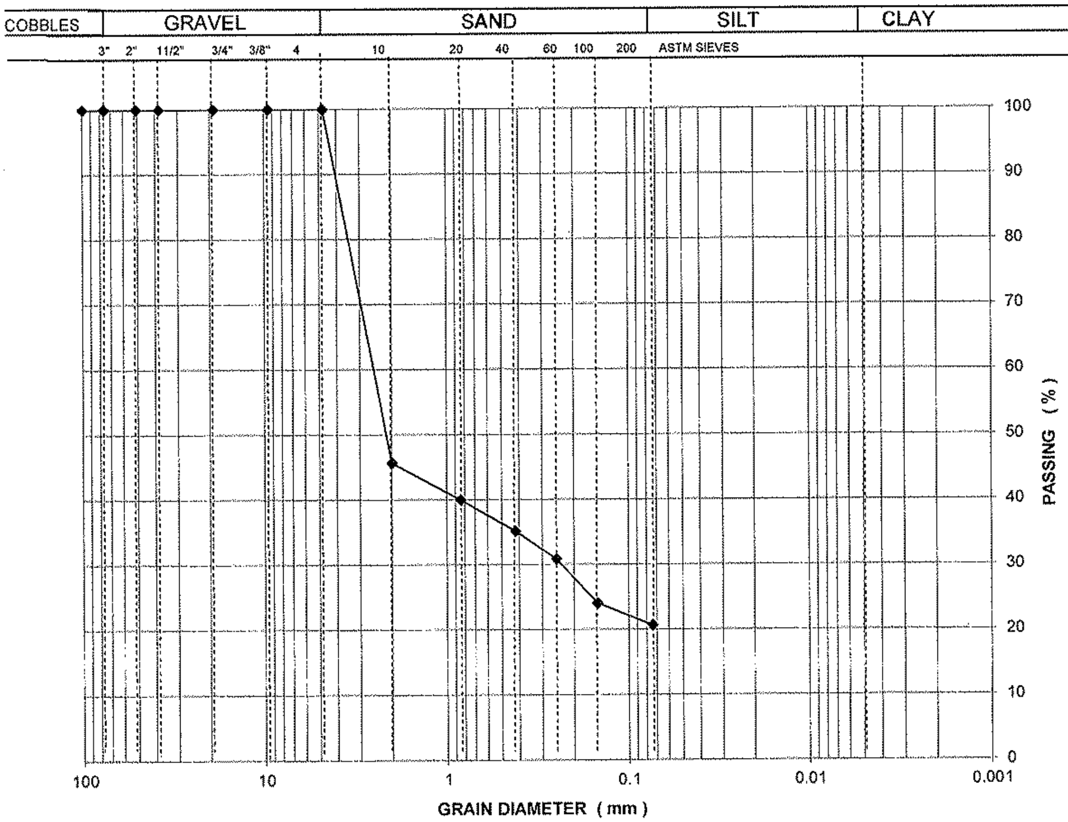
Tested By: Ikram Ullah
Checked By: Mahmood
Dated: 10.09.2020

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	BH-1	**SAMPLE**	SPT-4
TYPE	DISTURBED	**DEPTH(m)**	4.00-4.45
SPECIMEN	1	**DATE**	23.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	46	35	24	21

LAB. REF.	57/2020

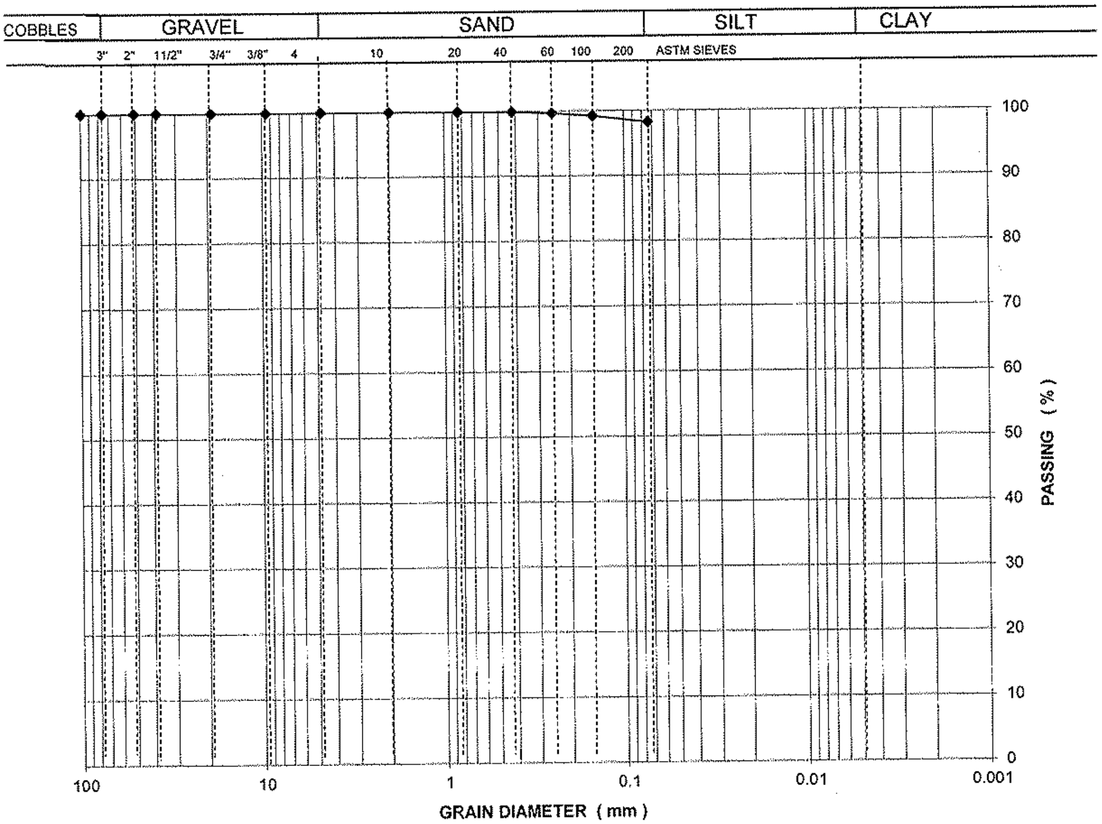
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	BH-1	SAMPLE	SPT-9
TYPE	DISTURBED	DEPTH(m)	9.00-9.45
SPECIMEN	1	DATE	23.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	100	100	99	98

LAB. REF.	57/2020

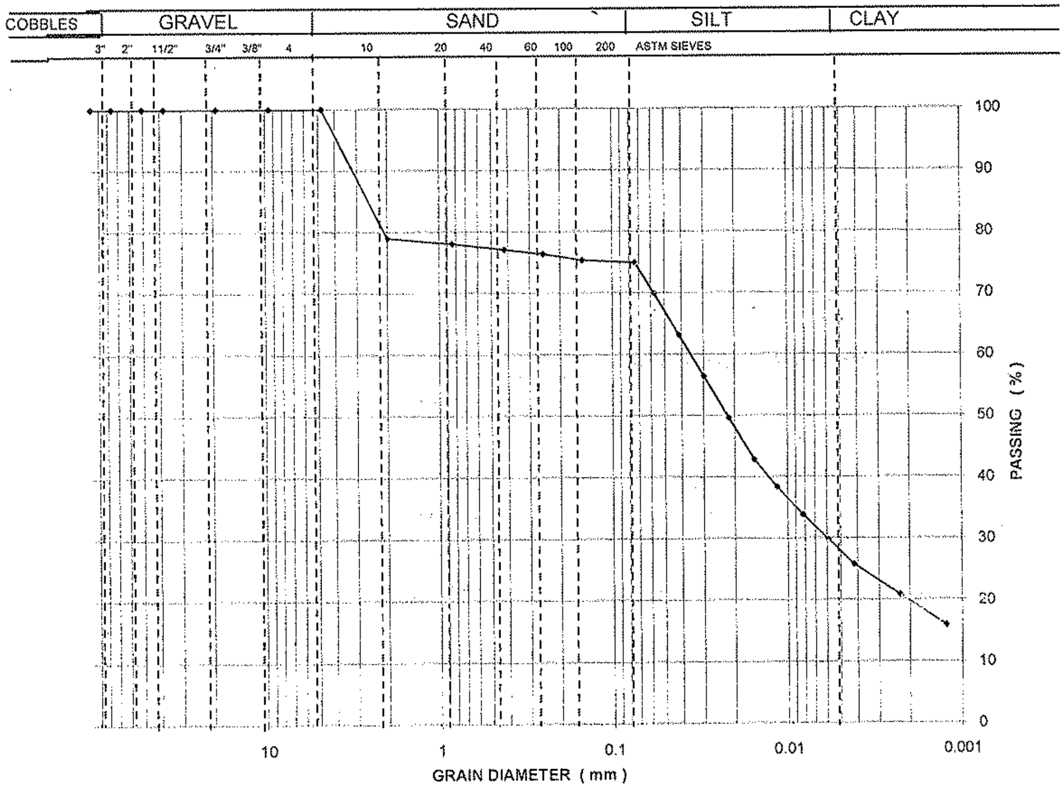
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	APPROVED BY
IKRAM	MAHMOOD

CLIENT	SOIL TESTING SERVICE		
PROJECT	TAS FOR 03 URBAN ROAD PROJECT IN KARACHI		
SITE	PACKAGE-2		
BORE HOLE	BH-2	SAMPLE	UDS-1
TYPE	UNDISTURBED	DEPTH m	5.50-6.05
SPECIMEN	1	DATE	29.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	79	77	75	75

LAB. REF.	61/2020

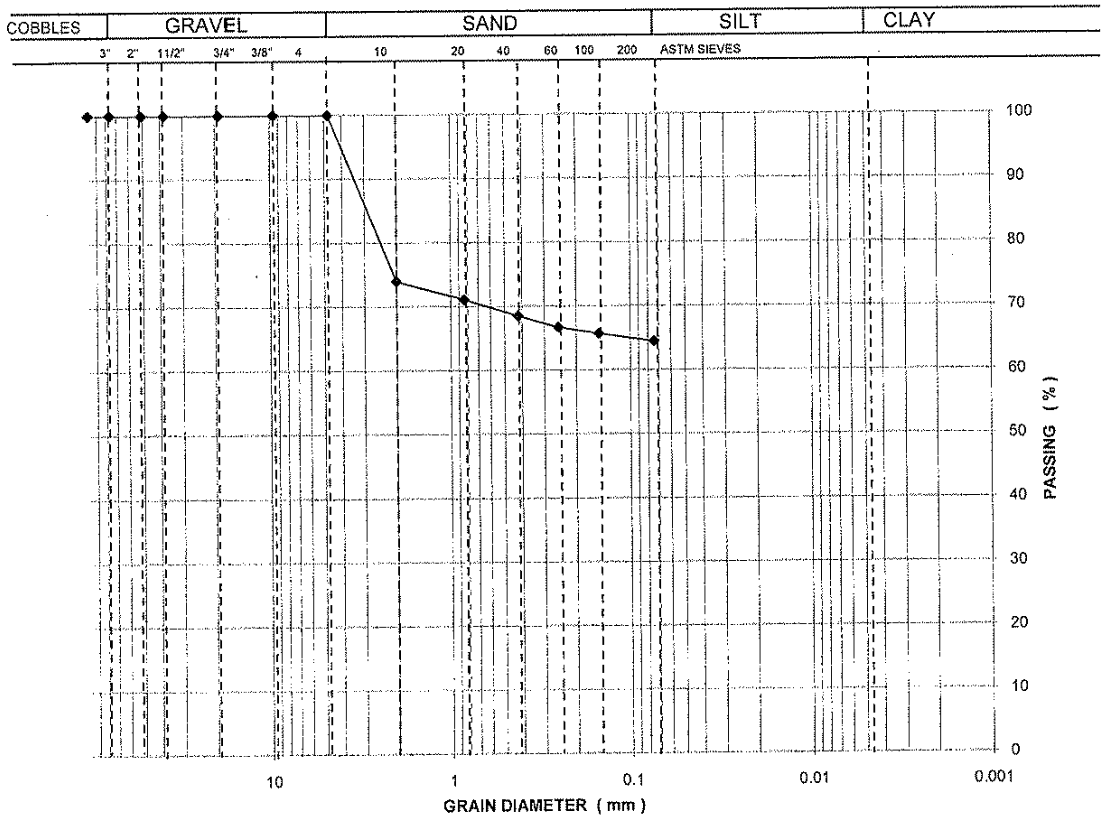
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR 03 URBAN ROADS IN KARACHI		
SITE	PACKAGE-2		
BORE HOLE	BH-2	SAMPLE	UDS-2
TYPE	UNDISTURBED	DEPTH(m)	10.50-11.05
SPECIMEN	1	DATE	29.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	74	68	66	64

LAB. REF.	61/20

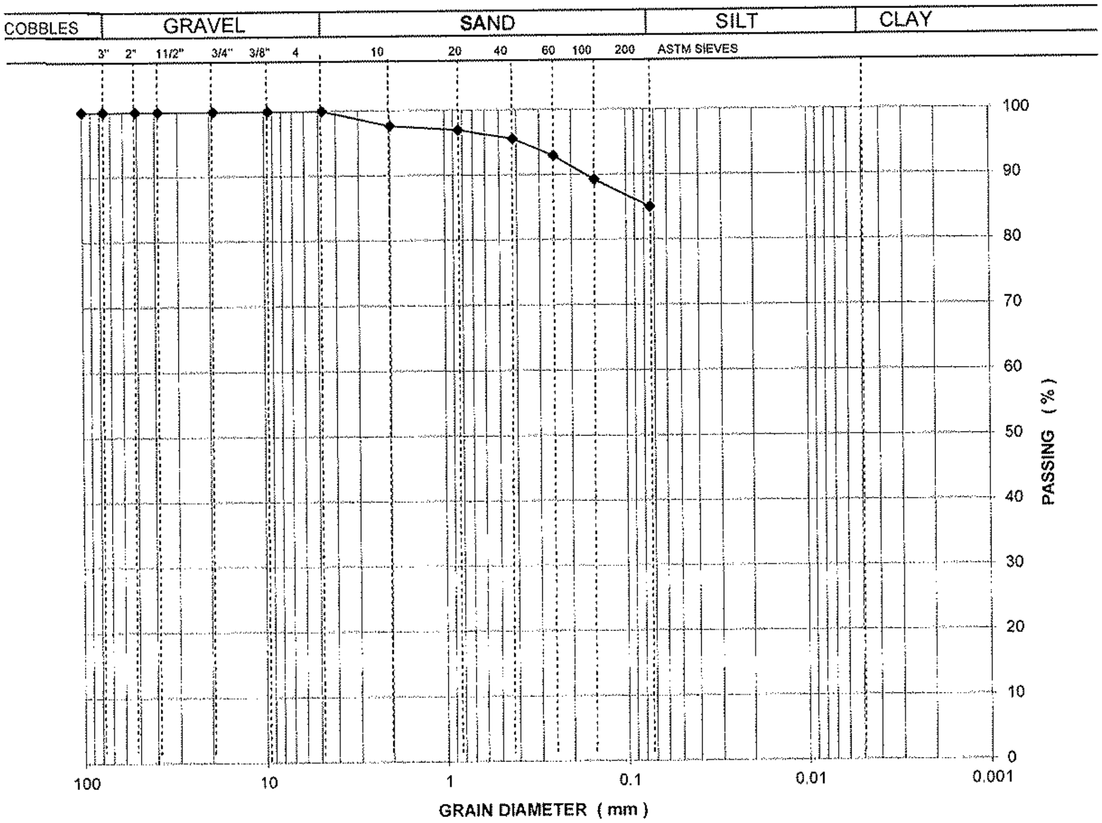
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	BH-3	SAMPLE	SPT-4
TYPE	DISTURBED	DEPTH(m)	4.00-4.45
SPECIMEN	1	DATE	09.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	98	96	89	85

LAB. REF.	57/2020

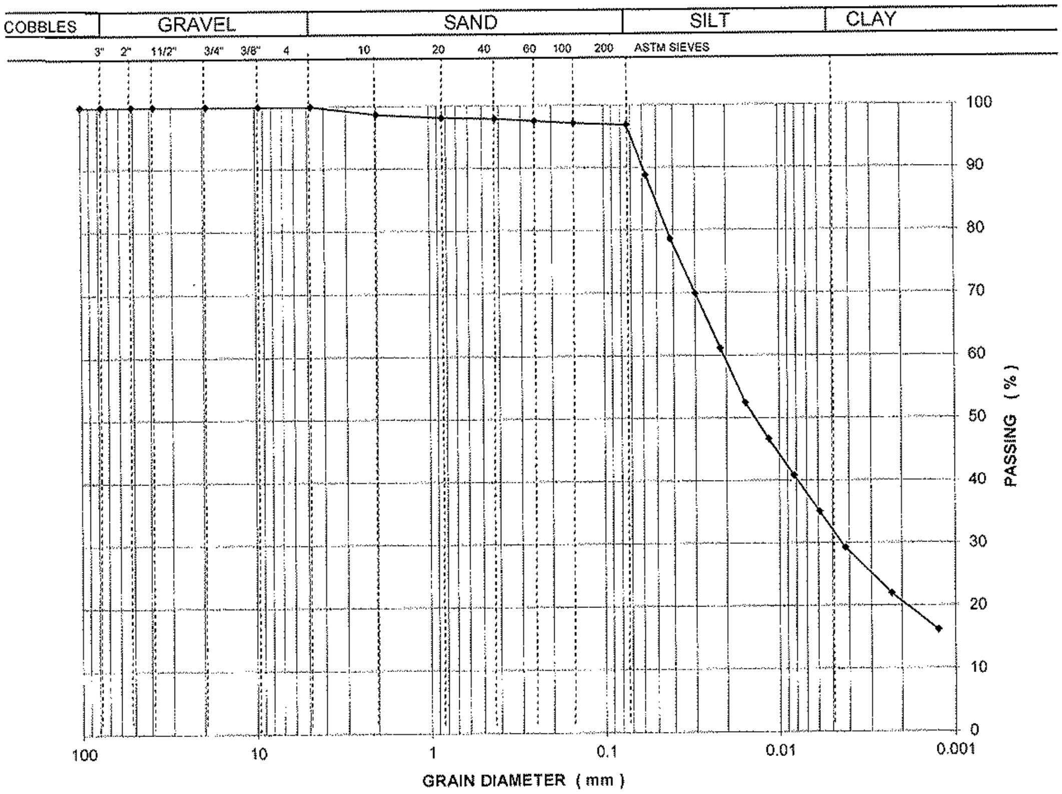
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR TO Y-JUNCTION		
BORE HOLE	BH-3	**SAMPLE**	UDS-1
TYPE	UNDISTURBED	**DEPTH m**	12.00-12.40
SPECIMEN	1	**DATE**	09.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	99	98	97	97

LAB. REF.	57/2020

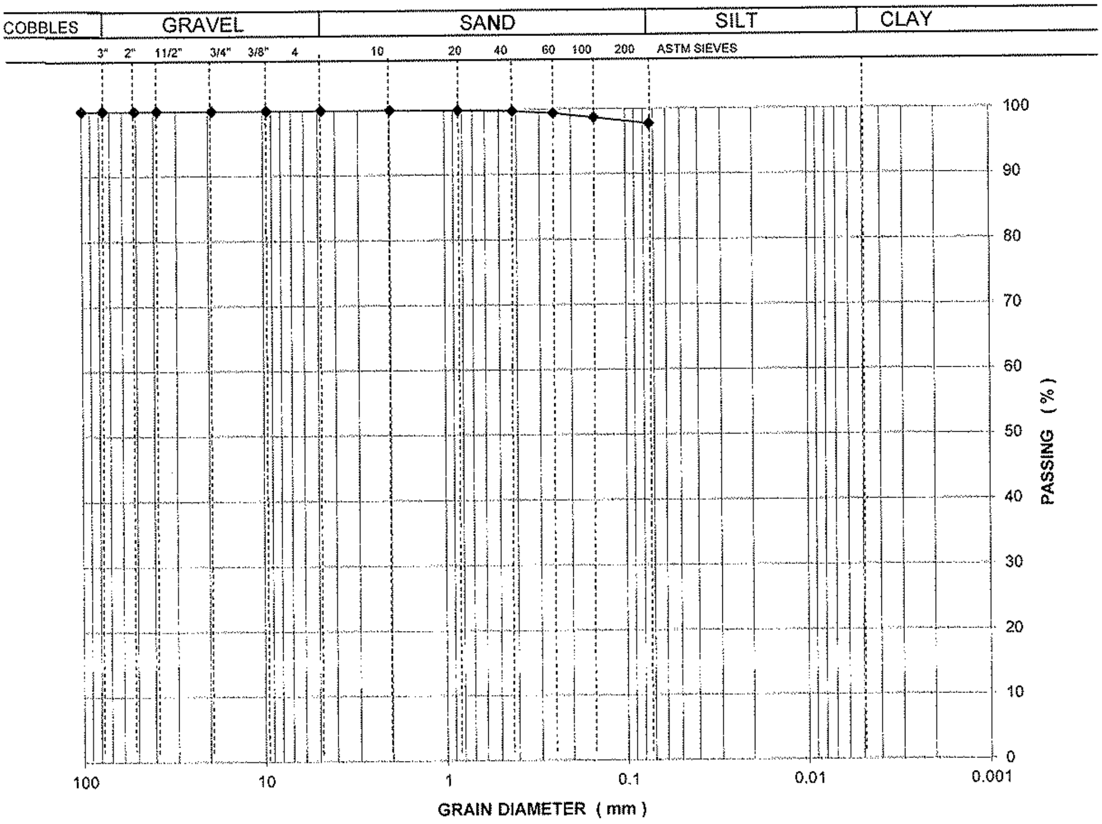
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY		
IKRAM ULLAH	MAHMOOD		

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	BH-3	SAMPLE	SPT-17
TYPE	DISTURBED	DEPTH(m)	18.00-18.45
SPECIMEN	1	DATE	09.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	100	100	99	98

LAB. REF.	57/2020

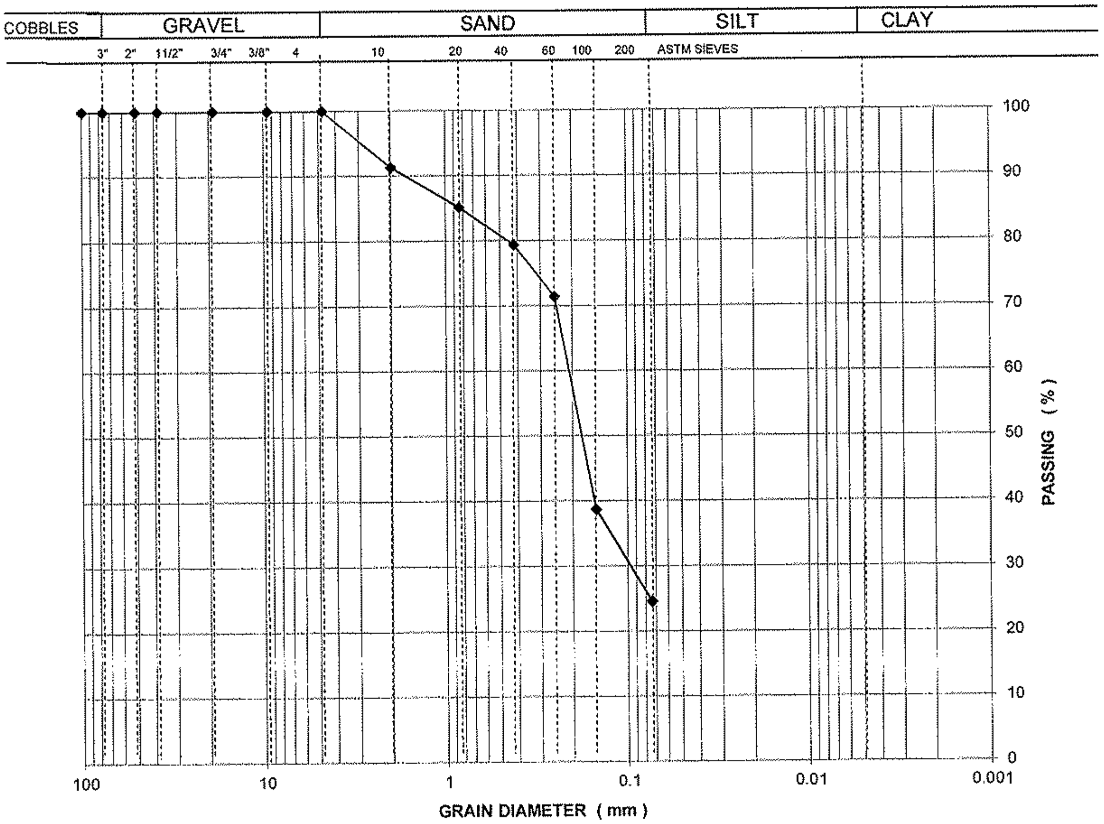
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	BH-4	SAMPLE	SPT-4
TYPE	DISTURBED	DEPTH(m)	4.00-4.45
SPECIMEN	1	DATE	23.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	91	79	39	25

LAB. REF.	57/2020

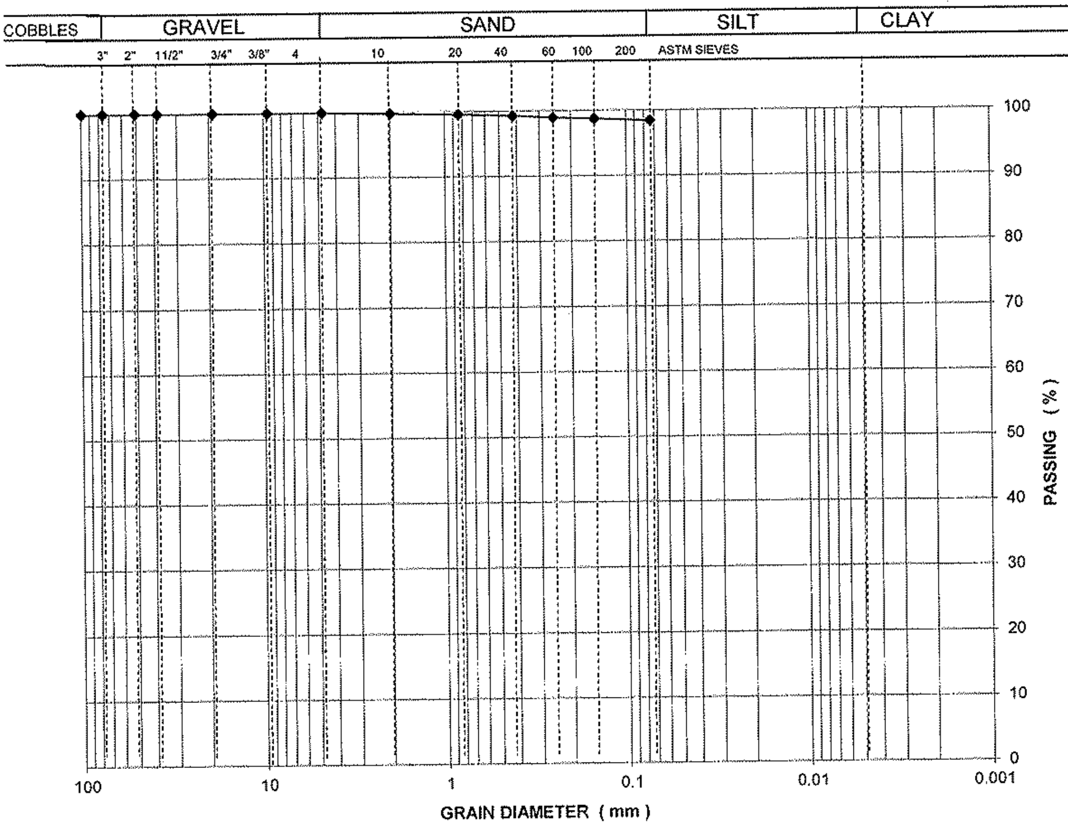
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	BH-4	SAMPLE	UDS-1
TYPE	UNDISTURBED	DEPTH(m)	10.00-10.55
SPECIMEN	1	DATE	23.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	100	99	99	98

LAB. REF.	57/2020

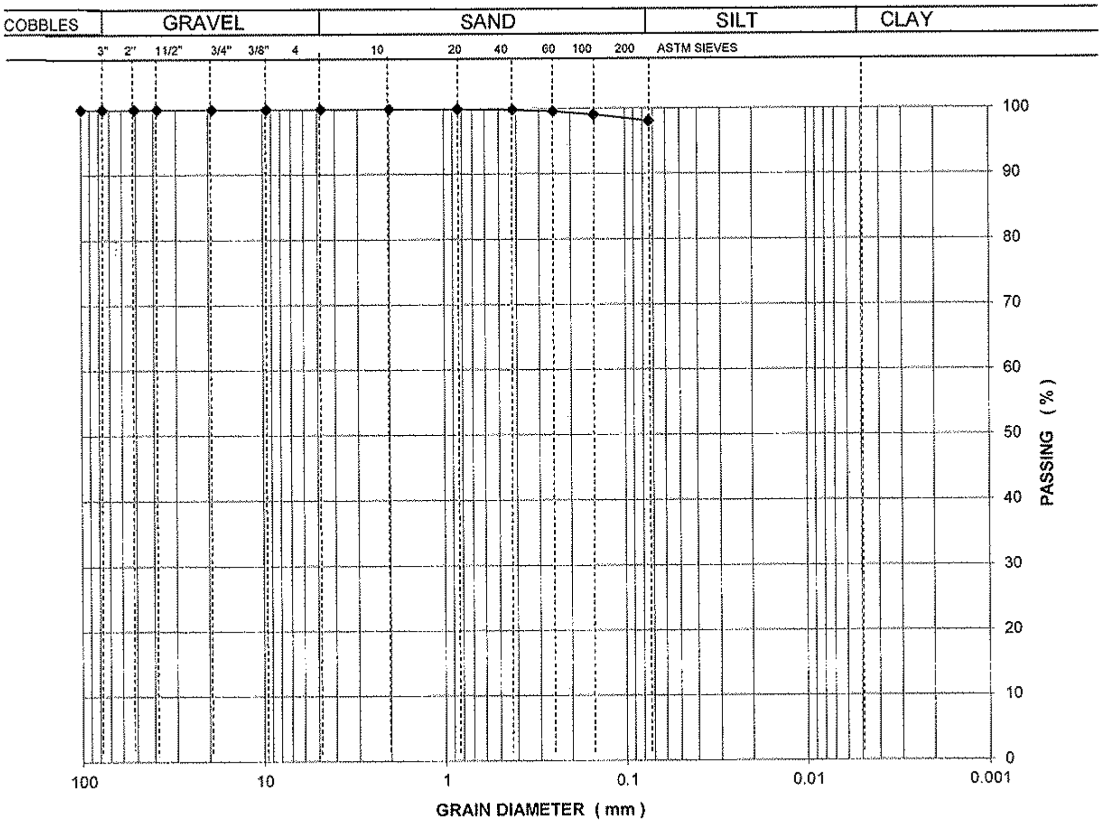
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	BH-4	SAMPLE	UDS-2
TYPE	UNDISTURBED	DEPTH(m)	14.00-14.60
SPECIMEN	1	DATE	23.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	100	100	99	98

LAB. REF.	57/2020

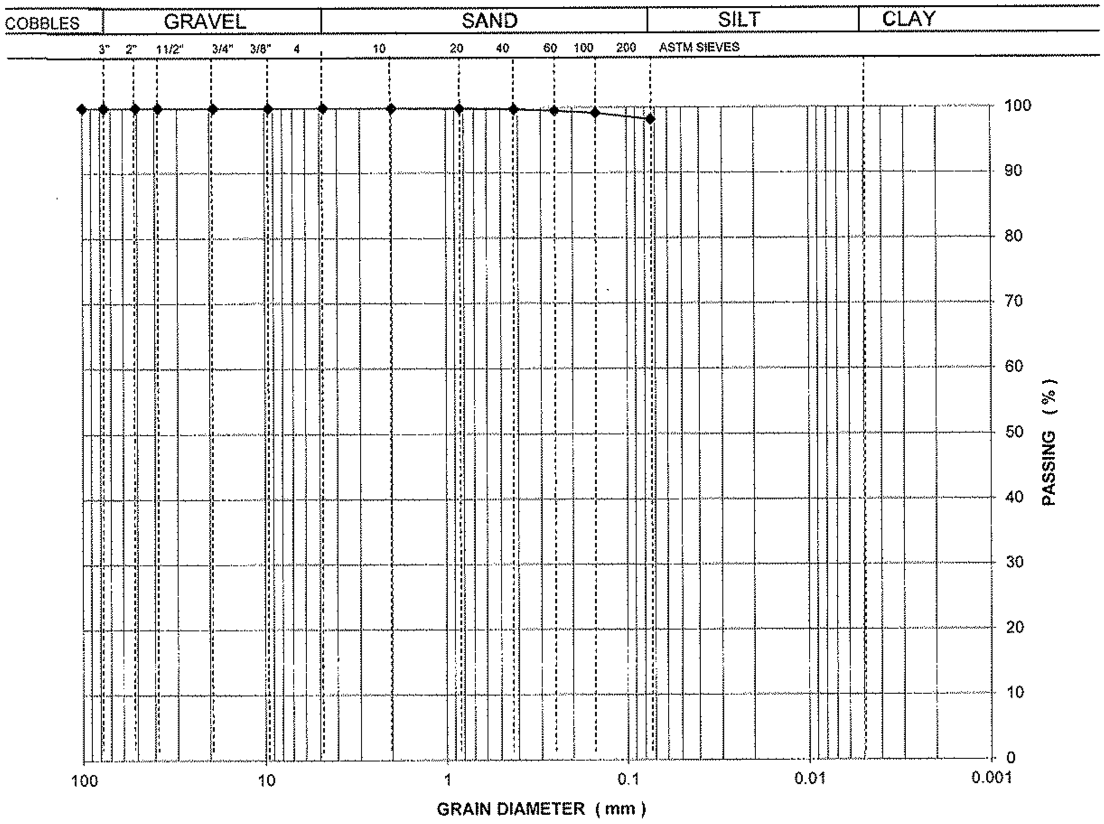
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	BH-4	SAMPLE	SPT-16
TYPE	DISTURBED	DEPTH(m)	18.00-18.45
SPECIMEN	1	DATE	23.09.2020

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	100	100	99	98

LAB. REF.	57/2020

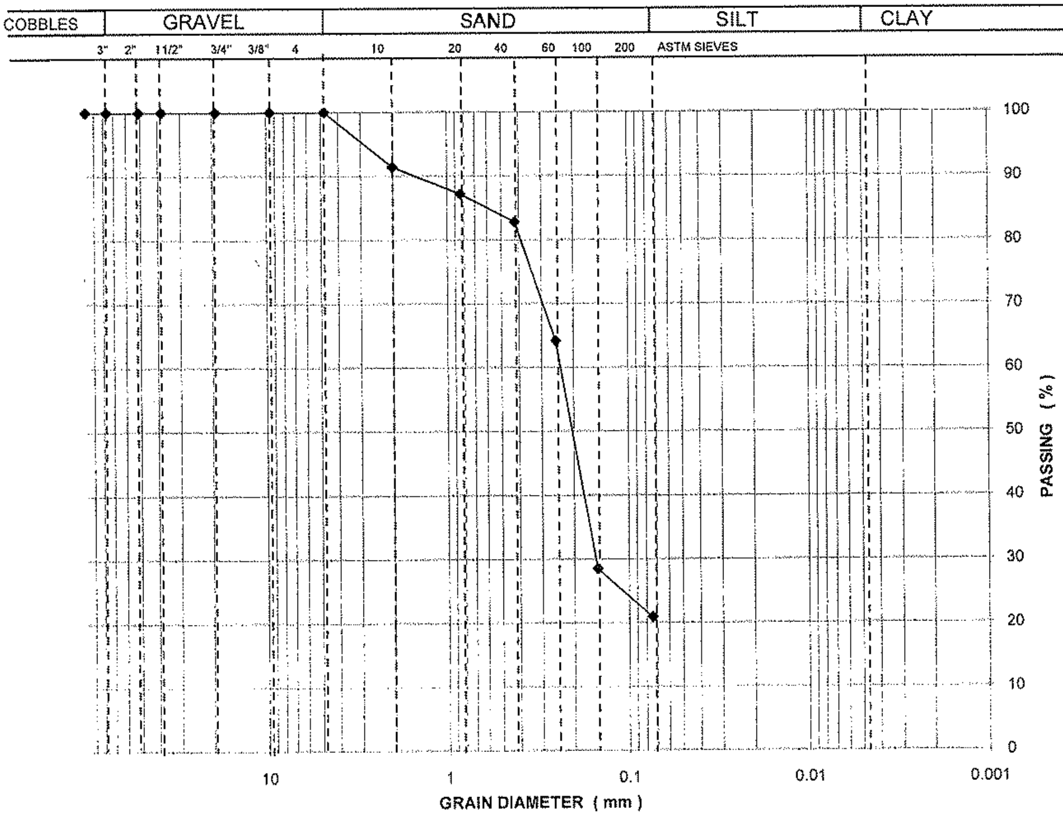
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR 03 URBAN ROADS IN KARACHI		
SITE	PACKAGE-2		
BORE HOLE	BH-5	SAMPLE	SPT-3
TYPE	DISTURBED	DEPTH(m)	3.00-3.45
SPECIMEN	1	DATE	29.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	91	83	28	21

LAB. REF.	61/20

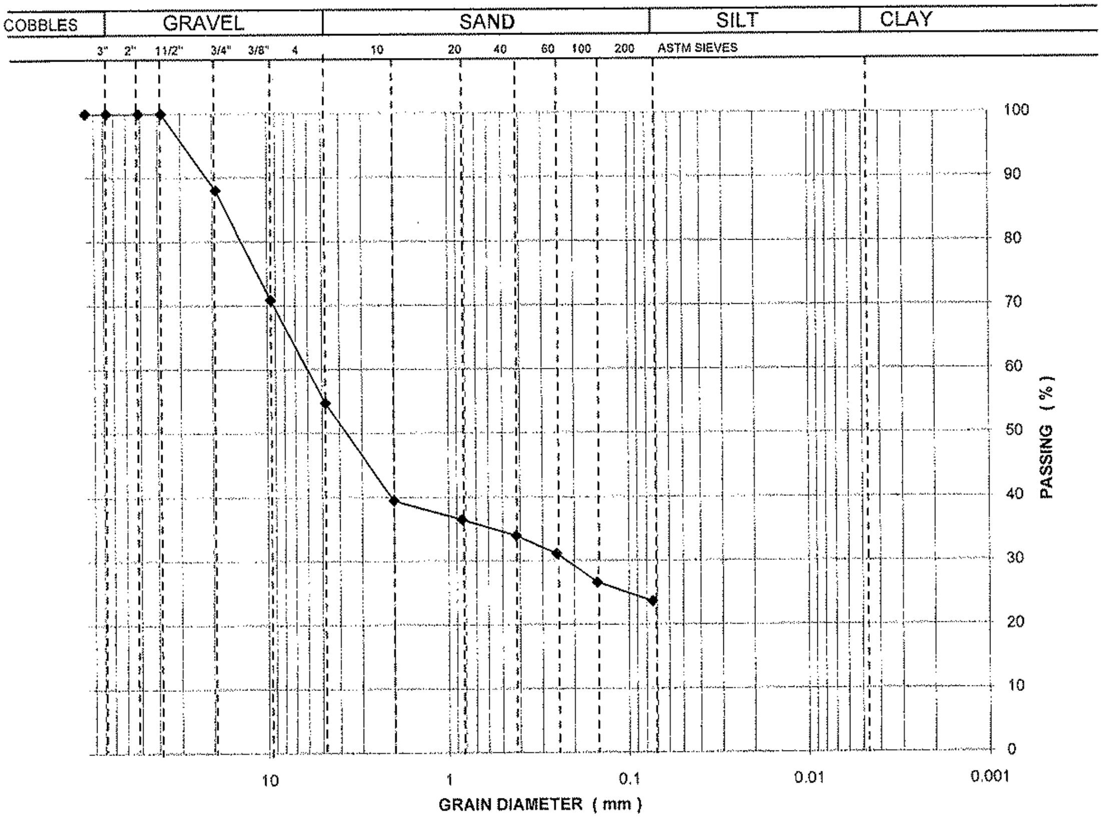
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR 03 URBAN ROADS IN KARACHI		
SITE	PACKAGE-2		
BORE HOLE	BH-5	SAMPLE	UDS-1
TYPE	DISTURBED	DEPTH(m)	6.50-7.40
SPECIMEN	1	DATE	29.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	88	71	55	39	34	27	24

LAB. REF.	61/20

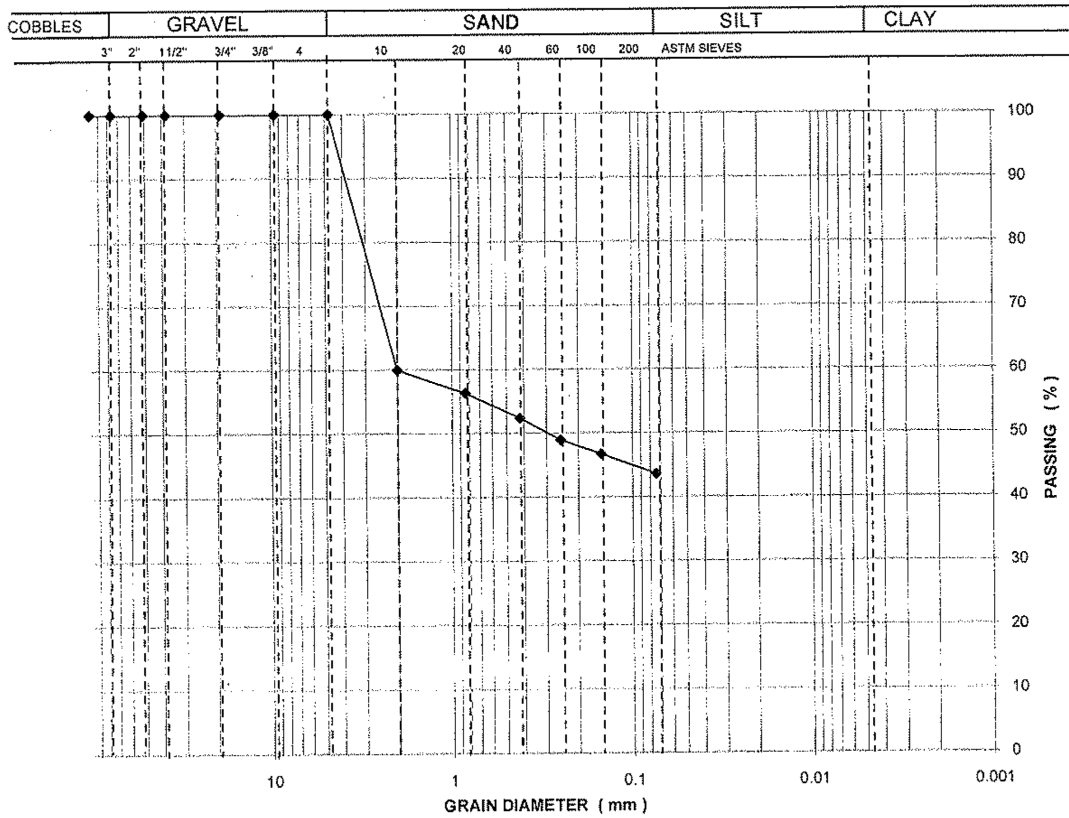
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR 03 URBAN ROADS IN KARACHI		
SITE	PACKAGE-2		
BORE HOLE	BH-5	SAMPLE	UDS-2
TYPE	DISTURBED	DEPTH(m)	12.60-13.00
SPECIMEN	1	DATE	29.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	60	52	47	44

LAB. REF.	61/20

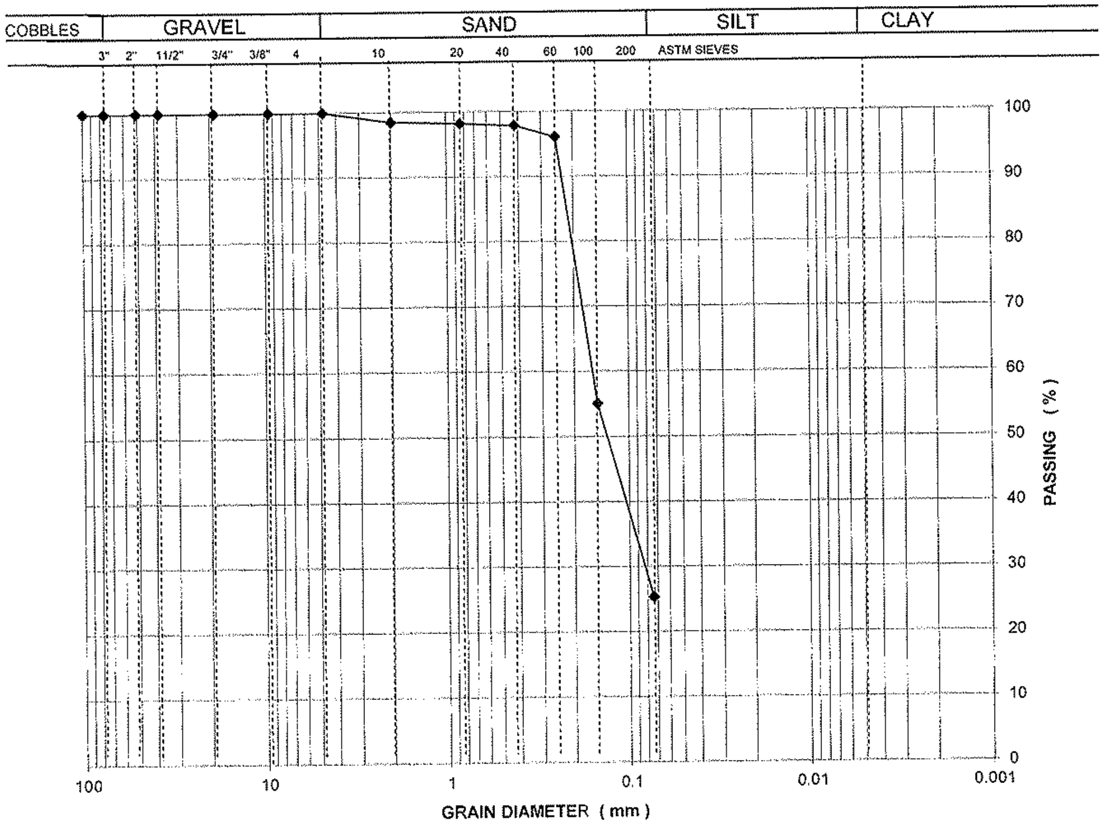
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	BH-6	SAMPLE	SPT-2
TYPE	DISTURBED	DEPTH(m)	2.00-2.45
SPECIMEN	1	DATE	09.09.2020

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	99	98	55	25

LAB. REF.	57/2020

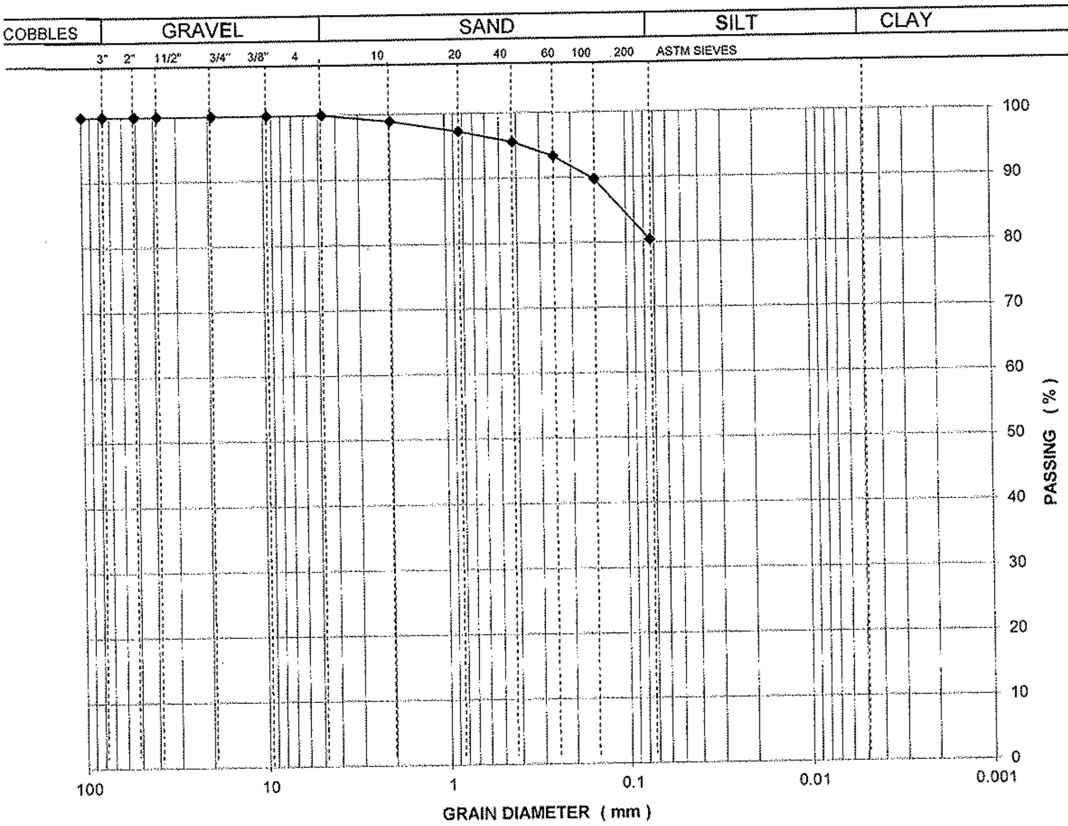
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	BH-6	**SAMPLE**	SPT-7
TYPE	DISTURBED	**DEPTH(m)**	7.00-7.45
SPECIMEN	1	**DATE**	09.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	99	96	90	80

LAB. REF.	57/2020

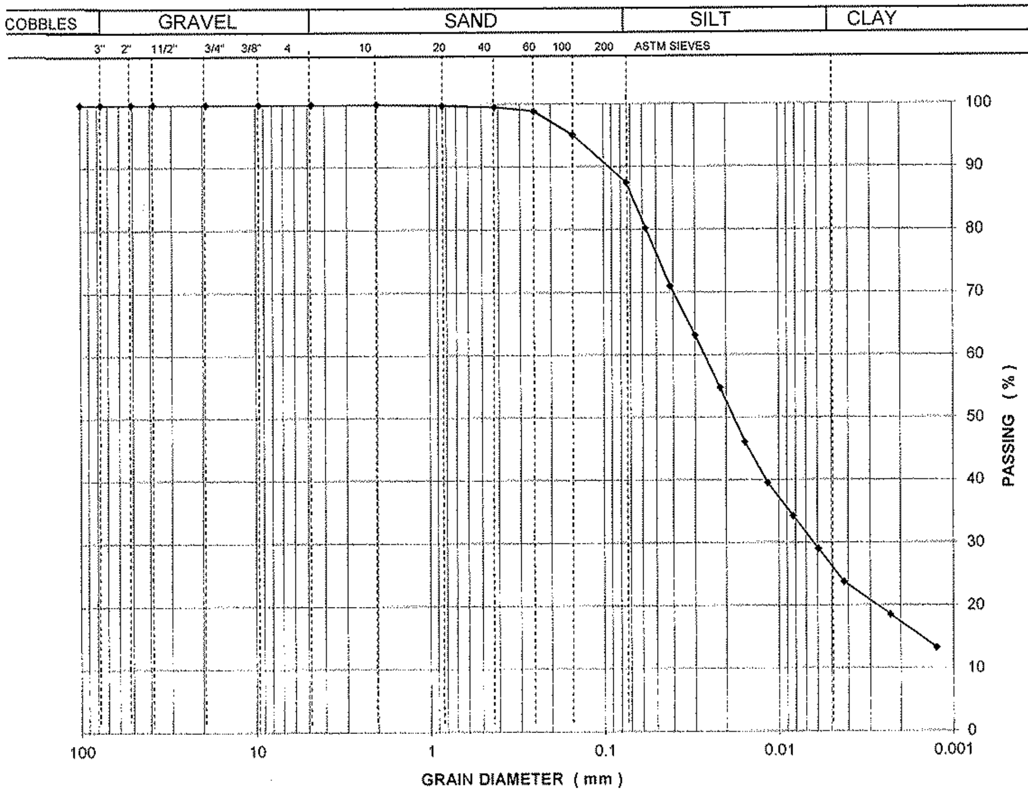
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR TO Y-JUNCTION		
BORE HOLE	BH-6	**SAMPLE**	UDS-2
TYPE	UNDISTURBEC	**DEPTH m**	13.50-14.00
SPECIMEN	1	**DATE**	09.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	100	100	100	100	100	95	88

LAB. REF.	57/2020

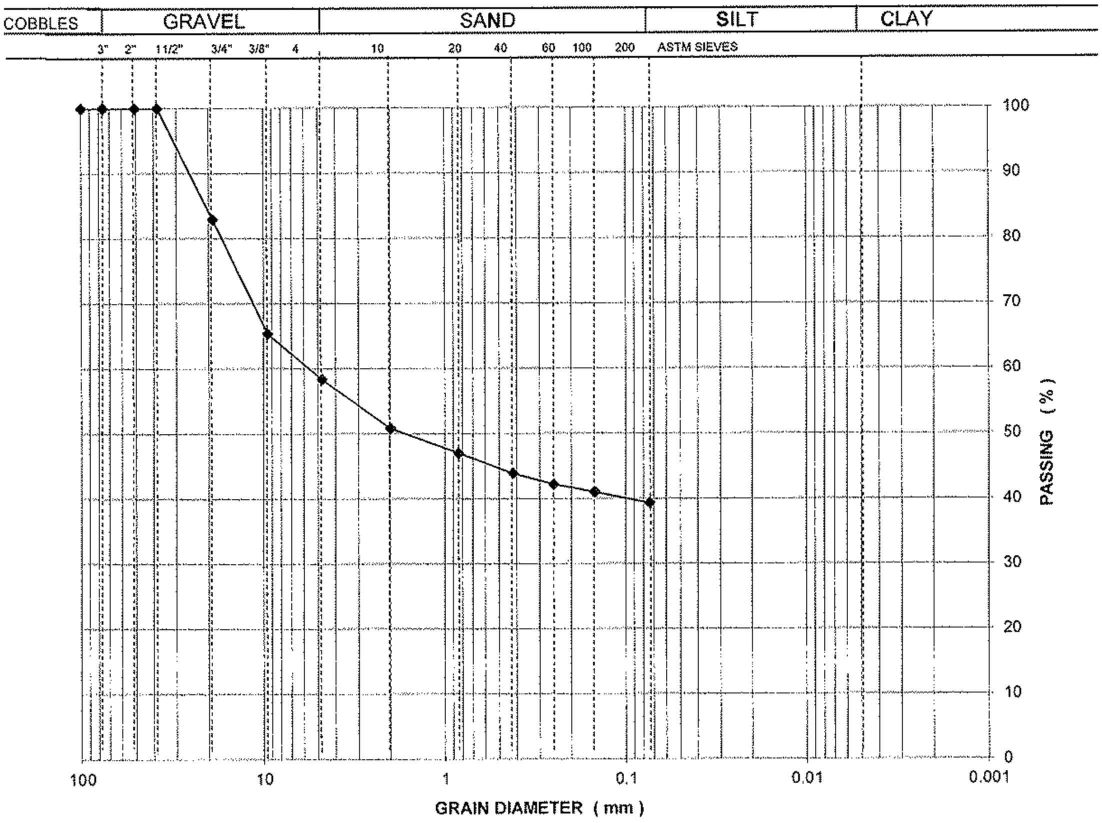
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	BH-6	SAMPLE	SPT-17
TYPE	DISTURBED	DEPTH(m)	22.00-22.45
SPECIMEN	1	DATE	09.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	83	65	58	51	44	41	39

LAB. REF.	57/2020

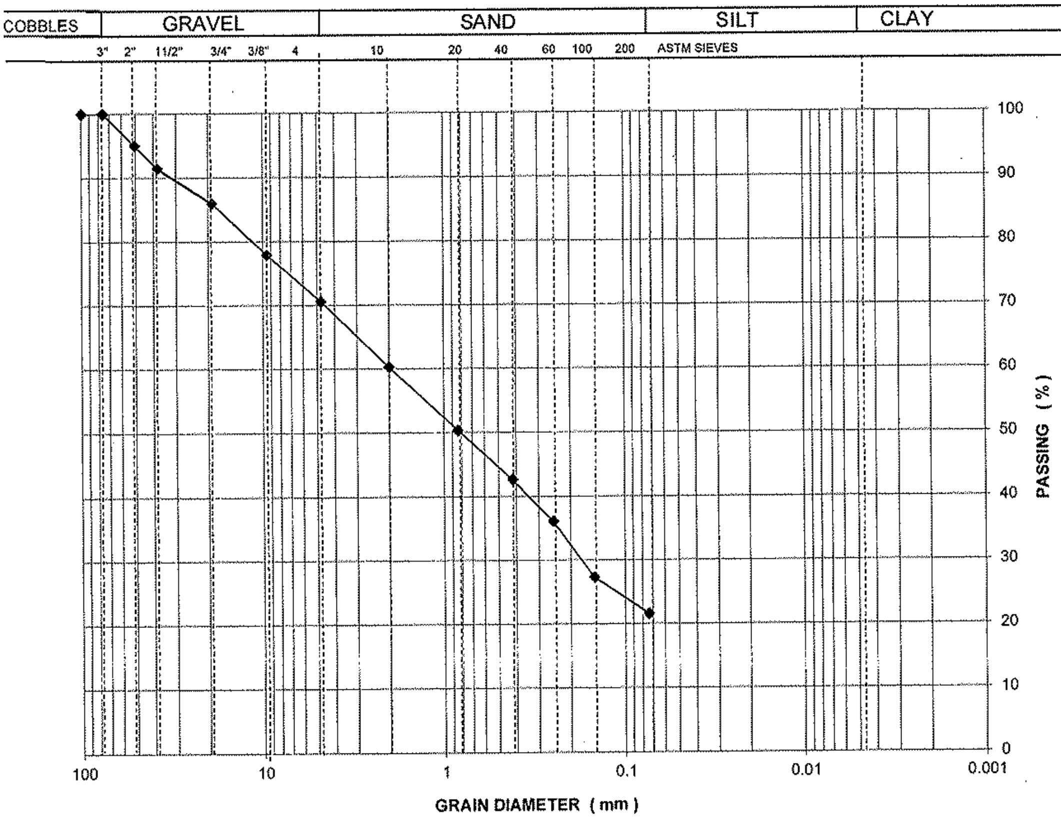
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	FEASIBILITY STUDY & TRANSACTION ADVISORY SERVICES		
SITE	FOR THREE URBAN ROAD PROJECTS IN KARACHI		
BORE HOLE	TP-1	SAMPLE	CS-1
TYPE	DISTURBED	DEPTH(m)	0.65-1.30
SPECIMEN	1	DATE	12.10.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	95	91	86	78	71	60	43	27	22

LAB. REF.	64/2020

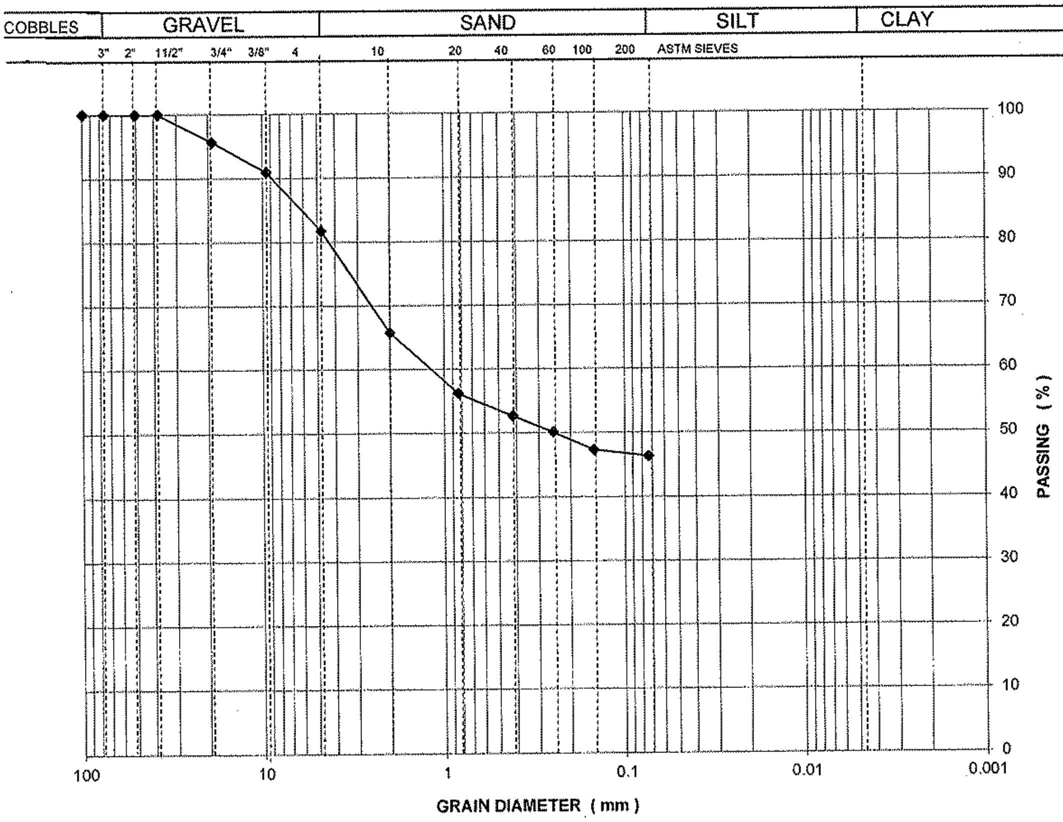
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	FEASIBILITY STUDY & TRANSACTION ADVISORY SERVICES		
SITE	FOR THREE URBAN ROAD PROJECTS IN KARACHI		
BORE HOLE	TP-2	SAMPLE	CS-1
TYPE	DISTURBED	DEPTH(m)	1.10-1.90
SPECIMEN	1	DATE	12.10.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	100	96	91	82	66	53	47	46

LAB. REF.	64/2020

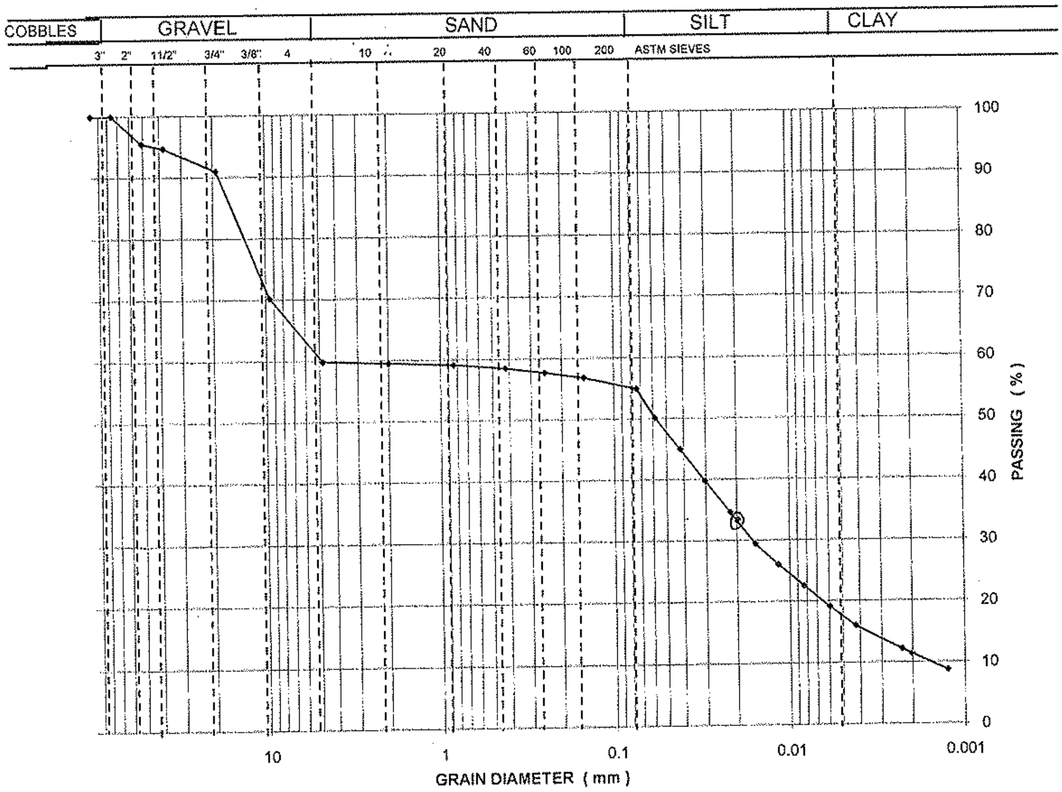
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICE		
PROJECT	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI		
SITE	PACKAGE-2		
BORE HOLE	TP-4	**SAMPLE**	CS-1
TYPE	UNDISTURBED	**DEPTH m**	0.18-1.15
SPECIMEN	1	**DATE**	15.10.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	95	95	91	70	60	60	59	57	55

LAB. REF.	64/2020

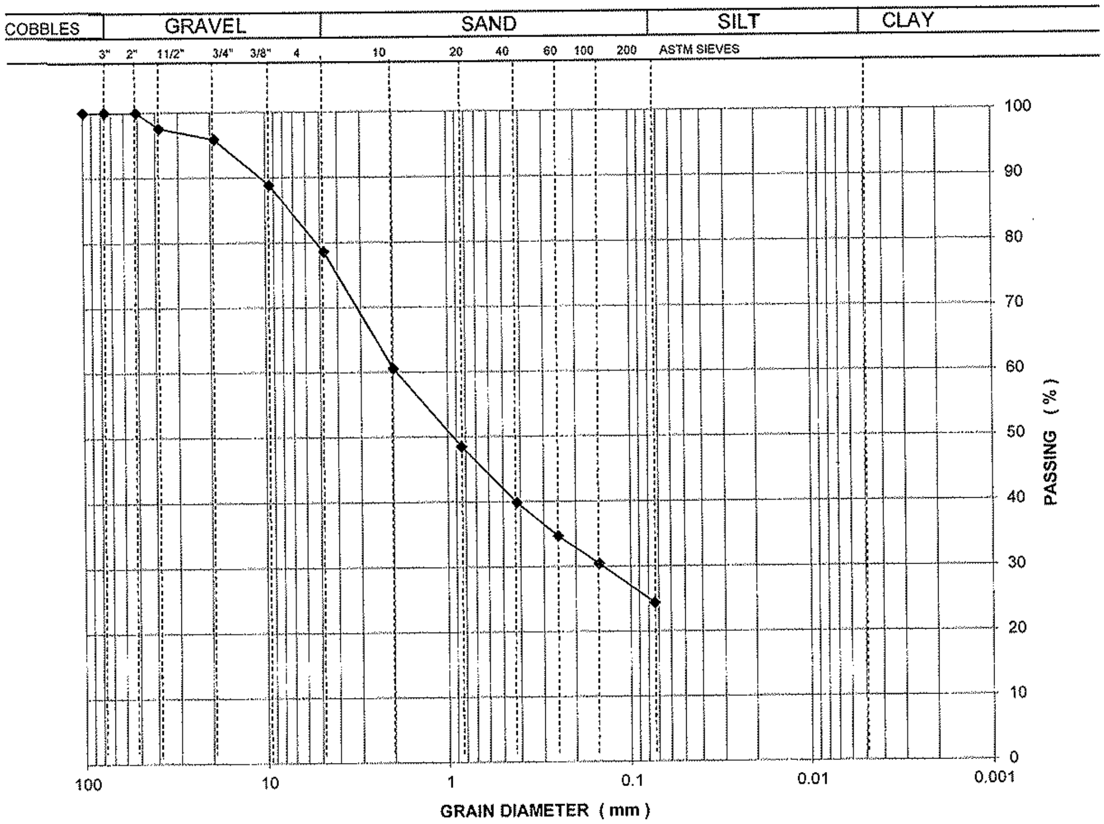
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICES		
PROJECT	TAS FOR THREE URBAN ROAD IN KARACHI		
SITE	PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION		
BORE HOLE	TP-5	SAMPLE	CS-1
TYPE	DISTURBED	DEPTH(m)	0.50-1.15
SPECIMEN	1	DATE	23.09.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	98	96	89	79	61	40	30	24

LAB. REF.	57/2020

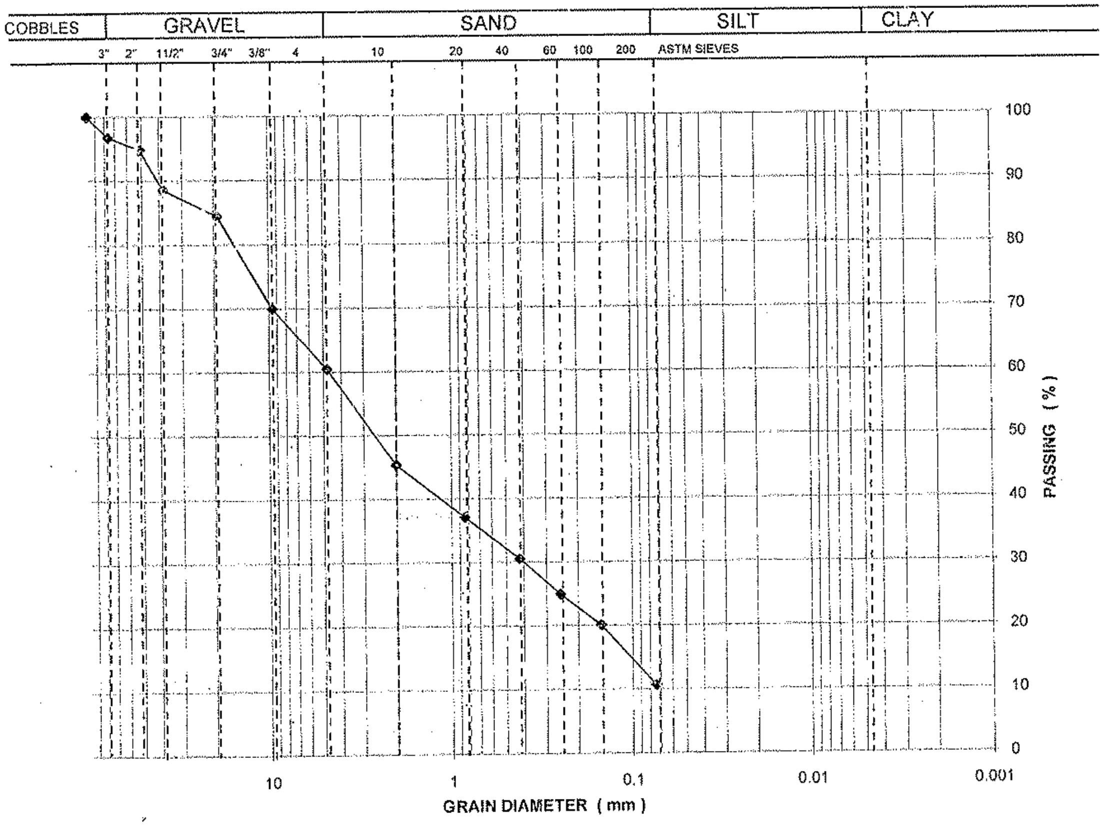
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICE		
PROJECT	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI		
SITE	PACKAGE-2		
BORE HOLE	TP-8	SAMPLE	CS-1
TYPE	DISTURBED	DEPTH(m)	0.82-1.07
SPECIMEN	1	DATE	15.10.2020



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	95	89	84	70	60	45	31	20	11

LAB. REF.	64/2020

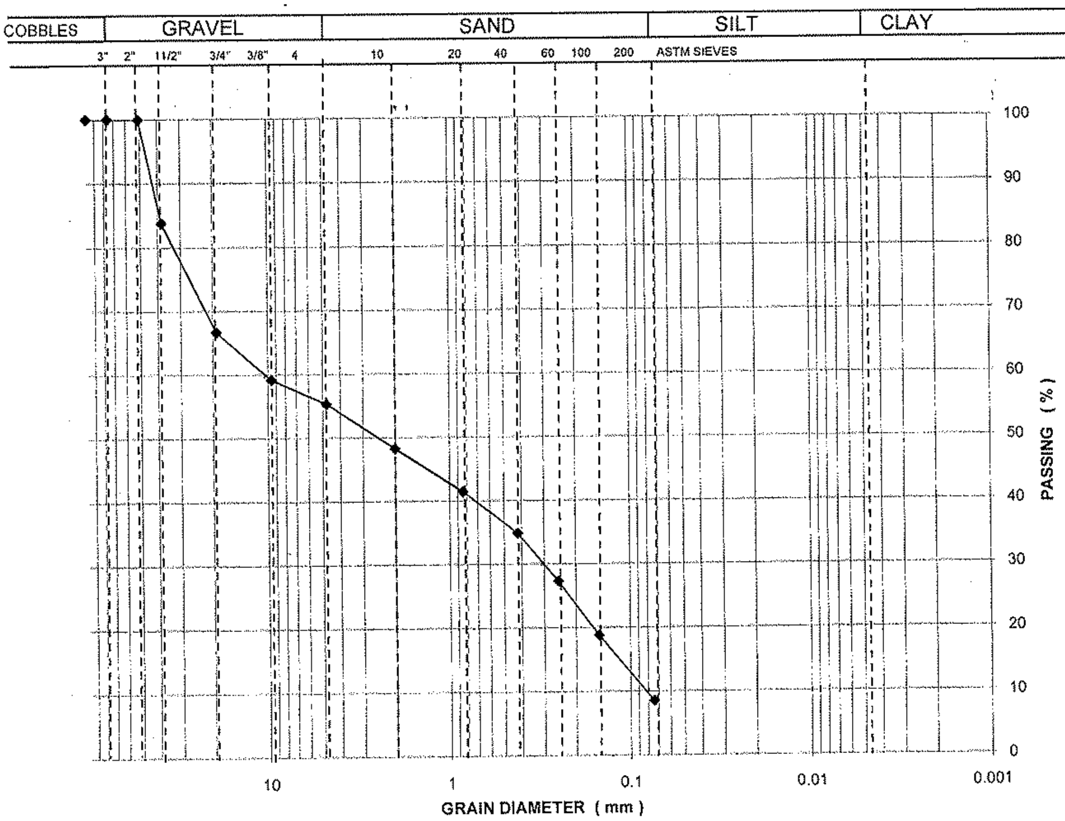
REMARKS :

SOILCON

GRAIN SIZE ANALYSIS

TESTED BY	CHECKED BY
IKRAM ULLAH	MAHMOOD

CLIENT	SOIL TESTING SERVICE		
PROJECT	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI		
SITE	PACKAGE-2		
BORE HOLE	TP-9	SAMPLE	CS-1
TYPE	DISTURBED	DEPTH(m)	0.22-0.65
SPECIMEN	1	DATE	15.10.202



SIEVE NO.	3"	2"	1"1/2	3/4"	3/8"	4	10	40	100	200
PASSING (%)	100	100	84	67	59	55	48	35	19	9

LAB. REF.	64/2020

REMARKS :

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR THREE URBAN ROADS IN KARACHI				
LOCATION	PACKAGE-2, EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-1	**SAMPLE**	SPT-9	**TYPE**	Disturbed
LAB. REF.	57/2020	**DEPTH m**	9.00-9.45	**DATE**	23.09.2020

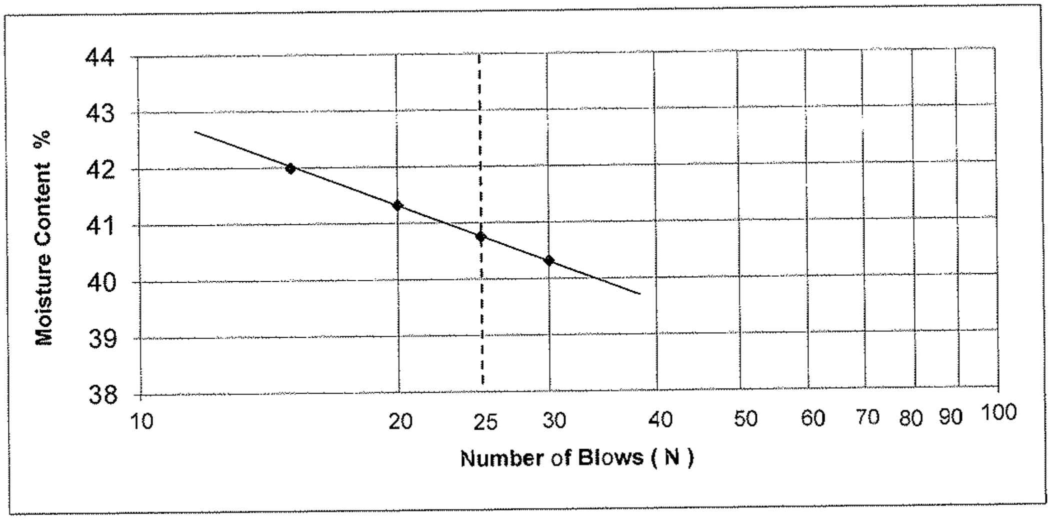
LIQUID LIMIT

Number of Blows N	15	20	25	30	
Moisture Content %	41.99	41.32	40.75	40.32	

PLASTIC LIMIT

Moisture Content %	22.86	22.91	22.95

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
41	23	18



TESTED BY	CHECKED BY
Azmat	Mahmood

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI				
LOCATION	PACKAGE-2				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-2	**SAMPLE**	UDS-1	**TYPE**	UNDISTURBED
LAB. REF.	61/2020	**DEPTH m**	5.50-6.05	**DATE**	29.09.2020

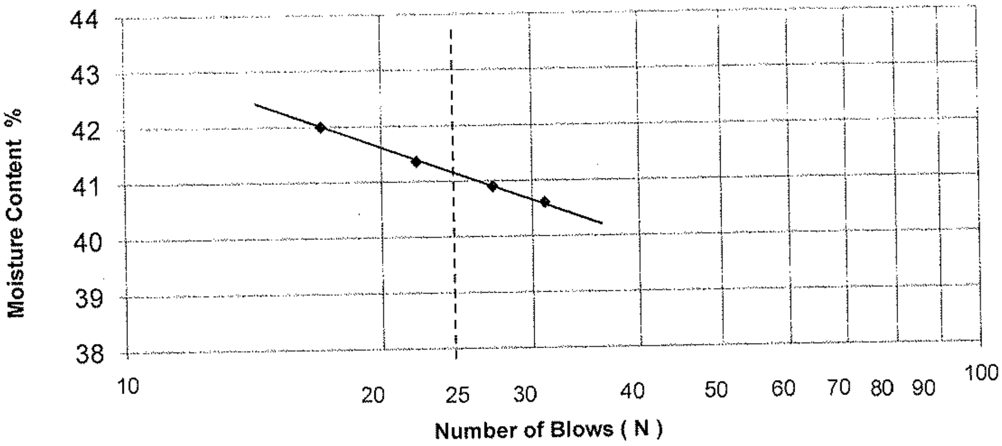
LIQUID LIMIT

Number of Blows **N**	17	22	27	31	
Moisture Content %	42.00	41.36	40.90	40.61	

PLASTIC LIMIT

Moisture Content %	23.21	23.25	23.31

LIQUID LIMIT	**PLASTIC LIMIT**	**PLASTICITY INDEX**
41	23	18



TESTED BY	CHECKED BY
MAHMOOD	IKRAM

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI				
LOCATION	PACKAGE-2				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-2	**SAMPLE**	UDS-2	**TYPE**	UNDISTURBED
LAB. REF.	61/2020	**DEPTH m**	10.50-11.05	**DATE**	29.09.2020

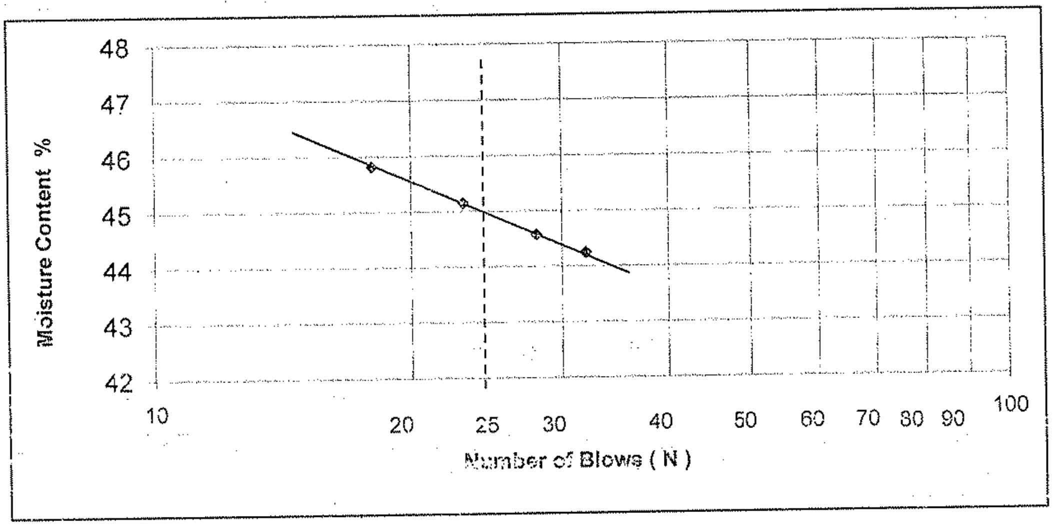
LIQUID LIMIT

Number of Blows N	18	23	28	32	
Moisture Content %	45.82	45.16	44.58	44.25	

PLASTIC LIMIT

Moisture Content %	25.04	25.09	25.12

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
45	25	20



TESTED BY	CHECKED BY
MAHMOOD	IKRAM

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR THREE URBAN ROADS IN KARACHI				
LOCATION	PACKAGE-2, EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-3	**SAMPLE**	SPT-4	**TYPE**	Disturbed
LAB. REF.	57/2020	**DEPTH m**	4.00-4.45	**DATE**	09.09.2020

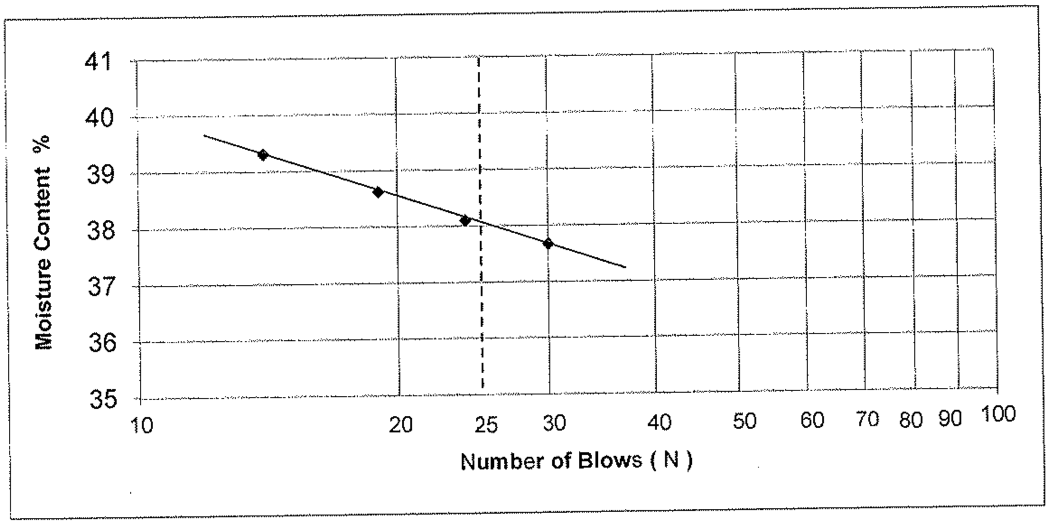
LIQUID LIMIT

Number of Blows N	14	19	24	30	
Moisture Content %	39.31	38.62	38.10	37.67	

PLASTIC LIMIT

Moisture Content %	22.07	22.12	22.15

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
38	22	16



TESTED BY	CHECKED BY
Azmat	Mahmood

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR THREE URBAN ROADS IN KARACHI				
LOCATION	PACKAGE-2, EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-3	**SAMPLE**	UDS-1	**TYPE**	Undisturbed
LAB. REF.	57/2020	**DEPTH m**	12.00-12.40	**DATE**	09.09.2020

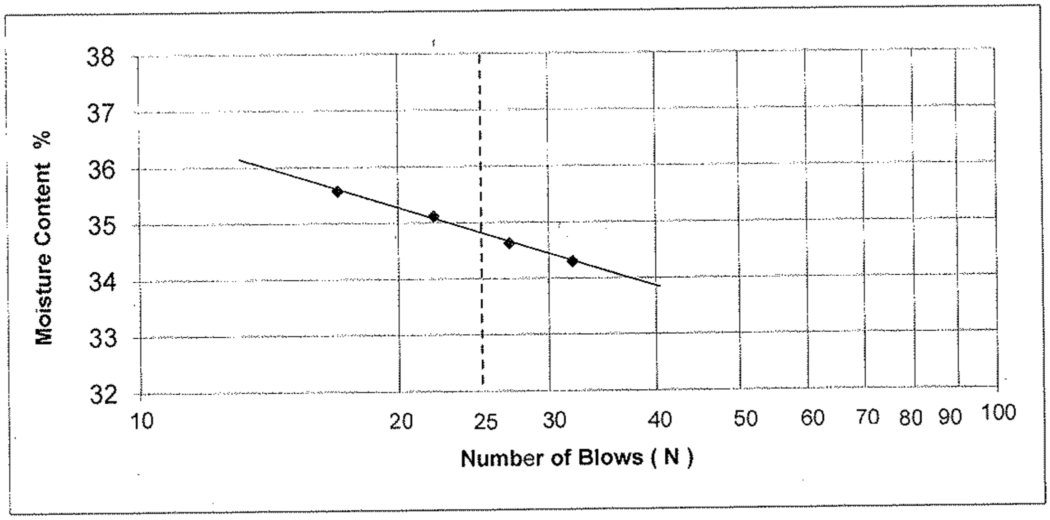
LIQUID LIMIT

Number of Blows N	17	22	27	32	
Moisture Content %	35.58	35.12	34.63	34.30	

PLASTIC LIMIT

Moisture Content %	20.97	21.01	21.05

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
35	21	14



TESTED BY	CHECKED BY
Azmat	Mahmood

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR THREE URBAN ROADS IN KARACHI				
LOCATION	PACKAGE-2, EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-3	**SAMPLE**	SPT-17	**TYPE**	Disturbed
LAB. REF.	57/2020	**DEPTH m**	18.00-18.45	**DATE**	09.09.2020

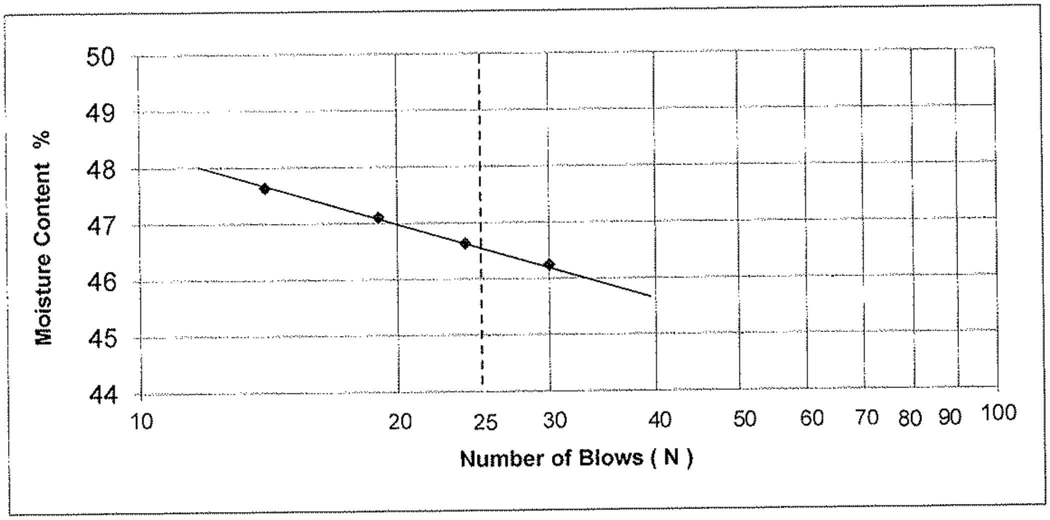
LIQUID LIMIT

Number of Blows N	14	19	24	30	
Moisture Content %	47.64	47.11	46.64	46.25	

PLASTIC LIMIT

Moisture Content %	24.87	24.92	24.96

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
46	25	21



TESTED BY	CHECKED BY
Azmat	Mahmood

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR THREE URBAN ROADS IN KARACHI				
LOCATION	PACKAGE-2, EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-4	SAMPLE	UDS-1	TYPE	Undisturbed
LAB. REF.	57/2020	DEPTH m	10.00-10.55	DATE	23.09.2020

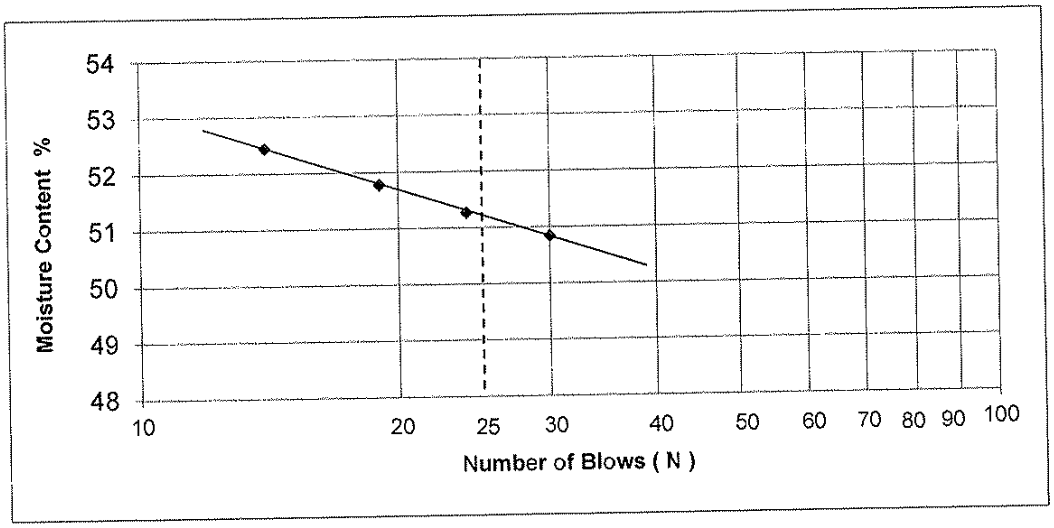
LIQUID LIMIT

Number of Blows N	14	19	24	30	
Moisture Content %	52.44	51.78	51.27	50.84	

PLASTIC LIMIT

Moisture Content %	26.11	26.15	26.20

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
51	26	25



TESTED BY	CHECKED BY
Azmat	Mahmood

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR THREE URBAN ROADS IN KARACHI				
LOCATION	PACKAGE-2, EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-4	SAMPLE	UDS-2	TYPE	Undisturbed
LAB. REF.	57/2020	DEPTH m	14.00-14.60	DATE	23.09.2020

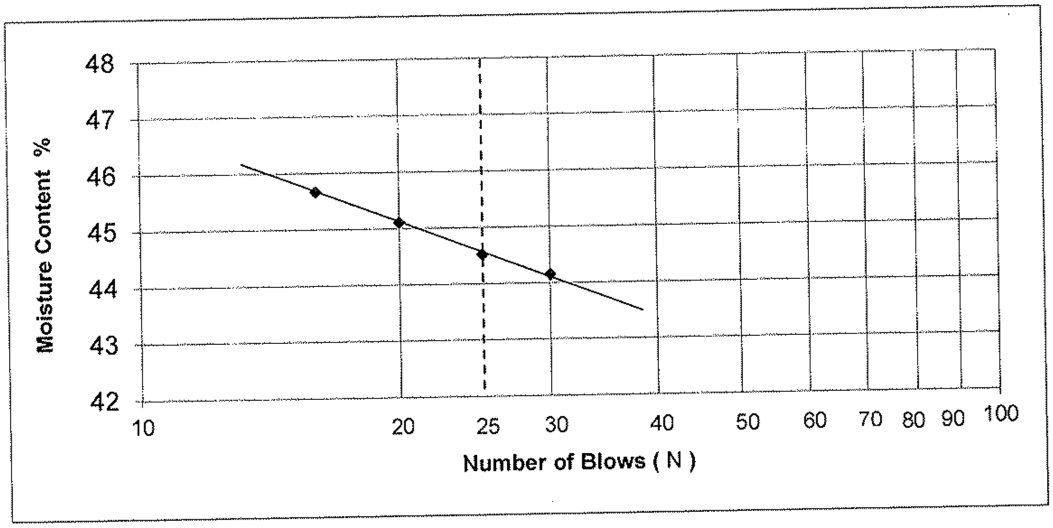
LIQUID LIMIT

Number of Blows N	16	20	25	30	
Moisture Content %	45.67	45.11	44.52	44.15	

PLASTIC LIMIT

Moisture Content %	24.78	24.82	24.87

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
45	25	20



TESTED BY	CHECKED BY
Azmat	Mahmood

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR THREE URBAN ROADS IN KARACHI				
LOCATION	PACKAGE-2, EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-4	**SAMPLE**	SPT-16	**TYPE**	Disturbed
LAB. REF.	57/2020	**DEPTH m**	18.00-18.45	**DATE**	23.09.2020

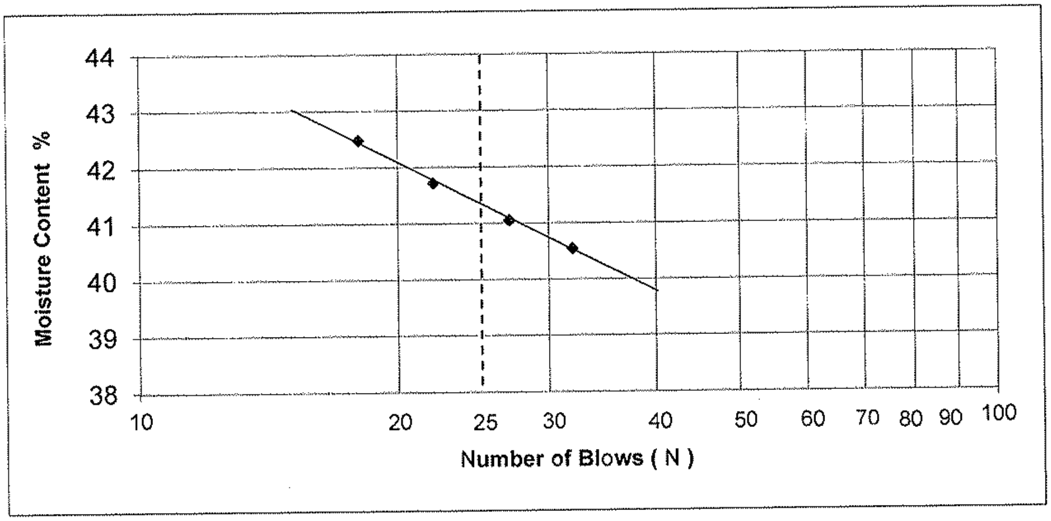
LIQUID LIMIT

Number of Blows N	18	22	27	32	
Moisture Content %	42.48	41.72	41.05	40.54	

PLASTIC LIMIT

Moisture Content %	23.19	23.23	23.27

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
41	23	18



TESTED BY	CHECKED BY
Azmat	Mahmood

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI				
LOCATION	PACKAGE-2				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-5	**SAMPLE**	UDS-2	**TYPE**	UNDISTURBED
LAB. REF.	61/2020	**DEPTH m**	12.60-13.00	**DATE**	29.09.2020

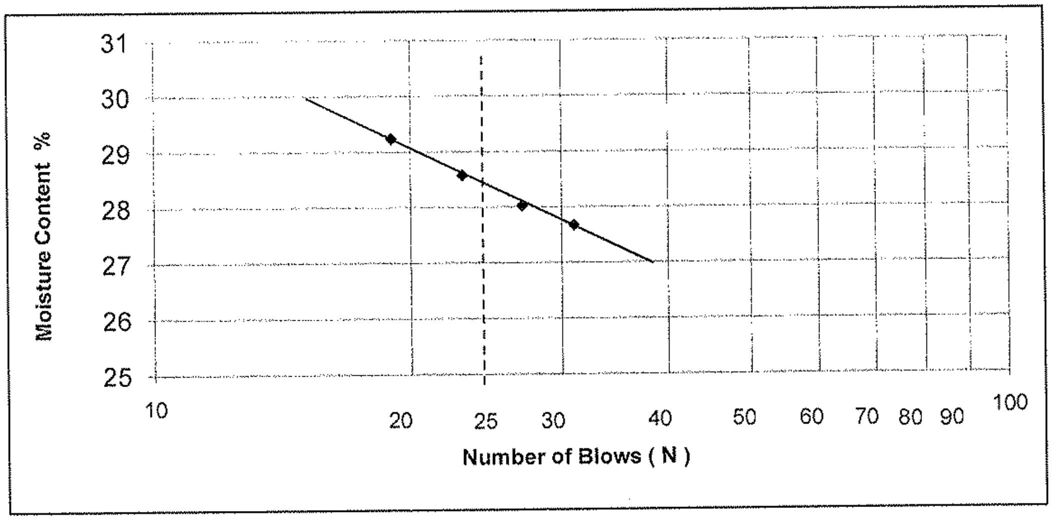
LIQUID LIMIT

Number of Blows **N**	19	23	27	31	
Moisture Content %	29.24	28.58	28.03	27.68	

PLASTIC LIMIT

Moisture Content %	20.21	20.25	20.31

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
28	20	8



TESTED BY	CHECKED BY
MAHMOOD	IKRAM

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR THREE URBAN ROADS IN KARACHI				
LOCATION	PACKAGE-2, EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-6	**SAMPLE**	SPT-7	**TYPE**	Disturbed
LAB. REF.	57/2020	**DEPTH m**	7.00-7.45	**DATE**	09.09.2020

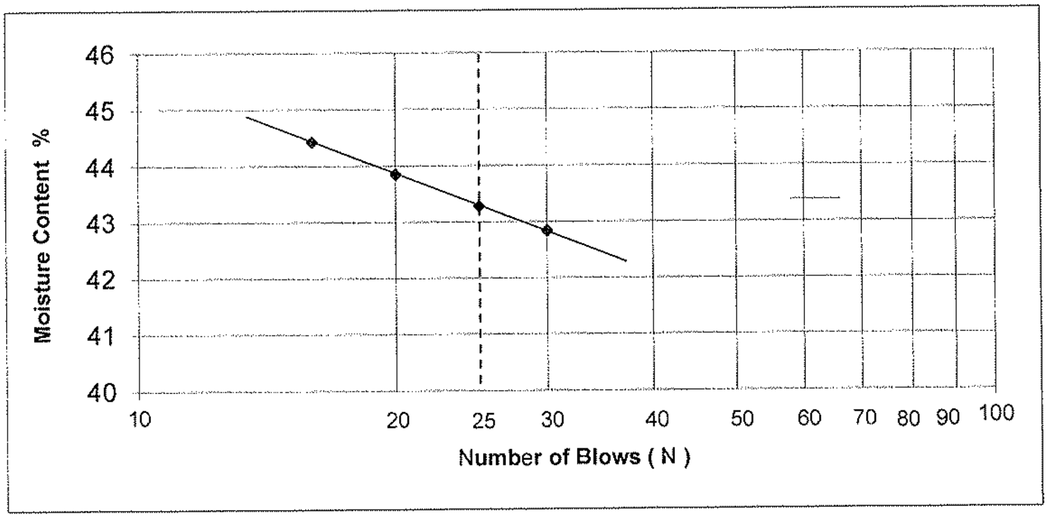
LIQUID LIMIT

Number of Blows N	16	20	25	30	
Moisture Content %	44.43	43.85	43.28	42.84	

PLASTIC LIMIT

Moisture Content %	24.17	24.22	24.26

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
43	24	19



TESTED BY	CHECKED BY
Azmat	Mahmood

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR THREE URBAN ROADS IN KARACHI				
LOCATION	PACKAGE-2, EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	BH-6	**SAMPLE**	UDS-2	**TYPE**	Undisturbed
LAB. REF.	57/2020	**DEPTH m**	13.50-14.00	**DATE**	09.09.2020

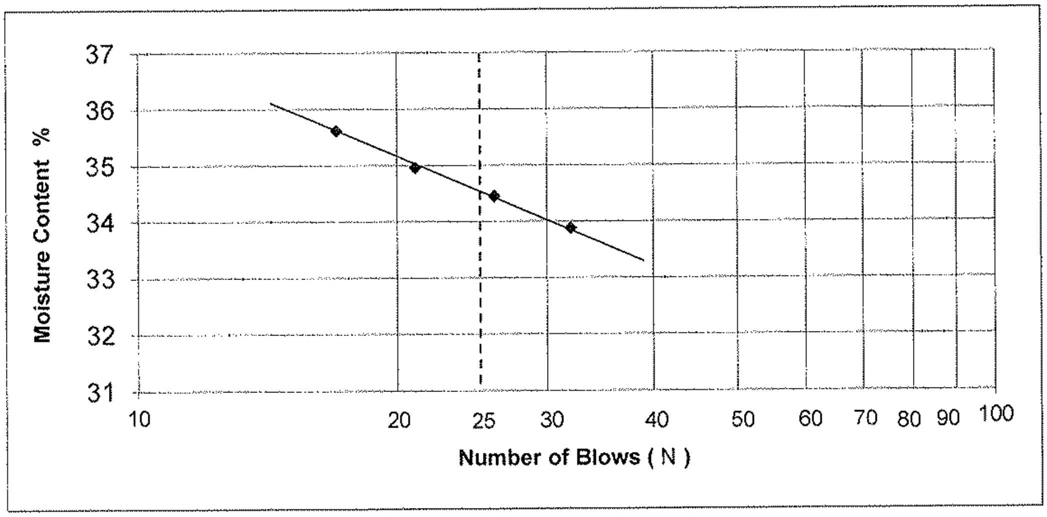
LIQUID LIMIT

Number of Blows N	17	21	26	32	
Moisture Content %	35.62	34.96	34.45	33.88	

PLASTIC LIMIT

Moisture Content %	20.82	20.86	20.90

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
34	21	13



TESTED BY	CHECKED BY
Azmat	Mahmood

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI				
LOCATION	PACKAGE-2				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	TP-4	**SAMPLE**	CS-1	**TYPE**	DISTURBED
LAB. REF.	64/2020	**DEPTH m**	0.18-1.15	**DATE**	15.10.2020

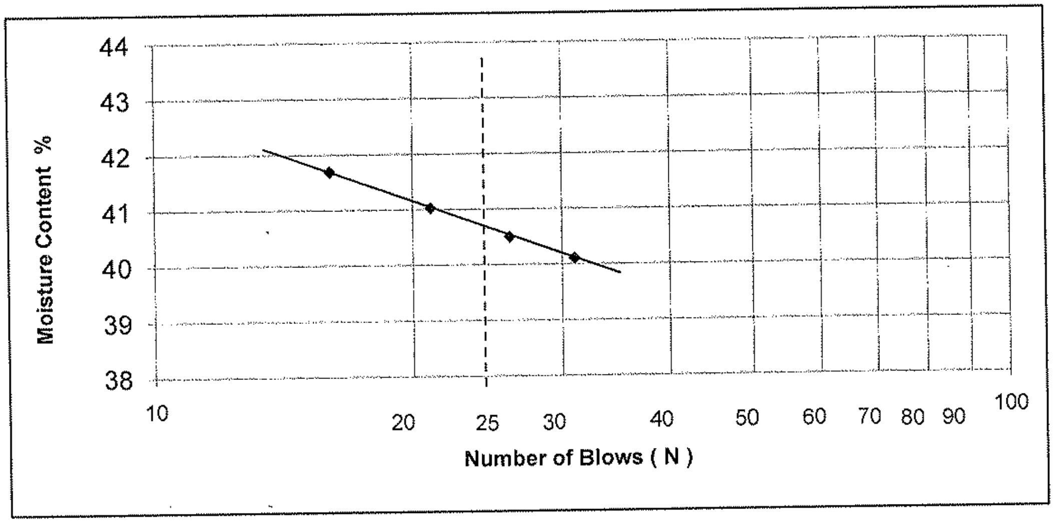
LIQUID LIMIT

Number of Blows N	16	21	26	31	
Moisture Content %	41.69	41.03	40.50	40.11	

PLASTIC LIMIT

Moisture Content %	23.85	23.88	23.91

LIQUID LIMIT	**PLASTIC LIMIT**	**PLASTICITY INDEX**
41	24	17



TESTED BY	CHECKED BY
MAHMOOD	IKRAM

SOILCON

LIQUID & PLASTIC LIMIT

(ASTM D - 4318)

PROJECT	TAS FOR THREE URBAN ROADS IN KARACHI				
LOCATION	PACKAGE-2, EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION				
CLIENT	SOIL TESTING SERVICES				
BOREHOLE	TP-5	SAMPLE	CS-1	TYPE	Disturbed
LAB. REF.	57/2020	DEPTH m	0.50-1.15	DATE	23.09.2020

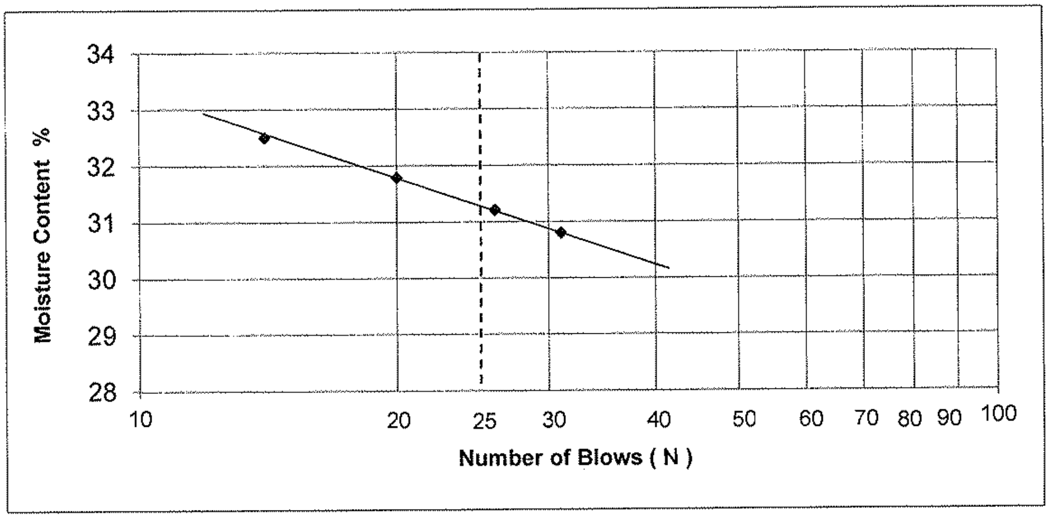
LIQUID LIMIT

Number of Blows N	14	20	26	31	
Moisture Content %	32.50	31.79	31.21	30.80	

PLASTIC LIMIT

Moisture Content %	20.05	20.09	20.12

LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
31	20	11



TESTED BY	CHECKED BY
Azmat	Mahmood

SOILCON
GEOTECHNICAL TESTING LABORATORIES, 18-Km,
MULTAN ROAD, LAHORE

UNCONFINED COMPRESSION TEST

PROJECT: TAS FOR THREE URBAN ROAD IN KARACHI
LOCATION: PACKAGE-2
LAB REF. 61/2020
DATE: 29.09.2020
SAMPLE DESCRIPTION:

BH NO BH-2
SAMPLE NO UDS-1
DEPTH m 5.50-6.05
CLIENT SOIL TESTING SERVICES

Specimen Conditions

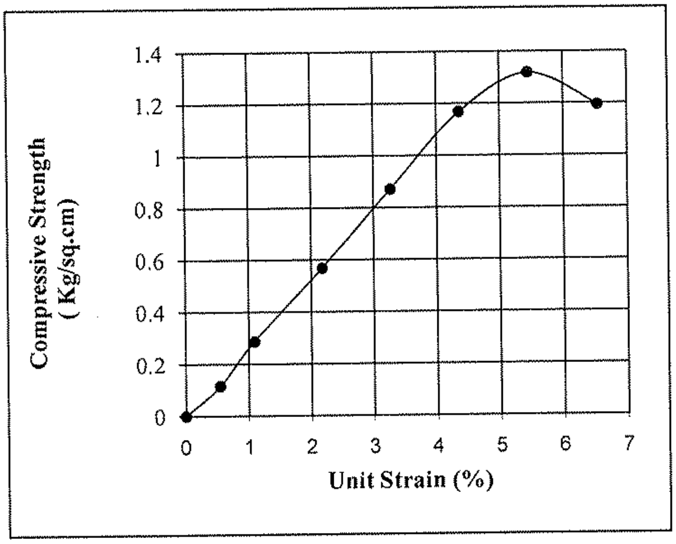
Diameter Average	4.52	cm
Area Average	16.04	cm^2
Height	9.17	cm
Volume	147.16	cm^3
Weight Wet	301.76	g
Water Content	15.58	%
Dry Density	1.774	g/cm^3
P.R Factor	0.9312	Kg/div.
Compressive Strength	1.32	Kg/cm^2
Strain	5.45	%

FAILURE SKETCHES

Front

Rear

Deformation Dial Reading	Unit Strain %	Compressive Strength (Kg/sq.cm)
0	0.00	0.00
50	0.55	0.12
100	1.09	0.29
200	2.18	0.57
300	3.27	0.87
400	4.36	1.17
500	5.45	1.32
600	6.54	1.19



Remarks:

Tested By: Azmat
Checked By: Mahmood

SOILCON
GEOTECHNICAL TESTING LABORATORIES, 18-Km,
MULTAN ROAD, LAHORE

UNCONFINED COMPRESSION TEST

PROJECT:	TAS FOR THREE URBAN ROAD IN KARACHI	**BH NO**	BH-2
LOCATION:	PACKAGE-2	**SAMPLE NO**	UDS-2
LAB REF.	61/2020	**DEPTH m**	10.50-11.05
DATE:	29.09.2020	**CLIENT**	SOIL TESTING SERVICES

SAMPLE DESCRIPTION:

Specimen Conditions

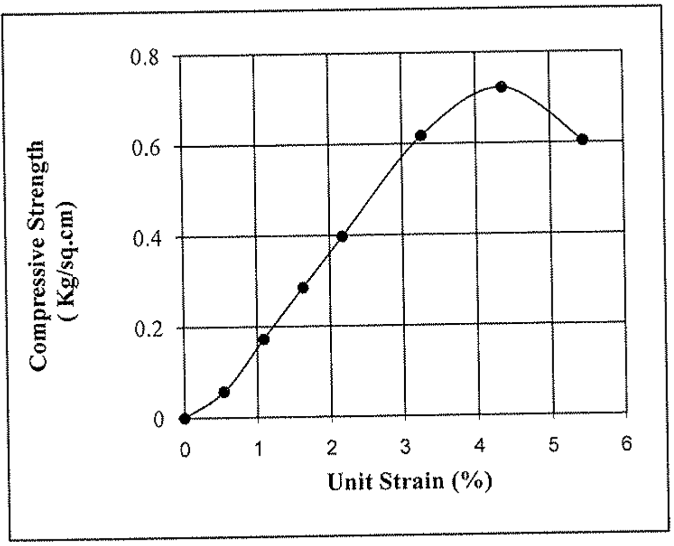
Diameter Average	4.52	cm
Area Average	16.04	cm^2
Height	9.17	cm
Volume	147.16	cm^3
Weight Wet	314.25	g
Water Content	16.54	%
Dry Density	1.832	g/cm^3
P.R Factor	0.9312	Kg/div.
Compressive Strength	0.72	Kg/cm^2
Strain	4.36	%

FAILURE SKETCHES

Front

Rear

Deformation Dial Reading	Unit Strain %	Compressive Strength (Kg/sq.cm)
0	0.00	0.00
50	0.55	0.06
100	1.09	0.17
150	1.64	0.29
200	2.18	0.40
300	3.27	0.62
400	4.36	0.72
500	5.45	0.60



Remarks:

Tested By: Azmat

Checked By: Mahmood

SOILCON
GEOTECHNICAL TESTING LABORATORIES, 18-Km,

UNCONFINED COMPRESSION TEST

PROJECT: TAS FOR 03 URBAN ROAD IN KARACHI
LOCATION: PACKAGE-2
LAB REF. 57/2020
DATE: 11.09.2020
SAMPLE DESCRIPTION:

BH # BH-3
SAMPLE NO UDS-1
DEPTH m 12.00-12.40
CLIENT SOIL TESTING SERVICE

Specimen Conditions

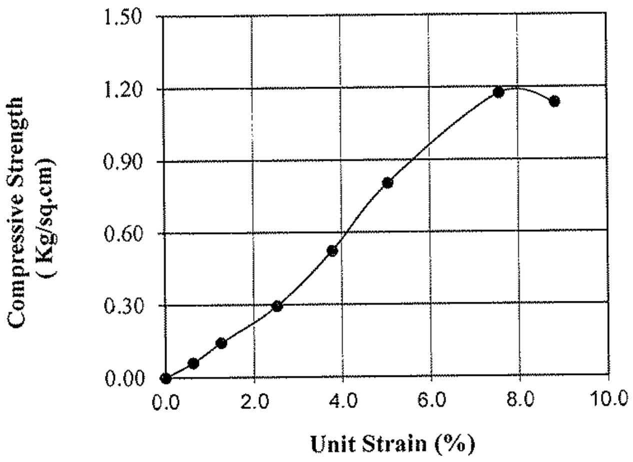
Diameter Average	3.86	cm
Area Average	11.75	cm^2
Height	7.925	cm
Volume	92.78	cm^3
Weight Wet	191.22	g
Water Content	13.18	%
Dry Density	1.821	g/cm^3
P.R Factor	0.1422	Kg/div.
Compressive Strength	1.17	Kg/cm^2
Strain	7.57	%

FAILURE SKETCHES

Front

Rear

Deformation Dial Reading	Unit Strain %	Compressive Strength (Kg/sq.cm)
0	0.00	0.00
50	0.63	0.06
100	1.26	0.14
200	2.52	0.29
300	3.79	0.52
400	5.05	0.80
600	7.57	1.17
700	8.83	1.14



Remarks:

Tested By: Mahmood
Checked By: Ikram Ullah

SOILCON
GEOTECHNICAL TESTING LABORATORIES, 18-Km,

UNCONFINED COMPRESSION TEST

PROJECT: TAS FOR 03 URBAN ROAD IN KARACHI
LOCATION: PACKAGE-2
LAB REF. 57/2020
DATE: 23.09.2020
SAMPLE DESCRIPTION:

BH # BH-4
SAMPLE NO UDS-1
DEPTH m 10.00-10.55
CLIENT SOIL TESTING SERVICE

Specimen Conditions

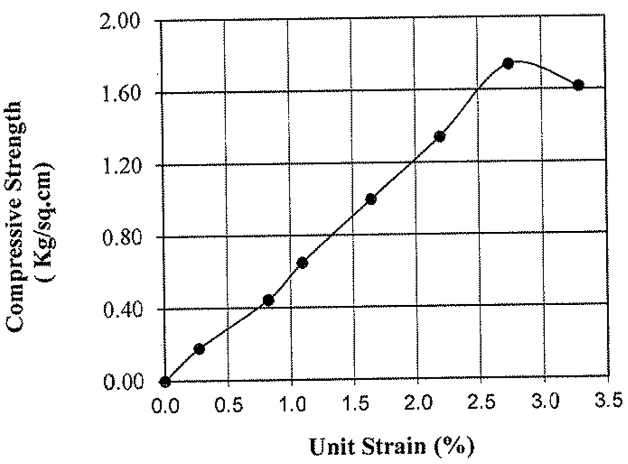
Diameter Average	4.46	cm
Area Average	15.62	cm^2
Height	9.12	cm
Volume	142.50	cm^3
Weight Wet	307.47	g
Water Content	14.26	%
Dry Density	1.888	g/cm^3
P.R Factor	0.9312	Kg/div.
Compressive Strength	1.74	Kg/cm^2
Strain	2.74	%

FAILURE SKETCHES

Front

Rear

Deformation Dial Reading	Unit Strain %	Compressive Strength (Kg/sq.cm)
0	0.00	0.00
25	0.27	0.18
75	0.82	0.44
100	1.10	0.65
150	1.64	1.00
200	2.19	1.34
250	2.74	1.74
300	3.29	1.61



Remarks:

Tested By: Mahmood

Checked By: Ikram Ullah

SOILCON

GEOTECHNICAL TESTING LABORATORIES, 18-Km,

UNCONFINED COMPRESSION TEST

PROJECT:	TAS FOR 03 URBAN ROAD IN KARACHI	**BH #**	BH-4
LOCATION:	PACKAGE-2	**SAMPLE NO**	UDS-1
LAB REF.	57/2020	**DEPTH m**	10.00-10.55
DATE:	23.09.2020	**CLIENT**	SOIL TESTING SERVICE

SAMPLE DESCRIPTION: ____________________

Specimen Conditions

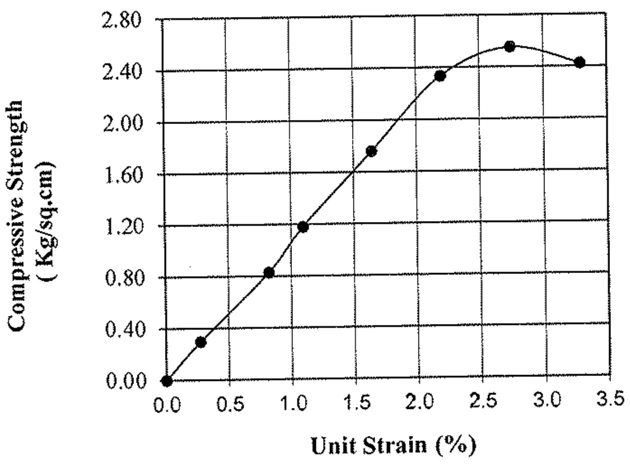
Diameter Average	4.46	cm
Area Average	15.62	cm^2
Height	9.12	cm
Volume	142.50	cm^3
Weight Wet	307.47	g
Water Content	14.26	%
Dry Density	1.888	g/cm^3
P.R Factor	0.9312	Kg/div.
Compressive Strength	2.55	Kg/cm^2
Strain	2.74	%

FAILURE SKETCHES

Front

Rear

Deformation Dial Reading	Unit Strain %	Compressive Strength (Kg/sq.cm)
0	0.00	0.00
25	0.27	0.30
75	0.82	0.83
100	1.10	1.18
150	1.64	1.76
200	2.19	2.33
250	2.74	2.55
300	3.29	2.42



Remarks: ____________________

Tested By: Mahmood

Checked By: Ikram Ullah

SOILCON
GEOTECHNICAL TESTING LABORATORIES, 18-Km,

UNCONFINED COMPRESSION TEST

PROJECT:	TAS FOR 03 URBAN ROAD IN KARACHI	**BH #**	BH-4
LOCATION:	PACKAGE-2	**SAMPLE NO**	UDS-2
LAB REF.	57/2020	**DEPTH m**	14.00-14.60
DATE:	23.09.2020	**CLIENT**	SOIL TESTING SERVICE

SAMPLE DESCRIPTION:

Specimen Conditions

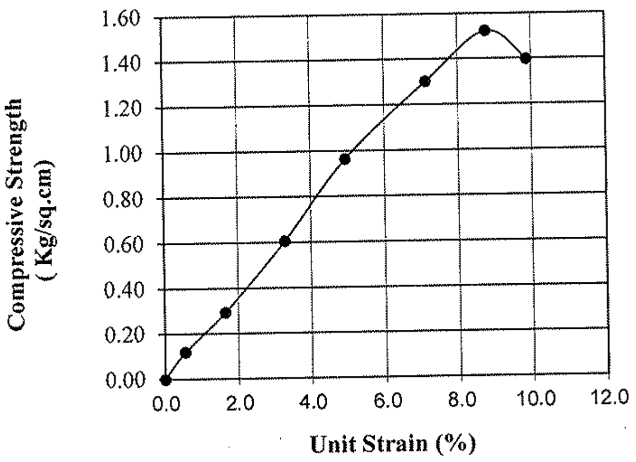
Diameter Avcrage	4.46	cm
Area Average	15.62	cm^2
Height	9.12	cm
Volume	142.50	cm^3
Weight Wet	286.54	g
Water Content	17.25	%
Dry Density	1.715	g/cm^3
P.R Factor	0.9312	Kg/div.
Compressive Strength	1.52	Kg/cm^2
Strain	8.77	%

FAILURE SKETCHES

Front

Rear

Deformation Dial Reading	Unit Strain %	Compressive Strength (Kg/sq.cm)
0	0.00	0.00
50	0.55	0.12
150	1.64	0.29
300	3.29	0.61
450	4.93	0.96
650	7.13	1.30
800	8.77	1.52
900	9.87	1.40



Remarks:

Tested By: Mahmood

Checked By: Ikram Ullah

SOILCON

GEOTECHNICAL TESTING LABORATORIES, 18-Km,
MULTAN ROAD, LAHORE

UNCONFINED COMPRESSION TEST

PROJECT:	TAS FOR THREE URBAN ROAD IN KARACHI	**BH NO**	BH-5
LOCATION:	PACKAGE-2	**SAMPLE NO**	UDS-2
LAB REF.	61/2020	**DEPTH m**	12.60-13.00
DATE:	29.09.2020	**CLIENT**	SOIL TESTING SERVICES

SAMPLE DESCRIPTION:

Specimen Conditions

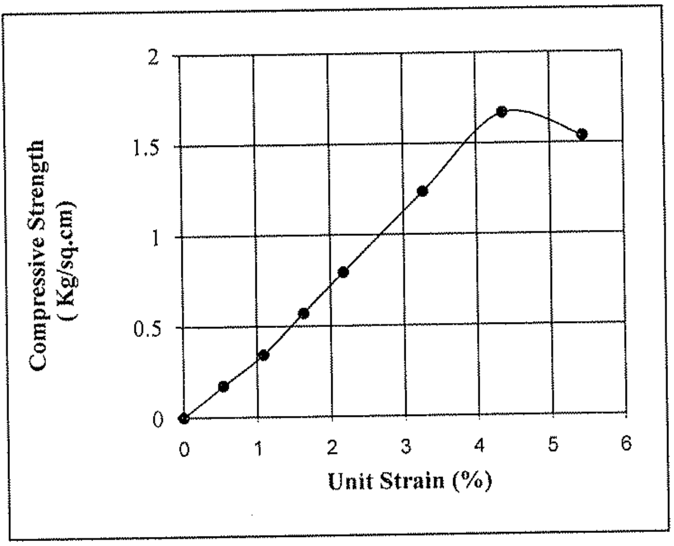
Diameter Average	4.52	cm
Area Average	16.04	cm^2
Height	9.17	cm
Volume	147.16	cm^3
Weight Wet	309.84	g
Water Content	17.06	%
Dry Density	1.799	g/cm^3
P.R Factor	0.9312	Kg/div.
Compressive Strength	1.67	Kg/cm^2
Strain	4.36	%

FAILURE SKETCHES

Front

Rear

Deformation Dial Reading	Unit Strain %	Compressive Strength (Kg/sq.cm)
0	0.00	0.00
50	0.55	0.17
100	1.09	0.34
150	1.64	0.57
200	2.18	0.80
300	3.27	1.24
400	4.36	1.67
500	5.45	1.54



Remarks:

Tested By: Azmat

Checked By: Mahmood

SOILCON
GEOTECHNICAL TESTING LABORATORIES, 18-Km,

UNCONFINED COMPRESSION TEST

PROJECT: TAS FOR 03 URBAN ROAD IN KARACHI
LOCATION: PACKAGE-2
LAB REF. 57/2020
DATE: 11.09.2020
SAMPLE DESCRIPTION:

BH # BH-6
SAMPLE NO UDS-2
DEPTH m 13.5-14.00
CLIENT **SOIL TESTING SERVICE**

Specimen Conditions

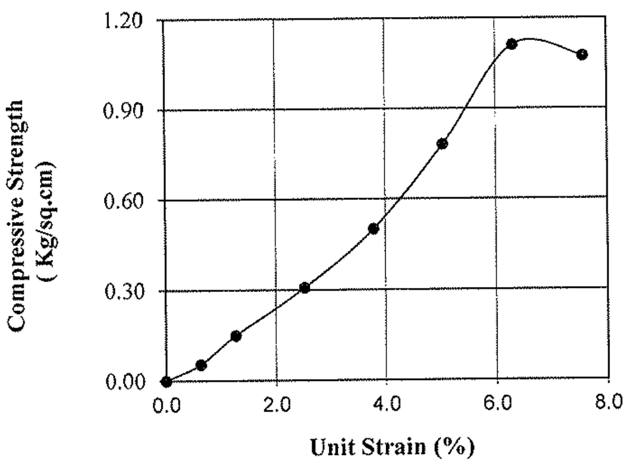
Diameter Average	3.86	cm
Area Average	11.75	cm^2
Height	7.925	cm
Volume	92.78	cm^3
Weight Wet	195.32	g
Water Content	17.54	%
Dry Density	1.791	g/cm^3
P.R Factor	0.1422	Kg/div.
Compressive Strength	1.11	Kg/cm^2
Strain	6.31	%

FAILURE SKETCHES

Front

Rear

Deformation Dial Reading	Unit Strain %	Compressive Strength (Kg/sq.cm)
0	0.00	0.00
50	0.63	0.05
100	1.26	0.15
200	2.52	0.31
300	3.79	0.50
400	5.05	0.78
500	6.31	1.11
600	7.57	1.07



Remarks:

Tested By: Mahmood
Checked By: Ikram Ullah

SOILCON

GEOTECHNICAL TESTING LABORATORIES, 18-K.M. MULTAN ROAD, LAHORE. Phone No. 37510942-3, Fax No. 37515267

Dated: 30.09.2020

To,

M/s: Soil Testing Service,
Karachi.

Subject: **NON TESTED SAMPLE(S).**

It is submitted that the following is the detail of non-tested samples of TAS for 03 Urban Road Projects in Karachi (package 1 & 2):

Sr. No.	**BH / TP #**	**Sample No.**	**Depth (m)**	**Test Required**	**Reason**	**Remarks**
01	BH-2	UDS-1	7.50-8.40	Direct Shear	Due to gravelly strata	Package-1
02	BH-5	UDS-1	650-7.40	Direct Shear	Due to clayey and gravelly strata	Package-2

Submitted for kind information please.

(Ghulam Mahmood Butt)
Supervisor, SOILCON

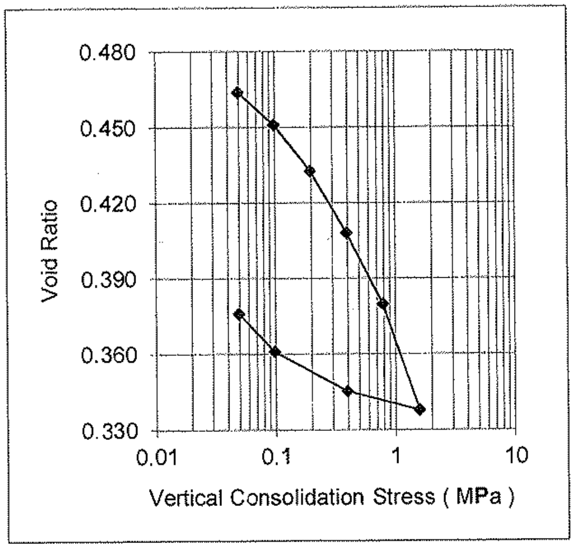
SOILCON

18-Km, Multan Road Lahore. Ph: 042-7510942, Fax: 042-7510944

CONSOLIDATION TEST

CLIENT	SOIL TESTING SERVICE		
PROJECT	TAS FOR 03 URBAN ROAD PROJECTS		
SITE	IN KARACHI, PACKAGE-2		
BORE HOLE	BH-2	**SAMPLE**	UDS-1
SPECIMEN	1	**TYPE**	UNDISTURBED
DEPTH m	5.50-6.05	**DATE**	30.09.2020

Operator	**Checked by**
Nisar Ahmad	Mahmood



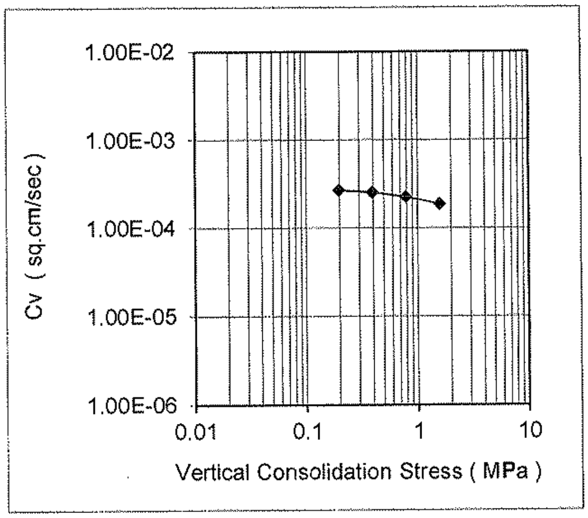
SOIL AND SPECIMEN CHARACTERISTICS

Initial Bulk Density	2119	Kg/m^3
Final Bulk Density	2235	Kg/m^3
Initial Water Content	15.62	%
Final Water Content	13.82	%
Initial Specimen Height	20.00	mm
Specimen Diameter	63.70	mm
Specific Gravity	2.702	
Initial Void Ratio	0.474	

TEST CHARACTERISTICS

No. of Loading Steps	6
No. of unloading Steps	3

LAB REF. 61/2020



Pressure Mpa	Void Ratio	Cv cm^2/sec
0		
0.049	0.464	
0.098	0.451	
0.196	0.433	2.68E-04
0.392	0.408	2.53E-04
0.785	0.380	2.25E-04
1.569	0.338	1.88E-04
0.392	0.345	
0.098	0.361	
0.049	0.376	

$$C_c = \frac{0.408 - 0.380}{\log\left(\frac{0.785}{0.392}\right)} = \frac{0.028}{0.3015}$$

$C_c = 0.092$

REMARKS:

SOILCON

GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF SWELL PRESSURE TEST RESULTS

Project: TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI
Location: PACKAGE-2

Client: SOIL TESTING SERVICE
Lab. Ref: 61/20

BH / TP No.	Sample No.	Depth (m)	Location	Free swell %	DENSITY (g/cu.cm)		Swell Pressure (kg/cm^2)	Remarks
					Bulk	Dry		
BH-2	UDS-1	5.50-6.05					0.235	

Tested By: Nisar Ahmad
Checked By: Mahmood
Dated: 30.09.2020

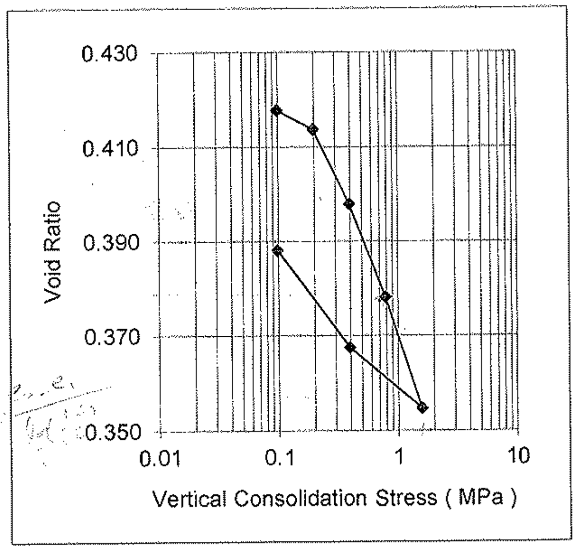
SOILCON

18-Km, Multan Road Lahore. Ph: 042-7510942, Fax: 042-7510944

CONSOLIDATION TEST

CLIENT	SOIL TESTING SERVICE (STS)		
PROJECT	TAS FOR 03 URBAN ROAD IN KARACHI		
SITE	PACKAGE-2		
BORE HOLE	BH-3	**SAMPLE**	UDS-1
SPECIMEN	1	**TYPE**	UNDISTURBED
DEPTH m	12.00-12.40	**DATE**	14.09.2020

Operator	Checked by
Nisar Ahmad	Mahmood



$C_c = \frac{e_0 - e_1}{\log}$ [illegible]

$C_c = \frac{0.023}{\log\left(\frac{1.7}{0.8}\right)} = 0.070$

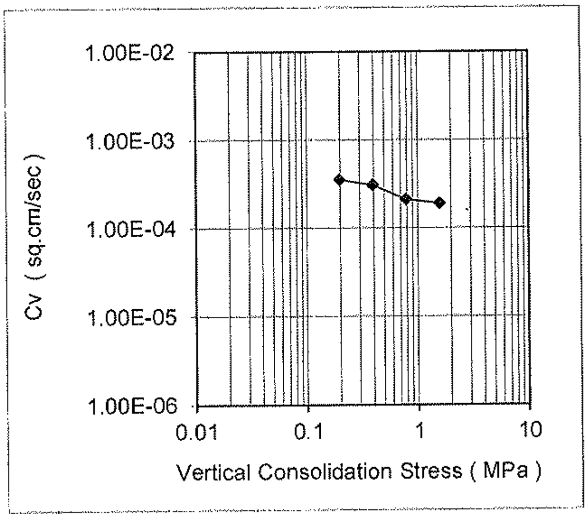
SOIL AND SPECIMEN CHARACTERISTICS

Initial Bulk Density	2191	Kg/m^3
Final Bulk Density	2223	Kg/m^3
Initial Water Content	15.17	%
Final Water Content	14.27	%
Initial Specimen Height	20.00	mm
Specimen Diameter	63.70	mm
Specific Gravity	2.701	
Initial Void Ratio	0.420	

TEST CHARACTERISTICS

No. of Loading Steps	5
No. of unloading Steps	2

LAB REF.	57/2020



Pressure	Void Ratio	Cv
Mpa		cm^2/sec
0		
0.098	0.418	
0.196	0.414	3.54E-04
0.392	0.398	3.09E-04
0.785	0.378	2.11E-04
1.569	0.355	1.90E-04
0.392	0.368	
0.098	0.388	

REMARKS:

SOILCON
GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF SWELL PRESSURE TEST RESULTS

Project: TAS FOR 03 URBAN ROAD IN KARACHI
Location: PACKAGE-2 EXPRESSWAY FROM MAURIPUR TO Y-JUNCTION
Client: STS
Lab. Ref: 57/20

BH / TP No.	Sample No.	Depth (m)	Location	Free swell %	DENSITY (g/cu.cm)		Swell Pressure (kg/cm^2)	Remarks
					Bulk	Dry		
BH-3	UDS-1	12.00-12.40					0.784	

Tested By: Nisar Ahmad
Checked By: Mahmood
Dated: 14.09.2020

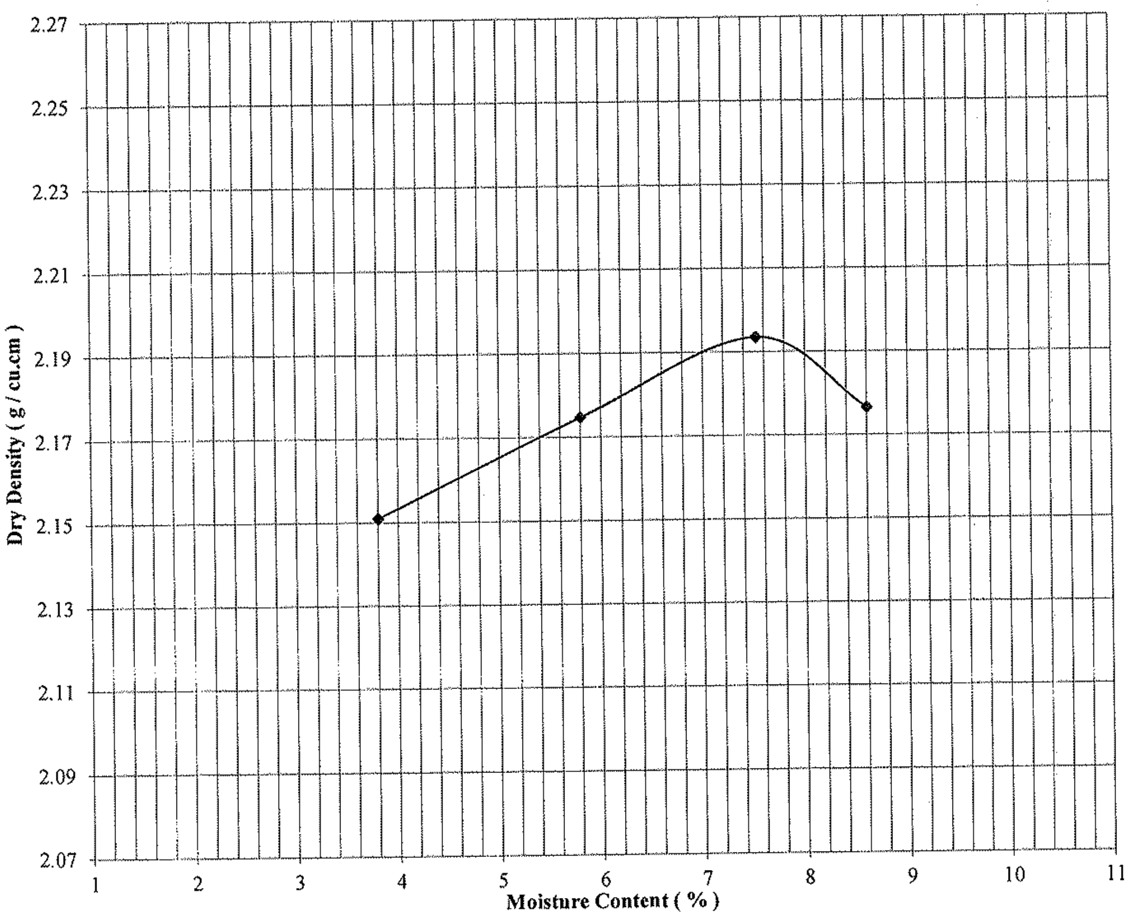
SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method : Modified AASHTO T-180 (Method A)
Dia of Mould : 4.0 inch
No of blows : 25 **No of Layers** 5
Test Pit No: TP-1 **Sample No.** CS-1

Volume of Mould : 954 cm^3
Drop : 18 inch
Wt of Hammer : 10 lbs
Depth (m): 0.85-1.30



Optimum Moisture Content (%)	7.52	**Maximum Dry Density**		2.194 g/cm^3	
Project:	**TAS FOR THREE URBAN ROAD PROJECTS IN KARACHI**				
Location :	**KARACHI**		**Client: STS**		
Tested By **Mahmood**		**Checked By** **Ikram**		**Dated** **06.10.2020**	**LAB. REF** **64/2020**

REMARKS: ______________________________

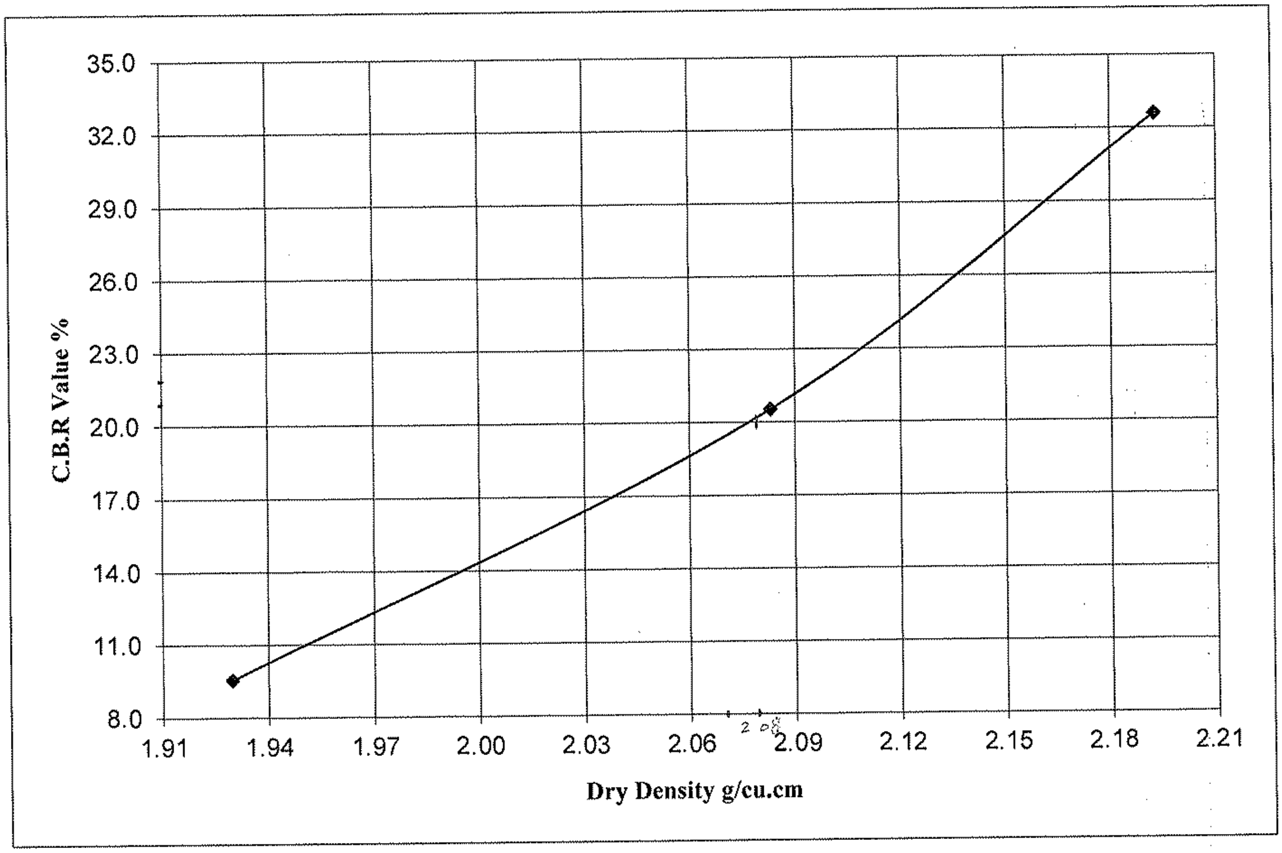
SOILCON
GEOTECHNICAL TESTING LABORATORIES, 18-Km,
MULTAN ROAD, LAHORE

C.B.R. TEST

(AASHTO T-193)

No.of Blows per Layer	65	30	10
CBR Value at 0.1 in %			
CBR Value at 0.2 in %	32.6	20.5	9.6
Dry Density g/ cm ^{3}	2.193	2.083	1.930
Moisture Content %	7.42	7.42	7.42
Absorption %	0.70	1.17	1.93
Swelling %		-	

COMPACTION	MODIFIED
M.D.D. g/cu.cm	2.194
O.M.C %	7.52



PROJECT:	TAS FOR THREE URBAN ROAD PROJECTS IN KARACHI				
LOCATION:	KARACHI			CLIENT	STS
TP NO:	TP-1	**SAMPLE NO:**	CS-1	DEPTH (m)	0.85-1.30
LAB REF. NO :	64/20	**DATE :**	13.10.2013		
TESTED BY : **Mahmood**		**CHECKED BY :** **Ikram**			

SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES

18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method : Modified AASHTO T-180 (Method A)

Dia of Mould : 4.0 inch

No of blows : 25 **No of Layers** 5

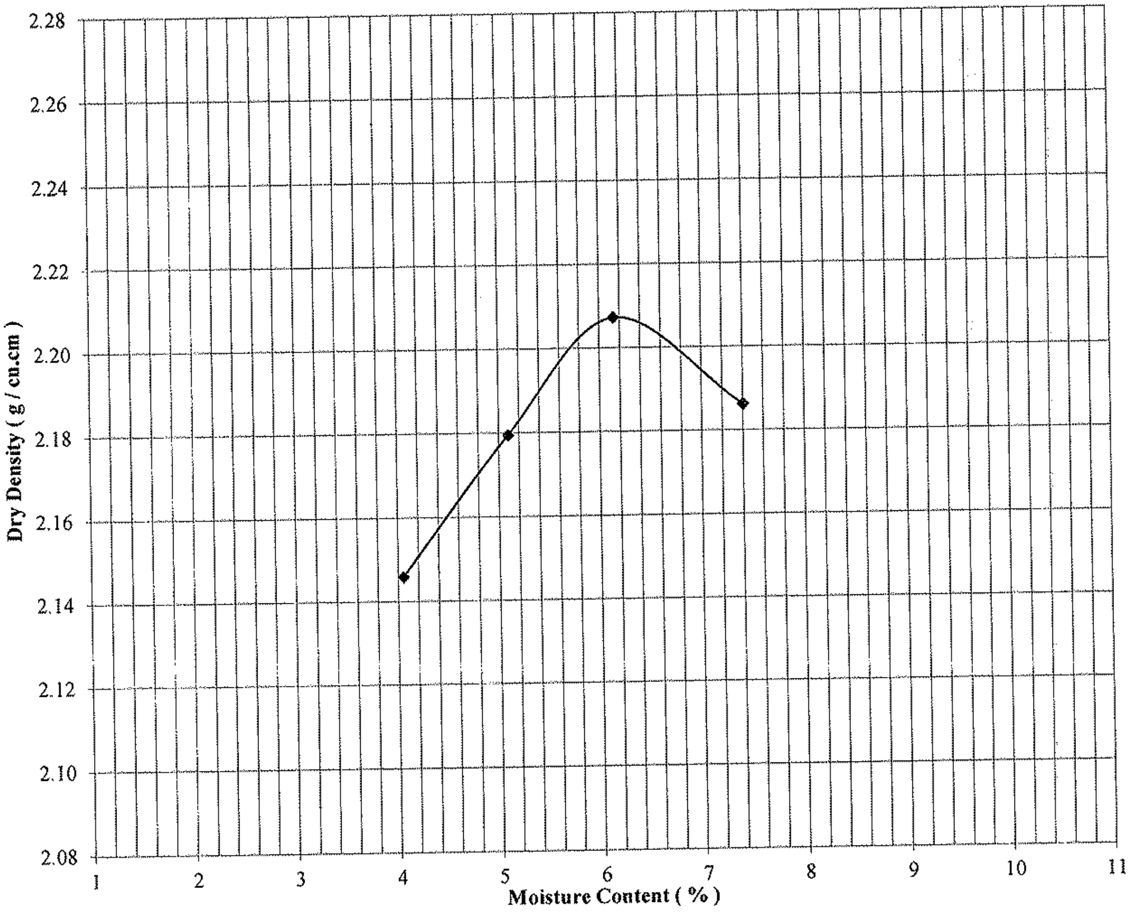
Test Pit No: TP-2 **Sample No.** CS-1

Volume of Mould : 954 cm^3

Drop : 18 inch

Wt of Hammer : 10 lbs

Depth (m): 1.10-1.90



Optimum Moisture Content (%)	6.14	**Maximum Dry Density**	2.207 g/cm^3
Project:	**TAS FOR THREE URBAN ROAD PROJECTS IN KARACHI**		
Loeation :	**KARACHI**	**Client: STS**	
Tested By **Mahmood**	**Checked By** **Ikram**	**Dated** **06.10.2020**	**LAB. REF** **64/2020**

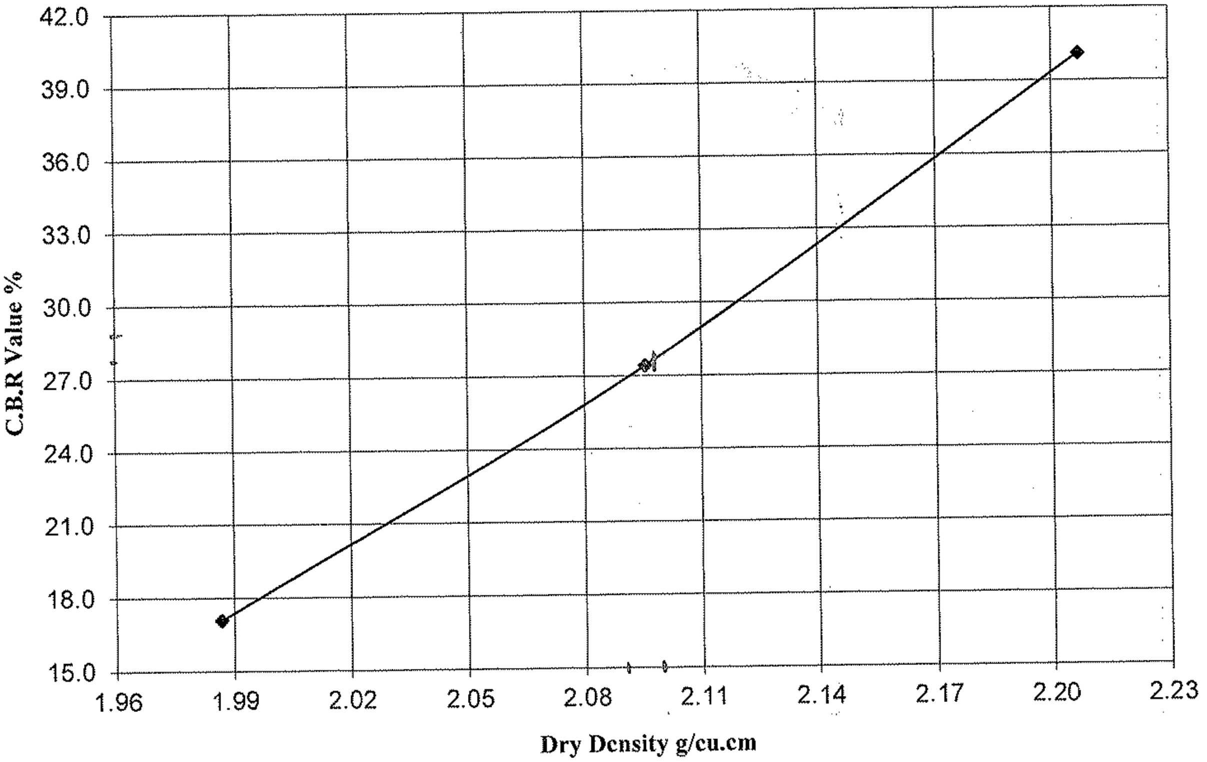
REMARKS:

C.B.R. TEST

(AASHTO T-193)

No.of Blows per Layer	65	30	10
CBR Value at 0.1 in %			
CBR Value at 0.2 in %	40.1	27.4	17.1
Dry Density g/ cm ^{3}	2.207	2.096	1.987
Moisture Content %	6.03	6.03	6.03
Absorption %	1.32	2.58	3.13
Swelling %		-	

COMPACTION	MODIFIED
M.D.D. g/cu.cm	2.207
O.M.C %	6.14



PROJECT:	TAS FOR THREE URBAN ROAD PROJECTS IN KARACHI				
LOCATION:	KARACHI			CLIENT	STS
TP NO:	TP-2	SAMPLE NO:	CS-1	DEPTH (m)	1.10-1.90
LAB REF. NO :	64/20	DATE :	13.10.2013		
TESTED BY : Mahmood			CHECKED BY : Ikram		

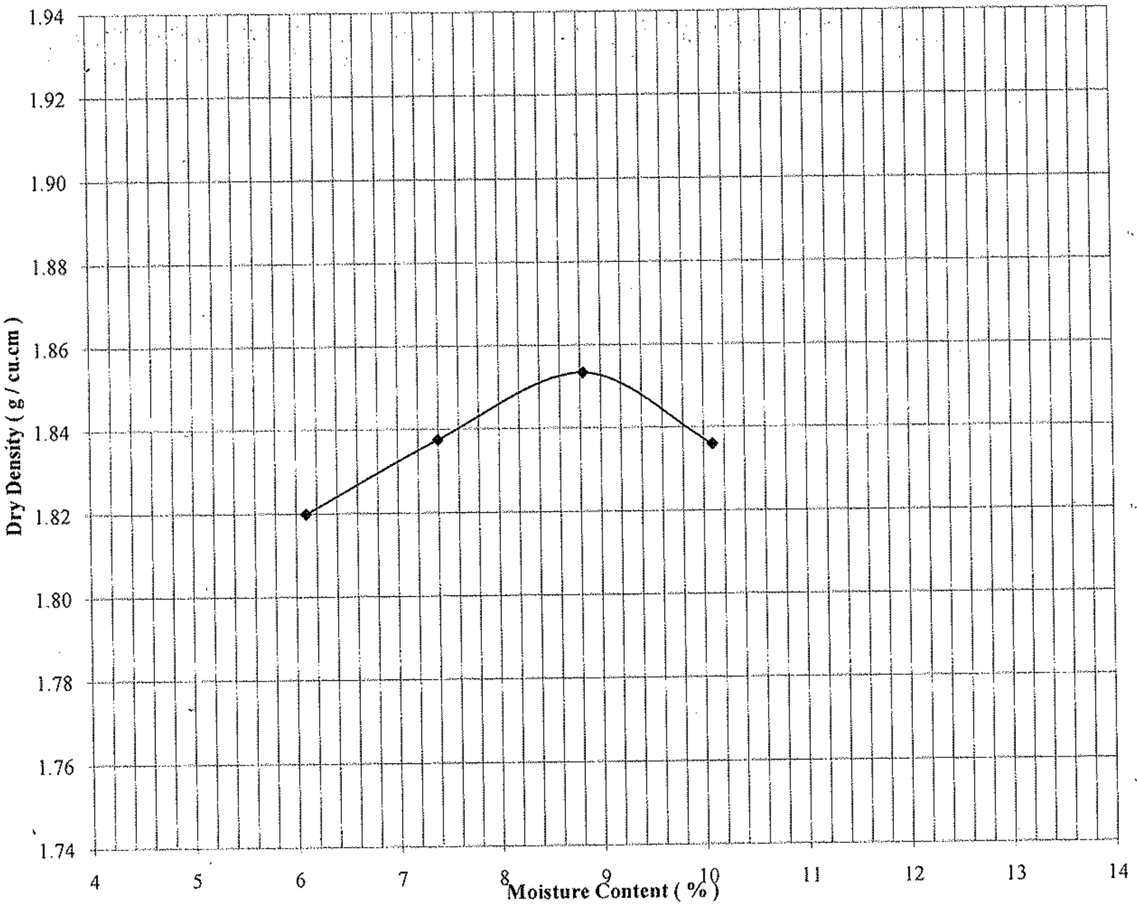
SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method : Modified AASHTO T-180 (Method A)
Dia of Mould : 4.0 inch
No of Blows : 25 **No of Layers** 5
Test Pit No: TP-4 **Sample No.** CS-1

Volume of Mould : 941 cm^3
Drop : 18 inch
Wt of Hammer : 10 lbs
Depth (m): 0.16-1.15



Optimum Moisture Content (%)	8.83	**Maximum Dry Density**	1.853 g/cm^3

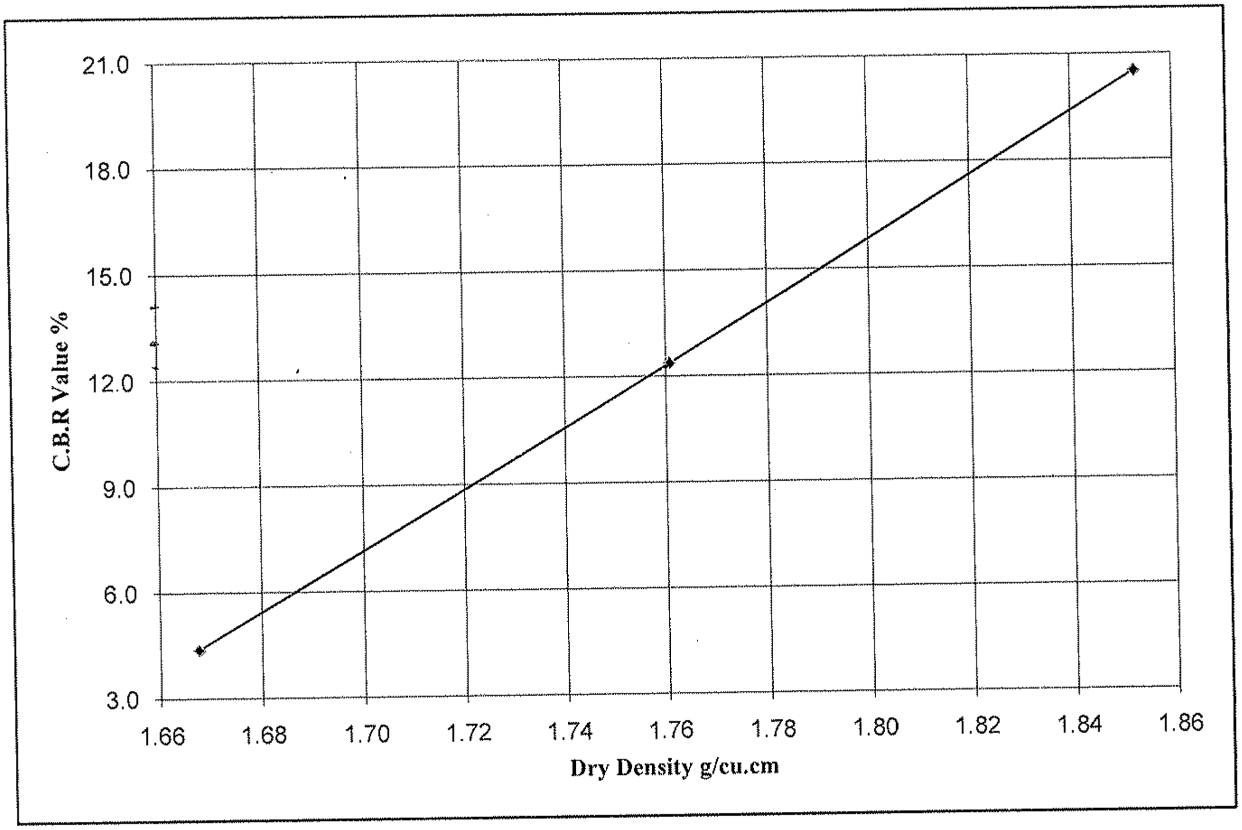
Project:	**TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI**				
Location :	**KARACHI**			**Client: SOIL TESTING SERVICE**	
Tested By		**Checked By**		**Dated**	**LAB. REF**
Mahmood		**Ikram**		**10.10.2020**	**64/2020**

REMARKS:

C.B.R. TEST
(AASHTO T-193)

No.of Blows per Layer	65	30	10
CBR Value at 0.1 in %			
CBR Value at 0.2 in %	20.5	12.4	4.4
Dry Density g/ cm ^{3}	1.853	1.761	1.668
Moisture Content %	8.51	8.51	8.51
Absorption %	3.33	5.22	7.67
Swelling %		-	

COMPACTION	MODIFIED
M.D.D. g/cu.cm	1.853
O.M.C %	8.83



PROJECT:	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI				
LOCATION:	KARACHI			CLIENT	SOIL TESTING SERVICE
TP/ BH NO:	TP-4	SAMPLE NO:	CS-1	DEPTH (m)	0.16-1.15
LAB REF. NO :	64/2020	DATE :	15.10.2020		
TESTED BY : Mahmood			CHECKED BY: Ikram		

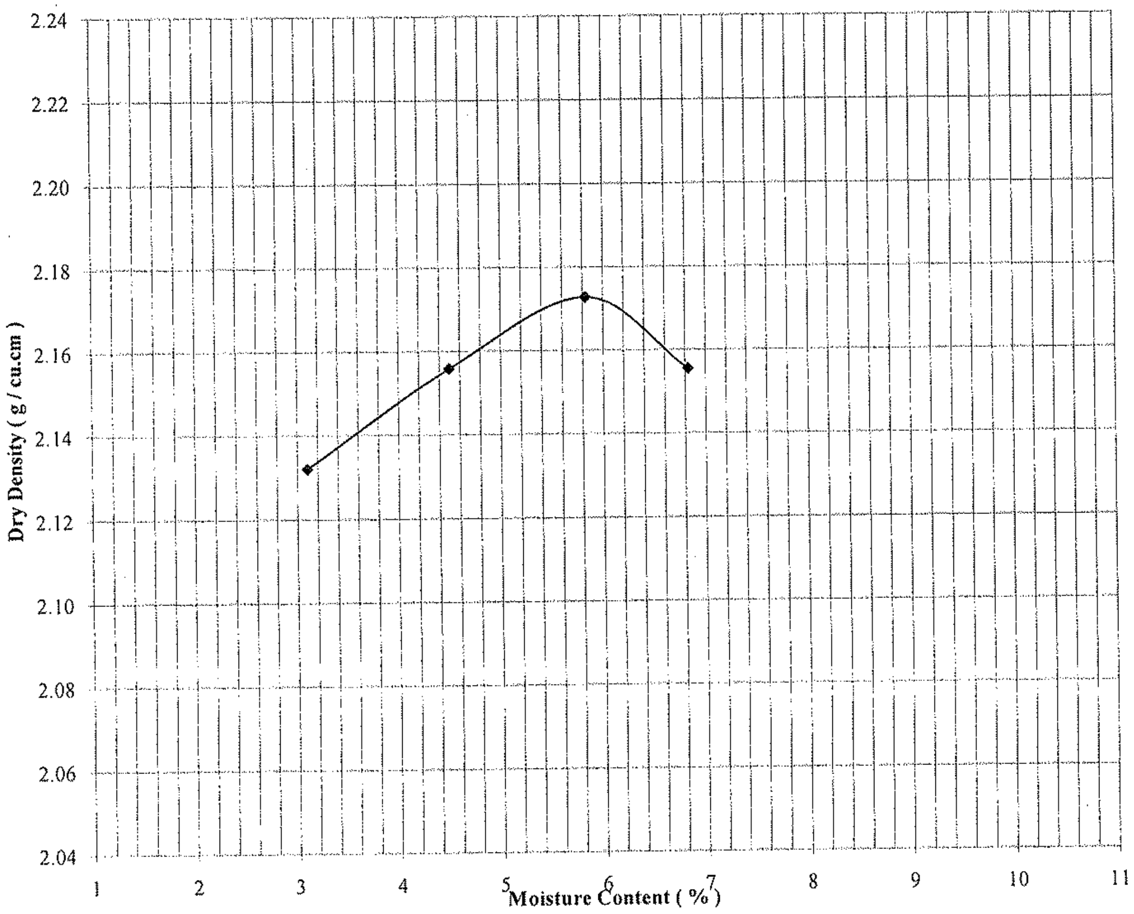
SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method : Modified AASHTO T-180 (Method D)
Dia of Mould : 6.0 inch
No of Blows : 55 **No of Layers** 5
Test Pit No: TP-5 **Sample No.** CS-1

Volume of Mould : 2104 cm^3
Drop : 18 inch
Wt of Hammer : 10 lbs
Depth (m): 0.50-1.15



Optimum Moisture Content (%)		5.83	**Maximum Dry Density**		2.173 g/cm^3
Project:	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI				
Location :	PACKAGE-2			**Client: SOIL TESTING SERVICE**	
Tested By **Mahmood**		**Checked By** **Ikram**		**Dated** **21.09.2020**	**LAB. REF** **57/2020**

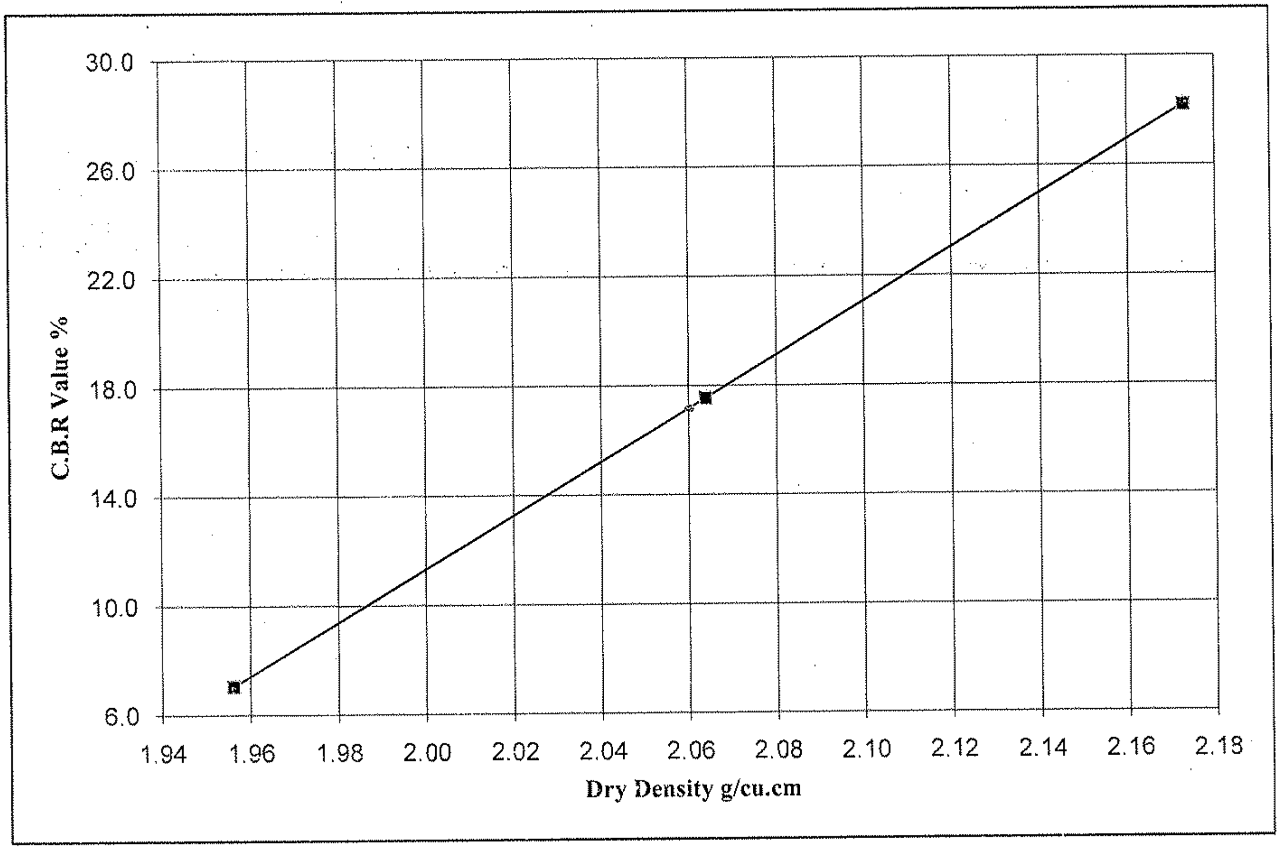
REMARKS:

SOILCON
GEOTECHNICAL TESTING LABORATORIES, 18-Km,
MULTAN ROAD, LAHORE

C.B.R. TEST
(AASHTO T-193)

No.of Blows per Layer	65	30	10
CBR Value at 0.1 in %			
CBR Value at 0.2 in %	28.2	17.5	7.1
Dry Density g/ cm ^{3}	2.173	2.064	1.956
Moisture Content %	5.44	5.44	5.44
Absorption %	2.19	3.03	4.07
Swelling %		-	

COMPACTION	MODIFIED
M.D.D. g/cu.cm	2.173
O.M.C %	5.83



PROJECT:	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI				
LOCATION:	PACKAGE-2			CLIENT	SOIL TESTING SERVICE
TP NO:	TP-5	SAMPLE NO:	CS-1	DEPTH (m)	0.50-1.15
LAB REF. NO :	57/2020	DATE :	25.09.2020		
TESTED BY : MAHMOOD			CHECKED BY : IKRAM		

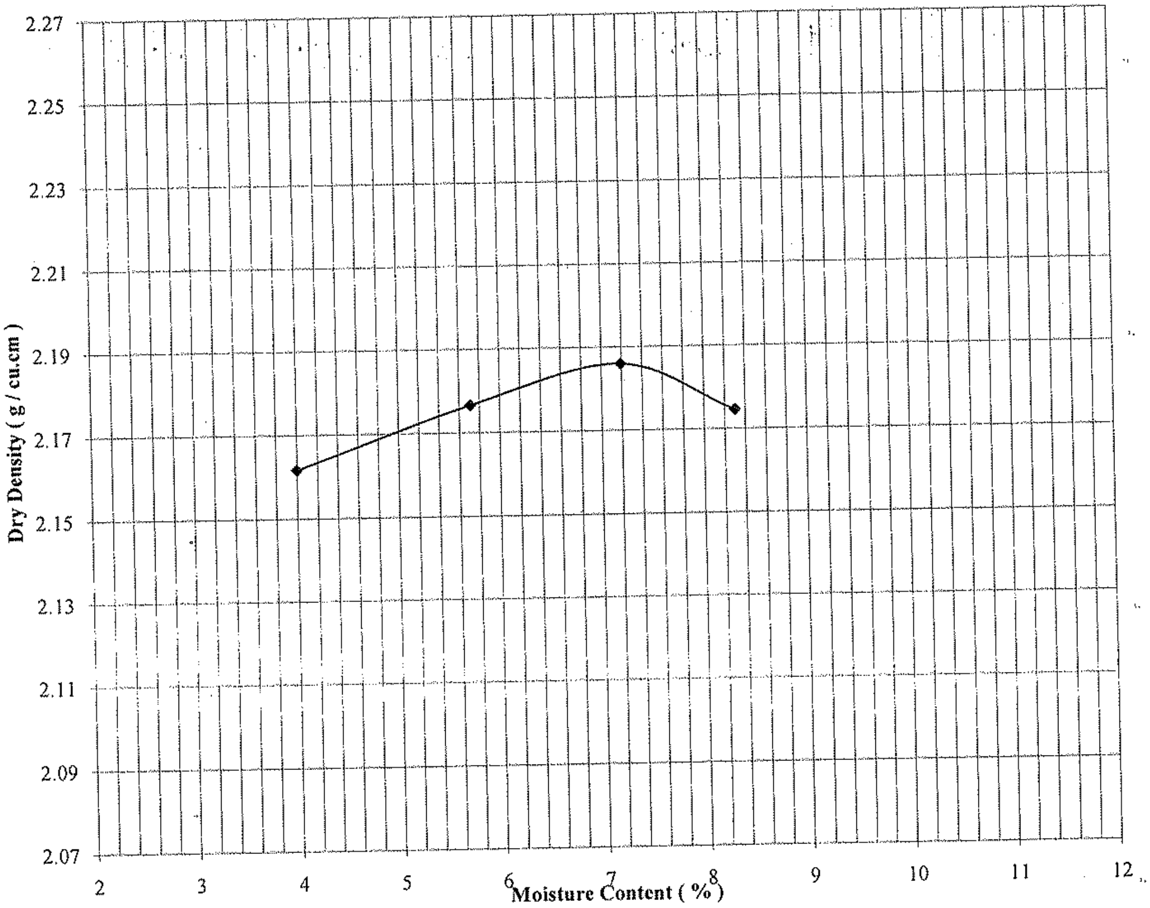
SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method : Modified AASHTO T-180 (Method D)
Dia of Mould : 6.0 inch
No of Blows : 56 **No of Layers** 5
Test Pit No: TP-8 **Sample No.** CS-1

Volume of Mould : 2104 cm^3
Drop : 18 inch
Wt of Hammer : 10 lbs
Depth (m): 0.82-1.07



Optimum Moisture Content (%)		7.19	**Maximum Dry Density**		2.186 g/cm^3
Project:	**TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI**				
Location :	**KARACHI**			**Client: SOIL TESTING SERVICE**	
Tested By **Mahmood**		**Checked By** **Ikram**		**Dated** **10.10.2020**	**LAB. REF** **64/2020**

REMARKS:

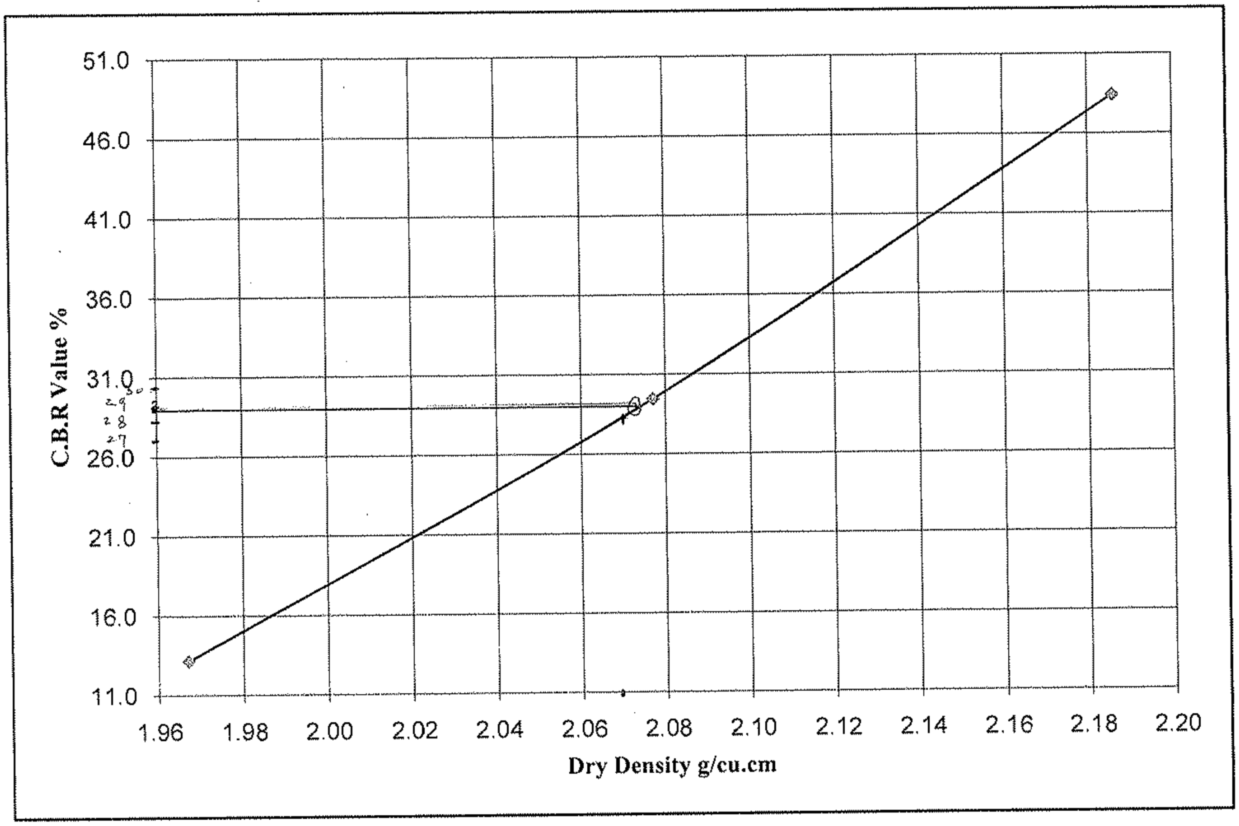
SOILCON
GEOTECHNICAL TESTING LABORATORIES, 18-Km,
MULTAN ROAD, LAHORE

C.B.R. TEST

(AASHTO T-193)

No.of Blows per Layer	65	30	10
CBR Value at 0.1 in %			
CBR Value at 0.2 in %	48.4	29.5	13.2
Dry Density g/ cm ^{3}	2.186	2.077	1.967
Moisture Content %	7.08	7.08	7.08
Absorption %	1.31	2.27	3.63
Swelling %		-	

COMPACTION	MODIFIED	
M.D.D. g/cu.cm	2.186	2.076
O.M.C %	7.19	



PROJECT:	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI				
LOCATION:	KARACHI			CLIENT	SOIL TESTING SERVICE
TP/ BH NO:	TP-8	SAMPLE NO:	CS-1	DEPTH (m)	0.82-1.07
LAB REF. NO :	64/2020	DATE :	15.10.2020		
TESTED BY : Mahmood		CHECKED BY: Ikram			

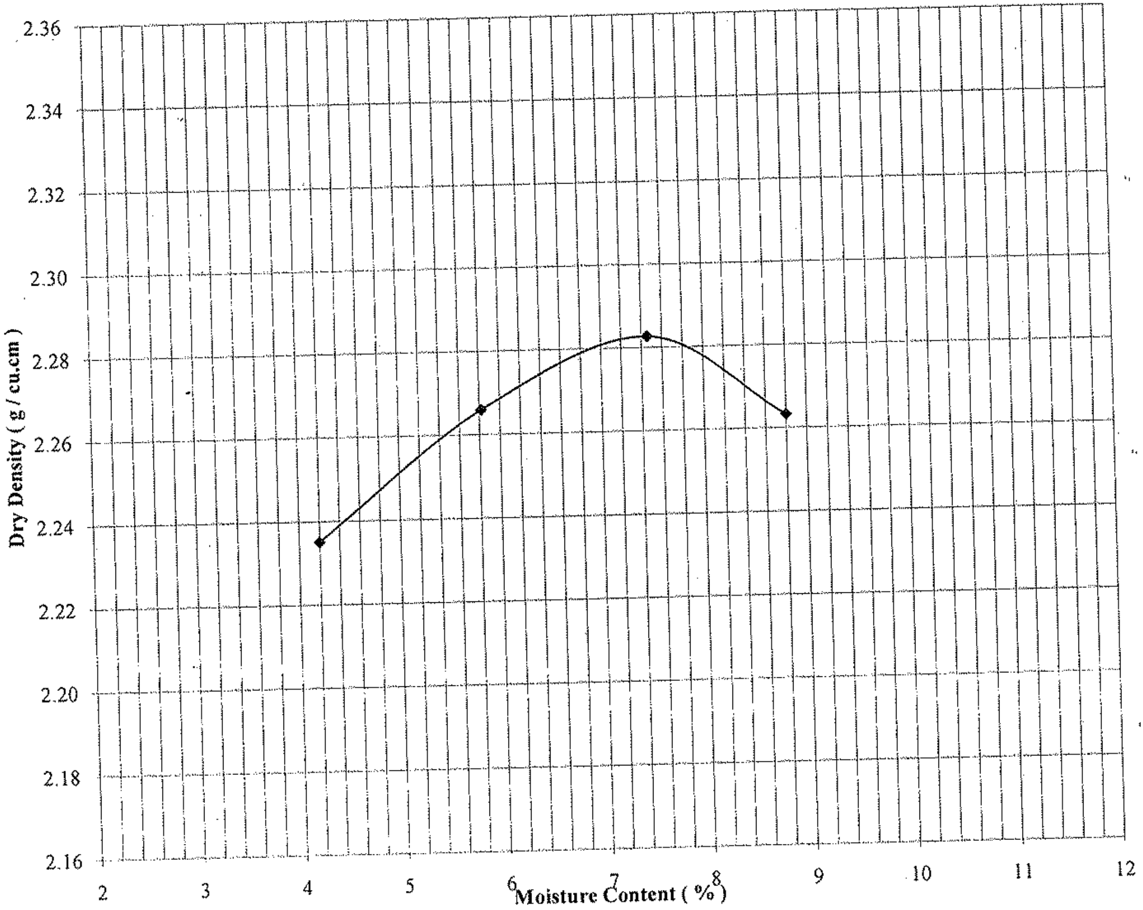
SOILCON

COMPACTION TEST

SOILCON GEOTECHNICAL TESTING LABORATORIES
18-Km Multan Road Lahore, Ph.No: 042-7510942-3 Fax No: 7510944

Test Method : Modified AASHTO T-180 (Method D)
Dia of Mould : 6.0 inch
No of Blows : 56 **No of Layers** 5
Test Pit No: TP-9 **Sample No.** CS-1

Volume of Mould : 2104 cm^3
Drop : 18 inch
Wt of Hammer : 10 lbs
Depth (m): 0.22-0.65



Optimum Moisture Content (%)		7.46	**Maximum Dry Density**		2.283 g/cm^3
Project:	**TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI**				
Location :	**KARACHI**			**Client: SOIL TESTING SERVICE**	
Tested By **Mahmood**		**Checked By** **Ikram**		**Dated** **10.10.2020**	**LAB. REF** **64/2020**

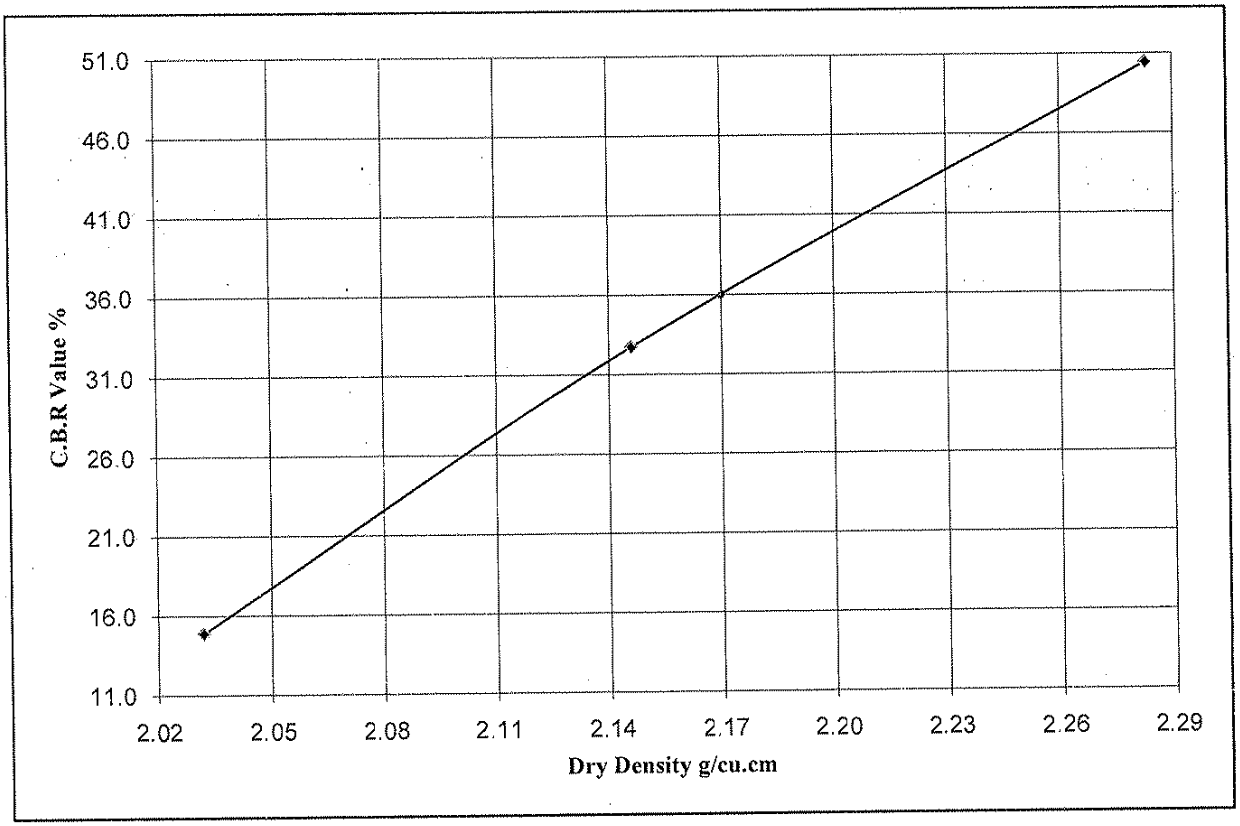
REMARKS:

SOILCON
GEOTECHNICAL TESTING LABORATORIES, 18-Km,
MULTAN ROAD, LAHORE

C.B.R. TEST
(AASHTO T-193)

No.of Blows per Layer	65	30	10
CBR Value at 0.1 in %			
CBR Value at 0.2 in %	50.4	32.7	14.9
Dry Density g/ em ^{3}	2.283	2.146	2.032
Moisture Content %	7.21	7.21	7.21
Absorption %	0.85	1.33	2.04
Swelling %			

COMPACTION	MODIFIED
M.D.D. g/cu.cm	2.283
O.M.C %	7.46



PROJECT:	TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI				
LOCATION:	KARACHI			CLIENT	SOIL TESTING SERVICE
TP/ BH NO:	TP-9	SAMPLE NO:	CS-1	DEPTH (m)	0.22-0.65
LAB REF. NO :	64/2020	DATE :	15.10.2020		
TESTED BY : Mahmood			CHECKED BY: Ikram		

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

Project: Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from mauripur road to Y-Junction

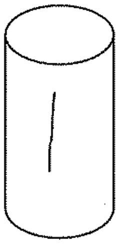
Job No. 3879

Dated: 10/9/2020

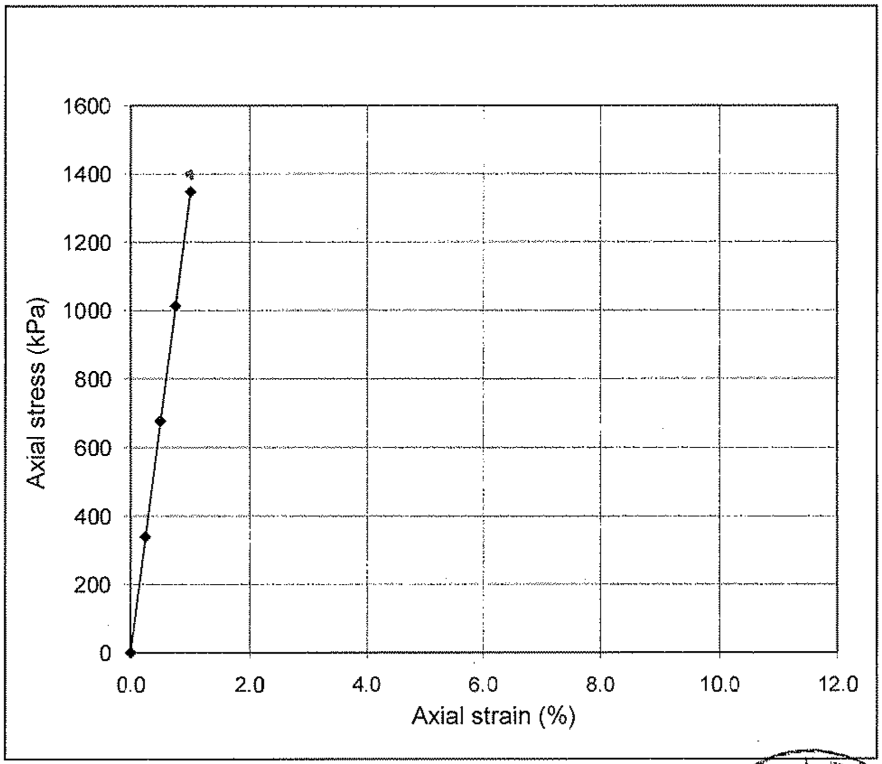
Client: NESPAK (Pvt) Ltd.

Location:	Mauripur Expressway	Height =	10.16 cm
BH/TP No.	BH-1	Diameter =	5.08 cm
Sample No.	WS-1	Bulk Density =	24.3 kN/m^3
Depth (m)	14.0-14.12	Moisture Content =	1.46 %

Uniaxial Compression Strength = **1347 kPa**



Test Method: ASTM D7012



red by:

Director

2/9/2020

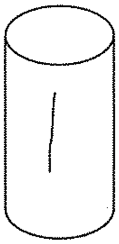
Checked by:

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

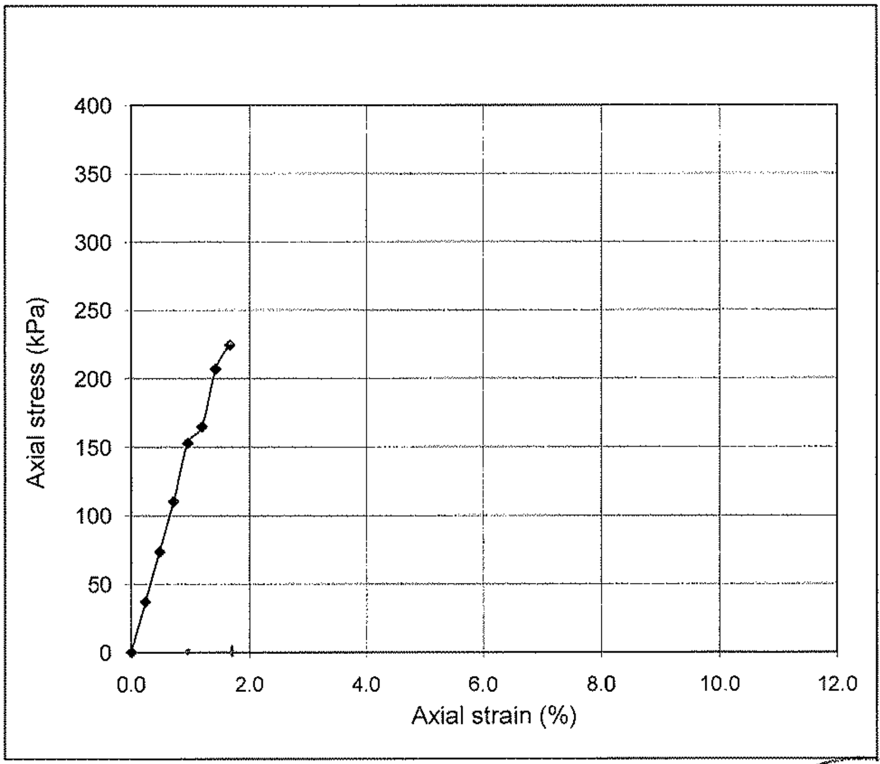
UNIAXIAL COMPRESSION TEST

Project:	Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from mauripur road to Y-Junction	**Job No.**	3879
		Dated:	10/9/2020
Client:	NESPAK (Pvt) Ltd.		
Location:	Mauripur Expressway	Height =	10.668 cm
BH/TP No.	BH-1	Diameter =	5.334 cm
Sample No.	WS-2	Bulk Density =	22.7 kN/m^3
Depth (m)	15.0-15.25	Moisture Content =	6.71 %

Uniaxial Compression Strength = **225 kPa**



Test Method: ASTM D7012



ired by:

Checked by:

21/9/2020

Director

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

Project: Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from mauripur road to Y-Junction

Job No. 3879

Dated: 10/9/2020

Client: NESPAK (Pvt) Ltd.

Location: Mauripur Expressway

BH/TP No. BH-1

Sample No. WS-3

Depth (m) 18.12-18.27

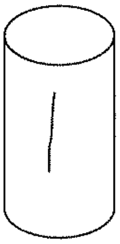
Height = 10.16 cm

Diameter = 5.08 cm

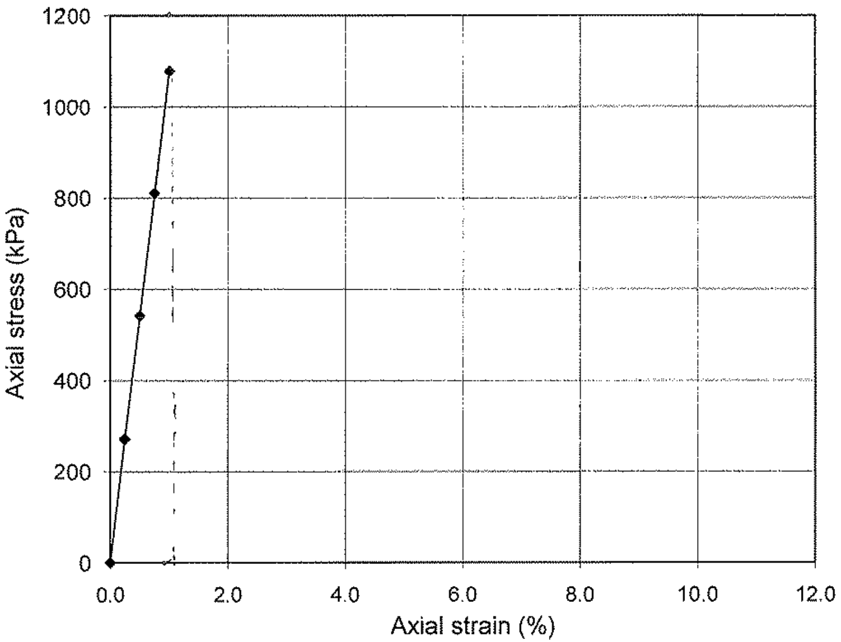
Bulk Density = 23.8 kN/m^3

Moisture Content = 1.04 %

Uniaxial Compression Strength = **1078 kPa**



Test Method: ASTM D7012



ted by:

Director

Checked by:

21/9/2020

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

Project: Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from Maripur Road to Y- Junction

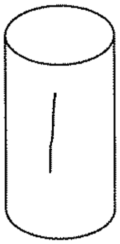
Job No. 3879

Dated: 15/9/2020

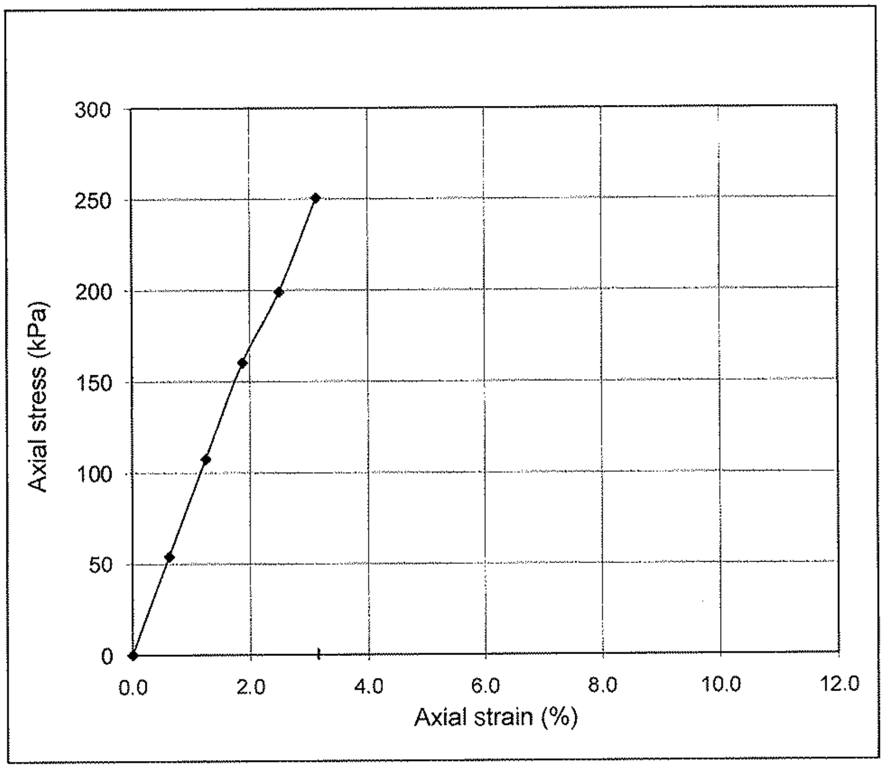
Client: NESPAK (Pvt) Ltd.

		Height =	10.16 cm
BH/TP No.	BH-2	Diameter =	5.08 cm
Sample No.	WS-1	Bulk Density =	21.9 kN/m^3
Depth (m)	13.14-13.30	Moisture Content =	7.94 %

Uniaxial Compression Strength = 250 kPa



Test Method: ASTM D7012



ired by:

Checked by:

Director

2/10/2020

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

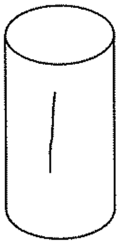
Project: Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from Maripur Road to Y- Junction

Job No. 3879
Dated: 15/9/2020

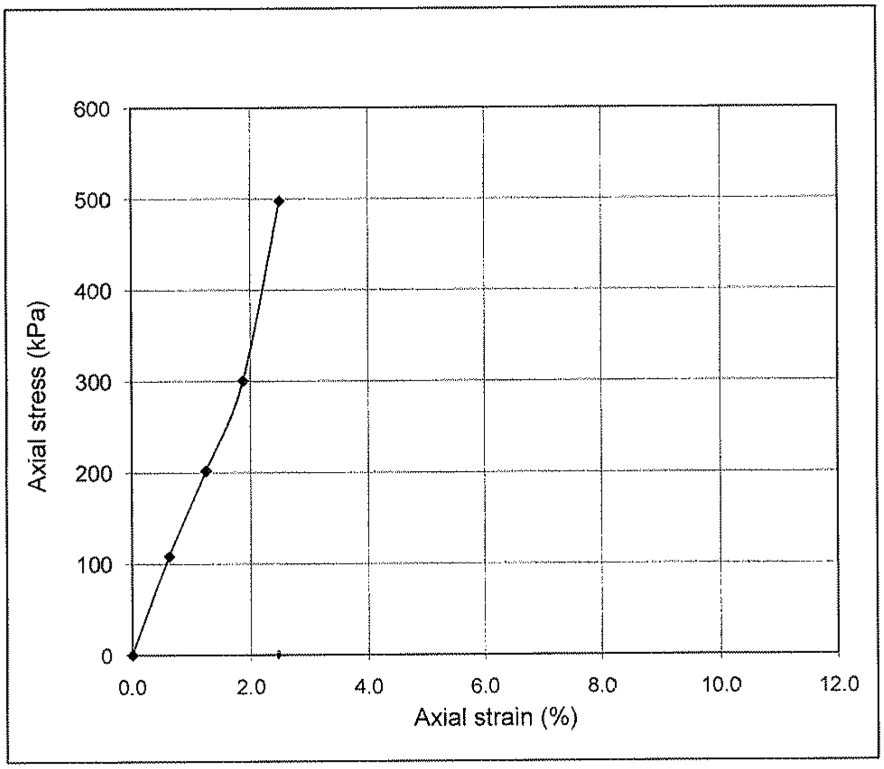
Client: NESPAK (Pvt) Ltd.

		Height =	10.16 cm
BH/TP No.	BH-2	Diameter =	5.08 cm
Sample No.	WS-5	Bulk Density =	21.7 kN/m^3
Depth (m)	16.81-16.97	Moisture Content =	8.83 %

Uniaxial Compression Strength = **500 kPa**



Test Method: ASTM D7012



ıred by:

2/10/2020

Checked by:

Geotech. Engg. Lab
Director
Civil Engg. Dept. UET Lhr.

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

Project: Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from Maripur Road to Y- Junction

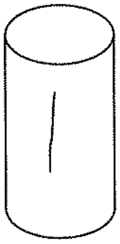
Job No. 3879
Dated: 15/9/2020

Client: NESPAK (Pvt) Ltd.

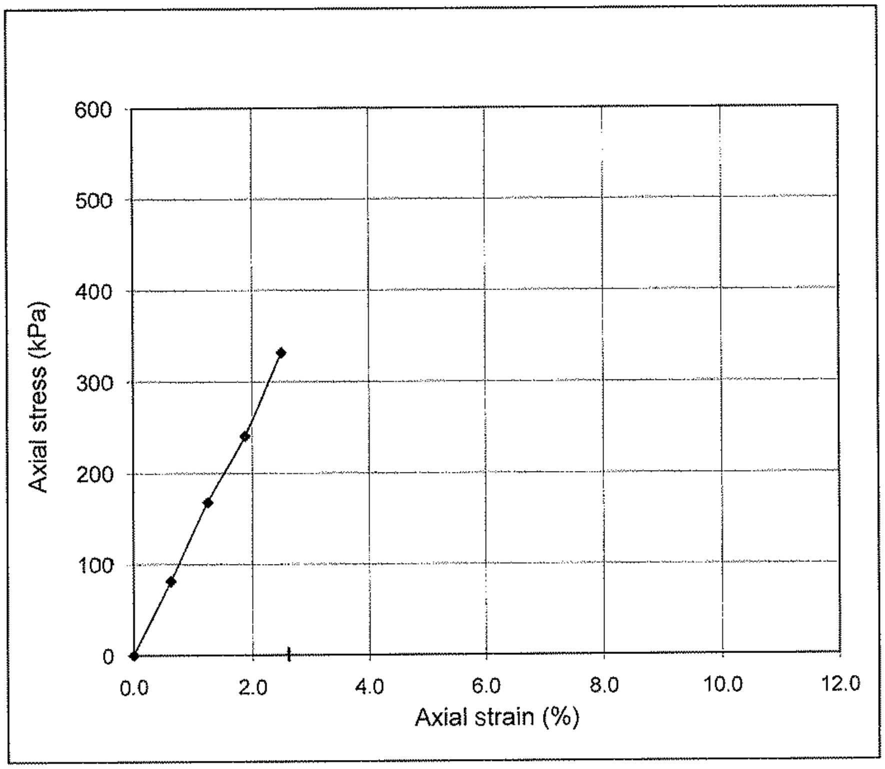
BH/TP No. BH-2
Sample No. WS-8
Depth (m) 19.40-19.69

Height = 10.16 cm
Diameter = 5.08 cm
Bulk Density = 23.8 kN/m^3
Moisture Content = 7.42 %

Uniaxial Compression Strength = **332 kPa**



Test Method: ASTM D7012



ired by:

2/10/2020
Checked by:
Director

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

Project: Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi
Package 2: Expressway from mauripur road to Y-Junction

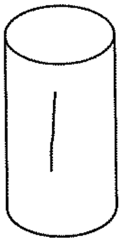
Job No. 3879
Dated: 27-8-2020

Client: NESPAK (Pvt) Ltd.

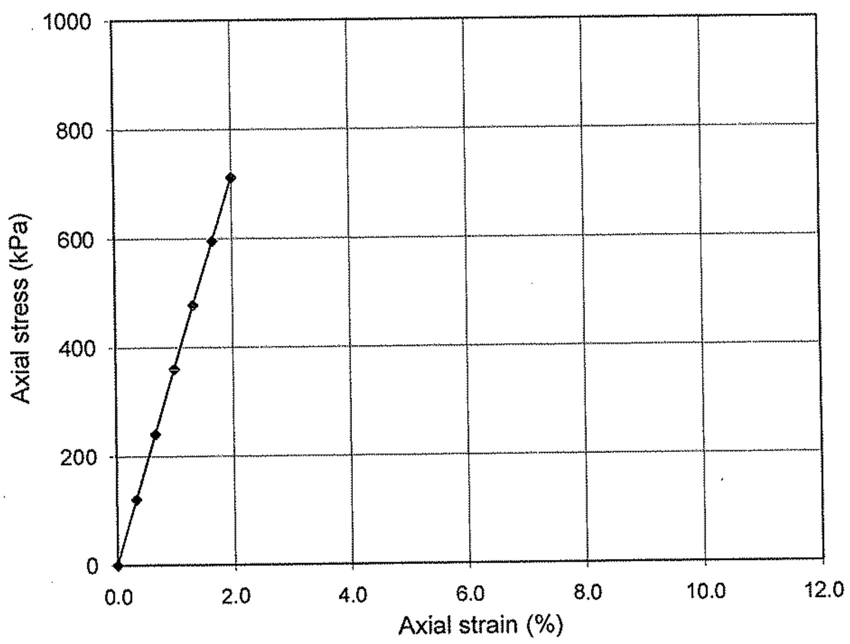
Location: Mauripur Expressway
BH/TP No. BH-3
Sample No. WS-1
Depth (m) 21.60 - 21.89

Height = 7.62 cm
Diameter = 3.81 cm
Bulk Density = 26.0 kN/m^3
Moisture Content = 0.99 %

Uniaxial Compression Strength = **712 kPa**



Test Method: ASTM D7012



red by:

14/9/2020

Checked by:

Director

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

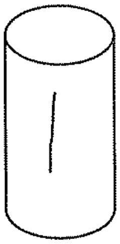
Project: Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from mauripur road to Y-Junction

Job No. 3879
Dated: 27-8-2020

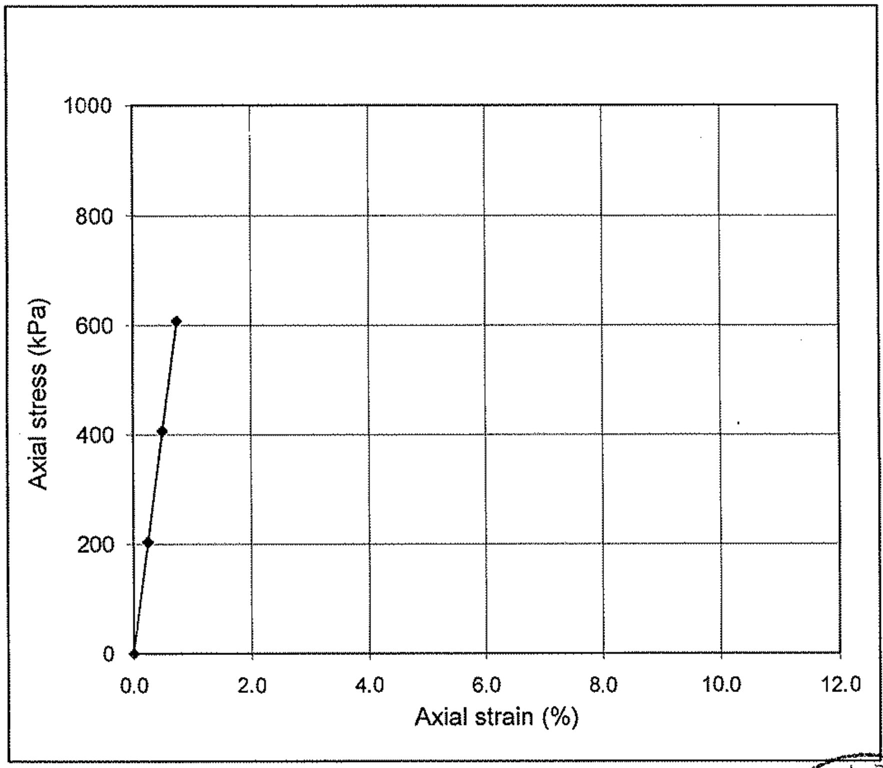
Client: NESPAK (Pvt) Ltd.

Location:	Mauripur Expressway	Height =	10.16 cm
BH/TP No.	BH-3	Diameter =	5.08 cm
Sample No.	WS-10	Bulk Density =	26.3 kN/m^3
Depth (m)	24.60-24.85	Moisture Content =	0.93 %

Uniaxial Compression Strength = **608 kPa**



Test Method: ASTM D7012



red by:

Director

4/9/2020

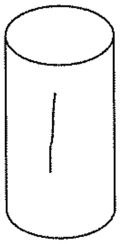
Checked by:

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

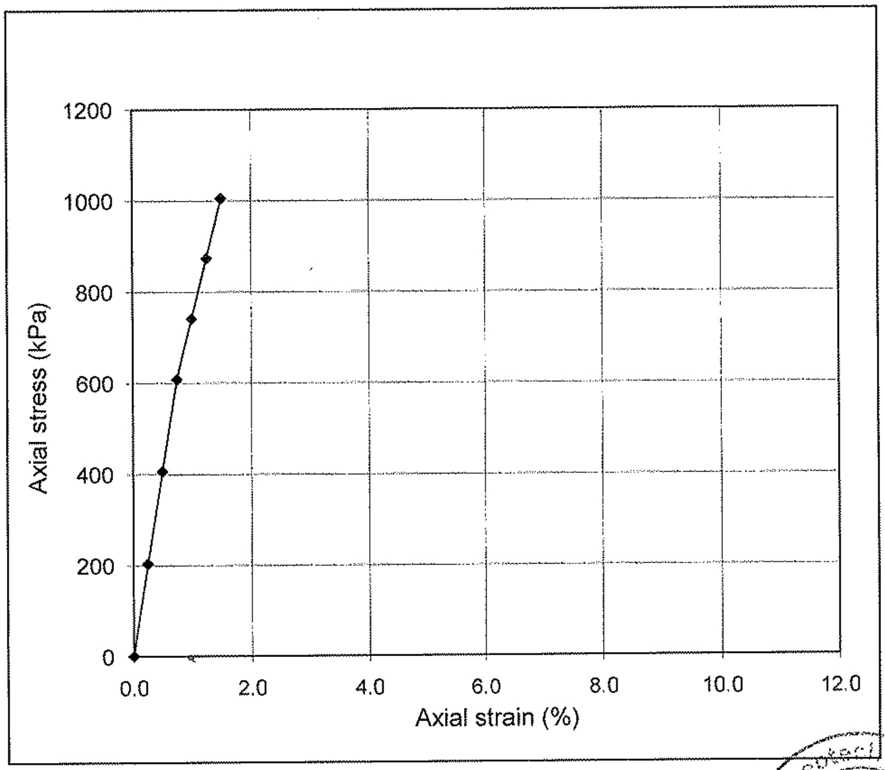
UNIAXIAL COMPRESSION TEST

Project:	Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from mauripur road to Y-Junction	**Job No.**	3879
		Dated:	10/9/2020
Client:	NESPAK (Pvt) Ltd.		
Location:	Mauripur Expressway	Height =	10.16 cm
BH/TP No.	BH-4	Diameter =	5.08 cm
Sample No.	WS-1	Bulk Density =	23.3 kN/m^3
Depth (m)	20.20-20.53	Moisture Content =	2.46 %

Uniaxial Compression Strength = **1006 kPa**



Test Method: ASTM D7012



red by:

Director

24/9/2020

Checked by:

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

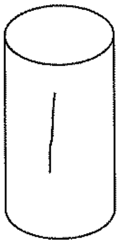
Project: Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from mauripur road to Y-Junction

Job No. 3879
Dated: 10/9/2020

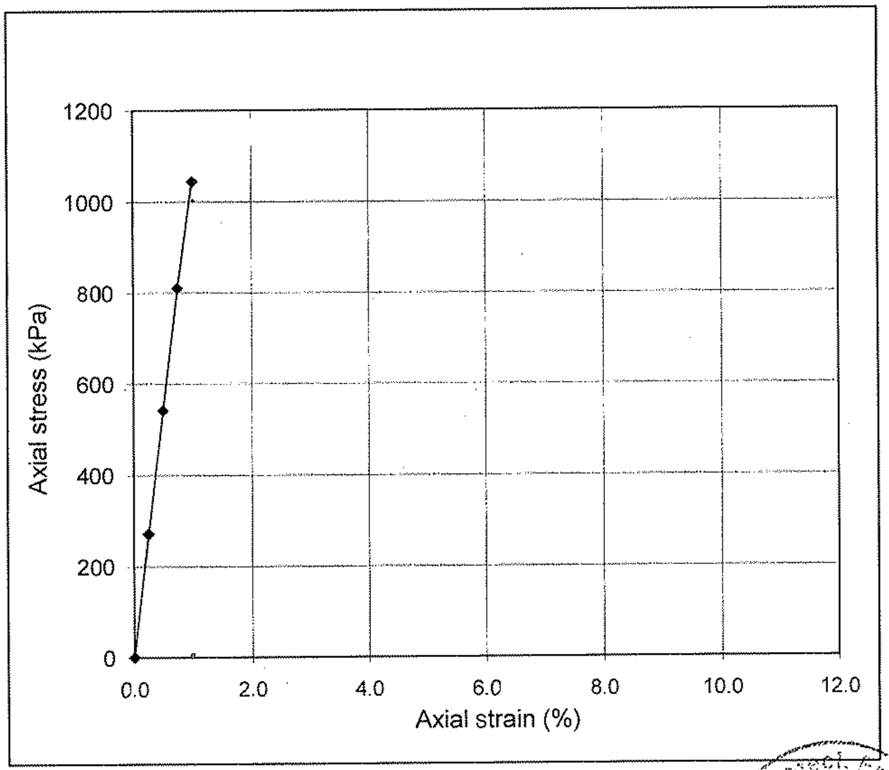
Client: NESPAK (Pvt) Ltd.

Location:	Mauripur Expressway	Height =	10.16 cm
BH/TP No.	BH-4	Diameter =	5.08 cm
Sample No.	WS-4	Bulk Density =	23.1 kN/m^3
Depth (m)	24.56-24.73	Moisture Content =	2.38 %

Uniaxial Compression Strength = **1044 kPa**



Test Method: ASTM D7012



ured by:

Director

21/9/2020

Checked by:

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

Project: Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from Maripur Road to Y- Junction

Job No. 3879

Dated: 15/9/2020

Client: NESPAK (Pvt) Ltd.

BH/TP No. BH-5

Sample No. WS-1

Depth (m) 17.64-17.86

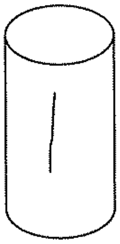
Height = 10.16 cm

Diameter = 5.08 cm

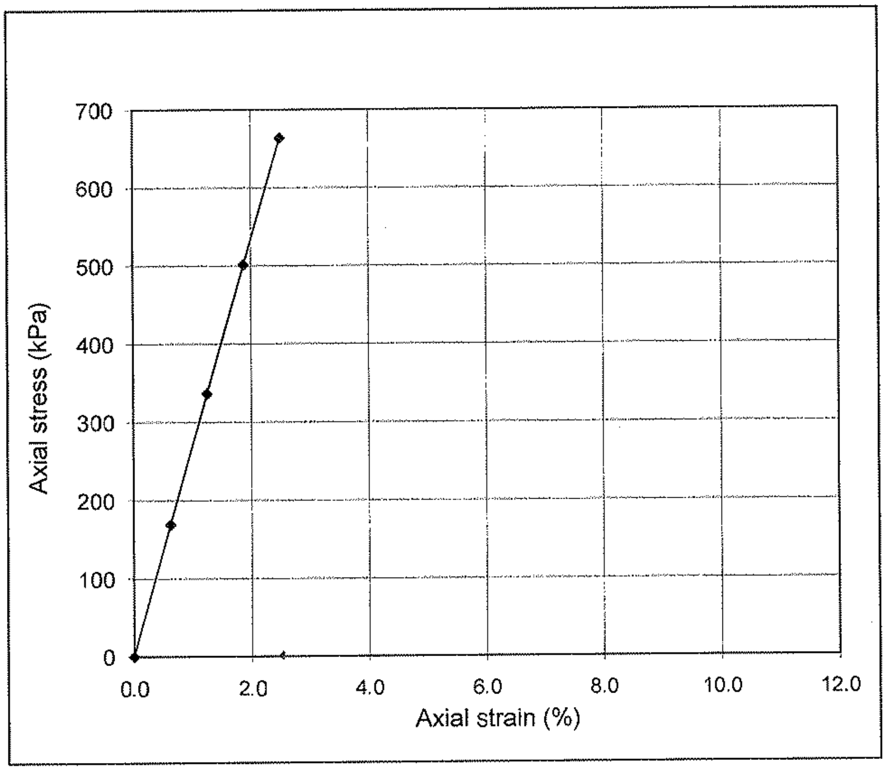
Bulk Density = 22.4 kN/m^3

Moisture Content = 8.08 %

Uniaxial Compression Strength = **664 kPa**



Test Method: ASTM D7012



ired by:

Checked by:

2/10/2020

Director

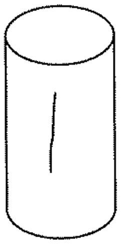
University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

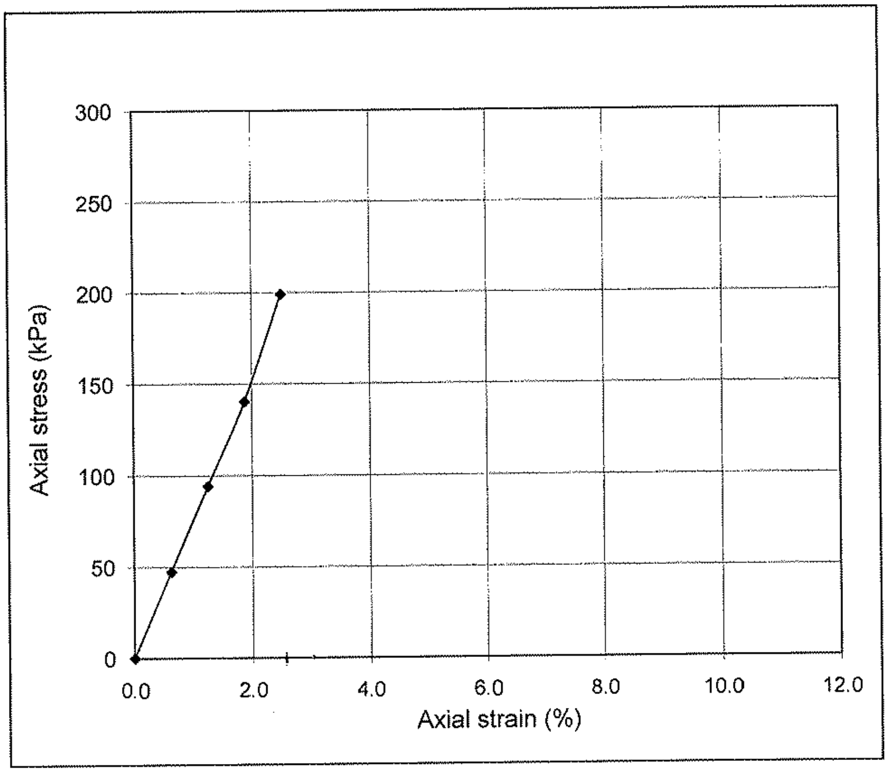
Project:	Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from Maripur Road to Y- Junction	**Job No.**	3879
		Dated:	15/9/2020
Client:	NESPAK (Pvt) Ltd.		

		Height =	10.16 cm
BH/TP No.	BH-5	Diameter =	5.08 cm
Sample No.	WS-2	Bulk Density =	22.6 kN/m^3
Depth (m)	20.52-20.64	Moisture Content =	8.90 %

Uniaxial Compression Strength = **200 kPa**



Test Method: ASTM D7012



red by:

2/10/2020

Checked by:

Director

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

Project: Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from Maripur Road to Y- Junction

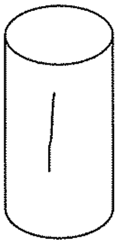
Job No. 3879
Dated: 15/9/2020

Client: NESPAK (Pvt) Ltd.

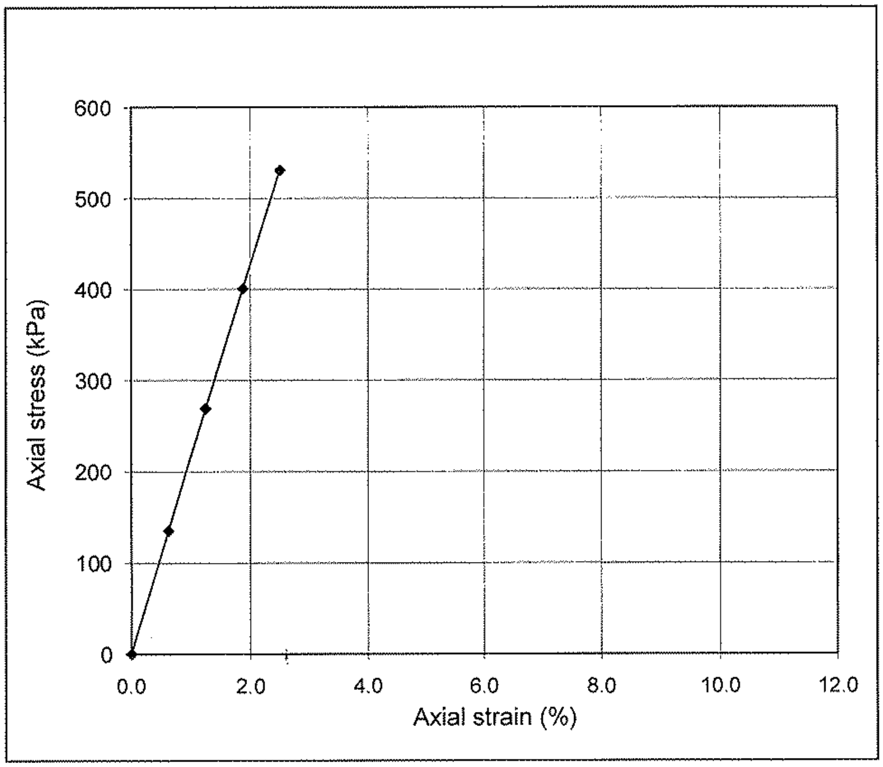
Height = 10.16 cm
Diameter = 5.08 cm
Bulk Density = 21.9 kN/m^3
Moisture Content = 6.55 %

BH/TP No. BH-5
Sample No. WS-5
Depth (m) 24.56-24.76

Uniaxial Compression Strength = **531 kPa**



Test Method: ASTM D7012



Tested by:

Checked by:
2/10/2020

Director

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

UNIAXIAL COMPRESSION TEST

Project: Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from mauripur road to Y-Junction

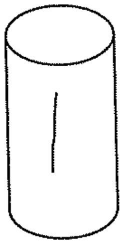
Job No. 3879
Dated: 27-8-2020

Client: NESPAK (Pvt) Ltd.

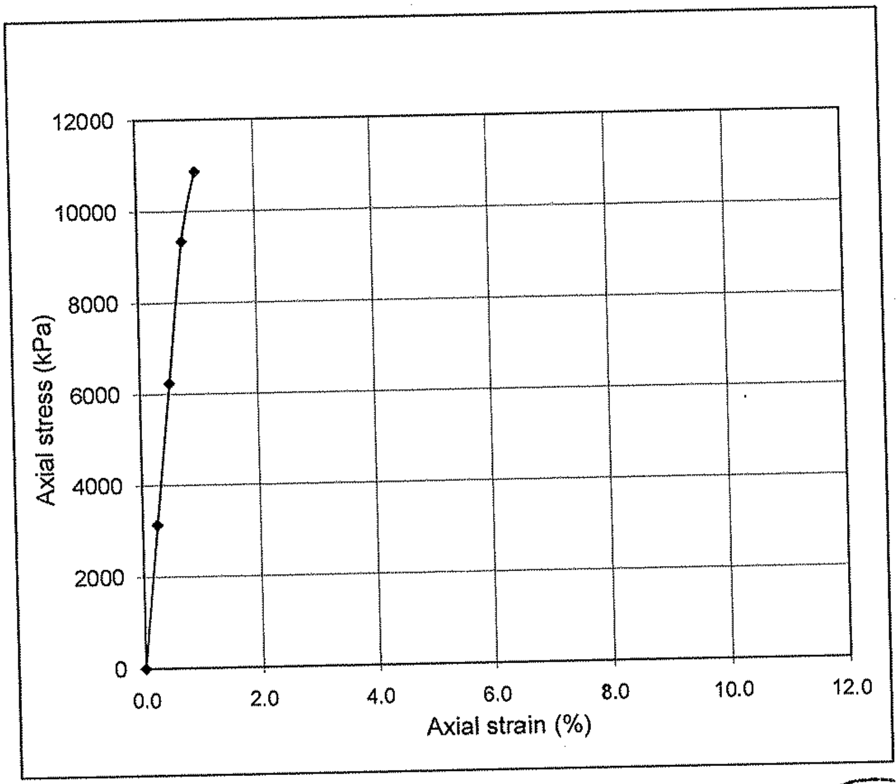
Location: Mauripur Expressway
BH/TP No. BH-6
Sample No. WS-1
Depth (m) 25.06-25.20

Height = 10.16 cm
Diameter = 5.08 cm
Bulk Density = 28.0 kN/m^3
Moisture Content = 0.59 %

Uniaxial Compression Strength = **10868 kPa**



Test Method: ASTM D7012



ed by:

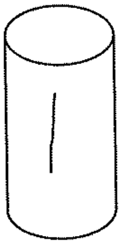
Director
14/9/2020
Checked by:

University of Engineering & Technology, Lahore
Department of Civil Engineering
Geotechnical Engineering Laboratory

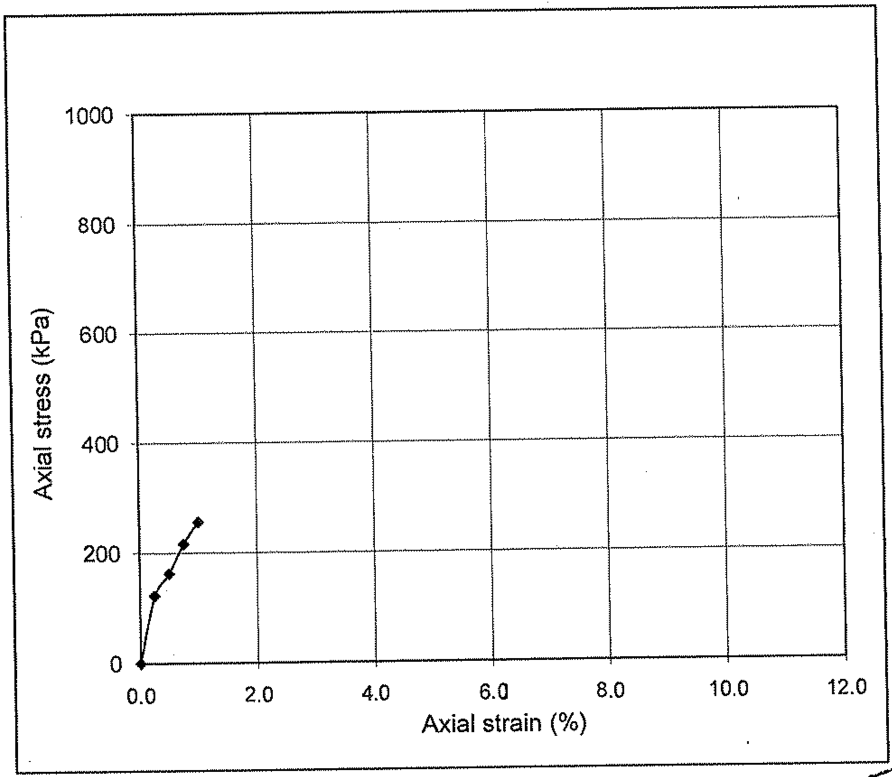
UNIAXIAL COMPRESSION TEST

Project:	Consultancy Services for Feasibility Study and Transaction Advisory Services (TAS) for Three Urban Roads in Karachi Package 2: Expressway from mauripur road to Y-Junction	**Job No.**	3879
		Dated:	27-8-2020
Client:	NESPAK (Pvt) Ltd.		
Location:	Mauripur Expressway	Height =	10.16 cm
BH/TP No.	BH- 6	Diameter =	5.08 cm
Sample No.	WS-3	Bulk Density =	21.7 kN/m^3
Depth (m)	26.72-27.0	Moisture Content =	2.38 %

Uniaxial Compression Strength = **256 kPa**



Test Method: ASTM D7012



ired by:

Checked by:
14/9/2020
Director

SOILCON

GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF CHEMICAL TEST RESULTS

Project: TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI
Location: PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION
Client: SOIL TESTING SERVICE
Lab. Ref: 57/2020

BH / TP #	Sample #	Depth (m)	Total Dissolved Solids (ppm)	Sulphate Contents SO_3 (Water Soluble) (g/l)	Chloride Content (g/l)	pH Electrometric Method	Remarks
BH-3	WS		3500	0.896	0.083	6.11	
BH-6	WS		1813	0.692	0.012	7.66	

Tested By: HAMZA Hamza
Checked By: UMAIR Umai
Dated: 10.09.2020

SOILCON

GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF CHEMICAL TEST RESULTS

Project: TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI

Location: PACKAGE-2 EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION

Client: SOIL TESTING SERVICE

Lab. Ref: 57/2020

BH / TP #	Sample #	Depth (m)	Total Dissolved Solids %	Sulphate Contents % (Water Soluble)	Organic Matter %	Chloride Contents %	REMARKS
BH-3	UDS-1	12.00-12.40		0.025	0.152	0.370	
BH-6	SPT-7	7.00-7.45		0.012	0.792	0.022	

Tested By: HAMZA

Checked By: UMAIR

Dated: 10.09.2020

SOILCON

GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF CHEMICAL TEST RESULTS

Project: TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI

Location: KARACHI

SOIL TESTING SERVICE

Lab. Ref:61/2020

BH / TP #	Sample #	Depth (m)	Total Dissolved Solids %	Sulphate Contents % (Water Soluble)	Organic Matter %	Chloride Contents %	REMARKS
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
BH-2	UDS-1	5.50-6.05		0.013	0.596	0.554	

Tested By: HAMZA Hamza

Checked By: UMAIR

Dated: 29.09.2020

SOILCON
GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF CHEMICAL TEST RESULTS

Project: TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI
Location: KARACHI

SOIL TESTING SERVICE
Lab. Ref:57/2020

BH / TP #	Sample #	Depth (m)	Total Dissolved Solids %	Sulphate Contents % (Water Soluble)	Organic Matter %	Chloride Contents %	REMARKS
BH-1	SPT-9	9.00-9.45		0.017	0.148	0.014	[illegible]
BH-4	UDS-1	10.00-10.55		0.018	0.133	0.016	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]

Tested By: HAMZA Hamza
Checked By: UMAIR
Dated: 25.09.2020

SOILCON

GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF CHEMICAL TEST RESULTS

Project: TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI
Location: KARACHI

SOIL TESTING SERVICE
Lab. Ref:61/2020

BH / TP #	Sample #	Depth (m)	Total Dissolved Solids (ppm)	Sulphate Contents SO_3 (Water Soluble) (g/l)	Chloride Content (g/l)	pH Electrometric Method	REMARKS
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BH-2	W-S		3426	0.995	1.029	5.95	[illegible]
BH-5	W-S		3376	0.788	0.819	5.75	[illegible]

Tested By: HAMZA Hamza
Checked By: UMAIR Umair
Dated: 29.09.2020

SOILCON

GEOTECHNICAL TESTING LABORATORIES
18-Km, Multan Road, Lahore. Ph: 042-7510942-43 Fax:042-7515267

SUMMARY OF CHEMICAL TEST RESULTS

Project: TAS FOR 03 URBAN ROAD PROJECTS IN KARACHI
Location: KARACHI

SOIL TESTING SERVICE
Lab. Ref:57/2020

BH / TP #	Sample #	Depth (m)	Total Dissolved Solids (ppm)	Sulphate Contents SO_3 (Water Soluble) (g/l)	Chloride Content (g/l)	pH Electrometric Method	REMARKS
BH-1	W-S		3374	3.265	8.31	5.88	PACKAGE-2
BH-4	W-S		3389	3.567	10.33	5.65	PACKAGE-2
BH-1	W-S		6373	2.506	1.486	5.88	PACKAGE-1

Tested By: HAMZA Hamza
Checked By: UMAIR
Dated: 25.09.2020

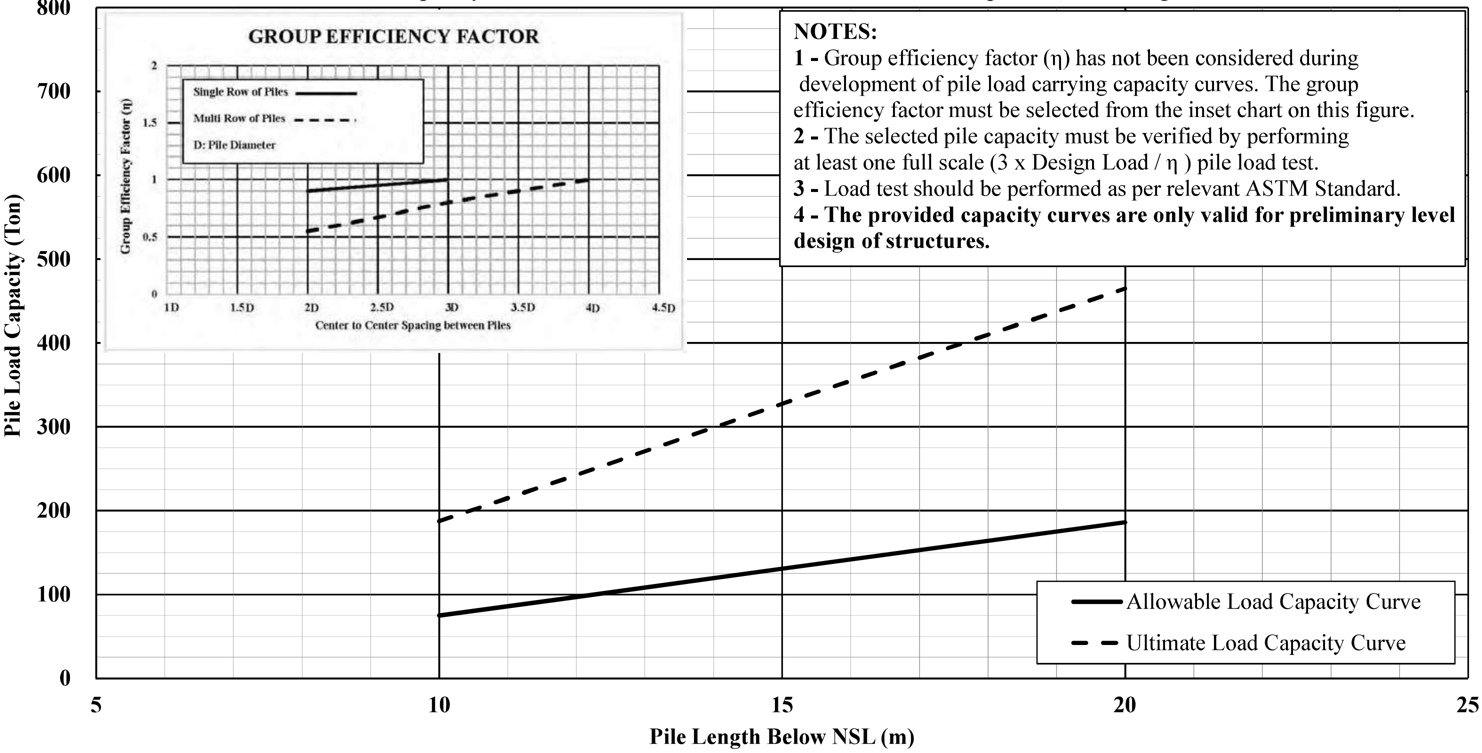
APPENDIX-E

FOUNDATION RECOMMENDATIONS

Fig. E-1

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI
Flyover at KakaPir Road

Load Capacity Curves for 760 mm Diameter Piles under Compression Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

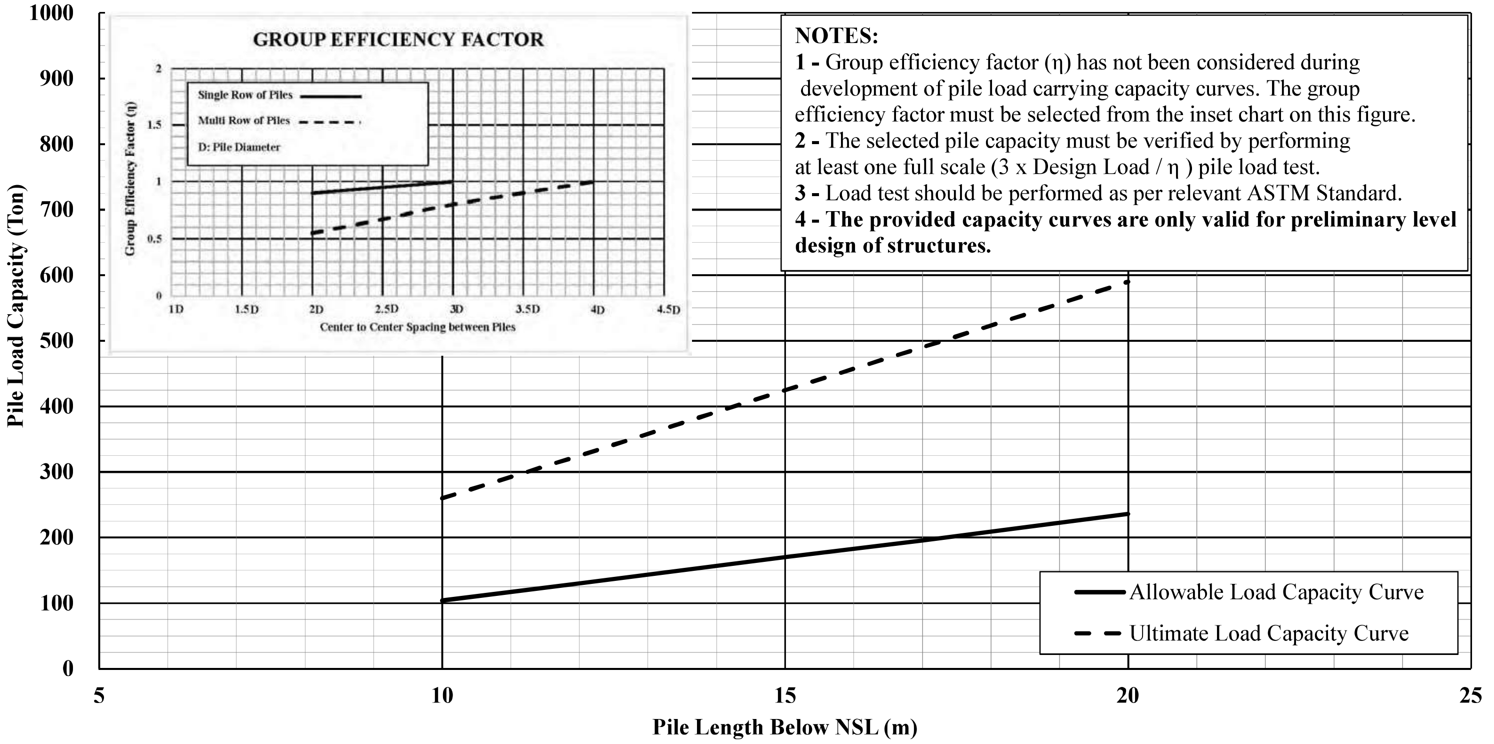
2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

4 - The provided capacity curves are only valid for preliminary level design of structures.

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI
Flyover at Kakapir Road

Load Capacity Curves for 900 mm Diameter Piles under Compression Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

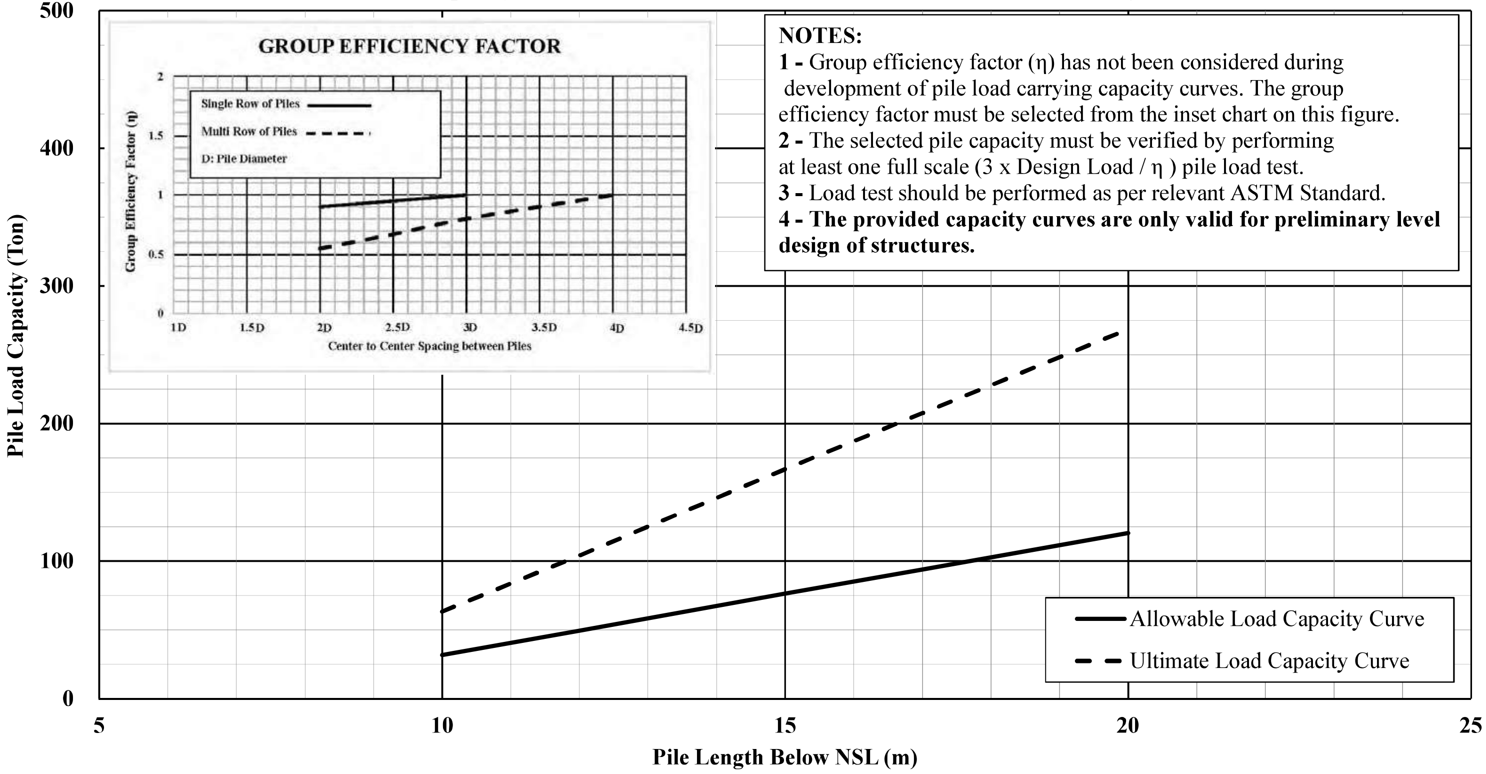
4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-3

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover at Kakapir Road

Load Capacity Curves for 760 mm Diameter Piles under Tensile Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

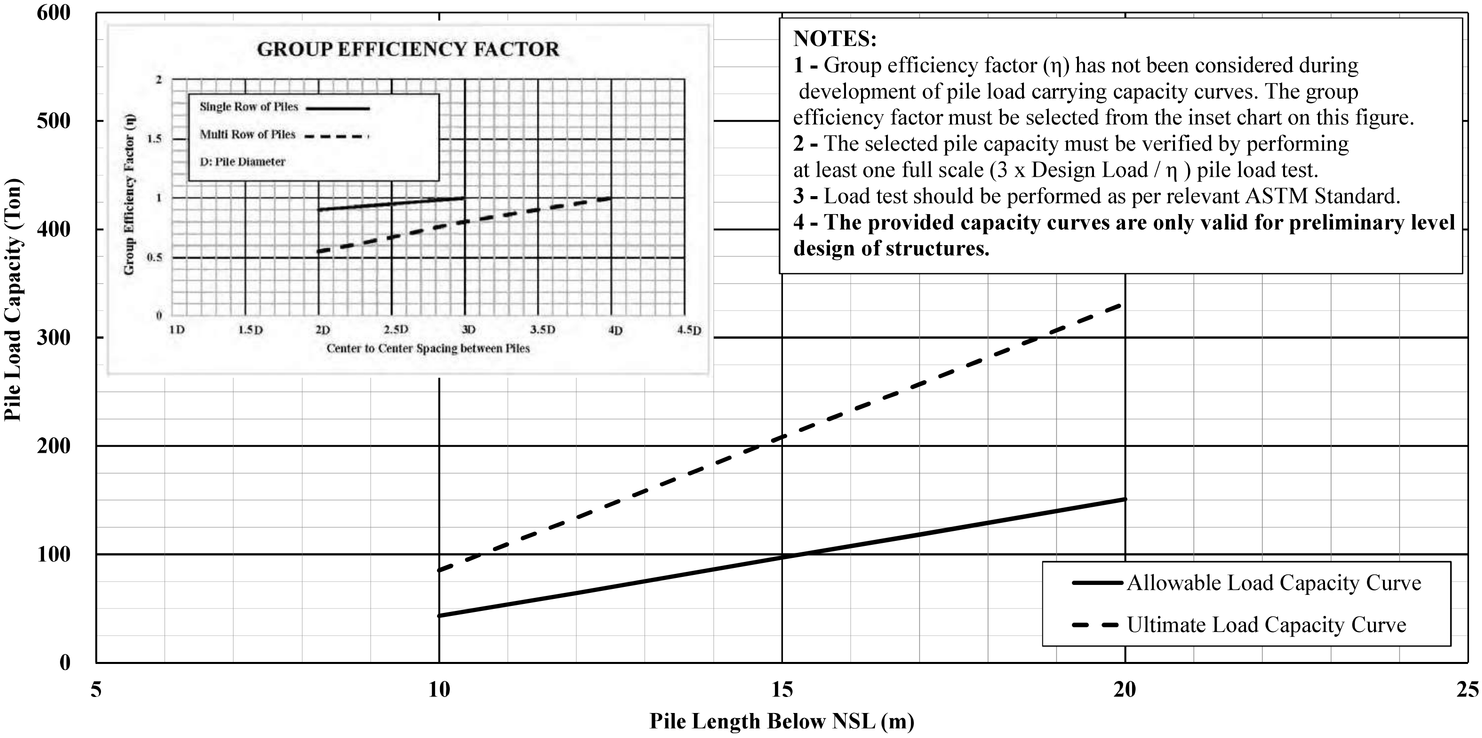
3 - Load test should be performed as per relevant ASTM Standard.

4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-4

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI
Flyover at Kakapir Road

Load Capacity Curves for 900 mm Diameter Piles under Tensile Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-5

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover at Kakapir Road

Soil Spring Stiffnesses

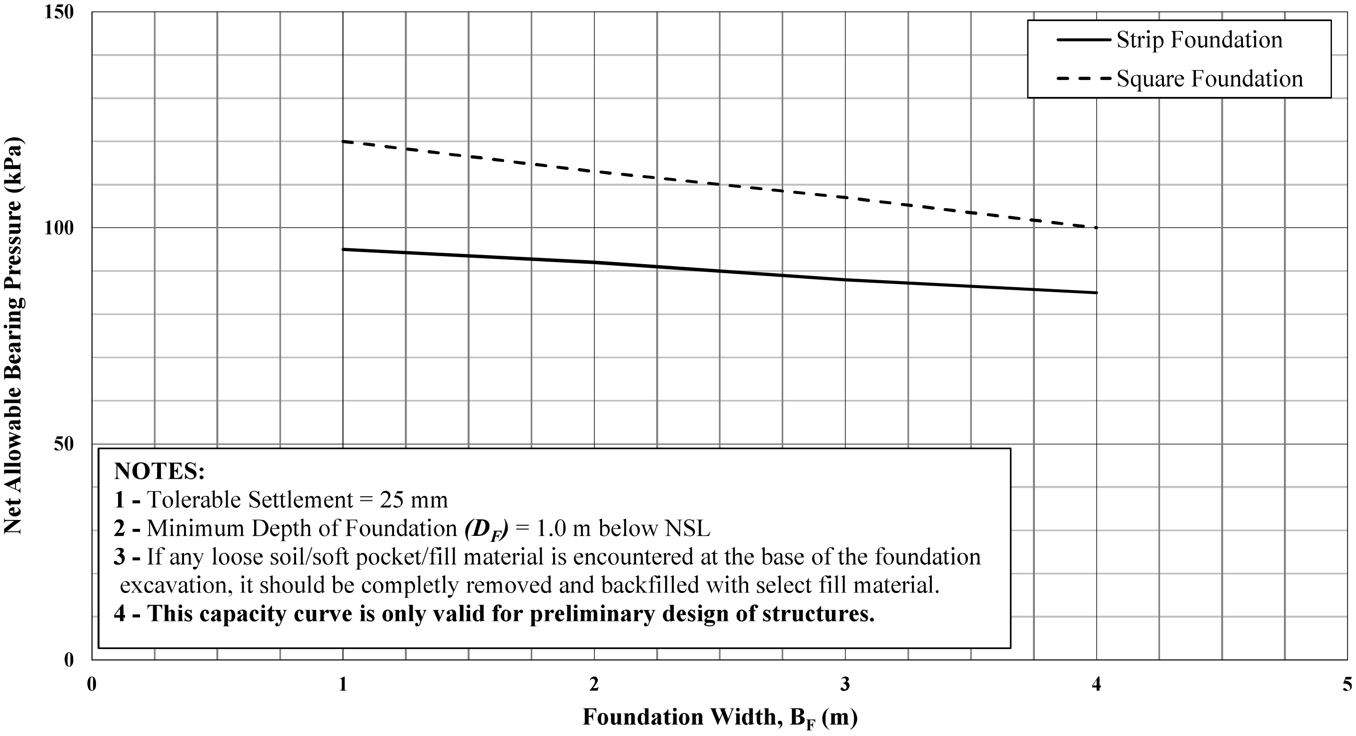
	Pile Diameter = 760 mm			Pile Diameter = 900 mm		
Pile Length below NSL (m)	Horizontal Soil Spring Stiffness ($K_{Horizontal}$)	Vertical Soil Spring Stiffness ($K_{Vertical}$)	Soil Spring Stiffness at Pile Tip (K_{Tip})	Horizontal Soil Spring Stiffness ($K_{Horizontal}$)	Vertical Soil Spring Stiffness ($K_{Vertical}$)	Soil Spring Stiffness at Pile Tip (K_{Tip})
	kN/m^3	kN/m^3	kN/m^3	kN/m^3	kN/m^3	kN/m^3
1	3646	800	-	3079	1000	-
2	7293	1300	-	6158	1750	-
3	10939	1800	-	9237	2250	-
4	36463	2300	-	30791	2750	-
5	45579	2800	-	38489	3250	-
6	54695	3300	-	46187	3750	-
7	63811	3800	-	53884	4250	-
8	72926	4300	-	61582	4750	-
9	82042	4800	-	69280	5250	-
10	**91158**	**5300**	**110000**	**76978**	**5750**	**112000**
11	200547	5800	111000	169351	6250	113000
12	218779	6300	112000	184747	6750	114000
13	237011	6800	113000	200142	7250	115000
14	255242	7300	114000	215538	7750	116000
15	**273474**	**7800**	**115000**	**230933**	**8250**	**117000**
16	291705	8300	116000	246329	8750	118000
17	309937	8800	117000	261724	9250	119000
18	328168	9300	118000	277120	9750	120000
19	346400	9800	119000	292516	10250	121000
20	**364632**	**10300**	**120000**	**307911**	**10750**	**122000**

NOTE: The provided soil springs are only valid for preliminary level design of structures.

Fig. E-6

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI
Flyover at Kakapir Road

FOUNDATION PROPORTIONING CURVES FOR STRIP & SQUARE FOUNDATION



NOTES:

1 - Tolerable Settlement = 25 mm

2 - Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL

3 - If any loose soil/soft pocket/fill material is encountered at the base of the foundation excavation, it should be completly removed and backfilled with select fill material.

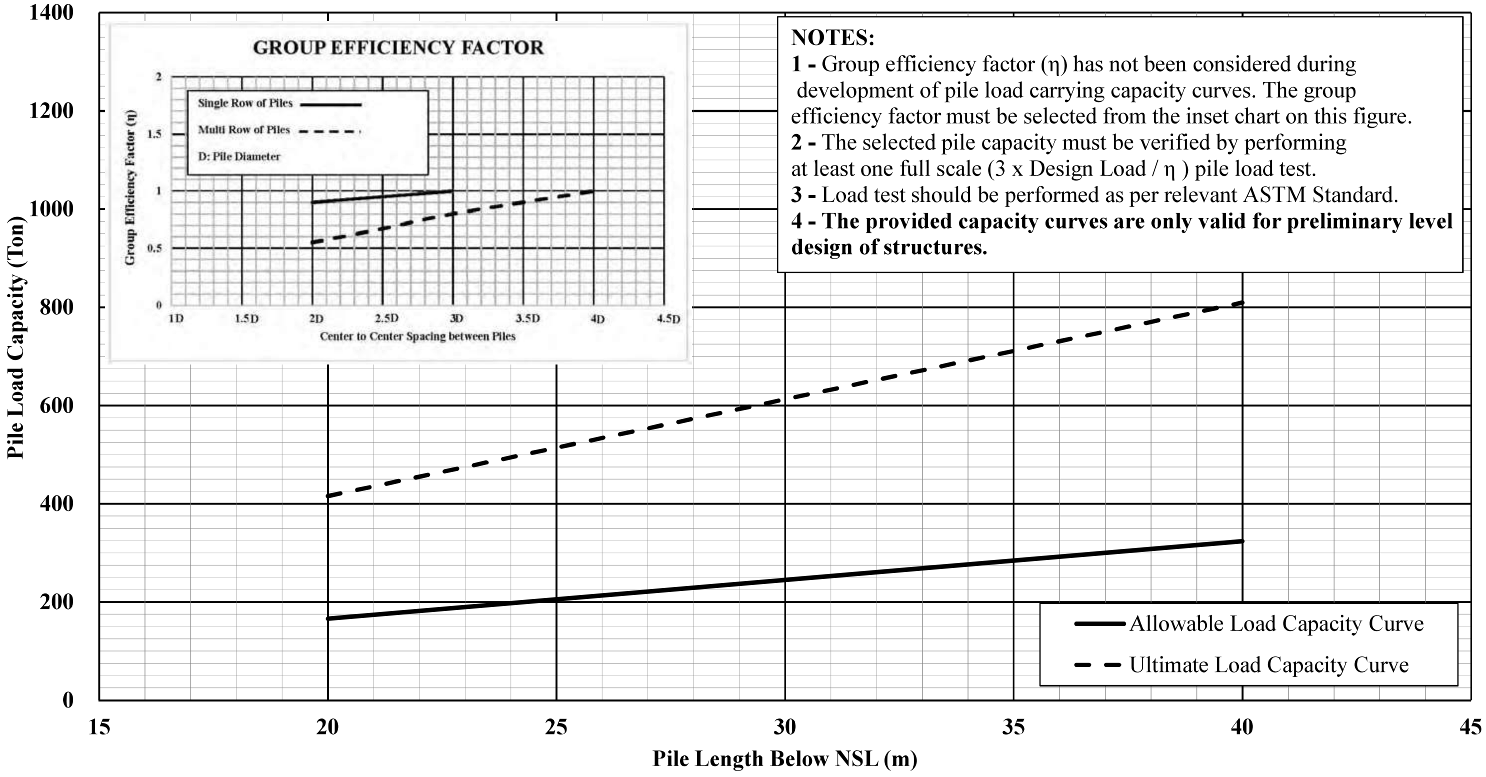
4 - This capacity curve is only valid for preliminary design of structures.

Fig. E-7

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover near Marine Academy

Load Capacity Curves for 760 mm Diameter Piles under Compression Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

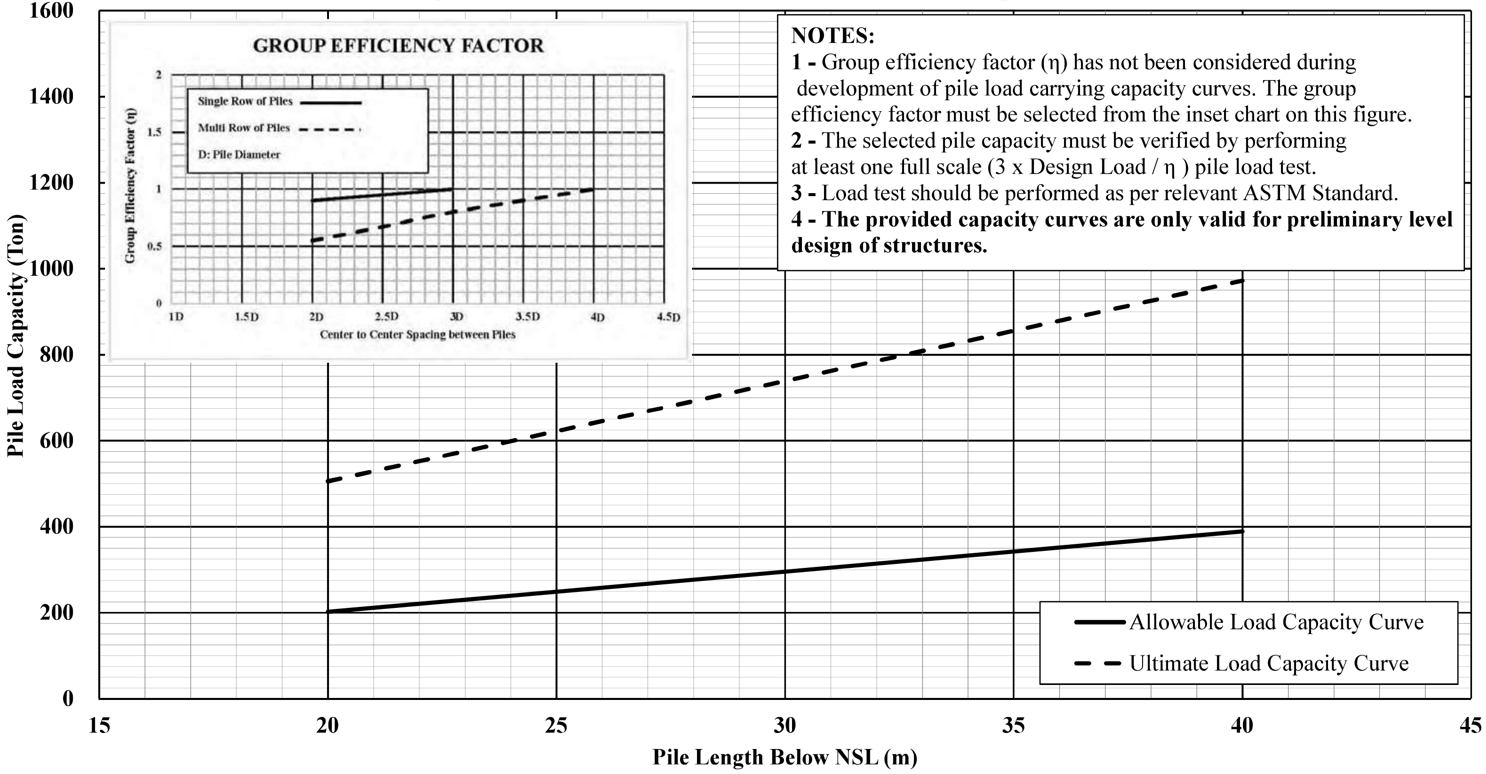
3 - Load test should be performed as per relevant ASTM Standard.

4 - The provided capacity curves are only valid for preliminary level design of structures.

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover near Marine Academy

Load Capacity Curves for 900 mm Diameter Piles under Compression Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

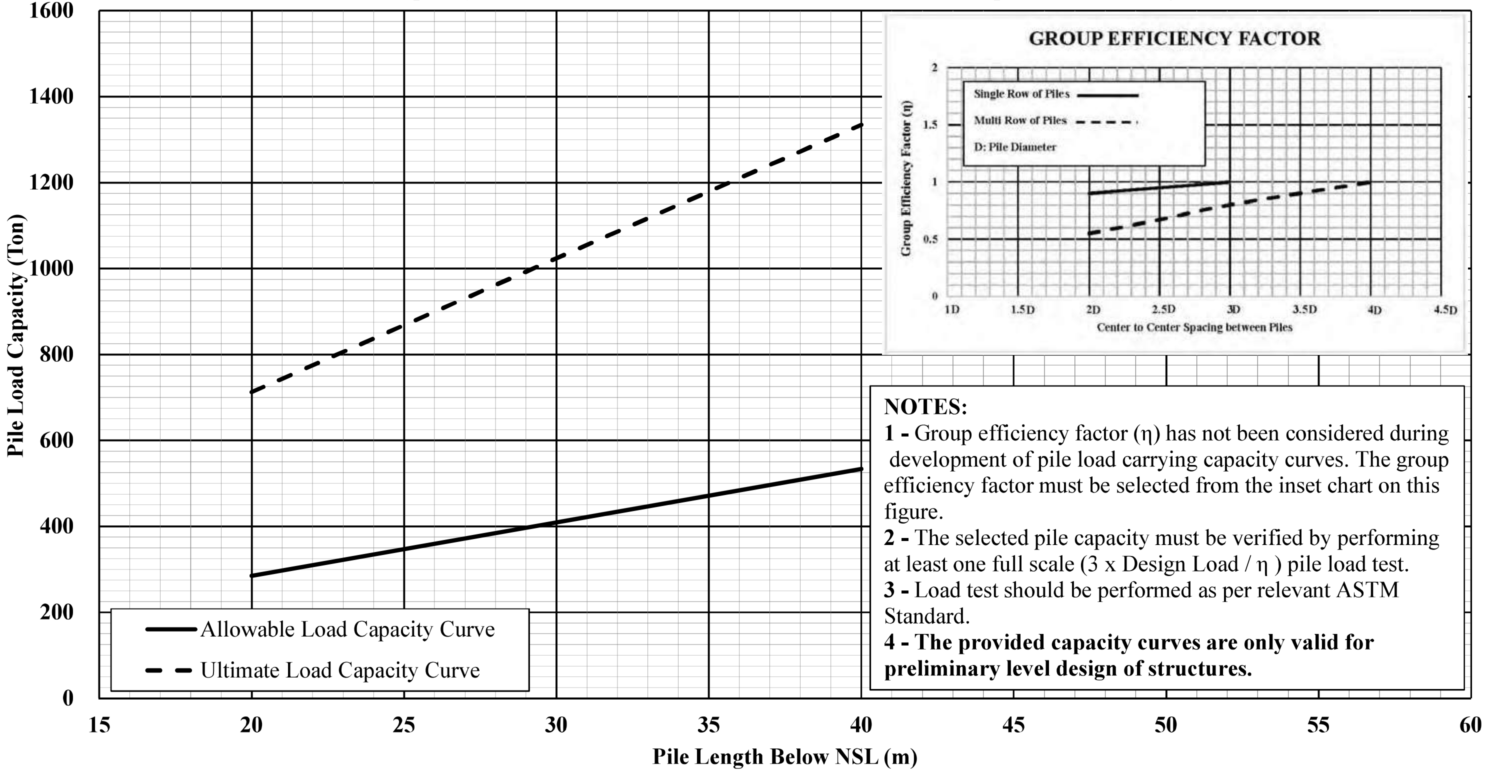
4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-9

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover near Marine Academy

Load Capacity Curves for 1200 mm Diameter Piles under Compression Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

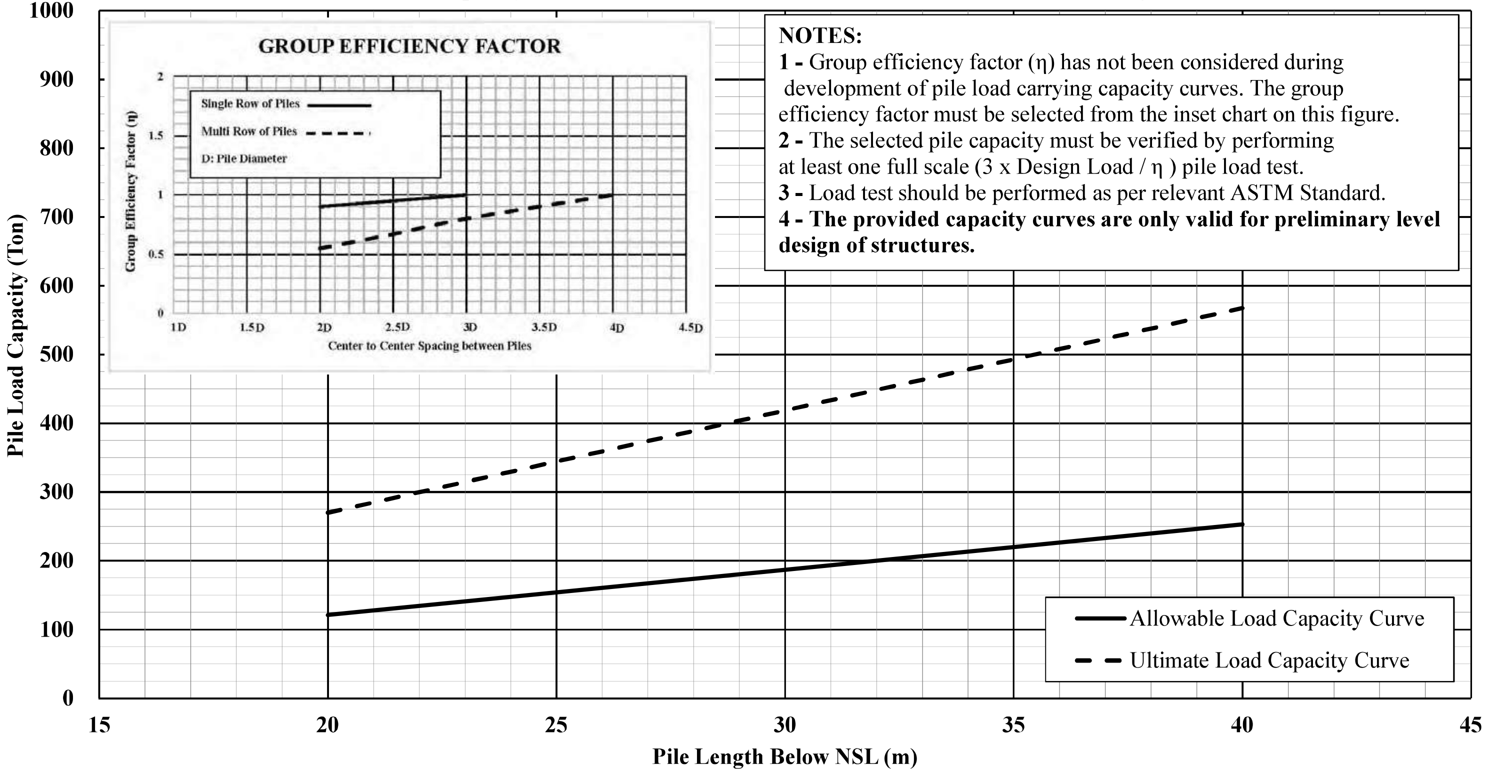
4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-10

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover near Marine Academy

Load Capacity Curves for 760 mm Diameter Piles under Tensile Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

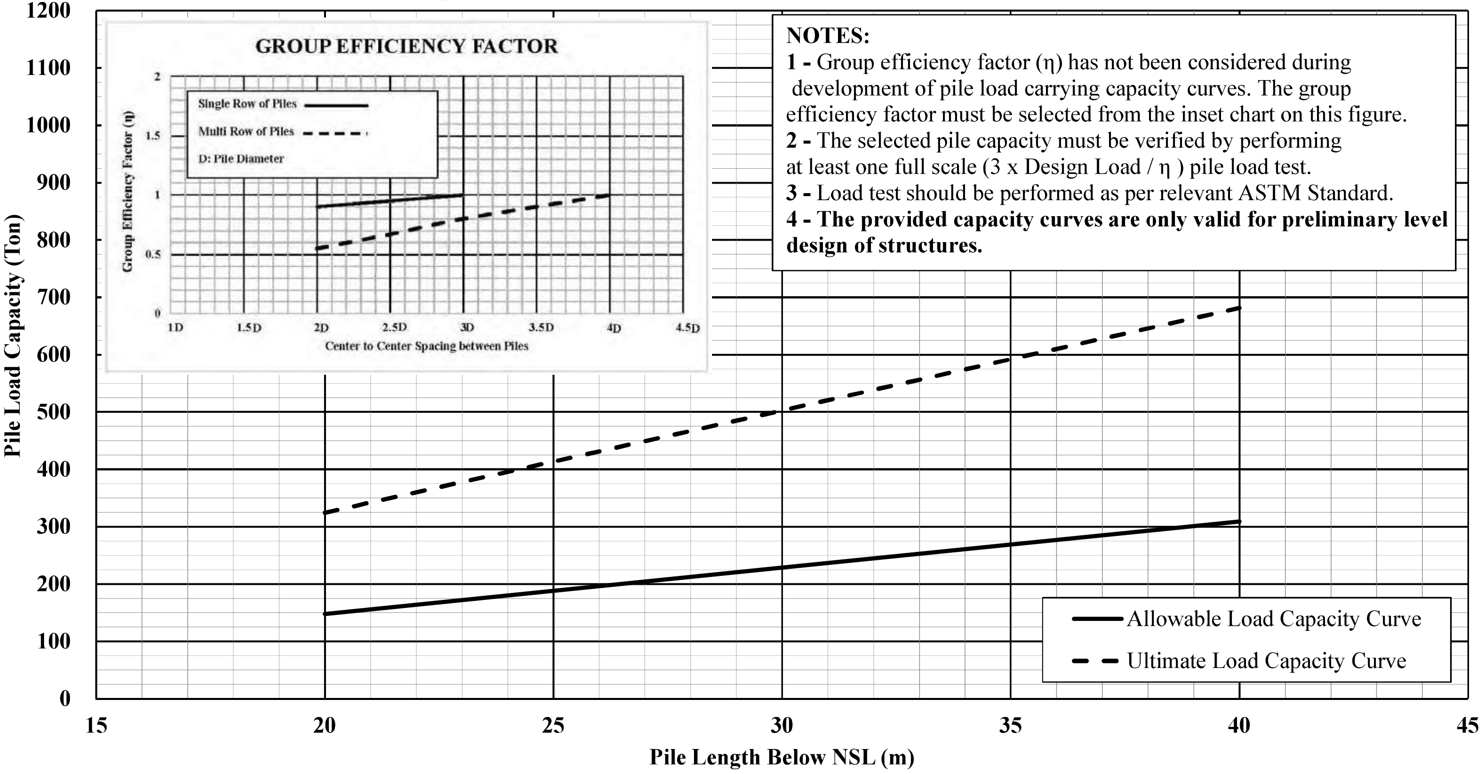
2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-11

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI
Flyover near Marine Academy
Load Capacity Curves for 900 mm Diameter Piles under Tensile Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

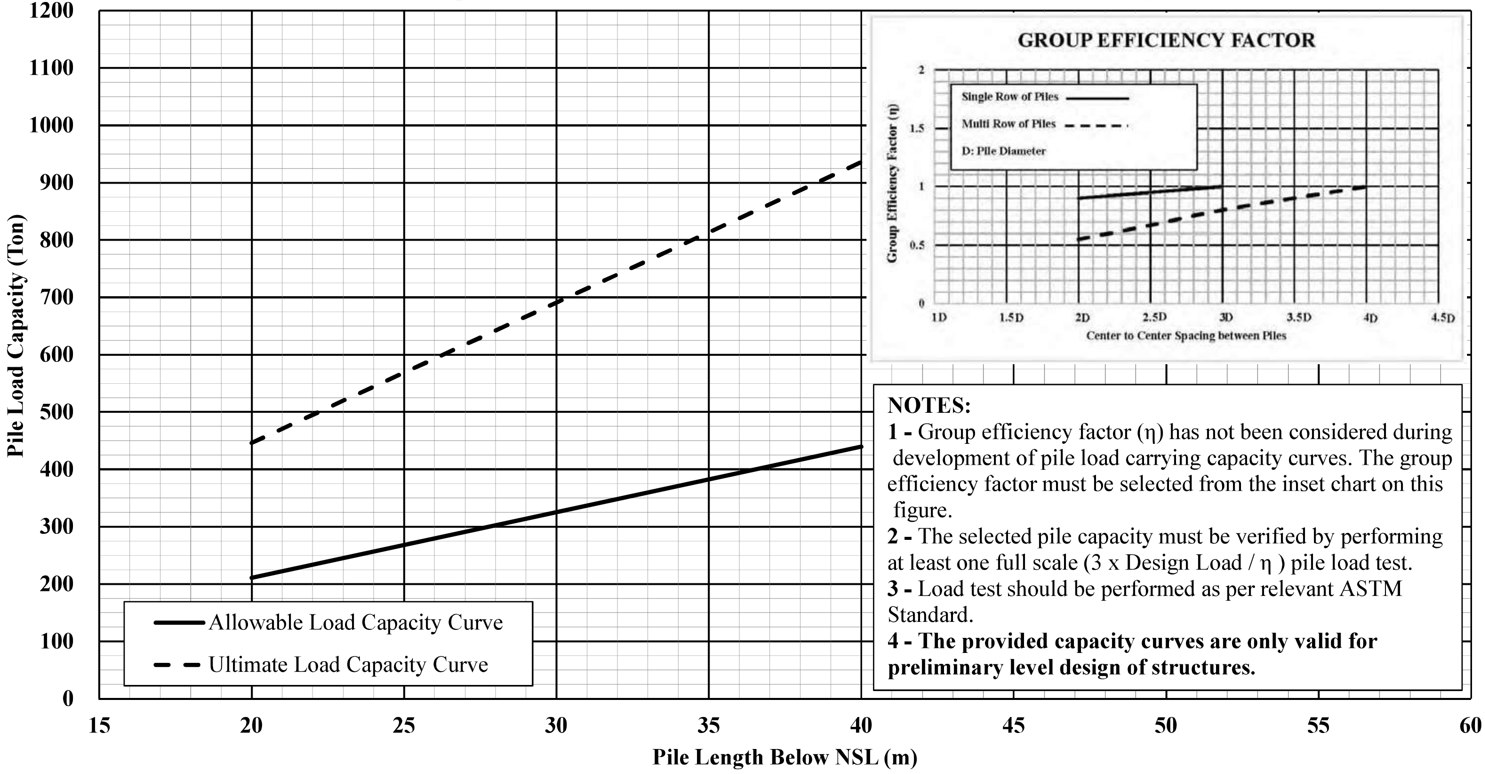
4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-12

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover near Marine Academy

Load Capacity Curves for 1200 mm Diameter Piles under Tensile Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

4 - The provided capacity curves are only valid for preliminary level design of structures.

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover near Marine Academy

Soil Spring Stiffnesses

Pile Length below NSL (m)	Pile Diameter = 760 mm			Pile Diameter = 900 mm			Pile Diameter = 1200 mm		
	Horizontal Soil Spring Stiffness ($K_{Horizonta}$)	Vertical Soil Spring Stiffness ($K_{Vertical}$)	Soil Spring Stiffness at Pile Tip (K_{Tip})	Horizontal Soil Spring Stiffness ($K_{Horizonta}$)	Vertical Soil Spring Stiffness ($K_{Vertical}$)	Soil Spring Stiffness at Pile Tip (K_{Tip})	Horizontal Soil Spring Stiffness ($K_{Horizonta}$)	Vertical Soil Spring Stiffness ($K_{Vertical}$)	Soil Spring Stiffness at Pile Tip (K_{Tip})
	kN/m^3	kN/m^3	kN/m^3	kN/m^3	kN/m^3	kN/m^3	kN/m^3	kN/m^3	kN/m^3
1	1367	500	-	1155	550	-	866	600	
2	2735	650	-	2309	725	-	1732	800	
3	4102	800	-	3464	900	-	2598	1000	
4	36463	950	-	30791	1075	-	23093	1200	
5	45579	1100	-	38489	1250	-	28867	1400	
6	54695	1250	-	46187	1425	-	34640	1600	
7	63811	1400	-	53884	1600	-	40413	1800	
8	72926	1550	-	61582	1775	-	46187	2000	
9	82042	1700	-	69280	1950	-	51960	2200	
10	91158	1850	-	76978	2125	-	57733	2400	
11	100274	2000	-	84676	2300	-	63507	2600	
12	191432	2150	-	161653	2475	-	121240	2800	
13	207384	2300	-	175124	2650	-	131343	3000	
14	223337	2450	-	188596	2825	-	141447	3200	
15	239289	2600	-	202067	3000	-	151550	3400	
16	255242	2750	-	215538	3175	-	161653	3600	
17	271195	2900	-	229009	3350	-	171757	3800	
18	287147	3050	-	242480	3525	-	181860	4000	
19	303100	3200	-	255951	3700	-	191963	4200	
20	**319053**	**3350**	**50000**	**269422**	**3875**	**54000**	**202067**	**4400**	**57000**
21	335005	3500	50500	282893	4050	54500	212170	4600	57500
22	350958	3650	51000	296364	4225	55000	222273	4800	58000
23	366911	3800	51500	309836	4400	55500	232377	5000	58500
24	382863	3950	52000	323307	4575	56000	242480	5200	59000
25	398816	4100	52500	336778	4750	56500	252583	5400	59500
26	414768	4250	53000	350249	4925	57000	262687	5600	60000
27	430721	4400	53500	363720	5100	57500	272790	5800	60500
28	446674	4550	54000	377191	5275	58000	282893	6000	61000
29	462626	4700	54500	390662	5450	58500	292997	6200	61500
30	**478579**	**4850**	**55000**	**404133**	**5625**	**59000**	**303100**	**6400**	**62000**
31	494532	5000	55500	417604	5800	59500	313203	6600	62500
32	510484	5150	56000	431076	5975	60000	323307	6800	63000
33	526437	5300	56500	444547	6150	60500	333410	7000	63500
34	542389	5450	57000	458018	6325	61000	343513	7200	64000
35	558342	5600	57500	471489	6500	61500	353617	7400	64500
36	574295	5750	58000	484960	6675	62000	363720	7600	65000
37	590247	5900	58500	498431	6850	62500	373823	7800	65500
38	606200	6050	59000	511902	7025	63000	383927	8000	66000
39	622153	6200	59500	525373	7200	63500	394030	8200	66500
40	**638105**	**6350**	**60000**	**538844**	**7375**	**64000**	**404133**	**8400**	**67000**

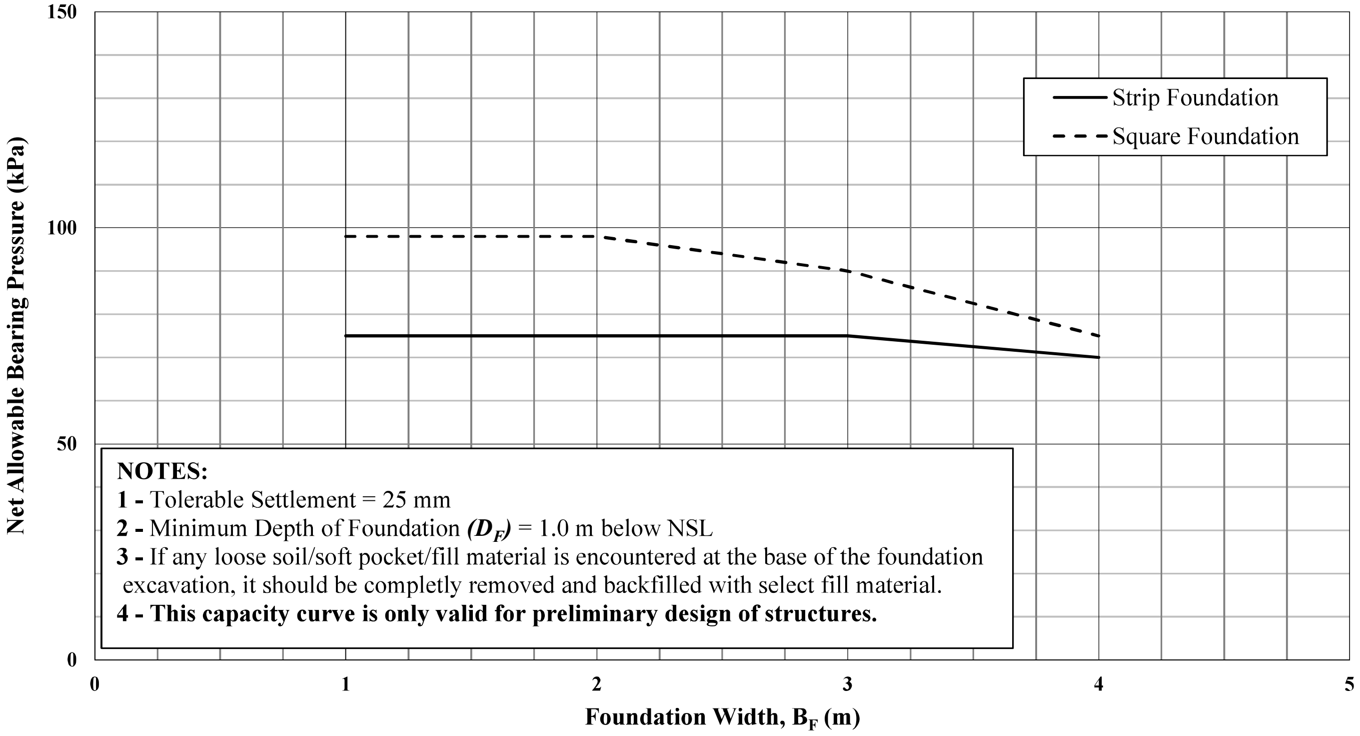
NOTE: The provided soil springs are only valid for preliminary level design of structures.

Fig. E-14

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

(Retaining Wall and Light Poles for Flyover near Marine Academy)

FOUNDATION PROPORTIONING CURVES FOR STRIP & SQUARE FOUNDATION

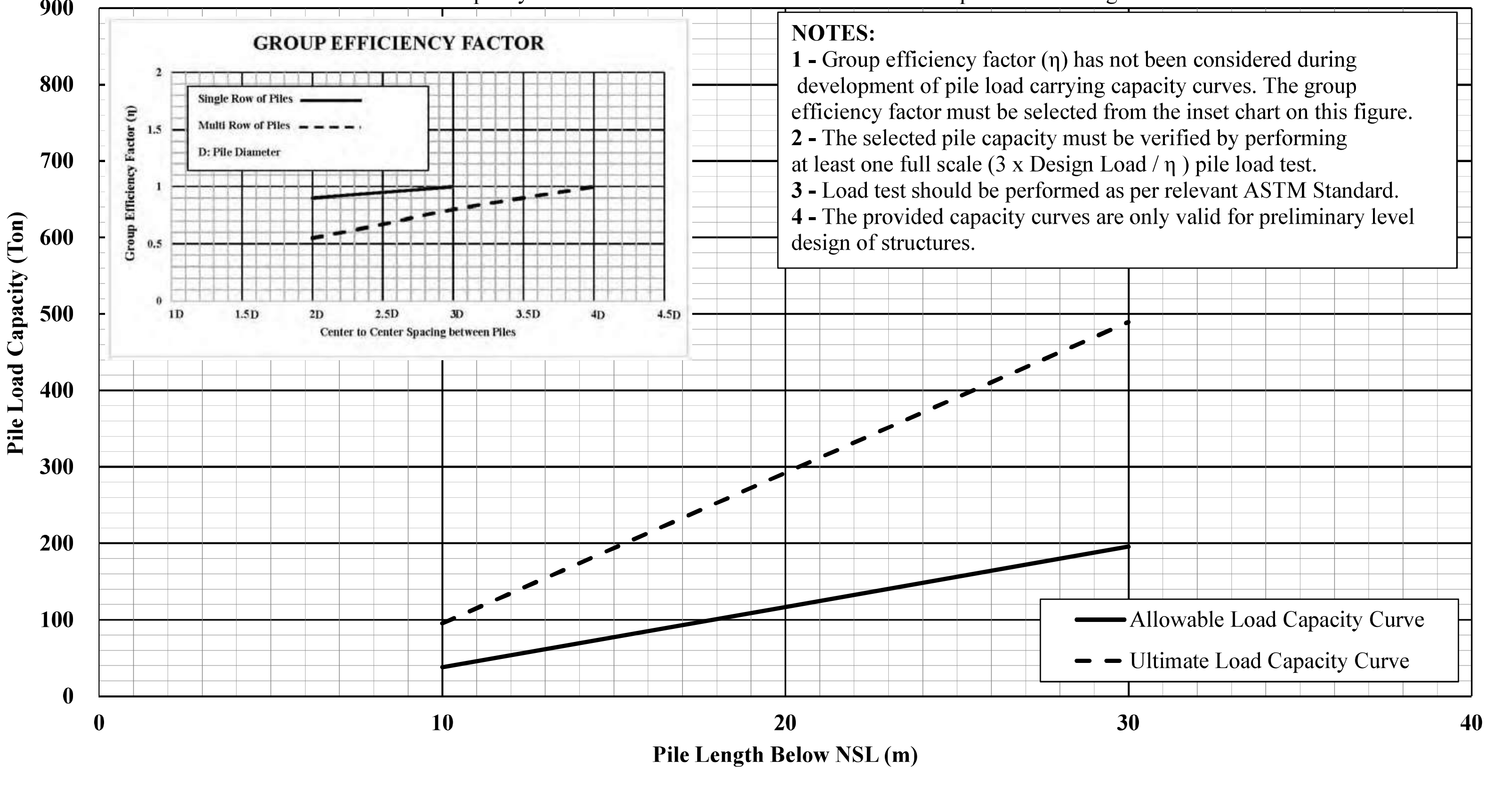


NOTES:
1 - Tolerable Settlement = 25 mm
2 - Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL
3 - If any loose soil/soft pocket/fill material is encountered at the base of the foundation excavation, it should be completly removed and backfilled with select fill material.
4 - This capacity curve is only valid for preliminary design of structures.

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

(Culvert C-2 & C-3)

Load Capacity Curves for 760 mm Diameter Piles under Compression Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

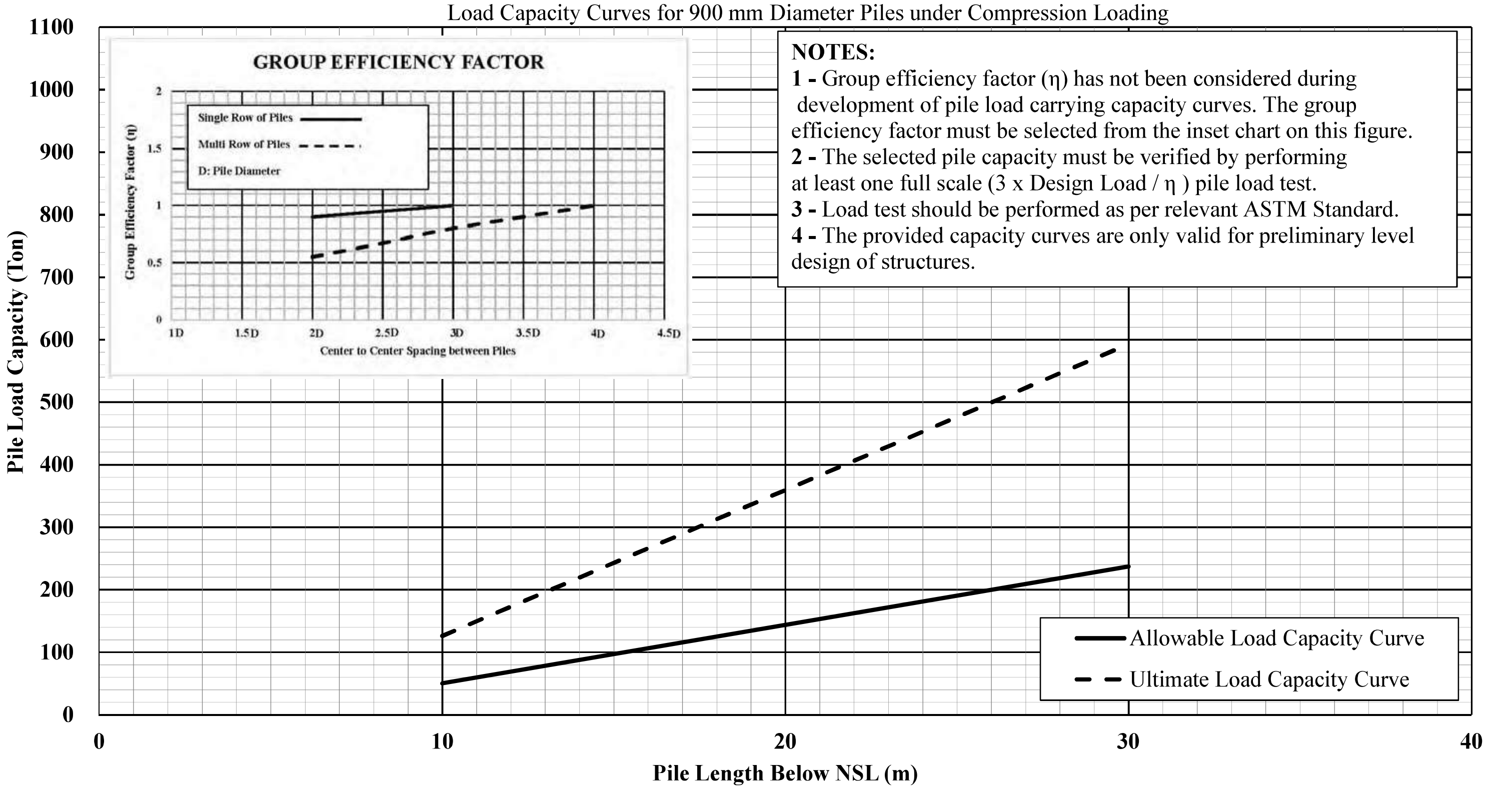
3 - Load test should be performed as per relevant ASTM Standard.

4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-16

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI
(Culvert C-2 & C-3)

Load Capacity Curves for 900 mm Diameter Piles under Compression Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

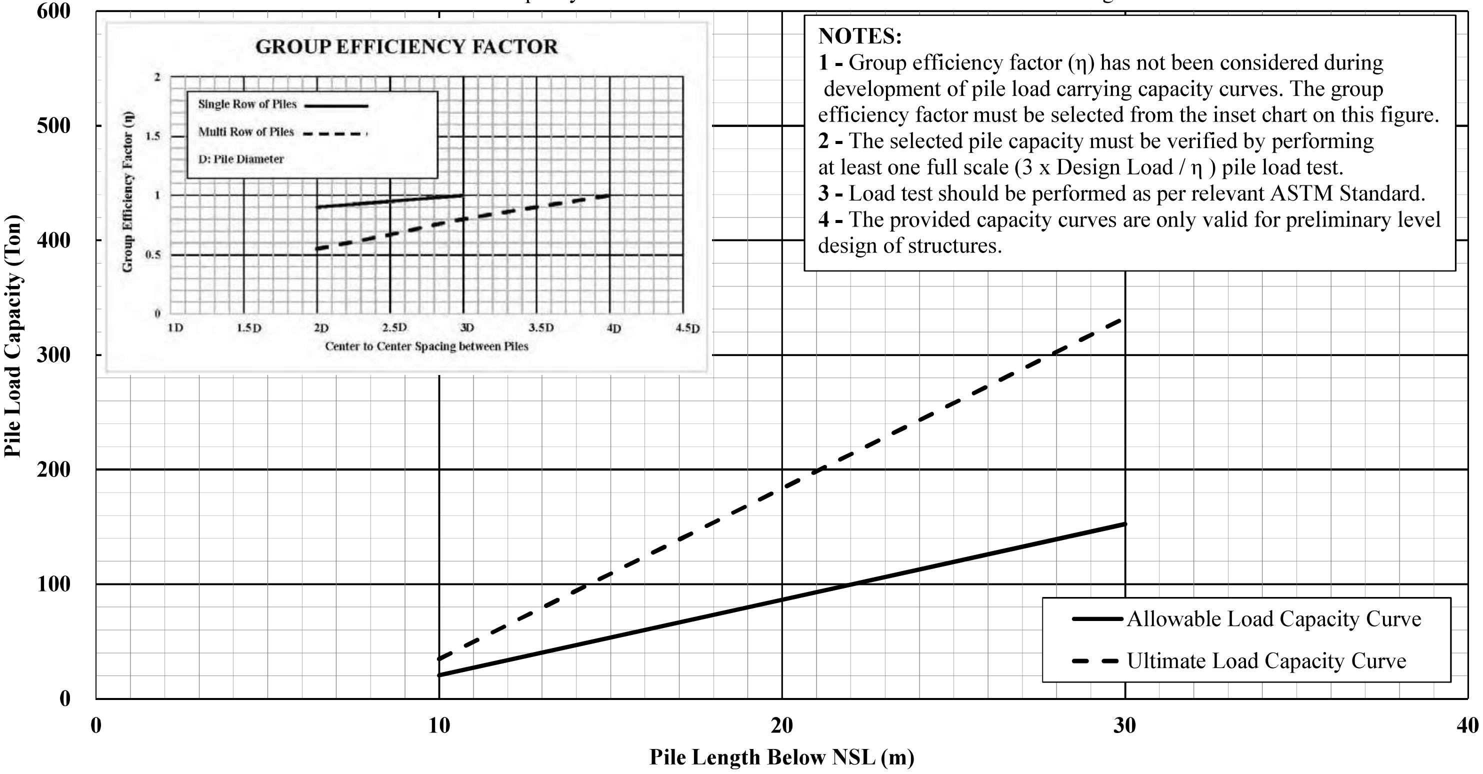
4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-17

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

(Culvert C-2 & C-3)

Load Capacity Curves for 760 mm Diameter Piles under Tensile Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

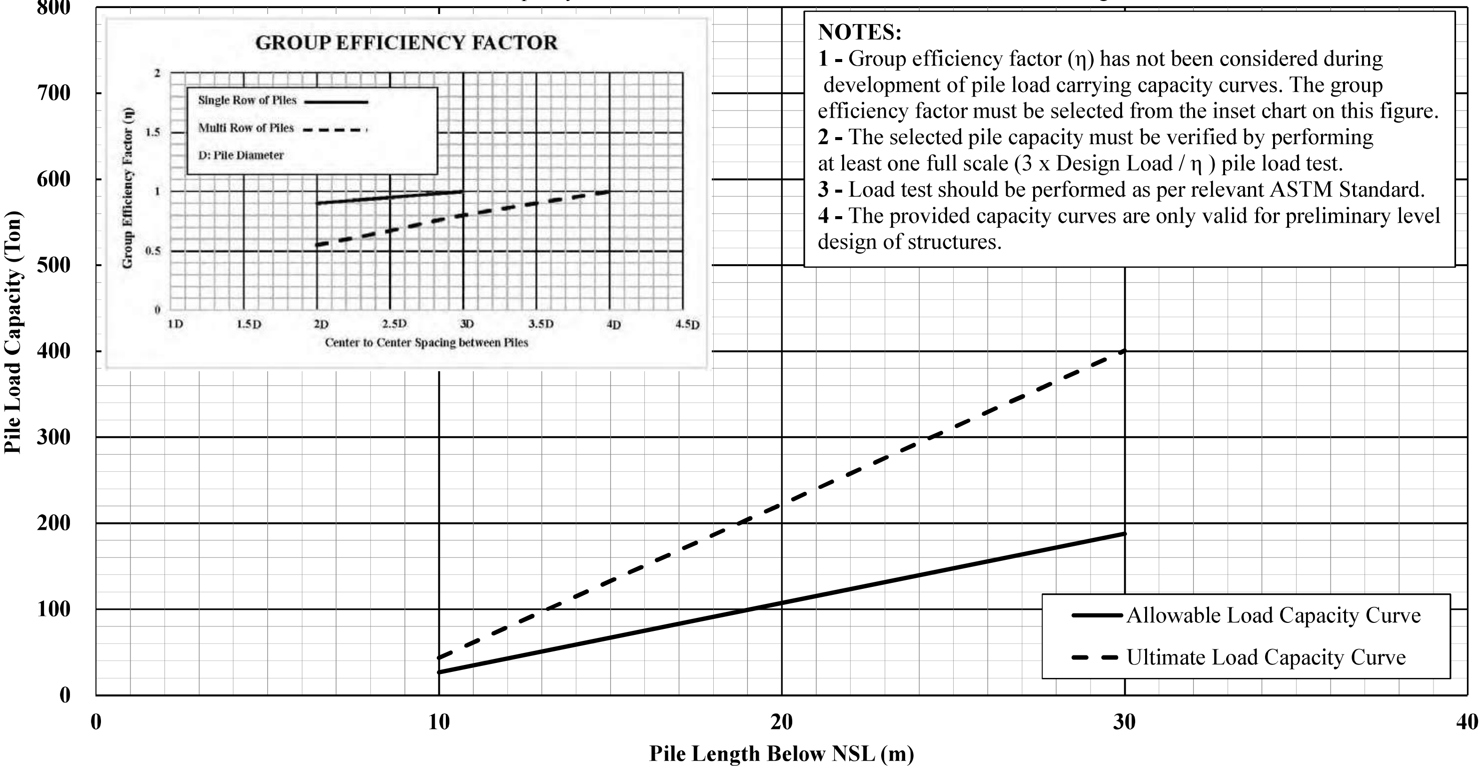
3 - Load test should be performed as per relevant ASTM Standard.

4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-18

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI
(Culvert C-2 & C-3)

Load Capacity Curves for 900 mm Diameter Piles under Tensile Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

4 - The provided capacity curves are only valid for preliminary level design of structures.

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

(Culvert C-2 & C-3)

Soil Spring Stiffnesses

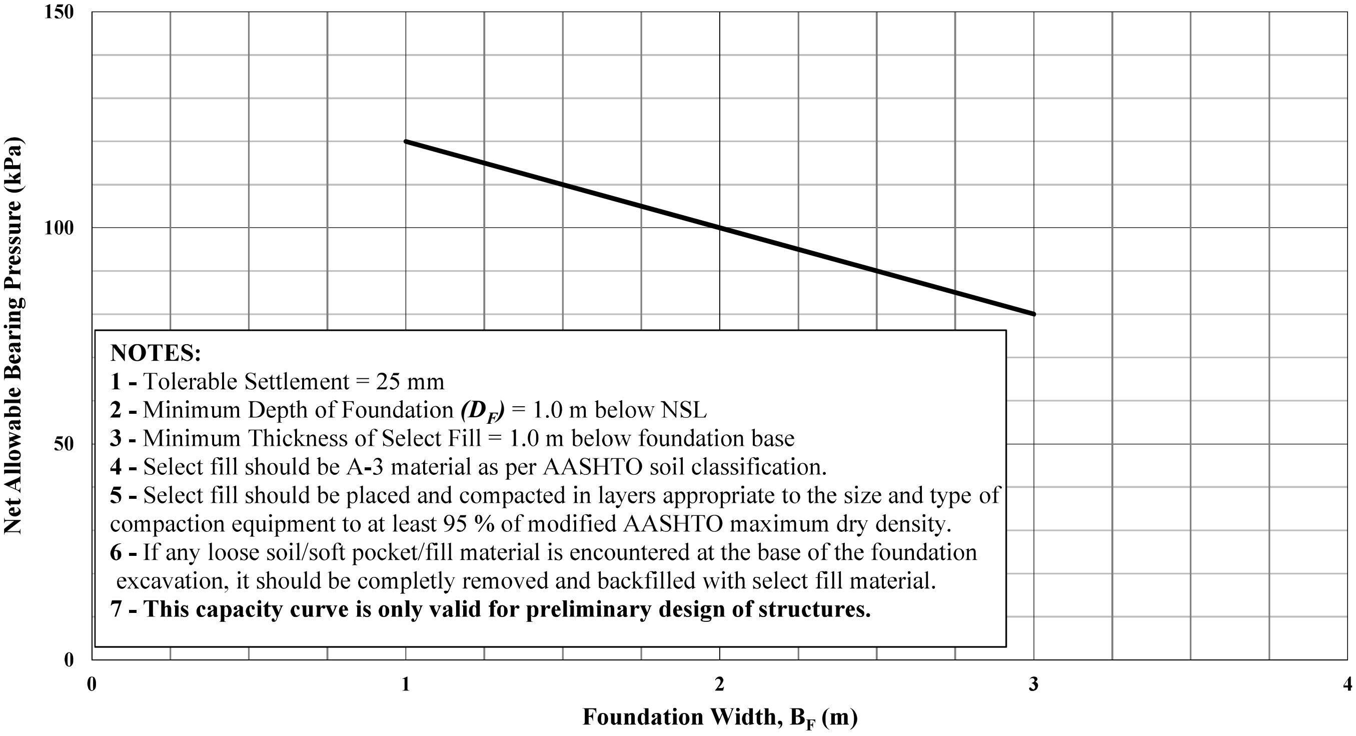
Pile Length below NSL (m)	Pile Diameter = 760 mm			Pile Diameter = 900 mm		
	Horizontal Soil Spring Stiffness ($K_{Horizontal}$)	Vertical Soil Spring Stiffness ($K_{Vertical}$)	Soil Spring Stiffness at Pile Tip (K_{Tip})	Horizontal Soil Spring Stiffness ($K_{Horizontal}$)	Vertical Soil Spring Stiffness ($K_{Vertical}$)	Soil Spring Stiffness at Pile Tip (K_{Tip})
	kN/m^3	kN/m^3	kN/m^3	kN/m^3	kN/m^3	kN/m^3
1	912	200	-	770	300	-
2	1823	300	-	1540	400	-
3	2735	400	-	2309	500	-
4	3646	500	-	3079	600	-
5	4558	600	-	3849	700	-
6	5469	700	-	4619	800	-
7	63811	1600	-	53884	1700	-
8	72926	1800	-	61582	1900	-
9	82042	2000	-	69280	2100	-
10	**91158**	**2200**	**50000**	**76978**	**2300**	**55000**
11	150411	2450	50250	127013	2600	55250
12	164084	2700	50500	138560	2900	55500
13	177758	2950	50750	150107	3200	55750
14	191432	3200	51000	161653	3500	56000
15	205105	3450	51250	173200	3800	56250
16	218779	3700	51500	184747	4100	56500
17	232453	3950	51750	196293	4400	56750
18	246126	4200	52000	207840	4700	57000
19	259800	4450	52250	219387	5000	57250
20	**273474**	**4700**	**52500**	**230933**	**5300**	**57500**
21	287147	4950	52750	242480	5600	57750
22	300821	5200	53000	254027	5900	58000
23	314495	5450	53250	265573	6200	58250
24	328168	5700	53500	277120	6500	58500
25	341842	5950	53750	288667	6800	58750
26	355516	6200	54000	300213	7100	59000
27	369189	6450	54250	311760	7400	59250
28	382863	6700	54500	323307	7700	59500
29	396537	6950	54750	334853	8000	59750
30	**410211**	**7200**	**55000**	**346400**	**8300**	**60000**

NOTE: The provided soil springs are only valid for preliminary level design of structures.

Fig. E-20

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI
(Light Poles at Culverts C 2 & C 3)

FOUNDATION PROPORTIONING CURVE FOR SQUARE FOUNDATION



NOTES:

1 - Tolerable Settlement = 25 mm

2 - Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL

3 - Minimum Thickness of Select Fill = 1.0 m below foundation base

4 - Select fill should be A-3 material as per AASHTO soil classification.

5 - Select fill should be placed and compacted in layers appropriate to the size and type of compaction equipment to at least 95 % of modified AASHTO maximum dry density.

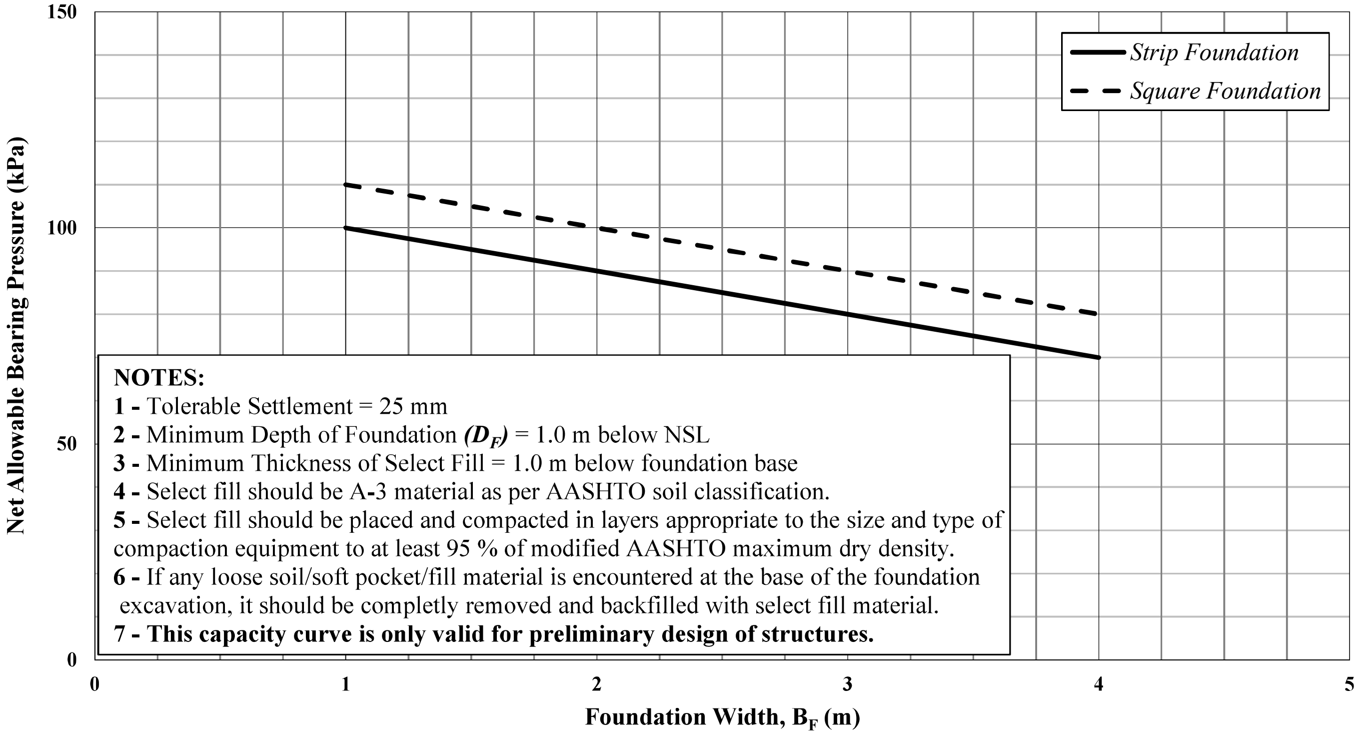
6 - If any loose soil/soft pocket/fill material is encountered at the base of the foundation excavation, it should be completly removed and backfilled with select fill material.

7 - This capacity curve is only valid for preliminary design of structures.

Fig. E-21

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI
(Admin Building, Toll Plaza and Light Poles)

FOUNDATION PROPORTIONING CURVES FOR STRIP & SQUARE FOUNDATION



NOTES:

1 - Tolerable Settlement = 25 mm

2 - Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL

3 - Minimum Thickness of Select Fill = 1.0 m below foundation base

4 - Select fill should be A-3 material as per AASHTO soil classification.

5 - Select fill should be placed and compacted in layers appropriate to the size and type of compaction equipment to at least 95 % of modified AASHTO maximum dry density.

6 - If any loose soil/soft pocket/fill material is encountered at the base of the foundation excavation, it should be completly removed and backfilled with select fill material.

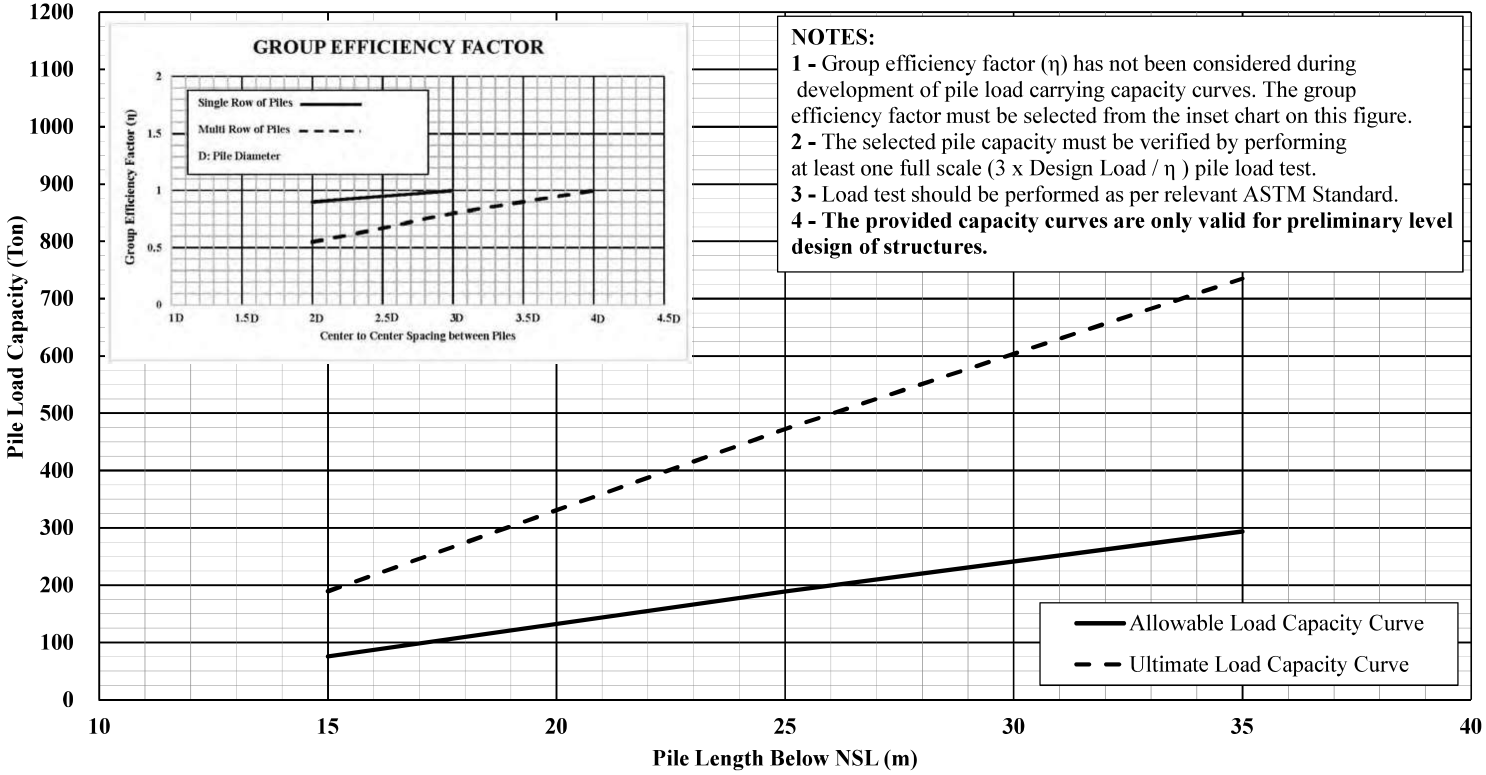
7 - This capacity curve is only valid for preliminary design of structures.

Fig. E-22

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover near Liyari Expressway

Load Capacity Curves for 760 mm Diameter Piles under Compression Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

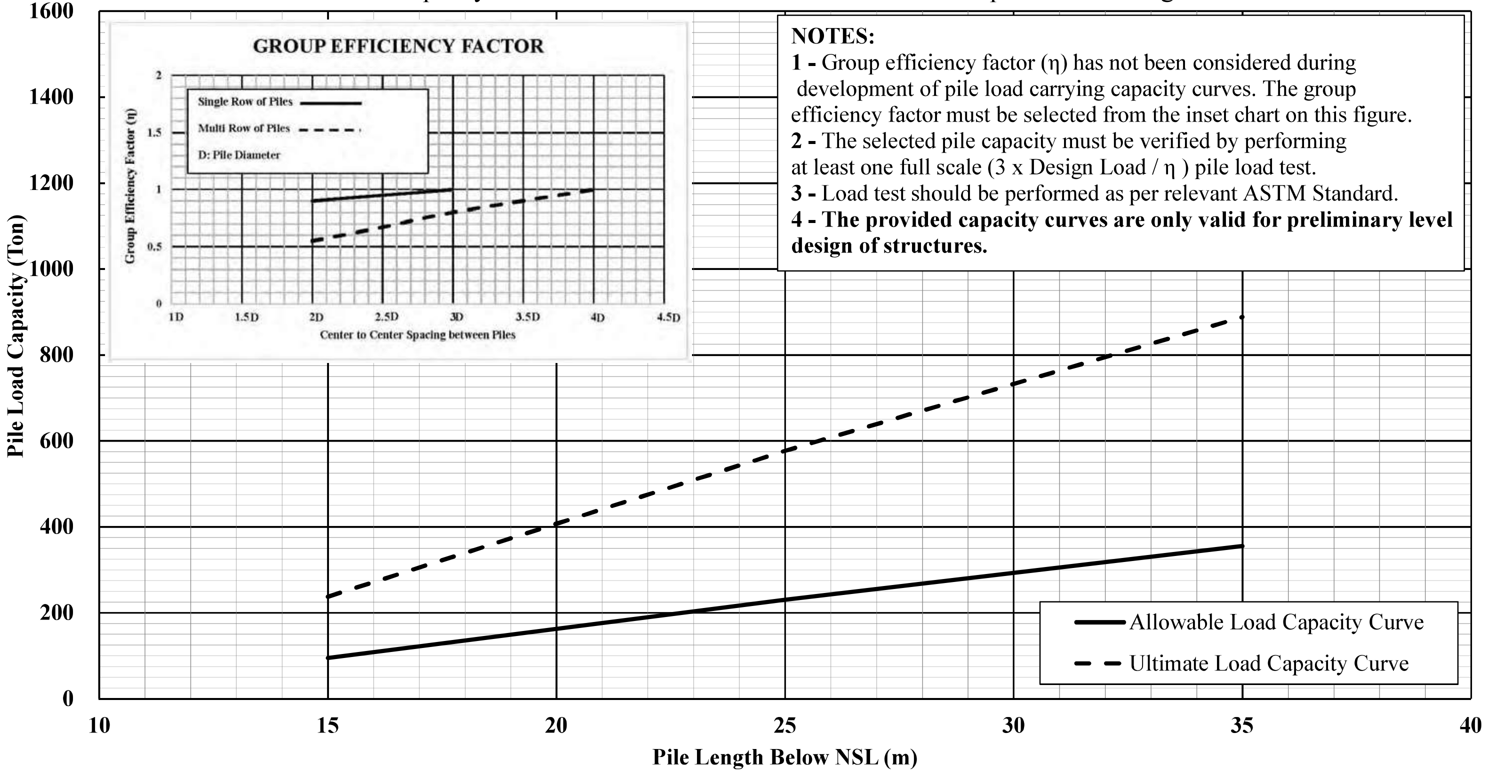
4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-23

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover near Liyari Expressway

Load Capacity Curves for 900 mm Diameter Piles under Compression Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

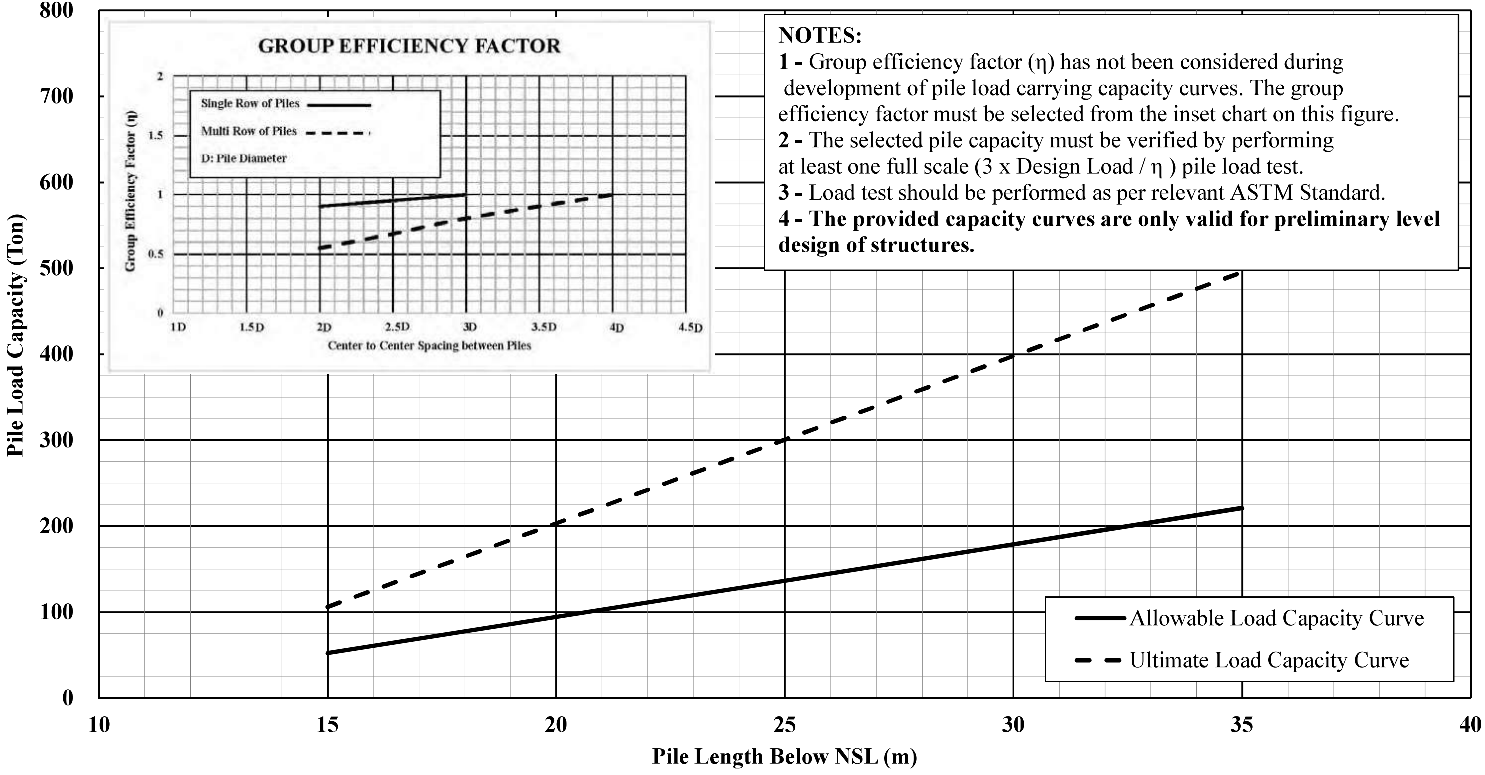
4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-24

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover near Liyari Expressway

Load Capacity Curves for 760 mm Diameter Piles under Tensile Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

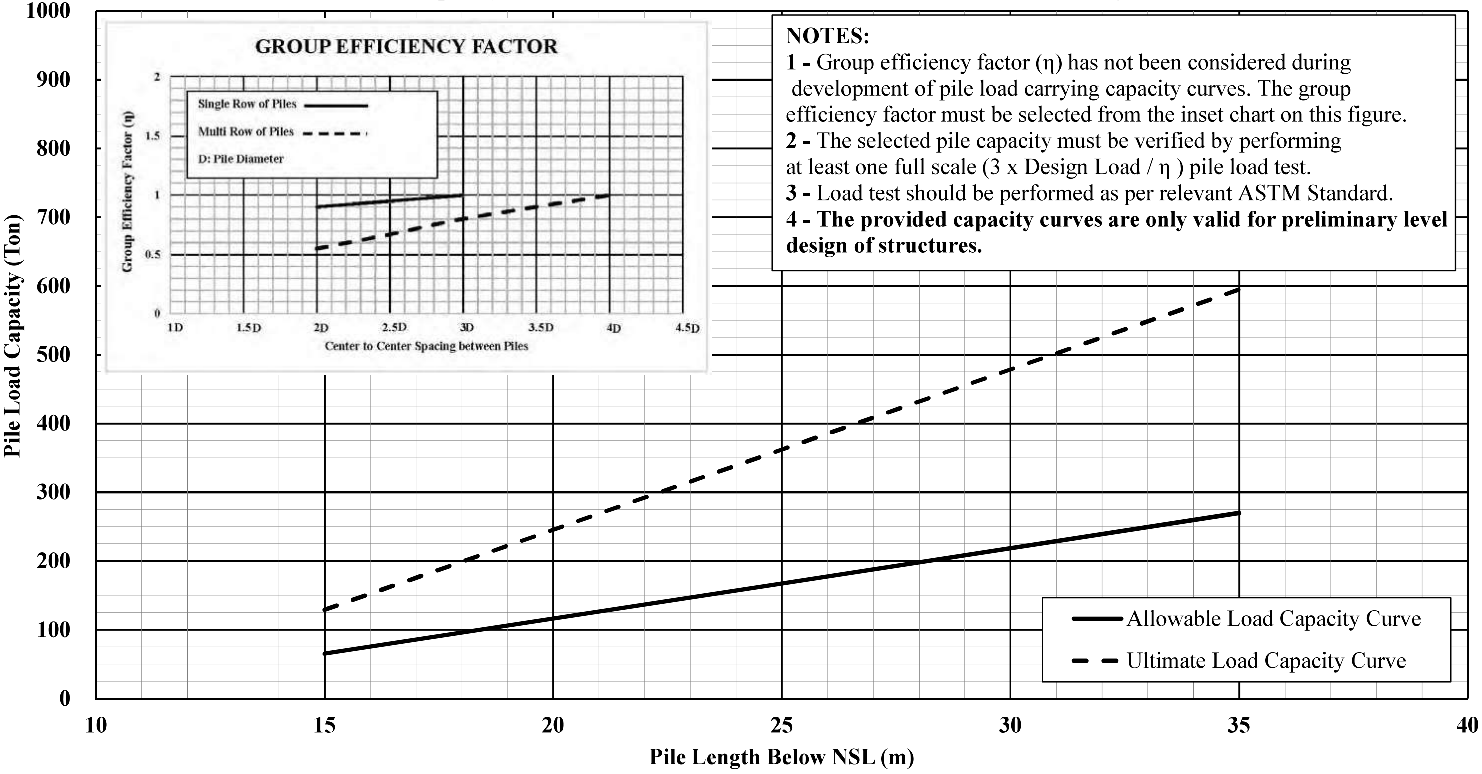
4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-25

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover near Liyari Expressway

Load Capacity Curves for 900 mm Diameter Piles under Tensile Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-26

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Flyover near Liyari Expressway

Soil Spring Stiffnesses

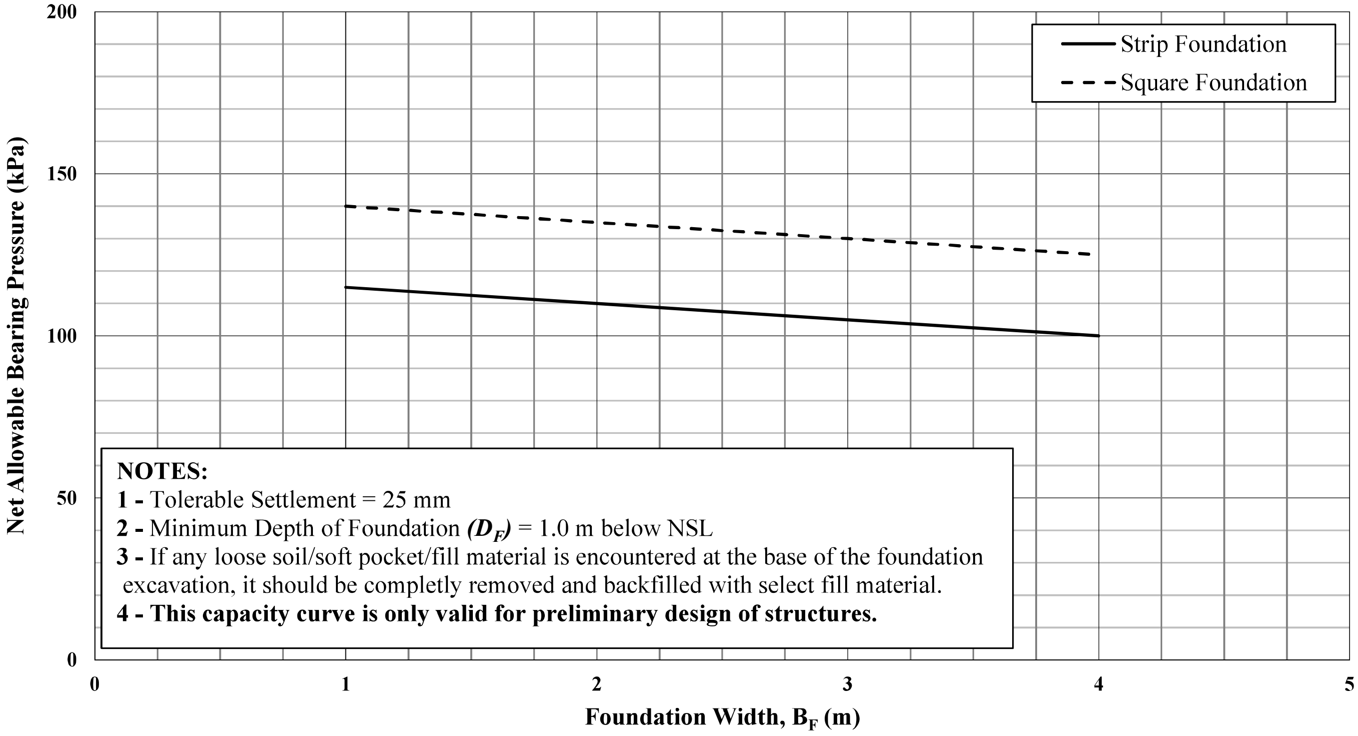
	Pile Diameter = 760 mm			Pile Diameter = 900 mm		
Pile Length below NSL (m)	Horizontal Soil Spring Stiffness ($K_{Horizontal}$)	Vertical Soil Spring Stiffness ($K_{Vertical}$)	Soil Spring Stiffness at Pile Tip (K_{Tip})	Horizontal Soil Spring Stiffness ($K_{Horizontal}$)	Vertical Soil Spring Stiffness ($K_{Vertical}$)	Soil Spring Stiffness at Pile Tip (K_{Tip})
	kN/m^3	kN/m^3	kN/m^3	kN/m^3	kN/m^3	kN/m^3
1	5014	500	-	4234	800	-
2	10027	700	-	8468	1000	-
3	15041	900	-	12701	1200	-
4	20055	1100	-	16935	1400	-
5	25068	1300	-	21169	1600	-
6	30082	1500	-	25403	1800	-
7	79763	1700	-	67356	2000	-
8	91158	1900	-	76978	2200	-
9	102553	2100	-	86600	2400	-
10	113947	2300		96222	2600	-
11	175479	2500		148182	2800	-
12	191432	2700		161653	3000	-
13	207384	2900		175124	3200	-
14	223337	3100		188596	3400	-
15	239289	3300	**60000**	202067	3600	**65000**
16	255242	3500	61000	215538	3800	66000
17	271195	3700	62000	229009	4000	67000
18	287147	3900	63000	242480	4200	68000
19	303100	4100	64000	255951	4400	69000
20	319053	4300	65000	269422	4600	70000
21	335005	4500	66000	282893	4800	71000
22	350958	4700	67000	296364	5000	72000
23	366911	4900	68000	309836	5200	73000
24	382863	5100	69000	323307	5400	74000
25	**398816**	**5300**	**70000**	**336778**	**5600**	**75000**
26	414768	5500	71000	350249	5800	76000
27	430721	5700	72000	363720	6000	77000
28	446674	5900	73000	377191	6200	78000
29	462626	6100	74000	390662	6400	79000
30	478579	6300	75000	404133	6600	80000
31	494532	6500	76000	417604	6800	81000
32	510484	6700	77000	431076	7000	82000
33	526437	6900	78000	444547	7200	83000
34	542389	7100	79000	458018	7400	84000
35	**558342**	**7300**	**80000**	**471489**	**7600**	**85000**

NOTE: The provided soil springs are only valid for preliminary level design of structures.

Fig. E-27

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI
(Retaining Wall and Light Poles for Flyover near Liyari Expressway)

FOUNDATION PROPORTIONING CURVES FOR STRIP & SQUARE FOUNDATION



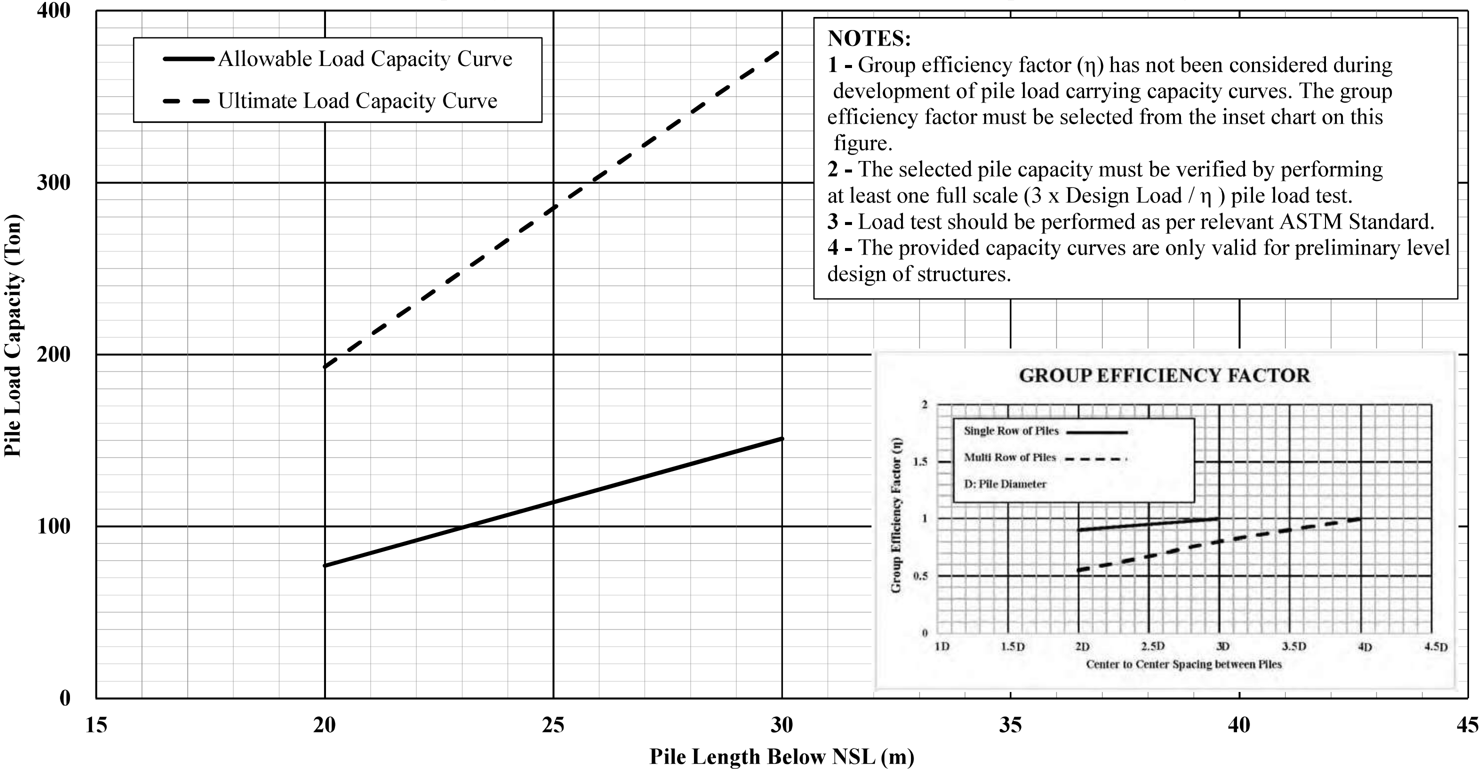
NOTES:
1 - Tolerable Settlement = 25 mm
2 - Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL
3 - If any loose soil/soft pocket/fill material is encountered at the base of the foundation excavation, it should be completly removed and backfilled with select fill material.
4 - This capacity curve is only valid for preliminary design of structures.

Fig. E-28

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Elevated U-Turn

Load Capacity Curves for 760 mm Diameter Piles under Compression Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

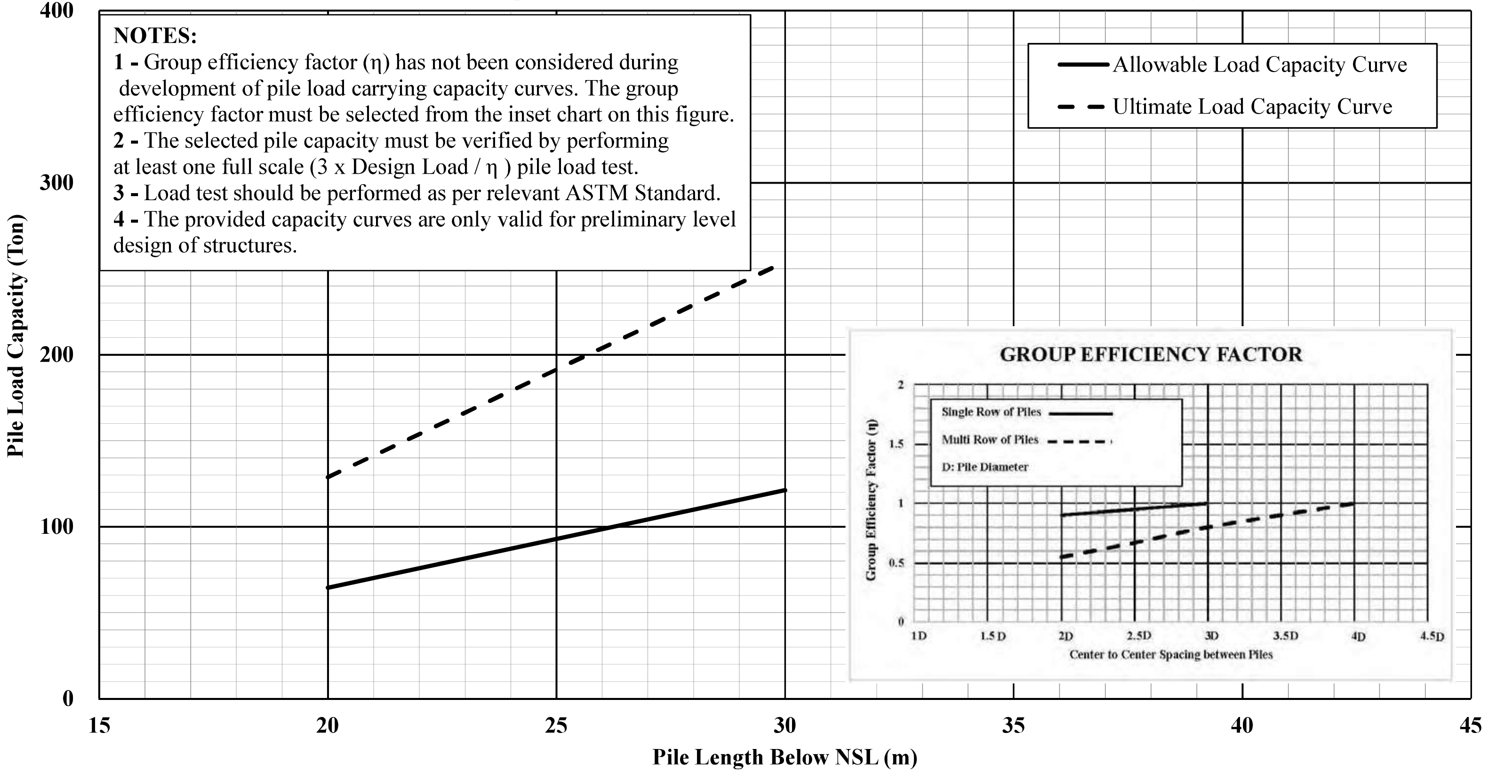
4 - The provided capacity curves are only valid for preliminary level design of structures.

Fig. E-29

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Elevated U-Turn

Load Capacity Curves for 760 mm Diameter Piles under Tensile Loading



NOTES:

1 - Group efficiency factor (η) has not been considered during development of pile load carrying capacity curves. The group efficiency factor must be selected from the inset chart on this figure.

2 - The selected pile capacity must be verified by performing at least one full scale (3 x Design Load / η) pile load test.

3 - Load test should be performed as per relevant ASTM Standard.

4 - The provided capacity curves are only valid for preliminary level design of structures.

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Elevated U-Turn

Soil Spring Stiffnesses for 760 mm Diameter Piles

Pile Length below NSL (m)	**Horizontal Soil Spring Stiffness ($K_{Horizontal}$)**	**Vertical Soil Spring Stiffness ($K_{Vertical}$)**	**Soil Spring Stiffness at Pile Tip (K_{Tip})**
	kN/m^3	**kN/m^3**	**kN/m^3**
1	912	200	-
2	1823	300	-
3	2735	400	-
4	3646	500	-
5	4558	600	-
6	5469	700	-
7	6381	800	-
8	7293	900	-
9	20511	1200	-
10	36463	1325	**27000**
11	40109	1450	28600
12	164084	1575	30200
13	177758	1700	31800
14	191432	1825	33400
15	205105	1950	35000
16	218779	2075	36600
17	232453	2200	38200
18	246126	2325	39800
19	259800	2450	41400
20	**273474**	**2575**	**43000**
21	287147	2700	45300
22	300821	2825	47600
23	314495	2950	49900
24	328168	3075	52200
25	341842	3200	54500
26	355516	3325	56800
27	369189	3450	59100
28	382863	3575	61400
29	396537	3700	63700
30	**410211**	**3825**	**66000**

NOTE: The provided soil springs are only valid for preliminary level design of structures.

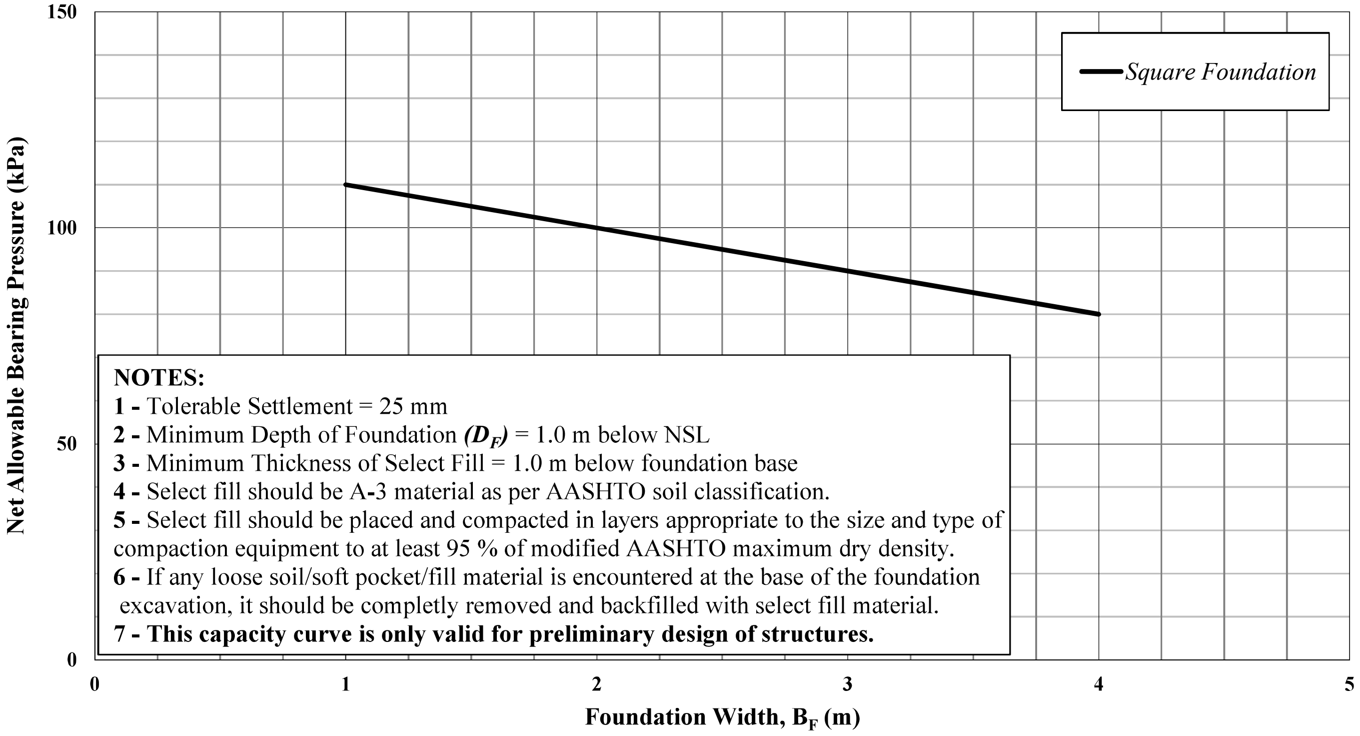
Fig. E-31

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES
URBAN ROAD INITIATIVES IN KARACHI

Elevated U Turn

(Light Poles)

FOUNDATION PROPORTIONING CURVES FOR SQUARE FOUNDATION



NOTES:

1 - Tolerable Settlement = 25 mm

2 - Minimum Depth of Foundation ***(D_F)*** = 1.0 m below NSL

3 - Minimum Thickness of Select Fill = 1.0 m below foundation base

4 - Select fill should be A-3 material as per AASHTO soil classification.

5 - Select fill should be placed and compacted in layers appropriate to the size and type of compaction equipment to at least 95 % of modified AASHTO maximum dry density.

6 - If any loose soil/soft pocket/fill material is encountered at the base of the foundation excavation, it should be completly removed and backfilled with select fill material.

7 - This capacity curve is only valid for preliminary design of structures.

APPENDIX-F

SITE PHOTOGRAPHS

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES,

‘URBAN ROAD INITIATIVES IN KARACHI’

(Sub Project 2: Expressway from Mauripur Road to Y-Junction)

Plate-1: Location of BH-06

Plate-2: Performance of Standard Penetration Test (SPT)

Plate-3: A View of Soil Sample Recovered in Split Spoon Sampler

Plate-4: Performance of Field Density Test in Base Course Layer

Plate-5: Performance of Field Density Test in TP-02

Plate-6: A View of Core box at BH-03

ANNEXURE – 5

OFFICIAL ASSIGNEE OF KARACHI
ADMINISTRATOR GENERAL OF SINDH
OFFICIAL LIQUIDATOR

HIGH COURT OF SINDH
1ST FLOOR, OLD ANNEXE
BUILDING, KARACHI - 74400
TEL: 99203129

No. OA/889/2020

Dated : 21-8-2020

The Project Manager,
National Engineering Services Pakistan
(Pvt) Limited,,
13th Floor, NICL Building,
Abbasi Shaheed Road,
Shahrah-e-Faisal,
Karachi.

Subject: - SUIT NO. 510 OF 1977
ALVIA TABLIGH TRUST VS
MUJEEBUR REHMAN AND OTHERS.

Please refer to your letter No.P-38035/RZ/01/2102 dated 17.08.2020 on the subject noted above.

It is to inform you that as per order dated 02.06.1980 of the Hon'ble High Court of Sindh, Karachi the Company known as M/s. Habib Ocean Industries (Salt Works) is under Receivership of the undersigned. In compliance of said order, all the affairs of the salt work is being dealt by the Official Assignee.

Your request is "allowed subject to that not a single inch of land of M/s. Habib Ocean Industries (Salt Works) be utilized without approval of the Hon'ble Court in Suit No.510 of 1977, as well as all inlets and outlets of M/s. Habib Ocean shall not be disturbed. Mr. Shaikh Muhammad Aamir is deputed as focal person to provide assistance particularly with the caution noted above."

21/08/2020

(DR. CHAUDRY WASIM IQBAL)
OFFICIAL ASSIGNEE OF KARACHI.
DISTRICT & SESSIONS JUDGE.

ANNEXURE – 6

PPPU

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

GOS

Feasibility Study and Transaction Advisory Services, 'Urban Road Initiatives in Karachi'

Sub Project 2: Expressway from Mauripur Road to Y-Junction

Design Criteria

November 2020

National Engineering Services Pakistan (Pvt.) Ltd.
13th Floor, N.I.C. Building, Abbasi Shaheed Road, Off. Shahrah-e-Faisal, Karachi
Phone: (0092 21) 99207277-84
Fax : (0092 21) 35651994
E-mail : nespakkh@khi.wol.net.pk
Web: http://www.nespak.com.pk

Clearance Code	38035/50W/PD/24(20)	Doc No.	P-38035/050P/P2/DC/02	Rev No.	00

Table of Contents

List of Figures

List of Tables

Design Criteria for Sub-Project 2, “Expressway from Mauripur Road to Y Junction”

1 Introduction

1.1 Background

Karachi is the largest city, main seaport and the financial center of Pakistan, as well as the capital of the province of Sindh. The metropolitan area of Karachi is spread over 3,500 sq km and has an estimated population of over 18 million. It is one of the world's largest cities in terms of population. It is Pakistan's premier center for banking, industry, economic activity and trade and is home to Pakistan's largest corporations, including those involved in textiles, shipping, automotive, entertainment, the arts, fashion, advertising, publishing, software development and medical research.

The commercial activities generate large volume of traffic within the city. Considerable volume of heavy freight traffic is generated to and from the Karachi Port and Korangi Industrial Area to the rest of the country.

In 1947 Karachi was populated on an area of 83 sq. km. which has presently expanded to 2500 sq. km. Due to the growth in population and the size of the city, the developments led to phenomenal increase in the road vehicles population.

The tremendous increase in population, industrialization and commercial activities in the city has resulted in rapid increase in all kinds of motorized traffic, and it became imperative to avert further aggravation of the problems of the residents.

Karachi maintains a 7,000 km road network. This limited road space combined with poor maintenance, delayed repair work, poor quality construction, and absence of essential support functions creates problems in satisfying the traffic demand. There are many places where large numbers of commuters move at the same time from one location to another, however, the access roads and links offer very few choices and hence there is considerable congestion on the roads specially during the peak hours.

The urban transport needs of a city are cyclic in nature and largely depend on the travel behavior of the citizens. Although the trips made by private and para transit vehicles are increasing, the noticeable feature is that the buses/minibuses still continue to cater to over 50% of the travel demand.

To mitigate the traffic congestion problems and provide quick and safe access to the commuters of Karachi, the local Government of Sindh has initiated three (03) urban road projects under Public Private Partnership (PPP) mode. These three projects are:

a) Sub-project 1: Link Road from Korangi (From KPT Interchange to PAF Airmen Academy),

b) Sub-project 2: Expressway from Mauripur Road (End of Lyari Expressway) to Y Junction (Kakapir Rd/Mauripur Rd Intersection), and
c) Sub-project 3: Interchange at ICI Bridge/Intersection.

In this regard, Government of Sindh has appointed the consortium led by the KPMG (Lead and Financial Consultant), NESPAK (Technical Consultant) and LEX FIRMA (Legal Consultant) to conduct the Feasibility study and Transaction advisory services to implement the Urban Road Initiative Projects in Karachi.

1.2 Report Purpose

This document provides information related to the design basis, which has been adopted/formulated by different engineering design specialties to finalize technical data, assumptions, codes of practice, methods and procedures for Sub-Project 2, “Expressway from Mauripur Road to Y Junction” of Feasibility Study & Transaction Advisory Services, Urban Road Initiatives in Karachi by Local Government & HTP Department, GOS.

1.3 Brief of Sub Project 2, “Expressway from Mauripur Road to Y Junction”

Mauripur Road is one of the busiest roads which serves the heavy traffic from the Karachi Port for onward journey to up-country via Northern Bypass or Hub Road. The construction of Lyari Expressway (which terminates at Mauripur Road) has increased the traffic on this particular road as Lyari Expressway provides fast and convenient access from Mauripur Road to the outskirts of the city i.e. Sohrab Goth and beyond.

Mauripur Road also connects with the Northern Bypass and Beaches i.e. Hawksbay, Sandspit & other recreational areas. Several Industrial units also located on Mauripur Road between Kakapir Road & PAF Base Masroor, which carries a mix of heavy and light vehicles. However, a large number of heavy vehicles cause significant delays for all modes of traffic.

In order to alleviate traffic congestion, a bypass road from the junction of Mauripur Road / Kakapir Road up to Lyari Expressway has been planned, which will significantly improve the traffic management of Mauripur and surrounding areas. This corridor will resolve the traffic pressure in the city as the proposed expressway will also have its connectivity with Lyari Expressway. Once the proposed expressway is constructed and merged with the Mauripur road and Lyari Expressway, the overall traffic load of the Mauripur area will be improved.

1.4 Project Location, Proposed Alignment and 3D Views

- Project Location is shown in Figure 1
- Proposed Alignment is shown in Figure 2
- 3D views of Toll Plaza and Admin Building are shown in Figure 3 and 4

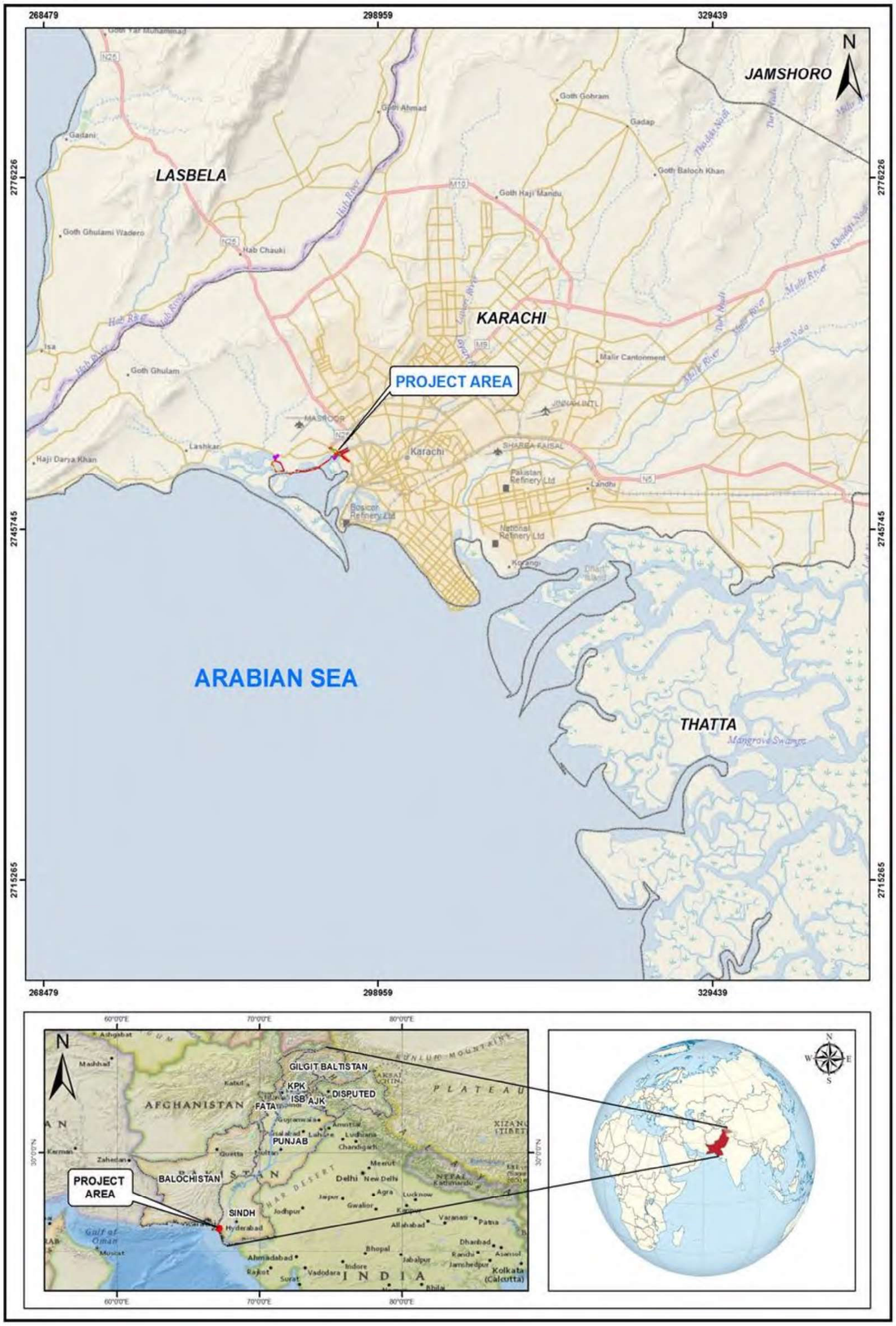


Figure 1: Project Location

Figure 2: Proposed Alignment

Figure 3: Admin Building and Toll Plaza (3D View - I)

Figure 4: Admin Building and Toll Plaza (3D View – II and III)

2 Topographic Survey

2.1 Introduction

The methodology covers details of locations of survey control network, instruments used, measurement details, position fixation, coordinates and layout of the above defined scope of works.

2.2 Location & Extents of The Project Site

The project area for which survey has been carried out includes Lyari Express way, Mauripur road, Kakapir road and strip along the coast. The Bathymetry survey data within the project area has also been collected for the study.

The location map of the subject project is shown in Figure-1.

2.3 Scope of Survey Work

Survey is required to obtain basic information regarding topography, terrain, drainage pattern, profile etc. of the project area.

The survey detail is inclusive of, but not limited to the elements listed below;

- Site Reconnaissance visit of the Project area.
- Establishment of survey Bench Marks (BM) in the project area.
- Topographic survey of entire project area.
- Inventory of existing structures.
- Processing of the observed data.
- Preparation of Topographic Survey Map and related report of project area.

The above-mentioned scope of the work has been completed by using the following methodology;

2.4 Work Plan and Site Reconnaissance Visit

A comprehensive work plan has been established and implemented in the field by qualified survey team during execution of survey works.

Site reconnaissance survey of the project area has been carried out to assess the field conditions and general topography to finalize the survey activities/ implementation plan.

2.5 Establishment of Survey Bench Mark (Bm)

Establishment of local control points is an essential activity which is to be carried out prior to actual commencement of surveying and mapping of the project area. New technology Global Navigation Satellite System (GNSS) makes it more efficient and effective to establish a primary control bench mark. Often National Geodetic Survey (NGS) vertical control is not readily available within the project area, thus the new procedures allow for establishing a vertical height easily, efficiently, and economically using GNSS.

Next activity is selection of a project control point and utilization of vertical data derived from GNSS observation processed through Online Positioning User Service (OPUS) as our primary control bench mark.

The values obtained in World Geographic System (WGS) can easily be transferred to local or Universal Transverse Mercator (UTM) Systems.

This Bench Mark has been used as a reference point for further establishment of horizontal and vertical control network, within the project area, to carry out the topographical and cross-sectional survey work.

The coordinates & location of established control points are presented in Table-1 and Table-2 in WGS-84 and UTM coordinate system respectively and shown in Figure-5.

2.6 Selection of Control Points Location

Quality is a characteristic of comparable things that allows us to decide that one thing is better than another. In the context of geographic data, the ultimate standard of quality is the degree to which a data set is fit for its effective use.

Selection of location for control points (Established Bench Marks) were based on three elements i.e. stability for the soil conditions encountered for each point set, safety of the established point and ample clear view to the sky, which are crucial for GNSS observations. In order to mitigate errors and to increase accuracy, the control network was planned and designed to form triangles wherever possible.

2.7 Establishment of Horizontal and Vertical Control Networks

Horizontal and vertical project control survey has been established for the project. Whenever feasible, the horizontal and vertical control is based on high-precision GNSS observations.

In order to achieve maximum possible accuracy and minimal spatial variations in both horizontal and vertical planes, control network was established by using state of the art "GNSS" equipment encompassing the entire project area.

For base line computation, three (3) GNSS instruments have been used simultaneously. To receive the signals from satellite, the receiver should have minimum obstructions like building, trees, power lines etc., around it.

In case of weakening of signals due to unfavorable weather conditions like rainfall, clouds and vehicle noise, the observations have repeatedly been noted till obtaining satisfactory readings/data.

For all time observations, at least four (4) satellites should be available with Geometric Dilution of Precision/Position Dilution of Precision (GDOP/PDOP) value of less than five (5).

The availability of satellites and `GDOP value can be known in advance with the help of computer program for given time, date and point of observations. Each instrument is set to work at least 30 minutes for simultaneous observations.

Out of three (3) receivers, one acted as reference (for which coordinates of the observing point are known) and the other two (2) as rovers (coordinates to be computed). The observed point coordinates served as reference for further observing points to make a triangle or large polygon. CPs has been engraved at the permanent structures.

Table-1: List of Control Points Coordinates in World Geographic System (WGS) 84

Sr. No.	Control Point	Latitude (DMS)	Longitude (DMS)	Elevation (m)
1	P2/BM T2	24° 52' 24.920" N	66° 58' 14.677" E	6.890
2	P2/CP T1	24° 52' 15.004" N	66° 58' 35.566" E	8.212
3	P2/CP01	24° 51' 57.182" N	66° 59' 3.022" E	5.384
4	P2/CP02	24° 52' 15.121" N	66° 58' 35.376" E	8.321
5	P2/CP03	24° 52' 21.322" N	66° 58' 28.068" E	16.052
6	P2/CP04	24° 52' 31.146" N	66° 58' 4.171" E	15.491
7	P2/CP04A	24° 52' 24.480" N	66° 58' 19.743" E	7.909
8	P2/CP05	24° 52' 10.499" N	66° 58' 3.576" E	4.329
9	P2/CP06	24° 51' 34.473" N	66° 57' 2.964" E	5.810
10	P2/CP07	24° 52' 5.211" N	66° 55' 5.494" E	6.283
11	P2/CP08	24° 51' 55.108" N	66° 54' 59.165" E	5.318
12	P2/CP09	24° 51' 37.948" N	66° 54' 59.472" E	4.493
13	P2/CP10	24° 51' 28.848" N	66° 55' 32.358" E	2.853

Table 1: List of Control Points in WGS 84

Table-2: List of Control Points Coordinates in Universal Transverse Mercator (UTM) Zone 42N

Sr. No.	Control Point	Easting (m)	Northing (m)	Elevation (m)
1	P2/BM T2	294991.422	2752477.976	6.890
2	P2/CP T1	295573.265	2752164.140	8.212
3	P2/CP01	296335.851	2751604.335	5.384
4	P2/CP02	295567.967	2752167.821	8.321
5	P2/CP03	295365.662	2752361.683	16.052
6	P2/CP04	294699.380	2752673.960	15.491
7	P2/CP04A	295133.425	2752462.330	7.909
8	P2/CP05	294673.189	2752038.914	4.329
9	P2/CP06	292955.045	2750955.879	5.810
10	P2/CP07	289671.616	2751951.704	6.283
11	P2/CP08	289489.201	2751643.541	5.318
12	P2/CP09	289489.729	2751115.393	4.493
13	P2/CP10	290408.725	2750821.297	2.853

Table 2: List of Control Points in UTM Zone 42N

The accuracy of the survey control points in static mode is as follows:

Horizontal …………….. ± 3 mm +1 ppm RMS
Vertical……………….. ± 5 mm +1 ppm RMS

2.8 Instruments Used

Leica Viva GS 10, GS 15 and Trimble R2, R9 were used to establish the control points. Also, these systems with one base and receivers (rovers) were used to collect the survey data in RTK mode.

The topographic survey has been carried out by using the GNSS in Real Time Kinematic (RTK) mode. The base station was placed on the known control point and the rover has been used for collecting the survey points. The accuracy of the GNSS equipment in RTK mode is as follows:

Horizontal ……………. ± 10 mm +1 ppm RMS
Vertical………………... ± 20 mm + 1 ppm RMS

2.9 Measurement Units

The linear measurement units used in survey and mapping work are in metric system of units and the angular measurement are in degrees, minutes and second of arc.

2.10 Field Data Processing

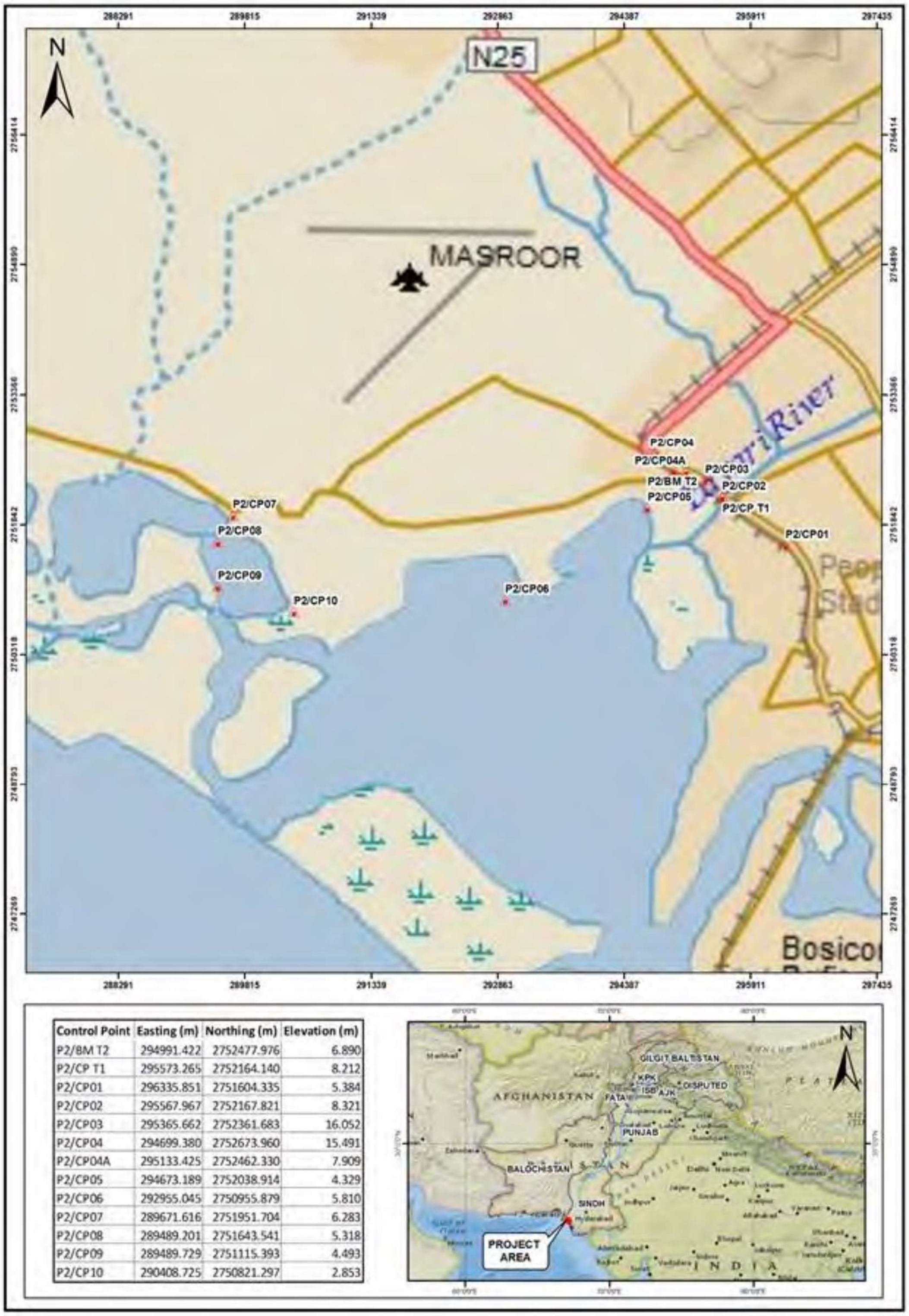
The data observed was downloaded to laptop which always remain available with survey team at the survey site. The data has been processed and checked at the site for quality and gaps, if any. The GPS baselines were processed using Leica Geo Office (LGO) and Trimble Business Centre (TBC) software. The default acceptance criteria for baselines were used in LGO & TBC. Any baseline not fulfilling the acceptance criteria has been repeated. As the GNSS reading is based upon the WGS-84, the data was converted into UTM Zone 42.

2.11 Software Used

All the observed data has been processed using LGO, TBC and ArcGIS software which are widely used for field data processing. AutoCAD and Eagle Point software have been used for preparation of the topographic survey layouts using the field survey data.

2.12 Data Post Processing and Production of Drawings

The observed data was digitized using AutoCAD software in the form of points, lines and polygons. The digitization of features has been done in different AutoCAD layers. The feature layers have unique style and symbols so that these can be well distinguished from other features.



Control Point	Easting (m)	Northing (m)	Elevation (m)
P2/BM T2	294991.422	2752477.976	6.890
P2/CP T1	295573.265	2752164.140	8.212
P2/CP01	296335.851	2751604.335	5.384
P2/CP02	295567.967	2752167.821	8.321
P2/CP03	295365.662	2752361.683	16.052
P2/CP04	294699.380	2752673.960	15.491
P2/CP04A	295133.425	2752462.330	7.909
P2/CP05	294673.189	2752038.914	4.329
P2/CP06	292955.045	2750955.879	5.810
P2/CP07	289671.616	2751951.704	6.283
P2/CP08	289489.201	2751643.541	5.318
P2/CP09	289489.729	2751115.393	4.493
P2/CP10	290408.725	2750821.297	2.853

Figure 5: Location Map of Established Survey Bench Marks

3 Geotechnical Investigations/Studies

3.1 Introduction

Geotechnical investigations are aimed at revealing the general subsurface soil / rock types at the site for the purpose of efficient and cost-effective feasibility level design of proposed development works for Expressway from Mauripur Road to Y-Junction

The following Sections provide our work plan and methodology for undertaking the conceived geotechnical investigations.

3.2 Planning

The subsoil / rock investigations have been planned through execution of boreholes, excavation of test pits, field testing and sampling followed by appropriate laboratory testing for the purpose of feasibility level design of proposed development works. The investigations have been planned in such a way as to provide sufficient information about the condition and the strength of various sub-strata.

3.3 Field Investigations

After finalization of scope of work, a specialist drilling Contractor has been engaged on the basis of competitive bidding as per PPRA Rules. Upon award of work, the field investigations have been directly supervised by NESPAK staff on full time basis. The Contractor mobilize to the site with straight rotary drilling / percussion boring equipment along with all necessary allied accessories for testing and sampling.

The following field investigations have been envisaged / planned to be carried out:

- Execution of boreholes up to a maximum depth of 40 m below NSL or up to rock strike level, whichever is met earlier, by straight rotary drilling / percussion boring method including backfilling of boreholes to their original position by cement: sand: bentonite mix.
- Continuous core drilling (NX size in general) in bedrock up to a minimum depth of 3 m below rock strike level, including preservation of core samples in core boxes, waxing of core samples, photography of rock cores and transportation of core samples to the laboratory.
- Performance of standard penetration tests (SPTs) in the boreholes in overburden soils, generally at 1 m depth interval, including collection and preservation of spilt-barrel samples as per ASTM D - 1586.
- Collection of relatively undisturbed soil samples (UDS) from boreholes through Shelby/Denison/Pitcher sampler.
- Excavation of test pits up to a maximum depth of 2 m or up to subgrade, whichever is met earlier, exposing of road / pavement layers and

backfilling of pits to their original condition along with collection of bulk composite samples, wherever considered necessary.

- Performance of field density tests (FDTs) through sand replacement method at the selected horizons in test pits.
- Collection of groundwater sample, if encountered in the boreholes/test pits.
- Logging of boreholes/test pits
- After completion of the field investigations, the site shall be restored to the condition existing before the work started, including backfilling of boreholes with cement-sand- bentonite slurry, unless otherwise directed.
- Establishment of coordinates and ground elevation of all the boreholes and test pits using Total Station.

3.4 Laboratory Testing

The laboratory testing be carried out at an approved laboratory. Selected representative samples of soil / rock and water obtained during site investigations will be subjected to appropriate laboratory tests to evaluate the following engineering properties:

- Classification
- Shear strength of soil / rock
- Moisture-density relationship
- Compressibility characteristics
- Chemical characteristics
- Other relevant engineering characteristics

3.5 Analysis and Report

After completion of the field work, subsurface soil / rock profiles be developed for each project site, separately on the basis of the information obtained from boreholes. These shall be studied in conjunction with the laboratory test results and state-of-the-art literature, to formulate soil / rock parameters. The following pertinent engineering studies shall be carried out on the basis of the formulated parameters and the field and the laboratory investigation data:

- Evaluation of subsurface materials and subsurface soil / rock profiles
- Considerations for appropriate foundation system
- Bearing capacity analysis
- Settlement analysis
- Geotechnical recommendations for feasibility level design of foundations
- Geotechnical recommendations for feasibility level design of road network
- Aggressivity of subsoils / rocks and groundwater on buried R.C. works and any special measures required for their protection

These studies shall be summarized in the form of comprehensive geotechnical investigation report for each project site, separately. The reports shall include but not limited to a general description of the site and field activities, location of all boreholes & test pits, groundwater elevation measurements, disturbed/undisturbed soil sample details, rock core details, field/laboratory test results and geotechnical recommendations for feasibility level design of foundations and road network.

3.6 Geotechnical Design Criteria

The foundations of all the structures and road network should meet the following design criteria:

- These should be safe against shear failure of the supporting ground. A factor of safety of 3.0 will be adopted for this purpose during bearing capacity evaluation of shallow foundations. However, a safety factor of 2.5 will be considered during pile load carrying capacity evaluation.
- All the foundations should not settle excessively under the service loads. A limit of 25 mm will be put on the total settlement of strip / square foundations and 50 mm on the total settlement of mat foundations. Similarly, the angular distortion between the edge and the center of the foundations should not exceed 1/500.
- The soil for sub-grade and embankment construction should be at least A-3/A-4 type as per AASHTO soil classification and minimum CBR value of 7 and 5 respectively at 95% Modified AASHTO density.

3.7 Geotechnical Investigation Report

Based on above criteria, Geotechnical Investigation Report has been established and shall be submitted accordingly.

4 Infrastructure Development (Roads and Drainage) Works

4.1 Introduction

The design of Expressway from Mauripur Road to Y-Junction is based on a set design criterion that represent the best internationally accepted engineering practice. At the same time, the specific local site conditions have also been effectively considered in the interpretation of these criteria. It is to be emphasized that engineering design is an integrated process of information collection, analysis, synthesis and evaluation. The ultimate objective of this process is achievement of the desired performance in the constructed facility. As such the design criteria represent the performance objective, while satisfying the economic constraints.

4.2 Reference Documents

Design parameters for this project are based principally on the following guideline documents:

- A Policy on Geometric Design of Highways & Streets 6th Edition 2011, AASHTO
- AASHTO Guide for Design of Pavement Structures 1993

4.3 Geometric Design Criteria

The design vehicle for this project has been divided into two categories:

- Single Unit Truck SU-12: For Elevated U-Turn (located on Mauripur Road)
- Interstate Semi Trailer WB-20: For the Mauripur Expressway including interchanges and flyovers.

However, during the detail design stage the Contractor shall confirm the same from the Independent Engineer/GOS.

4.3.1 Design Speed

Following design speed have been considered.;

- Mauripur Expressway : 90 kph
- Marine Academy Flyover : 80 kph
- At interchanges : 30 to 40 kph.

However, during the detail design stage the Contractor shall confirm the same from the Independent Engineer/GOS.

4.3.2 Design Elements

The curve radii and the sight distances adopted for the geometric design of the project is given in Table-3 below:

<table>
<tr><th rowspan="2">Sr. No</th><th rowspan="2">Description (m)</th><th colspan="6">Speed KPH</th></tr>
<tr><th>30</th><th>40</th><th colspan="2">80</th><th colspan="2">90</th></tr>
<tr><td>1</td><td>Stopping sight distance (m)</td><td>35</td><td>50</td><td colspan="2">130</td><td colspan="2">160</td></tr>
<tr><td>2</td><td>Passing sight distance (m)</td><td>120</td><td>140</td><td colspan="2">245</td><td colspan="2">280</td></tr>
<tr><td>3</td><td>Minimum Curve Radius (m)</td><td>22</td><td>47</td><td>280</td><td>252</td><td>375</td><td>336</td></tr>
<tr><td>4</td><td>Maximum super-elevation rate</td><td>4%</td><td>4%</td><td>4%</td><td>6% (For Marine Academy Flyover Only)</td><td>4%</td><td>6%</td></tr>
<tr><td rowspan="2">5</td><td>Minimum K (at Crest) for SSD</td><td>2</td><td>4</td><td colspan="2">26</td><td colspan="2">39</td></tr>
<tr><td>Minimum K (at Sag) for SSD</td><td>6</td><td>9</td><td colspan="2">30</td><td colspan="2">38</td></tr>
<tr><td>6</td><td>Minimum K (at Crest) for PSD</td><td>17</td><td>23</td><td colspan="2">69</td><td colspan="2">91</td></tr>
</table>

Table 3: Design Elements

The maximum upgrade gradient for this project has been taken as 4.5%.

4.4 Cross-sectional Elements

4.4.1 Lane Width

Maximum Lane width : 3.5 meters
Minimum Lane width : 3.0 meters

The Contractor shall provide road widening considering the AASHTO requirement for largest vehicle, where deemed necessary, during the detail design stage after due consultation with the Independent Engineer/GOS.

4.4.2 Shoulder Width

- Mauripur Express Way, a high-speed road

  Outer Shoulder : 3.0 meters
  Inner shoulder : 1.2 meters

- Flyovers:
  Outer Shoulder : 1.2 meters
  Inner shoulder : 1.2 meters

- No shoulder is provided at the Elevated U-turn because of the space constraint.

4.4.3 Cross-Slope

The cross-slope of the alignment has been taken as 2% for the main carriageway, and 2.5% for the shoulder. The cross slope is kept towards sea side.

4.4.4 Vertical Clearance

The vertical clearance of the structures from the road level has been taken as minimum 5.1 meters, while where the proposed alignment crosses the railway line, the vertical clearance has been kept as minimum 6.5 meters.

4.5 Pavement Design

Following two types of pavements have been considered for this project, namely

a. Flexible pavement
b. Rigid pavements.

Flexible pavement has been provided on the complete alignment, while the Rigid pavement has been provided at the Toll Plaza.

There are primarily two reasons for providing rigid pavement at Toll Plaza. Toll Plaza is the area where vehicles will stop for longer periods of time, and leakage of fuel or oil could be expected. Such spills are harmful for asphaltic surfaces and may results in early degradations/deterioration of pavement. Similarly, due to continuous application of brakes at the booths, shoving of the asphalt surfacing may take place therefore, rigid pavement is recommended at this location.

4.5.1 Flexible Pavement

The road flexible pavement is a layered structure to distribute concentrated axle loads to the sub-grade. The performance of pavement structure is directly related to the physical properties and conditions of the roadbed soils and traffic which pavement can be expected to carry from time of construction to the time of terminal service-ability. The pavement, which is the vital component in the road design, must be structurally sound and should be economical and cost effective at the same time. Realistic assessments of traffic and soil properties are necessary to design the technically sound and economical pavement.

4.5.1.1 Design Procedure

The following procedure has been adopted for the design of the flexible pavement structure for the road:

- The traffic data has been projected for 20 years using the traffic growth factors obtained from different studies.

- Projected traffic has been converted in to equivalent standard axle load (ESAL’s) using standard ESA factors recommended by AASHTO and NTRC.
- The cumulative standard axle load has been computed. For the design load calculations and total cumulative standard, axle load has been multiplied with directional distribution factor and lane factor recommended by AASHTO Guide for Design of Pavement Structure 1993.
- Designed California Bearing Ratio (CBR) value has been taken as 10%.
- The flexible pavement design has been finalized by using the AASHTO Guide for Design of Pavement Structures. The governing factors for the flexible pavement design are Equivalent Standard Axle Load (ESALs) and CBR values of sub grade soil.
- Finally, the pavement section has been finalized by using AASHTO Guide for Design of Pavement Structures 1993.

4.5.1.2 Design Life

The design life for flexible pavement has been taken as 20 years.

4.5.1.3 Design Parameters

Following parameters have been used to analyze the pavement structure.

- Reliability (%)
- Overall standard deviation
- Initial Serviceability (Po)
- Terminal Serviceability (Pt)
- Subgrade CBR %
- Resilient Modulus (psi)
- Drainage Coefficient (m)
- Layer Coefficients

Using the above inputs and design equation as per AASHTO guidelines layer thicknesses in a flexible pavement were determined.

4.5.2 Rigid Pavement

A typical rigid pavement has three elements:

1. Subgrade
2. Sub-base
3. Concrete pavement

Subgrade is the in-situ soil over which the pavement structure is supported.

Sub-base is the layer of selected granular materials placed on the subgrade soil and immediately below the concrete pavement. Concrete pavement is designed on the basis of flexural strength of concrete.

4.5.2.1 Design Procedure

Rigid pavement design is based on AASHTO 1993 design guide with following governing design parameters;

- Modulus of Rupture
- Modulus of Subgrade Reaction (k)
- Design Life
- Equivalent Standard Axle Load (ESALs) Millions
- Load Transfer Coefficient (Cd)
- Loss of Support Value
- Standard Normal Deviation (Zr)
- Standard Deviation
- ΔPSI

There are many types of joints used in the construction of concrete pavements but they all control the movement of the pavement and the associated cracking and/or differential settlement. Unless otherwise indicated, all joints are placed perpendicular to the grade. Longitudinal joints are placed parallel to the centre line, and transverse joints are placed at right angles to the centre line for the full width of the pavement.

4.5.2.2 Design Life

The design life for rigid pavement is taken as 20 years.

5 Structural Works

5.1 Introduction

This section describes the details and design parameters considered for Sub Project-2 of Urban Road Initiative project. The Sub Project-2 is mainly an Expressway from Mauripur Road to Kakapir Road and has four flyovers, single span bridges and other ancillary structures, details of which are as follows:

a) A flyover will connect Expressway with existing Lyari bridge at Mauripur Road.

b) The second flyover will be constructed near Marine Academy, to pass the traffic over existing Jetty of the Academy, named as Marine Academy Flyover.

c) Third flyover provides an interchange to expressway over Kakapir road, named as Kakapir Flyover.

d) Fourth one is titled as Elevated U-turn that will be constructed over Mauripur Road near Lyari bridge.

e) Besides above four bridges, nine single span bridges will also be constructed along the expressway to provide uninterrupted traffic flow movement and to avoid obstruction against flow of water bodies and to maintain the hydrology of the site.

f) In addition to above, a Toll Plaza and an Admin Building will also be constructed near Lyari bridge to collect toll and control the expressway.

Vehicle loads and its associated parameters will be considered from West Pakistan Highway Code 1967 and Seismic analysis will be carried out as per code requirements (AASHTO/ UBC 97).

The flyovers are categorized under “Other Bridges” (non-essential) since there are alternative routes available to the area served.

Abutments have been planned keeping the height that will allow maintenance work to be carried out underneath.

The Contractor to be hired by the Employer/GOS for this project should keep in mind to leave space requirement for uninterrupted traffic flow in design of the scaffolding and formwork for the box girders construction.

The Contractor should also keep in the mind the right of way of Karachi Circular Railway/Pakistan Railway along the corridor while detailed design of the foundations.

All the flyovers have end abutments followed by a retaining wall, except for bridge near Lyari expressway where there is abutment at one end and the other end of the bridge has been planned in a way to match with the existing Lyari Bridge for traffic flow to and from the existing flyover. At this location there is an existing railway line for which piers of the proposed bridge have been planned in a way to maintain the clearance to the track and its right of way. The same should mandatorily be considered during detailed design stage by the Contractor.

Spans of bridges with pre-cast girders have been planned for fast track construction, however, Box girders have also been planned wherever required as per structural safety and stability requirements.

GOS / Independent Engineer shall take special care for deflections to allow smooth flow of traffic from one flyover to other, while reviewing detailed design to be submitted by the Contractor.

5.2 Earthwork

The Earthwork shall require to be carried out as per geotechnical investigation report and Roads/Structural drawings for flyovers and other structures.

5.3 Foundation

5.3.1 For Flyovers

Successful bidder shall arrange for confirmatory soil investigation before proceeding with the detailed design and construction works. However, piles diameter of 760mm, 900mm and 1200mm have been assumed for designing purpose as per recommendations of Geo-Technical investigation report carried out by NESPAK and as per space & load requirements. Furthermore, design of all structural components of bridge and allied facilities shall be based on the results / recommendations of confirmatory Geo-Technical investigation to be carried out by the contractor.

5.3.2 Toll Plaza and Admin Building

Shallow foundations have been planned for Toll Plaza and Admin Building as per recommendations of Geo-Technical Investigation Report carried out by NESPAK proposing a minimum of 1.0 m thickness of selected fill under the foundations.

5.3.3 For Pole Foundations (Max 15m high)

As per recommendations of Geo-Technical investigation report, spread foundation at grade locations of Light Pole have been planned at 1.0m depth below NSL/ FRL with selected material fill.

5.4 Superstructure

5.4.1 Flyovers

The super-structure for flyovers comprises of pre-cast pre-stressed girders; however, some portions of superstructure at the curvature will be continuous box girders. All girders will be simply supported on laminated elastomeric bearings resting on reinforced concrete transoms, whereas pot bearings have also been proposed to support box-girders.

5.5 Loading

5.5.1 Types of Loads

- **Dead Loads**
  - Structural Dead Weight : Reinforced Concrete = 24 KN/m3
  - Earth Fill : Compacted Soil = 19 KN/m3
  - Wearing Surfaces (50+50) mm : Load Carpeting = 23 KN/m3
    (50mm Future Provision has been kept in design)
  - Soil Fill : Compacted Soil = 19 KN/m3

- Concrete Barrier Load : Reinforced Concrete = 24 KN/m3
  (As per actual)
- Foot Path Load : Concrete/Fill/planks =24/19 KN/m3
  (As per actual)

- **Transient Loads**

  - Vehicular Load : Class A & AA loading of West Pakistan Highway Code. (Except vehicular load, all loads will be applied in accordance with AASHTO LRFD Bridge Design Specifications 2012; such as)

    - Vehicular Dynamic Load Allowance (WPHC)
    - Live Load Surcharge
    - Tractive force
    - Centrifugal force
    - Pedestrian Load : 3.6 kN/m^2

- **Environmental Loads : Ref: Aashto Lrfd 2012**

  - Seismic Loads

    - Seismic Zone : 2B as per BCP 2007
    - Soil Profile Type : As per GT report
    - PGA : 0.16 to 0.24 (Zone 2B)

  - Wind Loads : N/A

    Since Seismic analysis is governing the design, therefore case of wind load needs not to be considered for flyover concrete structure, however, pole foundation has been designed for wind loading.

    - Basic wind speed (Fastest mile) : 100mph
    - Exposure : AS per location
    - Wind Importance factor (Iw) : 1.0

  - Water Loads : Water loads shall be applied as per AASHTO LRFD article 3.7 wherever required.

  - Equipment Loads : N/A

  - Piping Loads : N/A

- Construction Loads : As per actual

5.6 Limit States Used

- **Bridge Design**
  - STRENGTH – I : Normal vehicular use of Bridge.
  - EXTREME – I : Including load due to earthquake.
  - SERVICE – I : Normal operational use of bridge.
- **Other Structures' Design**
  - Strength Combinations : As per UBC-97
  - Alternate Basic Load Combinations : As per UBC-97

5.7 Construction Materials

5.7.1 Concrete

All concrete shall be tested in accordance with ASTM standards C31, C39, C172 & specifications and the minimum cylinder specified strength of concrete at 28 days shall be as per Table 5 below.

Class* (NESPAK standard)	Min. Cylinder crushing strength At 28 days (MPA).	Equivalent NHA class
A2	42 MPa	D2
A1	35 MPa	D1
A	28 MPa	A3
B	21 MPa	A1
C	17 MPa	B
D	08 MPa	-
E	05 MPa	Lean Concrete

Table 4: Concrete Strength

** Concrete strengths shall be as per NESPAK's standard specifications.*
*** Maximum Aggregate Size shall be 20 mm*

Class of concrete along with type of cement for different structures shall be as follows unless noted otherwise in the Preliminary design drawings.

Type of Construction/Structure	Class	CLASS* (NESPAK Standard)	Equivalent NHA Class
Pre-cast I-Girders/Box Girders	A2	Ordinary Portland Cement	D2
Deck, Pre-cast Planks, Approach slab, diaphragm, Barrier, shear key	A	Ordinary Portland Cement	A3
Columns of Bridge	A1	Ordinary Portland Cement	D1
Piles, Pile caps and Abutments	A1	Modified Cement	D1
Retaining walls, Abutments	A	Ordinary Portland Cement	A3
Fill	C/ D	Ordinary Portland Cement	B
Lean Concrete	E	Ordinary Portland Cement	Lean Concrete

Table 5: Cement Type

5.7.2 Reinforcement

Reinforcing steel shall comply with ASTM A706. ASTM A615 grade 60 reinforcement shall be permitted if:

- The actual yield strength based on mill tests does not exceed fy by more than 18,000 psi; and
- the ratio of the actual tensile strength to the actual yield strength is not less than 1.25.

All pre-stressing steel shall conform to ASTM 416 and the ultimate tensile strength of pre-stressing steel shall not be less than 1860 MPa.

5.7.3 Cement

Type of Cement shall be as follows

Modified Portland Cement, Modified Portland Cement with the following limitations shall be used for all concrete works (below ground), except for transoms, girders and deck slab where Ordinary Portland Cement shall be used.

20 to 30% cement shall be replaced with fly ash (or as per manufacturer's recommendations) meeting the requirements of ASTM C618. Percentage of fly ash shall be fixed after a successful mix design for required strength of concrete.

- C_3 A shall neither be less than 5% nor more than 8%
- C_4 AF + $2C_3A$ shall be less than or equal to 25%
- AL_2 O_3 shall be less than or equal to 6%

Ordinary Portland Cement conforming to ASTM C 150 and meeting the above requirements may also be used in lieu of modified cement.

All concreting shall be done by Batching plant and no hand mixing shall be done.

5.8 Special Considerations in Design

a. Modified Portland Cement: Minimum 5ksi (35 MPa) concrete cylindrical strength has been considered with 20 to 30% cement to be replaced with fly ash (or as per manufacturer's recommendations), meeting the requirements of ASTM C618, for components below ground considering the high chloride and sulphate contents as given in chemical test reports of soil and water carried out by NESPAK.

b. Relocation of Existing Structure: There is a railway station on one side and a drain on other side parallel to Elevated U-turn. Both of these structures have been planned to be re-located and hence no provision in design has been kept at this stage for these obstructions.

c. Cracking of Bridge decks have been observed to be one of the major problems in prestressed concrete bridges.

   Polypropylene fibers have been proposed in the bridge deck to cater for the fatigue crack formation due to vehicular live load and shrinkage & temperature cracks. The fibers provide the three-dimensional reinforcement to increase impact resistance, toughness, ability to delay crack initiations and crack propagation.

   Polypropylene fibers shall extend the service life of the deck and decrease the maintenance cost and traffic inconvenience for reparation.

d. GoS/ Independent engineer shall consider the KCR/PR right of way while designing the structures.

5.9 Design Methods

- USD : Concrete elements
- WSD : Checking Bearing Capacity, Design of Bearings and Stress analysis of Pre-stressed Girders

5.10 Codes and Standards

- AASHTO LRFD Standard Design Specifications for Highway Bridges 2012
- Building Code of Pakistan (Seismic Provisions-2007)

- American Concrete Institute ACI 318 Building Code requirements for Reinforced Concrete
- American Institute of Steel Construction Specifications AISC.

5.11 Software Used

- CSi BRIDGE 20
- SAP 2000
- SAFE
- In house developed Software and Excel Sheets

6 Plumbing and Fire Protection Works

In plumbing design, for toilet block of Admin Building, 30 number of users will be considered with water requirement of 35 gal/capita/day.

Accordingly, a septic tank, soak pit(s), an underground and overhead Fiber glass water tank and portable firefighting extinguishers are included in the scope of plumbing and fire protection works.

An underground water tank of at least 2 days' storage with an overhead fiber glass water tank and an automatic pumping machinery with standby arrangement, operating at high-level and low-level switches for filling overhead tank are proposed for the facility.

Sewage generated in the facility shall be passed and treated through septic tank and disposed through soakage pits.

Water based firefighting system is not proposed and only portable fire extinguishers are provided such as Carbon-dioxide, Foam or Dry Chemical Powder Type.

7 Electrical and Telecommunication System

7.1 Introduction

This section provides information related to the basic design guidelines for Electrical and Telecommunication works, which has been adopted / formulated to finalize technical data, design assumptions, codes of practice, methods and procedures.

7.2 Applicable Codes and Standards

The design, manufacturing, installation and commissioning of all Electrical and Telecommunication systems shall conform to the following international and local standards / codes:

- IEC - International Electro technical Commission
- EN - European Standards
- BSI - British Standards Institutions
- NEC - National Electric Code
- IEEE - Institute of Electrical and Electronics Engineers
- ANSI - American National Standards Institute
- ASA - American Standards Association
- NEMA - National Electrical Manufacturers Association
- ISO - International Standards Organization
- DIN - Deutsche Industrie Normen (German Industrial Standards)
- ANSI/TIA/EIA - Commercial Building Telecommunications Cabling & Pathways
- Local Electrical Inspector’s requirement/regulations
- Local Explosives Inspector’s requirements/regulations

Following specialized standards shall be adhered for the related scope of work:

- BS 7671 - IEE wiring Regulation (latest edition)
- ESNA - Illuminating Engineering Society of North America (latest edition)
- BS EN 12464 - Lighting of work places
- BS EN 13201 - Road lighting
- CIE 115 - Lighting of Roads for Motor & Pedestrian Traffic

The electrical products/material used in this project shall be approved to meet the applicable standards by one of the independent test laboratories including following:

- KEMA
- CESI
- ASTM
- UL or other similar laboratories

7.3 Power Supply Data

Power supply shall be 0.4 kV, 3 Phase 50 Hz with neutral plus protective conductor. The characteristics of the supply are as follows:

- Power supply voltage : LT 415 V
- Frequency : 50 Hz
- Rated voltage of equipment : 400 V, 3 Phase 230 V, 1 Phase
- Required power factor : 0.9 or higher
- Permissible fluctuation in rated voltage of equipment : ± 10%
- Permissible fluctuation in Frequency : ±2%
- Power Supply System : Neutral Directly / Solidly Earthed

7.4 Climatic Conditions:

The electrical power supply and all needed equipment and systems shall be suitable for operation in the ambient conditions, designed for easy operation and shall be purchased new. Switchgear / DBs and all other equipment shall be suitable for the project ambient conditions. Also, applicable derating factors shall be considered while selecting the equipment.

- Temperature - Indoor: 45°C (max) and 0°C (min)
  - Outdoor: 50°C (max) and 0°C (min)
- Relative Humidity - ±90%

Surface treatment of equipment, stainless steel, heavy duty plastic and proper enclosures shall be used. Due to the environmental conditions, equipment shall be properly classified & IP rated accordingly. Moreover, high performance epoxy paint / marine paint shall be applied as an additional protection on the equipment / lighting columns.

7.5 Design Provision

- Maximum allowed design voltage - 4% of line voltage
- drop from power source up to final load
  Spare capacity for future expansion - +20%
- Earthing System - TT
- Earth Electrode - Plate type / rod type
- Earth conductor - Insulated/Bare
  stranded Copper bare
- Degree of Protection - IP 42 for indoor areas
  IP 54 for indoor damp Areas
  IP 65 for outdoor areas

7.6 Scope Outlines

The Electrical and Telecommunication scope mainly encompasses the following:

a) Low Voltage Power supply from utility
b) Low voltage power distribution network for Road lighting
c) Low voltage power distribution network for Admin Building and Toll Plaza
d) Standby power supply
e) Internal illumination and Small Power Distribution of Admin building
f) External illumination of Toll plaza
g) Road lighting
h) Earthing system
i) Structured Cabling Network
j) CCTV System
k) Access Control System

7.6.1 Low Voltage Power supply from Utility

It is envisaged that the estimated power demand of the project will be approximately 130 kW, including the road network, administration building and toll plaza power supply requirements. However, the final power system demand of the project shall be calculated by the Detail designer/Contractor during detailed design stage based on actual power demand of the road /facility and accordingly the necessary provision would be ensured in the existing K Electric's system.

In this regard, it is proposed that the power supply connection at low voltage (415V) shall be taken from K-Electric's pole/pad mounted transformer, located near the project premises.

There shall be six 415/230V Low voltage power supply intakes from KE's network to cater the low voltage supply at various locations specified in the preliminary design drawings and mentioned below;

- MLTOD-3
- MLTOD-6
- MLTOD-9
- MLTOD-12
- MLTOD-U
- LTOD-AD

The further distribution of Utility's power supply is shown in Table-7 below:

Low Tension Outdoor Distributors	Loads Fed
MLTOD -3	Road lighting for Interchange at Lyari Express way
MLTOD -6	Road lighting for Mauripur Expressway
MLTOD -9	Road lighting for Mauripur Expressway
MLTOD -12	Road lighting for Right Turn Flyover Kakapir
MLTOD -U	Road lighting for Elevated U-Turn
LTOD -AD	Lighting and small power at Toll Plaza and Admin Building

Table 6: Distribution of Power Supply

The location of Low-Tension Outdoor Distributors marked on the preliminary design drawing is tentative. The Detail designer is advised to design the Low voltage network by investigating services, emphasizing the quality of supply and safe operation of equipment as per the international and local standards.

7.6.2 Low Voltage power distribution network for Road lighting

The power supply from the above-mentioned Low-Tension Outdoor Distributors is further routed / distributed to nine Sub main Low-Tension Outdoor Distributors (SLTOD) at various locations specified in the preliminary design drawings and mentioned below:

- SLTOD-1
- SLTOD-2
- SLTOD-4
- SLTOD-5
- SLTOD-7
- SLTOD-8
- SLTOD-10
- SLTOD-11
- SLTOD-13

The locations of Sub main Low-Tension Outdoor Distributors marked on the preliminary design drawings are tentative. The Low voltage (0.415kV) power distribution from the above shall be designed to feed the road lighting poles installed on bridges, expressway & interchanges etc. in the entire project.

7.6.3 Low Voltage power distribution network for Admin Building & Toll Plaza:

The power supply from the above-mentioned Low-Tension Outdoor Distributors is further distributed to Distribution boards at appropriate locations specified in the preliminary design drawings to cater the lighting, small power and HVAC loads of the Admin building and Toll plaza.

7.6.4 Standby Power supply for Admin Building and Toll Plaza:

For the purpose of maintaining the quality and security of supply, the Contractor shall make appropriate provisions for standby power. Generators shall provide standby power to the Admin building and Toll plaza, where necessary and it shall be ensured that the backup power supply system kicks in automatically in case of mains power failure.

Uninterruptable power supply (UPS) shall be provided to computers, servers, routers, core switches, distribution switches and access control system or where considered necessary and specified in the preliminary design drawings.

7.6.5 Internal illumination and Small Power Distribution of Admin building:

7.6.5.1 Internal Illumination:

Internal illumination has been designed as per international standards and local regulations, for all structures/buildings through distribution boards located at appropriate places.

The light fixtures shall be LED, recessed/surface type. Lights provided shall be dust proof with glass cover where necessary and the lux levels shall be as per BS EN 12464-1. The light fixtures shall be finalized during detail design stage by the Contractor and this shall be based upon various factors including availability, sufficiency of lighting levels, energy efficiency, economy of construction, aesthetics, and ease of maintenance etc.

Area	Lux Levels
Security/Office/ facilitation center	300 – 500 Lux
Lounges	300 – 350 Lux
Lobby	300 - 350 Lux
Kitchen/Pantry	250 – 300 Lux
Toilets	100 – 150 Lux

Table 7: Lux Levels for Internal Illumination

The lux levels, uniformity ratios, quality and design of the lighting in the building interior shall be in accordance with the latest recommendations of Illumination Engineering Society (IES), USA. All factors and reflectance affecting the above perimeters shall be considered for achieving the required lux levels.

The light fixtures shall be controlled either by means of magnetic contactor or switch controlled where required depending upon the user convenience. Local switches shall control the lighting in offices and other rooms.

7.6.5.2 Emergency lighting:

Emergency lighting shall be provided as per BS 5266 requirement where required. Emergency illumination shall be provided in Kitchen and Washroom

7.6.5.3 Small Power distribution:

Small power distribution shall be designed as per international standards and local regulations for all structures/buildings through distribution boards located at appropriate places. Small power shall be provided as outlined below:

- 16A Schuko socket outlet shall be provided through UPS supply (in weatherproof enclosure, if required).
- 13A /16A International socket outlets shall be provided on normal / generator supply (in weatherproof enclosure, if required).
- 20A double pole switch with neon indication shall be provided for Hand dryers (in weatherproof enclosure).
- 3 phase/1 phase Moulded case circuit breakers in weather proof enclosure for AC units (in weatherproof enclosure).
- 3 pin industrial socket outlet for communication server.

Small power shall be designed considering the ergonomic requirements, furniture layouts and convenience of the user.

7.6.6 External illumination of Toll plaza:

External illumination shall be designed as per International standards & local regulations for all structures through distribution boards located at appropriate places.

The light fixtures shall be LED, hanging/recessed/surface type. Lights provided shall be dust proof/ corrosion resistant, IP rated with glass cover where necessary and the lux levels shall be as per BS EN 12464-2.

Illumination level, uniformity ratios, quality and design shall be in accordance with the relevant standards and codes ensuring anti-glare, smooth adaptation of the driver travelling on road.

7.6.7 Road Lighting:

Road lighting shall be designed as per international standards and local regulations, for all roads through Sub main Low-Tension Outdoor Distributors located at appropriate places.

The light fixtures shall be LED, pole mounted type. Lights provided shall be dust proof/ corrosion resistant, IP rated with cover where necessary and the lux levels shall be as per BS EN 13201-2, CIE 115 & BS 5489-1.

The average road surface luminance (L in cd/m2), the overall uniformity of the luminance (Uo), the longitudinal uniformity of the luminance (Ul), the threshold increment (TI) and the surround ratio (SR) shall be calculated and measured in accordance with ME2 lighting Class (as per Table 1a of EN 13201-2) or M2 lighting Class (as per Table 2 of CIE 115) whichever is applicable.

The light fixtures shall be contactor controlled through timer switches and photo sensors, directly from the relevant Sub main LT Outdoor Distributor.

7.6.8 Earthing System:

The Earthing scheme shall be in accordance with IEC 60634 based on TT system, with the star point at the supply source connected directly to earth.

Dedicated earthing protection shall be provided separately to all Low-Tension Outdoor Distributors, lighting poles, apparatuses, motors and any metallic structure including all electrical and communication equipment's and apparatus in the entire project.

Continuity of protective earthing circuit must be observed. Removal of any equipment due to maintenance reason shall not interrupt the earthing circuit.

The Earthing system shall mainly comprise of the following components:

- Earth continuity conductors (ECC)
- Earth connecting point (ECP)
- Earthing leads
- Earth electrodes with concrete inspection pit having suitable type CI cover

All accessories necessary for the satisfactory operation of the associated electrical and communication system.

7.6.9 Structured Cabling Network:

Structured Cabling Network shall be provided in Admin Building and Ticket Booths as per international standards and local regulations.

Detailed engineering design of structured cabling network shall follow the EIA/TIA & ISO/IEC standards and local regulations.

The system shall be universal and support telephone, data and video. The system shall support Ethernet as defined by IEEE 802.3 standard and shall be open to any new applications that requires an ISO/IEC 11801.

The system shall include but not limited to the following:

- Telecommunication RJ45 Outlets
- Copper Cat6A LSZH Cabling
- Copper and Fiber Patch Panels

- Copper and Fiber Patch Cords
- Disconnection Modules
- Layer 2 Managed Ethernet Switch
- Transceivers
- Equipment Racks
- Raceway and Conduits

7.6.10 CCTV System:

A modern IP CCTV system shall be provided for the Toll Plaza. The Network Video Recorder (NVR) shall record the IP cameras based on program and events. Each lane areas shall be monitored.

CCTV Cameras shall be capable of video analytics function shall generate an alarm for any non-defined behavioral change. Video Analytics shall provide advanced detection and tracking capabilities covering a wide range of behavioral events.

ANPR cameras shall be capable of reading and extracting detailed vehicle information day and night. It shall be equipped with intelligent deep learning algorithms that shall allow recognition of vehicle license plate, vehicle brand, model, logo and color. Record of number plate shall be saved with date and time for all the vehicles passing from Toll Plaza.

The system shall include but not limited to the following:

- Security cameras
- ANPR cameras
- Network Video Recorder (NVR)
- Monitoring Display
- Workstation
- CCTV Software

7.6.11 Access Control System:

Access Control System shall be provided on each lane for collecting toll fare for each type of vehicle.

Boom barrier can be open by following two methods:

- Manually by Operator of Ticket Booth
- Automatically by UHF Long Range Integrated Reader

The system shall include but not limited to the following:

- Boom Barrier
- Network Access Controller
- Manual / Exit Push Button
- Inductive Safety Loop Vehicle Detector with underground Cable
- Traffic Signal Light
- Steel Post
- UHF Long Range RFID Integrated Reader
- UHF Anti-tamper label Tags
- UHF RFID Desktop Reader / Writer
- POS Printer with Paper Receipt
- Toll Station Workstation
- Outdoor Display
- Access Control Software
- Access Control Server
- Wiring / Cabling

8 HVAC WORKS

8.1 Salient Features

Facilitation Center, Security and Office Room in Admin Building are provided with Air-conditioning system for cooling in summer through Single Split Inverter Type Air-conditioning (AC) Units. However, outdoor units are to be placed on nearest wall / projection

Other areas like Wash Rooms and Pantry are provided with forced mechanical ventilation.

8.2 Location and Site Data

North Latitude	:	25°
East Longitude	:	67°
Altitude, above Mean Sea Level	:	4 m

8.3 Design Climatic Conditions

Summer	:	Dry Bulb Temperature = 40°C
	:	Wet Bulb Temperature = 28.9°C
	:	Daily Range = 7.8°C

8.4 Design Indoor Conditions

8.4.1 Air-conditioned Areas

Summer	:	Dry Bulb Temperature	24 °C±1
	:	Relative Humidity	50% ± 10

8.4.2 Ventilated Areas

Minimum Exhaust Rate

Toilets	:	As per ASHRAE Standard.
Pantry	:	As per ASHRAE Standard.

8.5 Codes and Standards

8.5.1 Climatic Design Information and Indoor Conditions

- As per ASHRAE Handbook (American Society of Heating, Refrigerating and Air-conditioning Engineers) or equivalent.

8.5.2 Standard Calculation Method

- As per ASHRAE Handbook (American Society of Heating, Refrigerating and Air-conditioning Engineers)
- CARRIER (Software)

Applicable method to be used for calculation.

8.5.3 Other applicable Standards

- As Specified in ASHRAE Handbook or equivalent.

8.6 General Consideration

Forced ventilation/exhaust system have been provided for areas like Wash Rooms and Pantry. Therefore, in order to balance the exhaust air, doors are to be with door undercuts or door louvers.

AC Units Drain Water to be properly and safely routed to the nearest drain points.

ANNEXURE – 7

URBAN ROAD INITIATIVES IN KARACHI

LOCAL GOVERNMENT & HTP DEPARTMENT

EXPRESSWAY FROM MAURIPUR ROAD TO Y-JUNCTION

Preliminary Hydrology Study Report of Lyari River for Mauripur Expressway

February 2021

National Engineering Services Pakistan (Pvt.) Ltd.
13th Floor, N.I.C. Building, Abbasi Shaheed Road, Off. Shahrah-e-Faisal, Karachi
Phone: (0092 21) 99207277-84
Fax: (0092 21) 35651994
E-mail: nespakkh@nespak.com.pk
Web: http://www.nespak.com.pk

PRELIMINARY STUDY REPORT

TABLE OF CONTENTS

Page No.

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

1.1 General

Karachi is located in the south of Sindh, on the coast of the Arabian Sea. Karachi is the largest city in Pakistan, capital of the Province of Sindh and seventh largest city in the world. The city is Pakistan's premier industrial and financial center. With its location on the Arabian Sea, Karachi serves as a transport hub, and is home to Pakistan's two largest seaports, the Port of Karachi and Port Bin Qasim. Imported goods are transferred from these ports to all other cities of the country. Karachi Metropolitan, being a mega city of Pakistan has potential to absorb people from all over the country in providing jobs, business opportunities, and housing facilities. The population of the city has now reached 14.91 million (PBS 2017). Due to this phenomenal population growth, increase in vehicular traffic, congestion and traffic jam issues arise on major roads of city. This adds an extra volume of heavy traffic on city roads up to super highway (Motorway M9) and National Highway N-5. Consequently, road users are facing inconvenience/hazards like wastage of time/fuel, environmental pollution (noise, smoke etc.) and accidents etc.

To address traffic congestion issues, Local Government & HTP Department, Government of Sindh has decided to provide the direct route to connect from Mauripur Road to Y-Junction of Kakapir Road and Mauripur Road to provide alternate route and reduce the traffic on exiting available route. The proposed intervention will be achieved by constructing a new road from near the existing right embankment of Lyari River from Lyari Expressway Entrance Ramp along seashore to Salt Range Area and ultimately terminate at Y-Junction of Kakapir Road and Mauripur Road.

1.2 Background

The feasibility study for Mauripur Expressway was approved on the public-private partnership mode in the 30th meeting of Public Private Policy Board held at the Chief Minister’s House in 2020. The Expressway is intended to provide speedy access to the Karachi Beach area (Hawksbay/Sandspit Side) from the center of city. The proposed intervention will be achieved by constructing a new express road along the right bund of Lyari River (refer **Figures 1-1** and **1-2** below).

1.3 Objective of the Study

To ensure safety of the built-up areas along both banks of river, it is essential to study the impact of proposed project components and protections of the existing infrastructure (Mauripur Road Bridge, Lyari Expressway Ramp Bridge, Karachi Circular Railway Bridge at Lyari River and Lyari riverbanks) within the study reach. The objectives may be outlined as follows:

- Determine the hydraulic parameters of Lyari Expressway Bridge, Railway Bridge and Mauripur Road Bridge crossing Lyari River adjacent to each other,
- Determine backwater effect at Railway Bridge, Lyari Expressway and Mauripur Road Bridge, and
- Estimate increase in water level for the reach after Lyari Expressway Bridge at Lyari River.

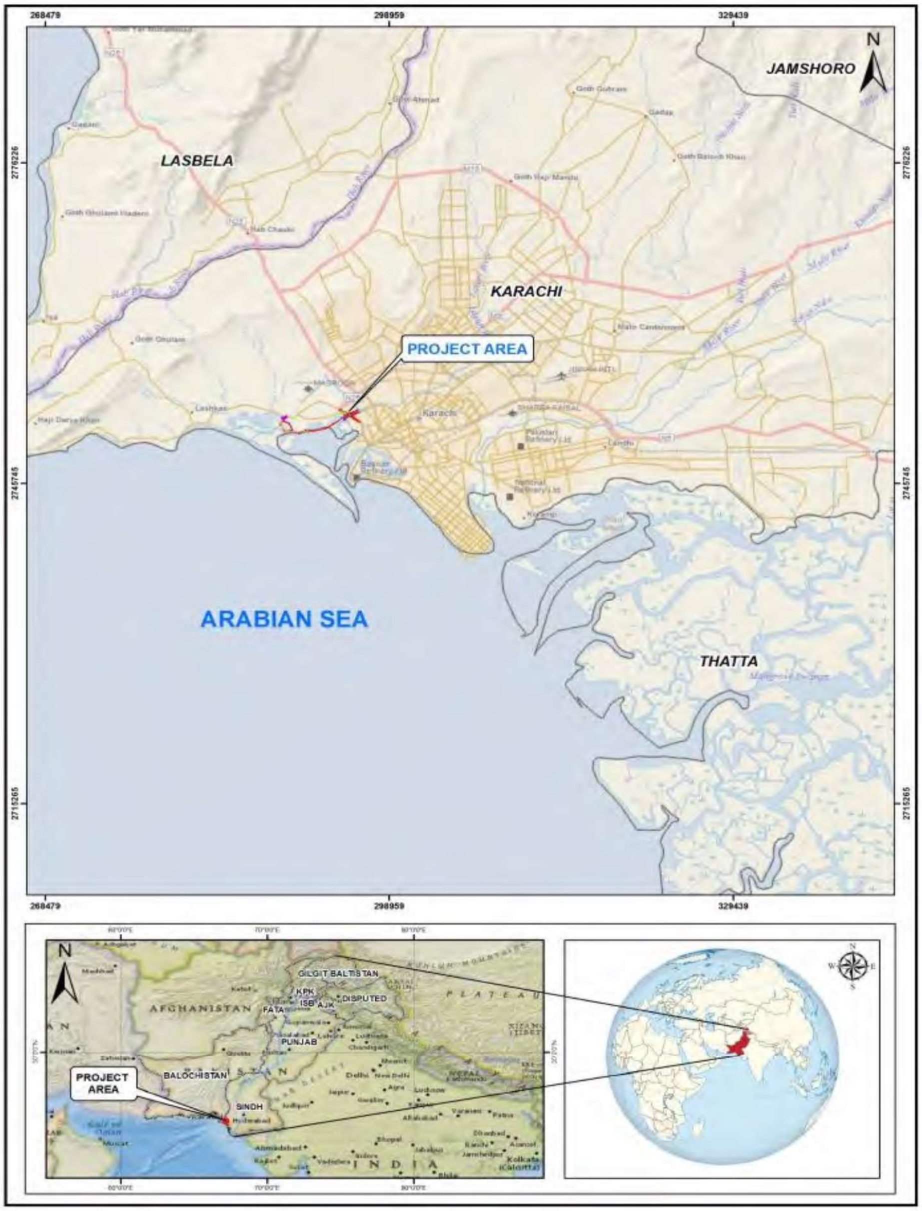


Figure Error! No text of specified style in document.**-1: Location Map of Project Area**

Figure Error! No text of specified style in document.**-2: Location Map of Project**

2. DATA COLLECTION AND FIELD VISIT

2.1 Data Collection

Following data/ information was available with NESPAK:

- Satellite Imagery showing proposed layout project alignment,
- Drawings showing proposed alignment of Mauripur Expressway along Lyari River, and
- Feasibility Report of Karachi Flood Control Plan by Hydro Electric Planning Organization / Planning and Investigations, Water and Power Development Authority, November 1990.

2.2 Additional Data

Following additional data following was available for this study:

- Topographical survey report,
- Bathymetric Survey,
- Hydrological study report, and
- Geotechnical Investigations Report.

2.3 Field Visits

Various field visits were carried out at different stages of the project. Photographs taken during the field visits are presented below:

Figures 2-1 & 2-2: Downstream Side of Lyari River at Railway Bridge with Right Bank

Figure 2-3: Downstream Side of Lyari River at Railway Bridge with Left Bank

Figure 2-4: Lyari River Between Mauripur Bridge and Lyari Expressway Bridge

3. TOPOGRAPHIC SURVEY OF LYARI RIVER AREA

The methodology covers details of locations of survey control network, instruments used, measurement details, position fixation and coordinates and layout of the above defined scope of works.

3.1 Location and Extents of the Project Site

The project area for which survey has been carried out includes Lyari Expressway, Mauripur Road, Kakapir Road and strip along the coast. The Bathymetry survey data within the project area has also been collected for the study.

The location map of the subject project is shown in **Figures 1-1** & **1-2** above.

3.2 Scope of Survey Work

Survey is required to obtain basic information regarding topography, terrain, drainage pattern, profile etc. of the project area. The survey detail is inclusive of, but not limited to, the elements listed below:

- Site Reconnaissance visit of the project area,
- Establishment of survey Benchmarks (BM) in the project area,
- Topographic survey of entire project area,
- Inventory of existing structures,
- Processing of the observed data, and
- Preparation of topographic survey map and related report of project area.

The above-mentioned scope of work has been completed by using the following methodology.

3.3 Work Plan & Site Reconnaissance Visit

A comprehensive work plan was established and implemented in the field by qualified survey team during execution of survey works. Site reconnaissance survey of the project area was carried out to assess the field conditions and general topography to finalize the survey activities/ implementation plan.

3.4 Establishment of Survey Benchmark

Establishment of local control points is an essential activity which is to be carried out prior to actual commencement of surveying and mapping of the project area. New technology Global Navigation Satellite System (GNSS) makes it more efficient and effective to establish a primary control bench mark. Often National Geodetic Survey (NGS) vertical control is not readily available within the project area, thus the new procedures allow for establishing a vertical height easily, efficiently, and economically using GNSS.

This BM has been used as a reference point for further establishment of horizontal and vertical control network within the project area to carry out the topographical and cross-sectional survey work.

The coordinates & location of established control points are presented **Section 2** of the technical feasibility report.

4. HYDROLOGICAL STUDY

4.1 General

Lyari River basin is adjacent of Malir River basin and is similar as far as the climate and watershed characteristics are concerned. Recently, NESPAK carried out Hydrology Study of Malir River at Korangi Causeway (KPT Interchange to PAF Airman Academy) under Sub-Project 1 (Link Road to Korangi) of the Urban Roads Initiative (URI) project. During the study, maximum hydro-meteorological data was collected from the Pakistan Meteorological Department (PMD) and NESPAK data bank. Therefore, the same data analysis (Frequency Analysis, PMP & PMF) as computed for the Malir River basin has been adopted for the Lyari River for calculating the flood runoffs at its outfall at various return periods. Furthermore, same analysis and estimation of peak discharges as worked out for Malir River, have been reproduced here with changes of Lyari River watershed characteristics.

Lyari is a small river with a catchment area of about 533 km^2 (206 $miles^2$), entirely within Karachi Division. The river flows through the heart of the city and into the harbor before entering the Arabian Sea. The river has two main tributaries i.e., Gujjar Nullah and Orangi Nullah. The river remains dry for most part of the year and carries urban sewage that is ultimately drained in the Arabian Sea.

Lyari River has very mild slopes in the outfall touching almost zero level downstream of Mauripur Road Bridge. The slope of the bed gradually increases upstream of the estuary up to the end of city limit. In the hilly areas, the bed slope is very steep and the river is about 50 km (30 miles) long.

The hydrological studies carried out include the following:

- Review of previous studies,
- Review of available hydro-met data,
- Reconnaissance site visit, and
- Rainfall-runoff analysis to estimate the design flood discharges.

4.2 Review of Previous Studies

4.2.1 Feasibility Report of Karachi Flood Control Plan – 1990

A Feasibility Study was carried out for Karachi Flood Control Plan in 1990. The study was conducted by Hydro Electric Planning Organization (HEPO) of WAPDA with the objective of designing of flood protection works for Karachi against inundations from Malir and Lyari rivers. For estimation of rainfall, retention magnitude of 0.1 inches was considered as consistent per hour for losses during the storm, whereas for the first increment this rate was enhance to 0.3 inches. The 100-year and 1,000-year, 36-hr point rainfall was estimated as 19.3 inch and 24.2 inch, respectively.

The study estimated discharges of Mol and Khadeji tributaries against 100-year and 1,000-year return periods as 235,000 ft^3/s (6,655 m^3/s) and 322,000 ft^3/s (9,118 m^3/s) at their confluence points respectively, whereas the 100-year discharge at the river mouth of Malir River was estimated as 409,000 ft^3/s (11,580 m^3/s) in the same report.

Lyari River basin is adjacent of Malir River and possess almost similar climate and watershed characteristics. **Table 4-1** below gives the peak discharges of Lyari River.

Table Error! No text of specified style in document.**-1: Peak Discharges of Lyari River**

Return Period	Discharge (ft^3/sec)
100-Year	104,146
75-Year	88,883
50-Year	53,620
20-Year	48,482

4.2.2 Hydrology & Hydraulic Report, Malir Expressway Project Along Left Bank of Malir River from KPT Interchange Near Jam Sadiq Bridge to Super Highway (M-9) - 2015

This study was conducted for the Local Government Department, Sindh in 2015 under Public Private Partnership (PPP) Mode by a consortium of three consultants i.e., M/s EA Consulting (Pvt) Ltd, M/s. Ernst & Young and M/s. Hydermota BNR & Co.

For the design of drainage structure, peak discharge is required. Peak discharge has been calculated using formulate based on catchment area sizes (Refer Annexure- A & B for calculations in the subject report).

4.3 Data Collection

There is no stream gauge installed at Lyari river, hence, no observed discharge data is available. Therefore, rainfall-runoff modelling approach has been adopted for estimation of peak flood discharges of various frequencies. Long term daily rainfall time series for Karachi Masroor for the period 1970-2020 was collected from Pakistan Meteorological Department (PMD). Historic rainfall records of 1913 storm (required for verification of HEPO-1990 analysis) were not available with PMD.

Perusal of the data shows that floods in the Lyari River are generally generated from the rainfall storms of more than 1-Day. The annual series of 1-Day, 2-Day & 3-Day annual maximum rainfalls are shown in **Figure 4-1** below.

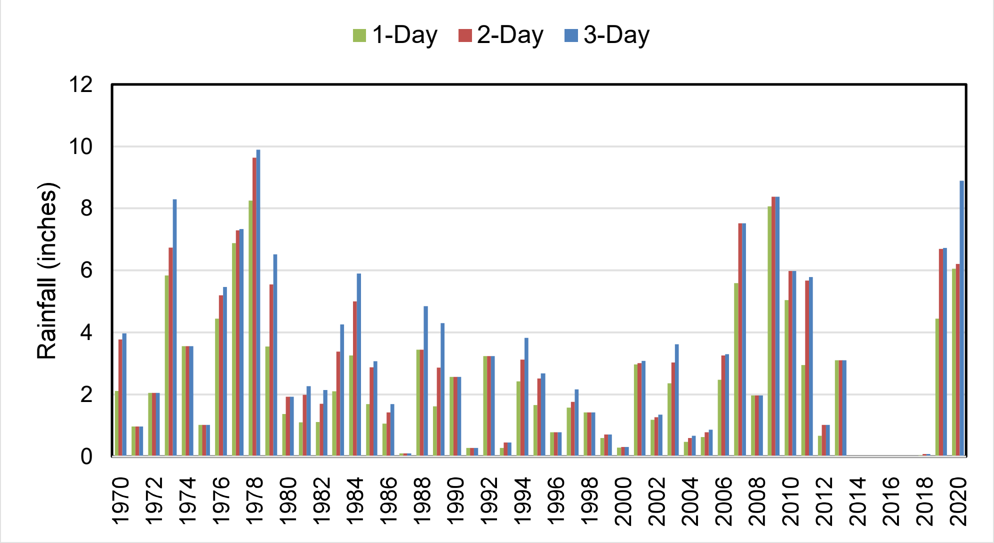


Figure Error! No text of specified style in document.**-3: 1-Day, 2-Day & 3-Day Annual Max. Rainfall (Karachi Masroor)**

Further, rainfall data corresponding to historic flood events (3-Day) in and around the project area have been collected and are given in **Table 4-2**. In addition, one day (24 Hours) heaviest rainfall in the Karachi City is also given in **Table 4-3**.

Observed rainfall depths of 25-27 August 2020 for Karachi City have also been collected and are given in **Table 4-4**. Rainfall magnitudes of 3-hourly rainfall data of August 2020 rainstorm is provided in **Table 4-5**.

Table Error! No text of specified style in document.**-2: Maximum Rainfall of Extra-Ordinary Storms in the Sindh Province**

S. No.	Event Date	Rainfall (mm)	Rainfall (inches)	Station
1	18-23 July,1913	425	16.73	Thatta
2	24-29 July, 1929	300	11.81	Near Tando Allah Yar
3	02-04August, 1944	225	8.86	Karachi A.P.
4	30th June to 6 July, 1959	250	9.84	Malir
5	11-12 September, 2012	457	18.00	Jacobabad
6	25-27 August, 2020	368	14.49	Faisal Base, Karachi

Table Error! No text of specified style in document.**-3: Heaviest Falls in 24 Hours of Extra-Ordinary Storms in the Karachi City (More Than 100 mm)**

Karachi - Airport				Karachi - Manora			
S. No.	**Event Date**	**Rainfall**		**S. No.**	**Event Date**	**Rainfall**	
		(mm)	**(inches)**			**(mm)**	**(inches)**
1	July 07,1933	119.9	4.7	1	April 12, 1881	104.4	4.1
2	August 02,1944	152.4	6.0	2	June 17,1902	182.1	7.2
3	September 06,1959	111.8	4.4	3	September 06,1926	206.0	8.1
4	July 01,1977	207.0	8.1	4	July 11,1942	222.50	8.8
5	August 7, 1979	166.0	6.5	5	August 07,1953	278.1	10.9
6	September 13,1962	101.3	4.0	6	September 12,1959	104.9	4.1
7	July 19, 2009	142.6	5.6	7	July 01,1977	185.7	7.3
8	August 10, 2007	124.0	4.9	8	August 18, 1978	93.4	3.7
9	August 27, 2020	121.9	4.8	-	-	-	-

Source: Three Documents, Monthly Climatic Normal of Pakistan, PMD, Karachi.

Table Error! No text of specified style in document.**-4: August 25-27, 2020 Rainfall Event at Various Gauge Stations in Karachi**

S. No.	Station	Rainfall (mm)	Rainfall (inches)
1	Airport	204	8.0
2	Masroor	226	8.9
3	Landhi	228	9.0
4	Gulshan-e-Hadeed	173	6.8
5	North Karachi	218	8.6
6	Nazimabad	254	10.0
7	Saddar	230	9.1
8	University Road	189	7.4
9	Surjani Town	243	9.6
10	Faisal Base	368	14.5
11	Kiamari Town	195	7.7

Table Error! No text of specified style in document.**-5: 3-Hourly Observed Rainfall Depths (August 25-27, 2020) at Karachi**

Date	Time	Rainfall (mm)	Date	Time	Rainfall (mm)
25/08/2020	0000z	1	26/08/2020	1200z	0
25/08/2020	0300z	7.1	26/08/2020	1500z	0
25/08/2020	0600z	5.7	26/08/2020	1800z	0
25/08/2020	0900z	65.7	26/08/2020	2100z	0
25/08/2020	1200z	7.7	27/08/2020	0000z	0
25/08/2020	1500z	0.7	27/08/2020	0300z	0
25/08/2020	1800z	0	27/08/2020	0600z	5
25/08/2020	2100z	0	27/08/2020	0900z	70
26/08/2020	0000z	0	27/08/2020	1200z	3
26/08/2020	0300z	0.8	27/08/2020	1500z	32
26/08/2020	0600z	0	27/08/2020	1800z	11.9
26/08/2020	0900z	2.1	27/08/2020	2100z	0

Analysis of the above collected rainfall events show that generally low frequency rains in the area last more than 2-3 days; therefore, analyses of 1-Day, 2-Day and 3-Day rainfall depths have been carried out for estimation of 100-year flood in the Lyari River Catchment.

4.4 Data Analysis

4.4.1 Frequency Analyses

100-year rainfall depths in the catchment have been estimated using frequency analyses of 1-Day, 2-Day & 3-Day annual maximum rainfall data. The frequency analyses have been carried out using Gumbel's EV Type-I distribution. Plotting positions have been computed by Weibull's formula (1-Day, 2-Day & 3-Day), are shown in **Figures 4-2** to **4-4**. The rainfall magnitudes for various return periods are shown in **Table 4-6**.

4.4.2 Time Distribution of Design Storms

It has been reported that rain event of 2020 was highest rainfall depth since the recorded history of Karachi city. Therefore, rainfall distribution of 25-27 August 2020 was analyzed and adopted for the rainfall-runoff modelling. The maximized 3-hr rainfall distributions of the event are shown in **Figure 4-5**.

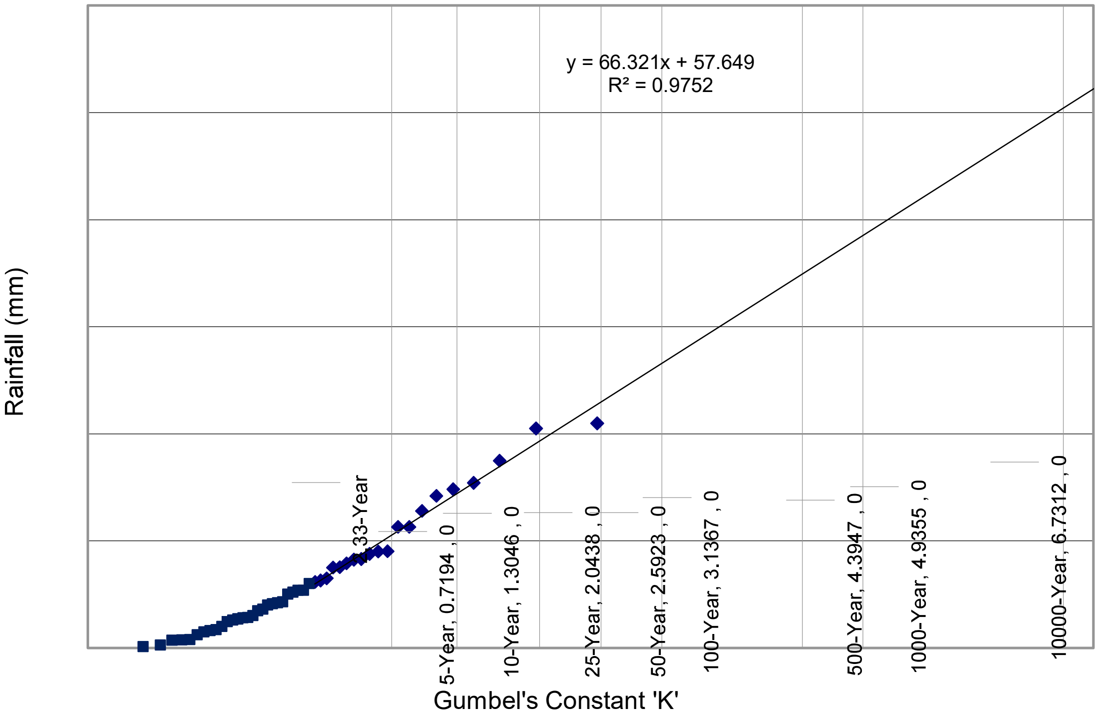


Figure Error! No text of specified style in document.**-4: Plotting Positions and Fitted Line to 1-Day Annual Maximum Rainfall**

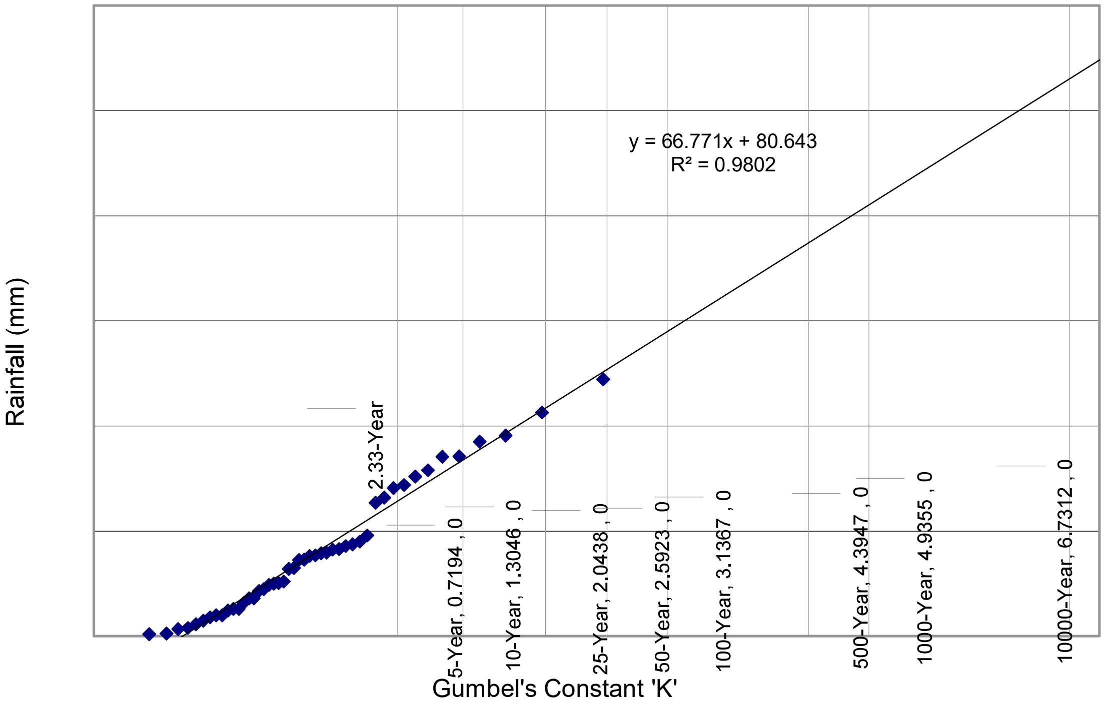


Figure Error! No text of specified style in document.**-5: Plotting Positions and Fitted Line to 2-Day Annual Maximum Rainfall**

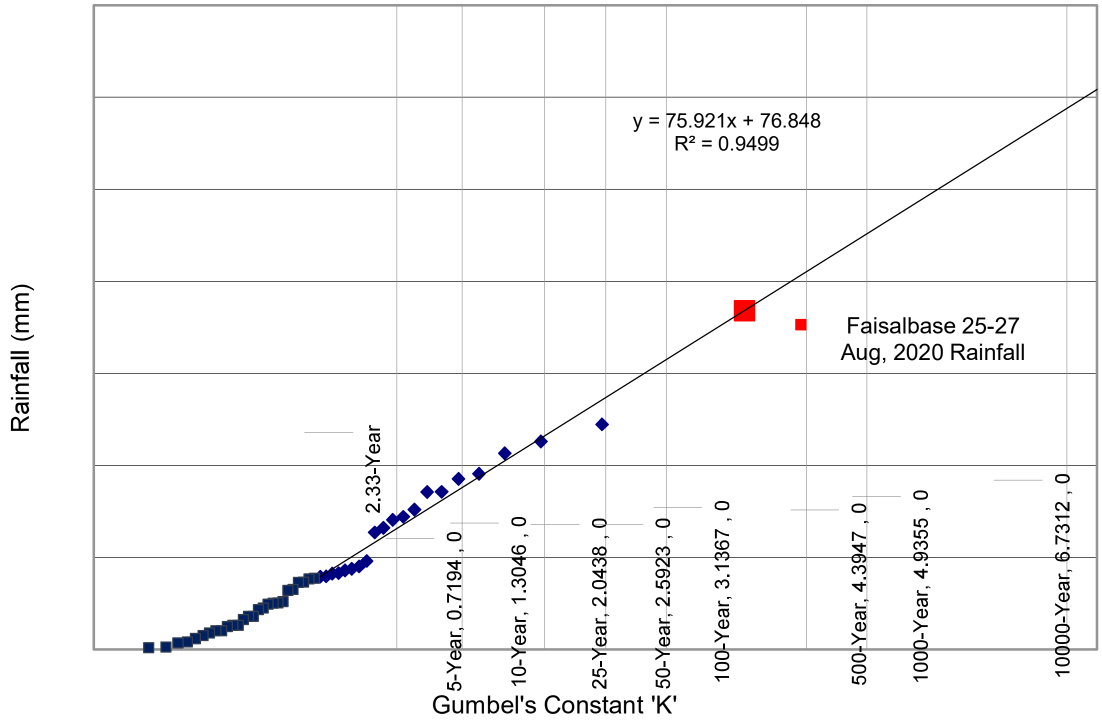


Figure Error! No text of specified style in document.-6: Plotting Positions and Fitted Line to 3-Day Annual Maximum Rainfall

Table Error! No text of specified style in document.**-6: Rainfall Magnitudes for Various Return Periods at Karachi Masroor**

Values in mm (inches)

Return Period (Year)	1-Day	2-Day	3-Day
2.33	58 (2.3)	81 (3.2)	76 (3.0)
5	107 (4.2)	127 (5.0)	132 (5.2)
10	145 (5.7)	168 (6.6)	175 (6.9)
25	193 (7.6)	218 (8.6)	231 (9.1)
50	229 (9.0)	254 (10.0)	274 (10.8)
100	267 (10.5)	290 (11.4)	315 (12.4)

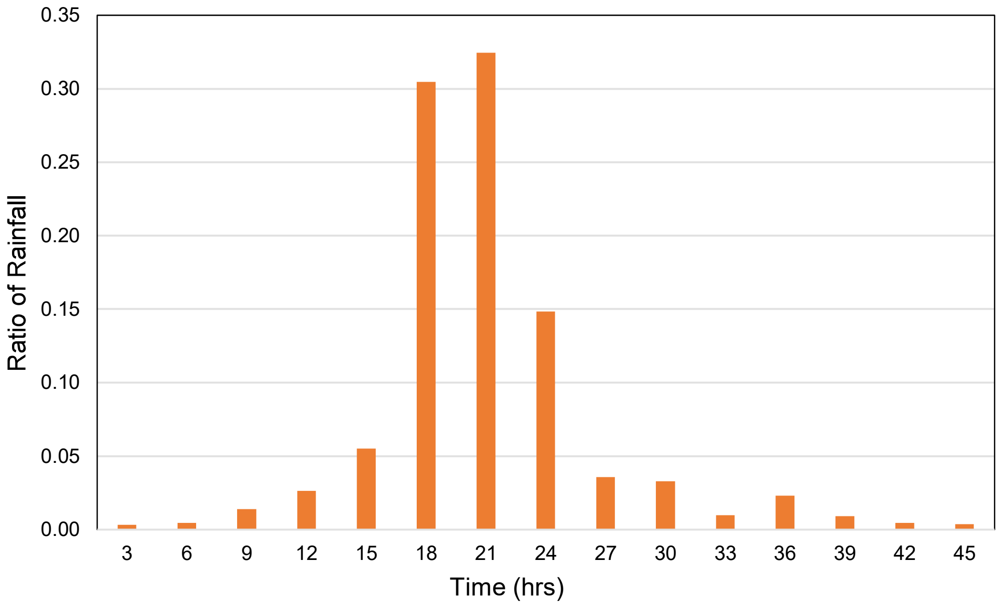


Figure Error! No text of specified style in document.**-7: Time Distribution of August 25-27, 2020 Event**

4.5 ESTIMATION OF PEAK DISCHARGES

4.5.1 Catchment Characteristics

The catchment characteristics of the area such as soil cover, land-use, soil type and extents affect the runoff generation potential. These parameters have been investigated using the public domain satellite imageries as well as from the field/catchment visit. The natural slope and the drainage network in the vicinity of the project area have been determined from the topographic maps and Digital Elevation Model (DEM) of Shuttle Radar Topographic Mission (SRTM).

4.5.2 Degree of Wetness of Watershed

The degree of wetness of watershed also influences the amount of runoff from a fixed amount of rainfall. The more wet the watershed, higher the runoff. The driest condition of watershed corresponds to Antecedent Moisture Condition-I (AMC-I), intermediate condition as (AMC-II) and the wettest condition as (AMC-III). The combination of a hydrological soil group (soil) and a land treatment class (cover) is a hydrological soil cover complex. The runoff generating potential of this complex is represented by a Curve Number (CN). Based on the above parameters, CN is selected for the project area under consideration.

4.5.3 Selection of Curve Number

Equivalent hydrologic soil group has been found for every soil and the curve number selected for each soil, keeping in view the future land use of the project area. Vegetation and land use have been determined by the field visit and Landsat 8 data. According to Antecedent Moisture Condition (AMC) selection criteria as discussed above the project area corresponds to Antecedent Moisture Condition (AMC-III). A weighted CN 92 has been estimated for the catchment, keeping in view the land use and soil types for AMC-III.

4.5.4 Time of Concentration

Kirpich formula has been used for estimation of time of concentration and time of concentration has been estimated as 15.4 hours.

$$T_c = \frac{L^{0.77}}{7700 \times S^{0.385}}$$

Where,

Tc= Time of Concentration (hours)

L= Length of the longest stream (feet)

S= Average slope of channel from farthest point to point under consideration.

4.5.5 Peak Discharges

Curve Number Method of U.S. National Resources Soil Conservation Service (US-NRCS) has been used to convert the rainfall depths to runoff depths. The method takes into account various factors affecting runoff from a given amount of rainfall such as soil, land use, type and density of vegetation and degree of wetness of watershed, represented by Curve Number. A curve number of 92 for AMC-III condition has been selected.

HEC-HMS model has been used for the estimation of peak discharges. The Natural Resources Conservation Services (NRCS) unit hydrograph method has been selected as runoff transform method whereas CN method has been selected as rainfall loss method. The schematic layout of HEC-HMS model is shown in **Figure 4-6**.

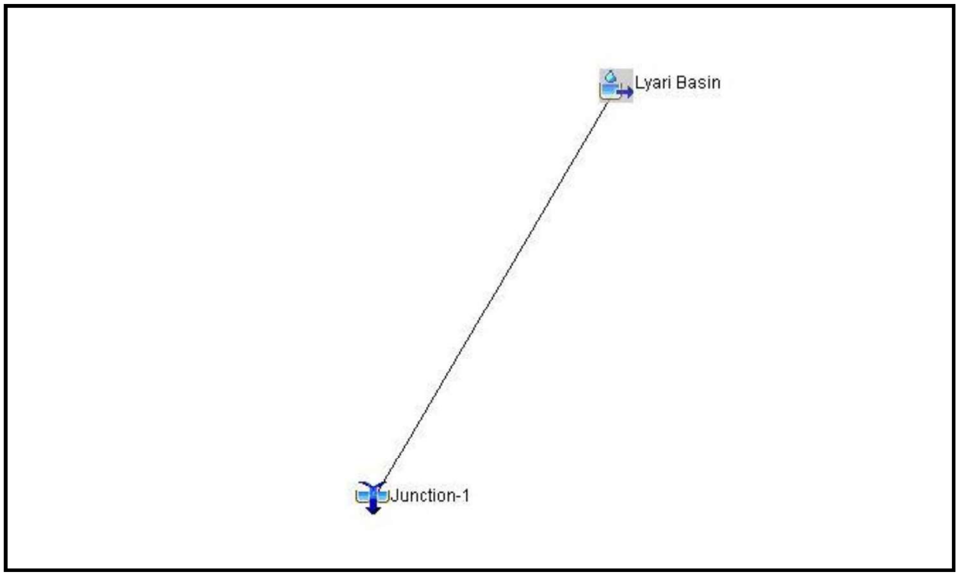


Figure Error! No text of specified style in document.**-8: Schematic Layout of Lyari River in HEC-HMS Model**

4.5.6 100-Year for 1-Day, 2-Day and 3-Day Rainfall

The 100-year 1-Day, 2-Day and 3-Day rainfall is given in **Table 4-5**. The 100-year 1-Day, 2-Day and 3-Day rainfall hyetographs have been simulated in HEC-HMS model, which has provided a discharge magnitude 66,000 ft3/s, 69,500 ft^3/s and 76,000 ft^3/s, respectively, at Mauripur Road Bridge/Lyari Expressway Ramp location.

4.5.7 August 25-27, 2020 Event as Design Rainfall

In this scenario, maximum rainfall among all stations during 25-27 August 2020 (**Table 4-4**) at Faisal Base (14.5") has been taken as design rainfall for the Lyari Basin. The HEC-HMS has provided a discharge magnitude of 84,500 ft^3/s at Mauripur Road Bridge/Lyari Expressway Ramp.

5. CONCLUSIONS AND RECOMMENDATION

As the Mauripur Expressway starts from the end of right bank side of the Lyari Expressway Ramp and its alignment is along right bank (downstream side) of the Lyari River, therefore, it was necessary to conduct a hydrology study of the Lyari River to review the impact of project at upstream and downstream side of the existing bridges (Railway Bridge, Lyari Expressway Ramp and Mauripur Road Bridge).

The 100-year 3-Day rainfall depth has been estimated as 315 mm (12.4 inch) at Karachi Masroor rain gauge station using rainfall data for the period 1970-2020, which resulted in flood peak estimates of 2,152 m^3/s (76,000 ft^3/s). Furthermore, Rainfall runoff simulations indicate that a rainstorm similar to August 2020 in the Lyari catchment can generate flood peak of as high as 2,392 m^3/s (84,500 ft^3/s).

While analyzing and selecting design discharge for a new embankment/structure along a river/stream, it is considered necessary to get maximum discharge flow along the embankments or/ carrying capacity of existing structures located upstream & downstream of newly proposed location/site. This information is required to avoid bottlenecks corresponding to design flood magnitude in the stream. Three discharge magnitudes are given below based on details mentioned above:

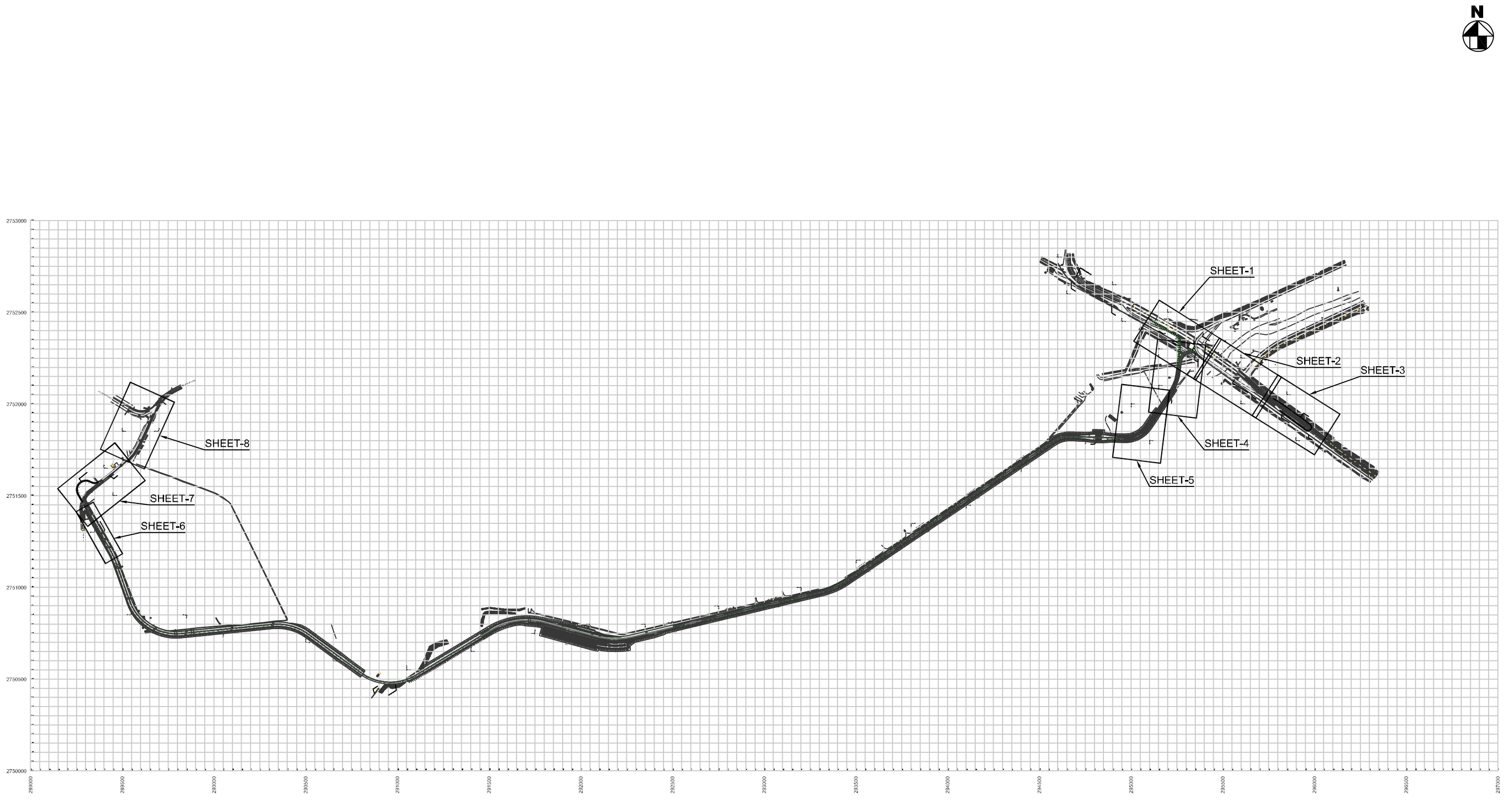
- The 100-year for HEPO-1990 Report is reproduced of 2,950 m^3/s (104,146 ft^3/sec), and
- The 100-year 3-Day rainfall depth flood peak estimates of 2,152 m^3/s (76,000 ft^3/sec).

In view of the uncertainties associated with rainfall data and likelihood of higher rainfall intensities and magnitude under future climate change scenarios, it is recommended that 100-year flood estimate by HEPO-1990 may be adopted as design flood for providing flood protection of embankments/ structures in study reach.

As mentioned above, the proposed project will be constructed along the right bank of the Lyari river, starting from the downstream side of the existing Lyari Expressway Ramp Bridge. A portion at the start of the project is on bridge/flyover structure (to cross the existing KCR length) and then it will be on embankment which will not disturb or change the existing cross section and slope of the river. Moreover, the Lyari river has wide bed at the start of embankment structures of the project as compared to upstream side of existing Lyari Expressway Ramp.

The finished levels of the project have been proposed around 3 feet (900 mm) above the existing bank levels to make the project much safer from unexpected future flooding conditions of the Lyari River. It was also noticed during the rain fall event of August 2020 (2,392 m^3/s) that the maximum water level was below from the existing right bank of the Lyari River along the length of the proposed project.

Based on the above, it can be concluded that the project will not disturb the existing cross section and slope of the Lyari River, therefore, increase in water level at upstream side of the project due to this project is not expected, and the Hydrology of the Lyari River will remain same after the construction of Mauripur Expressway.



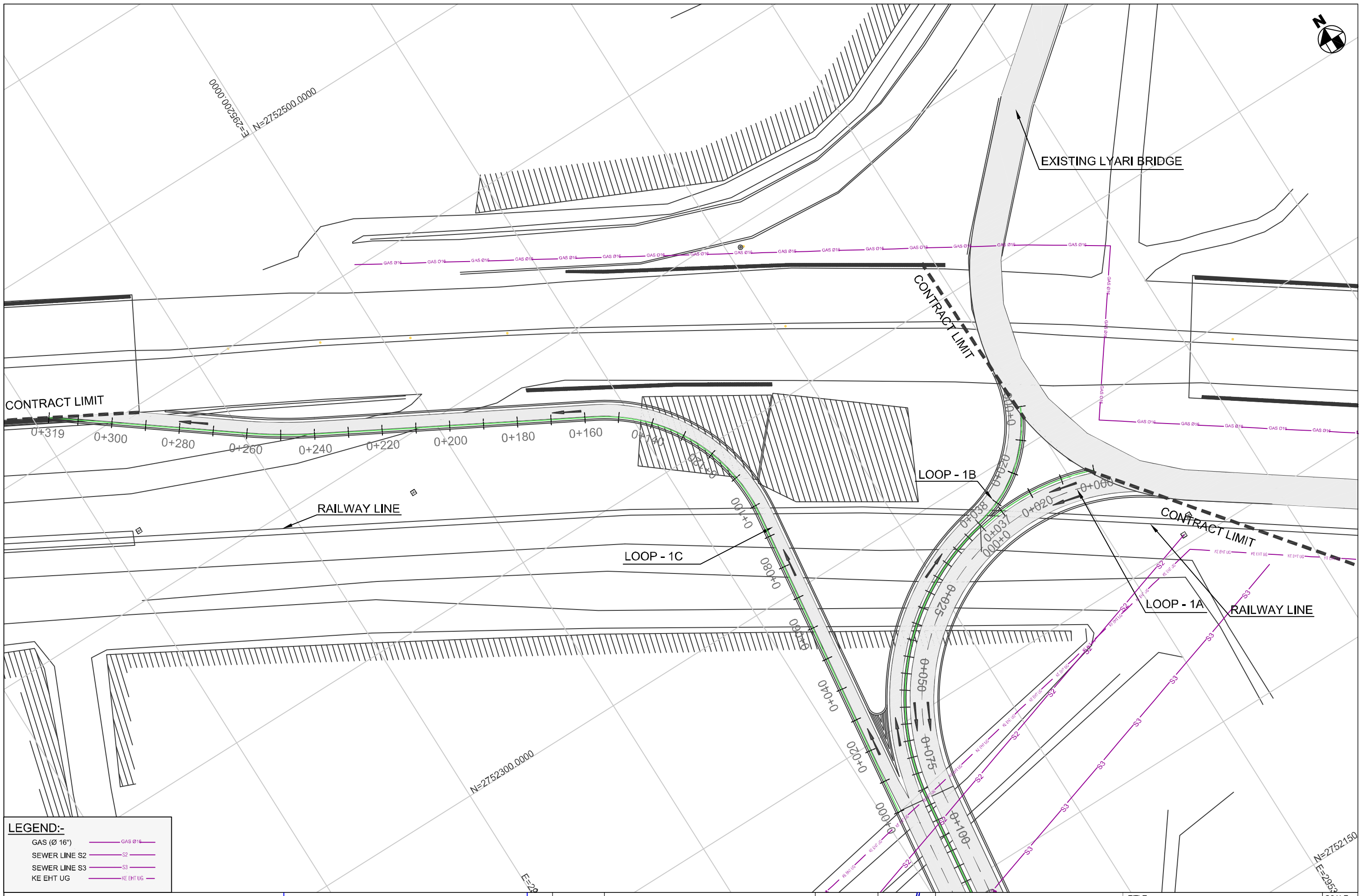
LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	M.A.K
C			DESIGNED	A.J
B			CHECKED	M.A
A			APPROVED	R.Z
0	NOV,2020	PRELIMINARY DRAWINGS		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE	UTILITY FOLDER INDEX PLAN	SCALE N.T.S
DATE NOV20	DWG. No. P-38035/P2/50P/PD/01C101	REVISION 0



LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

REV.	DATE	DESCRIPTION
D		
C		
B		
A		
0	NOV,2020	PRELIMINARY DRAWINGS

DRAWN	M.A.K
DESIGNED	A.J
CHECKED	M.A
APPROVED	R.Z

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

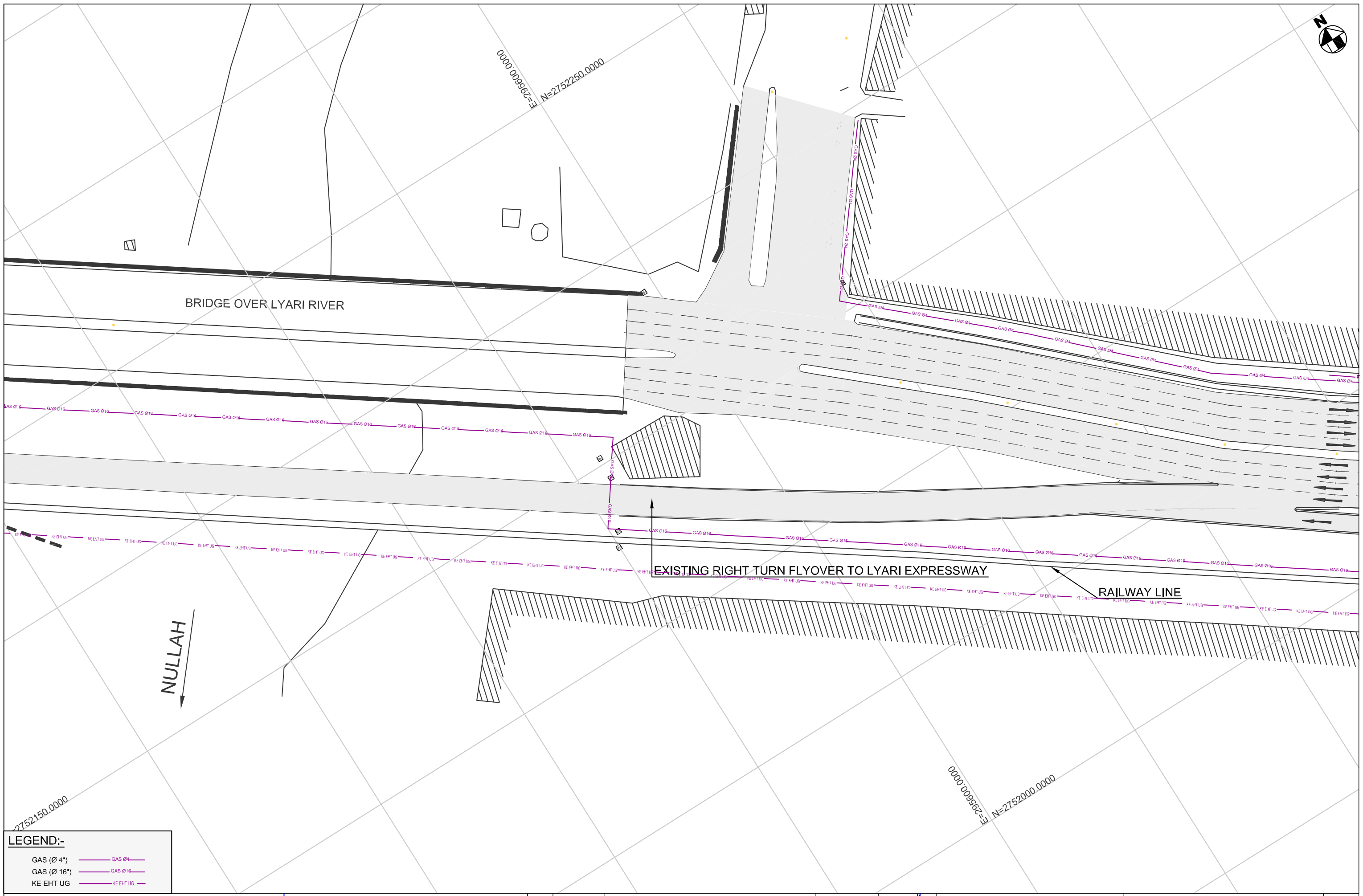
TITLE
UTILITY FOLDER
(SHEET 01 OF 7)

SCALE
1:1000

DATE
NOV20

DWG. No.
P-38035/P2/50P/PD/01C102

REVISION
0



LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	M.A.K
C			DESIGNED	A.J
B			CHECKED	M.A
A			APPROVED	R.Z
0	NOV,2020	PRELIMINARY DRAWINGS		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

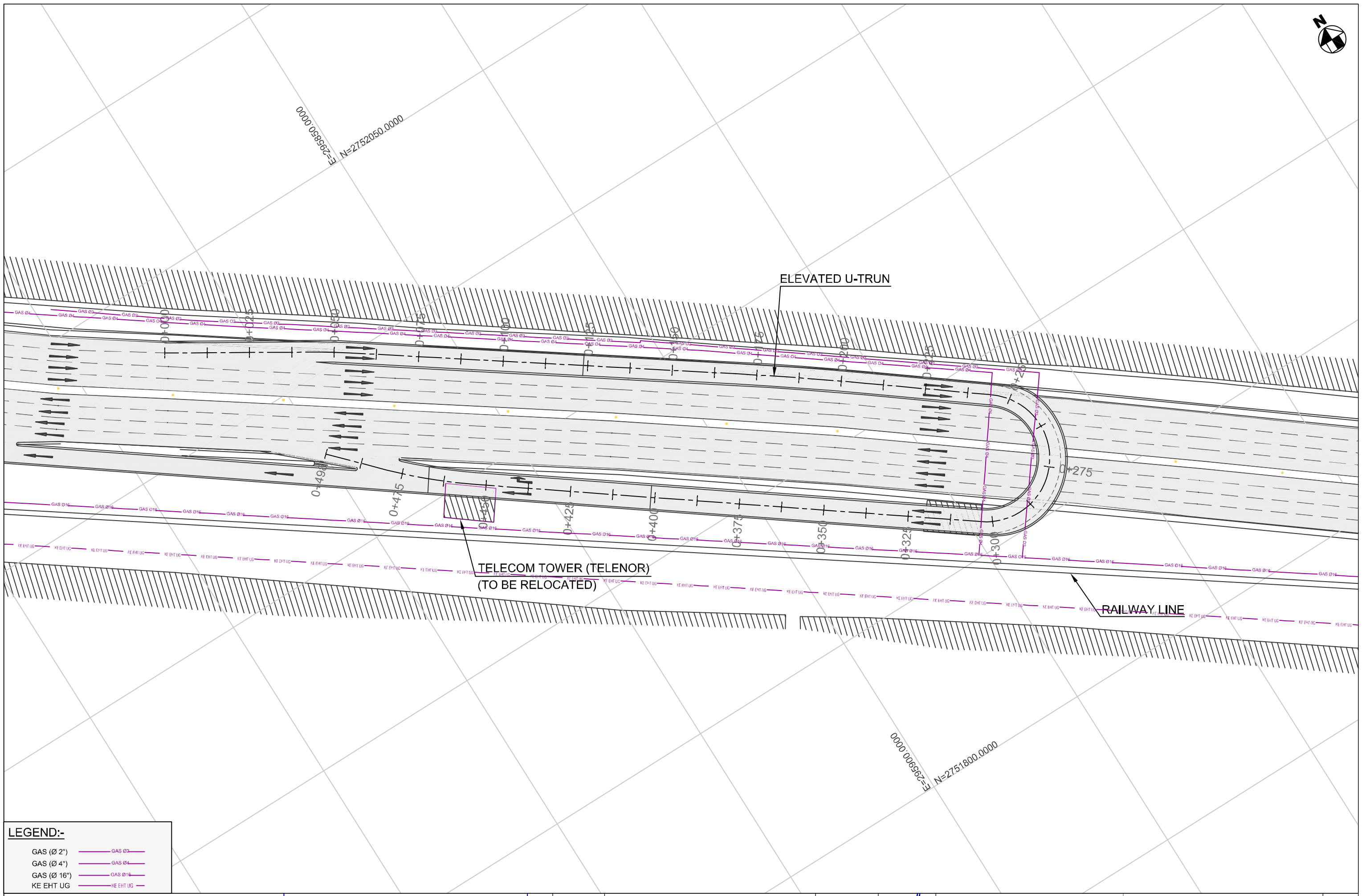
TITLE
UTILITY FOLDER
(SHEET 02 OF 7)

SCALE
1:1000

DATE
NOV20

DWG. No.
P-38035/P2/50P/PD/01C103

REVISION
0



LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

REV.	DATE	DESCRIPTION
D		
C		
B		
A		
0	NOV,2020	PRELIMINARY DRAWINGS

DRAWN	M.A.K
DESIGNED	A.J
CHECKED	M.A
APPROVED	R.Z

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

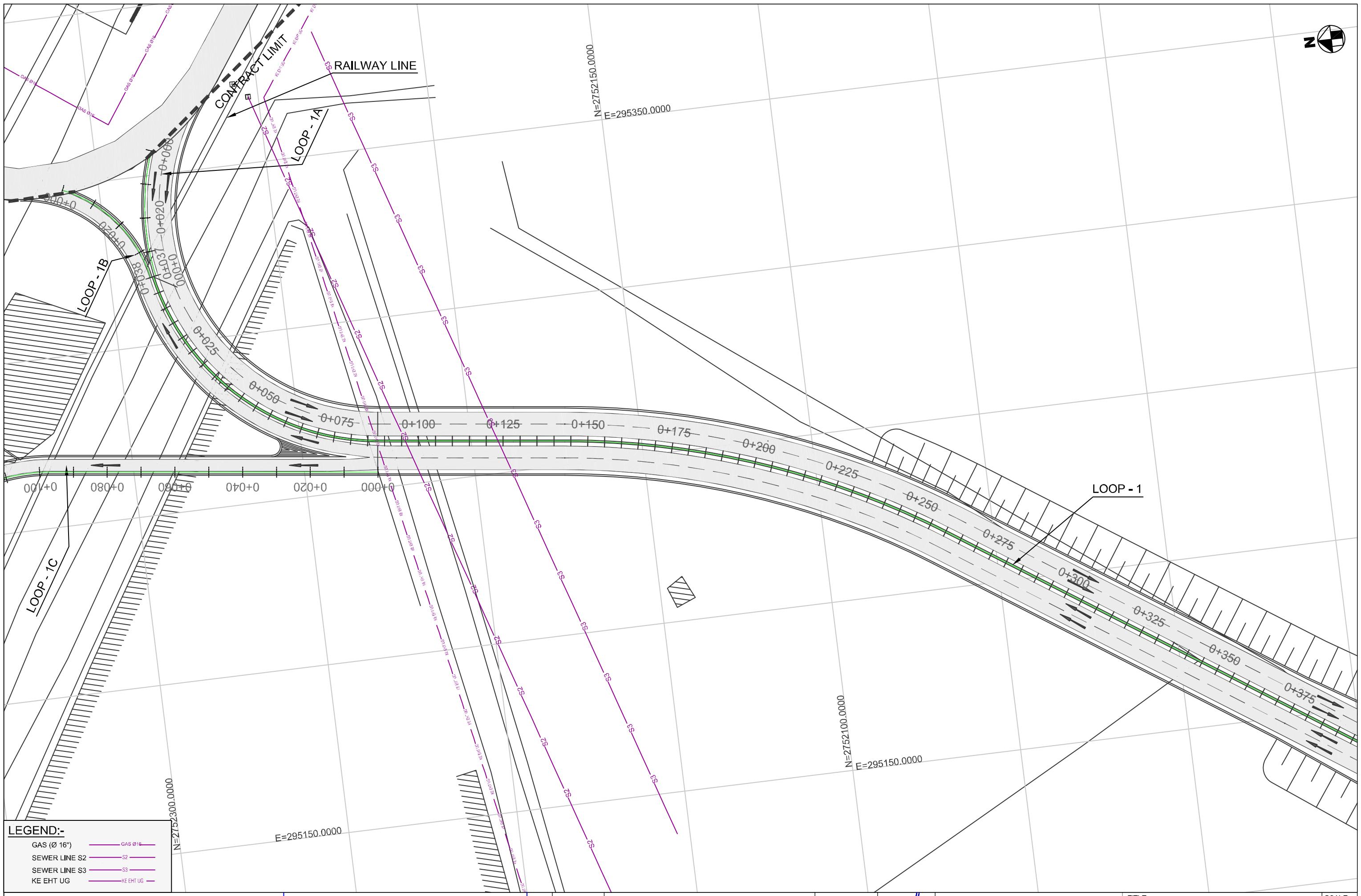
TITLE
UTILITY FOLDER
(SHEET 03 OF 7)

SCALE
1:1000

DATE
NOV20

DWG. No.
P–38035/P2/50P/PD/01C104

REVISION
0



LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

REV.	DATE	DESCRIPTION
D		
C		
B		
A		
0	NOV,2020	PRELIMINARY DRAWINGS

DRAWN	M.A.K
DESIGNED	A.J
CHECKED	M.A
APPROVED	R.Z

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

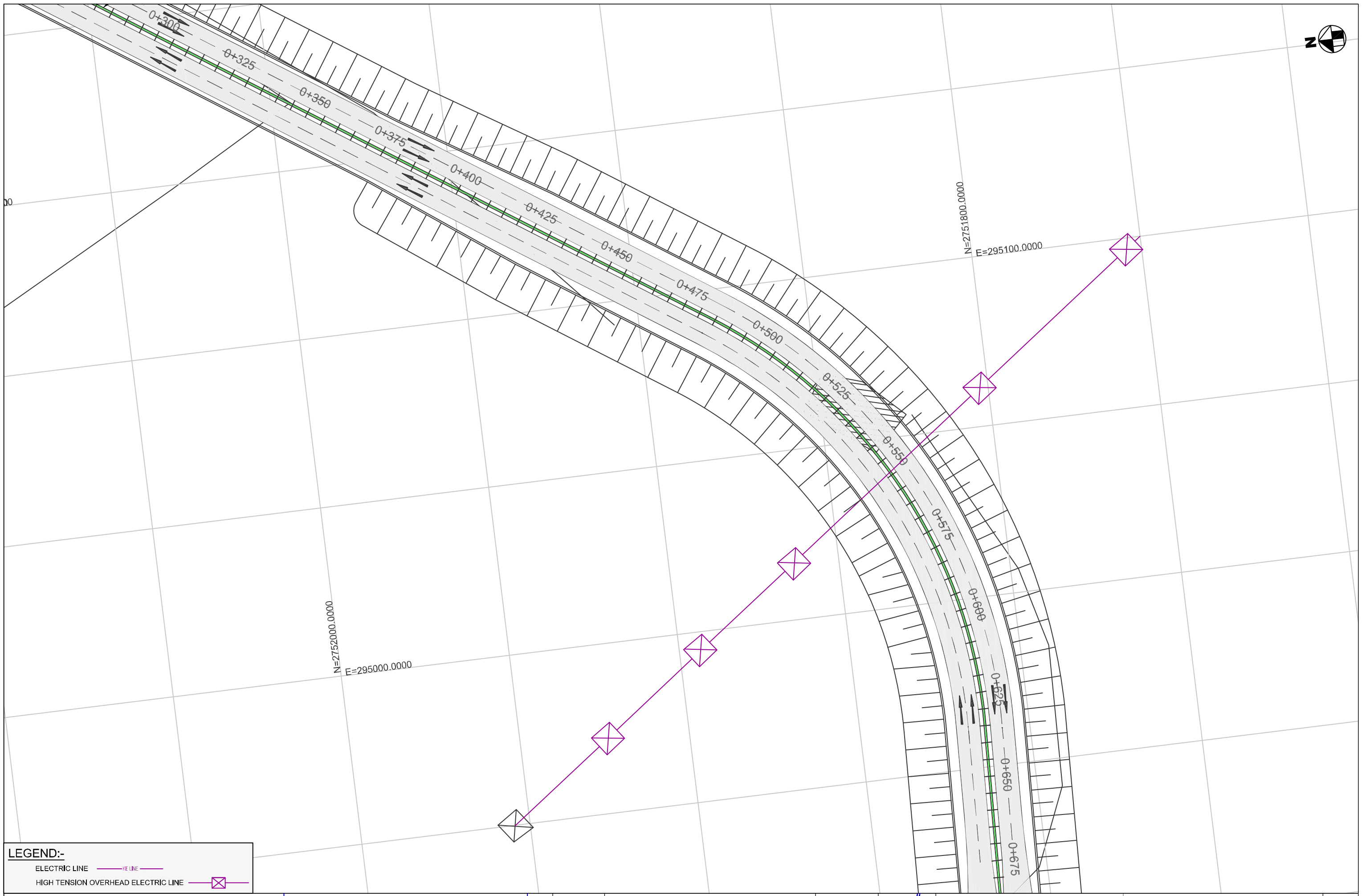
TITLE
UTILITY FOLDER
(SHEET 04 OF 7)

SCALE
1:1000

DATE
NOV20

DWG. No.
P–38035/P2/50P/PD/01C105

REVISION
0



LEGEND:-

ELECTRIC LINE ——KE LINE——

HIGH TENSION OVERHEAD ELECTRIC LINE ——☒——

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

D			DRAWN	M.A.K
C			DESIGNED	A.J
B			CHECKED	M.A
A			APPROVED	R.Z
0	NOV,2020	PRELIMINARY DRAWINGS		
REV.	DATE	DESCRIPTION		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

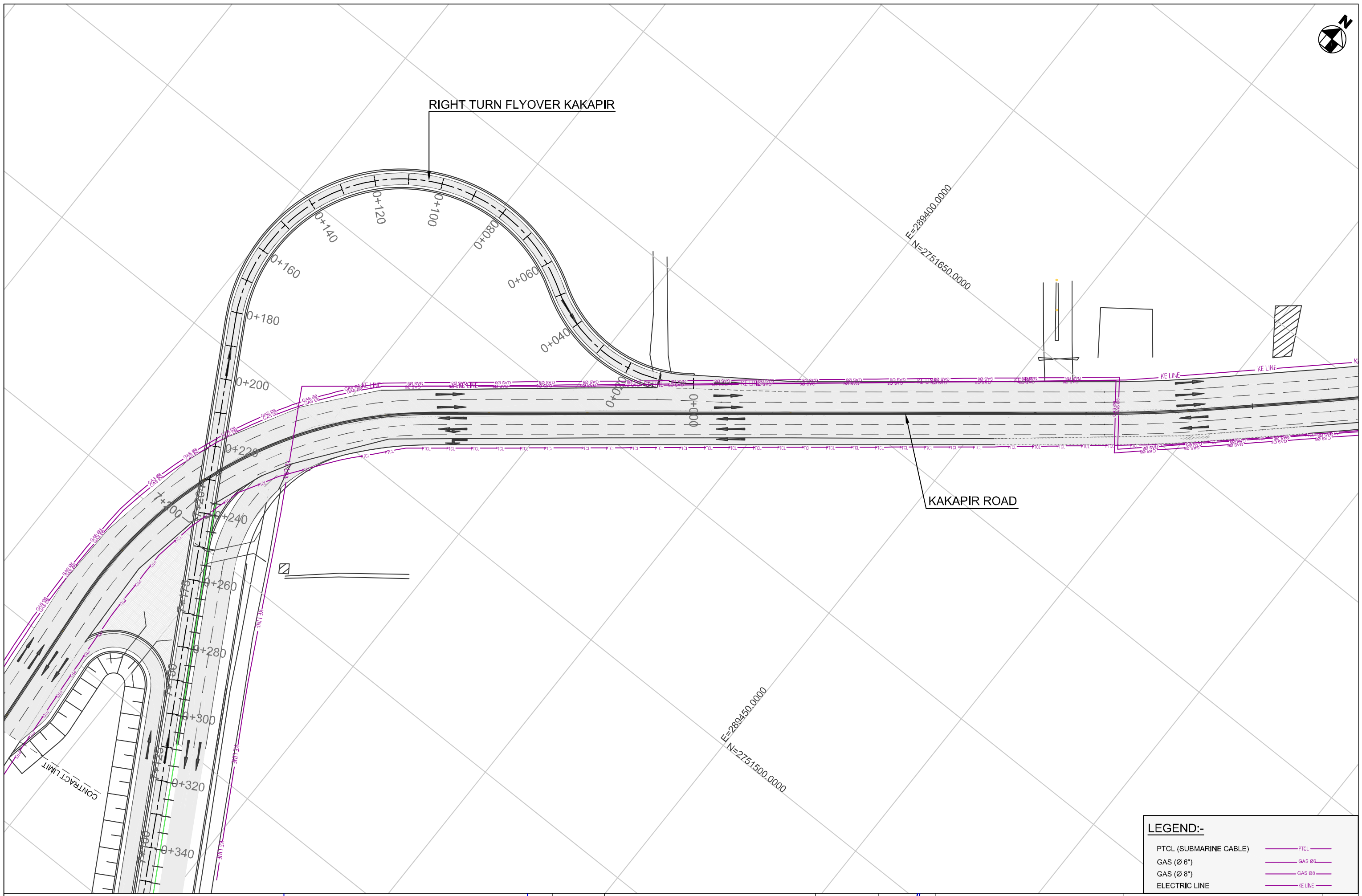
TITLE
UTILITY FOLDER
(SHEET 05 OF 7)

SCALE
1:1000

DATE
NOV20

DWG. No.
P-38035/P2/50P/PD/01C106

REVISION
0



LEGEND:-

PTCL (SUBMARINE CABLE)	PTCL
GAS (Ø 6")	GAS Ø6
GAS (Ø 8")	GAS Ø8
ELECTRIC LINE	KE LINE

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

REV.	DATE	DESCRIPTION		
D			DRAWN	M.A.K
C			DESIGNED	A.J
B			CHECKED	M.A
A			APPROVED	R.Z
0	NOV,2020	PRELIMINARY DRAWINGS		

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

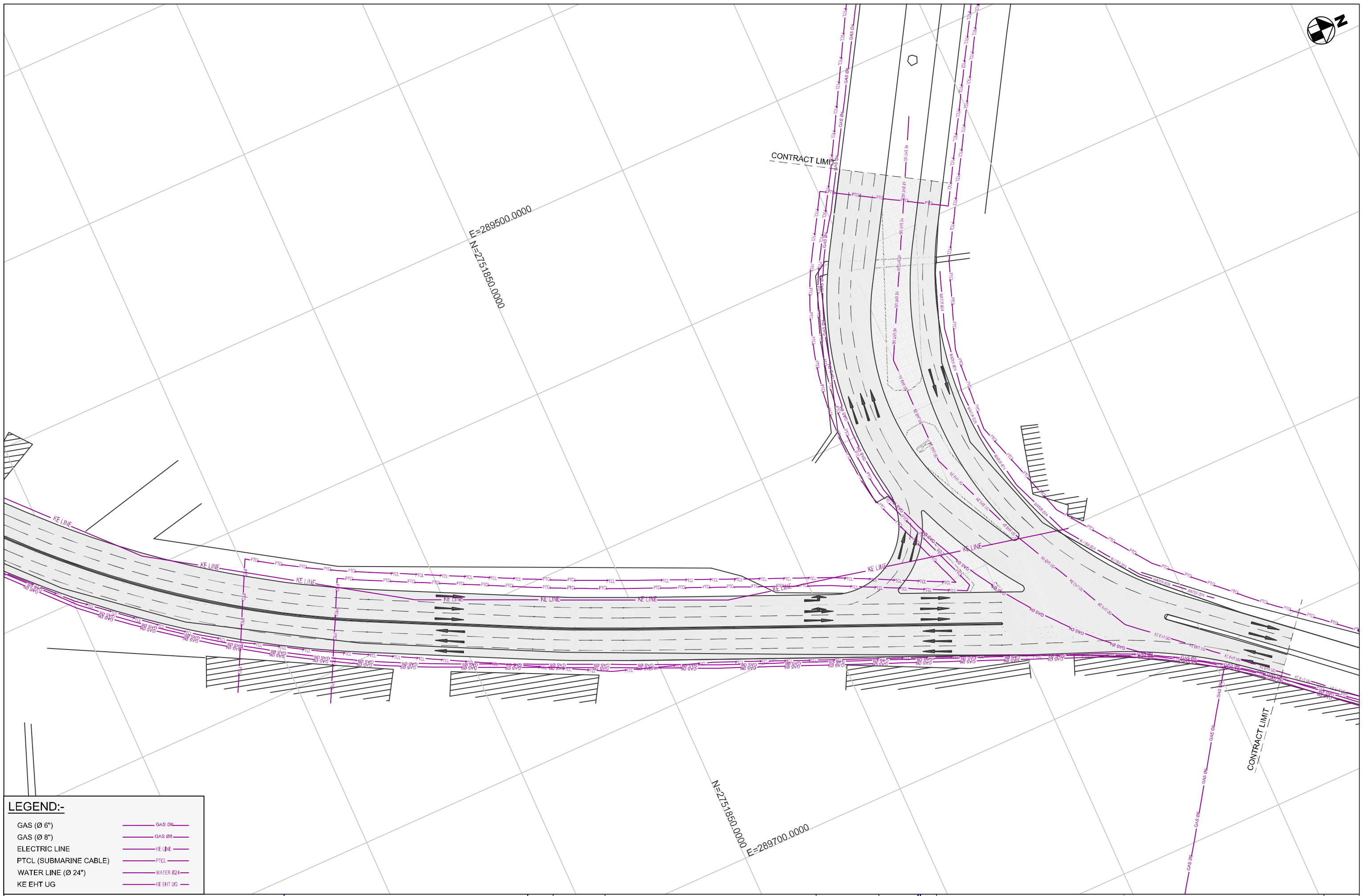
TITLE
UTILITY FOLDER
(SHEET 06 OF 7)

SCALE
1:1000

DATE
NOV20

DWG. No.
P–38035/P2/50P/PD/01C107

REVISION
0



LEGEND:-

GAS (Ø 6")	GAS Ø6
GAS (Ø 8")	GAS Ø8
ELECTRIC LINE	KE LINE
PTCL (SUBMARINE CABLE)	PTCL
WATER LINE (Ø 24")	WATER Ø24
KE EHT UG	KE EHT UG

LOCAL GOVERNMENT & HTP DEPARTMENT
GOVERNMENT OF SINDH

NESPAK
NATIONAL ENGINEERING SERVICES
PAKISTAN (PVT) LIMITED

REV.	DATE	DESCRIPTION
D		
C		
B		
A		
0	NOV,2020	PRELIMINARY DRAWINGS

DRAWN	M.A.K
DESIGNED	A.J
CHECKED	M.A
APPROVED	R.Z

URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 2 : EXPRESSWAY FROM
MAURIPUR ROAD TO Y-JUCTION

TITLE
UTILITY FOLDER
(SHEET 07 OF 7)

SCALE
1:1000

DATE
NOV20

DWG. No.
P-38035/P2/50P/PD/01C108

REVISION
0

LOCAL GOVERNMENT DEPARTMENT
GOVERNMENT OF SINDH

LOCAL GOVERNMENT &HTP DEPARTMENT GOVT OF SINDH

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES INKARACHI' PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

INTERCHANGE AT ICI BRIDGE

Volume 01 of 02

JUNE, 2021

National Engineering Services Pakistan (Pvt) Limited
1C, Block N, Model Town Ext, Lahore 54700, Pakistan
Phone: +92-42-99090000 Ext 200 Fax:+92-42-99231950
Email: geotech@nespak.com.pk, info@nespak.com.pk
http://www.nespak.com.pk

Consultant

National Engineering Services Pakistan (Pvt) Limited
1C, Block N, Model Town Ext, Lahore 54700, Pakistan
Phone: +92-42-99090000 Ext 200 Fax: +92-42-99231950
Email: geotech@nespak.com.pk, info@nespak.com.pk
http://www.nespak.com.pk

Client

Local Government Department,
Ground Floor, Tughlaq House, Sindh Secretariat, Karachi.
Tel: +92-21-9921-2314, +92 300 2197526

DOCUMENT CONTROL

Category	Information		
Project	FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, 'URBAN ROAD INITIATIVES IN KARACHI'PROJECT		
Job / Proposal No.	38035	Division: Karachi Office	
Project Manager	Mr. Rehan Zamin- Chief Engineer		
Specialty Group Leader(s)	GL1 (GT&GE): Mr Shariq Ahmad- Chief Engineer		
Title	Environmental Impact Assessment (EIA) for Interchange at ICI Bridge		
Document No.		No. of Documents	01 / 01
Clearance Code	Unique identifier that sets them apart from others		
Date of Issue	December 31, 2020		
Document Location	Divisional document management system		

Rev No.	Date	Description	Prepared by		Checked by		Approved by HOD	
			Name	Signature	Name	Signature	Name	Signature
0	18-12-2020	Draft EIA	Ms. Sanober Zubair Mr. Waseem Abbas Mr. Saeed Hussain Mr. IbadUllah Khan		Mr. M. Shariq Ahmad Mr. M. Ramzan Javed Mr. Ali Sher Shah			
01	23-04-21	Final EIA	"		"			
02								
04								

Feasibility Study and Transaction Advisory Services, 'Urban Road Initiatives In karachi' Project

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
INTERCHANGE AT ICI BRIDGE

TABLE OF CONTENTS

Page No.

ANNEXES

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATONS

AKM	Avenue Kilometer
AASHTO	American Association of State Highway and Transportation Officials
ASTM	American Society of Testing Materials
BDL	Below Detection Limit
BHU	Basic Health Unit
BOD	Bio-chemical Oxygen Demand
CC	Construction Contractor
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
COI	Corridor of Impact
dB (A)	Decibel
DC	Design Consultant
DCR	District Census Report
DD	Deputy Director
DO	Dissolved Oxygen
DPC	Displaced Person Committee
DPs	Displaced Persons
DRR	Disaster Risk Reduction
EA	Environmental Assessment
EE	Environmental Engineer
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environment Protection Agency
EPD	Environment Protection Department
EPO	Environmental Protection Ordinance
ERSD	Environment, Resettlement and Social Development Section
ESMS	Environmental and Social Management System
ESR	Environmental Sensitive Receiver
ESS	Environmental & Social Standards of World Bank
FCC	Forest Conservation Committee
GHG	Green House Gases
GoP	Government of Pakistan
GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
IBAT	Integrated Biodiversity Assessment Tool
IEE	Initial Environmental Examination
Km	Kilometer
KMC	Karachi Metropolitan Corporation
KWSB	Karachi Water and Sewerage Board
LAC	Land Acquisition Collector
NESPAK	National Engineering Services Pakistan (Pvt.) Ltd.
NGO	Non-Governmental Organization
NOC	No-Objection Certificate
NO_x	Nitrogen Oxides
NSL	Natural Surface Level
NSR	Noise Sensitive Receiver
^{O}C	Degree Centigrade
OSHA	Occupational Safety and Health Administration
PAPs	Project Affected Persons
PEPA	Pakistan Environmental Protection Act
PEPC	Pakistan Environmental Protection Council
PM	Particulate Matter
PNCS	Pakistan National Conservation Strategy
PPC	Pakistan Penal Code
PPP	Public Private Partnership

PSF	Project Support Facility
RAP	Resettlement Action Plan
RE	Resident Engineer
ROW	Right of Way
SC	Supervision Consultant
SEPA	Sindh Environmental Protection Agency
SEQS	Sindh Environmental Quality Standards
SO_x	Sulfur Oxides
SPS	ADB’s Safeguard Policy Statement 2009
SSEMP	Site Specific Environmental Management Plan
SSGC	Sui Southern Gas Company
SSWMB	Sindh Solid Waste Management Board
TA	Technical Assistance
TSS	Total Suspended Solids
UC	Union Council
URI	Urban Road Initiatives
USEPA	United States Environmental Protection Agency
VGF	Viability Gap Fund

EXECUTIVE SUMMARY

ES-1 INTRODUCTION

1. The Local Government & HTP Department, Government of Sindh (GoS) intends to establish Urban Road Initiatives Projects (URI) in Karachi under PPP modality. GoS intends to develop these roads to reduce traffic congestion and to provide quick and safe access to the commuters. The Sub-Projects in this initiative include:

- Link Road for Korangi,
- Expressway from Mauripur Road to Y-Junction, and
- Interchange at ICI Bridge.

2. This report presents the findings of Sub Project 3 i.e. “Interchange at ICI Bridge”.

3. The proposed project i.e Interchange at ICI Bridge is located along Mauripur Road between Jinnah Flyover and Lyari Expressway.(refer Figure-1 for Project Corridor Map) The project is primarily conceived (i) To facilitate Karachi port heavy traffic going / coming from all over country through the junction without stopping, also to facilitate city traffic using Lyari Expressway and Mauripur Road for their ultimate destination; and (ii) To resolve traffic congestion during peak hours on Jinnah Bridge, where currently more than one kilometer queue length of vehicles can be observed due to this signalized junction.

4. The proposed project requires an EIA in accordance with the Sindh Environmental Protection Act, 2014, Review of IEE/EIA Regulation, 2014 and also to fulfill requirements of international financial institutions such as the Asian Development Bank (ADB) Safeguard Policy Statement (2009) requirements and is fully endorsed by the GoS. The objective of preparing this EIA is to provide a formal structure through which the environmental impacts of proposed project can be assessed and mitigated by the Executing Agency in the future, in compliance with the ADB policy.

5. The proposed project requires an EIA in accordance with the Sindh Environmental Protection Act, 2014. According to Sindh Environmental Protection Agency (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, the proposed project falls under category ‘E’ (Transport) of Schedule II, which requires EIA before commencement of construction.

ES-2 LEGAL AND ADMINISTRATIVE FRAMEWORKS FOR EIA

6. The Government of Pakistan (GoP) has promulgated laws/acts, regulations and standards for the protection, conservation, rehabilitation and improvement of the environment. The applicable environmental policies are; ADB Policy, National Conservation Strategy (NCS), 1992, National Environment Policy, 2005, National Resettlement Policy, 2002, Pakistan Labour Policy, 2010, National Climate Change Policy, 2012, Sindh Environmental Protection Act, 2014, Sindh Environmental

Protection Agency (Review of IEE/EIA) Regulations, 2014, Sindh Environmental Quality Standards (SEQS), 2016, Cutting of Trees (Prohibition) Act, 1975, The Sindh Forest Act 2012, Sindh Factories Act 2015, The Antiquities Act, 1975, Land Acquisition Act, 1894, Pakistan Penal Code, 1860, Sindh Wildlife Protection (Amendment) Act 2008. Protection of Trees and Brushwood Act, 1949, Building Code of Pakistan (Seismic Provisions-2007), Occupational Health, Sindh Cultural Heritage Act 1994, Environmental Assessment Guidelines, Guidelines for Policy and Procedures for Filing, Review and Approval of Environmental Assessment Reports, Guidelines for the Preparation and Review of Environmental Reports, Sectorial Guidelines: for Major Roads, Guidelines for Public Consultation. International Convention, Protocols and Obligations includes The Rio Declaration, 1992. Bonn Convention- The Convention on Conservation of Migratory Species of Wild Animals, 1979. Convention on International Trade of Endangered Species of Flora and Fauna (CITES) - 1979.

7. The implementing agency of the proposed project is Local Government & HTP Department, Government of Sindh. They will ensure that all the proposed measures are effectively implemented at the design, construction and operational stages of the project.

ES-3 PROJECT DESCRIPTION

8. The proposed project involves construction of a flyover at the present at-grade ICI intersection and rehabilitation of connecting roads. Approximately 684 m^2 of land will be acquired for the project.

9. The geometric design of the project is governed by prevalent standard codes for highways design and as per the geometric design criteria for roads given in the AASHTO Standards. Total length of elevated two lane right-turn flyover is 0.56 km and at-grade section of three lanes in each direction is 0.75 km. Rehabilitation work for Ghulam Ali Alana Road, Akbar Siddiq Road, Nawab Muhabat Khanji Road, and West Wharf Road having a length of 1.75 km is also part of the proposed project.

10. The expected duration for construction is about twelve (12) months. The tentative manpower required during the construction is 50 people and estimated project cost is Rs. 917 million.

Figure 1: Project Corridor Map of proposed Project.

ES-4 ANALYSIS OF ALTERNATIVES

11. Following alternatives were considered for the proposed project;

- Option I: No Improvement (Do Nothing / No Project Scenario)
- Option II: Flyover on Mauripur Road & Kharadar with grade U-turn under ICI Bridge
- Option III: Elevated Expressway parallel to Jinnah Flyover
- Option IV: Right-turn Flyover from Mauripur Road onto ICI Bridge and rehabilitation of existing West Wharf Road / Akbar Siddiq Road

12. After careful deliberation among the project team and subsequent consultations with the Client, it was planned to provide a right-turn flyover from Mauripur Road to ICI Bridge (Option IV) due to its long term benefits of reducing traffic load and consequent emissions, dust and noise from these vehicles. The length of proposed flyover is 556m and it will be used by all types of vehicles. Construction of this flyover will eliminate one of the major at-grade turn movements (consisting of truck / trailer traffic). It has also been proposed that cross-movements across Mauripur Road will be banned to facilitate the thru movements (approx. 59% of the total traffic at this intersection). The banned movements would be made to use existing West Wharf Road / Akbar Siddiq Road just south of the ICI intersection, for which rehabilitation of the road would be carried out as part of this project. This road is under Karachi Metropolitan Corporation (KMC) jurisdiction. The ICI intersection will be rehabilitated as part of the project. A central median will be introduced to restrict the cross movements. The proposed scheme would allow for free-flow movements for the thru traffic on Mauripur Road, which would result in the intersection operating within capacity.

ES-5 DESCRIPTION OF THE ENVIRONMENT

13. The existing environment in and around the project area has been studied with respect to the physical, biological and socio-economic conditions.

PHYSICAL ENVIRONMENT

14. Karachi is located in the south of Sindh, on the coast of the Arabian Sea. As per the Karachi Metropolitan Corporation (KMC), it covers an area of approximately 3,530 km2, comprised largely of flat or rolling plains, with hills on the western and northern boundaries of the urban sprawl. The city represents quite a variety of habitats such as the sea coast, islands, sand dunes, swamps, semi-arid regions, cultivated fields, dry stream beds, sandy plains, hillocks. Karachi City District can be divided into three broad categories on the basis of physiographic features; Hilly Region (Mountain Highland), Alluvial Plain (Piedmont Plain) and Coastal Areas (Valley Floor).

15. The topography of the district West of Karachi is dominated by ridges, plains and coastal belt; the area which at one time was predominantly under agriculture is now crowded with new colonies and township like Hawksbey, Moach Goth, Baldia, Orangi, Qasba Colony and Ittehad Town. The proposed project site is located adjacent to the existing ICI Bridge, which is in a well-built urban environment.

16. The site can be accessed through Mauripur Road and Dockyard – Ghulam Ali Allana Road. Test results for on-site test pits indicated that A-1-a / A-4 soils with soaked CBR as 30 % & 32.5 % at 95 % modified AASHTO maximum dry density are present on existing road locations. On-site or alternatively, borrow area soils that belongs to A-4 or better AASHTO soil classification group can be used for road works.

17. The subsoil can be categorized as soil profile type SD, as per criteria of Building Code of Pakistan Seismic Provisions (2007), for structural design of the project structures.

18. According to Building code of Pakistan, 2007, the project area falls in Seismic Zone 2B of Pakistan (moderate damage), and peak ground acceleration (PGA) from 0.16 to 0.24 g.

19. The climate of the Karachi can be characterized by dry, hot and humid conditions and in general terms it is moderate, sunny and humid.

20. The maximum temperature range is 24 – 37°C The average temperature range is 21 - 34°C. The minimum monthly temperature range is 17– 30 °C. April to November are the hot months whereas cold months are December to March. During heat wave event, maximum temperature of Karachi was recorded 44.8°C in 2015.

21. The maximum rainfall occurs during the months of July and August. Winter rains generally occur during the months of December to March, whereas, May, October and November are normally the months with least precipitation.

22. The minimum average monthly rainfall of the project area varies from 0 to 0.8 mm the month of August has historically received maximum rainfall in Karachi. The maximum rainfall recorded between the years 2016 to 2019 varies from 37.9 mm to 161.5 mm. As this region falls in the semi-arid climatic zone, the rainfall in Karachi is extremely low and erratic. However, recent record-breaking rainfall in August 2020 turned Karachi's roads into waterways and caused havoc due to poor drainage system in Karachi.

23. Relative humidity levels are mostly high during the month of July and August, whereas, these are lower during December.

24. The data reveals that the wind speeds are generally lower during winter (December to March) while higher wind speeds are recorded during summer (May, June, July).

SOCIOECONOMIC ENVIRONMENT

25. The project area as well as the residential houses in surrounding, road users, commuters, educational and health centers and the commercial shops were studied for the socio-economic survey. This included the collection of demographic and socio-economic baseline information as well as commercial activity survey in the project area. The main objective of the study was to analyze socioeconomic and cultural characteristics of the project beneficiaries in order to understand their interrelationships, dynamics, and qualities. The study also provide information to the

project design in order to make the project interventions more effective, socially acceptable, culturally appropriate, gender sensitive and economically viable.

26. During the baseline survey, 119 respondents were consulted including 71 respondents of socioeconomic baseline survey, 33 respondents of community consultations and 15 respondents of the gender consultation. Consultation was carried out with different primary and secondary stakeholders including government departments, educational institutes, Business operators and residents of the project area. Issues raised and the relevant suggestions were recorded and documented in the EIA Study.

ECOLOGICAL ENVIRONMENT

27. Sindh has more than 400 km of coastline along the Arabian Sea. This coastal zone is endowed with abundant natural resources especially mangrove forests, fisheries and wildlife eco-systems. The coast of Karachi is classified as sub-tropical maritime desert influenced by the Arabian Sea with high relative humidity and strong wind velocity.

28. Phyto-geographically the natural vegetation of the tract falls in Saharo-Sindian region. Floristically this region is considered very poor. However, the project is located close to the coast therefore; marine phytoplankton and mangrove forests are in relative abundance in the coastal areas. Project area consists of built urban environment with limited floral and faunal species.

29. Integrated Biodiversity Assessment Tool (IBAT) was conducted in the project area. Based on the findings of IBAT Proximity report 1, initially 111 nos. of IUCN red list species were identified at point 1 i.e.(Location: [24.9, 67] Date of analysis: 16 April 2021, Buffers applied: 1 km | 3 km | 5 km). No (0) Protected Area and Key Biodiversity Area were identified within this buffer. However, the initial screening species identified by IBAT are potentially found within 5km of the area of interest.

30. IBAT species were verified/authenticated through various tools including literature review, stakeholders/departmental consultations and random ground trothing.

ES-6 STAKEHOLDERS CONSULTATION

31. To ascertain the perceptions of different stakeholders about the project (during/ after construction), meetings were held within the project area. These meetings were held in an open atmosphere, in which participants expressed their views freely. Informal group discussions were also held as an additional tool for the assessment of the perceptions of the stakeholders about the project and potential impacts both positive and adverse likely to occur due to its implementation., Consultations were held with PPP Unit, Client, PSF, PN, KPT, Forest, Agricultural Departments, NGOs, Traffic Police Karachi, Road Users and local community. Their views and suggestions were recorded and incorporated in the EIA report. Overall, all the stakeholders appreciated the project need to reduce traffic congestion at the intersection.

ES-7 IMPACTS AND MITIGATION MEASURES

32. Based on the findings of the desk studies, available satellite imageries, aerial photographs and the rapid assessment, the screening checklist for the potential impacts are prepared to screen out the significant and non-significant impacts of the Project on physical, biological and social & cultural environment with and without project situation.

33. Evaluation matrix determined that the implementation of the proposed project will have many beneficial impacts on population residing around the project area and the daily road user/ travelers using the proposed Project.

34. The major positive impacts of the project include the following:

- Smooth traffic flow through the ICI intersection, thereby facilitating the people of Karachi and business community;
- Provide an additional passage to the heavy and light vehicles;
- Reduction of noise and air pollution;
- Less time required for travelling and reaching the destination;
- During the construction phase, local labour will be accommodated in the construction activities;
- Less fuel consumption for the user moving in and around the project area; and
- Reduction in road accidents due to ease of mobility along the proposed road project.

35. The major adverse environmental impacts and mitigations drawn from the environmental assessment are given below:

- One of the major project related impact will be the land acquisition. The land required for the proposed project is 684 sq.m.
- Daily commute of the business community, residents and students of the project area will be disturbed during the construction phase due to construction activities. Moreover, improper traffic management may result in traffic jams at ICI Bridge, which will also cause inconvenience;
- Public utilities like electric poles, sewerage line, water line, light poles, underground electric cable, sui gas pipeline and operational setup may be affected and will create disruption of public services and economics;
- Generation of solid waste including construction and hazardous waste during construction phase if not managed properly;
- Health risks and work safety problems may result at the workplace/camps if the working conditions provide unsafe and/or unfavorable working environment due to storage, handling and transport of construction materials and malfunctioning in operation of construction machinery and equipment;
- Air quality will be deteriorated both during pre-construction (site clearing) and construction phase of Proposed Project due to construction activities (operation of construction machinery, dust emissions, vehicular movement, etc.) which results in increase air and noise pollution along with associated health risks. During construction, the continuous operation of machinery and movement of heavy trucks/vehicles and construction activities may generate gaseous emissions, dust,

noise/vibration which may severely affect the health of local residents and businessmen; and

- Improper implementation of EMP may lead to incidents/ accidents which may cause serious health, safety and environment risks.

36. Recommended Mitigation Measures include:

- Adequate budget shall be provided in LARP to compensate the affected persons.
- Soil contamination can be controlled by proper storage of chemicals.
- Loss of trees should be mitigated by transplant of affected trees and compensatory plantation along both sides of road.
- Surface runoff and wastewater shall be controlled and collected in septic tanks and soakage pits.
- Dust, fugitive emissions shall be controlled by maintenance of equipment, fine tuning of the vehicles, regular sprinkling of water on soil.
- Noise and vibration can be controlled by equipment maintenance and providing noise barrier and by scheduling the construction activities to avoid peak activity hours in the area.
- Solid waste including construction and hazardous waste should be managed by adopting a solid waste management plan for the collection and disposal of all types of wastes and site shall be restored back.

37. The impact screening matrix for the project is provided in the below **Table ES-1.**

Table ES-1; Impact Screening Matrices

Sr. No.	Impact on Valued Environmental Receptor	Impacts Significance	Mitigation Measure
Pre-Construction Phase			
1	**Permanent Land Acquisition** The proposed project Interchange at ICI Bridge will be constructed on existing alignment. But widening of existing road is proposed on few sections for which about 0.17 acres land will be acquired.	High Adverse	Compensation should be made to the affected people according to the guidelines of Land Acquisition Act, 1894, ESMS of PPPU and ADB's Resettlement Guidelines for the lost assets and restoration of their livelihoods. Adequate budget will be provided in the Project cost for this compensation. Land Acquisition and Resettlement Plan (LARP) shall be prepared for the acquisition and compensation strategies as per ADB's guidelines.
2	**Renting/Leasing Land** The development of Contractor camps and facilities i.e. storage, workshops, equipment parking and washing areas; aggregate quarries; and access roads/tracks for haulage, transportation etc. will required renting/leasing	Medium Adverse	Land for above mentioned facilities will be directly rented from the private landowners by the Contractors. Rental terms should be negotiated to the satisfaction of the concerned landowners and the agreement should be in local language to make the process clear.

Sr. No.	Impact on Valued Environmental Receptor	Impacts Significance	Mitigation Measure
	land. The approximate area required for the establishment of one Contractor's camp facilities will be 10,000 m2 at the different locations.		Mitigation mentioned in Section 7.6.8
3	**Public Utilities** Public utilities will be affected and creating disruption of public services and inconvenience to the local residents due to proposed Project. The utilities like sewerage drain, pedestrian bridge, vacant electric pole, Gas operation system of SSGC, 07 street lights and 03 security lights fixed on existing flyover will be disturbed according to the preliminary design of the ICI Intersection. These utilities if not handled properly will cause difficulties to the peoples of Project Area	Medium Adverse	• Proper compensation and restoration mechanism of public utilities will be considered. • Strengthening of utilities, wherever required; • Close coordination with the concerned departments to curtail inconvenience to the residents of the Project area. • Timely public notification of unexpected disruption of services. Mitigation mentioned in Section 7.5.4 shall be followed.
4	**Resource Conservation** Resources involved in the construction of proposed project would include water, fuel and construction materials. Excessive water consumption, non-renewable construction material, and fuel for energy will cause stress on these resources.	Medium Adverse	• A good camp design and an efficient worksite management plan can help the contractor to reduce the water demand, wastewater and solid waste volumes to the lowest levels. • The efficient and well-maintained equipment and machinery should be used; • Reuse of construction waste materials may be adopted wherever possible;
5	**Seismicity** The Project Area is located in Seismic Zone 2B, where 2B (upper limit of moderate damage) represents peak horizontal ground acceleration from 0.16 to 0.24 g.	Medium Adverse	• The proposed road and the associated structures should be designed and constructed as per Seismic Building Code of Pakistan 2007 (SBC-07) to comply with minimum requirements for seismic safety of structures.
	Construction Phase		

Sr. No.	Impact on Valued Environmental Receptor	Impacts Significance	Mitigation Measure
1	**Traffic Management** Due to the proposed construction activities and movement of heavy project vehicles for construction material supply; traffic problems may arise for the commuters and transporters travelling to the proposed areas. The movement of vehicles along the haulage routes will cause soil erosion, debris flow, dust emissions etc.	Medium Adverse	• Movement of vehicles carrying construction materials and equipment/machinery will be restricted during the daytime. • Traffic Management Plan will be implemented to avoid traffic accidents, jams/public inconvenience.
2	**Community Health and Safety** The construction activities and vehicular movement at construction sites may result in roadside accidents deteriorate quality of groundwater and surface water resources, cause air/dust emissions, noise pollution, vibrational impact and spread of different transmittable diseases due to outside labour	Medium Adverse	Proper control on construction activities, restrict entry of labours with different transmittable diseases, adopt mitigations for dust, noise & vibration impacts and create awareness about road safety will be ensured.
3	**Occupational Health and Safety** Occurrence of accidents / incidents and other natural emergencies during the construction stage is a common phenomenon and workers as well as locals will be more prone to serious accidents.	Medium Adverse	Safety precautions for the construction workers, Training of workers in construction safety procedures and use of Personnel Protective Equipment (PPE) will contribute in mitigating this impact. Mitigations mentioned in section 7.6.2.4 will be adopted.
4	**Ambient Air Quality** Airborne dust from access road construction and use, wind erosion of material stockpiles, emissions from diesel vehicles and construction equipment, disposal of waste have potential to adversely impact the sensitive	Medium Adverse	• The following effective measures need to be adopted for controlling the potential adverse impacts on ambient air quality: • The existing quarries will be used to borrow the aggregate materials; • Concrete batching plants will be equipped with dust control equipment such as fabric filters or wet scrubbers to reduce the

Sr. No.	Impact on Valued Environmental Receptor	Impacts Significance	Mitigation Measure
	receptors in the Project area.		level of dust emissions; • Ensure the proper and periodic tuning of the vehicles; • Dust emissions from trucks will be reduced by a regular sprinkling of water for keeping the dust settled at least twice a day; • Haul-trucks carrying sand aggregate and other materials will be kept covered with tarpaulin to reduce the dust pollution; • Turn off the engines for all vehicles, while parked on the site; • Regular monitoring of air quality in accordance with SEQS.
5	**Noise and Vibration** Noise and vibration generated by the construction machinery during the construction stage is likely to affect the sensitive receptors like nearby schools, houses and settlements etc.	Medium Adverse	• There are a variety of ways by which construction equipment and worksite noise can be controlled as mentioned in section 7 of this report.
6	**Soil Erosion** Construction activities such as clearing of earth, levelling, compaction, carpeting, pavement finishing will affect the existing soil condition in the CoI. Soil erosion may also occur in the workshop areas as a result of improper drainage system of equipment washing-yards and improper management of construction activities.	Medium Adverse	Good engineering practices will help to control or minimize the soil erosion both at the construction sites and in peripheral areas. All the disturbed areas need to be protected against soil erosion by stripping and stockpiling of all the available topsoil for later re-vegetation. Special slope protection measures will be adopted in the sensitive areas and along the shoulders of roads. Site restoration plan for the Project will be strictly followed.
7	**Soil Contamination** Land may be contaminated due to the spillage of chemicals, fuels, solvents, oils, paints, concrete, solid waste generated at campsites etc. This normally happens when these materials are transported in	Medium Adverse	• The Contractors will be required to instruct and train their workforce in the storage handling and management of materials and chemicals that can potentially cause soil contamination; • Material Safety Data Sheets (MSDS) will be strictly followed during handling and storage of

Sr. No.	Impact on Valued Environmental Receptor	Impacts Significance	Mitigation Measure
	open or loosely capped containers. The possible contamination of soil by oils and chemicals at camp sites, workshop area and equipment washing-yards may limit for future land use		chemicals; • Soil contamination due to concrete transportation and solid waste will be minimized by placing all containers in casings.
8	**Wastewater Generation at Construction Camps** Wastewater will be generated at the construction camps and from construction activities. Based on the estimated, 1,890 gallons/day wastewater will be generated from camps during the construction phase which may affect water bodies if disposed off without proper treatment.	Medium Adverse	• To dispose the liquid waste generated from the construction activities, the following steps will be taken by the Contractor: • Domestic and chemical effluents from the construction camp will be disposed by the development of on-site sanitation systems i.e. septic tanks Proper monitoring to check the compliance of SEQS will be carried out; and • Sewage from construction camps will be disposed of after proper pre-treatment and processes such as soakage pit.
9	**Solid Waste Generation at Construction Camps** Considering the labourers (about 50 Nos.) residing in the construction camp and the locally available labour, a total of about 25 kg of solid waste will be generated from the construction camp daily. The major components of the labour camp waste will be garbage, putrescible waste, rubbish and small portion of ashes and residues. Other type of wastes may include inorganic construction wastes.	Medium Adverse	• All the solid waste from the camps will be properly collected at source and disposed of through proper solid waste management system. The Contractor will coordinate with local representatives and administration concerned department for the disposal of solid waste; • The concerned department must develop a plan of action for transporting the waste to the disposal site for final disposal. It is the responsibility of the concerned department to ensure that the disposal site is properly lined to prevent the leachate from contaminating the groundwater; • Secondly, the disposal site must be located away as far as practical from populated areas and regions that have a high density of Wildlife; • Toxic waste will be handled, stored, transported and disposed separately; • The waste will be properly sealed in containers with proper labels indicating the nature of the waste; and

Sr. No.	Impact on Valued Environmental Receptor	Impacts Significance	Mitigation Measure
			• Solid waste will be segregated at source so that it can be re-used or recycled.
10	**Waste Generation at Construction Site** The construction waste will include wastewater, oil spillage from machinery and solid waste (damaged or spoiled materials, temporary and expendable construction materials etc.). The handling and storage of oil and other hazardous waste will be a source of environmental pollution during the excavation, foundation, levelling, carpeting and pavement activities.	Medium Adverse	• Waste Management Plan will be developed to implement an efficient and responsive solid waste management system during construction phase.
11	**Borrow Pits** Borrow pits and its excavation activities may result in land disputes, soil erosion, loss of vegetation and landscape degradation. Borrow pits may also become potential sources of mosquito breeding and may prove hazardous to human beings, livestock and wildlife. This will also degrade hygienic condition of the Project Area.	Medium Adverse	• Necessary permits will be obtained for any borrow pits from the competent authorities. • In borrow pits, the depth of the pits will be regulated so that the sides of the excavation will have a slope not steeper than 1: 4; • Soil erosion along the borrow pit will be regularly checked to prevent/ mitigate impacts on adjacent lands; • In case borrow pits are filled with water, measures have to be taken to prevent the creation of mosquito-breeding sites; and • Borrow pits will be used for construction waste, but during the excavation, top 20 cm soil cover will be preserved for vegetation after the filling of the pits. This is the best way to restore the flora of that area.
12	**Flora** The project will involve disturbance to vegetation cover on construction areas particularly along proposed road construction.	Minor Adverse	• Cutting of trees and disturbance of orchards shall be avoided, as far as possible so, that negative effects on the process of natural regeneration of species are minimized and possible alternate route must be considered for proposed road, in which minimum ecological and environmental losses are expected.

Sr. No.	Impact on Valued Environmental Receptor	Impacts Significance	Mitigation Measure
			• A tree plantation program shall be formulated with the recommendations and technical support of concerned Agriculture and Forest Department.
13	**Fauna** During construction phase the existing population of mammals and reptiles of the construction areas will be affected due to disturbance arising from construction activities involving excavation, blasting, movement of machinery and vehicular traffic, movement of labour, camping, etc.	Minor Adverse	• Care shall be taken during construction activities for avoiding purposely or chance killing of animals. • If found any wild species and habitat during construing that must dealt carefully and local wildlife department officials should be called. • Special measures should be adopted to minimize impacts on birds such as avoiding noise generating activities during the critical period of breeding. • Hunting, poaching and harassing of wild animals shall be strictly prohibited, and Contractor shall be required to instruct and supervise its labour force accordingly and clear orders should be given in this regard.
14	**Social Impacts** • Social and Cultural Conflicts, • Health Impacts (Communicable Diseases)	Minor Adverse	• Local labour especially from nearby communities should be given preference for the construction works; • Careful planning and training of work force to minimize disturbance to the local people; • Public notification through print or electronic media during the entire construction phase to avoid any inconvenience in accessibility to the locals; and • Adequate training of especially for the transitive workforce of the station (involved both in the construction process and in the commissioning) to regard the customs of the area so that the locals do not feel insecure. • Proper check-up of skilled and unskilled workers before their hiring; • Labour camp should be away from the residential area and workers' management plan should be formulated by Contractor to minimize the adverse impacts on local

Sr. No.	Impact on Valued Environmental Receptor	Impacts Significance	Mitigation Measure
			communities and workers; • Trainings, awareness and campaigns should be conducted for workers and surrounding communities on awareness and prevention of HIV/AIDs and COVID-19; • Workers should be educated for personal hygiene and the sanitation concerns, leading to communicable and non-communicable diseases; • Water should not be allowed to stagnate even if clean, and measures should be taken to cover the area; and • Insecticides should be periodically sprayed.
15	**Influx of Labour** Social problems and conflicts that are associated with Labour Influx are Risk of social conflict, Increased risk of illegitimate behaviour and crime, Impacts on community dynamics, Local inflation of prices, accommodations and rents, Increase in traffic and related accidents, etc.	Minor Adverse	• Labour camp(s) should be established away from residential population; • Preference should be given to the local people to work with contractor, and contractor should hire maximum labour force from the project area because this will reduce the labour influx; • An effective GRM should be established for the project to resolve all issues related to the community. Thus, progress regarding resolving the issues should be monitored closely;
16	Religious, Cultural, Historical Sites No notified religious, archaeological, cultural and historical sites are located within the CoI including RoW of the proposed Project.	Minor Adverse	• No notified archaeological site will be affected due to the implementation of the proposed Project. However, the Contractors will be required to train the construction crews and the site supervisors in archaeological site recognition, conservation procedures and temporary site protection. • In case of a chance archaeological find during excavation, the Contractors must halt work at the site immediately and notify the Department of Archaeology and Museums through Project Director.
17	**Gender Based Violence (GBV)** The Project route is passing through the urban and semi	Minor Adverse	• Awareness should be created among the females at individual and community levels about the construction's sights;

Sr. No.	Impact on Valued Environmental Receptor	Impacts Significance	Mitigation Measure
	urban areas where women are involved in working activities. During construction phase gender-based violence might arise due to discrimination made against women by unequal work distribution and unequal pay structure among others. Sexual harassment against women might occur as a consequence of mixing of men and women at the construction site, and moving on the roads, bus stops and markets. Educational institutions near the project alignment are also sensitive regarding gender issues.		• The Contractor should make sure that no discrimination is made on the basis of gender while hiring of workers; • Raise awareness among the communities of the potential risks of GBV, and establish response services in the communities that can respond to instances of GBV (particularly those related to issues of labour influx); • Contractor should take proper measures to address and resolve issues relating to harassment, intimidation, and exploitation, especially in relation to women.
18	**Child Labour** Inhabitants of the project area have mix economic background and different sources of income. Children of low income groups mostly involve in different earning activities, as their parents prefer to get their children hired in small shops as helpers, and waiters in hotels for earning money, and supporting household livelihoods.	Minor Adverse	• The chance of hiring of underage worker for the project activities will be minimized by adopting the following mitigation measures: • Awareness should be created among the local communities about the adverse impacts of child labour. For the public awareness, meetings should be held in the project area, and announcements should be made using the available local platforms with the involvement of all sectors of the society; • Contractor through contractual agreement should be bound to follow the labour standards, rules and regulations during hiring the labour force and all activities should be monitored by the social and environmental staff of the implementing agency; • Client and Supervision consultant should ensure that contractor shall have its employment policy in

Sr. No.	Impact on Valued Environmental Receptor	Impacts Significance	Mitigation Measure
			accordance with relevant act and labour policies in Sindh and Pakistan; and • Contractor should ensure the presence of all persons at site are adults and have their proper identity cards with them. • Reduce or eliminate the worst forms of child labour and rescue and rehabilitate the children in the worst forms of child labour. • Penalize contractors/employees using the worst forms of child labour and penalize adults who violate children's rights and who force children to enter child labour, especially in its worst forms. • Reduce the health hazards and dangers to young persons in the workplace.
Operation and Maintenance Phase			
1	**Air Quality** Improvement in road condition will help reduce traffic related emissions in the short term by allowing a smoother traffic flow. However, in the longer run, increased traffic levels may lead to higher values of emissions. The impact is permanent. It is positive in case of improvement of road conditions; and low negative, when traffic volume increases.	Positive / Minor Adverse	• Proponent with the help of SEPA may set up system to monitor air quality along project area in accordance with SEQS for a specific period to record the quality of air during the operation phase.
2	**Road Safety** Enhanced vehicular movement and speed in the long run may result in road safety issues like traffic accidents. This impact is permanent but moderately adverse in nature, since the frequency of accidents may be lowered, but their intensity may be quite severe due to enhanced	Minor Adverse	• Strict enforcement of speed limits, installation of speed guns and channelization of traffic with respect to categories (heavy vehicle traffic and light vehicle traffic), should be ensured for the smooth flow of traffic moving from major road crossings. Enforcement of penalties for the violators will reduce the significance of this impact.

Sr. No.	Impact on Valued Environmental Receptor	Impacts Significance	Mitigation Measure
	speeds at which vehicles will move.		
3	**Drainage** During the operational phase, poor maintenance of the road drainage system, particularly during the monsoon season can cause nuisance to the travelers and public due to flooding in the existing drainage line. In case of chocking of road drainage, the increased surface runoff due to heavy rains will accumulate at the start and end point of the proposed interchange can cause traffic jams.	Minor Adverse	• The impact can be controlled/reduced by timely and continuous maintenance/ cleaning of the drainage system; and • Placement of sign boards instructing not to dispose of solid waste to avoid chocking of drain around the flyover and at grade road alignment.
4	**Landscape / Flora** During the operation stage, new saplings of different plants and trees would be planted to enhance the aesthetics and compensate the loss of affected trees. The presence of adequate flora at available spaces along the proposed alignment will help in absorbing flue gases, emitting from a large number of vehicles and public transport passing through the project area, which shall help improve the air quality.	Positive	• This will have a positive impact of permanent nature. • The saplings planted in the project area against the trees affected should be properly maintained throughout their growth.
5	**Change in Aesthetic Value** Construction of the proposed interchange will change the aesthetic value of the area. Proper landscaping and plantation of grasses and ornamental plants along the alignment will increase the aesthetic value of the proposed project area and will have a positive impact.	Positive	• No mitigation required

ES-8 ENVIRONMENTAL MANAGEMENT PLAN

38. An Environmental Management Plan (EMP) for the phases (design, construction and operation) has been developed as part of the report which provides a detailed mitigation matrix that covers impacts, mitigation measures roles and responsibilities and timings to avoid, minimize or mitigate the adverse impacts of the project. During the construction phase, the Monitoring plan shall be implemented by the Construction Contractor and LG & HTP Department. Environmental monitoring will be conducted by construction contractor during construction whereas during operation phase monitoring will be conducted by LG & HTP Department.

39. Environmental monitoring has been proposed for construction and operation phases of the project for ambient air, surface water/wastewater, drinking water and noise level. Environmental monitoring report will be prepared biannually or as per the requirement of Sindh Environmental Protection Agency (SEPA) and submitted to SEPA. Cost for implementation of EMP will be Rs. 3,947,600 and is part of the estimated project cost.

ES-9 GRIEVANCE REDRESS MECHANISM

40. This section provides the structure, roles and functions of the GRM, to address the grievances arising due to execution of the project works. It provides a predictable, transparent, and credible process to all parties, resulting in outcomes that are seen fair, effective, and lasting.

41. The Grievance redress mechanism available under LAA 1894 to address the concerns of legal title holders about matters related to assessment and valuation of land asset, land ownership and payment of compensation for acquired ROW land and it will not be available to the encroachers/non-title holders in the sub-project corridor. Thus, the mechanism does not enable the project executors and the DPs to resolve their grievances except those related to land acquisition matters only. So, to address the gaps a mechanism will be established to address/resolve the project related grievances including the DPs concerns or grievances related to impact assessment, valuation and compensation to eligible DPs resettlement and relocation related grievances as well as social and environmental grievances encountered during execution of the project works.

42. Accordingly, the GRM proposed in the LARP is tasked to address any grievances raised by DPs on LARP implementation grievances and their concerns related to social and environmental grievances that could arise during execution of project work

ES-10 CONCLUSION AND RECOMMENDATIONS

- Adequate budget shall be provided for the compensation to the affected people as per Land Acquisition Act, 1894. During detail design stage, land acquisition shall be worked out and RAP will be prepared as per resettlement framework.

- A proper traffic management/diversion plan must be formulated in consultation with the contractor and Karachi Traffic Police Department and conveyed to the road users;
- Health and safety plan for the workers must be strictly followed and implemented during the construction phase;
- Use of horn should be strictly prohibited in the close proximity of sensitive receptors;
- Tree plantation/Landscape must be planned and implemented during operational phase by Local Government & HTP Department and Directorate of Parks and Horticulture- KMC;
- Monitoring of air, noise, surface water/wastewater and water quality should be done according to the devised schedule in the EMP and compared with the SEQS; and
- Operation and maintenance of the drainage structures and road wear and tear must be done periodically with respect to best management practices.

43. Proper implementation of EMP will be ensured during all three phases of the proposed project. All personnel staff, employees and contractors/s will undertake appropriate training prior to construction to ensure they are aware of the on-site responsibilities in respect of all environmental and social issues. In addition, EMP will be a part of contract document of Contractor/s. Moreover, the cost for environmental management, monitoring and training has been estimated which will be included in the PC-I or overall Project.

.

1 INTRODUCTION

1.1 PROJECTBACKGROUND

44. The Local Government & Housing Town Planning (LG & HTP) Department, Government of Sindh intends to implement the ‘Urban Road Initiatives (URI) in Karachi’ under Public Private Partnership (PPP) modality to reduce traffic congestion and to provide quick and safe access to the commuters.

45. The proposed sub-project, Interchange at ICI Bridge, aims to provide smooth traffic flow through this intersection and ultimately reduce traffic jams and boost the economic activity. The proposed project is a direct connectivity for traffic coming from Mauripur Road to West Wharf and will ease out traffic on Jinnah Flyover and ICIinter section once constructed. The construction of this flyover will resolve the traffic pressure at ICI intersection and surrounding areas. The overall traffic congestion of the project area will be reduced and people of Karachi and business community will be the overall beneficiary.

46. M/s NESPAK has been awarded the project to carry out the Environmental Impact Assessment (EIA) study for the proposed project.

1.2 OBJECTIVES OF EIA STUDY FOR THE PROPOSEDPROJECT

47. The purpose of this EIA report is to assess significant adverse environmental and social impacts and to suggest mitigation and remedial measures to make the project environment friendly and sustainable during the construction and operational stages of the project and to initiate the process of No Objection Certificate (NOC) from the Sindh Environmental Protection Agency (SEPA).

1.3 NEED OF EIA STUDY FOR THE PROPOSEDPROJECT

48. The proposed project requires an EIA in accordance with the Sindh Environmental Protection Act, 2014. According to SEPA (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, 2014, the proposed project falls under Category ‘E’ (Transportation) of Schedule II, which requires EIA before commencement of construction and also to fulfill requirements of international financial institutions as per ADB’s Environmental Assessment Guidelines the project falls under Category ‘B’.

1.4 THE PROPONENT OF THEPROJECT

49. The implementing agency of the proposed project is Local Government & HTP Department, Government of Sindh (GoS), while the Consultant is National Engineering Services Pakistan (Pvt.) Limited (NESPAK). The contact details of proponent are given asunder:

a) **Proponent Contact Details**
Mr. Najeeb Ahmed
Project Director Local GovernmentDepartment,
Ground Floor, Tughlaq House, Sindh Secretariat, Karachi.
Tel: +92-21-9921-2314, +92 306 2075902

1.5 NATURE, SIZE AND LOCATION OF THEPROJECT

50. The proposed project is the rehabilitation of ICI Bridge intersection located along Mauripur road between Jinnah Flyover and Lyari Expressway. It is one of the busiest intersections which carriesa large number of heavy vehicles from the East and West Wharves of Karachi Port.

51. Cross street traffic from Kharadar constitutes mostly private vehicles (motorcycles, rickshaws, small cars), which serves the needs of residential area of Kharadar. The intersection of Mauripur Road with Ghulam Ali Allana Road, commonly known as ICI Bridge Intersection due to its location at the approach to ICI Bridge over Karachi Circular Railway, is among the most congested intersections in the southern part of the city.

52. It serves the heavy traffic moving between Karachi Port, SITE area and other parts of the country through the Motorway, M10 / Northern Bypass and Site Avenue in addition to the city traffic moving along Mauripur Road from Mai Kolachi Bypass and M.T. Khan Road via Jinnah Bridge and from other areas of the city through Lyari Expressway.Besides, it serves localized traffic from the densely populated adjoining areas of Lyari, Kharadar, Methadar, Saddar and other areas of old city. The road also serves the recreational traffic towards Hawkesbay, SandspitManora, Gaddani, Golden, KundMalir beaches of Sindh and Balochistan. It is the fastest route for port traffic avoiding congestion on at-grade roads, Jinnah Flyover and ICI Intersection.

Figure 1.1: Location Map of the Proposed Project

1.6 STUDYTEAM/ CONSULTANT EIA TEAM

53. A multidisciplinary team was formulated to conduct the study. The key team comprises the following persons:

Mr. Rehan Zamin	Project Manager
Mr. M. Shariq Ahmad	Team Leader
Mr. M. Ramzan Javed	Principal Engineer/ Quality Assurance
Mr. Ali Sher Shah	Principal Engineer
Ms. Sanober Zubair	Environmental Engineer
Mr. Waseem Abbass	Senior Sociologist
Mr. Ibadullah Khan	Ecologist

1.7 STUDY APPROACH &METHODOLOGY

1.7.1 Study Approach

54. The study has been conducted in accordance with Sindh Environmental Protection Agency (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, 2014. The study is based on both primary and secondary data. The primary data includes data collected from field observations and secondary data includes review of relevant published reports and information from government departments. Discussions were held with various stakeholders including government officials, community representatives and a wide range of road users and roadside dwellers. The main purpose of this approach was to obtain a fair impression on the people's perception of the project and its environmental and social impacts.

1.7.2 Methodology

55. The following methodology was adopted for carrying out the EIA study of the proposed project:

a) Orientation

56. Meetings and discussions were held among the members of the EIA Consulting Team. This activity was aimed at achieving a common ground of understanding of various issues of the study.

b) Planning for Data Collection

57. Meetings and discussions were held to plan the project execution. Available data was reviewed and planning was done to collect information/data, defining the roles, responsibilities and timelines for completion of EIA Study.

c) Data Collection

58. In this step, primary and secondary data was collected through field observations, environmental monitoring in the field, concerned departments and published materials to establish baseline profile for physical, biological and socio-economic environmental conditions. Following activities were performed for data collection:

- Site Reconnaissance;
- Analysis of Maps and Plans;
- Literature Review;
- Desk Research;
- Stakeholder's Consultations;
- Field Observations & Studies ;and
- Laboratory Analysis

Physical Environment

59. Information was collected on the existing physical environment, particularly related to geology, topography/ bathometry, soils, hydrology and drainage, water quality, air quality and noise.

Geology, Topography, Soils

60. Data related to geology, topography and soil was collected to establish the baseline of the project area and further to find out the impacts of the Project during the construction and operational phases.

Drainage

61. The storm water drainage of the area has been studied considering the construction of the flyover from the Mauripur road to existing ICI Bridge. Although the drainage pattern of the area will remain same but for a segment the existing storm water drains will be shifted considering the locations of the bridge with required intake arrangement for rain water so that the efficient drainage can be ensured. Contractor shall ensure the Storm drainage scheme as per existing site conditions and nearby disposal for the works at ICI intersection as well as road rehabilitation works

Air Quality

62. Ambient air quality was monitored for Carbon Monoxide (CO), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Particulate Matter (PM_{10}), for 24 hours at two locations. CO was analyzed for eight hours period by M/s SGS, while SO_2 and NO_2 were analyzed according to "Standard Methods" based on recognized ISO 6767 and ISO 6768 of USEPA respectively.

Noise

63. Noise level measurements were taken at two sampling point for continuously 24 hours and hourly average data was reported. Sound level measurements were taken with the help of a calibrated instrument.

Water Quality

64. The objective of the water quality monitoring was to determine the water quality situation before construction. The extent of water contamination in the project area was assessed based on the test results of chemical and microbiological parameters. Dissolved Oxygen (DO), pH and conductivity measurements were taken in situ at all sampling stations. Laboratory analyses were performed by M/s SGS laboratory according to Standard Methods based on recognized methods of American Society of Testing Materials (ASTM); “United States Environmental Protection Agency (USEPA)” or “American Public Health Association (APHA) methods”.

Biological Environment

65. The status of the flora and fauna of the study area was determined by an ecological survey, review of literature relevant to the area, and an assessment of terrestrial environment.

Flora

66. The vegetative communities were identified and classified into community types. Identification was carried out of dominant tree species, assessment of stage of growth (mature or sapling) and assessment of canopy cover.

Fauna

67. Information on fauna was gathered from existing literature on reported species as well as observations in the field.

The Integrated Biodiversity Assessment Tool (IBAT)

68. IBAT software was utilized to carry out the initial ecological based screening of the proposed project. The species presence/confirmation with the utilization of various tools including literature review, stakeholders/departmental consultations and random ground trothing was conducted for the authentication of data.

Socio-Cultural Environment

69. The Consultants utilized a combination of desk research, field investigations, census data, structured interviews, maps, reports to generate the data required for description of the existing social environment and assessment of the potential impacts due to the

construction of the proposed project. Data was collected on the following aspects given below:

- Land use and Municipal Status;
- Traffic, Transportation and Access Roads;
- Demographics;
- Livelihoods;
- Poverty;
- Education;
- Health;
- Social Setup;
- Community Facilities;
- Solid Waste Management;
- Recreational Activities;
- Archaeological and Cultural Heritage; and
- Proposed Developments.

d) Identification and Evaluation of Environmental Impacts

70. The impacts of the road project on the physical, biological and socio-economic environment prevalent in the project area are visualized at the design, construction and operational phases.

e) Mitigation Measures and Implementation Arrangements

71. The adequate mitigation measures and implementation mechanisms are proposed so that the Proponent could incorporate them before and in the design phase.

f) Environmental Management Plan (EMP)

72. Environmental management plans describe how an action might impact on the natural environment in which it occurs and set out clear commitments from the person taking the action on how those impacts will be avoided, minimized and managed so that they are environmentally acceptable.

g) Grievance Redress Mechanism (GRM)

73. The structure, roles and functions of the GRM are provided to address the grievances arising due to execution of the project works. It provides a predictable, transparent, and credible process to all parties, resulting in outcomes that are seen fair, effective, and lasting.

1.8 STRUCTURE OF THEREPORT

74. This report contains ten chapters. The content of the chapters are described as under

75. Section1: **Introduction** briefly presents the project background and locations, objectives, methodology and need of the EIA study.

76. Section 2: **Policy, Legal and Administrative Framework** comprise policy guidelines, statutory obligations and roles of institutions concerning EIA study of the proposed Project.

77. Section3**: Project** Description furnishes information about the location of the proposed Project, cost and size of the project, its major components.

78. Section4: **Analysis of Alternatives** provides the alternatives considered for the proposed project to select at the preferred one for the detailed environmental impact assessment.

79. Section 5: Description **of Environment** establishes baseline conditions for physical, biological, and socio-economic conditions prevalent in the project area.

80. Section 6: **Stakeholder Consultation** identifies the main stakeholders and their concerns rose through scoping sessions and deals with the measures to mitigate the social impacts.

81. Section 7: **Anticipated Environmental Impacts and Mitigation Measures** identifies, predicts and evaluates impacts of the project activities during the construction and operation stages and deals with the measures proposed to mitigate potential environmental impacts of the proposed project.

82. Section 8: **Environmental Management Plan** outlines institutional arrangements for the implementation of the proposed mitigation measures, training needs of the staff for implementation of the mitigation measures, monitoring requirements and monitoring cost.

83. Section 9: **Grievance Redress Mechanism (GRM)** provides a predictable, transparent, and credible process to all parties, resulting in outcomes that are seen fair, effective, and lasting.

84. Section 10: **Conclusions and Recommendations** provide the outcome of the study and major observations of EIA and suggestions for environmental management and pollution control.

2 POLICY, LEGAL ANDADMINISTRATIVE FRAMEWORKS

2.1 GENERAL

85. This section deals with the current environmental policy as well as legal and administrative framework related to carrying out the Environmental Impact Assessment (EIA) of Interchange at ICI Bridge. All the relevant provisions of Environmental policies and Guidelines of Sindh-EPA, Pak-EPA, International Financial Institutions and legal frameworks have been duly discussed.

86. The proposed project requires an EIA in accordance with the Sindh Environmental Protection Act, 2014 and IEE/EIA Regulations, 2014 and also to fulfill requirements of international financial institutions.

2.2 POLICYFRAMEWORK

87. The Ministry of Climate Change is the responsible authority for policy making on environmental protection in Pakistan.

2.2.1 National Conservation Strategy (NCS), 1992

88. The Pakistan National Conservation Strategy (NCS) that was approved by the Federal Cabinet in March 1992 is the Principal Policy Document on environmental issues in the country (EUAD/IUCN, 1992). The NCS outlines 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 in the context of the proposed project are pollution prevention and abatement, restoration of rangelands, increasing energy efficiency, conserving biodiversity, supporting forestry and plantations and the preservation of cultural heritage.

2.2.2 National Forest Policy, 2001

89. The goal of this policy is to foster the sustainable development of Renewable Natural Resources (RNR) in Pakistan, through maintenance and rehabilitation of these essential resources and enhancement of sustainable livelihoods of rural masses, particularly women, children and other deserving groups.

90. The various components of the policy include:

91. Reducing poverty, powerlessness and unemployment;

- Population planning in critical ecosystems;

- Reducing the impact of socio-economic factors;
- Providing substitutes to firewood in the mountain-woods;
- Reducing political interferences in Forestry and Wildlife Departments;
- Renovating and invigorating the institutions of RNR;
- Supporting Local Governments in the sustainable development of their RNR;
- Policies for fragile ecosystems;
- Riverside forests;
- Irrigated plantations;
- Preservation of sensitive and unique forests;
- Wildlife conservation;
- Rangelands and desert ecosystems; and
- Planting trees and fodder on farmlands.

2.2.3 National Environment Policy, 2005

92. In March 2005, Government of Pakistan launched its National Environmental Policy, which provides a framework for addressing the environmental issues. Section 5 of the policy commits for integration of environment into development planning as instrument for achieving the objectives of National Environmental Policy. It further states in clause (b) of subsection 5.1 that EIA related provisions of Environmental Protection Act, 1997, will be diligently enforced for all developmental Projects. It also provides broad guidelines to the Federal Government, Provincial Governments, Federally Administered Territories and Local Governments to address their environmental concerns and to ensure effective management of their environmental resources.

2.2.4 Pakistan Labour Policy, 2010

93. The main objective of the Labour Policy, 2010 is the social and economic well-being of the labour of Pakistan. The Labour Policy, 2010 has following 4 parts:

- Legal Framework;
- Advocacy: rights of workers and employers;
- Skill development and employment; and
- Manpower export.

2.2.5 National Climate Change Policy, 2012

94. The National Climate Change Policy was approved by the Federal Cabinet on 26th September, 2012. With an overall goal, to ensure that climate change is main streamed in the economically and socially vulnerable sectors of the economy and to steer Pakistan towards climate resilient development', the Policy puts forward comprehensive policy objectives of sustained economic growth, integration of climate change into inter-related national policies, pro-poor gender sensitive adaptation and cost- effective mitigation, water, food and energy security, DRR, effective decision making and coordination, creating awareness, building capacities, and conservation of natural resources and long term sustainability. It also seeks effective use of financial opportunities, and public and private sector investment in adaptation measures. After

18thamendment, the decreased budget of the Climate Change Division and the lack of climate or adaptation policies at the provincial level has created confusion over the responsibility over implementing climate policy and formulating adaptation strategies. Nevertheless, it is clear that each province has the responsibility to acknowledge and act on risks and vulnerabilities set out in the National Climate Change Policy, 2012

2.2.6 National Action Plan for Covid-19 Pakistan

95. Government of Pakistan has launched the National Action Plan for COVID-19 Pakistan to combat the challenge of prevailing virus, also available at https://www.nih.org.pk/wp-content/uploads/2020/03/COVID-19-NAP-V2-13-March-2020.pdf. The Government of Pakistan has launched the real-time data portal for COVID-19 at http://covid.gov.pk/. These measures are mostly relating to the containment and awareness and capacity building. Besides this COVID-19 daily situation report is also available at https://www.nih.org.pk/wp-content/uploads/2020/04/COVID-19-Daily-Updated-SitRep-03-April-2020.pdf.

2.2.7 Sindh Strategy for Sustainable Development, 2007

96. The Sindh Strategy for Sustainable Development (SSSD) proposed a ten-year sustainable development agenda for Sindh. The main focus of SSSD is to promote the sustainable use of natural resources. It targets to reduce poverty and enhance social development through the participation of the people of Sindh. The SSSD recommends that the rehabilitation and extension of water supply and sanitation networks, effective water and wastewater quality monitoring and treatment to comply with SEQS, improved coordination among stakeholders (public agencies, private sector, and residents) for the effective management of air pollution, consultation based infrastructure planning and development with main focus on minimizing traffic and pollution hazards, and conducting environmental impact assessment of all the major projects.

97. SSSD recommends for the sustainable development and environmentally complying operations of industries: incentive mechanisms for reducing pollution; awareness raising of industrialists and stakeholders; promote cleaner production; enforce pollution charges as per SEPA,2014; prepare baseline of all industrial estates and sites to establish the pollution levels, waste disposal practices, air emissions, generation of hazardous waste for the preparation of environmental management plans for complying SEPA, 2014; preparation of EIAs for all industrial development and infrastructure projects.

98. This strategy is applicable as the project involves the construction of Proposed Expressway for improve the traffic situation with least environmental burden and sustainable operation of transportation in the city.

2.2.8 Sindh Drinking Water Policy, 2017

99. Sindh Drinking Water Policy, 2017is related to the provision of safely managed drinking water whose supply is adequate, well maintained and sustainable; and to enhance public awareness about health, nutrition and hygiene related to safe drinking water. The basic objective of this policy is to introduce legislative measures and regulations to create an enabling framework for safely managed drinking water supply, regulation of water usage, extraction, treatment transportation and distribution.

2.3 LEGAL FRAMEWORK

100. Government of Sindh has promulgated laws/acts, regulations and standards for the protection, conservation, rehabilitation and improvement of the environment. In addition to this, they have also developed environmental assessment procedures governing developmental projects. Following are the excerpts of these laws and procedures relevant to the proposed project.

2.3.1 Sindh Environmental Protection Act, 2014

101. Sindh Environmental Protection Act, 2014 provides framework for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution, and promotion of sustainable development.

102. It advises establishment of the Sindh Environmental Protection Council and Sindh Environmental Protection Agency. It defines its Functions and powers of the Agency.

103. It also outlines Establishment and Management of the Sindh Sustainable Development Fund of the Sindh Sustainable Development Fund, Prohibition of certain discharges or emissions and compliance with standards, prohibition of import of hazardous waste. Handling of hazardous substances, prohibition of action adversely affecting Environment, Regulation of motor vehicles, Certified Environmental Laboratory, Initial environmental examination and environmental impact assessment, Strategic environmental assessment, Environmental monitoring, offences and penalties, Environmental Protection Tribunals and Courts.

104. Sindh Environmental Protection Agency (Review of IEE/EIA) Regulations,2014

105. The SEPA Review of IEE and EIA Regulations, 2014 (The 2014 Regulations) promulgated under SEPA 2014 were enforced on December, 2014. The 2014 Regulations define the applicability and procedures for preparation, submission and review of IEEs and EIAs. These Regulations also give legal status to the Pakistan Environmental Assessment Procedures prepared by SEPA in 2014. The Regulation classifies projects on the basis of expected degree of adverse environmental impacts and lists them in two separate schedules. Schedule I lists projects that may not have significant environmental impacts and therefore require an IEE. Schedule III is ts projects of potentially significant environmental impacts requiring preparation of an EIA.

The Regulations also require that all projects located in environmentally sensitive areas require preparation of an EIA. The proposed project falls under the category E (Transportation) of Schedule II.

2.3.2 Sindh Environmental Quality Standards (SEQS), 2016

106. In exercise of the powers conferred under clause (g) of sub-section (1) of section 6 of the Sindh Environmental Protection Act, 2014, the Sindh Environmental Protection Council has issued the Sindh Environmental Quality Standards (SEQS), 2016.

107. They endow information on the permissible limits for discharges of municipal and industrial effluent parameters and industrial gaseous emissions in order to regulate environmental pollution.

I. Air Quality Standards

108. Air quality standards issued by SEPA in 2016 is given in **Table 2.1**.

Table 2.1: Air Quality Standards SEQS 2016

Sr. No.	Pollutant	SEQS 2016	
		Time-Weighted average	**Concentration standard**
1	SO_2	Annual average	80 µg/m^3
		24 hours	120 µg/m^3
2	NO	Annual average	40 µg/m^3
		24 hours	40 µg/m^3
3	NO_2	Annual average	40 µg/m^3
		24 hours	80 µg/m^3
4	O_3	1 hour	130 µg/m^3
5	SPM	Annual average	360 µg/m^3
		24 hours	500 µg/m^3
6	PM_{10}	Annual average	40 µg/m^3
		24 hours	150 µg/m^3
7	$PM_{2.5}$	24 hours	75 µg/m^3
8	Lead	Annual average	1 µg/m^3
		24 hours	1.5 µg/m^3
9	CO	8 hours	5 mg/m^3
		1 hour	10 mg/m^3

II. NoiseStandards

109. Noise standards issued by SEPA is given in **Table 2.2.**

Table 2.2: Noise Standards SEQS 2016

Sr. No	Category of Area	SEQS 2016	
		Day Time	Night Time
1	Residential Area	65	50
2	Commercial Area	70	60
3	Industrial Area	80	75
4	Silence Zone	55	45
5	Motor Vehicle	85	85

III. Drinking Water Quality Standards

110. Drinking Water Quality Standards issued by SEPA is given in **Table 2.3**

Table 2.3: Drinking Water Quality Standards SEQS, 2016

Sr. No.	Parameters	SEQS (mg/l)
1	Aluminum (Al)	≤ 0.2
2	Antimony (Sb)	≤ 0.005
3	Arsenic (As)	≤ 0.05
4	Barium (Ba)	0.7
5	Boron (B)	0.3
6	Cadmium (Cd)	0.01
7	Chloride (Cl)	< 250
8	Chromium (Cr)	≤ 0.05
9	Copper (Cu)	2
10	Cyanide (CN)	≤ 0.05
11	Fluoride (F)	≤ 1.5
12	Lead (Pb)	≤ 0.05
13	Manganese (Mn)	≤ 0.5
14	Mercury (Hg)	≤ 0.001
15	Nickel (Ni)	≤ 0.02
16	Nitrate (NO_3)	≤ 50
17	Nitrite (NO_2)	≤ 3
18	Selenium (Se)	0.01
19	Residual Chlorine	0.2-0.5
20	Zinc (Zn)	5.0
21	Color	≤ 15 TCU
22	Taste	Non Objectionable/ Acceptable
23	Odour	Non Objectionable/ Acceptable
24	Turbidity	< 5 NTU
25	Total hardness	< 500 mg/l
26	TDS	< 1000
27	pH	6.5-8.5
28	E-Coli	Must not be detectable in any 100 ml sample
29	Total Coliforms	Must not be detectable in any 100 ml sample

2.3.3 The Sindh Forest Act, 2012

111. The law requires review and revision to meet the challenges of management and empower the forest managers to carryout management interventions with full legal support. The new legal instrument should amply address the provision and requirements of UNFCCC, CBD and Convention on Combating Desertification. Legal aspects of carbon sequestration and carbon credit marketing should also be kept in view.

2.3.4 Sindh Factories Act, 2015

112. The Sindh Factories Act 2015 deals with regulations related to project area, workers and workplace Environment Health and Safety (EH&S) requirements. The Factories Act also provides regulations for handling and disposal of toxic and hazardous materials. As construction activity is classified as ‘industry’, these regulations will be applicable to the project & construction contractors’ scope of work also.

2.3.5 The Sindh Irrigation Act (1879) and the Canal and Drainage Act (1873)

113. This Sindh Irrigation Act covers the construction, maintenance and regulation of canals for the supply of water and for the levy of rates of water supplied in the Province of Sindh. Canals are defined as channels, pipes and reservoirs constructed and maintained by the Government for the supply for storage of water. Under section 27 of the Act a person desiring to have a supply of water from a canal for purposes other than irrigations hall submit a written application to a Canal Officer who may, with the sanction of the Provincial Government give permission under special conditions. The Act Under section 61 also prohibits the damaging, altering, enlarging or obstructing the canals without proper authority. 51. The Canal and Drainage Act (1873) prohibits corruption or fouling of water in canals (defined to include channels, tube wells, reservoirs and watercourses), or obstruction of drainage. 52. The canals and associated irrigation network exists in the project area and provisions of these acts applies to certain activities like water abstraction by project contractors etc. There is no project activity planned near the canal and associated network which could directly cause physical damage to the canal or alteration in water quality. Any abstraction of water from the canal shall be only done after getting formal approval from the concerned irrigation department.

2.3.6 Sindh Cultural Heritage Act, 1994

114. This provincial Act empowers the Government of Sindh to preserve and protect any premises or objects of archaeological, architectural, historical, cultural, or national interest in Sindh by declaring them protected.

2.3.7 Sindh Wildlife Protection (Amendment) Act, 2008

115. The Sindh Wildlife Ordinance 1972 empowers the government to declare certain areas

reserved for the protection of wildlife and to control activities within these areas. It also provides protection to endangered species of wildlife.

2.3.8 Sindh Solid Waste Management Board (SSWMB) Act, 2014

116. The SSWMB Act, 2014 enacted to establish a board for collection and disposal of all solid waste, to arrange effective delivery of sanitation services, to provide pollution free environment and to deal with other relevant matters. The Board established under the Act headed by the Chief Minister or his nominee and constitutes of thirteen other ex-officio members of other relevant departments. This act is applicable as project will generate the solid waste which will be managed and disposed of as per the legislative requirements of this act.

2.3.9 The Sindh Local Government Act 2013 and Sindh Local Government (Amendment) Act, 2019

117. Under the Sindh Local Government Act 2013 (SLGA), Chapter VI, land use planning; implementation of building by-laws; management of environmental and health hazards; food adulteration; provision and maintenance of water supply schemes and public sources of drinking water; and mobilization of communities for the upgrade of local infrastructure (transportation, landscaping, and removal of encroachments) are the responsibilities of municipal corporations/committees. This act is applicable for the proposed project due to its location and nature of use of public sources during construction stage of the proposed project.

2.3.10 Protection of Trees and Brushwood Act, 1949

118. This Act prohibits cutting or lopping of trees and brushwood without permission of the Forest Department. The Forest Department will be approached for permission to cut trees along the road alignment.

2.3.11 Cutting of Trees (Prohibition) Act, 1975

119. The Act prohibits cutting or chopping of trees without permission of the Forest Department. The act presents fine or imprisonment or both, for illegal cutting of tree but has not mentioned any compensatory afforestation. However, it’s a common practice to plant 7 - 10 trees for compensation of 1 tree uprooted.

2.3.12 The Antiquities Act, 1975

120. Archaeological sites and monuments are specifically protected under this Act.

2.3.13 Land Acquisition Act, 1894 (Sindh Amendment Act, 2009)

121. The Land Acquisition Act (1894), (Sindh Amendment, 2009) deals with the acquisition of private properties for public purposes. The large development projects including

road projects are also being considered under this Act. There are 55 sections in this Act mainly dealing with area notifications, surveys, acquisition, compensation, apportionment awards, disputes resolution, penalties and exemptions.

2.3.14 Forest Act, (1927) /Addendum

122. This act is applicable to all regions of Pakistan. It includes procedures for constituting and managing various types of forests, such as reserved forests and protected forests. The act empowers the provincial forest departments to declare any forest area as reserved or protected and also prohibit the breaking up or clearing of forest for cultivation, grazing, hunting, removing forest produce; quarrying and felling, lopping and topping of trees, branches in reserved and protected forests. It also defines the duties and roles off ores related public servants, and penalties for any infringement of the rules. There is no protected forest located within the EIA project area.

2.3.15 Pakistan Penal Code, 1860

123. This Act defines the penalties for violations concerning pollution of air, water bodies and land.

2.3.16 Highways Safety Ordinance, 2000

124. This ordinance includes provisions for the licensing and registration of vehicles and construction equipment; maintenance of road vehicles; traffic control, offences, penalties and procedures; and the establishment of a police force for motorways and national highways charged with regulating and controlling traffic on the national highways, and keeping the highways clear of encroachments.

2.3.17 Building Code of Pakistan (SeismicProvisions-2007)

125. Building Code of Pakistan (Seismic Provisions-2007) is established after devastating earthquake of 2005 to prescribe the minimum requirements for the earthquake design and construction of buildings and building-like structures and/or their components subjected to earthquake ground motions.

126. Construction of buildings in violation of the Building Code shall be considered as violation of professional engineering work.

2.3.18 Occupational Health

127. Construction and operational activities could affect the occupational health of the workers. Quantitative national standards with respect to the above aspect are yet to be developed in Pakistan. However, guidance in qualitative terms can be obtained from the Labour Laws (Amended) Ordinance, 1972.

2.3.19 Environmental Assessment Guidelines

128. Pak-EPA has also published environmental assessment procedures and guidelines in October, 1997, which contains the following sets of information relevant to the proposed project:

- **Guidelines for Policy and Procedures for Filing, Review and Approval of Environmental Assessment Reports**

129. It describes environmental policy and administrative procedures to be followed for filing of environmental assessment reports by the proponents and its review and approval by the concerned environmental protection agency/department.

- **Guidelines for the Preparation and Review of Environmental Reports**

130. These guidelines are developed to facilitate both the proponents and decision makers to prepare reports (inclusive of all the information contained therein) and carry out their review so as to take informed decisions.

- **Sectoral Guidelines: Major Roads**

131. These guidelines embody issues/impacts commonly arising due to the road projects, the mitigations to reduce/eliminate these impacts and the need for environmental management plan and monitoring plan to protect the environment.

- **Guidelines for Public Consultation**

132. These guidelines deal with possible approaches to public consultation and techniques for designing an effective programme of consultation that involves all major stakeholders and ensures that their concerns are incorporated in any impact assessment study.

2.3.20 Private Partnership Act, 2010 (Amended)

133. The Act was created to enable an environment for private sector participation in infrastructure development projects in the province of Sindh through public-private partnership projects. It extends to the whole of the Province of Sindh.

134. It is expedient to expand the provision of infrastructure services and improve their reliability and quality for accelerating economic growth and achieving the social objectives of the Government; to mobilize private sector resources for financing, construction, maintenance and operation of infrastructure projects; to improve efficiency of management, operation and maintenance of infrastructure and development facilities by introduction of modern technologies and management techniques; to incorporate principles of fairness, competition and transparency in public-private partnership projects.

135. The Local Government & HTP Department, Government of Sindh (GoS) intends to implement the ‘Urban Road Initiatives in Karachi’ under Public Private Partnership (PPP).

2.4 INTERNATIONAL CONVENTION, PROTOCOLS ANDOBLIGATIONS

136. As Pakistan is a member country of a number of international organizations like United Nations Organization (UNO), Organization of Islamic Countries (OIC), South Asian Association for Regional Co-operation (SAARC), Economic Co-operation Organization (ECO), etc., it has to follow the international protocols and obligations related to environmental protection.

2.4.1 The Rio Declaration, 1992

137. The Rio Declaration comprises 27 principles which address important issues such as; sustainable development to integrate environmental protection into the development process; common but differentiated responsibilities to conserve, protect and restore the Earth’s ecosystems; public participation and information access at the national level, reduce and eliminate unsustainable patterns of production and consumption. Pakistan signed the treaty on 13 Jun 1992 and ratified on 1 June 1994 with a focus on protection of natural environment.

2.4.2 Bonn Convention-The Convention on Conservation of Migratory Species of Wild Animals, 1979

138. The Convention requires the countries to take action to avoid endangering migratory species. Species covered in the Convention should be given special attention during EA and monitoring and any impacts identified should be mitigated to acceptable levels.

139. The Bonn Convention was signed in 1979 and entered into force on 1 November 1983. The Convention defines the following terms:

- "Migratory species" means the entire population or any geographically separate part of the population of any species or lower tax anomic of wild animals a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries;
- "Conservation status of a migratory species" means the sum of the influences acting on the migratory species that may affect its long-term distribution and abundance; and
- "Endangered" means that the migratory species is in danger of extinction throughout all or part of the territory of a State

140. The parties to the Convention acknowledge the importance of conserving migratory species. To avoid any migratory species becoming endangered, the parties must endeavor:

- To promote, cooperate in or support research relating to migratory species;

- To provide immediate protection for migratory species; and

141. To protect endangered migratory species, the parties to the Convention will endeavor:

- To conserve or restore the habitats of endangered species;
- To prevent, remove, compensate for rminimize the adverse effects of activities or obstacles that impede the migration of the species; and
- To the extent feasible and appropriate, to prevent, reduce or control factors those are endangering or are likely to further endanger the species.

2.4.3 Convention on International Trade of Endangered Species of Flora and Fauna (CITES)- 1979

142. The principal obligations of contracting parties to the CITES are to safeguard the trade in rare or endangered species and to restrict the import and export of listed species. According to this convention species threatened with extinction whose movement between countries is prohibited except for conservation purposes such as captive breeding, species whose commercial trade is permitted but export permits are needed.

143. This convention deals with the taxonomy of species (class, order, family, scientific and common names), biological parameters (distribution, habitat, population status-trends, geographic trends, role of species in its eco-system and threats faced), utilization and trade practices at national level, legal international trade, Illegal trading, potential trade impacts, captive breeding, conservation and management on national and international level, legal statuses, species management (population monitoring, protection of habitat, domestic measures) and information on similar species.

2.4.4 The Basel Convention, 1989

144. Basel Convention on the control of trans-boundary movements of hazardous wastes and their disposal is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to Less Developed Countries (LDCs). It does not, however, address the movement of radioactive waste. The Convention is also intended to minimize the amount and toxicity of wastes generated, for environmentally sound management as closely as possible to the source of generation, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate. The provisions of this convention imply to minimize the amount of waste generated and its management during construction and O&M phases.

2.4.5 The Rio Declaration, 1992

145. The Rio Declaration comprises 27 principles which address important issues such as; sustainable development to integrate environmental protection into the development process; common but differentiated responsibilities to conserve, protect and restore the Earth’s ecosystems; public participation and information access at the national level, reduce and eliminate unsustainable patterns of production and consumption. Pakistan

signed the treaty on 13 Jun 1992 and ratified on 1 June 1994 with a focus on protection of natural environment.

2.4.6 United Nation Framework Convention on Climate Change (UNFCCC), 1992

146. The UN Framework Convention on Climate Change (UNFCCC) is a multilateral agreement to address the issue of climate change. The Convention, was sets out and opened for signature at the June 1992 UN Conference on Environment and Development (UNCED), also known as the Rio Earth Summit. The UNFCCC entered into force on 21 March 1994.

147. Pakistan being signatory of this treaty is bound to control the GHG emissions and climate change. Recent conference of parties (COP) for UNFCCC was held from 6 to 17 Nov, 2017 in Bonn Germany.

2.4.7 Sustainable Development Goals (SDGs) – 2015-2030

148. The Sustainable Development Goals (SDGs) are a good collection of 17 global goals set by the United Nations in 2015. Pakistan was the first country to adopt SDGs 2030 agenda through a unanimous resolution of the Parliament of Pakistan. Pakistan has recently committed to Agenda 2030 and has become signatory to SDGs where Goal 6 calls, among others, for ensuring availability and sustainable management of water and sanitation for all, water use efficiency and integrated water resources management. The SDG 5 on gender equality and women's empowerment emphasizes to ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life.

2.4.8 Paris Agreement, 2016

149. Paris Agreement was signed by Pakistan on 22 April 2016 and ratified on 10 November 2016. The Paris Agreement's long-term temperature goal is to keep the increase in global average temperature to well below 2 °C above pre-industrial levels; and to pursue efforts to limit the increase to 1.5 °C, recognizing that this would substantially reduce the risks and impacts of climate change. It also aims to increase the ability of parties to adapt to the adverse impacts of climate change, and make "finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development." Under the Paris Agreement, each country must determine, plan, and regularly report on the contribution that it undertakes to mitigate global warming.

2.5 INTERNATIONAL FINANCIAL INSTITUTIONS (IFIS)

150. There are mandatory requirements of International Financial Institutions which need to be followed in the project. The major financing institutions which may be involved in the later stage of the project are Asian Development Bank (ADB) or World Bank (WB). As per the Environmental and Social Management System (ESMS) Arrangement prepared

for Public–Private Partnership Investments projects in Sindh Province, the major requirements of Asian Development Bank (ADB) will be followed in case of their involvement. Following are the major requirements of Asian Development Bank (ADB) which need to be followed in case of their involvement.

2.5.1 ADB's Requirements for Preparation of Environmental Assessments of Projects

151. A project is classified as Category 'A' if it is likely to have adverse environmental impacts that are irreversible, adverse or unprecedented. In the light of significance devoted by ADB to various environmental impacts, the proposed project is to be assigned Category 'A', wherein an EIA is required.

152. The main rationale to assign Category 'A' is that the proposed project may cause adverse impacts on local communities, land and mangroves/trees etc.

153. During the design, construction, and operation of the project, the borrower/client will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards. These standards contain performance levels and measures that are normally acceptable and applicable to projects. When host country regulations differ from these levels and measures, the proponent will comply with whichever requirement is more stringent.

2.5.2 ADB's Access to Information Policy (AIP) 2018

154. ADB's new Access to Information Policy (AIP), reflects the ADB's ongoing commitment to transparency, accountability, and participation by stakeholders. The policy contains principles and exceptions to information sharing with external stakeholders, led by a new overarching principle of "clear, timely, and appropriate disclosure."

2.5.3 ADB's Accountability Mechanism Policy 2012

155. The objectives of the Accountability Mechanism are providing an independent and effective forum for people adversely affected by ADB-assisted projects to voice their concerns and seek solutions to their problems, and to request compliance review of the alleged noncompliance by ADB with its operational policies and procedures that may have caused, or is likely to cause, them direct and material harm. The Accountability Mechanism is a "last resort" mechanism.

2.5.4 ADB's Safeguard Policy Statement, 2009

156. ADB affirms that environmental and social sustainability is a cornerstone of economic growth and poverty reduction in Asia and the Pacific region. ADB's Strategy, 2020 therefore emphasizes assisting Developing Member Countries (DMCs) to pursue environmentally sustainable and inclusive economic growth. The objectives of ADB's safeguards are to:

- Avoid adverse impacts of projects on the environment and affected people, where possible;
- Minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and
- Help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

157. ADB's SPS sets out the policy objectives, scope and triggers, and principles for three key safeguard areas:

- Environmental safeguards;
- Involuntary resettlement safeguards; and
- Indigenous Peoples safeguards.

158. To achieve the policy objectives and deliver the policy principles, ADB carries out the actions described in the subsection i.e. "B. Policy Delivery Process". To help borrowers/clients and their projects achieve the desired outcomes, ADB adopts a set of specific safeguard requirements that borrowers/clients are required to meet in addressing environmental and social impacts and risks. ADB staff, through their due diligence, will review, supervise and ensure that borrowers/clients comply with these requirements during project preparation and implementation. These safeguard requirements are as follows:

- Safeguard Requirements 1: Environment (Appendix 2 of SPS, 2009);
- Safeguard Requirements 2: Involuntary Resettlement (Appendix 3 of SPS, 2009);
- Safeguard Requirements 3: Indigenous Peoples (Appendix 4 of SPS, 2009); and
- Safeguard Requirements 4: Special Requirements for Different Finance Modalities (Appendix 5 of SPS, 2009).

Table 2.4: ADB Safeguard Policies 2009 Relevant to Project

Sr. No.	Safeguard Policies	Key Requirements	Remarks
1.	Environment	Projects and subprojects need EIA to address important issues not covered by any applicable regional or sectoral EA.	Applicable to proposed project.
2.	Involuntary Resettlement	Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs. Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be assisted in their efforts to improve their livelihoods	As of now, involuntary resettlement is envisaged for the proposed project and Land Acquisition and Resettlement Plan (LARP) will be submitted by Client.

Sr. No.	Safeguard Policies	Key Requirements	Remarks
		and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher	
3.	Indigenous Peoples	Measures to avoid potentially adverse effects on the Indigenous People's communities; and when avoidance is not feasible, minimize, mitigate, or compensate for such effects. Bank-financed projects are also designed to ensure that the Indigenous People receive social and economic benefits that are culturally appropriate and gender and inter generationally inclusive.	As per the ADB definition, there are no groups of people in the project area who could be categorized as indigenous people, therefore this policy does not apply to the proposed project.

2.5.5 Implications of ADB's Safeguard Policies on Proposed Project

159. The objective of the environmental safeguards is to ensure the environmental soundness and sustainability of projects and to support the integration of environmental considerations into the project decision-making process. ADB's policy principles are summarized in **Table 2.5** below.

Table 2.5: ADB Policy Principles

Sr. No.	Policy Principle	Summary
1	Screening and Categorization	Screening process initiated early to determine the appropriate extent and type of environmental assessment.
2	Environmental Assessment	Conduct an environmental assessment to identify potential impacts and risks in the context of the project's area of influence.
3	Alternatives	Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts, including no project alternative.
4	Impact Mitigation	Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts. Prepare an environmental management plan (EMP).
5	Public/Stakeholder Consultations	Carry out meaningful consultation with affected people and facilitate their informed participation. Involve stakeholders early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project

Sr. No.	Policy Principle	Summary
		implementation. Establish a grievance redress mechanism.
6	Disclosure of Environmental Assessment	Disclose a draft environmental assessment in a timely manner, in an accessible place and in a form and language(s) understandable to stakeholders. Disclose the final environmental assessment to stakeholders.
7	Environmental Management Plan	Implement the EMP and monitor its effectiveness. Document monitoring results, and disclose monitoring reports.
8	Biodiversity	Do not implement project activities in areas of critical habitats.
9	Pollution Prevention	Apply pollution prevention and control technologies and practices consistent with international good practices. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges. Avoid the use of hazardous materials subject to international bans or phase outs.
10	Occupational Health and Community Safety.	Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities
11	Physical Cultural Resources	Conserve physical cultural resources and avoid destroying or damaging them. Provide for the use of “chance find” procedures.

2.6 COMPARISON OF INTERNATIONAL AND LOCAL ENVIRONMENTAL LEGISLATIONS

160. In order to select the most stringent standards applicable, a mix of local (SEQS) and international (IFC) regulations have been selected. The IFC Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines: Environmental, Noise Management has noise level guidelines for daytime and night time, which are applicable. Considering the high baseline noise levels in the project area, it shall be ensured that the increase in noise levels is minimized as far as possible. Also, project related noise levels in the project area are not allowed to increase the existing levels by 3 dB or more. Furthermore, it shall be ensured that all necessary noise mitigation measures are implemented to minimize the noise levels in the project area.

161. **Table 2.6** presents IFC workplace noise standards that are applicable to the construction workers. It should also be noted that IFC EHS guidelines advise that where existing ambient noise levels already exceed thresholds, the Project should not result in an increase of more than 3 dB over existing ambient noise at the nearest receptor location off-site.

Table 2.6: IFC Work Environment Noise limits

Sr. No.	Type of Work, workplace	IFC General EHS Guidelines
1	Heavy Industry (no demand for oral communication)	85 Equivalent level Leq,8h
2	Light industry (decreasing demand for oral communication)	50-65 Equivalent level Leq,8h

162. A comparison of applicable local and international guidelines for ambient air quality has been provided in **Table 2.7** below. In the case of most pollutants, the SEQS standards for ambient air quality are more stringent in comparison to USEPA and WHO/IFC standards. The applicable and most stringent parameters for each respective pollutant are highlighted in green.

Table 2.7: Comparison of International and local Air Quality Standards*

Sr. No.	Pollutants	USEPA		WHO/IFC		SEQS	
		Avg. Time	Standard	Avg. Time	Standard	Avg. Time	Standard
1	SO2	3 hrs 1 hr	0.5 ppm 75 ppb	24 hr 10 min	20 ug/m3 500 ug/m3	Annual Mean 24 hrs	80 ug/m3 120 ug/m3
2	CO	8 hrs 1 hr	9 ppm (11 mg/m3) 35 ppm (43 mg/m3)	-	-	8 hrs 1 hr	5 mg/m3 10 mg/m3
3	NO2	Annual Mean 1 hr	100 ug/m3 (53 ppb) 100 ppb	1 yr 1 hr	40 ug/m3 200 ug/m3	Annual Mean 24 hrs	40 ug/m3 80 ug/m3
4	O3	8 hrs	0.07ppm (148 ug/m3)	8 hrs	100 ug/m3	1 hr	130 ug/m3
5	TSP	-	-	-	-	Annual Mean 24 hrs	360 ug/m3 500 ug/m3
6	PM10	24 hrs	150 ug/m3	1 yr 24 hr	20 ug/m3 50 ug/m3	Annual Mean 24 hrs	120 ug/m3 150 ug/m3
7	PM2.5	Annual Mean 24 hrs	15 ug/m3 35 ug/m3	1 yr 24 hr	10 ug/m3 25 ug/m3	Annual Average 24 hrs 1 hr	15 ug/m3 35 ug/m3 15 ug/m3

** The standards highlighted in green for each respective pollutant are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed project.*

** In instances where the airshed is significantly degraded and the pollutant levels are already exceeding the ambient pollutant concentrations provided in the table above, it shall be ensured that the project activities cause as small an increase in pollution levels as feasible, and amounts to a fraction of the applicable short term and* *annual average air quality guidelines or standards as established in the project specific environmental assessment.*

163. Similar to the standards for air quality, the comparison of noise standards provided in **Table 2.8** clearly shows that SEQS standards for noise are more stringent in comparison to the IFC standards. The only exception is the daytime noise level standard for Industrial areas where the IFC standard is more stringent i.e. 70 dB(A) in comparison to SEQS i.e. 75 dB(A) and so for this particular parameter, the IFC standard will be used. Apart from this one exception, the SEQS standards have been used for the proposed Biogas plant project.

Table 2.8: Comparison of International and Local Noise Standards

Sr. No.	Category of Area/Zone	Limit in dB(A) Leq			
		SEQS		WHO/IFC	
		Day Time 06:00 – 22:00	Night Time 22:00-06:00	Day Time 07:00 – 22:00	Night Time 22:00-07:00
1	Residential area (A)	55	45	55	45
2	Commercial area (B)	65	55	70	70
3	Industrial area (C)	75	65	70	70
4	Silence zone (D)	50	45	55	45

** The standards highlighted in green for each respective Area/Zone are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed project.*

** In instances where baseline noise levels are already exceeding the standards above, it will need to be ensured that the project activities do not cause an increment of more than 3 dB(A) from the baseline noise levels.*

164. The comparison of water quality standards provided in **Table 2.9** and **Table 2.10** clearly shows the SEQS standards for surface and drinking water quality as compare to WHO and FAO standards.

Table 2.9: Comparison of National and International Drinking Water Standards

Sr. No.	**Parameter**	**Units**	**SEQS**	**WHO Standards**
1	Temperature (During Sample Collection)	OC	NS	NS
2	Color	Pt-Co	≤15TCU	<15TCU
3	pH	pH unit	6.5-8.5	6.5-8.5
4	Turbidity	NTU	<5	<5
5	Total, Hardness	mg/L	<500.00	NS
6	Total Dissolved Solid (TDS)	mg/L	<1000.00	<1000.00
7	Total Suspended Solid (TSS)	mg/L	NS	NS
8	Ammonia	mg/L	NS	NS
9	Fluoride F-	mg/L	<1.50	1.50
10	Sulfate (SO4-2)	mg/L	NS	NS
11	Chloride(Cl-)	mg/L	<250.00	250
12	Nitrate (NO3)-	mg/L	<50.00	50.00

Sr. No.	Parameter	Units	SEQS	WHO Standards
13	Odor	-	Non-Objectionable / Acceptable	Non-Objectionable / Acceptable
14	Taste	-	Non-Objectionable / Acceptable	Non-Objectionable / Acceptable
15	Sodium	mg/L	NS	NS
16	Iodine	ppm	NS	NS
17	Arsenic (As)	mg/L	< 0.05	0.01
18	Iron (Fe 3+)	mg/L	NS	NS
19	Zinc (Zn 2+)	mg/L	5.0	3.0
20	Conductivity	µS/cm	NS	NS
21	Bicarbonate	mg/L	NS	NS
22	Nitrite	mg/L	<3	3
23	Magnesium	mg/L	NS	NS
24	Calcium as Ca	mg/L	NS	NS
25	Phosphate	mg/L	NS	NS
26	Potassium	mg/L	NS	NS
27	Boron	mg/L	<0.3	0.3
28	SAR Iodine (I)	mg/L	NS	NS
29	Aluminum	mg/L	< 0.2	0.2
30	Antimony	mg/L	<0.005	0.02
31	Cadmium	mg/L	0.01	0.003
32	Mercury	mg/L	<0.001	0.001
33	Nickel	mg/L	<0.02	0.02
34	Selenium	mg/L	0.01	0.01
35	Barium	mg/L	0.7	0.7
36	Total Chromium	mg/L	<0.05	0.05
37	Copper	mg/L	2	2
38	Lead	mg/L	<0.05	0.01
39	Cyanide (CN)	mg/L	<0.05	0.07
	Manganese	mg/L	<0.5	0.5
40	Total Coliforms	cfu/100ml	0/100 ml	0/100 ml
41	Fecal Coli forms (E.Coli)	cfu/ml	0/100 ml	0/100 ml

NS = Not Specified

** The standards highlighted in green for each respective pollutant are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed project. Other are same in both case.*

Table 2.10: Comparison of National and International Surface Water Standards

Sr. No.	Parameter	Units	SEQS	WHO Class V (Agriculture)	FAO Standards
1	Temperature	°C	--	--	--
2	pH	pH unit	6-9	<5.3	6.0-8.5
3	COD	mg/L	150	>30	--
4	(BOD5)	mg/L	80	--	--
5	Solids, Total dissolved (TDS)	mg/L	3500	--	0-2000
6	Solids, Total suspended (TSS)	mg/L	200	--	--
7	Chloride	mg/L	1000	--	0-1065
8	Fluoride (F-)	mg/L	10	--	--
9	Oil & grease	mg/L	10	--	--
10	Phenols, Total (Phenolic Compounds)	mg/L	0.10	--	--
11	Cyanide(CN-)	mg/L	01.00	--	--
12	Anionic Detergents as MBAS	mg/L	20.00	--	--
13	Sulfate (SO4-2)	mg/L	600	--	0-960
14	Sulfide (S)	mg/L	01.00	--	--
15	Ammonia NH3	mg/L	40.00	--	--
16	Cadmium (Cd)	mg/L	0.10	>0.0039 mg/L	--
17	Chromium (Cr) as Hexavalent & Trivalent	mg/L	1.00	>0.016 mg/L	--
18	Copper (Cu)	mg/L	1.00	>0.018 mg/L	--
19	Lead	mg/L	0.50	>0.082 mg/L	--
20	Nickel	mg/L	1.00	>1.4 mg/L	--
21	Zinc	mg/L	5.00	>0.12 mg/L	--
22	Iron	mg/L	8.00	--	--
23	Manganese	mg/L	1.50	--	--
24	Selenium	mg/L	0.50	--	--
25	Silver	mg/L	1.00	--	--
26	Arsenic	mg/L	1.00	>0.36 mg/L	--
27	Barium	mg/L	1.50	--	--
28	Magnesium	mg/L	--	--	0-61
29	Nitrate	mg/L	--	--	0-10
30	Sodium	mg/L	--	--	0-920
31	Boron	mg/L	6.00	--	0-2
32	Mercury	mg/L	0.01	>0.0024 mg/L	--
33	Chlorine	mg/L	01.00	--	--
34	Total Toxic Metals	mg/L	02.00	--	--
35	Turbidity	NTU	NS	--	--
36	Oxygen, Dissolved	mg/L	NS	--	--
37	Pesticides	µg/L	NS	--	--
38	Nutrients as Potassium	mg/L	--	--	0-2
39	Nutrients as Nitrogen	mg/L	--	--	--
40	Nutrients as Phosphorous	mg/L	--	--	--

Sr. No.	Parameter	Units	SEQS	WHO Class V (Agriculture)	FAO Standards
41	Total Coliform	MPN/100ml	--	--	--
42	Fecal Coliform	MPN/100ml	--	--	--

NS = Not Specified

** The standards highlighted in green for each respective pollutant are the most stringent based on a comparison between local and international regulations and thus shall be applicable for the proposed project. Other are same in both case.*

165. SEQS standards for ambient air quality, noise, water and wastewater are more stringent in comparison to USEPA and WHO/IFC standards. Based on the above comparison, local regulations or environmental quality standards (SEQS) are more stringent and consider more parameters than other and thus shall be applicable for the proposed project. As far as regulations regarding other environmental parameters are concerned such as acceptable effluent disposal parameters, the local regulations i.e. SEQS take precedence over any other international regulations such as IFC.

2.7 ADMINISTRATIVEFRAMEWORK

166. The proposed project falls under the following Institutional and Administrative Framework.

2.7.1 Local Government & HTP Department, Government of Sindh

167. The implementing agency of the proposed project is Local Government & HTP Department, Government of Sindh ,therefore, it is responsible for liaising with line departments to ensure that the Project complies with the laws and regulations controlling the environmental concerns of express way construction and operation, and that all pre-construction requisites, such as permits and clearances are met. The office of Environment Section of Local Government & HTP Department will be responsible for ensuring that all the measures proposed in the Environmental Management Plan are effectively implemented by the contractor during construction phase and operation phase of the proposed Project.

2.7.2 PPP Unit Government of Sindh

168. Public-Private Partnership Unit, Sindh will promote and facilitate the development of Public- Private Partnership projects in the Province. The unit may provide technical and financial support to the Agencies throughout the Public-Private Partnership process, evaluate and prioritize project proposals submitted by the Agencies, submit all project proposals for consideration to Project Support Facility for the purpose of approval of funding, evaluate the type and amount of government support sought for a project; review the bid evaluation report submitted by an Agency, prepare semi-annual review, annual consolidated reports and project completion reports on the Public-Private Partnerships in the province and submit the same to the PPP Board. The Unit may procure technical and professional assistance and advice from other governmental authorities, multilateral agencies, professional bodies and private firms. The Unit may

also provide technical assistance and advisory services to the persons and entities in the Province. The PPP Unit in performance of its function may also consult the Project Support Facility (PSF) from time to time as mentioned in the Sindh Public Private Partnership Act 2010 (Amended),

2.7.3 Sindh Environmental Protection Agency

169. Before the 18th amendment in the Constitution of Pakistan, environment related issues were governed by the federal regime through Pakistan Environmental Protection Act 1997. However, after the 18th amendment in 2010, Sindh Environmental Protection Agency (SEPA) as provincial agency and headed by Director General is responsible for environmental protection and pollution control in the province of Sindh and will be responsible for reviewing the report, issuing Environmental Approval and overall/broad based monitoring of proposed project activities.

3 PROJECT DESCRIPTION

170. This section describes the rationale and objectives of the project. The project components and its details are discussed as under:

3.1 DESCRIPTION OF ICI BRIDGE PROJECT AREA

171. The project is located in Karachi, Sindh along Mauripur Road between Jinnah flyover and Lyari expressway. The intersection of Mauripur Road with Ghulam Ali Allana Road is commonly known as ICI Bridge.

172. ICI Bridge intersection is one of the busiest intersections which carries a large number of heavy vehicles from the East and West Wharves of Karachi Port, cross street traffic from Kharadar constitutes private vehicles (motorcycles, rickshaws, small cars), which mostly serve the needs of residential area of Kharadar. **Figure 3.1** shows traffic congestion at ICI Bridge.

Figure 3.1: Pictorial View of Traffic at ICI Bridge

3.2 OBJECTIVES OF THE PROPOSED PROJECT

173. The proposed solution envisages to reduce the overall delays witnessed at this intersection through construction of a grade-separated structure. The following objectives will be achieved with implementation of the project:

- Objectives of the proposed project are to serve the heavy traffic moving between Karachi Port, SITE area and other parts of the country through the Motorway, M10 / Northern Bypass and Site Avenue in addition to the city traffic moving along Mauripur Road (from Mai Kolachi Bypass and M.T. Khan Road via Jinnah Bridge) and from other areas of the city through Lyari Expressway.
- To serve the localized traffic of the densely populated adjoining areas of Lyari and other old city areas and the recreational traffic towards the Hawkesbay, Sandspit and Manora beaches.
- Cross street traffic from Kharadar mostly constitutes private vehicles (motorcycles, rickshaws, small cars), which serves the needs of residential area of Kharadar. This cross street traffic adds on to the congestion witnessed at this intersection.
- Heavy traffic congestion is witnessed during most of the day due to non-working signals and high number of heavy vehicles. The major movements at this intersection are the straight movements along Mauripur Road and right-turning traffic from Mauripur Road towards West Wharf Road.
- At present, no internal road access exists between the East and West wharves of Karachi Port. Port traffic from West Wharf towards East wharf has to traverse Mauripur Road from ICI bridge and then use Jinnah flyover to enter East Wharf and vice versa. This further increases the congestion on existing Mauripur Road.
- With the construction of proposed Project, traffic load on ICI intersection will be reduced as the traffic coming from Mauripur Road and moving towards West Wharf will clear the intersection through the proposed right turn flyover.
- The proposed solution envisages to reduce the overall delays witnessed at this intersection through construction of grade-separated structure(s). There will be relief in severe traffic congestion during the peak hours and it will provide quick and safe access to the commuters of Karachi.
- Employment opportunities for the locals.

3.3 GEOMETRIC DESIGN OF THE PROPOSED ROAD PROJECT

174. The Geometric Design of the project is governed by prevalent standard codes for highways design and as per the geometric design criteria for roads given in the AASHTO Standards.

175. The design life for flexible and rigid pavement is taken as 20 years. Based on the design criteria, the horizontal alignments were fixed to suit the topography, and plans were prepared showing the details of road centerline geometry, the super elevations at curves, setting out data for the centerlines both for its straight and curvilinear segments. The vertical profile was designed to cater for the elevations at structures and the pavement design requirements of various road structural layers

176. Start point of the project is 0.3 Km North of ICI bridge intersection at Mauripur road and end point is proposed elevated right turn merges at ICI Bridge at railway crossing /Ghulam Ali Allana road Figure 3.2 shows the Layout plan of the proposed project.

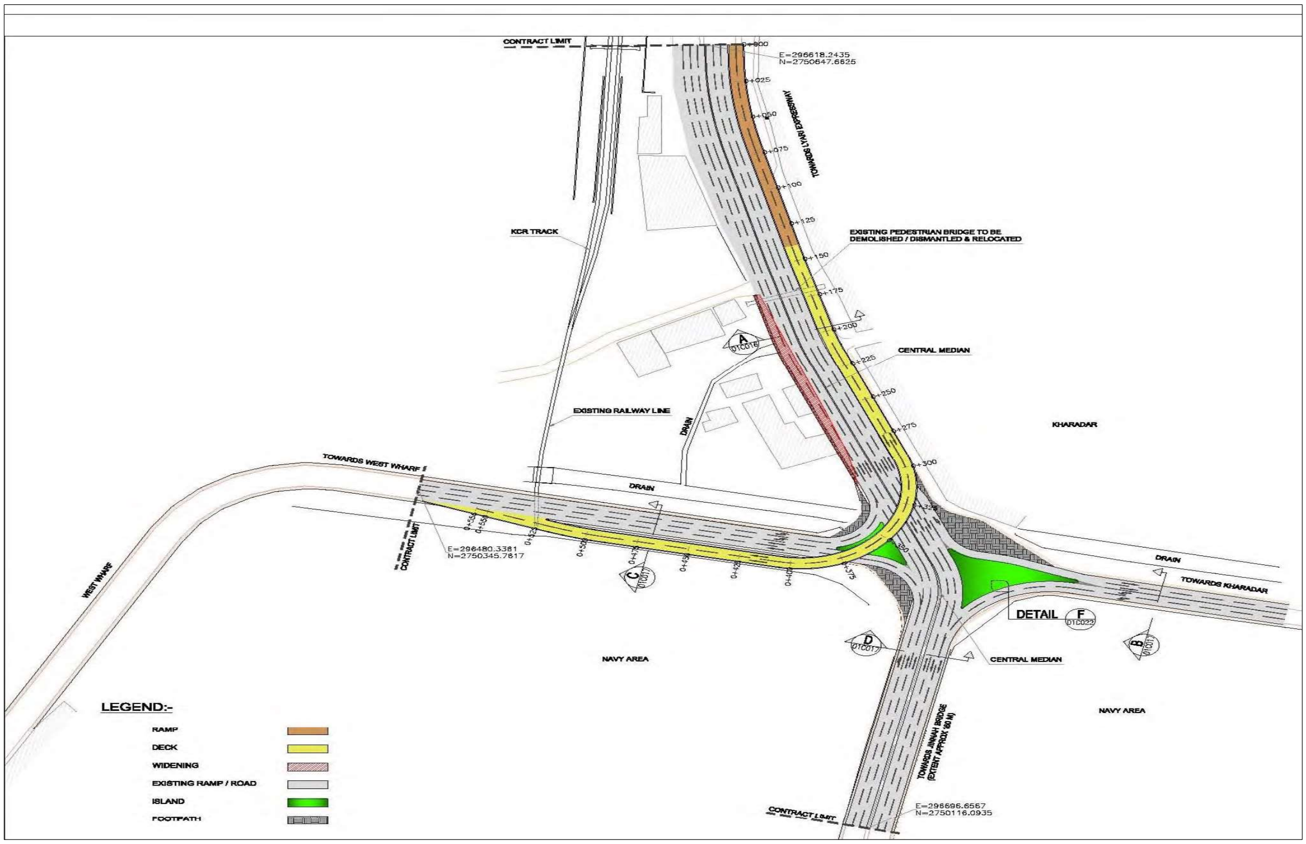


Figure 3.2: Layout Plan of Proposed Project

3.4 Design Parameters

177. The proposed design was based on the concept of easy maneuverability ensuring minimum conflicts and maximum road safety for passengers. Road aesthetics were also part of the criteria. Pedestrian safety was also considered in the design. Interstate Semi-Trailer, WB 20, have been used as the design vehicle; The design speed of Mix Traffic envisaged as 60 Kph whereas speed at Elevated Right Turn is kept as 40 Kph. The summary of Geometric design parameters is given below and typical cross-sectional details are shown in Figure 3.3

Total Length

- Elevated section approx.= 0.56 km (Approx.)
- At Grade Section to be improved including approaches = 0.75 km (Approx.)
- Road Rehabilitation (Ghulam Ali Allana Road, Akbar Siddiqui Road, Nawab Muhabat Khanji Road, and West Wharf Road) = 1.75 km (Approx.) as shown in Figure 3.4.

Number of lanes

- At Grade Section = 3 in each direction
- Elevated Section = 2 Right Turn Lanes – single direction Intersection and approach Roads which shall be improved = 0.15- 0.2 km

Design Speed

- Mix Traffic = 60 Kph
- Elevated Right Turn = 40 Kph

Cross Section

- Elevated Right Turn lane = 3.5 m
- Mix Traffic lanes = 3.5 m
- Footpath = 1.2 m to 2 m
- Vertical Clearance = 5.1 m
- Gradient=Max4%(3.5%adopted)

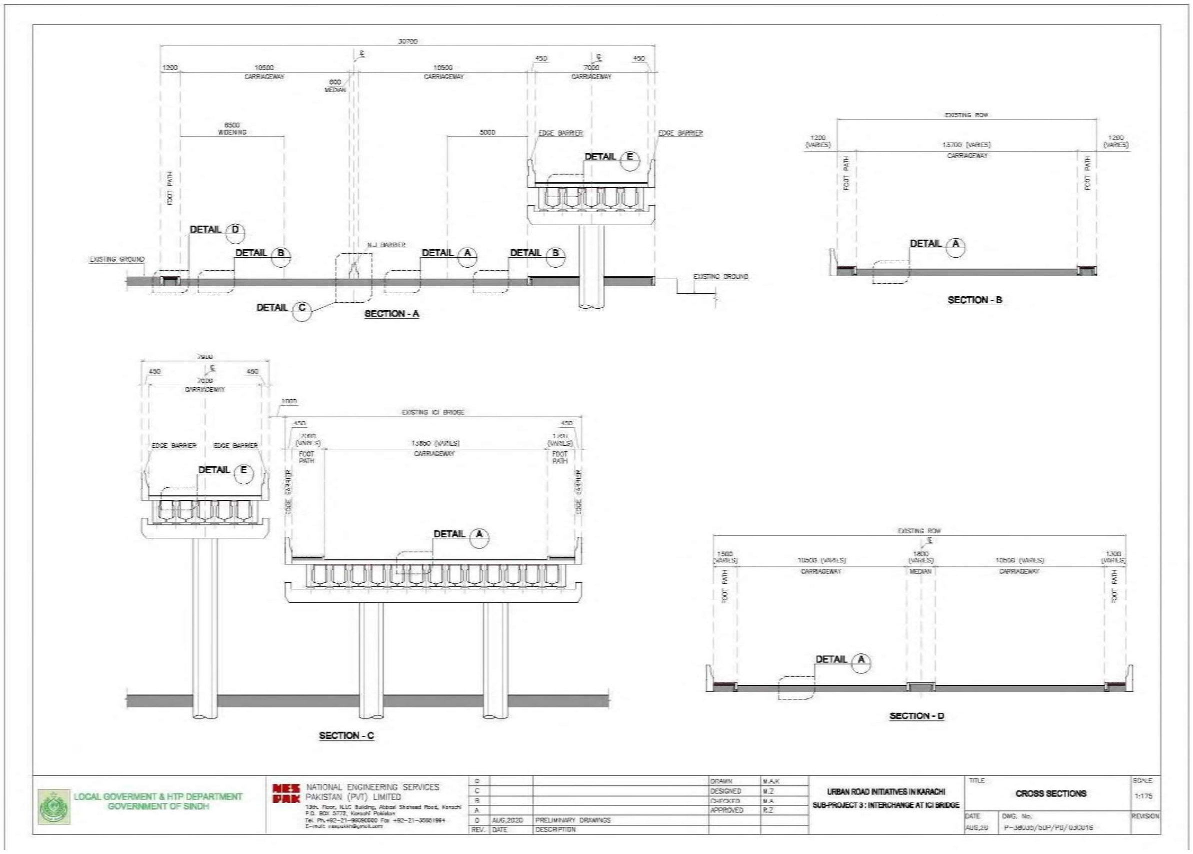


Figure 3.3: Typical Sections at Interchange at ICI Bridge

3.5 DESIGN PROCEDURE

178. The following procedure has been adopted for the design of the flexible pavement structure for the road: The traffic data has been projected for 20 years.

179. Projected traffic has been converted into equivalent standard axle load (ESAL's) for 10 years using standard ESA factors recommended by AASHTO and NTRC.

180. The cumulative standard axle load has been computed for 10 years. For the design load calculations and total cumulative standard axle load was multiplied with directional distribution factor and lane factor recommended by AASHTO Guide for Design of Pavement Structure 1993.

181. Designed California Bearing Ratio (CBR) value have been taken as 10%.

182. Using the AASHTO Guide for Design of Pavement Structures, the flexible pavement design has been completed. For the flexible pavement design, the governing factors are Equivalent Standard Axle Load (ESALs) and CBR values of sub grade soil.

183. Finally, the pavement layer thickness has been decided by using AASHTO Guide for Design of Pavement Structures 1993.

184. Cross-movements on Mauripur Road will be banned to facilitate the direct movements (approx. 59% of the total traffic at this intersection). The banned movements would be made to use existing West Wharf Road / Akbar Siddiq Road just south of the intersection, for which rehabilitation of Ghulam Ali Allana Road, Akbar Siddiqui Road, Nawab Muhabat Khanji Road, and West Wharf Road,which are under Karachi Metropolitan Corporation (KMC) jurisdiction, would be carried out as part of this project.
.

Figure 3.4: Layout Plan of Road Rehabilitation for the proposed project

3.6 TRAFFIC SURVEY

185. Traffic surveys for proposed project were conducted by the Advanced Traffic Lab for Analytics & Simulation (ATLAS) of NED University of Engineering and Technology. Classified traffic counts consisting of all modes of transportation (private vehicles, motorcycles, buses, trucks, rickshaws, others) were conducted at ICI intersection for two (02) days (one weekday and one (01) day on weekend (Sunday)) during the month of July. Traffic survey location plan is shown below in **Figure 3.5,**

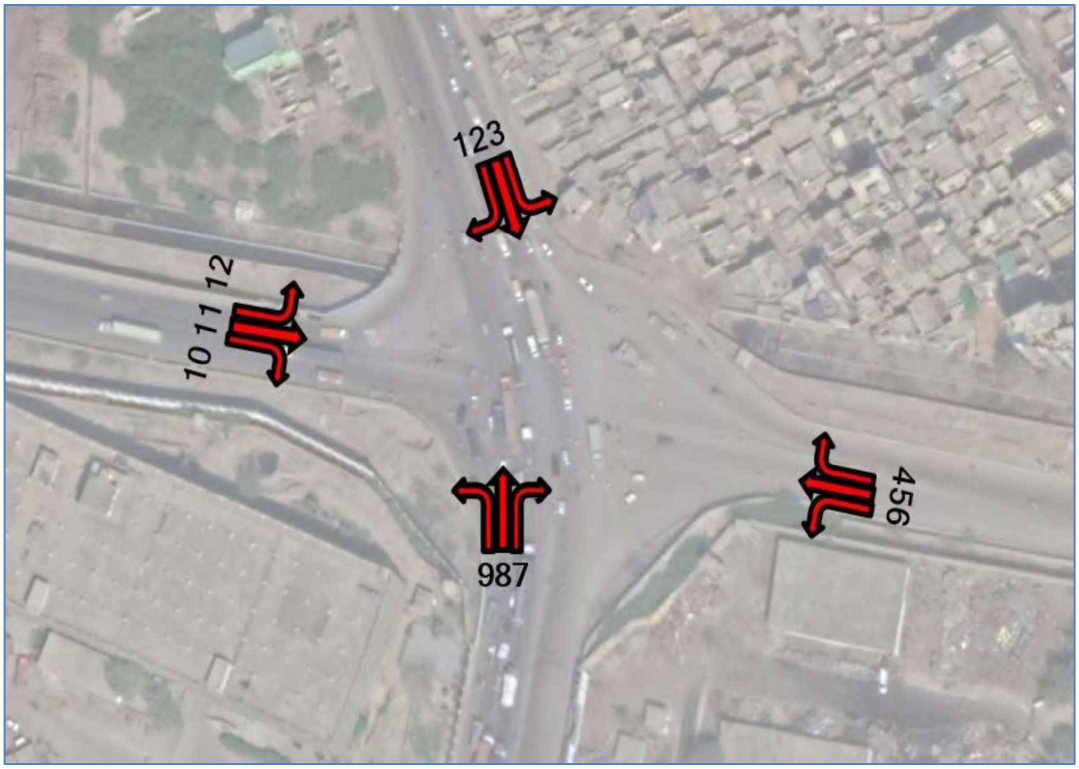


Figure 3.5: TMC Location (ICI Intersection)

186. Results of the traffic count survey conducted during weekday indicates that the intersection carries over 103,000 traffic daily and weekend traffic were calculated as (73,246) i.e., a mix of all types of vehicles, in all directions. Therefore, results of traffic survey conducted during the typical weekday were used in designing appropriate solution(s) for mitigation of traffic congestion at this intersection.

3.7 DURATION OF THE PROJECT

187. Construction work of the proposed project is scheduled to be completed within twelve (12) calendar months from the date of commencement of construction works at site.

3.8 CONSTRUCTION COST

188. The estimated construction cost of the infrastructure development works for Interchange at ICI Bridge Intersection is approximately PKR 917 Million.

3.9 CONSTRUCTION MATERIALS

189. The construction materials used in the construction of Interchange at ICI Intersection would include coarse/fine aggregates, steel, water, asphalt, Portland and sulphate resistant cements etc. Aggregates and soil shall be transported outside the project area, while the cement and steel will be procured from other sources in Karachi. The other construction material suitable for construction of Interchange at ICI Intersection

infrastructure will be obtained from the nearby local quarry.

3.10 CONSTRUCTION CAMP

190. Construction camp site will be selected keeping in view the availability of adequate area for establishing camp site, including parking areas for machinery, stores and workshops, access to communication and local markets, at an appropriate distance from sensitive areas in the vicinity. Land for camp sites will be directly rented from the Pakistan Railways by the Contractors. However, final location and mode of acquisition will be selected by the contractor after approval from the Client. The tentative location map of construction camps is shown in **Figure 3.6**.

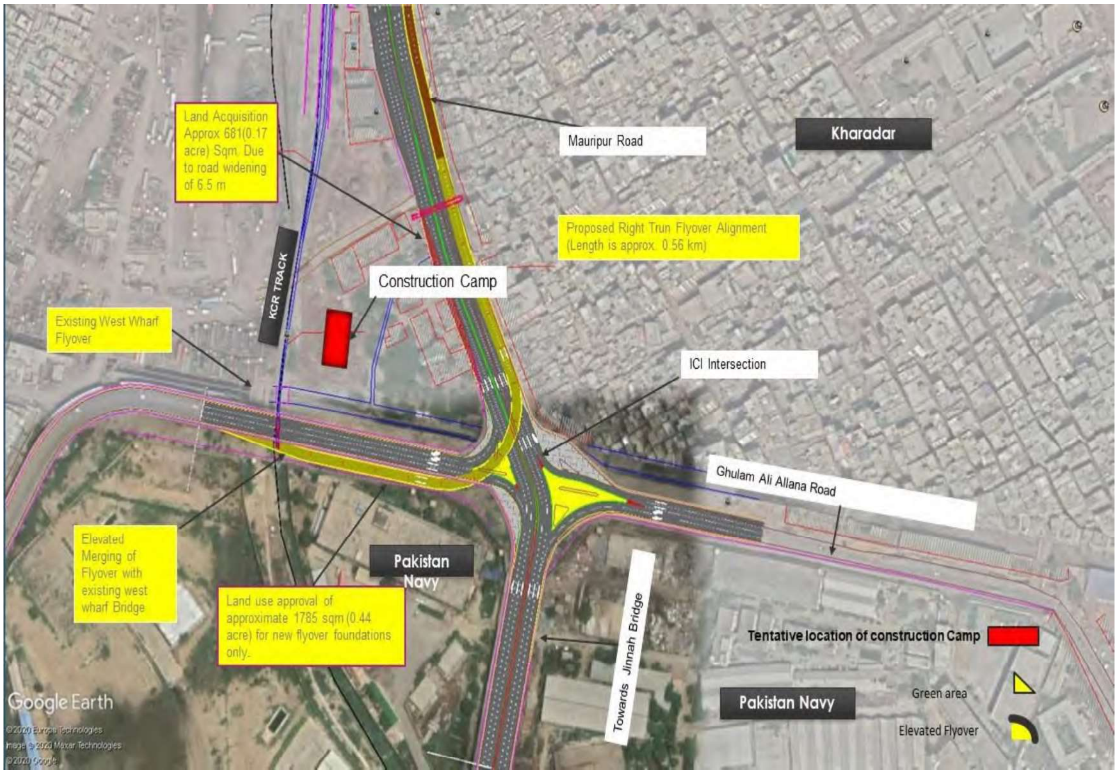


Figure 3.6: Tentative Location of Construction Camp

3.11 LAND ACQUISITION

191. The land acquisition plan has been prepared along with the preliminary design. Construction of ramp on Mauripur Road will require the lanes to be shifted to one side, for which land acquisition will be required in order to maintain three (3) lanes in each direction. Approximately 684 sq. meter area is required for the proposed improvements. The area required for land acquisition is shown in **Figure 3.7**, highlighted in red.

Figure 3.7: Area Required for Land Acquisition at ICI Intersection

3.12 MANPOWER REQUIREMENTS

192. The Contractor will mobilize staff of about 50 people. The manpower required during the construction and operation phases of the proposed Road is presented in **Table 3.1.**

Table 3.1: Tentative Manpower Requirements during Construction Phase

Designation	Tentative No of Posts
Manager Admin	1
Office Engineer	1
Soil Engineer	1
Design Engineer	1
Civil Engineers	1
Electrical Engineer	1
Mechanical Engineer	1
Skilled	8
Unskilled	35

3.13 WATER REQUIREMENTS

193. The water consumption for around fifty (50) staff during the construction phase of the

project is estimated to be 2,700 gallons/day[1]. Water consumption for construction activities will include for curing, concrete mixing, road compaction etc.

3.14 WASTEWATER GENERATION

194. The wastewater generation from camp during the construction phase of the project is estimated to be 1,890 gallons/day.[2]

3.15 SOLID WASTE GENERATION

195. An average solid waste generation rate of 0.5 kg/capita/day[3] is adopted for the estimation of solid waste generation from the camp. Based on this assumption, a total of about 25 kg of municipal waste will be generated from the construction camp daily. Construction waste will include empty cement bags, empty containers, debris, dismantling waste etc., and most of the construction waste will be reused or recycled.

3.16 EQUIPMENT REQUIRED DURING CONSTRUCTION

196. The following are the machinery and equipment required for the proposed project and is provided in **Table 3.2.**

Table 3.2: Machinery and Equipment Requirement for the Proposed Project

S. No.	Type of Machinery and Equipment
1.	Dump Trucks
2.	Front End Loaders
3.	Graders
4.	Vibratory Rollers
5.	Pneumatic Tyre Rollers
6.	Three Wheel Rollers
7.	Tandem Rollers
8.	Water Tankers
9.	Concrete Batching Plant
10.	Concrete Transit Mixers
11.	Concrete Pumps
12.	Excavators
13.	Water Pumps
14.	Cranes
15.	Generators
16.	Asphalt Distributors
17.	Welding plants
18.	Air compressors
19.	Steel cutters

---

[1] KW&SB, Average Daily Per Capita Water Consumption (54 gallons/day)
[2] KW&SB Average generation of 70% of water supplied/consumed
[3] Source: The World Bank Report 2012 – What a Waste: A global review of solid waste management. Based on UNEP estimates for waste generation in the Asia Pacific. Average is 0.45 kg/capita/day.

3.17 POWER REQUIREMENT

3.17.1 Power Requirement during Construction Phase

197. The main source of power during construction phase will be electricity/electric power and diesel generators.

3.17.2 Power Requirement during Operational Phase

198. Major source of power would be taken from main electric power grid of K-Electric, supplying power to the main city.

4 ANALYSIS OF ALTERNATIVES

4.1 GENERAL

199. This section deals with an analytical overview of the different alternatives that have been considered for the proposed project. The analysis has been carried out keeping in view the environmental and social aspects to select the most suitable alternative for the project

200. Following alternatives were considered for the proposed project;

- Option I: No Improvement (Do Nothing / No Project Scenario),
- Option II: Flyover on Mauripur Road & Kharadar with U-turn under ICI Bridge,
- Option III: Elevated Expressway parallel to Jinnah Flyover, and
- Option IV: Right-turn Flyover from Mauripur Road onto ICI Bridge and rehabilitation of existing West Wharf Road / Akbar Siddiq Road

4.2 OPTION I: NO IMPROVEMENT (DO NOTHING / NO PROJECT SCENARIO)

201. ICI Bridge intersection is one of the most congested intersections in the southern part of the city. The congestion is compounded due to non-working traffic signals and lack of traffic management controls. This intersection exhibits high daily traffic volumes of over 100,000 which comprise of heavy truck / trailer traffic due to its vicinity to the Karachi Port. At present, no internal road access exists between the East and West wharves of Karachi Port. Traffic from West wharf towards East wharf has to traverse Mauripur Road from ICI Bridge and then use Jinnah flyover to enter East Wharf and vice versa. This further increases the congestion on existing Mauripur Road.

202. Currently, the ICI Bridge Intersection is already operating at a LOS ‘F’. Considering the existing condition and upcoming projects / expansion schemes of Karachi Port Trust (KPT) and other stakeholders, if no solution is provided, then traffic congestion and delays will increase significantly. There will be high travel demand and the intersection will not cater to the future traffic growth.

203. The assessment of alternatives to the Project compares the likely benefits of proceeding with the Project with the “Do Nothing” alternative where the decision would be made not to proceed with the Project. The “Do Nothing” alternative means that proposed project would not proceed and the existing situation will continue to be the same. Therefore, in case of “no-project” or “do nothing” option, no action will be taken to address the critical issues of congestion and traffic jam at ICI Bridge Intersection.

4.3 OPTION 2: FLYOVER ON MAURIPUR ROAD & KHARADAR WITH GRADE U-TURN UNDER ICI BRIDGE

204. In the current situation, there is a need to implement mitigation measures for the traffic

congestion and provision of quick and safe access to the commuters in the proposed project area. Therefore an option of providing right-turn flyover from Mauripur Road and merge with existing ICI Bridge was considered. In this option, free-flow traffic movement was proposed on Mauripur road / Jinnah Flyover, which restricted the cross movements at ICI Bridge intersection. In order to cater to some of the banned movements, a flyover on Ghulam Ali Allana Road and at grade U-turn under ICI Bridge was proposed to accommodate the straight movement and right-turn movement from Kharadar. The proposed flyover would ramp up from Kharadar and merge with existing ICI Bridge, while the other ramp of the flyover would go down and join at grade U-turn under ICI Bridge.

205. To construct the above scheme, existing ICI Bridge would be demolished up to the height of 6m (before KCR crossing) having approx. length of 150m. The new segment of the bridge would be widened to accommodate traffic coming to/from ICI Bridge. **Figure 4.1** shows the proposed layout plan for Option-II.

206. Following were the issues with this option:

- Land Acquisition towards Wazir Mansion
- Demolition of ICI Bridge
- High construction time and cost

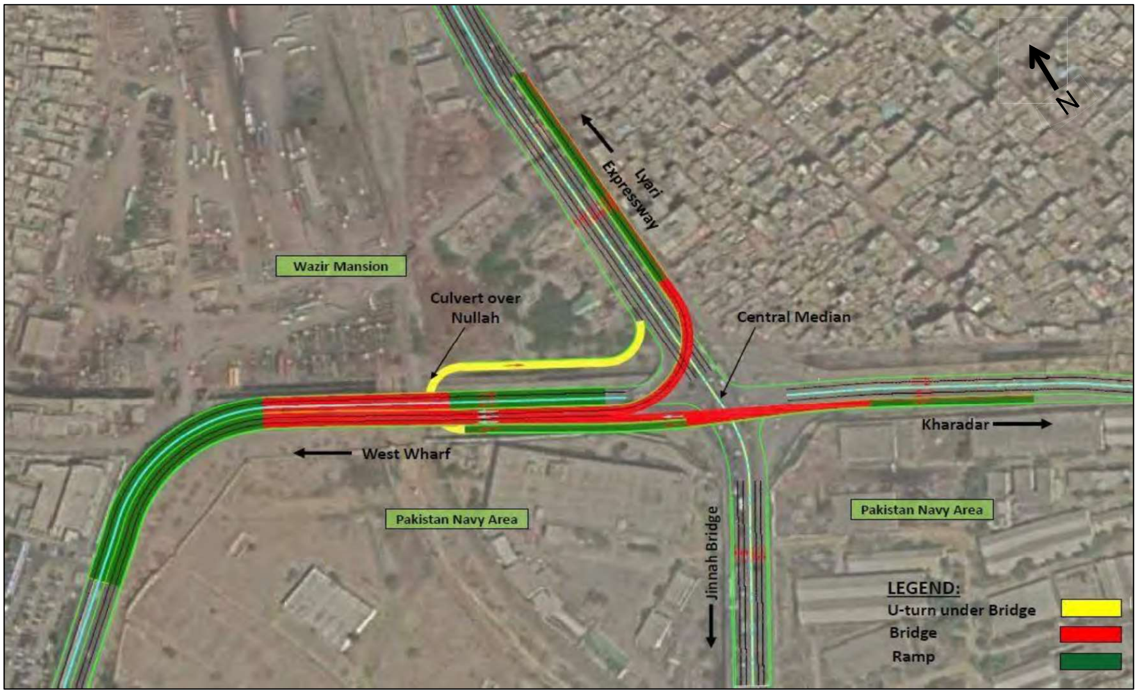


Figure 4.1: Option II - Flyover on Mauripur Road & Kharadar with grade U-turn under ICI Bridge

4.4 OPTION III: ELEVATED EXPRESSWAY PARALLEL TO JINNAH FLYOVER

207. In another option, an elevated expressway parallel to Jinnah Flyover was proposed that would connect port traffic of East and West Wharves to Mauripur Road and continue towards Lyari Expressway. The proposed expressway was four (4) lane two-way structure which would start near proposed security check-posts and gates to KPT wharves and pass through the Pakistan Navy (PN) area and ramp down at Mauripur Road. The construction of elevated expressway required land acquisition currently under the Jurisdiction of PN. Moreover, Mauripur Road would also be realigned to accommodate ramps of elevated expressway and construction of slip roads for which land towards Wazir Mansion had to acquire. **Figure 4.2** shows the proposed layout plan for Option-III.

208. Following are the drawbacks of this option:

- Extensive land acquisition from various stakeholders (PN/PR/KPT).
- Being planned on highly sensitive and classified area, security was also the major concern.
- Expressway was only for port traffic coming from East / West Wharfs to Lyari Expressway.
- No connection for port traffic coming from/to ICI bridge was provided
- High Construction cost and time.

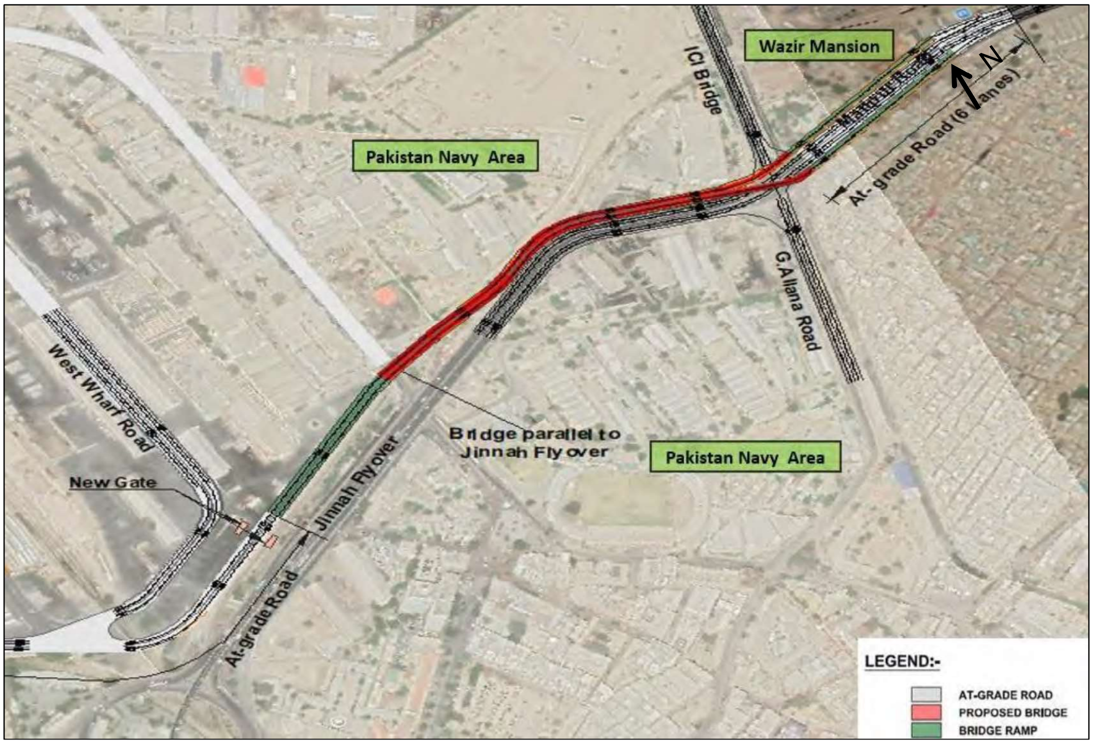


Figure 4.2: Option III - Elevated Expressway parallel to Jinnah Flyover

4.5 OPTION IV: RIGHT-TURN FLYOVER FROM MAURIPUR ROAD ONTO ICI BRIDGE AND USE OF EXISTING WEST WHARF ROAD / AKBAR SIDDIQ ROAD

209. Another option to provide a right-turn flyover from Mauripur Road onto ICI Bridge (approx. 6% of the total intersection traffic) was proposed. Construction of this flyover will eliminate one of the major turn movements (consisting of truck / trailer traffic). It was also proposed that cross-movements on Mauripur Road would be banned to facilitate the through movements (approx. 59% of the total traffic at this intersection). The banned movements would be made to use existing West Wharf Road / Akbar Siddiq Road just south of the intersection. The proposed scheme would allow for free-flow movements for the through traffic on Mauripur Road, resulting in the intersection operating within capacity. **Figure 4.3** shows the proposed intersection movements, while **Figure 4.4** shows the diverted movements on West Wharf Road.

210. The above scheme was shared with various project stakeholders. In a meeting with Karachi Port Trust (KPT), it was revealed that KPT also has plans to ease the traffic congestion at this intersection by building a road corridor along the KCR track for which land would be required from Pakistan Navy and Pakistan Railways. KPT recommended to allow right-turning traffic access from ICI Bridge as the West Wharf Road would witness heavy congestion due to diversion of this movement. As the KPT plan for new road corridor along KCR gets approved, most of the port traffic would shift from Mauripur Road, which would relieve the intersection of major traffic (especially on Mauripur Road).

211. Considering the above, it was decided to provide temporary access to turning traffic at ICI intersection till the time issue of road corridor along KCR is finalized. The temporary intersection improvement plan is provided in **Figure 4.5.**

4.6 SELECTED OPTION

212. After careful deliberation among the project team and subsequent consultations with the Client, Alternative 4 (Right-Turn Flyover from Mauripur Road onto ICI Bridge) is the most feasible option. It ensures that a decision to proceed with the Project would not result in substantial negative effects as compare to other options that could negate the obvious positive effects of economic development. It will help resolving traffic congestion resulting in reduction in associated time delays, reduction in fuel consumption, minimum land acquisition, reduction in conflicts/accidents, air pollution and noise. Smooth flow of traffic will also help in lesser wear and tear of vehicles.

.

Figure 4.3: Proposed Intersection Improvement Plan

Figure 4.4: Proposed Diversion of Traffic (Red Line)

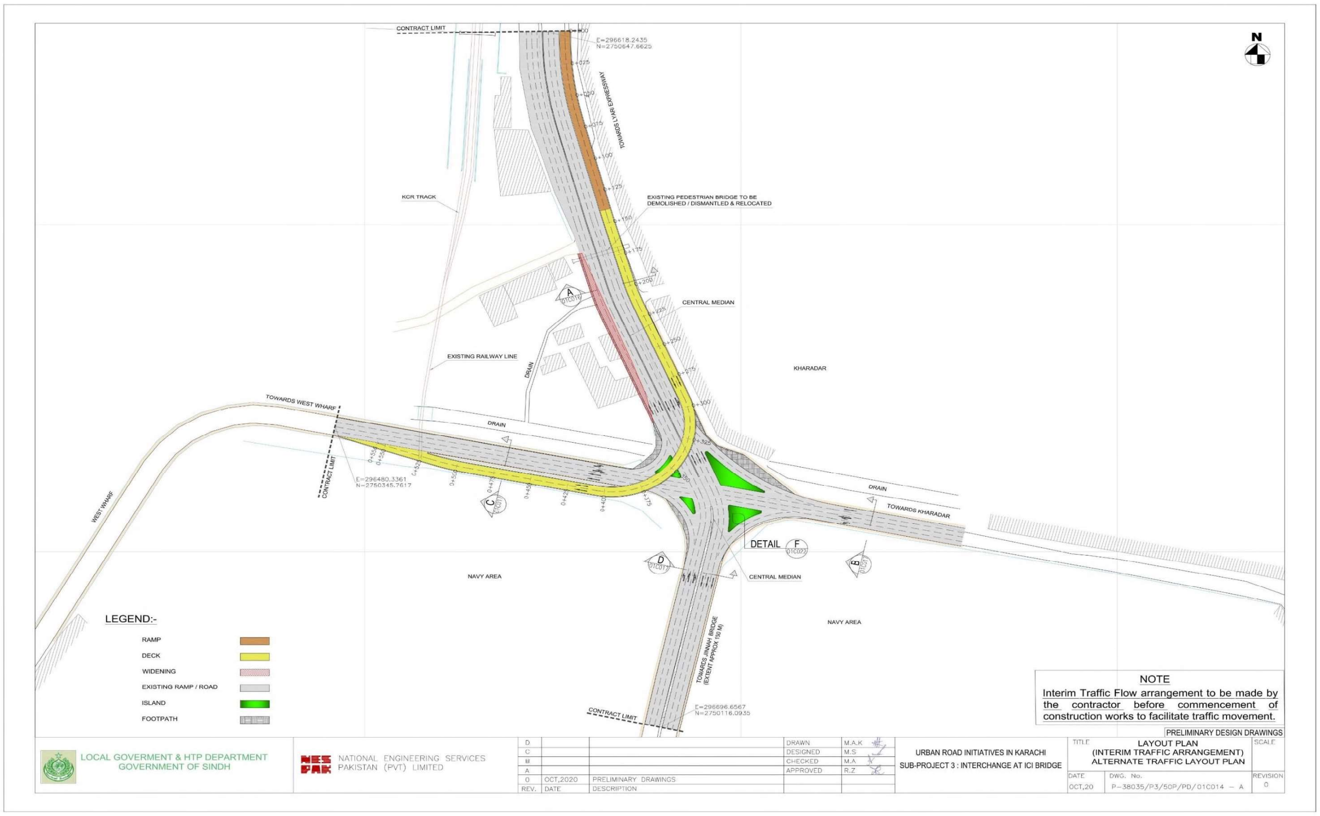


Figure 4.5: Proposed Intersection Improvement Plan (Short-term)

5 DESCRIPTION OF THE ENVIRONMENT

5.1 GENERAL

213. An environmental baseline study is intended to establish a data base against which potential impacts can be predicted and managed later. The EIA of the proposed project (Interchange at ICI Bridge / Intersection) covers a comprehensive description of the project area

214. The existing environmental conditions around the proposed project have been considered with respect to physical, biological and socio-economic aspects.

215. Site visits were conducted to survey the field area and to collect environmental data on physical, biological and socioeconomic parameters. The baseline surveys were carried out during November 08, 2020 to November 19, 2020. Further, interviews were also held with the general public and stakeholders of the project area in order to seek the public opinion on the implementation of the proposed project. Various Governmental and Non-Governmental Organizations (NGOs) were also visited for the collection of relevant data and recording their views on the proposed project.

5.2 PHYSICAL ENVIRONMENT

216. The areas covered under physical resources are; climate, drainage, water resources, topography, seismology, geology and soil, hydrology, surface water, groundwater, ambient air quality, dust monitoring and noise levels.

217. The detailed description of physical resources is discussed as under:

5.2.1 Topography & Geography

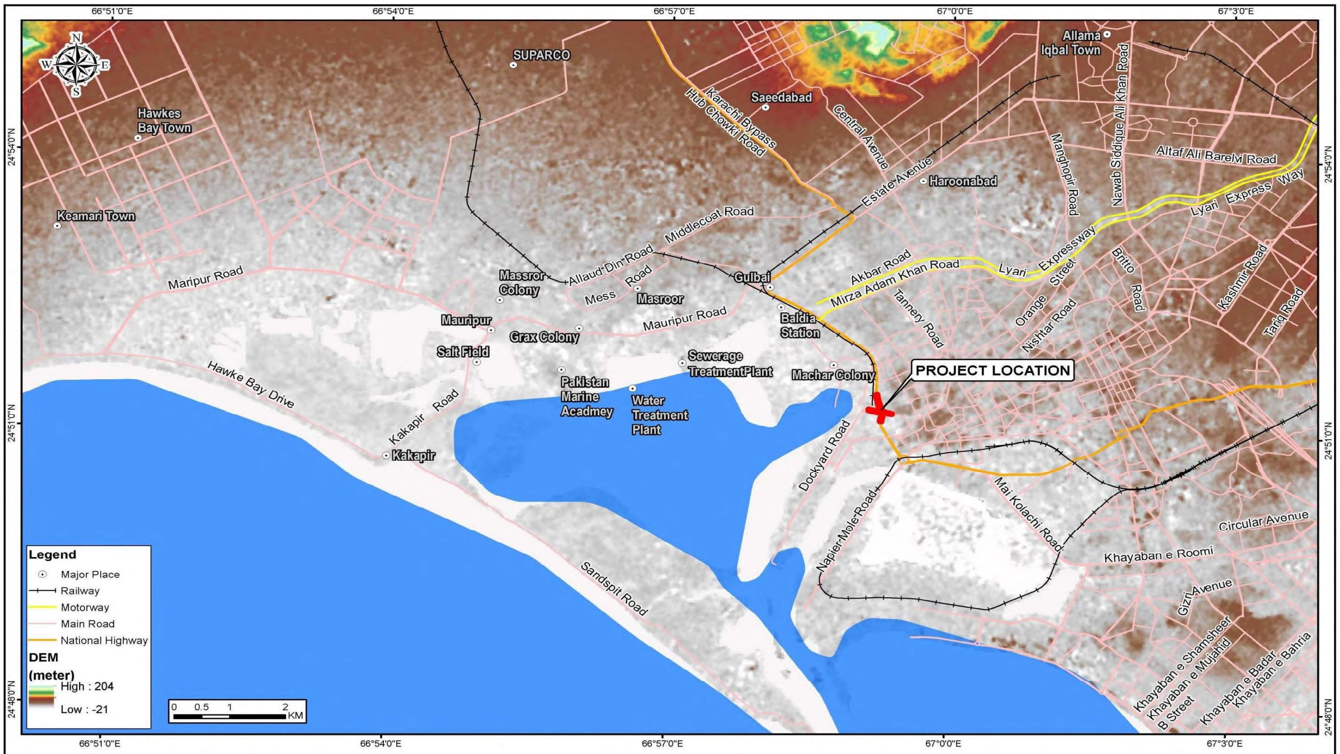
218. Karachi City District can be divided into three broad categories on the basis of physiographic features; Hilly Region (Mountain Highland), Alluvial Plain (Piedmont Plain) and Coastal Areas (Valley Floor). The proposed project site comes under the topography of the district West of Karachi, which is dominated by ridges, plains and coastal belt; the area which at one time was predominantly under agriculture is now crowded with new colonies and township like Hawksbey, Moach Goth, Baldia, Orangi, Qasba Colony and Ittehad Town.

219. The proposed project site is located adjacent to the existing ICI Bridge. The site can be accessed through Mauripur Road and Dockyard – Ghulam Ali Allana Road. It is one of the busiest intersections.

220. The terrain of the site area is flat. The existing site is fairly leveled and already developed. Furthermore, the future development is planned according to the international standards for the design.

Figure 5.1: Topography of Project Area

221. The topographic map of the project area is shown in **Figure 5.2.**



CLIENT
LOCAL GOVERNMENT &
HTP DEPARTMENT
GOVERNMENT OF SINDH

CONSULTANT
NATIONAL ENGINEERING
SERVICES PAKISTAN
(PVT.) LTD
HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N
MODEL TOWN EXTENSION, LAHORE, PAKISTAN

REV.	DATE	DESCRIPTION	APPROVED		
04				DRAWN	IMRAN
03				SUBMITTED	
02				RECOMMENDED	
01				CHD/VER.	S.BADAR
				APPROVED	M.SHARIQ

PROJECT
URBAN ROAD INITIATIVES IN KARACHI
SUB-PROJECT 3: INTERCHANGE AT
ICI BRIDGE

TOPOGRAPHIC MAP

SCALE
1:60,000

DATE
OCT, 2020

DRAWING No.

REV.
0

Figure 5.2: Topographic Map of the Project Area

5.2.2 Geology and Soil

5.2.2.1 Regional Geology

222. Regionally, the Project Area is located in the Karachi Arc which is located on the southern margin of the Sulaiman Kirther Fold Belt. Karachi Arc is an eastward arcuate feature bounded by east west oriented sinistral and dextral faults near Mancher Lake in north and near Karachi in south respectively (Sarwar and DeJong, 1979).

223. The major structures of the area are the Pir Mangho Anticline (PMA) and the Lalji Syncline (LS). The strike of the pronounced structural trend is NE-SW in the area. In the north of Pir Mangho Anticline, structural trend changes sharply to the NS. A number of sinistral strike slip faults displace the strata. The most important is the Pir Mangho Fault (PMF), which is a NWSW trending vertical fault with sub-horizontal striation and having sinistral displacement. This fault has partitioned the strain in the area.

224. Laji Syncline is located in the SW of the Pir Mangho Anticline which is a double syncline with a kink geometry and hinges plunging towards SW. The two synclinal hinges are separate in the NE but converge towards SW, where they join together and form a single hinge asymmetric fold facing SE in Orangi area. Where fold is double hinged, its eastern limb is dipping at a low angle towards west, while its northwestern limb is dipping at a higher angle towards SE (Structural Geometry and Tectonics of Southern Part of Karachi Arc - A Case Study of Pir Mangho and Lalji Area, April 2012).

5.2.2.2 Site Geology

225. 219. The project site lie at the foot hills of Sulaiman Kirther Mountains and is comprised of unconsolidated surficial deposits of clay, silt, sand and gravel which forms distinct piedmont plains. These piedmont plains are characterized by gentler slope comprising of softer rocks and commonly contain parallel or concentric, low, scalloped, homoclinal ridges and hogbacks.

226. 220. The geotechnical investigations[4] indicated that the project area consists of fill material up to 2 m depth underlain by Lean Clay / Silty Clay / Silty Sand / Clayey Gravel up to the depth of 33.5 m below NSL. Bedrock consists of weak to very weak Sandstone / Claystone, from 33.5 m to maximum investigated depth of 40 m below NSL Based on the subsurface ground conditions and the type of loads of the proposed structures, R.C. piles are recommended to be used for proposed interchange and retaining walls.

227. Test results for on-site test pits indicated that A-1-a / A-4 soils with soaked CBR as 30% & 32.5% at 95% modified AASHTO maximum dry density are present on existing road locations. On-site or alternatively, borrow area soils that belongs to A-4 or better AASHTO soil classification group can be used for road works.

---

[4] Geological Investigation Report of URI Subproject-3 (2020)

228. The subsoil can be categorized as soil profile type SD, as per criteria of Building Code of Pakistan Seismic Provisions (2007), for structural design of the project structures. The field and laboratory investigation data indicated that overburden soils and bedrock, present at the project site, has low to medium shear strength characteristics. Test results for natural moisture content indicated that the overburden soils at the project site are in moist condition while the bedrock is in dry to moist condition. The standard penetration test results indicated that onsite soil deposits have medium to high compressible characteristics up to 6 **–** 7 m depth below NSL. However, the overburden soil has low compressibility below 7 m depth.

229. Chemical test results indicated that the subsurface soil consists of negligible proportion of harmful salts. However, test results for water samples indicated severe proportion of harmful salts as per ACI Building Code Requirements for Structural Concrete.

Figure 5.3: Performance of Standard Penetration Test (SPT)

5.2.3 Seismicity

230. Seismo-tectonics of Pakistan is related to interaction of the following three lithospheric plates: Indian, Arabian, and Eurasian plate. Tectonically, almost 75% of Pakistan is prone to earthquake as it lies on fault lines5. **Figure 5.4** shows the location of Karachi with respect to tectonic plate boundaries.

---

[5] Country update paper on Pakistan, Bukhari, S. H. S., Proceedings World Geothermal Congress 2010 Bali, Indonesia, 25-29 April 2010

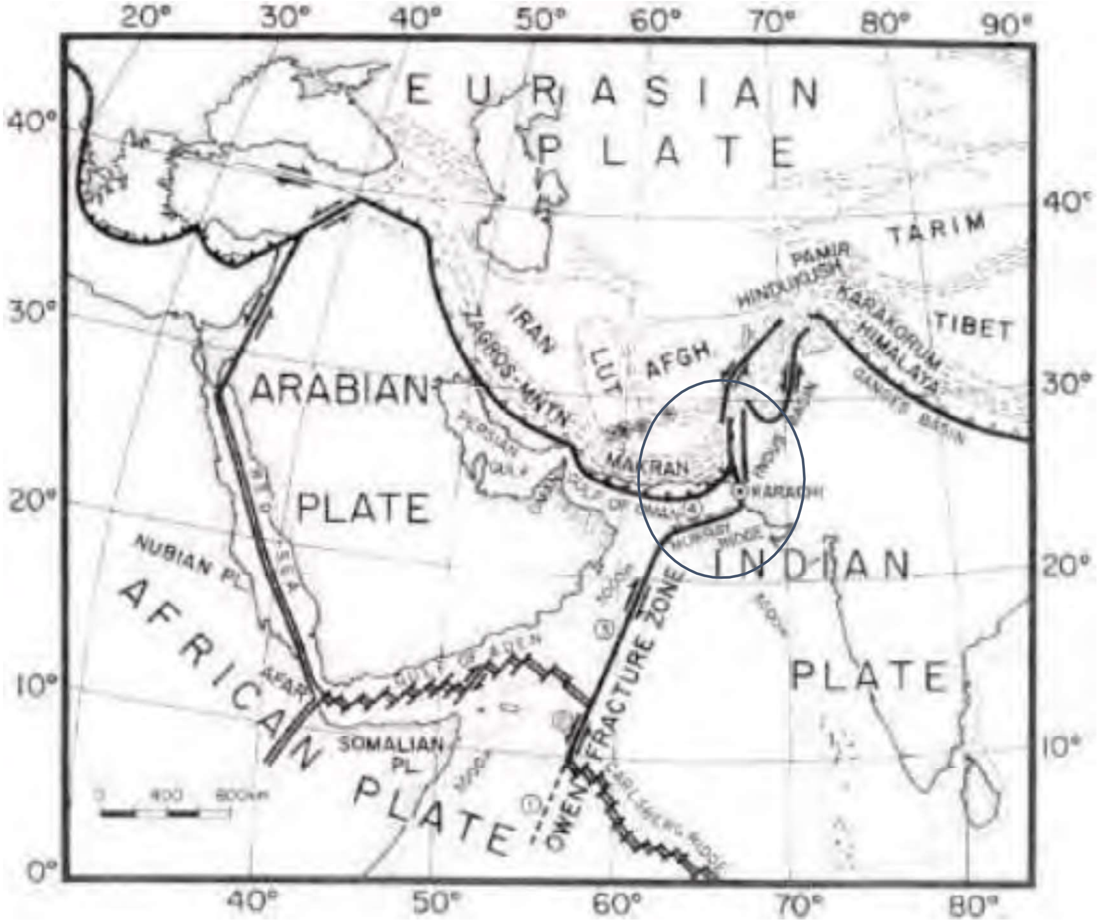


Figure 5.4: **Plate-Tectonic Sketch Map**

231. Karachi is located in the seismo-tectonic region where a moderate level of seismic activity is believed to exist, but large magnitude earthquakes are rare. Moreover, as per the seismic zoning map of Pakistan, the Project Area is located in Seismic Zone 2B, where 2B represents peak horizontal ground acceleration value ranges from 0.16g to 0.24g. **Figure 5.5** shows the seismic zoning map of the Project area falling under Seismic Zone-2B. The ICI interchange design must meet the criteria to withstand in seismic zone 2B.

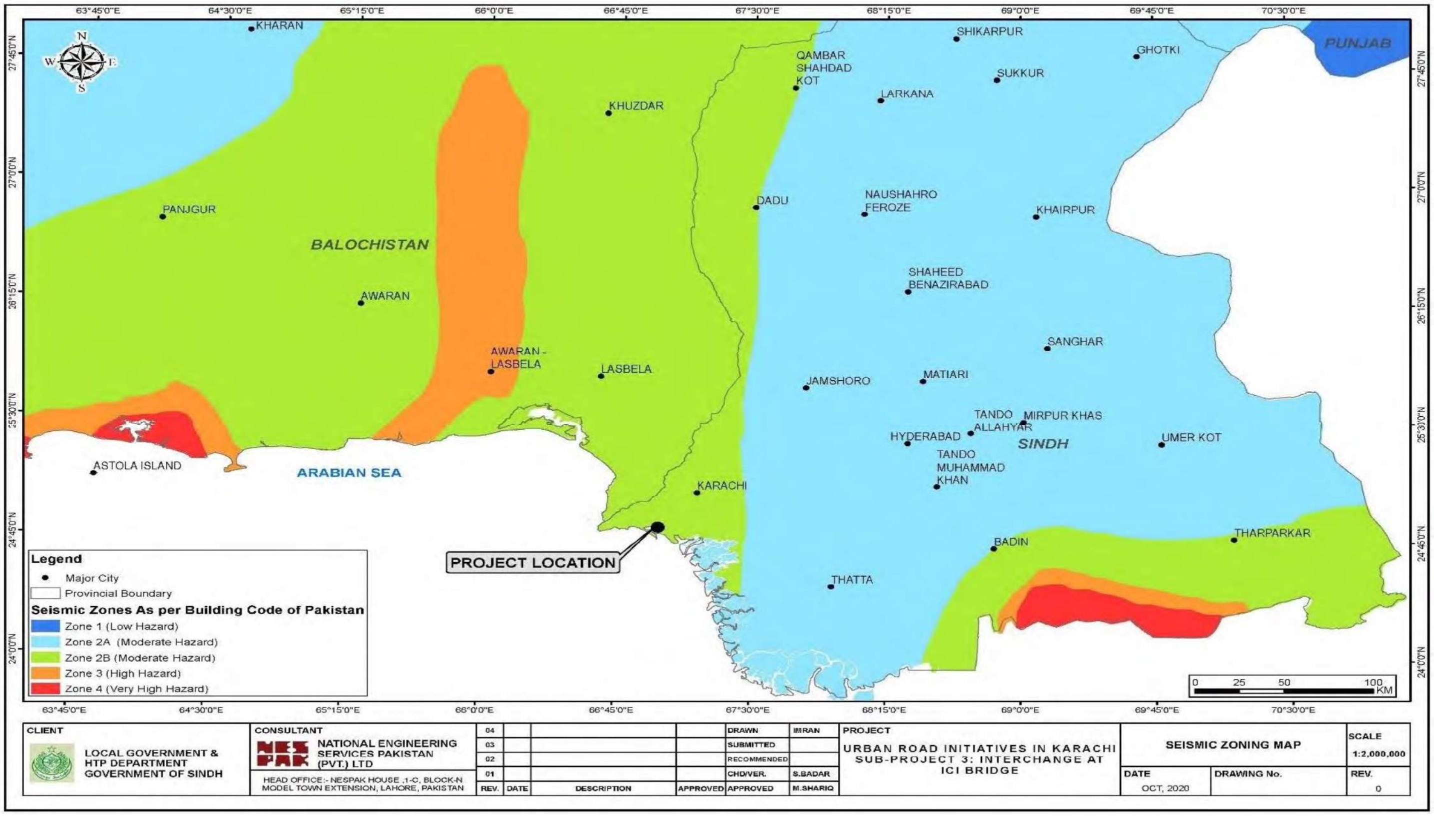


Figure 5.5: Seismic Zoning Map of Project Area

5.2.4 Hydrology

232. Seawater despite being saltwater is also considered surface water. However, it is not being used as a source of drinking water for Karachi. Therefore, Karachi obtains its drinking water from the Indus River about 120 km to the east and the Hub River in the west. Some limited groundwater is extracted for private use in the Karachi area, but groundwater resources in the Karachi area are limited. The aquifers close to the coastal belt are mostly saline and unusable for domestic purposes. Aquifers near the Hub River are well developed and serve as sources of water for agriculture and domestic use. The aquifers are estimated to lie at depths of 50-100 m.

233. Groundwater was encountered at a depth of 1.5 m to 1.7 m below NSL during field geotechnical investigations executed in the month of September 2020.

234. Major water body near the Study Area is Lyari River which mostly carries sewage flow of the city. The river flows through the heart of the city and into the harbor before entering the Arabian Sea. The river has two main tributaries i.e., Gujjar Nullah and Orangi Nullah. The river remains dry for most part of the year and carries urban sewage that is ultimately drained in the Arabian Sea.

235. Sewerage drainage systems in the proposed Project area is very old and it doesn’t have ability for storm water drainage. The design capacities of the system, is much lower than required.

5.2.5 Climate

236. The climate of the Karachi can be characterized by dry, hot and humid conditions and in general terms it is moderate, sunny and humid. There is a minor seasonal intervention of a mild winter from mid-December to mid- February followed by a long hot and humid summer extending from April to September, with monsoon rains from July to mid- September. The level of precipitation is low for most of the year. Karachi also receives the monsoon rains from July to September. The humidity levels usually remain high from March to November, while very low in winter as the wind direction in winter is North Easterly. The description of various climatic parameters in the project area is as follows:

5.2.5.1 Temperature

237. **Table 5.1** and **Figure 5.6** show the maximum, minimum and average monthly temperatures of the Karachi for the recent years (2016-2020). The maximum temperature range is 24 – 37 °C. The average temperature range is 21 - 34 °C. The minimum monthly temperature range is 17– 30 °C. April to November are the hot months whereas cold months are December to March.

238. In 2015, Karachi also experienced the deadliest heat wave which had seen in over 50 years. The city witnessed sweltering heat that continued for more than five days and in its wake left over 1,200 people dead and 40,000 suffering from heatstroke and heat exhaustion. On the heat index scale, which is a good explanatory concept utilized to

gauge the impact of heat-wave phenomenon to a person in a particular area by combining the overall impacts of temperature, air pressure, humidity and wind speed, in Karachi, during this event, the maximum temperature recorded was 44.8°C but the heat index was around 66°C on the peak heat wave day i.e. 20th June 2015 because of low air pressure and wind speed and very high humidity.[6]

Table 5.1: Maximum, Minimum and Average Temperature (Karachi)

Year	Month's Temperature °C											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016												
Max	26	29	32	34	35	36	33	33	32	33	32	29
Avg	22	24	27	29	31	31	30	30	28	28	27	24
Min	19	20	24	25	28	28	29	28	26	25	23	21
2017												
Max	25	29	32	35	37	35	32	32	32	34	30	27
Avg	21	24	27	30	32	32	30	29	29	30	26	23
Min	18	21	23	26	28	29	28	27	27	27	23	20
2018												
Max	26	28	31	35	37	34	32	30	30	35	34	29
Avg	22	24	27	30	33	31	30	28	27	33	32	26
Min	19	21	24	26	29	29	28	27	26	30	28	23
2019												
Max	27	27	30	34	35	36	33	31	32	34	30	27
Avg	25	24	28	32	33	34	31	30	31	32	28	24
Min	21	20	23	27	28	29	28	27	27	28	24	20
2020												
Max	24	30	30	34	35	35	35	32	33	35	-	-
Avg	21	27	27	32	33	33	33	31	31	32	-	-
Min	17	21	21	25	27	29	29	28	28	28	-	-

Source: Extract from Temperature Graph (World Weather Online)

---

[6] Technical Report on Karachi Heat wave June 2015, Ministry of Climate Change, Government of Pakistan.

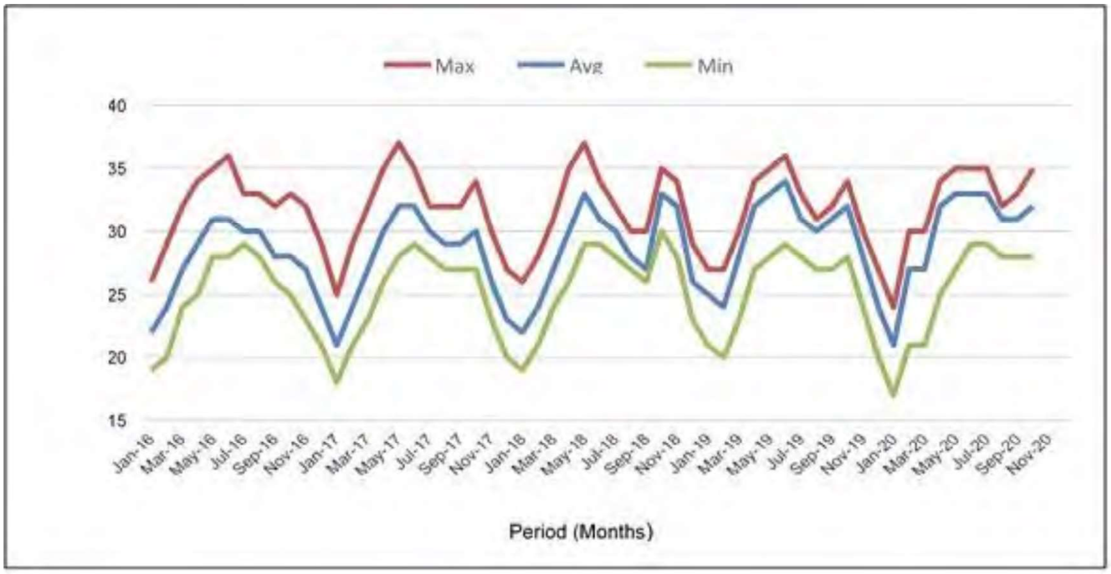


Figure 5.6: Maximum, Minimum and Average Temperature (Karachi)

5.2.5.2 Rainfall

239. Mean monthly rainfall data and the number of rainy days recorded at Airport Weather Station, Karachi met station in the vicinity of the Project Area is given in **Table 5.2.** The minimum average monthly rainfall of the project area varies from 0 to 0.8 mm whereas maximum average monthly rainfall varies from 14.31 mm to 118.90 mm. As this region falls in the semi-arid climatic zone, the rainfall in Karachi is extremely low and erratic.

240. The maximum rainfall occurs during the months of July and August. The recent record-breaking rainfall in August 2020 turned Karachi roads into waterways and caused a havoc due to poor drainage system in Karachi. Winter rains generally occur during the months of December to March, whereas, May, October, November is normally the months with least precipitation.

Table 5.2: Average Rainfall of Karachi

Year	Average Monthly Rainfall (mm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	2.63	0	3.9	0.11	0.09	9.71	10.23	41.09	1.2	0.01	0	0.1
2017	5.61	0.03	0.1	0.01	0.06	3.47	20.4	27.17	16.92	0	0.14	0.22
2018	0.01	0	0.04	0.53	0	5.92	11.86	14.31	2.53	0	0	0.4
2019	13.7	4.8	3.2	18	0.8	2.9	61	118.9	16.1	12.6	5.6	3.3
2020	3	0	2.1	0.1	0.7	3.9	32.1	227.7	0.8	0.4	--	--

Source: Extract from Temperature Graph (World Weather Online)

241. Graphical representation of month-wise precipitation is provided below in **Figure 5.7.** The maximum rainfall occurs during the monsoon season in the months of July and August.

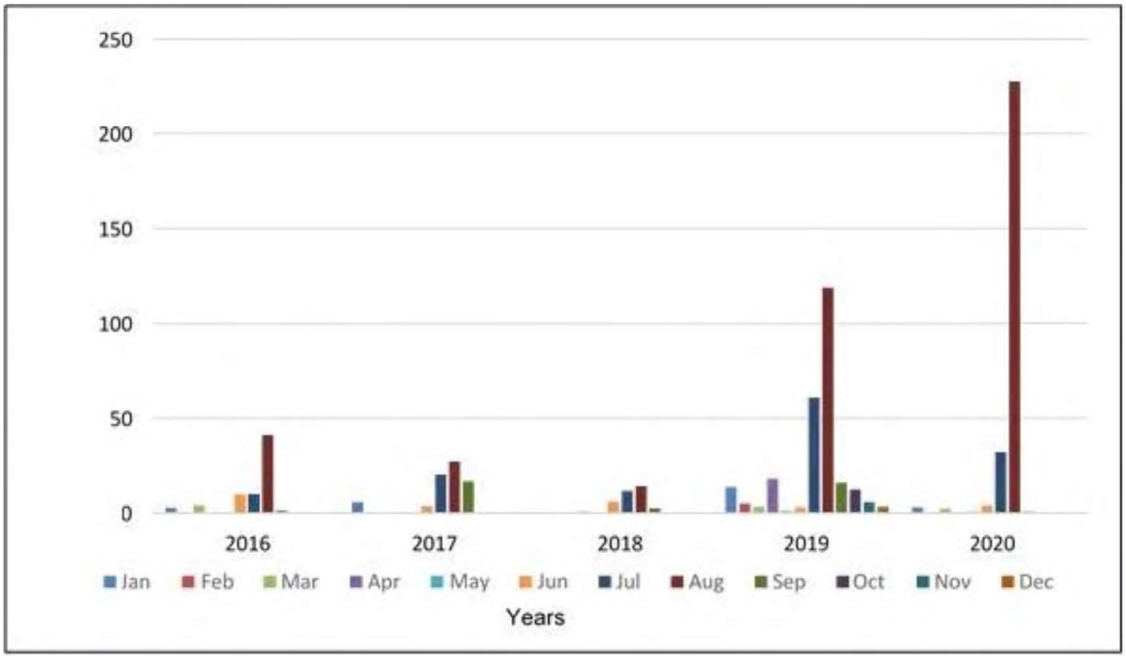


Figure 5.7: **Average Rainfall of Karachi (mm)**

5.2.5.3 Relative Humidity

242. The relative humidity data at Karachi metrological station at Airport near the proposed Project Area is given in **Table 5.3.** Relative humidity levels are mostly high during the month of July and August, whereas, these are lower during December.

Table 5.3: **Average Humidity of Karachi**

Year	Humidity (%)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	48	33	49	54	66	67	72	73	71	63	39	44
2017	37	29	49	52	63	68	74	72	69	55	38	25
2018	42	45	50	51	52	69	73	75	72	47	37	35
2019	42	39	47	50	58	66	72	76	70	53	40	31
2020	38	37	48	58	67	70	69	76	69	47	--	--

Source: Extract from Temperature Graph (World Weather Online)

243. Graphical representation of month-wise Relative Humidity is provided below in **Figure 5.8**

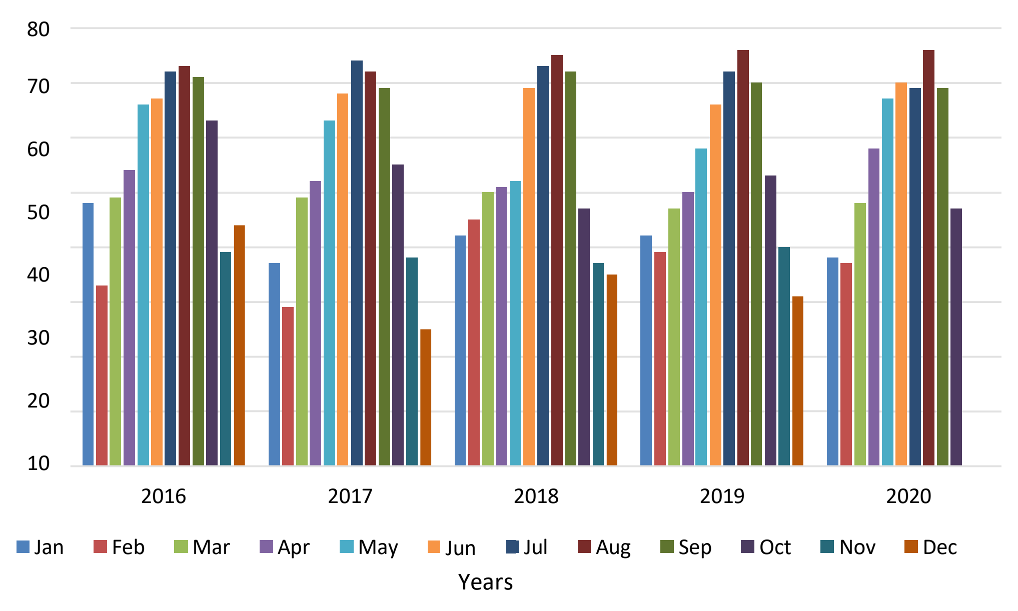


Figure 5.8: Average Humidity (%) of Karachi

5.2.5.4 Wind Speed

244. The mean monthly wind speed at Airport, Karachi metrological station around proposed Project Area is given in **Table 5.4**. The data reveals that the wind speeds are generally lower during winter (December to March) while higher wind speeds are recorded during summer (May, June, July).

Table 5.4: Average Wind speed

Year	Wind Speed (kmph)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016												
Max.	10.1	11.7	16.3	19.1	24.5	24.2	24	21.6	23.7	15.3	10.2	10.1
Avg.	10.1	11.7	16.3	19.1	24.5	24.2	24	21.6	23.7	15.3	10.2	10.1
2017												
Max.	13.3	13.5	16.2	20.4	23.6	23.8	26	23.8	19.4	14.4	10.7	13.3
Avg.	13.3	13.5	16.2	20.4	23.6	23.8	26	23.8	19.4	14.4	10.7	13.3
2018												
Max.	10.3	11.6	16.6	18.9	21.6	25	25.2	24.7	22.1	20.6	17.5	17.8
Avg.	10.3	11.6	16.6	18.9	21.6	25	25.2	24.7	22.1	13.6	11.4	12
2019												
Max.	18.6	23.3	24.1	29.5	32.8	29.7	34.7	28.8	25.6	20.9	20.4	21.4
Avg.	12.3	16.3	16.8	22.7	26.2	23.8	30.6	24	20.4	14.8	15	15.9
2020												
Max.	24.2	21.7	26.6	29.4	33.3	28.9	31.9	29.5	23.6	20.9	--	--

Avg.	17.3	14.1	17.6	20.9	25.7	23.1	25.8	23.7	19	14.3	--	--

Source: *Extract from Temperature Graph (World Weather Online)*

245. Graphical representation of month-wise wind speed at Airport Karachi meteorological gauging station is provided below in **Figure 5.9.**

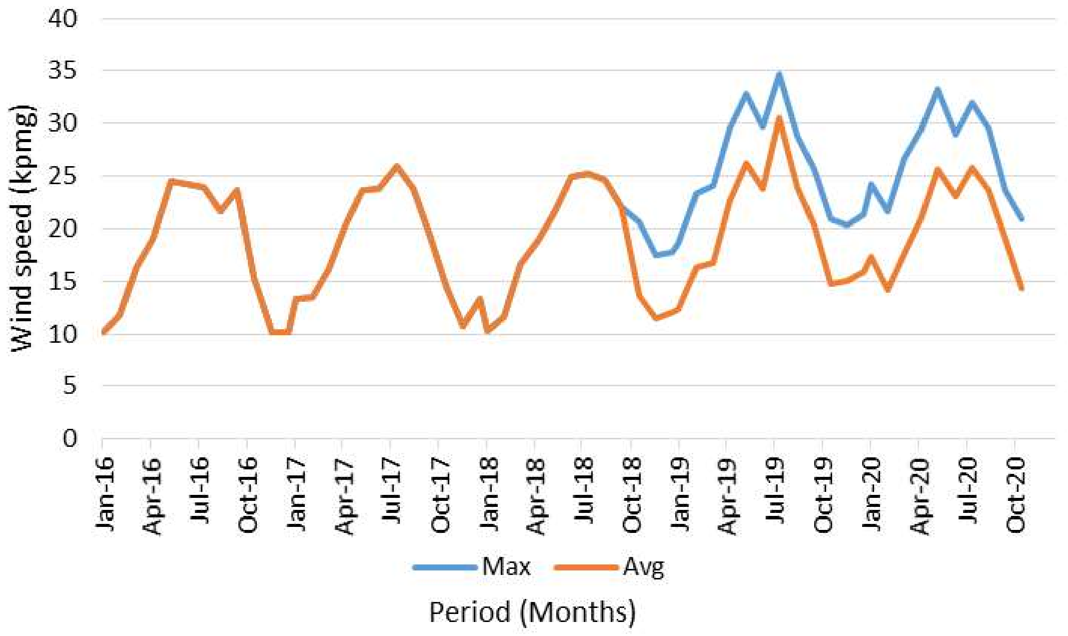


Figure 5.9: Monthly Average and Maximum Wind Speed of Karachi

246. Karachi has an arid climate. Karachi is located on the coast and as a result has a relatively mild climate. Karachi has two main seasons; summer and winter, while spring and autumn are very short. Summer season persists for longest period during the year. Karachi also receives the rains from July to September. The city enjoys a tropical climate encompassing warm winters and hot summers. The humidity levels usually remain high from March to November, while very low in winter as the wind direction in winter is northeasterly.

5.2.6 Urban Flooding

247. Climate of Karachi is semi-arid and rainfall is low and highly variable. Torrential rains and heavy rainfall mostly occur in the month of June under the effect of tropical storms. Torrential and heavy rains rarely affect coastal areas but cause flooding within the city. Moreover, almost 50 slum areas along the banks of River Lyari, approximately 0.8 million people reside there makes them the most vulnerable to floods during seasons of heavy rainfall. River Malir also experiences flooding during the rainy season. Moreover, Rivers Malir and Lyari are also mainly responsible for recharging the coastal aquifers of Karachi.

248. As the result of a tropical storm (6 June 2010) Karachi received 130 mm rain within a

day which caused huge surface runoff. The heavy monsoon rain mostly occurs in July and August and is the main cause of flooding in the city. The recent record breaking (24-27 August 2020) rainfall in Karachi turned the roads into waterways. Most of the main roads and streets in Karachi looking like nullahs and drains after the rainfall as three to four feet of water standing in many parts of Karachi. According to Metrological department, record breaking rainfall was recorded in the vicinity of the project during the month of August 2020. It is the highest rainfall record over the last 90 years. In the project area, based on the consultations with locals there is no major urban flooding history except of flooding due to heavy rainfall events occur after decades.

5.2.7 Air Quality Index

249. Air Quality Index (AQI) is a uniform index for reporting and forecasting daily air quality. It is used to report criteria pollutants for ambient air including ground-level ozone, Total Suspended Particulate Matter, PM10 and PM2.5, carbon monoxide (CO), and sulfur dioxide (SO2) and Nitrogen dioxide (NO2) and (NO). The Index is used for reporting air quality to public. Usually the values communicated to public comprises of PM2.5 as these particles can be easily inhaled and affect human health. It is color coded system that ranges from 0 to 500 (no units). **Table 5.5** indicates the colors and associated range of PM$_{2.5.}$

Table 5.5: Ambient Air Quality Index

AQI Value	AQI Category	Health Concerns
0 - 50	Good	None
51 - 100	Moderate	Unusually sensitive people should reduce prolonged or heavy exertion
101 - 150	Unhealthy for Sensitive Groups	Sensitive groups should reduce prolonged or heavy exertion
151 - 200	Unhealthy	Sensitive groups should avoid prolonged or heavy exertion; general public should reduce prolonged or heavy exertion
201 - 300	Very Unhealthy	Sensitive groups should avoid all physical activity outdoors; general public should avoid prolonged or heavy exertion
301 - 500	Hazardous	Everyone should avoid all physical activity outdoors

250. Recently, Karachi is being ranked in top five places in the world with higher AQI values as indicated in Air Visual. AQI of Karachi is in the range of unhealthy to very unhealthy from 7 December to 10 December (AQI 238 to 177, Ref: iqair.com). Now a days, from April 20-22, AQI is in the range of 92 to 96 which is moderate in category.

5.2.8 Environmental Parameters for Monitoring

251. The environmental parameters like ambient air quality, noise level and ground water were monitored at different locations of the proposed project site for analyzing the quality of air, ground water, surface water, and level of noise, for establishing the baseline profile of the area as shown in **Table 5.6.**

Table 5.6: Detail of Environmental Monitoring Parameters and Locations

Sr. No.	Parameters	Sampling Points	Sampling Locations	Location Coordinates
1	Ambient Air	2	Karma Wali Mosque In front of ICI	24°51'17.41"N, 66°59'15.95"E 24°51'9.13"N, 66°59'0.28"E
2	Noise Level	2	Karma Wali Mosque In front of ICI	24°51'17.41"N, 66°59'15.95"E 24°51'9.13"N, 66°59'0.28"E
3	Wastewater	1	ICI Inter change	24°51'15.80"N, 66°59'16.14"E
4	Drinking Water	1	ICI Inter change	24°51'15.80"N, 66°59'16.14"E

252. The locations of the environmental monitoring and sampling points are shown in **Figure 5.12**

5.2.8.1 Ambient Air Quality

253. The major source of air pollution in the vicinity of the project area is due to exhaust from considerable volume of heavy freight traffic generated to and from the project area. Monitoring of primary pollutants i.e., Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Ozone (O_3) and Particulate Matter (TSP, $PM_{2.5}$, and PM_{10}) were carried out at two different locations of the proposed project site. Preliminary visits were conducted before selection of the points, giving special attention to the sites having large volume of traffic.

254. The sampling locations were selected through receptor-based approach. One monitoring point was Karma Mosque near the intersection as it the major road where traffic gridlock occurs. Second ambient air monitoring was conducted in front of ICI due to the sensitive receptor and surroundings represents residential and commercial area

Figure 5.10: Ambient Air Monitoring at Karma Mosque

255. The sampling was conducted for 24 hours period for SO_2, NO_2, and PM_{10} and for eight hours period for CO. The average concentrations of ambient air pollutants are given in **Table 5.7.**

Table 5.7: Ambient Air Quality Monitoring Results

Monitoring Locations	24 hours Average conc. . of CO (mg/m3)	24 hours Average conc. of Nitrogen Dioxide (NO2) μg/m3	24 hours Average conc. of Nitrogen Dioxide (NO2) μg/m3	24 hours Average conc. of Sulphur Dioxide (SO2) μg/m3	24 hours Average conc. of Total suspended Particulat e (TSP) μg/m3	24 hours Average conc. of Particulate Matter (PM10) μg/m3	24 hours Average conc. of Particulate Matter (PM 2.5) μg/m3	01 hours Average conc. of Ozone (O3) PPb	24 hours Average conc. of Lead (Pb) μg/m3
Monitoring Location-1 (Karmawali Mosque)	2.5	0.1	9.4	5	**553.2**	**404.8**	68.1	24.0	< 1.0
Monitoring Location-2 (In front of ICI)	2.7	0.0	8.8	4.1	**527**	**364**	**91.1**	24.6	< 1.0
SEQS	5.0*	80**	40**	120**	500**	150**	75**	130***	1.5**

SEQS: Sindh Environmental Quality Standards
μg/m^3: micro grams per cubic meter mg/m^3: milligram per meter cube.
ppm: part per million
ND: Not Detected
* SEQS limit of CO as per 8 hours
** SEQS limit for 24 hours
*** SEQS Limit of Ozone as per 1 hour measurement

256. The detailed environmental reports are attached as **Annex-I.** The results of ambient air monitoring indicate that:

- The carbon monoxide, Nitrogen oxide, nitrogen dioxide and sulfur dioxide level are below the permissible limits.
- Total suspended solid and particulate matter is the highest in this region as compared to the permissible limits because of dust and vehicular movement due to high traffic flow on roads.

5.2.8.2 Noise

257. Noise associated with road development affects the environment through which roads pass by degrading human welfare and disrupting wildlife as a result of sonically vibrating structures (Tsunokawa and Hoban, 1994). Residents of Karachi are under a continuous risk of noise pollution.

258. Recently, in order to evaluate the noise level of the project site, noise level monitoring was carried out at different locations. Noise levels were monitored with the help of a potable digital sound meter at the project site for 24 (twenty-four) hours and are compared with SEQS for noise. Average values of noise levels are given in **Table 5.8.**

Table 5.8: Average values of Noise Levels

Sr. No.	Sampling Locations	Leq Equivalent (Leq) Hourly Maximum - dB(A)		SEQS (Industrial)		SEQS (Commercial)	
		Day Time (0600-2200 hrs)	Night Time (2200-0600 hrs.)	Day Time (0600-2200 hrs)	Night Time (2200-0600 hrs)	Day Time (0600-2200 hrs)	Night Time (2200 - 0600 hrs)
1	Karmawali Mosque	80.02	66.05	75	65	65	55
2	Infront of ICI	77.49	74.05	75	65	65	55

259. Noise monitoring results show that the noise levels at day and night time exceed from the permissible limits of SEQS (Industrial & commercial) at Karmawali Mosque and In-front of ICI, which may be due to noise generated by usage of pressure horns by vehicles, commercial activities and traffic congestions in the project area.

5.2.8.3 Water Quality

260. One (01) drinking water sample was collected from the Tap near Karmawali Mosque at ICI Interchange. The sample was analyzed in SGS laboratory for biological, chemical, and physical parameters to check their compliance with Sindh Environment Quality Standards (SEQS) for Drinking Water Quality. **Table 5.9** shows the results of drinking water analysis.

Table 5.9: Drinking Water Analysis of the Project Area

Sr. No.	PARAMETER	Unit	Results	SEQS
1	pH	-	7.34	6.5 – 8.5
2	Color	TCU	5.00	≤15
3	Odor	-	Odorless	Non
4	Taste	-	Sweet	Non objectionable
5	Turbidity	NTU	3.0	5
6	Hardness Total as $CaCO_3$	mg/l	184.53	<500
7	Total Dissolved Solids (TDS)	mg/l	352.0	1000
8	Aluminum,	mg/L	0.017	≤0.2
9	Antimony	mg/L	<0.005	≤0.005
10	Arsenic	mg/L	<0.005	≤0.05
11	Barium	mg/L	0.047	0.7
12	Boron	mg/L	0.093	0.3
13	Cadmium	mg/L	<0.003	0.01
14	Total Chromium	mg/L	<0.005	≤0.05
15	Copper	mg/L	0.007	2
16	Lead	mg/L	<0.005	≤0.05
17	Manganese	mg/L	0.023	≤0.5

Sr. No.	PARAMETER	Unit	Results	SEQS
18	Nickel	mg/L	<0.005	≤0.02
19	Zinc	mg/L	0.25	5
20	Selenium	mg/L	<0.005	0.01
21	Mercury	mg/L	<0.001	≤0.001
22	Chloride	mg/L	95.24	<250
23	Cyanide	mg/L	<0.01	≤0.5
24	Fluoride	mg/L	0.12	≤1.5
25	Nitrate (NO_3), Nitrogen	mg/L	0.10	<0.50
26	Nitrite(NO_2), Nitrogen	mg/L	<0.003	≤3
27	Total Phenols	mg/L	<0.002	<0.002
28	Temperature at the Field	°C	23.1	-
29	Residual Chlorine	mg/L	<1.00	1.5 at source
30	Chloro Pesticides	µg/L	<1.00	-
31	Total Coliform	CFU/100ml	TNTC	-
32	Fecal Coliform (E.Coli)	CFU/100ml	absent	0

261. The above table reveals that all that parameters are well within the permissible limits of Sindh Environmental Quality Standards. The detailed results are attached as **Annex-I**

5.2.8.4 Wastewater

262. Public sewerage system was observed at some parts of the Study Area in the form of sewerage drains and pipes transferring the domestic sewerage to open and wide drains Sewerage drainage systems in the proposed Project area is very old and it doesn't have ability for storm water drainage. The design capacities of the system, is much lower than required.

263. 251. In order to evaluate the current wastewater condition of the project area, sampling was carried near the ICI interchange in November 2020 by SGS Pakistan. The samples were analyzed by SGS Pakistan for the parameters specified in SEQS, 2016. The detailed wastewater results are given in **Table 5.10.**

Table 5.10: Wastewater Quality Results

Sr. No.	Parameters	SEQS	(ICI Interchange) Concentration (mg/L)	Method / Equipment Used	Remarks
1.	pH	6 – 9	7.3	SMWW 4500H^+B	Within Limits
2.	BOD5 at 20^{o}C	80mg/L	**511**	APHA 5210 D	Exceeding Limits
3.	COD	400 mg/L	**1,480**	APHA 5220 D	Within Limits
4.	TSS	200 mg/L	**238**	APHA 2540 D	Exceeding Limits
5.	TDS	3500 mg/L	**8,252**	APHA 2540 C	Exceeding Limits

Sr. No.	Parameters	SEQS	(ICI Interchange) Concentration (mg/L)	Method / Equipment Used	Remarks
6.	Total Phenols	0.30 mg/L	0.016	APHA 5530 B & C	Within Limits
7.	Grease and Oil	10 mg/L	**74.50**	US. EPA 1664 B	Exceeding Limits
8.	Chloride	1000	**4,013.69**	APHA 4500 CL B	Exceeding Limits
9.	Fluoride	10 mg/L	0.32	APHA 4500 F C	Within Limits
10.	Cyanide	1 mg/L	<0.001	APHA 4500 CN E	Within Limits
11.	An-ionic surfactants (as MBAS)	20 mg/L	0.33	APHA 5540 C	Within Limits
12.	Sulfate (SO4^{2-})	1000	257	APHA 4500 - SO4 C	Within Limits
13.	Sulfide (S^{2-})	1.0 mg/L	<1	APHA 4500 S F	Within Limits
14.	Ammonia (NH3)	40 mg/L	**128.98**	APHA 4500 NH3 B, C	Exceeding Limits
15.	Chlorine (Cl)	1.0 mg/L	<1.00	APHA 4500 CL B	Within Limits
16.	Cadmium (Cd)	0.1 mg/L	<0.003	APHA 3120 B	Within Limits
17.	Chromium (Trivalent and Hexavalent)	1.0 mg/L	<0.005	APHA 3120 B	Within Limits
18.	Copper (Cu)	1.0 mg/L	0.032	APHA 3120 B	Within Limits
19.	Lead (Pb)	0.5 mg/L	<0.005	APHA 3120 B	Within Limits
20.	Mercury (Hg)	0.01 mg/L	<0.001	APHA 3120 B	Within Limits
21.	Selenium (Se)	0.5 mg/L	<0.005	APHA 3120 B	Within Limits
22.	Nickel (Ni)	1.0 mg/L	<0.005	APHA 3120 B	Within Limits
23.	Silver (Ag)	1.0 mg/L	<0.005	APHA 3120 B	Within Limits
24.	Total Toxic Metals	2.0 mg/L	1.8	APHA 3120 B	Within Limits
25.	Zinc (Zn)	5.0 mg/L	0.034	APHA 3120 B	Within Limits
26.	Arsenic (As)	1.0 mg/L	<0.005	APHA 3120 B	Within Limits
27.	Barium (Ba)	1.5 mg/L	0.051	APHA 3120 B	Within Limits
28.	Boron (B)	6.0 mg/L	1.7	APHA 3120 B	Within Limits
29.	Iron (Fe)	8.0 mg/L	4.3	APHA 3120 B	Within Limits
30.	Manganese (Mn)	1.5 mg/L	0.23	APHA 3120 B	Within Limits
31.	Temperature °C	≤3°C	26.2	Thermometer	

264. The laboratory analysis of wastewater shown that some of the values for the parameters such as BOD, COD, TSS, TDS, grease & oil, ammonia are not within prescribed limits of SEQS. It's due to the discharge of industrial effluents into surface water body without treatment.

Figure 5.11 : Waste Water Sampling at the Proposed Location

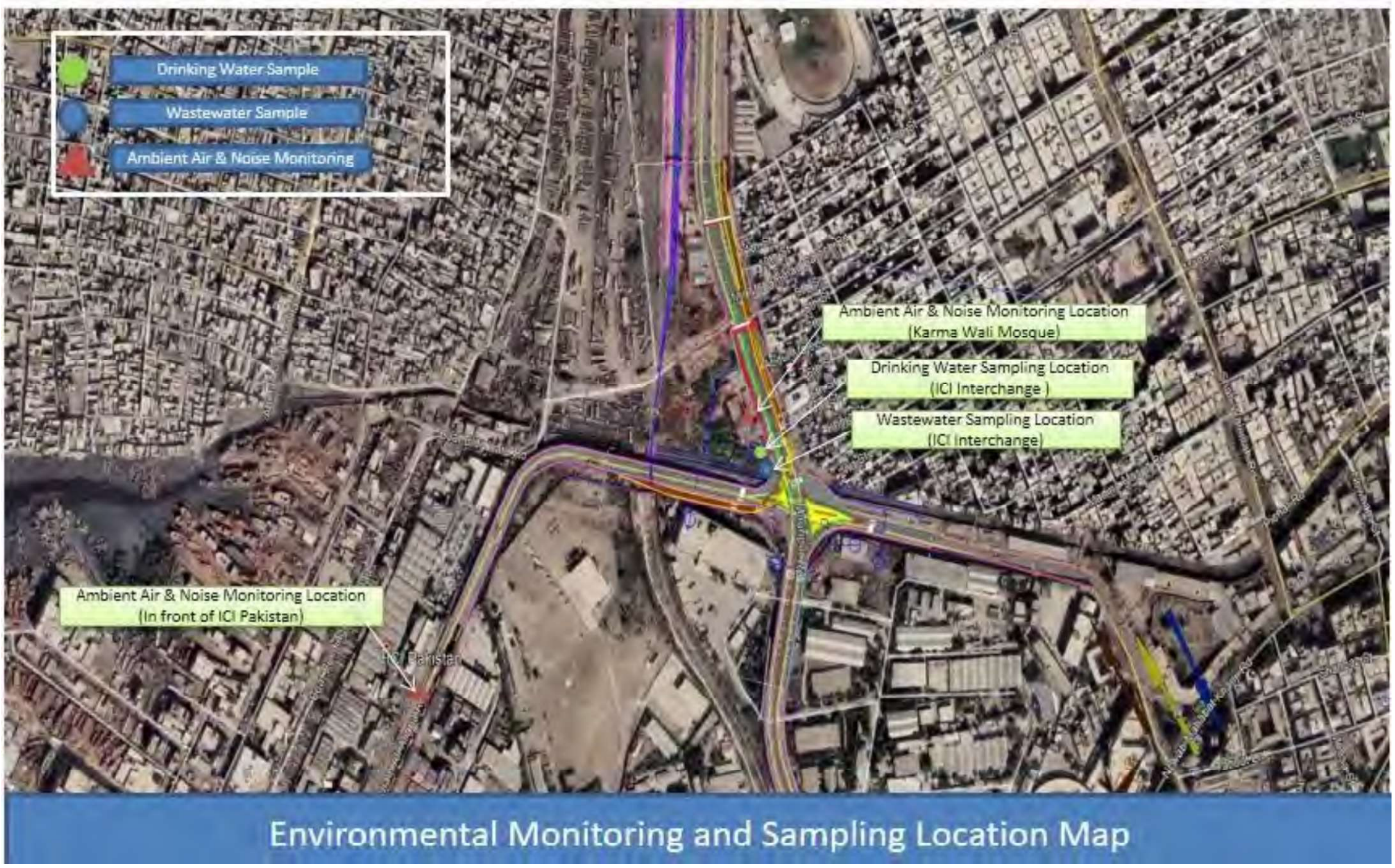


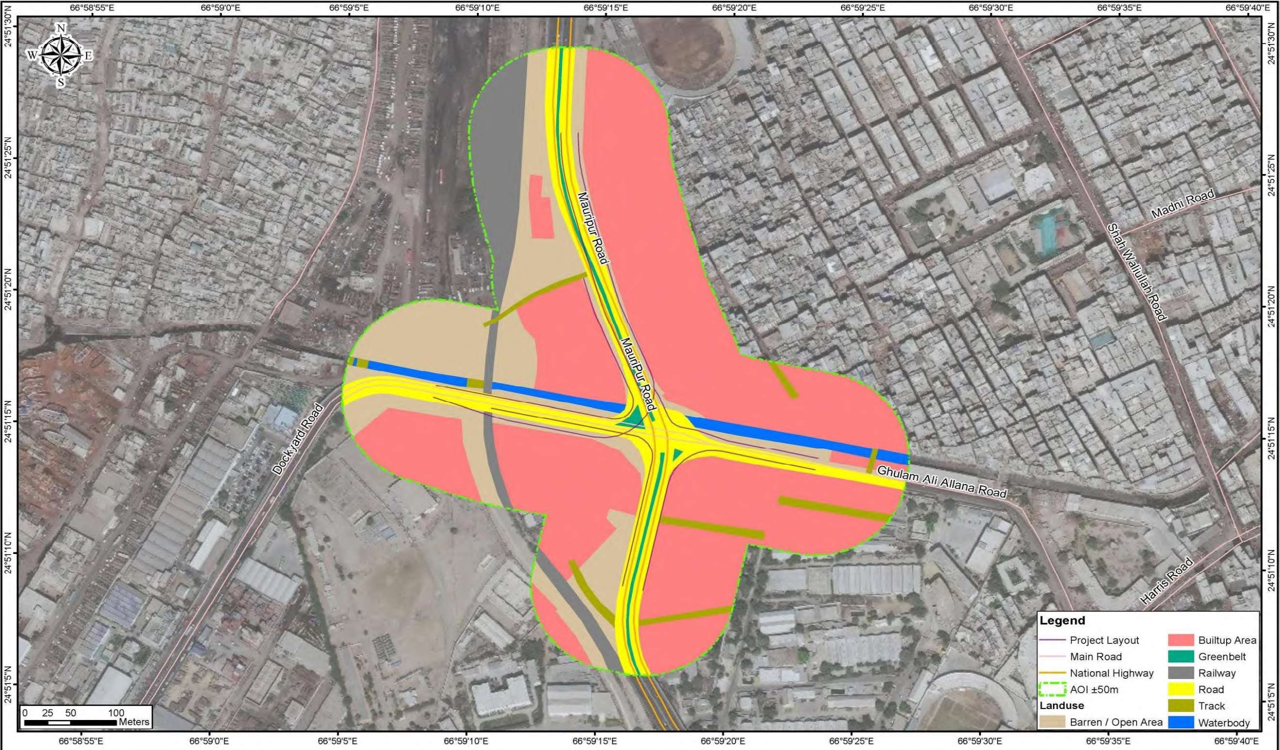
Figure 5.12: Environmental Monitoring and Sampling Location Map

5.2.9 Land Use Pattern

265. The land use of the project area is mainly barren area, water body, built-up area, railway and road including greenbelt. **Table 5.11** shows the details of the Land use of Project route within COI. **Figure 5.13** shows pictorial view of land use. Detailed Land use maps are attached in **Annex-II**

Table 5.11: Summary of Land Use

Sr. No.	Landuse Type	Area (m^2)
1	Barren / Open Area	46,650.7
2	Built-up Area	127,304.6
3	Greenbelt	2,954.4
4	Railway	16,064.9
5	Road	28,822.9
6	Track	5,498.5
7	Water body	5,238.0



CLIENT LOCAL GOVERNMENT & HTP DEPARTMENT GOVERNMENT OF SINDH	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	IMRAN	PROJECT URBAN ROAD INITIATIVES IN KARACHI SUB-PROJECT 3: INTERCHANGE AT ICI BRIDGE	LANDUSE MAP
		03				SUBMITTED			SCALE 1:3,500
		02				RECOMMENDED			DATE OCT, 2020
		01				CHD/VER.	S.BADAR		DRAWING No.
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	M.SHARIQ		REV. 0

Figure 5.13: Map of Land use Map

5.2.10 Environmental Sensitive Receptors

266. The sensitive receptors identified for the proposed project within 50 meter of the alignment are commercial and residential area, religious area, petrol pump, lifesaving institute, Wazir Mansion station etc. They are prone to sensitivity during construction phase, due to emission of air pollutants, noise and vibration, traffic jams, temporary edifice of construction camps, and mobilization issues. A comprehensive map showing environmental sensitive receptors of the project area is given as **Figure 5.16.** Tentative locations of these sensitive receptors are indicated on the maps.

5.2.11 Electricity Supply

267. Karachi Electric Supply Corporation (KESC), now K-Electric, is authorized to supply electricity to all parts of Karachi. However, the present demand for electricity in Karachi is approximately 2,228 megawatts, while there is a shortfall of 600 to 800 megawatts.

5.2.12 Storm Drainage System

268. The storm water drainage of the area has been studied considering the construction of the flyover from the Mauripur Road to existing ICI Bridge.

269. Although the drainage pattern of the area will remain same but for a segment the existing storm water drains will be shifted considering the locations of the bridge with required intake arrangement for rain water so that the efficient drainage can be ensured.

270. Contractor shall ensure the Storm drainage scheme as per existing site conditions and nearby disposal for the works at ICI intersection as well as road rehabilitation works.

Figure 5.14: Drain alongside Intersection

271. Aesthetically, the Proposed Project is not in very good condition. Open dumping of waste was identified; People throw their domestic or other waste on road side which will create nuisance and presents worst condition in rainy days.

5.2.13 Solid Waste

272. Aesthetically, the Proposed Project is not in very good condition. Open dumping of waste was identified; People throw their domestic or other waste on road side which will create nuisance and presents worst condition in rainy days.

273. During site visit of the proposed site some Large and small waste bins beside the road and street of the community area were observed but lack of proper handling is observed local drains of the area were also found chocked with solid waste.

Figure 5.15: Aesthetic condition of the proposed site

5.2.14 Historic and Archeological Features

274. There is no historic or ancient features exist within or along the proposed project site.

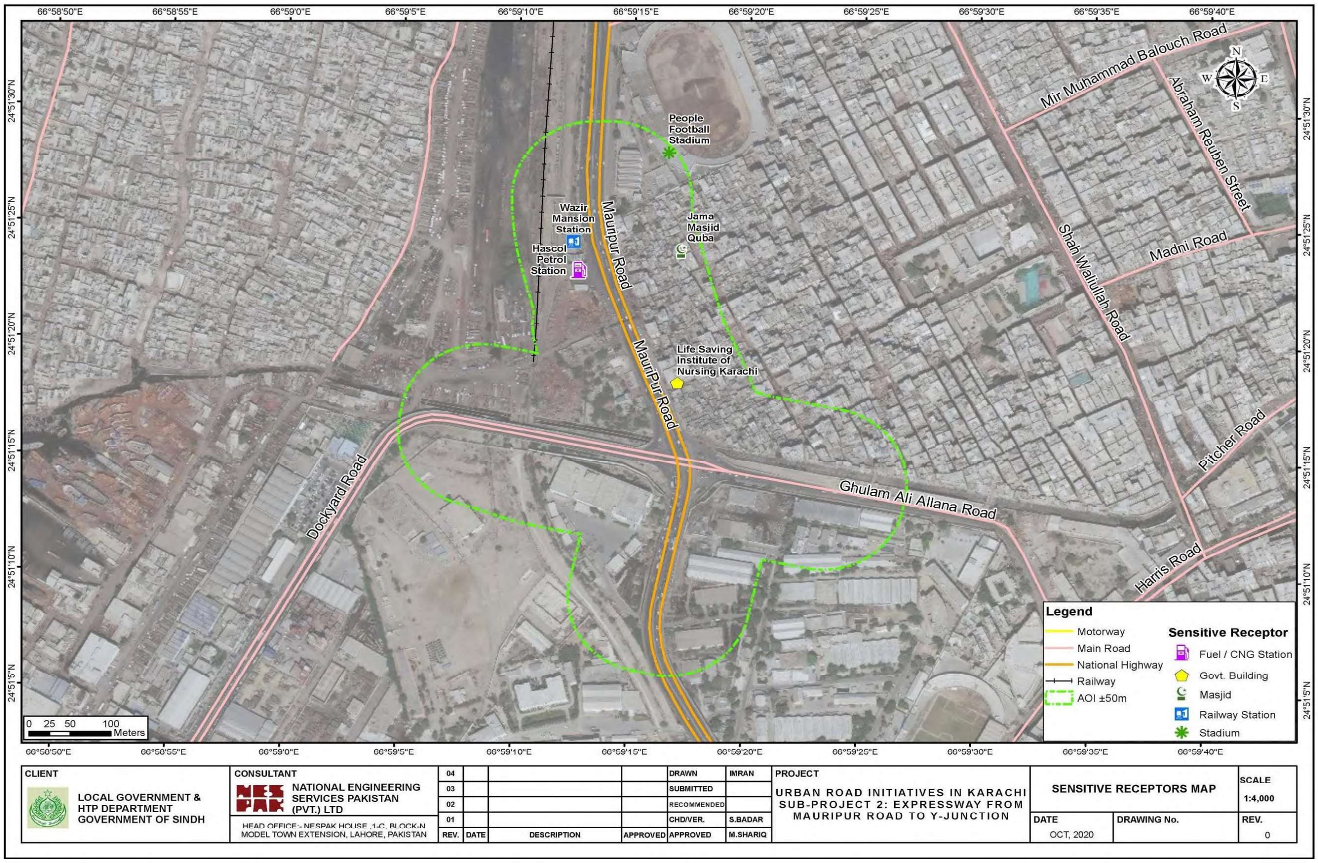


Figure 5.16: Sensitive Receptors Map

5.3 ECOLOGICAL ENVIRONMENT

275. Information regarding the ecological profile of study area was gathered through desk study, reconnaissance and field visit. Consultation with concerned field formations was done to obtain information regarding Flora and Fauna (mammals and birds with migration pattern).

5.3.1 Flora

276. The initial survey result shows that there are approximately 07 small trees/shrubs. The main species are Pipal, Conocarpus and Date Palm etc.

5.3.2 Fauna

277. Proposed project site is located in urban environment, however the faunal species as per available data are mainly of desert or forest origin. A list of reported avifauna and mammals species of the proposed project area is produced below.

5.3.3 Avifauna

278. The avian species, which are quite abundant and common in the proposed project area, include Indian Roller, Green Bee Eater and Indian Myna.

5.3.4 Mammals

279. Land mammals including stray dogs, bats, camels, goats are visitors for purpose of foraging and taking shelter. None of the species recorded is protected, threatened or included in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

5.3.5 Integrated Biodiversity Assessment Tool (IBAT)

280. The Integrated Biodiversity Assessment Tool (IBAT) software was utilized to carry out the initial ecological based screening of the proposed ICI-Bridge project area. The species presence/confirmation with the utilization of various tools including literature review, stakeholders/departmental consultations and random ground trothing was conducted for the authentication of data. Based on the investigations, there are no species of conservation importance, endemic species, endangered, critically endangered etc.

281. IBAT was conducted in the project area. Based on the findings of IBAT Proximity report 1, initially 111 nos. of IUCN red list species were identified at point 1 i.e.(Location: [24.9, 67] Date of analysis: 16 April 2021, Buffers applied: 1 km | 3 km | 5 km). No (0) Protected Area and Key Biodiversity Area were identified within this buffer. However, the initial screening species identified by IBAT are potentially found within 5km of the area of interest.

282. The report of IBAT Proximity is attached as **Annex-III**. As mentioned in the IBAT report, there is however a possibility of incomplete, incorrect or out-of-date information. All findings in this report must be supported by further desktop review, consultation with experts and/or on-the-ground field assessment. Based on this, the presence/confirmation of initially securitized IBAT species were verified/authenticated through various tools including literature review, stakeholders/departmental consultations and random ground trothing. Based on the ground realities and values, the habitats in the study area have been assessed in detail which are as under:

5.3.6 Literature Search

283. The extensive literature and research papers were thoroughly reviewed which majorly deal with the habitat and biodiversity features of the proposed ICI-Bridge project area. Commercial and residential development can impact the connectivity of the landscape, which is important for species persistence and maintaining genetic diversity (Turner 1989), however, wildlife populations can tolerate some fragmentation as long as critical movement corridors are maintained otherwise a single change and alteration can lead to habitat modification (Turner 1989).

284. Trees were cut down mercilessly which lead to deforestation in the city which consequently lead to the spread of many diseases due to pollution. The lack of government's environment friendly policies is the main reason Karachi is under the grip of multifarious pollutions.

285. Deforestation in Karachi has become a slow killer for the crores of residents of the city. It also destroyed the nature and climate of the city. It was the main reason behind land erosion and water erosion. Cutting down trees causes an increase in carbon dioxide in the atmosphere that harms the environment and living creatures like human beings, birds and animals, etc.

286. With such heavy population pressure and consequential heavy demand on natural resource sustaining forests even at current level seems an uphill task as remaining meagre forest resources are insufficient to fulfill the demand for timber fuel wood and Non-Timber, Forest Products (NTFPs) on a sustainable basis. Demographic data suggests that the existing pressure from increases in population will further rise when 76 percent population in less than 25 years (41.6 percent under 15 and 34.5 percent from 16 to 25 years of age) will begin to construct new homes. In view of future planning, housing societies are mushrooming especially in mega cities of Karachi, Lahore, Faisalabad, Rawalpindi, Peshawar, and Islamabad. Due to land hunger and lust for money, many big investors are grabbing forest lands resulting in resource depletion. (FAO- Forest sector review: Pakistan-2019)

287. To record every possible species in the study area, the available literature is collected and reviewed. The literature included published and unpublished reports and books of private and government conservation organizations, Books and brochure from forest and wild life departments, research articles, popular articles and newspapers. Based

on the available literature, a checklist of different species was developed which was confirmed through observing different species during the survey. Most of the reptiles were observed during field visits

5.3.7 Focus Group Discussions (FGDs)

288. FGDs were conducted during the field visits (Nov, 2020) with the stakeholder community members of different ages at different locations of the project area and details of proposed project were shared for better understanding of the project related activities.

289. Interviews with local residents are valuable not only for the survey site selection but also in identifying the potential areas and a good source of primary data about the existing wildlife and flora of the area. This method was very helpful in locating all the study sites. Main focus of the engagements was getting an idea of the local inhabitants regarding ecological/natural resources of the targeted area. The locals of project area shared that non availability of alternative resources in past severely damaged the green cover of the area and no such type of habitats and forest are present. The native wildlife species are mostly disappeared because of human induced activities and climate change.

290. The area is highly commercialized and over populated so, no space for the existence of wildlife is expected. Only few numbers of plants were found on site raised by local inhabitants.

5.3.8 Field Observations

291. The findings of literature review and FGDs were verified during the field observations. The proposed road passing near the residential area mostly near to the habitation along the bridge area. Observations were recorded on the sites during field survey and different ecological aspects were considered for assessing the approximate values different areas. The vegetation cover was found extremely poor and with open canopy cover altered from original conditions. Now the habitats of wild species are found unsuitable.

292. The problem is severe and of the regional nature because of conversion into commercial buildings and residential societies. The ecosystem basic functions of the project area are damaged and not working properly. Based on the above reasons and discussions, the past conditions were totally different. We must look upon all the natural resources as renewable resources. If effectively managed could alleviate the problem not only for the present but also for the future generation.

5.3.9 Site Specific Field Data and Primary Observations

293. Consultant carried out a detailed survey to assess flora and fauna of the URI project area and limits to RoW. Habitat characteristics along with Flora and Fauna diversity

have been observed in detail. Consultant found no legally and ecologically protected/ important sites related to localized habitats and termed the overall area as degraded habitat.

294. The project area is highly commercialized and over populated. There is no space space for habitat improvement in the project area. The area is under severe pressure of commercial and residential buildings.

5.3.10 Departmental Consultations

295. The departmental consultations were carried out as per the methodology adopted. Moreover, the concerned departments delivered the problem that in general, entire ecosystem is under degradation due to over exploitation of natural resources, and other biotic factors. The illicit cutting of trees, damages to soil and wildlife disturbances is common in the region and the concerned departments are trying their best to deal with the law violators and to protect the precious natural resources and which is under biotic pressure and climate change due to which, the wildlife and forests habitats become degraded, fragmented and shrunk. The virginities and originalities of natural conditions are now altered and modified which leads to non-proper functioning of ecosystem.

296. After the consideration of all the above techniques and methodologies, only those IBAT results are part of the report which have been verified by utilizing the above best available resources. By considering the above methods, the species given in the ecological baseline were developed and augmented, only those species are remains part of the report which were verified and authenticated specific to the project area after passing through different reliable stage.

5.4 SOCIO- ECONOMIC CHARACTERISTICS

5.4.1 Objectives of the Socio-economic Baseline Survey

297. Socio-economic baseline survey presents an overview of the socio-economic conditions of project area in general, focusing on the key socio-economic development indicators such as demography, education and health facilities, income, expenditure trends and employment, to provide the context of the area in general. The main objective of the study was to analyze socioeconomic and cultural characteristics of the project beneficiaries in order to understand their interrelationships, dynamics, and qualities. The study also provide information to the project design in order to make the project interventions more effective, socially acceptable, culturally appropriate, gender sensitive and economically viable.

298. One of the key objectives of the study was to plan more sustainable and equitable development through adequate social risk management by identifying and assessing negative and positive impacts caused by a project, to design and implement measures to prevent, reduce or compensate adverse impacts and enhance positive ones.

5.4.2 Information / Data Collection Methodology

299. The methodology adopted for the survey included a detailed desk review of Project documents and relevant secondary information including official records and statistics, as well as academic and other subject matter reports. The secondary source information/data/reports include Detail Design drawings and latest Population Census (2017) of Karachi and possible available data regarding district West of Karachi Division. Similarly, primary source include focus group discussions (FGDs), community consultations, individual interviews and walk through in the Project area, which helped the survey team to physically observe the socio-economic conditions in the project area and data collection. Meetings were held with all stakeholders including the affected community.

300. The sample size for the survey depends on the size of the affected persons in a project. A sample survey of 71 households was undertaken for the socio-economic survey from the possible affected community. Sample of 71 respondents including (males and females) was taken from the different locations depending on the proportion of route of the proposed road passing in the areas on the basis of random sampling technique, which included local residents, shop keepers, pedestrians, drivers, government and private job holders etc. The objective of using the random sampling technique was to get the data of the respondents of different categories along the alignment of the proposed road and covering the entire area. The purpose of this survey was to assess socio-economic condition of the area and get responses about the perceived impacts and preferences towards the project implementation.

301. Although the representative sample size is little low but due to law & order situation in the Karachi it was difficult to have an access to the people who can provide information. Generally, people hesitate to provide information in the urban settings due to security concerns. Even female enumerators were appointed for socioeconomic survey but due to uncertain law & order situation in the city, respondents were reluctant in providing any information. In addition, a complete list of affected private/government structures and public utilities was prepared.

302. The key variables covered in the surveys and qualitative interviews include (i) identification and enumeration of the affected population; (ii) demography, (iii) social organization (iv) education and health facilities, (iv) occupational structures, (v) income and expenses level, (vi) access to social amenities, (vi) personal property, (vii) project's impacts on the local communities (viii) identification of gender impact including priorities and needs of the women. Questionnaire for socio-economic baseline is attached herewith as **Annex-IV**

5.4.3 Areas of Socio-economic Baseline Survey

303. The proposed Flyover will be started from north of ICI Bridge section at Mauripur road and proposed elevated Right Turn merges at ICI Bridge at Railway Crossing, Ghulam Ali Allana Road, District West. Moreover, Road Rehabilitation at Ghulam Ali Allana

Road, Nawab Khanji road, Akber Siddique road & West Wharf road will be carried out which is approximately 1.7 Km. proposed roads are to be rehabilitated, improved and widened for better traffic circulation. To find out the social status of the residents, social survey near the Project Area was carried out at the Mauripur road, Wazir Mansion, Khadda Market, Kemari and Kharadar. **Figure 5.17** and Figure 5.18 show Gender Consultation Map and Public Consultation Map respectively.

5.4.4 Description of the Area

304. The project area is located in Karachi city and profile is discussed as under:

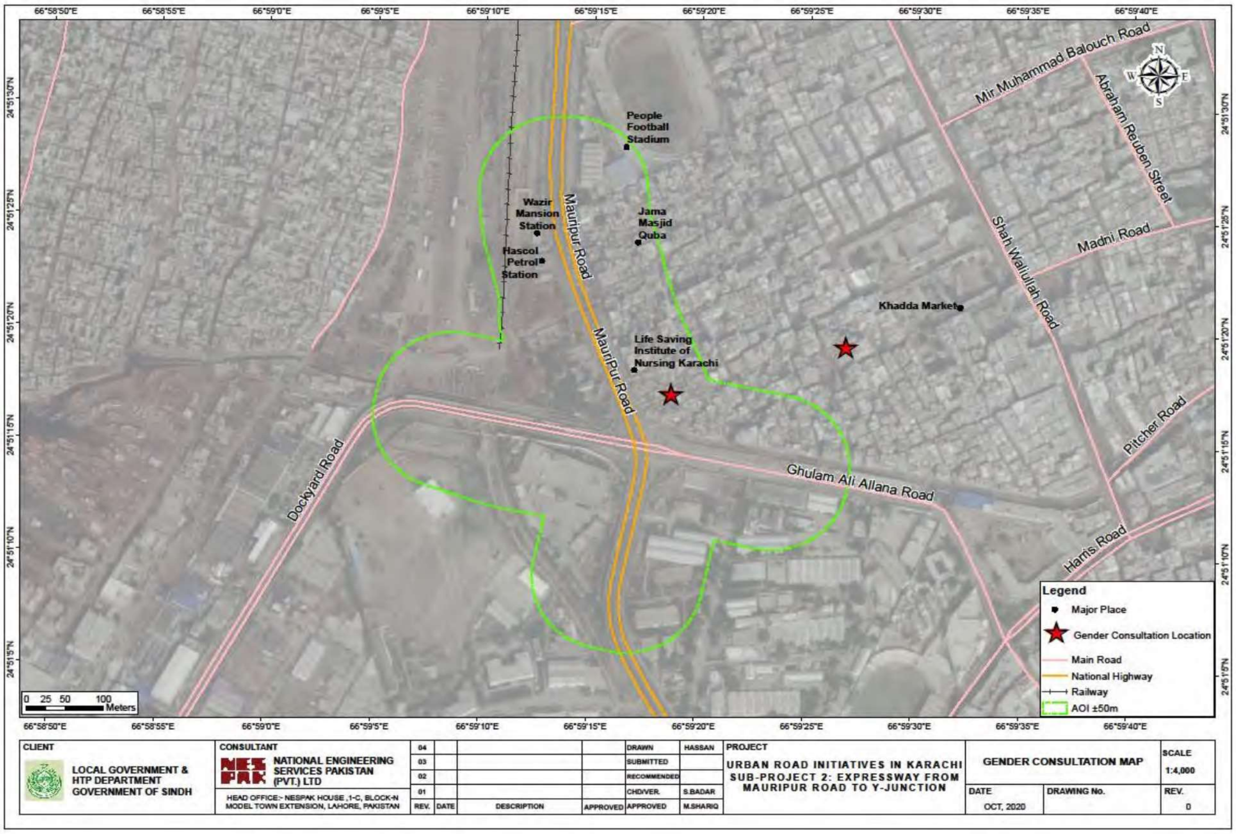


Figure 5.17: Gender Consultation Location Map

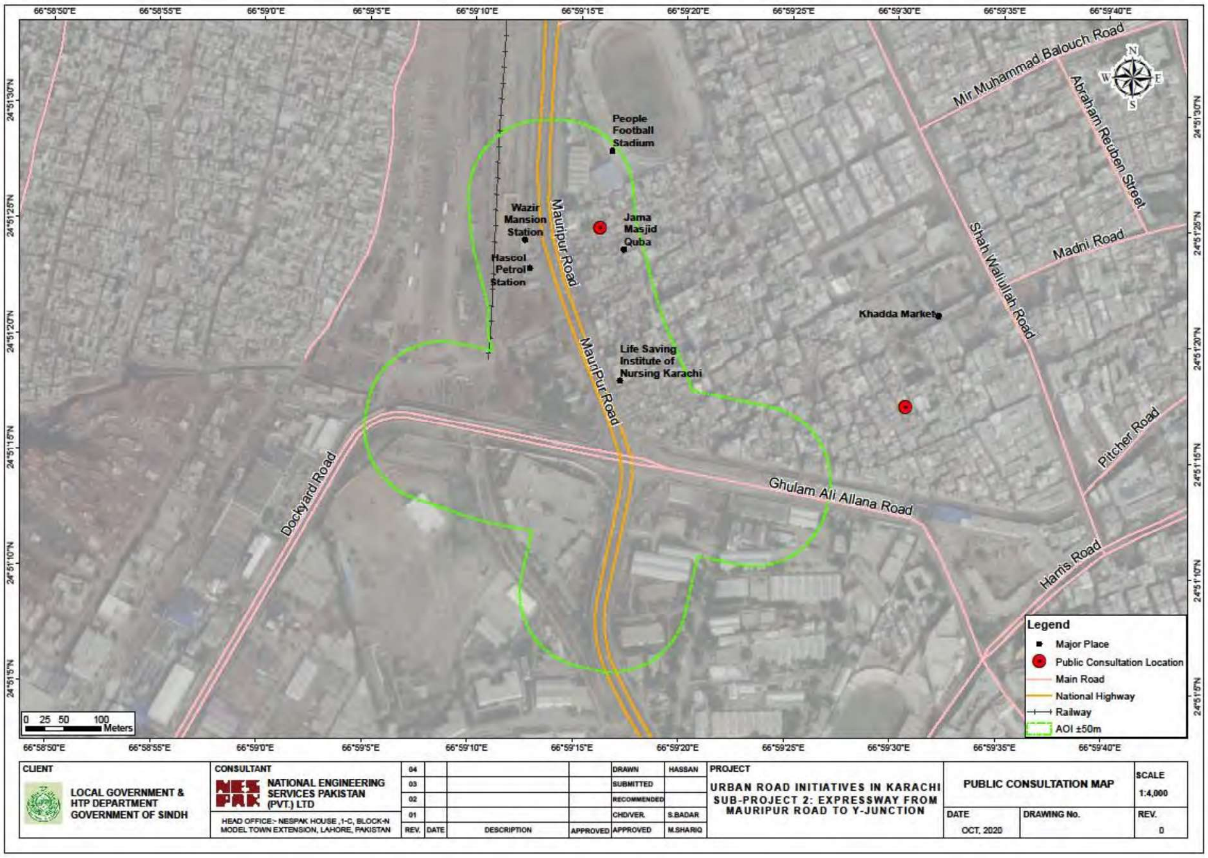


Figure 5.18: Public Consultation Location Map

5.4.5 Political and Administrative Settings

305. The Karachi City District is a three-tiered system comprising the City District Government (CDG), the Town Municipal Administration (TMA) and the Union Administration (UA). There are following seven districts of Karachi;

- South Karachi;
- East Karachi;
- Malir;
- Korangi;
- Central Karachi;
- West Karachi. and
- Keamari

306. The district is managed by the Deputy Commissioner (DC) who is District Magistrate as well as district Collector. As District Magistrate, he is responsible for law & order and other allied matters for whole of the district.

307. Union Council (UC) is the lowest tier of the local government. A union council is an area within a district consisting of one or more revenue estates, one or more census villages or one or more census blocks. Union councils are divided into rural and urban and have been demarcated as such, that the population of within each are equal.

308. Tehsil Council is the next tier of local government. About 4 to 5 UCs fall in the Tehsil Council (TC). Tehsil is a sub-unit of the district, which is the highest tier of the local government system, dealing with the administrative matters at district level.

309. A district is composed of 3 to 5 Tehsil's and is governed by the Deputy Commissioner. Our proposed project falls at Karachi west district. Karachi West District is an administrative district of Karachi Division. It is located in the western part of Karachi. The District was abolished in 2000 and divided into four towns namely Kemari Town, SITE Town, Baldia Town and Orangi Town. On 11th of July 2011 Sindh Government restored again Karachi West District.

5.4.5.1 Population

310. Provisional results of the 2017 census show urban Karachi with a population of 14,910,352 capita, an increase of 58% over the 1998 urban population 9,448,808. Karachi's urban population is divided into seven districts, two of which also contain rural populations.. As per the 2017 census, the population of District West is about 3,914,757.

5.4.5.2 Language

311. Ethnically, the majority of the people who live in district West are Pakhtuns who have settled here from various parts of the country. Apart from Pakhtuns, the other major ethnicities in the area are Punjabis and Seraikis. In line with Pakhtun culture, the family

size is large and women are restricted to their house work. Though a large majority of the inhabitants are Muslims, there are small pockets of Hindu and Christian communities residing in the area. As per findings of socioeconomic survey, Pashto, Sindhi and Urdu are dominant languages of the study area. 7

5.4.5.3 Education

312. There are large number of private as well as govt. schools and madrassahs in the Project Area. In the areas where Pakhtun culture is dominant such as Keamari, a large number of families send their male children to madrassahs either as day or boarding students. Though many adults are not educated beyond primary and secondary levels, a high percentage of the young population are studying in schools, colleges and universities. However, literacy rate is much low in Keamari and Mauripur. Mostly people are poor in these areas they cannot afford children higher level education expenses due to most of the children are not sent to school after primary. While in Kharadar high school is available and education situation is better. However, Keamari and Kharadar areas have several govt. and private sector education institutions. Literacy rate among females in these areas are low, especially in adult females.

313. Training in technical skills is inadequate. Skilled labour consists of drivers, mechanics, water pump attendants who are estimated to be less than 10% total labour force.

5.4.5.4 Health

314. Clean and safe water is one of the major problems being faced by the residents of Kharadar, Mauripur and Kemari. Though the Karachi Water and Sewerage Board's pipelines bring in approximately 580 million gallons of water daily from the Indus river and Hub Dam to Karachi and route the bulk of it through Bin Qasim Town, yet a majority of the areas have not been given water connections and have to depend on brackish ground water and other sources including purchasing water tankers, for drinking as well as domestic purposes. Health problems of the respective area are generally associated with water availability and quality aggravating sanitary conditions due to lack of facilities and reliable water supply. Health facilities are inadequate and sub- standard.

315. To meet the health demands of the people, there are numerous clinics in the area as well as a small number of quacks. However, the Karachi Port Trust Hospital, Dr. Ruth Pfau civil hospital, Benazir Shaheed ANF MATRC and the Dr. Ziauddin Hospital Kemari are the major health facilities in the area that offer all types of medical treatment.

5.4.5.5 Local Economy

316. Though the Project Area is highly dense and has many small unpaved roads, it is highly accessible both for local residents as well as visitors. The area is well connected

---

[7] Socioeconomic survey and community consultations

with the surrounding areas and other Karachi towns through public bus system as well as taxis, rickshaws and motorcycle rickshaws.

317. The majority of the people in the area of Keamari and Mauripur are businessmen, private and govt. job holders, workers in industries etc., can be categorized as low-income earners. Being near the harbor, a large number of people are earning their livelihood by working with the departments and companies working in the harbor environs. While Manora, Baba Bhit and Bhit Shah Area shipping and fishing are the two major industries in the area that employ local people. Many residents of Keamari & Liyari also work in various professions at posh residences, offices and entertainment areas of Clifton and Defense Housing Authority as drivers, gardeners, sweepers, security guards, and house maids. Various local people were also working in the SITE industrial estate in different sectors.

5.4.5.6 Religion

318. As per social survey of the project area, majority people are Muslim, then followed by Christian and Hindu. Other religious groups are also settled in and around the project area include Parsis and Sikhs but at small scale.

5.4.5.7 Mother Language

319. The most commonly spoken language in Karachi and in project area is Urdu,. Other national languages spoken in the project area are Pashto and Sindhi, Punjabi, and Balochi are also being spoken in the area.

5.4.5.8 Ethnicity/Tribes of the Project Area

320. The population of the project area is a mixture of various heterogeneous groups and cultures. The main tribes are Pathan, Syeds, Mohana, Baluchs, Ranghar, Mari, Arain, Qureshi and Sheikh. Many people from Punjab and KPK have settled in the project area.

5.4.5.9 Main Occupation of the Project Area

321. The entire community in the nearby islands Baba Bhit, Bhit Shah and Manora has a fisheries based economy and there is a tendency among the young men to search employment in shipping related services and on passenger /pleasure boats. Many families of Keamari and Liyari are associated with fishing for their livelihood. The contribution of women in earning livelihood is minimal. While at Keamari mostly people are associated with different business. Findings of the Socio-economic baseline Survey.

5.4.6 Findings of the Socio-economic baseline Survey

5.4.6.1 Sex Ratio of the Respondents

322. About 71 respondents, comprising 77% male and 23% female population in the project was contacted to carry out socio-economic and impact assessment survey.

Table 5.12: Sex Ratio of the Respondents

Sex Ratio of the Respondents			
Sr. No.	**Sex Ratio**	**Number**	**Percentage (%)**
1	Male	55	77
2	Female	16	23
Total		**71**	**100**

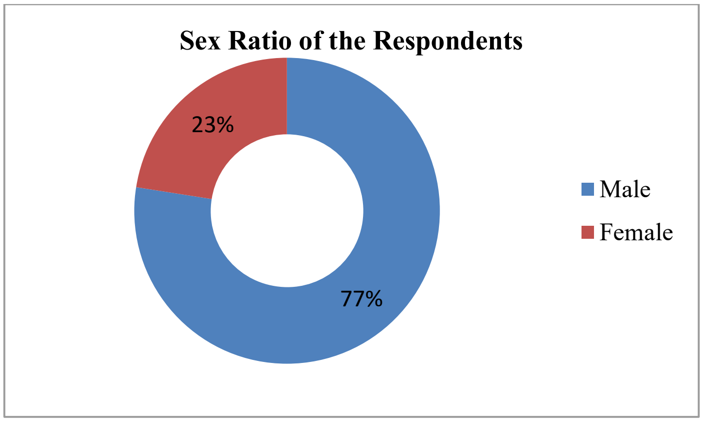


Figure 5.19: Sex Ratio of the Respondents

5.4.6.2 Age Composition

323. The demographic characteristics of the survey show **Table 5.13** that 10% of the respondents were 15 to 25 years of age. About 51% and 21% of the respondents were between the age group of 26 to 35 years and 36 to 45 years respectively. The remaining 18% were bearing up to 46 years of age and above of this age group. These age brackets of the respondents show that by and large respondents were mature enough to express their opinion/concerns about construction of proposed project and foresee its impacts.

Table 5.13: Age Composition of the Respondents

Age Composition of Respondents			
Sr. No.	**Frequency Distribution**	**Number**	**Percentage (%)**
1	15-25	7	10
2	26-35	36	51

Age Composition of Respondents			
Sr. No.	Frequency Distribution	Number	Percentage (%)
3	36-45	15	21
4	Above 45	13	18
Total		**71**	100

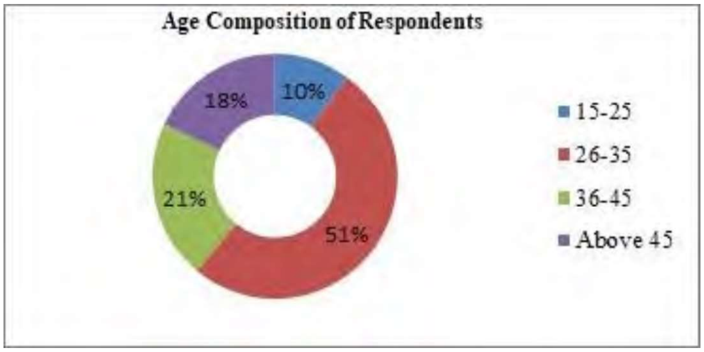


Figure 5.20: Age Composition of the Respondents

5.4.6.3 Educational Status of the Respondents

324. Educational distribution of the respondents is shown in **Table 5.14.** The data in the table presents that 21% of the respondents were illiterate. Moreover, 28% were educated up to primary level, 13% were for each of the middle and matriculate. Whereas, 17% respondents were reported themselves intermediate level. A very small number, i.e., 08% respondents were found graduates and masters and above for each level. The chart representation of educational status of project people is depicted in **Figure 5.21** below:

Table 5.14: Educational Level of the Respondents

Educational Status of the Respondents			
Sr. No.	Educational Status	Number	Percentage (%)
1	Illiterate	15	21
2	Primary	20	28
3	Middle	9	13
4	Metric	9	13
5	Intermediate	12	17
6	Graduation & Above	6	08
Total		**71**	**100**

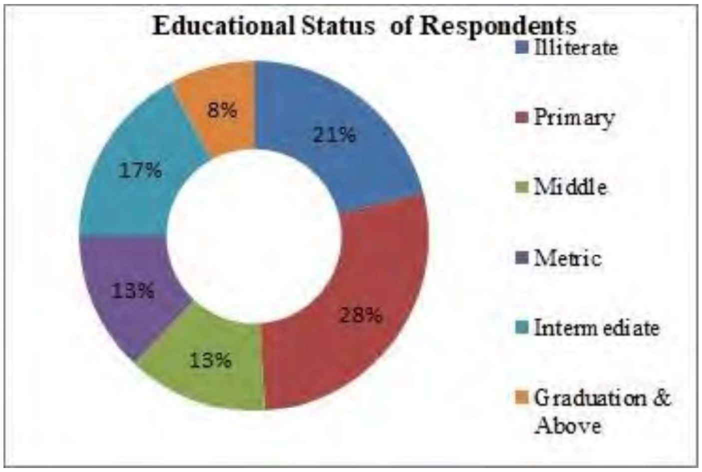


Figure 5.21: Educational Status of the Respondents

5.4.6.4 Occupation of the Respondents

325. Socio-economic condition of the respondents was also studied during the field survey. Majority (32%) of the respondents were running different types of business and shops. 15% were associated with profession of driving, 14% were associated with different types of labour, 18% and 03% were associated with private and government jobs respectively. While, 09% were indulged in fishing as their source of income. Whereas, 09% respondent were associated with different types of professions for their livelihood. The detailed statistics regarding occupational status of the respondents is presented in **Table 5.15** given below. **Figure 5.22** shows the chart view of occupational status of the interviewed people in project area of influence

Table 5.15: Occupation of the Respondents

Professional Status of Respondents			
Sr. No.	**Professional Status**	**Number**	**Percentage (%)**
1	Business / Shopkeeper	23	32
2	Driver	11	15
3	Labour	10	14
4	Private Job	13	18
5	Govt. Job	02	03
6	Fisherman	06	09
7	Any Other	06	09
Total		**71**	**100**

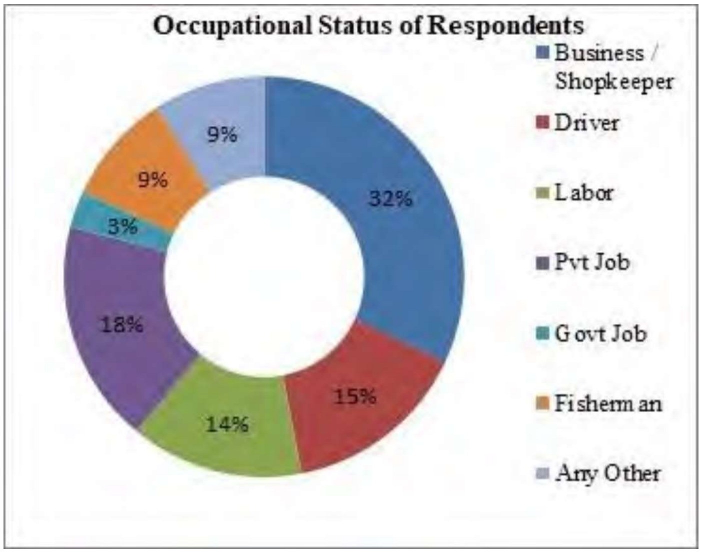


Figure 5.22: Occupational Status of the Respondents

5.4.6.5 Monthly Income of the Respondents

326. Most of the families are comprised of big family size. The young adults of these families are associated with the different professions to earn their livelihood. Many of them are associated with fishing as well as working on hotels and different shops. Due to prevailing trend of joint family system, they become able to earn a handsome amount in the end of month. From the **Table 5.16**, it is clear that 14% of the respondents falls in the low income group up to rupees 17,500. 35% from the range 17,501 – 30,000 rupees, and 27% of the respondents were earning their monthly income between the ranges of 30,001 – 50,000 rupees per month. Whereas, the income ranges of 50,001-75,000 reported by 18% and 06% were earning between 75,001 to 100,000 per month. Income distribution details are given below;

Table 5.16: Average Monthly Income of the Respondents

Sr. No.	Average Monthly Income (Rs.)	Number of Respondent	Percentage
1	Upto 17,500	10	14
2	17,501 – 30,000	25	35
3	30,001 – 50,000	19	27
4	50,001-75,000	13	18
6	75,001-100,000	04	06
7	Above 100,000	0	0
Total		**71**	**100**

327. In the following chart the income groups of various respondents are shown below.

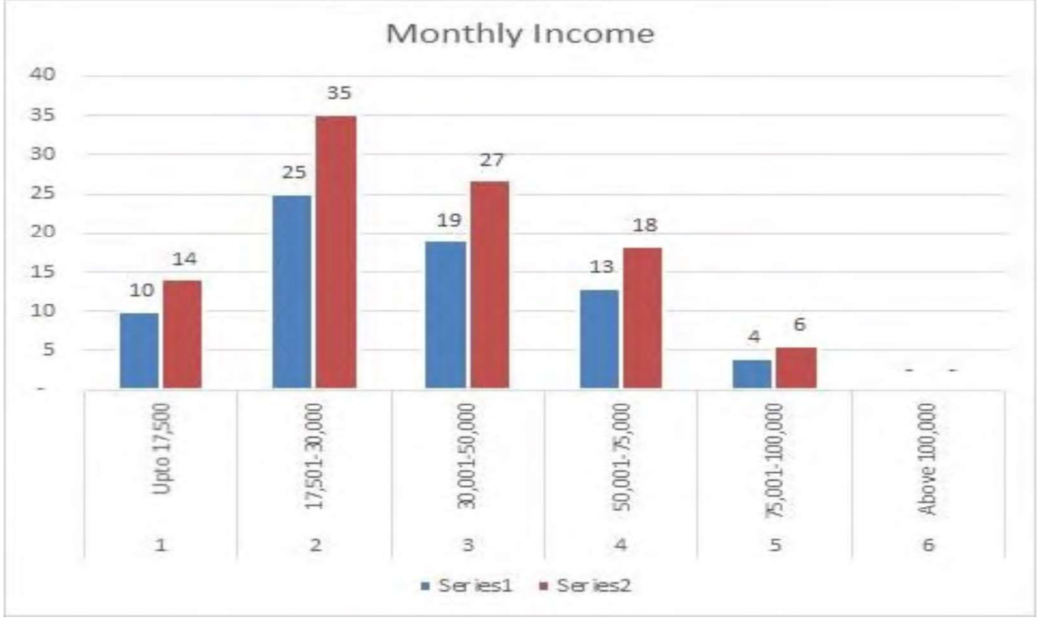


Figure 5.23: Range Monthly Income of the Respondents

5.4.6.6 Expenditure of the Respondents

328. Household expenditure depends on the earning. 8% respondents reported their monthly expenditure up to than 17,500, and 52% respondents found within the range of 17,501 – 30,000 per month. While, 34% fall between the expenditure range of 30,001 – 50,000 and 6% recorded their monthly expenditures between the range of 50,001-75,000 per month. Whereas, 0% were having their expenses more than 100,000 per month. The average monthly expenditures has shown in below **Table 5.17** and **Figure 5.24** below;

Table 5.17: Range of Monthly Expenditures of the Respondents

Sr. No.	Average Monthly Income (Rs.)	Number of Respondent	Percentage
1	Upton 17,500	6	8
2	17,501 – 30,000	35	52
3	30,001 – 50,000	23	34
4	50,001-75,000	5	6
5	75,001-100,000	02	0
6	Above 100,000	0	0
Total		**71**	**100**

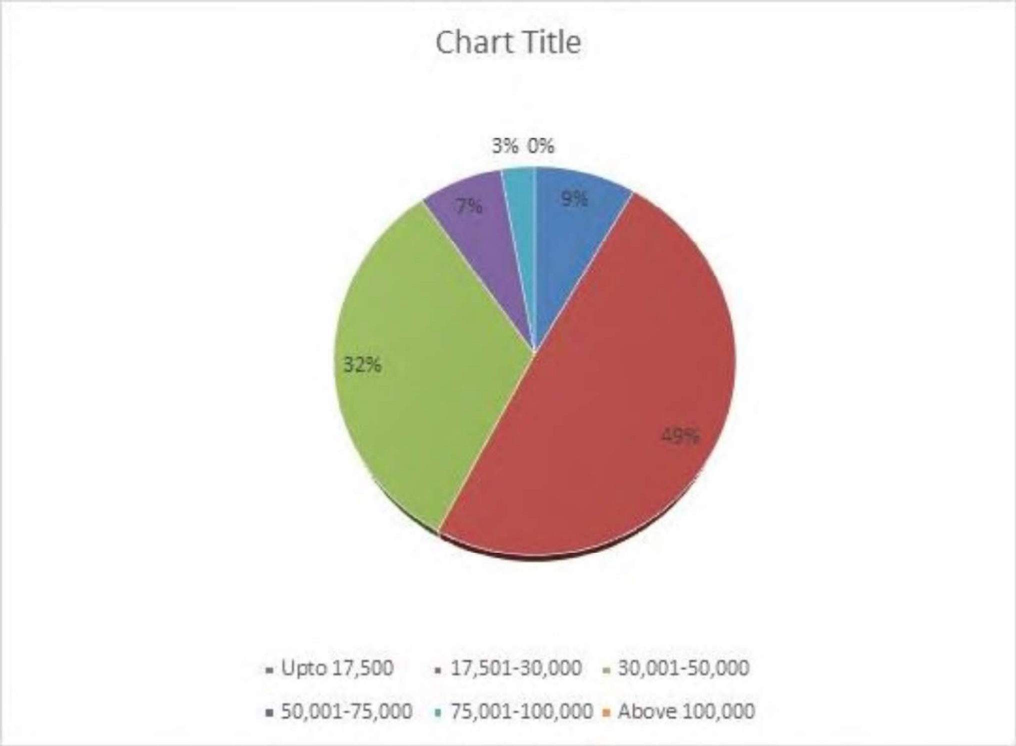


Figure 5.24: Range Monthly Expenditure of the Respondents

5.4.6.7 Ownership Status of the Houses

329. Sampled respondents were asked about their housing ownership status in order to know their level of living standard as reflected in **Table 5.18**. Majority of respondents 68% were living in their own houses whereas, 32% were living in rented houses in the town area.

Table 5.18: Houses Ownership Status

Sr. No.	Type of Ownership of House	Number of Respondent	Percentage
1	Owner	48	68
2	Renter	23	32
Total		**71**	**100**

Figure 5.25: Ownership Status of the Respondents

5.4.6.8 Borrowing Status

330. There are two types of credit sources available to the people, formal and informal. The survey revealed that only 2% sampled household's availed credit from informal sources whereas none of the remaining respondents availed any type of loan facility. The loan was obtained for marriages or to observe other rituals and to meet house hold expenditure. **Table 5.19** shows the barrowing status of the respondents and also depicted in **Figure 5.26.**

Table 5.19: Borrowing Status of the Respondents

Sr. No.	Borrowing Status	Number	Percentage (%)
1	Yes.	3	4
2	No.	68	96
Total		71	100

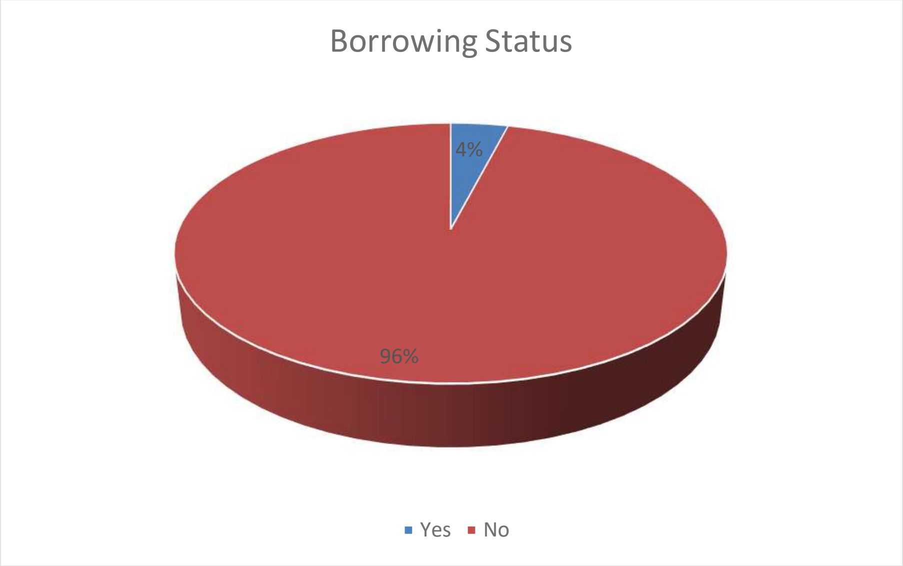


Figure 5.26: Borrowing Status

331. **Table 5.20** describes mode of transport being used by the respondents sampled during social impact assessment survey. About 30% of respondents were using public transport and 70% reported their own private transport. While, the respondents using personal transport, use to go for public transport when they have to travel a far distance area in Karachi city. In this way they were enjoying both mode of transport including public & private for travel purpose. Data also depicted in the **Figure: 5.27.**

Table 5.20: Mode of Transport

Mode of Transport	Number of Respondents	Percentage
Public	21	30
Personal	50	70
Total	**71**	**100**

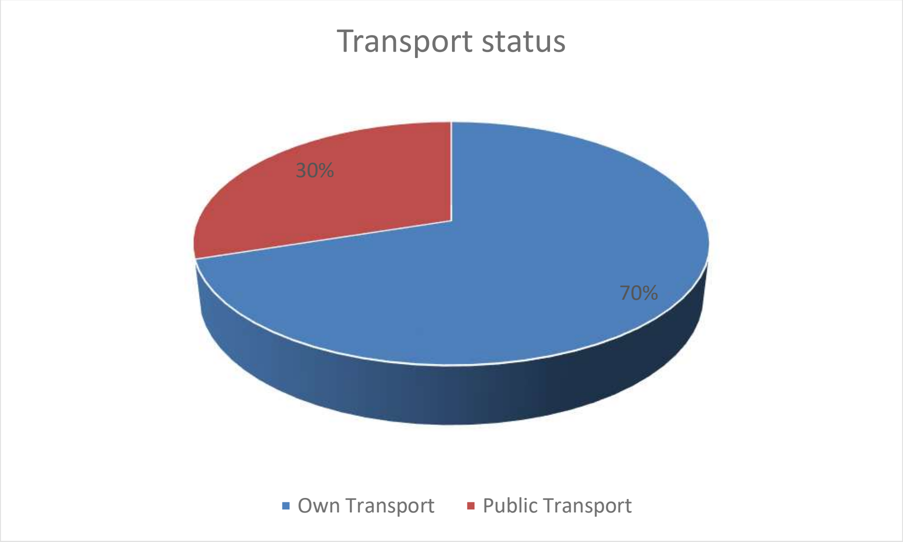


Figure 5.27: Mode of Transport of Households

5.4.6.9 Respondents Access to Social Amenities in the Project Area

332. Social infrastructure and amenities are crucial to creating sustainable communities. This assessment sets spaciousness of a household's dwelling, household amenities like availability of electricity and modern appliances, nature of access to water, fuel for cooking (ease of fetching in what are primarily women's tasks), and type of sanitation facilities available as primary indicators for assessing standard of living.

333. The result of the survey revealed that 100% of the households had electricity facility, water supply was available for the 96% of the sampled households while the health care facilities in shape of dispensaries/hospitals were available to majority 97% of the surveyed population. Rest of the 03% were of the view that they don't have any health facility near their residences and they have to travel some distance to avail health facilities. Providing basic level of education is the responsibility of the government, and facility of school was available in the area to almost 100% of the respondents and facility of mettle road and proper sewerage system mentioned by 100% households. The information in respect of access to social amenities and their quality of services is given in **Table 5.21.**

Table 5.21: Access to Social Amenities in the Project Area

Sr. No.	Facility	Available (%)
1	Electricity	100
2	Water Supply	96
3	Dispensary/hospital	97
4	School	100
5	Mettle Road	100
6	Sewerage	100

Source: field survey

5.4.6.10 Source of Drinking Water in the Project Area

334. Drinking water, also known as potable water or improved drinking water is water safe enough for drinking and food preparation. Access to safe drinking water supply is not only a basic need and a precondition for healthy life, but is also a basic human right. The quality of water is directly linked to the quality of health.

335. Clean and safe water is one of the major problems being faced by the residents of Project area especially in Keamari, Mauripur and Kharadar where there is poor water supply facility is available to the local residents. Although quality of water is not good which comes through water supplies but local people are forced to drink this water as the purchasing of tanker water is a separate task and difficult to achieve due to its price and shortage. People are supposed to purchase water from tankers or by the water purification centers on high rates. The water of supply lines is insufficient and polluted in many of the areas which is not hygienic for drinking purpose. In many of the areas, water normally comes for few hours and not available in sufficient quantity. **Table 5.22** shows the source of water for domestic usage. The findings of the impact study indicate that water supply and purchase of water from water tanker. Details are given below;

Table 5.22: Sources of Drinking Water

Sr. No.	Water Supply Source	Number of Respondent	Percentage
1	Water Supply	65	96
2	Tanker	06	04
Total		**71**	**100**

336. In the pie chart (**Figure 5.28**), sources of domestic water have been shown below:

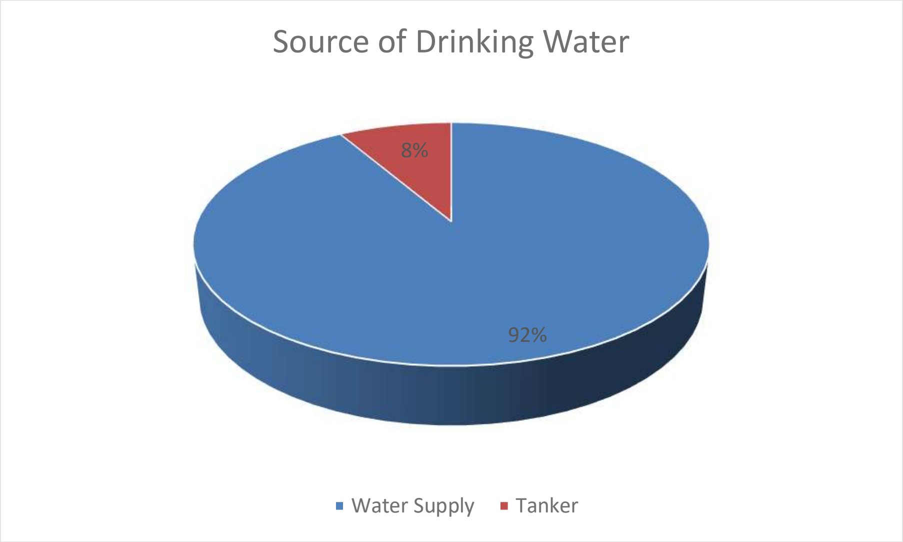


Figure 5.28: Sources of Water Drinking Water in the Project Area

5.4.7 Satisfaction about Quality of Water

337. **Table 5.23** shows the current situation of the water quality in the project area. Many of the respondents 38% were not satisfied with the quality of water available in the project area. While, 62% respondents were happy with the quality of water.

Table 5.23: Satisfaction about Quality of Water

Sr. No.	Satisfaction about Quality of Water	Number of Respondent	Percentage
1	No	34	48
2	Yes	37	52
Total		**71**	**100**

338. In the pie chart (**Figure 5.29**), the satisfaction about quality of water is shown below.

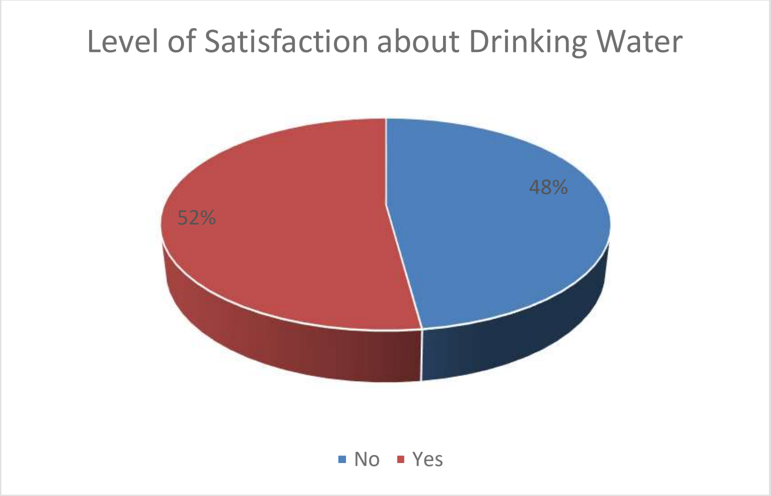


Figure 5.29: Level of Satisfaction with Quality of Water

5.4.8 Summary of Comments and Suggestions of the Respondents

339. Comments and suggestions about the proposed project were asked by the respondents of the socio-economic baseline survey. Respondents pointed out the following concerns and suggestions relating to proposed project activities;

- Most of the respondents showed their consent about the positivity of the project.
- Construction of proposed flyover will resolve the traffic issues and make easy access by avoiding traffic jam.
- Respondents demanded the compensation as per replacement value for the possible affected land and their assets if any;
- Many of the respondent raised their concerns regarding their privacy. They were of the view that due to flyover, their family privacy will be disturbed. In this regard, it was made sure to those respondents that their privacy will be ensured by fixing iron sheets on the sides of the flyover. They were satisfied with the possible solution.
- Local women mobility will be restricted because of construction activities;
- Construction should be done as fast as can be, because, in some emergencies,

women and children will have to go hospitals for health care purposes; even alternate route is required under this condition.
- Dust and noise should manage during construction activities.
- Construction activities must carried out in night to avoid traffic issues.
- Respondents demanded that the supply of public utilities will remain continue during construction phase.

340. The educated youth is jobless, hence jobs should be provided to these male and females during project execution;

5.4.9 Gender Situation

341. The women had no recognized role in the authority structure in the past despite representing of 50% of the population of the project area but the trend is changing now; the literacy rate of female population is 47%.8 The traditional attitude of not sending the girls to school is changing now, because the parents realized and understand that the basic education is necessary for each individual without the discrimination of sex. Most of the women stay home and only travel outside in case of going to relatives and weddings and to hospitals.

342. Local women pointed out the following major issues relating to this project activities;

- Local women mobility will be restricted because of construction activities in populated areas;
- Construction should be done as fast as can be because, in some emergencies, women and children will have to go hospitals for health care purposes; even alternate route is required under this condition.
- Women demanded the improvement in available health facilities in the local hospitals.
- Women demanded for the upgradation of educational facilities in local schools.
- Drinking water is not safe and insufficient. Women demanded for the improvement in quality and quantity of the drinking water.
- The educated women are jobless, hence jobs should be provided to these women during project execution if possible;
- Numerous women are doing the embroidery work for domestic use; their skill should be enhanced through providing training and setting up of the skill development centers in the project area.

5.4.10 Women Participation Level

343. The women participation in different activities was assessed as part of socioeconomic survey. The views of the females were obtained so that the true feelings can be captured for the project implementation. The participation level is discussed as in **Table 5.24.**

---

[8] https://www.statista.com/statistics/572781/literacy-rate-in-pakistan/

Table 5.24: Women Participation in the Various Activities

Sr. No.	Activities	Physical Participation Level
1	Household	92%
2	Child caring	98%
3	Business Activities	01%
4	Employment	02%
5	Sale & Purchase of properties	15%
6	Social obligations (marriage, birthday& other functions)	88%
7	Local representation (councilor/political gathering)	38%

Source: Field Survey

344. The **Table 5.24** above reveals the women participating in the daily life activities however; their participation level was varied in various activities. The women participation was 92% in the household activities and 98% for child caring. Very few females were associated in earning activities like only 01% & 02% were earning thorough business and jobs respectively. Only 15% were of the view that they were asked in matters like sale and purchase of properties by their male family members. 88% women participants revealed that they celebrate and participate in social obligations with great enthusiasm. Moreover, 38% of the participants told that they participate in political gatherings etc.

5.4.11 Women Issues:

345. The women of the project area reported the following issues during the survey which are prioritized as under;

i. Availability of Sui Gas facility
ii. More income generating opportunities
iii. Establishment of skill development center
iv. Access to better medical treatment facilities
v. Access to improved education facilities in native schools
vi. Availability of improved and quality potable water
vii. Good transport services for local community

6 STAKEHOLDER CONSULTATION

6.1 GENERAL

346. Stakeholder's involvement, especially the local population is an important feature of the environmental assessment and can lead to a better and more acceptable decision-making regarding the project design and implementation. Public involvement, undertaken in a positive manner and supported by a real desire to use the information gained to improve the Project design, will lead to better outcomes and lay the basis for on-going positive relationships between the stakeholders. It gives the feeling of an ownership to the local population. Public involvement is necessary for smooth implementation of the project and especially the local community whose support is required for the success of the project.

347. Given the dimension and nature of the project, the proposed project management and implementation authorities are committed for undertaking public consultation at all the relevant departments as a part of project planning/design.

6.2 OBJECTIVES

348. The objectives of consultation were to:

- Inform the stakeholders about the proposed project;
- Provide an opportunity to those who remained unable to present their views and values, thus allowing more sensitive consideration of mitigation measures and trade-offs;
- Provide those involved with planning, the proposal with an opportunity to ensure that the benefits of the proposal are maximized and that any major impact has not been overlooked;
- Provide an opportunity for the public to influence the project design in a positive manner;
- Increase public confidence in front of proponent, reviewers and decision makers;
- Provide better transparency and accountability in decision making;
- Reduce conflict through the early identification of contentious issues, and working through these to find acceptable solutions; and
- Create a sense of ownership of the proposal in the minds of the stakeholders.

6.3 STAKEHOLDER IDENTIFICATION

349. Identification of stakeholder is an important step which ensures that all stakeholders are identified in the Project. The Project identified different types of stakeholders i.e. classified as primary and secondary stakeholders.

350. Primary stakeholders are those who are directly concerned with the Project or directly affected due to the proposed project activities. The primary stakeholders of the Project include all the Project AFs/Aps and Government/Private departments being affected by

project activities such as the areas of ICI Intersection and General public travelled through the area. Under the proposed Project, public and stakeholder consultations with the locals carried out in the above mentioned nearby areas and departments.

351. Secondary stakeholders are those influenced by the firm's operations but not directly engaged in transactions with the firm and consequently not essential for its survival. Examples of secondary stakeholders are local communities and local business support groups[9]. It means Secondary stakeholders are people or groups that are indirectly affected from the project activities and they have no direct concern with the project such as in this project, Health department, local NGOs etc.

352. Considering the importance of the project, consultations were carried out at all the important relevant departments. Consultation is an on-going process which continues during the project life cycle and even after the submission of Environmental Assessment. Therefore, four-tier approach was adopted. Stakeholders were identified, categorized and consulted at government level departments, and community level.

353. Consultations with the relevant departments were carried out through meetings and presentations while consultations with local communities and directly affected people, etc. were undertaken during the baseline survey of the Study Area. Consultations were held with the following departments as listed in **Table 6.1.**

Table 6.1: List of Major Stakeholders

Sr. No.	Agency / Department / Stakeholder
1	Public Private Partnership (PPP) Unit
2	Client/ Local Government & HTP Department, GoS
3	Sindh Environmental Protection Agency (SEPA)
4	Works & Services Department, GoS
5	Irrigation Department, GoS
6	Culture & Antiquities Department
7	National Transmission & Dispatch Company (NTDC)
8	World Wild Life Fund (WWF) Pakistan, Karachi
9	Parks & Horticulture KMC
10	Conservator Wildlife
11	Sui Southern Gas Company (SSGC)
12	Conservator of Social Forestry
13	KW&SB
14	Pakistan Navy
15	Local Community
16	Road Users
17	Traffic Police Karachi

---

[9] https://www.britannica.com/topic/stakeholder#:~:text=Secondary%20stakeholders%20are%20those%20influenced,and%20local%20business%20support%20groups.

Sr. No.	Agency / Department / Stakeholder
18	Project Management, NESPAK Karachi Office
19	Karachi Port Trust
20	Karachi Electric (KE)

6.4 CONCERNS/FEEDBACK

354. Feedback received during public/stakeholder consultations includes both project related concerns and other/general concerns.

355. Project related concerns/issues and suggestions of the people are related to their willingness and acceptability of the project, livelihood, drinking water supply & sewerage, health facilities, road infrastructures, education and women health issues. Brief Introduction about the proposed project, its various components, positive and negative impacts and other technical details related to the environment, social and economic considerations were provided before the consultation to stakeholders.

356. Details of the officials contacted are given in **Table 6.2.**

Table 6.2: Schedule of Meetings with Stakeholders and their Concerns / Apprehensions

Sr. No	Agency / Department / Stakeholder	Representative's Details	Date	Apprehensions/Suggestion
1	**PPP Unit**	Mr. Sajjad Gilal Director Technical	19-10-2020	Consultation regarding required document was held with Mr. Sajjad and required documents were provided by the concerned official.
2	**Client/ Local Government Department**	Syed Mohammad Taha Special Secretary (Tech)/PD (URI) '0300-9232470, (021) 99230658 Pictorial view see Plate:1	26-10-2020	Consultation regarding EIA of Urban Road Initiative (URI) Project were held with Mr. Muhammad Taha. Mr. Taha brief advantages of initiatives of the Project as after the implementation of all three sub-Projects neighborhood along the route will be benefited and congestion of traffic will be reduced.
3	**Works & Services Department GoS**	Mr. Ghulam Haider Assistant Chief Development (Not allowed for picture)	26-10-2020	After the project brief, Mr. Ghulam Haider was satisfied with the project benefits and considered it as a good step for the development of proposed project area.

Sr. No	Agency / Department / Stakeholder	Representative's Details	Date	Apprehensions/Suggestion
		Ms. Shama Parveen Assistant Chief Development (Not allowed for picture)	26-10-2020	After the project brief, Ms. Shama Parveen was satisfied with the project benefits and considered it as a good step for the development of the proposed project area.
		Mr. S.M Khalid Huda Chief Development '021-99212953 (Not allowed for picture)	26-10-2020	After the project brief, Mr. Khalid Huda was satisfied with the project benefits and considered it as a good step for the development of Proposed project area.
4	**Agriculture, Supply & Prices Department GoS**	Engr. Shakil Ahmed Rahimoon Add secretary (Tech)	27-10-2020	After the project brief, Mr. Shakil Ahmed ensured to forward the letter to field office for their
		'0333-2524601 Pictorial view see Plate:04		Comments and will let us know. He asked to draft additional letter to Secretary Agriculture, Supply & Prices Department GoS.
5	**Irrigation Department**	Mr. Jamaluddin Mangan Special secretary (Tech) Pictorial view see Plate:05	27-10-2020	Mr Jamal shared his concerns that ownership of Lyari and Malir Rivers are out of irrigation department jurisdiction. He suggested regarding design that it should be such that it create less hindrance in water way of the river. Plan should be of 200 years flood data. Reimbursement must be at least 5 times.
		Mr.Fahad Ali Jagrani S.O '0333-7578749 Pictorial view see Plate:07	27-10-2020	After the project brief, Mr. Fahad Jagrani was satisfied with the project benefits and considered it as a good step for the development of the proposed project area.
6	**Culture & Antiquity Department**	Mr. Ashfaq Ahmed Patoly S.O '0336-3119904 Pictorial view see Plate:06	27-10-2020	After the project brief, Mr. Ashfaq Pathology was satisfied with the project benefits and considered it as a good step for the development of the proposed project area.
7	**NTDC**	Mr. Nek Muhammad Executive Engineer '0333-57402578 (Not allowed for picture	28-10-2020	After the project brief, Mr.Nek Muhammad was satisfied with the project benefits and considered it as a good step for the development of the proposed project area.

Sr. No	Agency / Department / Stakeholder	Representative's Details	Date	Apprehensions/Suggestion
8	**World Wild Life Fund (WWF) Karachi**	Mr. Salvador Furnandus Office Manager 021-34544791-2 Pictorial view see Plate:02	29-10-2020	After the project brief, it was requested to share the information with relevant person for apprehensions/suggestions.
9	**Shehri**	Ms. Amber Ali Bhai General secretary 021-34530346, 0300-8209296 (Not allowed for picture)	29-10-2020	URI sub-projects were briefed and Madam Amber Ali showed her concerns to consider all the sensitive areas of all three URI projects
10	**Parks & horticulture KMC**	Mr.Junaid Ullah khan Director Parks.Khi,KMC '021-99204300 Pictorial view see Plate:03	29-10-2020	He has concerns regarding widening of bridge for ICI Interchange Project as there are encroachment and very less space for widening.
		Mr. Mohammad Azad Khan PA to DG parks '021-99204301 Pictorial view see Plate:03	29-10-2020	After the project brief, Mr. Mohammad Azad Khan was satisfied with the project benefits and considered it as a good step for the development of the Proposed project area.
		Ms. Mehreena Khatoon Finance Secretary '021-99204302 Pictorial view see Plate:03	29-10-2020	After the project brief, Ms. Mehreena Khatoon was satisfied with the project benefits and considered it as a good step for the development of the proposed project area.
11	**Conservation Wildlife Sindh**	Mr. Javed Ahmed Maher Sindh Wildlife Department (SWD) conservator'021-99204951 Pictorial view see Plate:02	29-10-2020	After the Project brief, Mr. Javed was satisfied with the Project benefits and considered it as a good step for the development of the proposed Project area. But he asked to take permission from all the authorities along the route as per act 2020 sec9. Act 2020 sec# 9 should be followed and permission is required. Chapter III section 9(1) Protected areas.
12	**DHO South**	Mr. Raj Kumar DHO South '0333-2265399 Pictorial view see Plate:13	29-10-2021	After the project brief, Mr. Raj Kumar was satisfied with the project benefits and Mr. Raj Kumar informed that there are four hospitals in his jurisdiction that are JPMC, civil, Indus hospital. Malaria, typhoid and dengue are the

Sr. No	Agency / Department / Stakeholder	Representative's Details	Date	Apprehensions/Suggestion
				common dieses prevail in the area among the people
		Mr. Mohammad Hanif Baloch Office Superintendent '0333-2115315 Pictorial view see Plate:14	29-10-2020	After the project brief, Mr. Mohammad Hanif was satisfied with the project benefits and considered it as a good step for the development of the proposed project area.
13	**SSGC**	Mr. Azeem Khan General Manager P&D '021-99021000 Pictorial view see Plate:10	3/11/2020	After the project brief, Mr. Azeem Khan was satisfied with the project benefits and considered it as a good step for the development of the proposed project area. He informed that services are present on intersection. Utility relocation plan will be shared with the design team.
14	**Conservator of Forest Mangroves**	Mr.Shehzad Sadiq Gill Divisional Forest officer '021-34400236 Pictorial view see Plate:11	3/11/2020	After the Project brief, Mr. Shehzad was satisfied with the Project benefits and considered it as a good step for the development of the proposed Project area. Parent department should approach and submit assessment report to forest department. Approx. 4500 $ /hector is the compensation cost for mangrove replantation, wood value will be evaluated on assessment report, environmental cost is the cost of compensation.
15	**Conservator of Social Forestry**	Mr. Sikander Ali Superintendent Conservator Forest Pictorial view see Plate:09	3/11/2020	Provision of planning is there on both side of malir river but after joint survey it will be evaluated correctly.
16	**KW&SB**	Mr. Mohammad Hanif Baloch Project Director '0306-3310750 Pictorial view see Plate:12	3/11/2020	After the project brief, Mr. Mohammad Hanif Baloch was satisfied with the projects benefits and considered it as a good step for the development of the proposed project area.
		Mr. Muktiar Ali Samtio Project Engineer (Not allowed for picture)	3/11/2020	After the project brief, Mr. Muktiar Ali was satisfied with the project benefits and considered it as a good step

Sr. No	Agency / Department / Stakeholder	Representative's Details	Date	Apprehensions/Suggestion
				for the development of the proposed project area.
17	**SEPA**	Ms. Farzana Naseem Assistant Director (tech) 0345-2625642 (Not allowed for picture)	5/11/2020	After the Project brief Ms. Farzana Naseem showed her concerns regarding flooding and suggested that embankments should be high enough to cater any worst scenario of flooding as catchment area will get narrow. She instructed it should be assured in design that all IFC guidelines have being followed, Environmental Monitoring at all environmental 6-7sensitive areas should be considered. NOC of all utility owner should be attached along with EIA report.
18	**Karachi Fisheries**	Dr. Aslam Jarwar Director Fisheries Sindh (Marine) Cell: 0300-2729587 Tell:021-99245221 Pictorial view see Plate:08	5/11/2020	After the Project brief, Mr. Asfand Jawar was satisfied with the Project benefits and considered it as a good step for the development of the proposed Project area as they suffer traffic congestion on Mauripur road due to traffic load. He also ensured to forward the letter to field office for their comments and will let us know and requested to draft additional letter to Secretary Fisheries. Mr. Asfand also suggested that all port activities should be routed outside of city area so that load on city traffic can be minimized, Further, he shared his concerns that before wastewater disposal to sea, it should be treated so that it may contribute less pollution to sea environment.

Sr. No	Agency / Department / Stakeholder	Representative's Details	Date	Apprehensions/Suggestion
17	**Local Community**	Pictorial view see Plate:15 &17	12,13/11/2020	Local community was briefed about the proposed Project during consultation and socio economic baseline interviews. Complete Project features and anticipated positive and negative impacts were discussed with the local residents and business operators. Participants discussed their concerns regarding possible difficulties which they may face during construction period. Their concerns were recorded and they were briefed that every possible protective measure will be taken to protect their interests. Participants were satisfied with the briefing as well as with the proposed Project.
18	**Road Users**	Pedestrian, transporters and drivers, commuters	12,13/11/2020	Pedestrian, transporters and commuters are important stakeholders of the proposed Project. They were also consulted at the site of proposed Project. They were briefed about the proposed Project during consultation and socio economics baseline interviews. These particular stakeholders demanded for the alternate traffic plans during construction period so that they can easily travel in the city. They were briefed that their concerns will be addressed well before starting of the construction. They were of the view that this proposed road will be helpful in reducing traffic burden on roads.

Sr. No	Agency / Department / Stakeholder	Representative's Details	Date	Apprehensions/Suggestion
19	**Traffic Police, Karachi**	Various traffic wardens	12,13/11/2020	Briefed about the proposed Project and they mentioned about traffic congestion issues at Mauripur Road. There must be an alternative route for smooth traffic flow and also ensured the alternate route for commuter during construction of proposed Project.
20	**Project Management, NESPAK Karachi Office**	Mr. Rehan Zamin, Mr. Ali Jawed	9/11/2020	Detailed discussion session was held on the preliminary design of the proposed project to understand project components.
21	**Pakistan Navy**	Commodore Syed Uzair Jilani (SI)M Area Commodore NSSD Area West Wharf Karachi Pictorial view see Plate:18	05-03-2021	Detailed discussion session was held on the preliminary design of the proposed project. Drawings of proposed project were shared with them for their review and issuance of NOC. During the meeting, they showed their concern regarding the privacy for its areas along the project. It was briefed that a 2 m high visual/sound barrier is proposed on top of 1 m high edge barrier.
23	**PSF**	Mr. Irfan Hashmi Environment Specialist Mr. Shahzad Hasan Rizvi Social Development Specialist	19-03-2021	Projects (URI 1,2&3) modalities were discussed along with the draft EIA report of the URI subpeoject-2. It was suggested that remaining two EIA reports of URI subprojects 1&3 need to be strengthened specially with respect to mangroves, biodiversity impacts and further revised In the light of review meeting decisions. For biodiversity assessment, IBAT software findings need to be incorporated in the EIA reports.

Sr. No	Agency / Department / Stakeholder	Representative's Details	Date	Apprehensions/Suggestion
24	**Karachi Port Trust (KPT)**	1) Mr.Nadir Mumtaz Warraich Chairman KPT 2) Mr.Raghib-Ul-Khair General Manager (P&D) KPT Pictorial view see Plate:18	19-03-2021	Detailed discussion session was held on the preliminary design of the proposed project, drawings of proposed project were shared with them for their review and issuance of NOC. During the meeting Chairman KPT suggested to allow unrestricted right turn movement from West Wharf to Jinnah Bridge till the time decision on KPT's road connectivity project is made.it was assured by the design team, that the same will be incorporated in design and layout plan of proposed project.

6.5 COMMUNITY CONSULTATION AND PARTICIPATION PROCESS

357. For ascertaining the perceptions of different stakeholders about the project (during/ after construction) meetings were held within the project area of influence. These meetings were held in an open atmosphere, in which participants expressed their views freely. Informal group discussions were also held as an additional tool for the assessment of the perceptions of the stakeholders about the project and potential impacts both positive and adverse likely to occur due to its implementation.

6.5.1 Methods of Public Consultation

358. The following methods were used for public consultation with project stakeholders in order to ascertain their stakes regarding project implementation. The views of the beneficiaries were formally recorded. The respondents were selected randomly residing or working in the COI of the proposed route of the proposed project.

- Informal Group Meetings
- Individual meetings
- Gender Consultations

359. The detail of the locations with number of participations is provided in the **Table 6.3.**

Table 6.3: Stakeholders Contacted in the Town

Sr. No.	Town	District	Participants
1	Wazir Mansion near Karman Wali Masjid	West	15
2	Khadda Market, Liyari	West	18

6.5.2 Categories of Stakeholders Contacted

360. Different categories of stakeholders contacted, during consultation is shown in the **Table 6.4.**

Table 6.4: Stakeholders Contacted in the Project Area

Sr. No.	Stakeholder Category
1	Residents
2	Business/ shop owners
3	Transporters
4	Drivers
5	Labourers
6	Pedestrians

6.5.3 Consultations with Local Communities and Project affected Persons

361. Consultations have been conducted with the local communities and possible Affected People in the Project area to take their views and incorporating in the project planning. Two (02) consultative meetings were held with more than 33 participants in the Study Area. The major categories participated in these meetings were local population, community groups, and Affected Persons (APs). The details of the participants with venue are given in **Table 6.5.**

Table 6.5: Consultation Meetings and Participants

Sr. No.	Date	Venue	Occupation	Name
1	13-11-2020	Wazir Mansion Near Karman Wali Masjid	Business	Saleh Muhammad s/o Khan Muhammad
			Pvt. Job	Kamran s/o Ghulam Qadir
			Business	Mehrab s/o Seydan
			Fisherman	Sharjeel s/o Ibrahim
			Plumber	Nazeer s/o Muhammad Hassan
			Fisherman	Muhammad Ishaq s/o Musa Khan
			Business	Irfan s/o Sakhi Shah
			Fisherman	Bashir Ahmad s/o Hassan
			Ex-Chairman	Amjad s/o Ibrahim
			Business	Abdul Khaliq Sheikh s/o Khuda Bux
			Fisherman	Ayaz s/o Muhammad Idrees
			Labourer	Qamar Zaman s/o Sher Ali
			Labourer	Fareed s/o Muhammad Ali
			Drive	Sajid Ali s/o Muhammad Akram
			Hawker	Shaji Haider s/o Zulfiqar
Question Raised				**Response**

Sr. No.	Date	Venue	Occupation	Name
• What will be the design of the proposed ICI Intersection?				• The participants were briefed about the route and length of the proposed ICI Intersection. It was also briefed that how it will reduce traffic load from the road.
• Is there any land acquisition involved in the project from private sector or residential and commercial infrastructures would be impacted?				• During designing of the proposed Flyover efforts have been made to minimize the impacts on residential structures and business infrastructure as the construction of the proposed Flyover and widening of the road will be carried out in available RoW. Almost 0.17 Acre land will be required for widening of the road. If any structure and business would be affected will be shifted with the proper compensation. Shifting allowance and livelihood disturbance allowance for the disturbance period will be provided.
• Our privacy will be disturbed due to construction of ICI intersection.				• It was made sure to the participants that their privacy will not be disturb due to construction of the ICI Intersection. It will be ensured that iron sheets will be fixed on the sides of the flyover.
Case No.	**Date**	**Venue**	**Occupation**	**Name**
2	13-11-2020	Khadda Market, Liyari	Pvt. Job	Abdul Razaq s/o M.Yousaf
			Business	Abdul Ali s/o Hazrat Ali
			Fisherman	Baqir Ali s/o Yaqoob Ali
			Business	Shahbaz Malik s/o Shareef Malik
			Pvt. Job	Ali Haider s/o Shafique Hussain
			Private Job	Noor Rehman s/o M. Ihsan
			Govt. Job	Rizwan s/o Anwaar
			Labourer	Anwar Ali s/o Feroz Ali
			Driver	Ghulam Mustafa s/o Habeeb
			Private Job	Yasir Abbas s/o Hafeez Ullah
			Private Job	Sheraz Ul Din s/o Khanam Din
			Business	Noor ul Din s/o Tajwar Khan
			Labourer	Saleem s/o Muhammad Achar
			Fisherman	Muhammad Aslam s/o Muhammad Dawood
			Driver	Anees Sheikh s/o Fareed Sheikh
			Business	Habeeb Ahmad s/o Roshan Khan
			Transporter	Hikmat Khan s/o Sher Khan
			Electrician	Sarfaraz Ali s/o Rizwan
Question Raised				Response

<table>
<tr><th>Sr. No.</th><th>Date</th><th>Venue</th><th>Occupation</th><th>Name</th></tr>
<tr><td colspan="4">• When will construction of the road start?</td><td>• After completion of all studies and final approval the construction of the road will start.</td></tr>
<tr><td colspan="4">• What will be the status of pedestrian bridge?</td><td>• Pedestrian bridge will be shifted/relocated due to construction activities.</td></tr>
<tr><td colspan="4">• Our water supply pipelines are spread over the streets, these shouldn't be disturbed. Moreover, our streets should not use for alternate route of the big vehicles.</td><td>• It was ensured to the local residents that such type of issues will settled with mutual consultation and no problem will be faced to the local community in this regard.</td></tr>
<tr><td colspan="4">• What is the purpose of the public consultations and social survey?</td><td>• The concerns of the local people will be recorded, addressed and design of the project will be improved with valuable suggestions.</td></tr>
</table>

6.5.4 Gender Consultations

362. Keeping in view the important role of the females in the household as well as in the society, gender consultations were also conducted on two locations to record views of the females and issues related to the project implementation (list of participants is provided in **Table 6.6.**

Table 6.6: Consultation Meetings and Participants

Siddique Street Liyari					
Sr. No.	**Date**	**Name**	**Age**	**Education**	**Occupation**
1.	13-11-2020	Nasreen	39	Middle	Housewife
2.		Maryam	44	Illiterate	Housewife
3.		Shazia Bibi	46	Primary	Housewife
4.		Rimsha Zainab	33	Middle	Housewife
5.		Farah	37	Middle	Housewife
6.		Hameed Bibi	65	Illiterate	Housewife
7.		Rukhsar	42	Middle	Housewife
Street No. 01, Khadda Fisherman					
Sr. No.	**Date**	**Name**	**Age**	**Education**	**Occupation**
1.	13-11-2020	Uzma	36	F.A	Housewife
2.		Firdos	44	Illiterate	Housewife
3.		Kausar Parveen	49	Illiterate	Housewife
4.		Gulnaaz	35	Middle	Housewife
5.		Mehar ul Nisa	32	Illiterate	Housewife

Siddique Street Liyari					
Sr. No.	**Date**	**Name**	**Age**	**Education**	**Occupation**
6.		Shahana	43	Primary	Housewife
7.		Rizwana	47	Illiterate	Housewife
8.		Shehla Parveen	37	Illiterate	Housewife

6.5.4.1 Awareness, Concerns about the Project and Response to their Queries

363. Women actively participated in the meetings and showed their support for the project. Most of the women were un-aware about the project. Upon describing the proposed projects details, they considered the project valuable for the local community. Participants of the consultations highlighted few issues related to women due to project execution. Their concerns were of minor nature related to residential disturbance and mobility of women in the area.

364. Participants were briefed that adverse impacts have been minimized designing route of the road has been proposed away from the main settlements and affected families will be compensated properly.

6.5.4.2 Problems Faced and Pressing Needs of the Women

365. Female participants highlighted various issues faced in the area which are:

- Lack of facilities of safe drinking water,
- Females were of the view that our water supply lines are spread over the street, due to traffic load in our streets these shouldn't be disturbed.
- Lack of health facilities in the health centers,
- Insufficient educational facilities in schools, and
- Lack of Transport facilities for females.

366. The foremost preferred needs of the female participant were clean drinking water, improved health facilities, better public transport and employment opportunities

6.5.4.1.1 Stakeholders Concerns/Feedback

367. Feedback received during public consultation includes both project related concerns and other/general concerns. Project related concerns and suggestions are related to the willingness of people to accept project issues related to livelihood and issues which may be faced during construction period to the local communities, drinking water supply and sewerage, health facilities, road infrastructures, education, women issues and security. Brief Introduction about the proposed project, its various components, positive and negative impacts and other technical details related to environment, social and economic considerations were provided before the consultation to stakeholders.

368. During consultations concerns noticed are listed as under:

- Disturbance for the local inhabitants and commercial activities in the area;
- Disturbance of livelihoods;
- Privacy of families living Ragura Mohallah near proposed ICI bridge, particularly of women will be disturbed due to outside labour force during construction work and
- Dust & noise, disruption to Local inhabitants. Increase of traffic pressure on the local roads and streets in the area due to construction activities.

6.5.4.1.2 Opinions of the Consulted Communities

369. In general, the consulted communities and officials consider the Project beneficial for the area. Due to construction of proposed ICI Intersection, the allied sectors will be benefitted. Indirect benefits include employment opportunities for the locals and traffic flow will become smooth in project area, resulting in the peaceful and smooth traffic movement in the area.

370. Participants demanded less impact on the residential and commercial structures by adopting proper protective measures. Business operators of the area demanded smooth implementation of the proposed project by managing dust and noise during business hours. Participants were of the view that;

- Civil work should be completed in the shortest possible time to avoid the adverse impacts on the daily activities and health of the people.
- Land should be acquired at market price where required,
- Drinking water supplies should be provided continuously to local residents.
- Our streets should not be used as alternative route for big vehicles during construction phase.
- Impact on housing and commercial structures should be minimize and if not avoidable proper resettlement compensation should be given.
- Sign boards should be provided along the construction site.
- Proper arrangements should be done to avoid construction hazards.
- The local communities during the stakeholder consultations have shown great desire to be included in the project's workforce.

6.5.4.1.3 Proposed Consultations for Next Phases

371. The stakeholder consultation and engagement is an ongoing process and will continue throughout the project's construction as well as operation and maintenance phases. The ongoing consultation process could be scheduled on need basis with the stakeholders including but not limited to the concerned government departments, local administration, community representatives and affected Persons from the proposed project area.

372. The overarching goal of consultations and community engagement is to support and facilitate the project's design and implementation, to reduce conflicts and project opposition, and to increase project's acceptability.

373. The community members will be compensated by project proponent (if eligible) and they will be encouraged to participate in project activities during construction and

operation phases. The consultations will be made in future to facilitate the community at the local level.

374. Further consultations to be undertaken as part of the Project EIA process include the Project public hearing. The Sindh EPA will require that public hearings to assess public opinion on the environmental impacts of the Project. The Sindh EPA will advertise the public hearings in a newspaper. The legal requirement is advertisement in at least one English or Urdu national newspaper, but in practice, advertisements are usually placed in two national newspapers and also in local newspapers. The public hearings will be held at least 30 days after the public notice. Concerns raised during the public hearing will be addressed in the EIA report before approval.

375. The consultations will be carried out during the construction and operation phases of project. Consultations will be undertaken in all the communities twice or more time in a year, depending on the number of concerns raised under each consultation. Ongoing stakeholders' engagement activities include:

- Ongoing reporting on progress on the implementation of environmental and social management measures identified during the EIA process and recording of comments on the effectiveness of these measures;
- Updating communities and other stakeholders about project developments and recording comments on these; and,
- Ongoing action of the grievance redress mechanism.

376. Efforts will be made to maximize the consultations during the project implementation. The consultations will be carried out with the objectives to develop and maintain communication linkages between the project promoters and stakeholders, provide key project information to the stakeholders, and to solicit their views on the project and its potential or perceived impacts, and ensure that views and concerns of the stakeholders are incorporated during the implementation with the objectives of reducing or offsetting negative impacts and enhancing benefits of the proposed project. The framework for the future consultations is elaborated in **Table 6.7** but not limited to the following:

Table 6.7: Proposed Consultations Framework

Sr. No.	Stakeholders	Project Phase	Frequency of Consultation
1	Institutions / Departments	• Pre-Implementation • During the Project mentation • At Closure period	• One round of consultation before start of implementation of project. • Bi-annually during operation phase • Once before the closure of the project.
2	Local Communities/ Key Persons	• Pre-Implementation • During the Project mentation • At Closure period	• Consultation at different stages, before implementation, periodic meetings during construction phase and at the time of Project completion.
3	NGOs/CBOs	• Pre-Implementation • During Project Implementation	• Periodic meetings will be conducted as per requirement of

Sr. No.	Stakeholders	Project Phase	Frequency of Consultation
		- At Closure period	the Project.

377. During the operational phase of the project consultation of stakeholder are important to assess the benefits of the project and impacts on the local communities. A comprehensive plan will be prepared to get feedback from the stakeholders and to resolve the issues.

6.5.4.1.4 Information Disclosure Plan

378. After suggesting the possible solutions of the stakeholders' concerns, the solutions (final EIA report) will be disclosed once again before the stakeholders and general public. EIA report will be accessible to interested parties on request and the version of final report will be available in the project office and its summary will be available in national language.

Plate: 1 Consultation with Mr. Muhammad Taha Special Secretary (Tech)/PD (URI)

Plate: 2 Consultation with Conservation Wildlife Sindh

Plate: 3 Consultation with Parks & horticulture KMC Department

Plate: 4 Consultation with Agriculture, Supply & Price Department

Plate: 5 Consultation with Special Secretary Irrigation

Plate: 6 Consultation with Culture & Antiquity Department

Plate: 7 Consultations with Irrigation Department

Plate: 8 Consultation with Sindh Fisheries Department

Plate: 9 Consultation with Social Forestry Representative

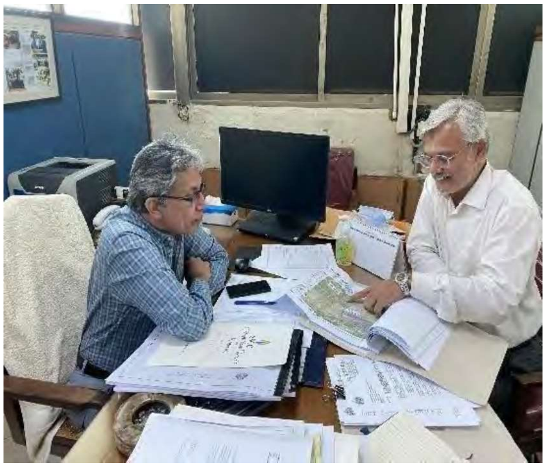


Plate: 10 Consultation with SSGC representative

Plate: 11 Consultation with Conservator of Forest Mangrove

Plate: 12 Consultation with KW&SB Representative

Plate: 13 Consultation with DHO (South)

Plate: 14 Consultation with Office Superintendent DHO (South)

Plate: 15 Consultation with Residents of Rangora Muhallah

Plate: 16 Consultation with Traffic police

Plate: 17 Consultations with Shop Owners

Plate: 18 Consultations with KPT & Pakistan Navy representatives

7 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

.

7.1 GENERAL

379. This section provides the analysis of the potential impacts during pre-construction/design, construction and operational phases of the proposed project on the physical, biological and socio- economic environment of the project area. In addition, it also describes the measures that will mitigate the project's potential environmental impacts.

7.2 IDENTIFICATION OF IMPACTS

380. The Impacts associated with Project are identified using Impact Evaluation Matrix.

7.2.1 Project Impact Evaluation Matrix

381. The Impact Evaluation Matrix was developed by placing project activities along one axis (i.e., Y- axis), and environmental parameters likely to be affected by the proposed project action on the other axis (i.e., X-axis) grouped into categories i.e. physical, ecological and socio-economic environment.

382. For the impact assessment, project impact evaluation matrix is used by dividing the project action into different phases (design/pre-construction, construction and operational phases).

7.3 CHARACTERIZATION OF IMPACTS

383. Primarily, anticipated impacts have been categorized as direct, indirect and induced impacts. These groups of impacts can be further broken down according to their nature into:

- Positive and negative impact;
- Minor, major and moderate impact;
- Local and widespread impact;
- Temporary and permanent impact;
- Short and long term impact; and
- Reversible and Irreversible impact

384. Characterization of Impacts is given in Table 7.1, 7.2 & 7.3 for design/preconstruction, construction and operation phases. Furthermore, the environmental impact evaluation matrices have also been developed to indicate magnitude of the impacts on different environmental settings for design/preconstruction, construction and operational phases (see Tables 7.4, 7.5 & 7.6). The following scale has been used for the evaluation of potential impacts on different environmental settings:

- O= Negligible/No Impact
- LA = Low Adverse
- MA= Medium Adverse
- HA = High Adverse
- B = Beneficial

385. The criteria used to define the high medium and low adverse impacts are as follows:

Negligible/No Impact:

386. The impact which has unapparent and negligible influence on natural and socio-economic environment.

Low Adverse Impact:

387. The impact which has a slight influence on the natural and socio- economic environment.

Medium Adverse Impact:

388. The impact which can be eliminated/ mitigated after applying the appropriate mitigation measures.

High Adverse Impact:

389. The impact which can be partially/ but not fully mitigated by applying the mitigation measure.

Positive/Beneficial Impact:

390. The impact which improve/enhance the natural and socio- economic environment.

7.4 CORRIDOR OF IMPACT (COI)

391. COI is a limit which identifies the area where direct and indirect impacts of the project activities are envisaged. The limit for COI for the proposed project was taken as 50 meters from the edge of ROW on both sides for collection of baseline information, impacts assessment and mitigation measures of physical, ecological as well as social resources.

392. As the location of construction/contractor camps, vehicles, equipment yard, material quarry areas and access tracks have not been identified yet, so impacts evaluated due to these facilities in this section have been predicted on the basis of similar projects

Table 7.1: Characterization of Environmentally Potential Impacts for Design/Pre-Design Phase

Environmental Component	Impact Characteristics														
	Type		Duration		Location		Frequency		Extent		Significance			Reversibility	
	Positive	Negative	Long	Short	Direct	Indirect	Cont.	Intermittent	Wide	Local	Large	Moderate	Small	Rev.	Irrev.
Land Acquisition & Resettlement		●	●		●		●			●		●			●
Surface and Ground Water Quality		●		●	●			●		●			●	●	
Physical Cultural Resources		●		●	●			●		●			●	●	
Public Utilities		●		●	●			●		●			●	●	

Legend: Negative Impact (●) Positive Impact (◙)

Table 7.2: Characterization of Environmentally Potential Impacts for Construction Phase

Environmental Component	Impact Characteristics														
	Type		Duration		Location		Frequency		Extent		Significance			Reversibility	
	Positive	Negative	Long	Short	Direct	Indirect	Cont.	Intermittent	Wide	Local	Large	Moderate	Small	Rev.	Irrev.
Topography		●	●		●		●			●			●		●
Surface Water Quality		●		●	●			●		●			●	●	
Groundwater Quality		●		●	●			●		●			●		●
Air Quality		●		●	●			●		●		●		●	
Soil Quality/Erosion		●		●	●			●		●		●		●	
Noise		●		●	●			●		●		●		●	
Flora		●	●		●		●	●				●		●	
Fauna		●		●	●		●			●			●	●	
Disturbance to Public Life		●		●	●			●		●		●		●	
Solid & Hazardous Waste Generation		●		●	●			●		●			●	●	
Land Acquisition		●	●		●		●			●	●				●
Traffic Management		●		●	●			●		●			●	●	
Health and Safety		●	●		●			●		●		●			●

Disruption of Public Utilities		●		●	●			●		●		●		●	
Employment	◙		◙		◙		◙		◙			◙			◙
Lifestyle and Culture	◙		◙		◙		◙		◙			◙			◙

Legend: **Negative Impact (●)** **Positive Impact (◙)**

Table 7.3: Characterization of Environmentally Potential Impacts for Operation Phase

Environmental Component	Impact Characteristics														
	Type		Duration		Location		Frequency		Extent		Significance			Reversibility	
	Positive	Negative	Long	Short	Direct	Indirect	Cont.	Intermittent	Wide	Local	Large	Moderate	Small	Rev.	Irrev.
Air Quality	●		●		●		●		●				●	●	
Noise		●	●		●		●			●			●		●
Solid Waste Generation		●	●		●		●			●			●		●
Flora	◙		◙			◙	◙			◙			◙	◙	
Fauna		●		●		●	●			●			●	●	
Traffic Situation in the area	◙		◙		◙		◙		◙		◙				◙
Lifestyle and Culture (Tourism)	◙		◙		◙		◙		◙			◙			◙
Local Economics	◙		◙			◙	◙		◙			◙			◙

Legend: **Negative Impact (●)** **Positive Impact (◙)**

Table 7.4: Environmental Impacts Evaluation Matrix during the Design and Pre-Construction Phase

Sr. No.		Physical Environment				Biological Environment		Socioeconomic Environment				
	Environmental Component / **Project Activities**	Surface Water Quality	Groundwater Quality	Air Quality	Noise & Vibration	Flora	Fauna	Health & Safety	Disruption of Public Utilities	Population Disturbance	Social Disorder	Cultural/Religious Values
1	Topographic Survey	LA	LA	O	O	LA	O	LA	O	O	O	O
2	Geotechnical Investigation	LA	LA	LA	LA	LA	O	LA	O	O	O	O
3	Land Acquisition and Resettlement	O	O	O	O	MA	LA	LA	LA	HA	MA	LA

Legend

O - Insignificant / no impact
NA - Not Applicable

LA = Low Adverse
LB = Low Beneficial

MA = Medium Adverse
MB = Medium Beneficial

Table 7.5: Environmental Impacts Evaluation Matrix during the Construction Phase

Sr. No.	Environmental Component / Project Activities	Physical Environment								Biological Environment		Socioeconomic Environment						
		Topography/Drainage	Soil Quality	Landscape	Surface Water Quality	Groundwater Quality	Landslide/Slope Stability	Air Quality	Noise & Vibration	Flora	Fauna	Health & Safety	Disruption of Public Utilities	Employment	Population Disturbance	Social Disorder	Cultural/Religious Values	Traffic Management
1	Construction camps, workshops etc.	MA	LA	O	LA	LA	LA	LA	LA	LA	O	LA	LA	MB	LA	LA	LA	LA
2	Site clearing	LA	LA	LA	LA	O	LA	LA	LA	LA	O	LA	LA	MB	LA	O	O	O
3	Excavation and reclamation operations	LA	MA	MA	LA	O	L A	LA	MA	MA	LA	MA	LA	MB	LA	O	LA	LA
4	Transportation of construction materials	O	LA	O	O	O	LA	LA	MA	O	O	LA	O	LB	LA	O	LA	LA
5	Open storage of construction materials, fuel etc.	O	HA	O	LA	LA	LA	LA	O	LA	LA	LA	O	O	O	O	O	LA
6	Waste generation	LA	LA	LA	LA	LA	O	MA	O	LA	LA	LA	LA	MB	LA	O	LA	LA
7	Use of Chemicals	O	MA	O	LA	LA	LA	LA	O	LA	LA	LA	LA	LB	LA	O	O	O
8	Earthwork operations	MA	MA	MA	LA	O	O	LA	MA	LA	LA	LA	LA	MB	LA	O	LA	LA
9	Operation of concrete batching plant	LA	LA	LA	LA	O	LA	O	MA	LA	LA	MA	LA	MB	LA	O	LA	LA
10	Operation of asphalt plants	O	LA	LA	L A	O	LA	O	HA	LA	LA	MA	O	MB	M A	O	LA	LA
11	Use of generators	O	LA	O	LA	O	LA	O	MA	LA	LA	LA	O	MB	LA	O	O	LA
12	Construction of Roads	LA	LA	LA	LA	La	LA	LA	LA	LA	LA	LA	M B	MB	LA	LA	LA	LA

O - Insignificant / no impact **LA = Low Adverse** **MA = Medium Adverse** **HA = High Adverse**

NA - Not Applicable **LB = Low Beneficial** **MB = Medium Beneficial** **HB = High Beneficial**

Table 7.6: Environmental Impacts Evaluation Matrix during the Operational Phase

Sr. No.	Environmental Components / Project Activities	Physical Environment					Biological Environment		Socioeconomic Environment			
		Topography	Soil Erosion/ / Stability	Surface Water Quality	Air Quality	Noise & Vibration	Flora	Fauna	Public Health & Safety	Employment	Improved Accessibility to tourism points	Economic Activities
1	Movement of Vehicle	O	O	LA	MB	LA	O	LA	LA	MB	MB	MB
2	Signaling / Traffic Control	O	O	O	LA	O	O	O	O	MB	O	MB
3	Maintenance	O	LA	LA	LA	LA	LA	LA	LA	MB	LA	MB

Legend

O - Insignificant / no impact	**LA = Low Adverse**	**MA = Medium Adverse**
NA - Not Applicable	**LB = Low Beneficial**	**MB = Medium Beneficial**

7.5 ANTICIPATED PROJECT IMPACTS DURING PRE- CONSTRUCTION / DESIGN PHASE

393. Following is the brief description of impacts envisaged and the recommended mitigation measures during Pre-construction and Design Phase.

7.5.1 Layout Planning and Technical Design

Impact Analysis

394. Incompatible layout plan and engineering design of the project's structures can undermine the overall aesthetic beauty and ambience of the project area. Also low utilization of the available spaces and designing the structures without considering the prospective and futuristic needs can result in structures with low social acceptability and functionality.

395. Moreover, in case the future traffic projection on proposed project is not achieved or if not considered in the detailed design properly, will also affect the road and public safety of the proposed project. The impact is temporary and minor negative in nature.

Mitigation measures

396. The technical design of the proposed project must consider all the above mentioned factors for the final design and should meet all the international highway standards; and

397. The proponent must review and validate all the design considering the possible impacts (as mentioned) before the start of construction of proposed Project.

Residual Impacts

398. The impact is temporary and minor negative in nature.

7.5.2 Land Acquisition and Resettlement

399. The land acquisition and resettlement is a major issue in the proposed project as land will be acquired for the construction of proposed project. As detailed design of the project is not finalized, therefore, amount of land to be acquired, which will be required at various segments of the project is based on the preliminary designing. In order to rehabilitate the existing roads, most of the civil work will be done in the existing RoW of the proposed roads. Affected land will be purchased/transferred after negotiations at departmental level.

400. Based on the preliminary design field survey, following structures will be affected. One (01) wood godown, two (02) residential structures of railway department and three (03) pacca rooms. These structures will be compensated fully on the market rates

401. Based on the field surveys, proposed bypass road will affect following infrastructure and utilities; nineteen (19) street lights, four (04) road lights, one (01) oil pipeline of PARCO, two (02) electric poles, one (01) PRL Oil Pipeline Underground and one (01) electric pole and transformer. Summary of the affected public utilities is given in **Table 7.7.**

Table 7.7: Summary of Affected Public Infrastructure / Utilities

Items	Infrastructure / Utilities (Nos.)	Location/ Description
Sewerage Drain	02	Elevation Point, Both Sides of Roads Flyover location
Pedestrian Bridge	01	Pedestrian Bridge near elevation Point
Vacant Poles	02	Pedestrian Bridge
Street Lights	07	Centre of Road
Security Lights	03	Flyover
Cable	4 Pipes with Cable	Flyover

402. The current land acquisition process and procedures are not adequate enough to ensure fair and justifiable compensation to the affectees (if private land involve during finalization of the design at any stage). Serious negative impacts may result if proper mitigation measures are not adopted. The detail of land under the impact and record of ownership status will be prepared by the Revenue Department. The impact will be permanent and high adverse.

Mitigation Measures

403. Effort has been and will be further made to avoid relocation of houses, religious structures, graves and protected areas while selecting the final alignment of the proposed project.

404. The process of land acquisition and compensation should be followed in a transparent manner to minimize the impacts to provide judicious compensation to the displaced by providing sufficient budget in the project cost. The Land Acquisition Act (LAA) of 1894 is the main law regulating land acquisition for public purpose. This impact can be mitigated by ensuring compliance of Land Acquisition Act, 1894, addressing community grievances on priority basis and timely compensation to affectees.

405. According to Land Acquisition Act 1894, the following points are to be considered while determining compensation for the project affectees:

406. The market value of land at the date of publication of notification under section 4 sub section (1);

407. The damage if any sustained by the person interested at the time of the collector’s taking possession of the land by reason of acquisition injuriously affecting his other property, moveable, or immoveable, in any other manner, or his earning; and

408. As a consequence of the acquisition of the land by the collector, the person affected is compelled to change his residence or place of business, the reasonable expenses incidental to such change.

Residual Impacts

409. Residual impact will be moderate adverse after adopting mitigation measures

7.5.3 Physical Cultural Resources

Impact Analysis

410. There is no physical cultural resource within the Right of Way (ROW) of the proposed alignment of the proposed project (ICI Intersection) except of one mosque (Jamia Masjid Karmawali). However, there will be no relocation of the Masjid in the preliminary design of proposed project. Moreover, there are other cultural resources such as graveyards, mosques and shrine are situated in nearby communities and are visited by local people.

Mitigation measure will include:

- There must be provision of the accessibility such as pedestrian corridor/crossing to masjid and other physical cultural resources in the technical design for the nearby communities.

Residual Impacts

411. The residual impacts will be insignificant in nature after the implementation of mitigation measures.

7.5.4 Public Utilities

Impact Analysis

412. Due to the proposed project, public utilities will be affected due to shifting, creating disruption of public services like water supply, electricity and natural gas and resulting inconvenience to the local residents. This impact is however temporary and minor negative in nature.

Mitigation Measures

- The provision in the design and budget for the relocation of the existing utility infrastructures wherever required shall be finalized in consultation with the concerned department;
- Incorporate technical design features to minimize effect on public utilities; and
- All public utilities likely to be affected by the proposed project need to be relocated

well ahead of the commencement of construction work.

Residual Impacts

413. The residual impacts will be minor adverse to insignificant in nature after the implementation of mitigation measures.

7.5.5 Seismic Hazard

Impact Analysis

414. The Project Area is located in Seismic Zone 2B, where 2B (lower limit of moderate damage) represents peak horizontal ground acceleration from 0.16 to 0.24 g. In this Zone, designing of various types of structures should be done on the basis of Peak Ground Acceleration (PGA). The earthquake can adversely impact the proposed Project. This will be a major negative impact.

Mitigation Measures

- The proposed project should be designed and constructed keeping in view low to moderate earthquakes. For seismic hazard analysis, updated structural and seismic evaluations should be conducted by the design engineer/consultant. Moreover, geo-technical investigations must be conducted prior to construction phase;
- Seismic Building Code of Pakistan 2007 (SBC-07) should be adopted. This code specifies minimum requirements for seismic safety of buildings and has to be applied and used by engineers in conjunction with the necessary understanding of the concepts of structural, geotechnical and earthquake engineering; and
- The structure of the proposed project should also be studied to evaluate its durability/strength to withstand moderate to high intensity earthquake.

Residual Impacts

415. The residual impacts will be minor adverse to insignificant in nature after the implementation of mitigation measures.

7.6 ANTICIPATED PROJECT IMPACTS DURING CONSTRUCTION PHASE

416. Following is the brief description of impacts and their mitigation envisaged during the Construction Phase.

7.6.1 Economic Activity

Impact Analysis

417. Due to the construction of the proposed Project, economic activities will be enhanced in the project area as the labourers and semi-skilled staff will have an opportunity to

work in the project area. This will provide them an opportunity to develop their skills and capacities. This is a moderate positive impact.

7.6.2 Physical Cultural Resources

Impact Analysis

418. There are no physical cultural resources as listed in UNESCO World Heritage list of archeological sites coming in the ROW. During excavation, there is a chance of finding artifacts. In case of finding any artifact, the contractor shall immediately report through Supervision Consultant to Sindh Directorate of Archeology and Museums to take further suitable action to preserve those antiques or sensitive remains. Chance find procedure (attached as **Annex-V**) shall be adopted in case of any accidental discover of cultural heritage.

7.6.3 Construction Camp/Camp Site

419. Due to the proposed camp site, loss of vegetation and assets on the selected land and dissatisfaction of rehabilitation measures during and after completion of construction phase may occur. However, it will be a temporary and minor negative impact. However, a range of impacts those either remain likely to occur or are unavoidable. For theses impacts, mitigation measures have been developed to minimize the likelihood, extent or duration of their occurrence, and any associated adverse effects.

Mitigation measures

- All efforts should be made to minimize the removal of existing macro-plants at camp sites;
- The contractor(s) will provide plan for removal & rehabilitation of site upon completion;
- Photographical and botanical inventory of vegetation before clearing the site; and
- Compensatory plantation to be scheduled when construction works near end.

Residual Impact

420. The residual impacts will be temporary and insignificant in nature after the implementation of mitigation measures.

7.6.4 Social Issues/Community Disturbance

421. During construction there will be a number of activities which, if not mitigated, are likely to cause disturbance to communities in the project area; these are:

422. Due to the proposed Project, entry/exit problems may occur for the residents. This will result in causing inconvenience to the residents/shopkeepers and affect their daily activities; also reducing the frequent interactions between families;
423. Increased traffic on public routes; and

424. 380. Movement of vehicles throughout the project area, especially along haulage routes passing alongside private land during disrupting local movement and posing traffic safety issues.

Mitigation measures

425. To mitigate this impact, it is suggested to install some kind of barriers for crossing the road in the median in the urban area and to restrict the pedestrians to use the overpasses. Other mitigation measures are:

- Maintaining regular communication with local communities and other stakeholders to minimize tensions arising from Project activities;
- Maintaining a Grievance Redress Procedure to facilitate stakeholders in expressing concerns and suggestions;
- Proper traffic diversion plans before the start of the construction;
- Proposal of pedestrian underpass/bridge for the locals;
- Timely completion of the project; and
- Local labour should be employed for construction works.

Residual Impact

426. The impacts on community will be minor adverse in the short term.

7.6.5 Blockage of Access

427. Blockage of access will be of moderate significance which may arise due to the movement of heavy vehicles from the communities.

Mitigation measures

428. A traffic diversion plan should be formulated by the contractor in consultation with Karachi Traffic Police and shall be approved by the Supervision Consultant.

Residual Impact

429. The residual impacts will be minor adverse to insignificant in nature after the implementation of mitigation measures.

7.6.6 Gender Issues

430. Gender-based violence: Construction workers are usually male. Those who are away from home on the construction job are typically separated from their family and act outside their normal sphere of social control. This can lead to inappropriate and criminal behavior, such as sexual harassment of women and girls, exploitative sexual relations, and illicit sexual relations with minors from the local community.

Child labour and school dropout:

431. There are two basic conventions on child labour adopted by the ILO, and one adopted by the United Nations. The ILO Minimum Age Convention, 1973 (No. 138) and its accompanying Recommendation (No. 146) set the goal of elimination of child labour, and the basic minimum age for employment or work (in developing countries at 14 years of age or the end of compulsory schooling, whichever is higher; and 15 or the end of compulsory schooling for developed countries). The Convention sets a minimum age of 2 years younger for "light work," i.e., 12 and 13 years, respectively; and a higher minimum age for dangerous or hazardous work (basically 18 years of age, but 16 in certain circumstances). The Convention also has various other flexibility clauses.

Minimum Age for Employment or Work (Convention 138)

I. Ensure that child labour contrary to the convention is not used in any ADB-funded project.
II. Define child labour as any work done by anyone under 14 years old, except for light work done by children 12 years and older.
III. Ensure that no work is done by anyone of less than the school-leaving age, at least if schooling is available.
IV. Ensure that no work is likely to jeopardize the health, safety, or morals of young persons, either by its nature or the circumstances in which it is carried out, is done in the project by anyone under 18 years of age.

Forms of Child Labour (Convention 182)

I. Ensure that "worst forms" of child labour—for anyone under 18 years of age are not used under any circumstances in an ADB-funded project.
II. Direct activities to take immediate and effective measures to eliminate these worst forms of child labour.10 Inhabitants of the project area have mix economic background and different sources of income.
III. Children of low-income groups mostly involve in different earning activities, as their parents prefer to get their children hired in small shops as helpers, and waiters in hotels for earning money, and supporting household livelihoods. However, the Sindh Restrictions on Employment of Children Act, 2017 prohibits the employment of child and restrict the employment of adolescents in certain occupations and processes such as construction industry, and whoever employs or permits a child (person under the age of 15 years) to work in an establishment shall be liable to punishment with imprisonment
IV. The child labour impact might arise during construction stage, as large number of skilled and unskilled labour will be required by the contractor for the construction activities of the proposed project.

Mitigation Measures

432. The chance of hiring of underage worker for the project activities will be minimized by adopting the following mitigation measures:

---

[10] *ADB-ILO Core Labor Standards-Handbook*

- Awareness should be created among the local communities about the adverse impacts of child labour. For the public awareness, meetings should be held in the project area, and announcements should be made using the available local platforms with the involvement of all sectors of the society;
- Contractor through contractual agreement should be bound to follow the labour standards, rules and regulations during hiring the labour force and all activities should be monitored by the social and environmental staff of the implementing agency;
- Client and Supervision consultant should ensure that contractor shall have its employment policy in accordance with relevant act and labour policies in Sindh and Pakistan;
- Contractor should ensure the presence of all persons at site are adults and have their proper identity cards with them;
- Reduce or eliminate the worst forms of child labour and rescue and rehabilitate the children in the worst forms of child labour;
- Penalize contractors/employees using the worst forms of child labour and penalize adults who violate children's rights and who force children to enter child labour, especially in its worst forms; and
- Reduce the health hazards and dangers to young persons in the workplace.

Residual Impacts

433. Residual Impacts will be minor after adopting mitigation measures.

7.6.7 Loss of Income

434. During the construction activities, people will suffer loss in their annual income due to the loss of business, land and land based assets (if any). This impact can be categorized as indirect, minor, local, medium term and permanent,

Mitigation measures

- Fair, prompt and negotiated compensation for the land & land based assets (if any in final design) and trees on private land will be provided to the affectees along with the land value;
- Business affectees should be compensated with some extra benefits (e.g. Provide low-interest small business loans during construction using third parties, Improve business accessibility and visibility by utilizing clearly visible signs to direct customers to businesses or available parking) ; and
- Affectees will be involved in the valuation process of the Project.

Residual Impacts

435. The residual impacts will be insignificant in nature after the implementation of mitigation measures.

7.6.8 Temporary Acquisition of Land

Impact Analysis

436. The Contractors will require temporary land acquisition for:

- The development of Contractor camps and facilities i.e. storage, workshops, equipment parking and washing areas;
- Aggregate quarries; and
- Access roads/tracks for haulage, transportation etc.

437. The approximate area required for the establishment of one Contractor's camp facilities will 10,000m2. Land utilization for Project activities and subsequent operation of Project may induce temporary as well as permanent changes in the existing land use pattern. This impact can be categorized as direct, low, site-specific, short term, temporary, medium probability and reversible. Mitigation measures will include

Mitigation Measures

- It is the foremost option to establish the construction camps at the acquired land to eliminate the issues of land leased etc. however, if this option is not feasible than the land for above mentioned facilities should be selected and leased prior to the start of construction phase.
- Land for above mentioned facilities will be directly rented from the private landowners by the Contractors. The provisions of the Land Acquisition Act (LAA), 1894 will not be involved as the acquisition of the land will be temporary and will be covered by short-term lease agreements between the landowners and Contractor. Rental terms should be negotiated to the satisfaction of the concerned landowners and the agreement should be in local language to make the process clear.
- In addition, these project facilities should be located at a minimum distance of 500 m from the existing settlements, built-up areas, archaeological and cultural monuments (if any) as the case may be. Prior to the commencement of the construction activities, the Contractor should submit a construction camp development/management plan to the Engineer- incharge and the SEPA (if required) for its scrutiny and approval. As far as possible, waste/barren land i.e. areas not under agricultural or residential use and natural areas located at high elevation should be used for setting up the contractor camps.

Residual Impacts

438. The residual impacts will be insignificant in nature after the implementation of mitigation measures.

7.6.9 Health and Safety

Impact Analysis

a) Occupational Health and Safety

439. Health risks and workers safety problems may result at the workplace if the working conditions provide unsafe and/or unfavorable working environment due to storage, handling and transport of hazardous construction material. Workers will be provided with safe and healthy working environment taking into account risks inherent to the particular sector and specific classes of hazards in Project area. Construction Safety Management Plan/Checklist is attached as **Annex-VI**.

Mitigation Measures

- Obligatory insurance against accidents for labourers/workers;
- Providing basic medical training to specified work staff and basic medical service and supplies to workers;
- Layout plan for camp site, indicating safety measures taken by the contractor, e.g. firefighting equipment, safe storage of hazardous material, first aid, security, fencing, and contingency measures in case of accidents;
- Work safety measures and good workmanship practices are to be followed by the contractor to ensure no health risks for labourers;
- Protection devices (ear muffs) will be provided to the workers doing job in the vicinity of high noise generating machines;
- Provision of adequate sanitation, washing, cooking and dormitory facilities including light up to satisfaction;
- Proper maintenance of facilities for workers will be monitored;
- Provision of protective clothing for labourers handling hazardous materials, e.g. helmet, adequate footwear for bituminous pavement works, protective goggles, gloves etc.;
- Ensure strict use of wearing these protective clothing during work activities;
- Elaboration of a contingency planning in case of major accidents;
- Instruct foremen to strictly enforce the keeping out of non-working persons, particularly children, off work sites;
- Adequate signage, lightning devices, barriers, yellow tape and persons with flags during construction to manage traffic at construction sites, haulage and access roads.

b) Community Health and Safety

440. The construction activities and vehicular movement at construction sites and access service roads may result in road side accidents. This is a temporary and minor negative impact. Quality of groundwater and surface water resources available in the nearby local communities may be affected due to the construction activities, oil spillage and leakage, roadside accidents etc.

441. The labour works with different transmittable diseases such as HIV/AIDS, COVID-19 may cause spread out of those diseases in the local residents. Moreover, the borrow pit areas located near the residential, settlements, may cause accident for the people moving near to those areas.

Mitigation Measures

- There should be proper control on construction activities and oil spillage leakage of vehicles;
- The Borrow areas should be fenced properly and banned for the movement of the residents. Quarry Management Plan is attached as **Annex-VII.**
- The labour works with different transmittable diseases should be restricted within the construction site;
- Efforts will be made to create awareness about road safety among the drivers operating construction vehicles;
- Timely public notification on planned construction works;
- Close consultation with local communities to identify optimal solutions for diversions to maintain community integrity & social links;
- Seeking cooperation with local educational facilities (school teachers) for road safety campaigns;
- Provision of proper safety and diversion signage, particularly at urban areas and at sensitive/accident-prone spots;
- Setting up speed limits in close consultation with the local stakeholders; and
- If identified, consider additional guard rails at accident-prone stretches and sensitive locations (schools);
- The communicable disease of most concern during construction phase, like sexually- transmitted disease (STDs) such as HIV/AIDS, should be prevented by successful initiative typically involving health awareness; education initiatives; training health workers in disease treatment; immunization program and providing health service;
- Labour camp should be away from the residential area to minimize the adverse impacts on local communities and workers;
- Trainings, awareness and campaigns should be conducted for workers and surrounding communities on awareness and prevention of HIV/AIDs and COVID-19. Guidelines to combat with COVID-19 are attached as **Annex-VIII:**
- Workers should be educated for personal hygiene and the sanitation concerns, leading to communicable and non-communicable diseases;
- Reducing the impacts of vector borne diseases on long-term health effect of workers should be accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease, which includes;
- Eliminate any unusable impounding of water;
- During construction work, pedestrian and vehicular passages should be provided for crossing near settlement;
- Fencing should be strong enough so that it cannot be broken easily by local people for making passages;

- Discharge of any wastewater at upstream of the point of public supply should be restricted;
- Batching plants should be installed away from settlements; and
- Use of water should not disturb public water availability. Source of water should be selected carefully.

Residual Impacts

442. The residual impacts will be minor adverse to insignificant in nature after the implementation of mitigation measures.

7.6.10 Borrow/ Open Pits

Impact Analysis

443. Borrow/ open pits and its excavation activities may result in land disputes, soil erosion, landscape degradation, and damage to road embankments.

444. Borrow/ Open pits may also result in potential sources of mosquito breeding and may prove hazard to human beings, livestock and wildlife. This will also degrade hygienic condition of the project area. This impact is permanent and minor negative in nature.

Mitigation Measures

- Necessary permits must be obtained for any borrow pits from the competent authorities;
- In borrow pits, the depth of the pit will be regulated so that the sides of the excavation will have a slope not steeper than 1:4;
- Soil erosion along the borrow pit shall be regularly checked to prevent / mitigate impacts on adjacent lands; and
- In case borrow pits fill with water, measures have to be taken to prevent the creation of mosquito-breeding sites.

Residual Impacts

445. The residual impacts will be minor adverse to insignificant in nature after the implementation of mitigation measures.

7.6.11 Resource Conservation

Impact Analysis

446. Almost all the materials to be used in the construction of ICI Interchange are non-renewable and therefore their sustainable use is necessary for the future use. Large quantities of water are used in the construction of concrete structures and in watering the unfinished surfaces. Use of excessive water is of major concern while developing

resource conservation strategy. Other construction material like aggregate, bitumen and sand are locally available but its sustainable use is prerequisite. Resources Conservation Plan is attached as **Annex-IX.**

Mitigation Measures

- Wastage of water should be reduced by training the workers involved in water use;
- Wastage of water should be controlled through providing proper valves and through controlling pressure of the water;
- Water jets and sprays should be used for watering surfaces rather than using overflow system;
- Source of water should be carefully selected. Water use should not disturb the existing community water supplies;
- Unnecessary equipment washings should be avoided; and
- Avoid wastage of bitumen during for road surfacing.

Residual Impacts

447. The residual impacts will be minor adverse to insignificant in nature after the implementation of mitigation measures.

7.6.12 Energy Efficiency

Impact Analysis

448. Use of electricity will be insignificant. Diesel and residual fuel oils will be used to operate construction machinery and asphalt and batching plants. Sustainable use of energy resources is very important not to continue future use but it will also help to reduce air emissions. For conservation of energy, efficiency of the engines and burning processes is very important. Electricity shortage is not expected but the sustainable use of diesel and residual fuel is necessary.

Mitigation Measures

- Ensure adequate insulation to reduce heat loss through batching plants;
- Regularly monitor CO and CO2 content of the flue gases to verify that combustion systems are using practical excess air volumes;
- Maintain clean heat transfer surfaces in asphalt batching plant;
- Regular service of the vehicles and bathing plants will reduce the mechanical losses of energy.

Residual Impacts

449. The residual impacts will be minor adverse in nature after the implementation of mitigation measures.

7.6.13 Pollution Prevention and Abatement

450. Pollution Prevention technologies and practices will be applied in construction phase according to the International good practices and national and international recognized standards. Sindh Environmental Quality standards (SEQS) will be adopted as performance indicators.

451. Different types of waste, especially construction waste, are expected to be generated in large quantities from different activities of the proposed project. Small quantities of hazardous waste may also be generated.

452. During the construction phase, gaseous emission may occur from a wide variety of activities. The impacts of different project activities and their appropriate preventive and abatement techniques and mitigation measures are discussed below:

a) Air Quality

453. Air quality will be affected by fugitive dust emissions from construction machinery, asphalt plants and vehicular traffic. Emissions may be carried over longer distances depending upon the wind speed, direction, temperature of surrounding air and atmospheric stability.

454. The critical sources of air pollution during the construction phase will be:

- Asphalt plants that generate toxic emissions which contain unburnt carbon articles, sulphur compounds and dust from batch preparation;
- Quarry areas that generate fugitive dust during crushing;
- Traffic diversion routes marked along dirt tracks that generate fugitive dust when in use by vehicular traffic; and
- Transportation of materials and other construction activities that create dust emissions.

455. During construction, the continuous operation of machinery and movement of heavy trucks and vehicles may generate gaseous emissions and have a minor negative impact on the surrounding environment. The overall impact on the quality of air during the construction phase will, however, be limited to the project's implementation phase only.

Mitigation measures

- All vehicles, machinery, equipment and generators used during construction activities should be kept in good working condition and be properly tuned and maintained in order to minimize the exhaust emissions;
- Open burning of solid waste from the Contractor's camps should be strictly banned;
- Preventive measures against dust should be adopted for on-site mixing and unloading operations. Regular water sprinkling of the Site should be carried out to

suppress excessive dust emission(s);

- Emissions from power generators and construction machinery are important point sources at the construction sites. Proper maintenance and repair is needed to minimize the hazardous emissions;
- Quarry areas and asphalt plants should be located at least 500m downwind from populated areas, wildlife habitats and contractor's camps to minimize the impact of dust emissions;
- Asphalt, hot mix and batching plants should be equipped with dust control equipment as a pollution preventive measure such as fabric filters or wet scrubbers to reduce level of dust emissions;
- SEQS applicable to gaseous emissions generated by construction vehicles, equipment and machinery should be enforced during construction works;
- Ensure precautions to reduce the level of dust emissions from hot mix plants, crushers and batching plants e.g. providing them as applicable, with protection canvasses and dust extraction units. Mixing equipment should be well sealed and equipped as per existing standards.
- The majority of dust problems caused during the construction phase of the project could be effectively mitigated by the implementation of simple procedures by the Contractor including but not limited to the following:
- Service roads (used for earthmoving equipment and general transport) should be regularly sprayed with water during dry weather;
- All excavation work should be sprinkled with water;
- Construction workers should be provided with masks for protection against the inhalation of dust;
- Vehicle speed in the project area should be prescribed not more than 20 km/ hr. and controlled accordingly; and
- Vehicles used for construction should be tuned properly and regularly to control emission of exhaust gases.

b) Noise

456. Noise is most pervasive environmental problem in the urban areas especially on the road side. Noise is a by-product of human activity, and area of exposure increases as function of mobility and construction activities. Main sources are heavy machinery such as bulldozers, excavators, stabilizers, concrete mixing plant, pneumatic drills, stone crushers asphalt plants and other equipment. The above machinery is expected to generate noise levels that would be severe in the areas whereas previously no roadside construction is done as in the case of the proposed project. Noise generated by construction machinery is likely to affect sensitive receptors located within 50 meter of the proposed roadway. This impact is temporary and minor negative in nature. All mitigation measures mentioned below should be taken in order to minimize the impacts of noise in the project area.

457. These measures include, but are not limited to the following:

- Selection of up-to-date and well-maintained plant or equipment with reduced noise levels ensured by suitable in-built damping techniques or appropriate muffling devices; Confining excessively noisy work to normal working hours in the day, as far as possible; Providing the construction workers with suitable hearing protection like ear cap, or earmuffs and training them in their use;

- Preferably, restricting construction vehicles movement during night-time;
- Heavy machinery like percussion hammers and pneumatic drills should not be used during the night without prior approval of the Client;
- Vehicles and equipment used should be fitted, as applicable, with silencers and properly maintained;
- Use of low noise machinery, or machinery with noise shielding and absorption;
- Contractors should comply with submitted work schedule, keeping noisy operations away from sensitive points; implement regular maintenance and repairs; and employ strict implementation of operation procedures;
- 405 Noise barriers in sensitive areas in the form of high boundary walls (concrete or wood), earth berms, etc. in front of schools, hospitals and mosques;
- Public hearings to discuss appropriate solutions and materials to control noise (e.g. mud or brick walls, bushes, etc.); and
- Locating the rock crushing, concrete mixing, and materials shipment yards at least 1km from residential areas, particularly schools, hospitals, and nursing homes will also help reduce local noise levels. Such activity taking place near or through villages will broadcast continuous noise in the 70–80 dB (A) range

c) Solid Waste

458. Due to construction activities, waste will be generated at construction and contractors camp site. The construction waste will include wastewater, oil spillage from machinery, domestic waste and solid waste etc. The handling and storage of oil, asphalt/bitumen may be a source of environmental pollution as a hazardous waste. This will result in unhygienic conditions, health risk to work force and public at the camp site. This impact is temporary and minor negative in nature.

Mitigation measures

- Wastewater effluent from contractor’s workshop and equipment washing yards would be passed through gravel/ sand beds to remove oil/ grease contaminants before discharging it into natural streams;
- Training of work force in the storage and handling of materials and chemicals that can potentially cause soil contamination;
- Solid Waste generated during construction and camp sites will be safely disposed in demarcated waste disposal sites and the contractor will provide a proper waste management plan (Attached as **Annex-X**);
- Proper labelling of containers, including the identification and quantity of the contents, hazard contact information etc.;
- Emergency Response plan (attached as **Annex-XI**) should be prepared to address the accidental spillage of fuels and hazardous goods;
- Immediate collection of spilled oils/fuels/lubricants by collection of contaminated

soils and skipping oils from surface water by applying appropriate technologies;
- Reusing bitumen spillage;
- Disposing non-usable bitumen spills in a deep trench providing clay linings at bottom and filled with soil at the top (for at-least 0.5m);
- Used oil should be collected in separate containers stored on impervious platform with restricted access and must be sold to licensed contractor and the burning of waste oil should be strictly restricted;
- Segregating and stockpiling scarified/ milled bituminous material and reusing this material in sub grade/shoulders;
- Collecting and stockpiling excessive bituminous material for reuse or controlled disposal;
- Training of employees involved in the transportation of hazardous material regarding emergency procedures;
- Providing the necessary means for emergency response on call 24 hours/day;
- The sewage system for camps will be properly designed (pit latrines or, as required, septic tanks) to receive all sanitary wastewaters; and
- Lined wash areas will be constructed within the camp site or at site, for the receipt of wash waters from construction machinery.

7.6.14 Resource Conservation

Impact Analysis

459. Almost all the materials to be used in the construction are non-renewable and therefore their sustainable use is necessary for the future use. Large quantities of water are used in the construction of concrete structures and in watering the unfinished surfaces. Use of excessive water is of major concern while developing resource conservation strategy. Although plenty of water is available in the project area but its use might affect the community water consumption. Other construction material like aggregate, bitumen and sand are locally available but its sustainable use is prerequisite. **(Annex IX**).

Mitigation Measures:

- Wastage of water should be reduced by training the workers involved in water use;
- Wastage of water should be controlled through providing proper valves and through controlling pressure of the water;
- Water jets and sprays should be used for watering surfaces rather than using overflow system;
- Source of water should be carefully selected. Water use should not disturb the existing community water supplies;
- Unnecessary equipment washings should be avoided; and
- Avoid excessive amount of bitumen for road surfacing.

Residual Impacts

460. The residual impacts will be minor adverse to insignificant in nature after the implementation of mitigation measures.

7.6.15 Surface and Groundwater

Impact Analysis

461. Wastewater generated during the construction of proposed project will in disposal problems. Also the water for construction and consumption may affect local water demand.

462. There is a possibility that various materials like fuel, lubricant oil and other oily products, which are used during the construction phase may contaminate groundwater, if they are not handled properly. During the construction phase, the sanitary wastewater will be generated at the workers' camp(s). If this wastewater is allowed to stagnate on the site, either contaminate groundwater or will burden the existing sewerage system. This impact is temporary and minor negative in nature.

Mitigation Measures

- Protection of surface and groundwater reserves from any source of contamination such as the construction and oily waste that will degrade its potable quality;
- The solid waste will be disposed off in designated landfill sites to sustain the water quality for domestic requirements;
- water required for construction is obtained in such a way that the water availability and supply to nearby communities remain unaffected;
- For construction purposes, water shall be drawn from surface water bodies on priority and as available;
- Regular water quality monitoring according to determined sampling schedule;
- The contractor shall ensure that construction debris do not find their way into the drainage or irrigation canals which may get clogged;
- To maintain the surface water flow/drainage, proper mitigation measures will be taken along the dual expressway, like drainage structures in urban areas;
- Prohibit washing of machinery and vehicles with surface waters, provided sealed washing basins and collect wastewater in sedimentation/retention pond is available;
- Construction work close to the streams or other water bodies will be avoided, especially during monsoon period;
- Take precautions construct temporary or permanent devices to prevent water pollution due to increased siltation;
- Wastes must be collected, stored and taken to approved disposal site; and
- Maintenance workshop, material yard, crushers, asphalt plant and construction camps should not be sited within 1 km of water resources.
- Septic tanks, settling ponds, washing yards shall be established to control the

wastewater and sediment loadings near construction camps.

Residual Impacts

463. The residual impacts will be minor adverse to insignificant in nature after the implementation of mitigation measures.

7.6.16 Disposal of Mucking Material

Impact Analysis

464. Inevitable cut and fill earthwork operations will open up scars on the land around the project area. This impact is temporary and minor negative in nature.

Mitigation Measure

465. Proper landscaping, which should be given due consideration along with re-establishment of the local/indigenous vegetation. The excavated materials that are unsuitable for use will need to be stored, transported and disposed of appropriately at designated sites.

Residual Impacts

466. The residual impacts will be minor adverse to insignificant and temporary in nature after the implementation of mitigation measures.

7.6.17 Disruption of Existing Public Utilities/ Infrastructure

Impact Analysis

467. There may be some disruption to the already existing utilities as following;

- Sewerage line at the both sides of the road for the ICI Intersection which will be relocated;
- Pedestrian bridge will be relocated;
- Approximately 02 electric poles;
- Sui Gas operational setup need to manage; and
- Seven street lights along with 02 security lights at existing flyover. 04 pipes with cables on flyover need to manage.

Mitigation measures

468. Rehabilitation of existing utilities before construction to avoid any inconvenience to the residents of the project area or provide them with alternate arrangement during the construction period.

Residual Impacts

469. These impacts are, however, temporary and minor negative in nature.

7.6.18 Traffic Management

470. Due to the proposed construction activities, proper traffic management may pose a challenge in the project area, particularly, at the ICI Intersection and adjoining roads. This may result in traffic jams and cause inconvenience to the people living and passing through the area due to movement of vehicles carrying construction materials. It will also increase the traffic load on the existing road network, thus deteriorating the existing condition of the road. Also, the movement of vehicles along the haulage routes may cause soil compaction and alteration of percolation, vegetation pattern and damage to properties and utilities. This impact is temporary and minor negative in nature.

Mitigation Measures

- Proper traffic management plan (**Annex-XII**); will be needed to avoid traffic jams/public inconvenience;
- Movement of vehicles carrying construction materials should be restricted during the daytime to reduce traffic load and inconvenience to the local residents;
- Coordinated planning of traffic diversions by the traffic police and the Transport Department in accordance with the construction programme with advance warnings to the affected residents and road users;
- Construction vehicles, machinery and equipment will move or be stationed in the designated ROW to avoid un-necessary compaction of soil.
- Availability of continuous services of the police in the diversion and control of traffic; and
- The executing agency is required to maintain liaison between the Traffic Police, local residents/ travelers and the contractor to facilitate traffic movement during construction stage.

Residual Impacts

471. The residual impacts will be insignificant in nature after the implementation of mitigation measures

7.6.19 Waste Disposal

Impact Analysis

472. Due to construction activities, waste will be generated at construction and contractor’s camp site. This may result in health risk to work force and public, if disposal site is improperly selected and operated. This impact is temporary and minor negative in nature.

Mitigation Measures:

- The waste generated from the camp site will be disposed off through municipal committee/team working under Sindh Solid Waste Management Board;
- Burning of waste will be prohibited; and
- Solid Waste will be safely disposed in demarcated waste disposal sites and the contractor will provide a proper waste management plan.

Residual Impacts

473. The residual impacts will be insignificant in nature after the implementation of mitigation measures.

7.6.20 Lifestyle and Culture

474. There are chances of arising of issues related to cultural differences/conflict between the Contractor's workforce and the local inhabitants, conflicts arising due to the mix of local and migratory job seekers as the use of local resources and products will be increased. In this situation, local residents may resist Contractor's workforce attitudes, cultural clashes particularly when local/international contractors are engaged, social disturbance and dissatisfaction with employing outsiders may arise. This impact is temporary and minor negative in nature.

Mitigation Measures

475. This impact can be mitigated by adopting the following mitigation measures:

- Timely and full public consultation and announcement of mobilizing equipment;
- Establishment of formal links with affected communities;
- Plan for social grievance redress mechanisms;
- Seek assistance from and cooperation with local NGOs;
- Familiarize outside labourers on local etiquettes;
- Local labour should be employed for construction works; and
- Water supply and sanitation facilities, Contractor's workforces should exacerbate the existing shortages and environmental hazards; contractor should primarily seek their own sources of water in due distance (min.1 km) from local user's wells.

7.6.21 Impacts of Heavy Vehicles on the Existing Road Network

476. The plying of additional heavy vehicles on the existing ICI bridge existing may result in air pollution, noise pollution due to tire-road friction especially near sensitive receptors (residential areas, school, health facility etc.), and damage to roads and traffic congestion. However, the impacts would be temporary and minor negative in nature for which the following mitigation measures are proposed:

- Any vehicle with an open load carrying area used for transport of potentially dust producing materials shall have properly fitted side and tailboards. Materials having potential to produce dust shall not be loaded to a level higher than the side and tail boards and shall be covered with clean tarpaulin in good condition. The tarpaulin shall be properly secured and extended to at least 300 mm over the edges of the sideboard and tailboard;

- Where dust emissions are high, diversion tracks, if required, shall be overlain with shingle or surface treated. Diversion roads in built-up areas shall be established and scheduled to minimize traffic congestion;
- The Contractor shall not use any vehicles either on or off road with grossly excessive noise pollution. In case of built-up areas, noise mufflers shall be installed and maintained in good condition on all motorized equipment under the control of the Contractor;
- The Traffic Management Plan shall be prepared, which will comprise strengthening and widening of the existing minor and major roads or construction of new temporary roads; and
- The traffic on the existing roads shall be managed by Karachi Traffic Police in order to avoid traffic accidents and congestions causing unnecessary delays.

7.6.22 Impacts on Flora

477. Approximately 07 small trees will be affected. The main affected species are Pipal, Conocarpus and Date Palm etc.

478. The likely impacts on the Flora are:

479. Establishment of contractors’ camp and warehouse for storage of equipment, material etc. may also involve, clearing of vegetation from the area, resulting in another minor negative impact;

480. During the entire construction period, dust laden polluted air will form a dust film on the leaves thus blocking sunshine and stomata, thereby hindering photosynthesis process and consequently causing detrimental effect on the plant health;

481. Exhaust of noxious gases from movement of heavy machinery will further pollute the air, which will adversely affect the health and vigor of plants;

482. Birds will try to find shelter and food somewhere else and will tend to move away from the project area due to the construction activities for fear of being hunted/trapped; and This impact will be of a temporary nature and minor negative in nature. After implementation of the Tree Plantation Plan, loss of trees shall be compensated.

Mitigation Measures

- The indigenous trees most suited to the tract will be re-planted;
- Trees will be compensated with 100 trees, which will be planted in the project area on both sides of the road to recover the ecological losses.

- Flowering and ornamental shrubs shall be planted along the road to beautify the landscape. Planting would however be done keeping in view the principles of landscape designing;
- The contractor's staff and labour should be strictly directed not to damage any vegetation such as trees or bushes. They should use the paths and tracks for movement and should not be allowed to trespass through farmlands;
- Construction vehicles, equipment and machinery should remain confined within their designated areas of movement;
- Contractor should supply gas cylinders at the camps for cooking purposes and cutting of trees/bushes for fuel should not be allowed;
- Camp sites and asphalt plants should be established on waste/barren land rather than on forested or agriculturally productive land. However, if such type of land is not available, it should be ensured that minimum clearing of the vegetation is carried out and minimum damage is caused to the trees;
- A tree plantation program will be formulated by the Sindh Government, in the proposed RoW with the help of local Forest Department, or private contractor. Trees will be planted in the available space on both sides of the proposed road.

7.6.23 Impacts on Fauna

483. During construction stage noise and movement of heavy machinery for road construction, shall disturb the fauna of the area. Their removal shall have a negative effect on the fauna. This impact may be considered permanent and minor adverse in nature.

Mitigation Measures

- New and good condition machinery with minimum noise shall be used in construction;
- Noisy work shall not be carried out in night time so that there should be no disturbance to local birds and animals;
- Contractor shall ensure that the no hunting, trapping of animals should be carried out during construction;
- Borrow pits shall be fenced so that no animal can fell into these;
- The camps shall be properly fenced and gated to check the entry of wild animals in search of eatable goods. Similarly, waste of the camps shall be properly disposed off to prevent the chances of eating by wild animals, which may prove hazardous to them; and
- Special measures shall be adopted to minimize impacts on birds such as avoiding noise generating activities during the critical period of breeding.

7.6.24 Social Conflicts

Impact Analysis

484. There are chances of arising of issues related to cultural differences/conflict between

the Contractor's workforce and the local inhabitants, conflicts arising due to the mix of local and migratory job seekers as the use of local resources and products will be increased. In this situation local residents may resist Contractor's workforce attitudes, cultural clashes particularly when local/international contractors are engaged, social disturbance and dissatisfaction with employing outsiders may arise. This impact is temporary and minor negative in nature.

Mitigation Measures

485. This impact can be mitigated by adopting the following mitigation measures:

- Timely and full public consultation and announcement of mobilizing equipment;
- Establishment of formal links with affected communities;
- Plan for social grievance redress mechanisms;
- Seek assistance from and cooperation with local NGOs;
- Familiarize outside labourers on local etiquettes;
- Local labour should be employed for construction works; and
- Water supply and sanitation facilities, Contractor's workforces should exacerbate the existing shortages and environmental hazards; contractor should primarily seek their own sources of water in due distance (min.1 km) from local user's wells.

Residual Impacts

486. The residual impacts will be insignificant in nature after the implementation of mitigation measures.

7.7 ANTICIPATED PROJECT IMPACTS DURING OPERATIONAL PHASE

487. The anticipated environmental impacts related to the proposed Project have been studied for the operational stage of the Project as discussed hereunder.

7.7.1 Road Safety

Impact Analysis

488. Smooth vehicular movement at ICI interchange, in the long run, may result in road safety and less traffic accidents. This impact is permanent and moderately beneficial in nature, since the frequency of accidents may be lowered, but their intensity may be severe due to enhanced speeds at which vehicles will move.

Mitigation Measures

489. Mitigation measure will include strict enforcement of speed limits, installation of speed guns and channelization of traffic with respect to categories (heavy vehicle traffic and light vehicle traffic) and enforcement of penalties for the violators.

Residual Impacts

490. The residual impacts will be minor adverse to insignificant in nature after the implementation of mitigation measures.

7.7.2 Landscape

Impact Analysis

491. After the construction of interchange the landscape of the project area will be changed in terms of road infrastructure, construction of flyovers, interchanges, and planned plantation of trees along the road.

Residual Impacts

492. This will permanently change the landscape of the project area and will have a positive impact in terms of socio-economic development of the project area.

7.7.3 Local Economy Development

Impact Analysis

493. Improved communication infrastructure will promote new business opportunities. In addition, such an activity will also increase the land value that will benefit the local residents. This impact will be permanent and major positive in nature.

7.7.4 Pollution Prevention and Abatement

494. Pollution Prevention technologies and practices will be applied in operation phase according to the International good practices and national and international recognized standards. Sindh Environmental Quality standards (SEQS) will be adopted as performance indicators.

495. During the operation phase, gaseous emission may occur from vehicles and road maintenance works. The impacts of different project activities and their appropriate preventive and abatement techniques and mitigation measures are discussed below:

a) Air Quality

Impact Analysis

496. Improvement in interchange will help reduce traffic related emissions in the short term by allowing a smoother traffic flow. However, in the longer run, increased traffic levels and congestion may lead to particulate pollution levels above the international standards, which may result in causing public health risks, nuisance and other impacts on bio-physical environment.

497. These conditions will result in the rise of vehicular emissions (CO, NOx, SOx, PM10) associated with the adverse effects on the environment and human.

498. This impact is permanent and positive due to reduction of traffic jams. However, when traffic volume is increased on the proposed interchange, the impact may be turned into minor negative for the sensitive receptors.

Mitigation Measures

- Setting up of a system to monitor air quality along project area in accordance with the applicable standards/limits;
- Helping the owners and occupants of the affected premises to identify and implement special measures such as hedges and vegetation to reduce air pollution;
- Roadside tree plantations as applicable and feasible under harsh climatic conditions; plants should be selected in accordance to their ability to absorb emissions;
- Regular road maintenance to ensure good surface condition;
- Speed limits at sensitive locations;
- Monitoring air quality at defined schedule;
- Regular vehicle check to control/ensure compliance with SEQS; and
- Enforcement and penalties against traffic rules violators.

b) Noise

499. During the operational phase, the noise levels are anticipated to increase due to traffic related noise pollution; vibrations from engines and tires and mainly use of pressure horns. This impact is permanent and minor negative in nature.

Mitigation Measures:

- According to monitoring results, additional sound barriers in form of trees and hedges for the area near the settlements will be discussed with the affected people and planted if agreed;
- Signs for sensitive zones (health centers / educational institutions etc.) to disallow the use of pressure horns; and
- Enforcement and penalties against traffic rules violators.

c) Solid Waste

500. During operation phase Solid waste may be generated from road sweepings.

Mitigation Measures

- Solid Waste generated will be properly disposed off through local solid waste management system;
- Proper labelling of containers, including the identification and quantity of the

contents,

- Providing the necessary means for emergency response;

Residual Impacts

501. The residual impacts will be minor adverse to insignificant in nature after the implementation of mitigation measures

7.7.5 Socio-economic Impacts

502. There will be smooth in traffic flow due to construction of flyover and less disturbance for the commuters. The impact is beneficial in nature.

503. Better communication and road infrastructure will facilitate transport of goods and services and will provide better trade and development opportunities to the locals resulting in uplift in economy. It will also result in social benefits like saving travelling fuel, time and lesser wear and tear of vehicles and reduction in conflicts/accidents. This is positive impact.

504. Improved Vehicle Condition during the operation of the proposed project, lesser wear and tear of the vehicles will occur and it will also result in lesser fuel consumption and decrease in operating cost. This impact is permanent and has a major positive impact.

7.7.6 Impact on Flora

505. No negative impacts are envisaged on the flora during the operational phase. Only (07) seven trees are expected to cut, plantation shall be raised on available spaces of this proposed interchange, which will not only compensate for the loss of trees from the project area, but will also improve the landscape of the area.

506. During the operation, Plantation of new trees, on either side will have a positive impact of permanent nature.

8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 GENERAL

507. This section provides an overall approach for managing and monitoring the potential environmental and social impacts and describes the institutional framework and resource allocations to implement these measures.

8.2 EMP OBJECTIVES

508. The main objectives of the Environmental Management Plan (EMP) are:

- Provide project impacts along with the proposed mitigation measures, and a corresponding implementation phase;
- To ensure that all necessary corrective actions are carried out in time to counter any adverse environmental impact;
- To ensure the regular monitoring of those factors which may affect the safety of the environment under a systematic monitoring approach;
- Define the roles and responsibilities of the Project Proponent and Contractor(s) in order to effectively communicate environmental issues among them;
- Provide a procedure for timely action in the face of unanticipated environmental situation;
- Identify training requirements at various levels including Project Proponent, Contractor(s) and Supervision Consultant (SC);
- Provide a monitoring mechanism in the form of an environmental monitoring program, which includes monitoring parameters, monitoring frequency to ensure that all the mitigation measures are completely and effectively implemented;
- Provides estimation of environmental cost for the implementation of EMP;
- Define the requirements necessary for documenting compliance with EMP and communicating it to all the concerned regulatory agencies; and
- Provide other plans considering the project specific requirements.

8.3 SCOPE OF THE EMP

509. The scope of the EMP includes the following phases of the proposed project Interchange at ICI Intersection.

- Pre-construction Phase;
- Construction Phase; and
- Operation and Maintenance Phase.

510. All the activities performed during these phases will be controlled and monitored according to this EMP.

8.4 ENVIRONMENTAL POLICY, LEGISLATION AND FRAMEWORK

511. The applicable polices, legislation, acts and guidelines are discussed in detail in Chapter 2 of EIA.

8.5 INTERNATIONAL FINANCIAL INSTITUTIONS (IFIS)

512. There are mandatory requirements of International Financial Institutions which need to be followed in the project. The major financing institutions which may be involved in the later stage of the project are Asian Development Bank (ADB) or World Bank (WB). As per the Environmental and Social Management System Arrangement (ESMS) prepared for Public–Private Partnership Investments projects in Sindh Province, the major requirements of Asian Development Bank (ADB) will be followed in case of their involvement.

8.5.1 ADB's Safeguard Policy Statement (2009)

513. Environmental safeguards requirements, including EIA requirements, are defined in ADB's SPS 2009. All projects funded by ADB must comply with SPS, 2009. The purpose of the SPS, 2009 is to establish an environmental review process to ensure that projects undertaken as part of programs funded under ADB loans are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and are not likely to cause significant environmental, health, or safety hazards.

8.6 INSTITUTIONAL SETUP FOR IMPLEMENTATION OF EMP

514. Local Government & HTP Department, Government of Sindh as Employer/Proponent with the support of PSF / ESMS are the main key players for the effective implementation, management and to control the supervisory affairs of EMP during design, construction and operation phases of the proposed project. The following staff will be involved in the implementation of EMP:

- Local Government & HTP Department / Proponent / Employer;
- PSF / ESMS;
- SC's; and
- Contractor's Environmental Manager.

515. The Local Government & HTP Department shall bind the contractor through contractual documents to implement the suggested mitigation measures in the EMP. The whole EMP will be included as a clause of the contract documents. Construction camps will be established after necessary approvals and submission of Site-Specific EMPs to be developed in the light of the relevant agencies requirements, before commencement of new works. The organizational setup for implementation of EMP is given below in **Figure 8.1.**

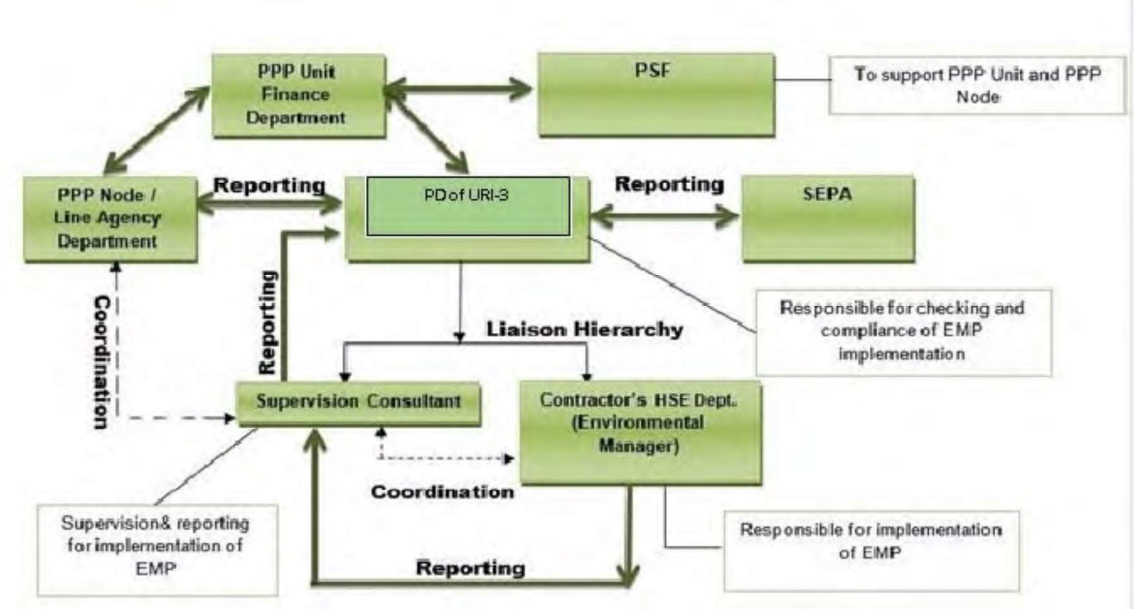


Figure 8.1 Organizational Setup for EMP Implementation

8.6.1 Roles and Responsibilities of the Functionaries involved in EMP Implementation

a) SEPA

516. As per Sindh Environmental Protection Act, 2014, SEPA responsible for environmental protection and pollution control. The SEPA is responsible for the approval of the EIA and IEE of all the developmental projects under their jurisdictions. SEPA will undertake audits (as and when required) of the proposed Project activities with respect to the protocols as defined in EMP.

b) Local Government & HTP Department

517. Local Government & HTP Department is directly in-charge for the financial and technical matters and directly reports to the Project Interchange at ICI Intersection. The general monitoring responsibilities will consist of:

- Ensuring that the required environmental training is provided to the concerned staff;
- To carrying out random site visits to the construction sites to review the environmental performance of the Contractor;
- Review monitoring reports for the progress of environment related activities;
- Make sure that the Contractor is implementing the additional measures suggested by the SC in environmental monitoring reports;
- Assessment and valuation of property (if any) and negotiation with the affectees for fixation of compensation to be paid for temporary as well as permanent acquisition of the land;

- Assist in checking genuine ownerships of the claimants, in consultation with the Revenue staff for prompt payment to the affectees;
- Assist the Contractor for the timely payments of negotiated prices;
- To assist Contractor for obtaining necessary approvals from the concerned departments;
- Maintaining interface with the other lined departments/stakeholders; and
- Reporting to the SEPA on status of EMP implementation.

c) PSF / ESMS

518. The PSF / ESMS shall be responsible to:

- Make sure that all the contractual obligations related to the environmental and social compliance are met;
- Monitor the progress regarding implementation of environmental safeguard as provided in the EMP;
- Oversee the compliance of all the monitoring programs as given in EMP;
- Check randomly whether monitoring of the environmental aspects of the Project during construction phase is being properly carried out;
- Document and disclose monitoring results and identify necessary corrective and preventive actions in the periodic monitoring reports (bi-annual reporting), and make follow-up on these actions to ensure progress toward the desired outcomes;
- Make sure that the Contractor is implementing the additional measures suggested by the M&E Contractor; and
- Report the status of EMP compliance to Local Government & HTP Department and PPP Unit, Finance Department.

d) Supervision Consultant (SC)

519. Roles and responsibilities of SC will be:

- To oversee the performance of the Contractor to make sure that the Contractor is complying with EMP;
- Ensuring that the day-to-day construction activities are carried out in an environmentally and socially sound and sustainable manner;
- Strong coordination with the Contractor and Local Government & HTP Department;
- Preparing training materials and implementing programs;
- Ensure the implementation of the mitigation measures suggested in EMP;
- To supervise and monitor environmental activities being performed at site;
- To organize periodic environmental training programs and workshops for the consultant's and contractor's staff;
- Periodic reporting as mentioned in EMP; and
- Suggest any additional mitigation measures (if required).

e) Construction Contractor

520. Contractors will be bond to appoint site based Environmental Manager with relevant educational background and experience for each construction camp. Contractors' Environmental Manager will carry out following activities:

- Implementation of the mitigation measures at construction site;
- Contractor will be bond through contract to take actions against all the special and general provisions of the contract document;
- Contractor will make sure the compliance of EMP recommendations and will also be responsible for effective liaison with local heads of villages;
- Provision of proper Personal Protective Equipment (PPEs) to the workers and train them for their proper use;
- To conduct the environmental and health & safety trainings to the workers/labour; and
- Coordinate with Environmental Specialist of SC.

8.7 ENVIRONMENTAL MANAGEMENT & MITIGATION MATRIX

521. The Environmental Management & Mitigation Matrix provides the framework for the implementation of the mitigating measures and environmental management and monitoring during the design, construction and operation phases of the proposed project. The Contractor(s) will be responsible for the preparation of Site Specific EMP (SSEMP) on the same format of this EMP along with the site-specific plans. **Tables 8.1** shows impacts, targets, mitigations and the responsible organizations for the implementation of the mitigations.

Table 8.1: Environmental Management & Mitigation Matrix

Sr. No.	Parameters	Target	Mitigation	Responsibility
			Design Phase	
1.	Land Acquisition and resettlement	To minimize land acquisition	▪ The ROW and alignment of the proposed project will be finalized in such a way that minimum people may be disturbed due to Project activities. ▪ Adequate budget will be provided in the Project cost for the compensation to the affected people as per Land Acquisition Act, 1894, ADB SPS, 2009 and ESMS of client including framing of a judicious and fair compensation package for provision of compensation on the prevailing market rates.	Local Government & HTP Department
2.	Flora and Vegetation	To avoid the cutting of ornamental plants/trees as less as possible.	▪ Selection of temporary lands for labour camps and other purposes should be at least 500 m away from the water bodies, forests or vegetated areas, natural flow paths, agricultural lands & residential areas to avoid impacts in future. ▪ Only barren lands or lands with minimum vegetation shall be selected for the above mentioned purposes. ▪ Incorporate technical design measures to minimize removal of trees. Road alignment shall be designed or changes made as far as possible in a way to keep the tree loss to its minimum level.	Local Government & HTP Department, Design Consultant
3.	Layout Planning and Design	To ensure safe and efficient functioning of the facility	▪ All structural, layout and engineering design of the project should be in strict accordance with the applicable national and international byelaws and ▪ Positive impact of permanent nature.	DC and Local Government & HTP Department
Sr. No.	**Parameters**	**Target**	**Mitigation**	**Responsibility**

4.	Drainage including surface and groundwater quality	To minimize inconvenience the public	▪ Provision of appropriate drainage structures to avoid flooding especially during the monsoon season. Proper slopes shall be incorporated in design feature to avoid the formation of the water layer on road surfaces in rainy Season. ▪ Careful hydraulic studies of existing streams / Nullahs with respect to contours and catchment areas need to be done at detailed design stage. ▪ Adequate vent height, free boards of hydraulic structures in accordance to the design discharge for flood occurrence of 100 years are considered at the design stage to avoid any flooding and overtopping of the roads. ▪ Planning of location of construction camps must be at an appropriate distance from the surface water bodies; Septic tanks and soakage pits should be designed to cater the wastewater from the construction camps.	Local Government & HTP Department, DC
5.	Seismic Hazard	To minimize the structural damage	▪ The proposed structure of the flyover should be designed and constructed as per Seismic Building Code of Pakistan 2007 (SBC-07) to comply with minimum requirements for seismic safety of structures.	Local Government & HTP Department, DC
6.	Public Utilities	To avoid public disturbance to the Public Utilities	▪ Incorporate technical design features to minimize effect on public utilities; ▪ NOCs from the likely affected government stakeholders (Sui Southern Gas, Karachi Water Sewerage Board, K- Electric and PTCL) shall be acquired prior to construction phase; and ▪ All public utilities likely to be affected by the proposed project need to be relocated well ahead of the Commencement of construction work.	Local Government & HTP Department, DC
Construction Phase				

1.	Soil	To minimize soil erosion and contamination.	▪ Excavations would be kept confined to the specified foundation spots as per the approved engineering drawings. ▪ Aggregate required for proposed interchange construction procured from quarry site should get approval from concerned authorities; ▪ Soil contamination by asphalt should be minimized by placing all containers in caissons; ▪ Non-productive, barren lands in broken terrain and publicly recognized waste lands should be given preference for borrowing materials; ▪ Runoff from washing of equipment and gadgets should be drained into either a septic tank or a sand-gravel bed for removal of the grit and contaminants. ▪ All spoils should be disposed of at site designated by waste management department (SSWMB) and the site should be restored back to its original conditions; ▪ Non-bituminous wastes from construction activities should be dumped at approved sites, in line with the legal prescriptions for dumpsites, and covered; ▪ Plantation of grasses and shrubs will be done at appropriate place where required, to reduce soil erosion;	CC and SC

2.	Camps/Camp Sites	To minimize the environmental and social disturbance	▪ Implement Waste Management Plan to ensure safe handling, storage, collection and disposal of wastes generated at camp sites and the training of employees who handle waste. ▪ Operate equipment in a manner sympathetic to the ambient noise environment. Do not leave equipment idling unnecessary ▪ Provide adequate warnings of impeding works to all potential receptors within a 1 km corridor surrounding the ROW via public notices and local news. ▪ State land will be a second preference for worker camp locations, followed by land where there is a willing lessee; ▪ The construction contractor is required to develop a Construction Camp Management Plan to address discipline, community liaison, ethnic tensions and communicable diseases; ▪ Training will be provided to all staff on camp management rules and overall discipline and cultural awareness; ▪ The location of the camp need to be finalized by Contractor and Local Government & HTP Department. The construction contractor will be required to assess the environmental/social sensitivity of any additional or alternative sites prior to their approval for adoption; ▪ Reinstate any temporary facilities to pre- existing conditions in ecologically sensitive areas; and	CC and SC

			▪ Implement landscaping plan for all facilities in areas where high landscape value and visual vulnerability to the proposed activities warrants site-specific landscape restoration measures	
3.	Occupational Health and Safety	To minimize health and accident risks related to the workers	▪ Obligatory insurance against accidents for labourers/workers; Providing basic medical training to specified work staff and basic medical service and supplies to workers; ▪ Layout plan for camp site, indicating safety measures taken by the contractor, ▪ e.g. firefighting equipment, safe storage of hazardous material, first aid, security, fencing, and contingency measures in case of accidents; ▪ Work safety measures and good workmanship practices are to be followed by the contractor to ensure no health risks for labourers; ▪ Protection devices (dust mark, ear muffs) should be provided to the workers doing job in the vicinity of high noise generating machines; ▪ Provision of adequate sanitation, washing, cooking and dormitory facilities including light up to satisfaction; ▪ Proper maintenance of facilities for workers will be monitored; ▪ Provision of protective clothing for keeping out of non-working persons, ▪ particularly children, off work sites; and labourers handling hazardous	CC and SC

			materials, ▪ e.g. helmet, adequate footwear for bituminous pavement works, protective goggles, gloves etc.; ▪ Ensure strict use of wearing these protective clothing during work activities; ▪ Elaboration of a contingency planning in case of major accidents; ▪ Instruct foremen to strictly enforce the keeping out of non-working persons, particularly children, off work sites; and ▪ Adequate signage, lightning devices, barriers, yellow tape and persons with flags during construction to manage traffic at construction site, haulage and access roads.	
4.	Community Health and safety	To ensure community safety and minimize health risks	▪ There should be proper control on construction activities and Oil spillage/leakage of vehicles; ▪ The labour works with different transmittable diseases should be restricted within the construction site; ▪ Efforts should be made to create awareness about road safety among the drivers operating construction vehicles; ▪ Timely public notification on planned construction works; ▪ Close consultation with local communities to identify optimal solutions for diversions to maintain community integrity & social links; ▪ Provision of proper safety and diversion signage, particularly at sensitive/accident-prone spots; ▪ Setting up speed limits in close	CC and SC

			consultation with the project stakeholders; ▪ Additional guard rails at accident-prone stretches and sensitive locations; ▪ The communicable disease of most concern during construction phase, like sexually-transmitted disease (STDs) such as HIV/AIDS, COVID-19 should be prevented by successful initiative typically involving health awareness; education initiatives; training health workers in disease treatment; immunization program and providing health service; ▪ Trainings, awareness and campaigns should be conducted for workers and surrounding communities on awareness and prevention of HIV/AIDs and COVID-19. Guidelines to combat with COVID-19 are attached as **Annex-VIII:** ▪ Workers should be educated for personal hygiene and the sanitation concerns, leading to communicable and non-communicable diseases; ▪ Reducing the impacts of vector borne diseases on long-term health effect of workers should be accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease, which includes prevention of larval and adult propagation of vectors through sanitary improvements and elimination of breeding habitat close to residential areas and by eliminating any unusable impounding of water;	

			▪ Fencing around the camps should be strong enough so that it cannot be broken easily by local people for making passages; and ▪ Use of water should not disturb public water availability and source of water should be selected carefully.	
5.	Emergency Preparedness	To be prepared in case of emergency and respond efficiently	▪ An Emergency Response Plan for earthquakes and manmade disasters should be developed by the Local Government & HTP Department. ▪ Emergency Response Plan should be implemented in close consultation with the Fire Fighting Department, bomb disposal squad and paramedics and Chippa Services; and ▪ Training of the staff/employees regarding the emergency procedures/plans should be regularly conducted.	CC and SC
6.	Borrow/ Open Pits	To avoid land disputes, soil erosion, loss of vegetation, landscape degradation, damage to road embankments and mosquito breeding	▪ It is suggested that during the planning stage of quarry development the groundwater level be defined so the quarry floor can remain at least 2 meters above groundwater; ▪ Determine the intended future-use and final landform of a site at an early	CC and SC

			▪ stage. This should be in consultation with the landowner and broader community (for a larger quarry); ▪ When siting a quarry existing natural features should be used to conceal the quarry and limit the visual impact; ▪ Plan sequencing of both quarrying and rehabilitation for the life of the quarry; and prior to the commencement of a quarrying activity the type of vegetation should be agreed with the landowner, and should be consistent with the proposed final land-use.	
7.	Air Quality	To minimize air pollution	▪ All vehicles, machinery, equipment and generators used during construction activities should be kept in good working condition and be properly tuned and maintained in order to minimize the exhaust emissions; ▪ Open burning of solid waste from the Contractor's camps should be strictly banned; ▪ Preventive measures against dust should be adopted for on-site mixing and unloading operations. ▪ Regular water sprinkling of the site should be carried out to suppress excessive dust emission(s); ▪ Emissions from power generators and construction machinery are important point sources at the construction sites. Proper maintenance and repair is needed to minimize the hazardous	CC and SC

			▪ emissions; and ▪ SEQS applicable to gaseous emissions generated by construction vehicles, equipment and machinery should be enforced during construction works. ▪ Service roads (used for earthmoving equipment and general transport) should be regularly sprayed with water during dry weather; ▪ All excavation work should be sprinkled with water; ▪ Construction workers should be provided with masks for protection against the inhalation of dust; ▪ Power generators and vehicles used for construction should be tuned properly and regularly to control emission of exhaust gases. ▪ Tyres of all the vehicles leaving the site should be washed. No earth, mud, dust and the like should be deposited on the public road. ▪ Quarry areas and asphalt plants should be located at least 500 m downwind from populated areas, wildlife habitats and contractor's camps to minimize the impact of dust emissions; ▪ Ensure precautions to reduce the level of dust emissions from hot mix plants, crushers and batching plants should be taken up; e.g. providing them as applicable, with protection canvasses	

			▪ and dust extraction units. Mixing equipment should be well sealed and equipped as per existing standards; and ▪ Regular monitoring of air quality in accordance with SEQS.	
8.	Noise/vibration	To minimize noise pollution and vibration	▪ Use of quieter equipment and avoid using over powered equipment; ▪ Use of damping materials and mufflers for equipment; ▪ The noise barriers may be used to control noise during construction; ▪ Construction activities shall be scheduled keeping in view the peak hours of activities carried out in sensitive receptors of the project area; and ▪ Regular maintenance of equipment shall be carried out.	CC and SC
9.	Solid including hazardous and Liquid Waste	To avoid nuisance and environmental pollution	▪ Effluent from contractor's workshop and equipment washing yards would be passed through gravel/ sand beds to remove oil/ grease contaminants before discharging it into natural streams; ▪ Training of working force in the storage and handling of materials and chemicals that can potentially cause soil contamination; ▪ Solid waste generated during construction and camp sites should be safely disposed in demarcated waste disposal sites by SSWMB and the	CC and SC

			▪ contractor will provide a proper waste management plan; ▪ Proper labelling of containers, including the identification and quantity of the contents, hazard contact information etc.; ▪ Training employees involved in the transportation of hazardous material regarding emergency procedures; ▪ The sewerage system for camps will be properly designed (pit latrines or, as required, septic tanks) to receive all sanitary wastewaters; ▪ Lined wash areas will be constructed within the camp site or at site, for the receipt of wash waters from construction machinery; ▪ Use of pesticides in nurseries should be done deemed necessary and suggested by the experts; ▪ Use of less toxic pesticide should be preferred; ▪ No refueling, storage, servicing or maintenance of equipment should take place within 150 feet of a drain or other sensitive environmental resources; ▪ Reusable/recyclable (iron bars, aluminium) waste should be sold to waste vendors and those which cannot be sold out may be used as a filling ▪ material for leveling the depressions, subject to technical feasibility; Debris	

			▪ generated by dismantling of existing pavement structures should be re-used subject to the suitability of the material; ▪ Proper labelling of containers, including the identification and quantity of the contents, hazard contact information etc.; ▪ Construction workers and supervisory staff should be encouraged and educated to practice waste minimization, reuse and recycling to reduce quantity of waste. ▪ Any fluids drained from the machinery during servicing will be collected in leak proof container and taken to an appropriate disposal or recycling facility; and ▪ A comprehensive plan for construction waste management	
10.	Ground Water	To avoid contamination of ground water	▪ Protection of groundwater reserves from any source of contamination such as the construction and oily waste that will degrade its potable quality; ▪ The solid waste should be disposed of in designated landfill sites to sustain the water quality for domestic requirements; ▪ Water required for construction is obtained in such a way that the water availability and supply to nearby	CC and SC

			▪ communities remain unaffected; ▪ Regular water quality monitoring according to determined sampling schedule; and ▪ Prohibit washing of machinery and vehicles outside washing yard, provide sealed washing basins and collect wastewater in sedimentation / retention pond.	
11.	Flora	To minimize the impact on flora	▪ The indigenous trees most suited to the tract should be re-planted; ▪ Mangroves will be compensated as per forest department approved/scheduled rates. ▪ Trees other than mangroves will be compensated with 1:10 and 1000 trees will be planted in the project area to recover the ecological losses. ▪ Flowering and ornamental shrubs should be planted along the road to beautify the landscape. Planting would however be done keeping in view the principles of landscape designing; ▪ Reasonable compensation should be provided to land holder for the loss of their standing trees at prevailing market rates to avoid financial losses; ▪ An awareness campaign targeted on the neighborhood farmers should be run to popularize the planting of trees; ▪ The contractor's staff and labour should be strictly directed not to damage any vegetation such as trees or bushes. They should use the paths	CC and SC

			▪ and tracks for movement and should not be allowed to trespass through farmlands; ▪ Construction vehicles, equipment and machinery should remain confined within their designated areas of movement; Contractor should supply gas cylinders at the camps for cooking purposes and cutting of trees/bushes for fuel should not be allowed; ▪ Camp sites and asphalt plants should be established on waste/barren land rather than on forested or agriculturally productive land. However, if such type of land is not available, it should be ensured that minimum clearing of the vegetation is carried out and minimum damage is caused to the trees; ▪ Construction of new tracts should be avoided and existing tracks should be used to access the proposed road; ▪ Construction vehicles, equipment and machinery will remain confined within their designated areas of movement; and ▪ A tree plantation program will be formulated by the Sindh Government, in the proposed ROW with the help of local Forest Department, or private contractor. Trees will be planted in the available space on both sides of the proposed road. Sindh Government shall execute the work through Forest Department or enter into an agreement with the/private contractor	

			to implement the program under deposit work. Implementation of such a policy will be the sole responsibility of concerned Government Departments.	
12.	Fauna	To minimize the impact on fauna of the project	▪ New and good condition machinery with minimum noise should be used in construction; ▪ Noisy work should not be carried out in night time so that there should be no disturbance to local birds and animals; ▪ Contractor should ensure that the no hunting, trapping of animals should be carried out during construction; ▪ Borrow pits should be fenced so that no animal can fell into these; ▪ The camps should be properly fenced and gated to check the entry of wild animals in search of eatable goods. Similarly, waste of the camps should be properly disposed off to prevent the chances of eating by wild animals, which may prove hazardous to them; and ▪ Special measures should be adopted to minimize impacts on birds such as avoiding noise generating activities during the critical period of breeding.	CC and SC

			▪ After consultation with the Wildlife Department, site specific Wildlife Safety Plans (Separate study) should be developed. These plans will include the following aspects, as appropriate: ○ Safety fencing and signage will be provided at wildlife hotspots. ○ Safe speed limit will be strictly implemented, to ensure fatal accidents involving wildlife or humans could be avoided. ○ Structure for wildlife movement (underpasses, culverts) will be provided. ○ Caution boards would be erected at crossing areas of wild animals. The exact location for boards would be determined through a survey of crossing animals. ○ Awareness material regarding wildlife will be developed and displayed prominently at the sites frequented by tourists. ○ Roadside reflectors may be used to scare animals away from the road when vehicles approach at night. ○ Fencing or plant barriers can reduce the risk of collisions between animals and vehicles. ○ The engineering design to integrate the principles of green infrastructure including habitat conservation, animal trespasses etc.	

			○ Noise produced by blasting and other construction activities may be kept to acceptable level. - Sindh Wildlife & Biodiversity Act 2020 will be followed for compliance. - Similarly, wastes of the camps shall be properly disposed of to prevent it being eaten by animals, as it may be hazardous to them. - Moreover, proper planning should be done for food storage, setting up of kitchens, production of sewage and waste water may result in multiplication of rodents like rats, mice and shrew etc. and vectors like mosquitoes, bugs and flies which will have a negative impact.	
13.	Disposal of Mucking Material	To avoid open up scars on the land around the project area.	- The excavated materials that are unsuitable for use will need to be stored, transported and disposed of appropriately at designated sites by SSWMB/ Local - Government & HTP Department	CC and SC
14.	Public Utilities and Infrastructure	To minimize the disturbance to public utilities and infrastructure	- Rehabilitation of existing utilities well before the start of construction to avoid - any inconvenience to the residents of the project area or provide them with alternate arrangement(s) during the construction period; and - Timely public notification of unexpected disruption of services.	CC and SC
15.	Traffic Management	To minimize traffic problems in the project area	- Proper traffic management plan should be implemented to avoid traffic jams/public inconvenience; - Movement of vehicles carrying construction materials should be restricted during the daytime to reduce traffic load and inconvenience to the	CC, Local Government & HTP Department. and Karachi Traffic Police

			local residents/ business owners; ▪ Coordinate planning of traffic diversions with the traffic police and the Transport Department in accordance with the construction program with advance warnings to the affected residents and road users; ▪ Availability of continuous services of the traffic police in the diversion and control of traffic; and ▪ The executing agency is required to maintain liaison between the Highway/ Traffic Police, local residents/ travelers and the contractor to facilitate traffic movement during construction stage.	
16.	Disturbance to public	To minimize the impact on community in the project area.	▪ Scheduling of construction activities to avoid/minimize hindrance in daily routine and activities; ▪ Timely notification to public about construction schedule to restrict movement along the alignment; and ▪ Ensure the timely completion of the construction works according to the agreed schedule by Local Government & HTP Department and provision of alternate routes for the project site.	CC, SC, Karachi Traffic Police.
Operation Phase				
1.	Landscape and flora	To enhance the landscape of the project area	▪ The saplings planted in the project area against the trees affected should be properly maintained throughout their growth.	Local Government & HTP Department
2.	Noise	To ensure enforcement of traffic rules to avoid noise pollution	▪ Noise measurements should be carried out at locations with respect to the schedule specified in the Environmental Monitoring Plan (EMP) to ensure the effectiveness of mitigation measures;	Local Government & HTP Department

			▪ Use of horn should be strictly prohibited in the close proximity of the educational facilities especially during the peak hours; ▪ Proper signboards should be installed to ensure reduce noise levels in the project area; and ▪ Enforcement and penalties against traffic rules violators by the Karachi Traffic Police Department.	
3.	Air Quality	To ensure traffic rules to avoid traffic congestion and reduced air emissions.	▪ Air quality monitoring along project area in accordance with Sindh Environmental Quality Standards (SEQS); ▪ Roadside tree plantations as applicable and feasible; ▪ Setting up speed limits for vehicles; and ▪ Enforcement and penalties by the concerned authorities against traffic rules violators	Local Government & HTP Department and Karachi Traffic Police
4.	Road safety and traffic management	To ensure safety of commuters using the road.	▪ Strict enforcement of speed limits, installation of speed guns/cameras and channelization of traffic with respect to categories (heavy vehicle traffic and light vehicle traffic), proper traffic signaling at Intersection should be ensured for the smooth flow of traffic and avoidance of accidents; and ▪ Enforcement of penalties for the traffic rules violators.	Karachi Traffic Police
5.	Flora	To minimize the impact on flora	▪ No negative impacts are envisaged on the flora of the tract during the operational phase. However, raising of new trees, on either side will have a positive impact of permanent nature.	Local Government & HTP Department
6.	Fauna	To minimize the impact on fauna of the project	▪ Increased noise due to increased traffic will disturb the wildlife, especially the	Local Government & HTP

			birds, which will avoid this area. Special measures should be adopted to minimize impacts on birds such as avoiding noise generating activities during the critical period of breeding.	Department
7.	Drainage	To ensure adequate drainage	▪ The impact can be controlled/reduced by timely and continuous maintenance/ cleaning of the drainage system; and ▪ Placement of sign boards instructing not to dispose of solid waste to avoid chocking of drain around the interchange at grade road alignment.	Local Government & HTP Department
8.	Changes in Socio-economic Conditions	To minimize the adverse socio economic impacts through potential enhancement measures	▪ Redefining basic land use allocation standards; Improvements in the design considerations of proposed road alignment so as to promote sustainable development of commercial areas; and ▪ Land use policies such as development restrictions and zoning implementation of bylaws/rules of Sindh Land Management and Development.	Local Government & HTP Department, Sindh Land Management and Development Company Limited

8.8 ENVIRONMENTAL MONITORING PLAN

522. Environmental Monitoring is undertaken during both the construction and operational phases to ensure the effectiveness of the proposed mitigation measures. The objectives of environmental monitoring plan during the construction and operational phases will be as follows:

- Monitor the actual project impacts on physical, ecological and socio-economic receptors;
- Recommend mitigation measures for any unforeseen impact or where the impact level exceeds the anticipated level in the EIA;
- Ensure compliance with legal and community obligations including safety during construction and operation phases;
- Ensure the safe disposal of excess construction materials, solid waste, water and wastewater and gaseous emissions;
- Appraise the adequacy of the EIA with respect to the project's predicted long-term impacts on the area's physical, ecological and socio-economic environment;
- Evaluate the effectiveness of the mitigation measures proposed in the EMP and recommend improvements in EMP, if required; and
- Compile periodic incidents/accidents data to support analyses that will help to minimize future risks.

523. Certain environmental parameters are selected and quantitative analysis is carried out. The results of analysis are compared with the guidelines; standards and pre-project condition to investigate whether the EMP and its implementation are effective for the mitigation of impacts or not. Parameters to be analyzed during construction and operation of the project and responsibilities for monitoring and reporting have been discussed below. A cost estimate for this measurement of parameters is given in Table 8.2.

8.8.1 Responsibilities for Monitoring and Reporting

524. Local Government & HTP Department and Construction Contractor will be responsible for environmental monitoring and reporting throughout the construction and operation phases. A monitoring report will be prepared on biannual basis and one comprehensive report will be prepared at the end of project and submitted to SEPA. Contents of the report will include results of environmental monitoring in comparison to the standards for the various parameters, location and sampling time along with recommendations.

8.8.2 Planning for EMP Implementation

a) NOC and Other Approvals

EPA Approval Process

525. The EIA report is to be submitted to SEPA for obtaining NOC. A demand draft of required EIA review fee has to be deposited along with the report by the Proponent to

SEPA for initiating the review and EIA approval process. The approval from SEPA is the mandatory requirement before commencement of the proposed Project activities.

Provincial Departments of Wildlife, Forest and Archaeology

526. At the feasibility stage of the Project as per the requirement of SEPA guidelines for the Sensitive and Critical Areas, concerned provincial forest and wildlife departments are informed through letters for the proposed project. The proposed Interchange involves the clearing of trees which belongs to the forest or wildlife department. The Project Proponent will be responsible for acquiring a No Objection Certificate (NOC) from the provincial forest department. The application for an NOC will need to be endorsed by Local Government & HTP Department.

527. Where construction is to be carried out in the close proximity of the any archaeology sites (if identified during construction stage), the Local Government & HTP Department is required to coordinate with the concerned departments to ensure that the impacts are minimized. The Contractor is also required to contact with concerned department before the start of the construction work.

Provincial Revenue Departments

528. Under the national law, matters relating to the land-use and ownership are the provincial subjects and the revenue department of the concerned province is empowered to carry out the acquisition of private land or built-up property for public purposes, including on behalf of other provinces. For this purpose, the Revenue Department of GoS must lodge an application with the Sindh Government to depute a Land Acquisition Collector (LAC) and other revenue staff, who will be responsible for handling the matters related to the acquisition and disbursement of compensation.

Table 8.2: Budget Estimate for Environmental Monitoring During Construction and Operation Phases

Components	Parameters	No. of Samples	Frequency	Responsibility	Duration	Unit Rate (Rs.)	Cost (Rs.)
Construction Phase (12 Month)							
Air Quality	CO, NOx, SOx, PM10	3	Twice	Contractor/ EE	24 hours	30,000/-	180,000/-
Drinking Water Quality	Total Coliforms, Fecal E. Coli, Total Colonial Count, Fecal Enterococci, pH, TDS, Total Hardness, Nitrate, Chloride, Sodium	1	Twice	Contractor/ EE	-	25,000/-	50,000/-
Wastewater / Surface Water Quality	pH, Dissolved Oxygen, TSS, TDS, Alkalinity, BOD5, COD, Turbidity	2	Twice	Contractor/EE	-	40,000/-	160,000/-
Noise Level	-	3	Twice	Contractor/EE	24 hours	5,000/-	30,000/-
					SUB-TOTAL		**420,000/-**
Operation Phase (For 1st year)							
Air Quality	CO, NOx, SOx, PM10	3	Biannual	LG & HTPD	24 hours	30,000/-	180,000/-
Drinking Water Quality	Total Coliforms, Fecal E. Coli, Total Colonial Count, Fecal Enterococci, pH, TDS, Total Hardness, Nitrate, Chloride, Sodium	1	Biannual	LG & HTPD	-	25,000/-	50,000/-
Wastewater / Surface Water Quality	pH, Dissolved Oxygen, TSS, TDS, Alkalinity, BOD5, COD, Turbidity	2	Biannual	LG & HTPD	-	40,000/-	160,000/-
Noise Level	-	3	Biannual	LG & HTPD	24 hours	5,000/-	30,000/-
					SUB-TOTAL		**420,000/-**

8.9 COMMUNICATION & DOCUMENTATION

529. Communication and documentation is an essential feature of EMP. For data recording and maintenance, forms to be used for recording information during the environmental monitoring will follow a standard format which will correspond to the data base in to which all the gathered information will be placed. Check boxes will be used as much as possible to facilitate data entry. Tracking system will be developed for each form. Similarly, monthly meetings will be held at site during the construction phase. The purpose of these meetings will be to discuss the routine activities, non-compliances and their remedial measures.

530. The Contractor will maintain a register of complaints record from local communities and measures taken to mitigate these concerns. The provision of the environmental mitigation cost will be made in the total cost of Project and if the Contractor fails to comply with the implementation of EMP, deductions will be made from the payments to the Contractor claimed under the heads of environmental components.

8.10 ENVIRONMENTAL TECHNICAL ASSISTANCE AND TRAINING PLAN

531. In order to raise the level of professional and managerial staff, there is a need to upgrade their knowledge in the related areas. Environmental Engineer (EE) should play a key role in this respect and arrange the trainings.

532. An environmental and social training and Technical Assistance (TA) program is to be carried out before the implementation of the project. Contractor’s environmental awareness and appropriate knowledge of environmental protection is critical to the successful implementation of the EMP because without appropriate environmental awareness, knowledge and skills required for the implementation of the mitigation measures, it would be difficult for the Contractor(s) workforce to implement effective environmental protection measures. A suitable training program is proposed to train the Contractor(s) staff who will be involved in the Construction Phase and the professional staff from the client involved at the operational stage of the project.

533. The proponent will engage TA consultant to manage the environmental training program. The objective of the TA will be, to help in establishment of appropriate systems, and to train proponent senior staff and Environmental Engineer (EE) responsible for managing environment, operations, and planning, who can then impart training at a broader level within and outside the Proponent (i.e., the training of trainers). The TA consultant will organize training courses for Proponent and contractor staff to train them in specialized areas such as air and noise pollution monitoring; develop environment operation manuals in consultation with the Sindh EPA. The details of this training program are presented in **Table 8.3.**

Table 8.3: Personnel Training Program/ TA Services

Provided by	Contents	Trainees/Events	Duration
TA consultants/ organizations specializing in social management and monitoring	Short seminars and courses on Social awareness	Two seminars for project staff dealing in social	2 days
TA consultants/ organizations Specializing in environmental management	Environmental awareness and managements, NEQS	One seminar for project staff dealing in environment One seminar/training workshop for Contractor's staff dealing in environment	2 days
TA consultants/ organizations Specializing in occupational, health and safety issues	Short lectures relating to Occupational Safety and Health (OSH)	Two seminars for contractor's staff	2 days

8.11 ENVIRONMENTAL MONITORING, MITIGATION TRAINING AND PLANATATION COST

534. The cost required to effectively implement the mitigation measures is important for the sustainability of the project both in the construction and operation stages of the project. These costs are summarized in Table 8.4. Detail of plantation cost is attached as **Annex-XIII.**

Table 8.4: Environmental Mitigation & Monitoring Cost

Item No.	Description	Unit Price	Total Qty.	Amount (Rs.)
Environmental Mitigation Cost				
1	**Medical Screening of workers**	**1400**	50	**70,000**
2	**Water Sprinkling**	**1500**	Twice a day	**540,000**
3	**First Aid Kit**	**3500**	2	**7,000**
4	**Traffic diversions**	**Lump sum**		**500,000**
5	**Workers health and safety***			
i)	Ear plugs	70	180	12,600
ii).	Helmets	1000	50	50,000
iii).	Safety shoes	2000	50	100,000
iv).	Safety goggles	200	30	6,000
v).	Gloves	200	180	36,000
vi).	Dust masks	100	750	75,000
6	**COVID-19 measures**	**Lump sum**		**200,000**
7	**Waste management at camps**	20,000	12 months	**240,000**
8	**Plastic and tarpaulin sheets for covering material stock piles**	30,000	2	**60,000**
9	**Fire/emergency equipment**			

i).	**DCP fire extinguishers**	3,300	10	**33,000**
ii).	**CO2 fire extinguishers**	7,500	10	**75,000**
iii).	**Emergency sirens**	20,000	1	**20,000**
iv).	**Demarcation tapes (reels)**	2,000	50	**100,000**
Total				**2,124,600/**
Environmental Monitoring construction (12 months)		**As per monitoring plan**		**420,000**
Environmental Monitoring operation (yearly)		**As per monitoring plan**		**420,000**
Environmental, Social and Safety Training Cost		**Lump sum**		**500,000**
Plantation Cost (for 4 years)		**Lump Sum (100 Trees)**		**483,000**
GRAND TOTAL				**3,947,600**

*** Detail of Personal Protective Equipment PPE during Construction Phase**

Ear Plug	1 set of ear plug to be used for 1 month for each labourer / staff
Safety Helmet	1 safety helmet for each labourer / staff
Safety Shoes	1 pair of safety shoe for each labourer / staff
Safety Goggles	1 safety goggles for labourer / staff
Gloves	1 pair of gloves for a labourer for a month
Dust mask	1 dust mask to be used daily by each labourer / staff

Note: Land acquisition and resettlement related cost is not included in this cost.

9 GRIEVANCE REDRESS MECHANISM

9.1 GRIEVANCE REDRESS MECHANISM (GRM)

535. A Grievances Redress Mechanism (GRM) provides a way to reduce risk for the proposed project, offers communities an effective system for expressing concerns and achieving remedies, and promotes a mutually constructive relationship. Moreover, it provides the structure, roles and functions of the GRM, to address the grievances arising due to execution of the project works. It provides a predictable, transparent, and credible process to all parties, resulting in outcomes that are seen fair, effective, and lasting.

536. The Grievance Redress Mechanism GRM is proposed to address any complaints or grievances arising during the implementation period of the projects undertaken by Project Authority such as (Local Government Department) which is responsible for executing the Project. Members of the public may perceive risks to themselves or their property or their legal rights or have concerns about the possible adverse environmental and social impact that a project may have. Any concerns or grievances should be addressed quickly and transparently, and without retribution to the affected person or complainant.

537. The primary principle is that any complaints or grievances are resolved as quickly as possible in a fair and transparent manner. However, the project based GRM will not bar aggrieved persons to avail remedies available under the court of law and they will be at liberty to approach the court of law as and when they wish to do so.

538. The Grievance redress mechanism available under LAA 1894 to address the concerns of legal title holders about matters related to assessment and valuation of land asset, land ownership and payment of compensation for acquired ROW land and it will not be available to the encroachers/non-title holders in the sub-project corridor. Thus, the mechanism does not enable the project executors and the DPs to resolve their grievances except those related to land acquisition matters only. So, to address the gaps a mechanism will be established to address/resolve the project related grievances including the DPs concerns or grievances related to impact assessment, valuation and compensation to eligible DPs resettlement and relocation related grievances as well as social and environmental grievances encountered during execution of the project works. Accordingly, the GRM proposed in the LARP is tasked to address any grievances raised by DPs on LAR implementation grievances and their concerns related to social and environmental grievances that could arise during execution of project work.

539. At first instance, the efforts will be made to avoid grievances through strong consultations participation and information disclosure strategy and the LAR activities will be conducted in accordance with the LARP provisions. Nevertheless, it may be expected that some problems cannot be resolved through Consultation, Participation

and Information Disclosure Strategy (CPID) actions and, therefore, DPs require an accessible and effective GRM. The Project (ICI Interchange) will put in place its GRM structures from the beginning, i.e., as soon as activities for project design and preparation or implementation of LARP and from the commencement of the construction activities. The GRM will remain intact throughout project implementation period to address the community concerns and grievances arising during execution of project works.

540. The formal GRM will be set up with a three-tiered structure including: first at site/village level set-up through community involvement; second at Project Implementation Unit (PIU) level and third at Project Management Unit (PMU) level enabling immediate local recourse to address grievances and higher-level review for addressing more difficult cases not resolved at the PIU or local level. To ensure that all geographic reaches and relevant administrative units involved in the project are covered, the GRM will set up (i) a local mechanism in each affected site with grievance redress focal points and; (ii) a grievance redress committees (GRC) at PIU and PMU levels.

541. A three tier GRM system will deal with all cases of grievances arising out of project implementation, particularly focusing on social/resettlement and environmental management and implementation of the Project. The functions and responsibilities for each level of GRM are explained below.

542. Grievance Redress Mechanism (GRM) is important for developmental projects where ongoing risks or adverse impacts are anticipated. This mechanism serves as a way to meet requirements, prevent and address community concerns, reduce risks, and assist larger processes that create positive social change. The major objective of GRM is to implement and maintain a procedure for handling environmental and social concerns of the project stakeholders. This procedure will include a redress mechanism scaled to the project’s identified risks and adverse impacts, focusing on stakeholders.

9.2 FIRST LEVEL OF GRM

543. The first level of grievance redress system includes the Site/village level Displaced Person Committee (DPC) selected and nominated by the displaced persons from each affected settlement located along the project road alignment. The DPC will be presided by its president who will be selected by the committee members nominated by the displaced persons. These DPCs will be a formal node for coordination and communication with the project execution authorities and are required to act as local node for recording and redress of grievances as per their local customs and practices. The technical staff will maintain a close liaison with the DPCs to guide and assist them in recording and resolution of grievances. In this regards, the resettlement/environmental specialist and social mobilizers will closely coordinate and work together with the DPC members and the local community to ensure grievances are recorded, investigated and discussed during DPC’s meetings and guide them to explore and recommend remedial measures at their level. They will also liaise with the counterpart engineering staff, and contractors to ensure implementation of the DPC’s

recommendations and/or raising the complaint to second level of GRM/GRC for review and redress if the grievances are not resolved at DPC level.

9.3 SECOND LEVEL OF GRM

544. If the grievance is not resolved at site DPC level, it shall be raised to formal grievance redress mechanism which is second level of GRM. A formal complaint will be tendered with the PIU GRC by the aggrieved DPs or through the social mobilizers. A complaint register will be maintained by the GRC through Assistant Director Environment & Social Safeguards (land management, implementation and social) to record the complaints received covering

545. Complaint receipt date, name and address of the complainant, gist of complaint, gist of field report, decision of GRC with its communication date to the DPs and decision implementation status or elevating the complaint to next level of GRM in case of disagreement by the aggrieved DPs.

546. Once the complaint is submitted with the PIU GRC, it shall be recorded in complaint register and send acknowledgement to the DP without delay; and initiate the process of investigation within 5 business days through its technical and resettlement field teams. After receipt of directions of GRC, the field teams including resettlement specialist and Land Staff will coordinate with complainant and complete its investigation of facts in consultation with aggrieved person, DPC representatives and local community and submit its fact-finding report and recommendations to the GRC within 15 business days from the receipt of complaint. Upon receipt of the fact-finding report, the GRC will summon and hear the aggrieved person and decide the complaint based on ground facts but in accordance with the agreed entitlements and provisions in the LARP/entitlement matrix and communicate its decision to the PMU and DPs within next 15 days. On an overall basis, the GRC will decide the grievances within 30 business days of receipt of complaint in GRC. If the final decision made by GRC is not acceptable to the DPs, they may advise GRC for elevation of their grievance to next higher level of GRM.

9.4 THIRD LEVEL OF GRM

547. In case the Displaced Persons (DPs) is unsatisfied with GRC decision, he himself or through GRC can elevate his complaint to third level of GRM i.e. at Environmental and Social Safeguards Unit (ESSU) in Project Management Unit (PMU) within 5 business days after GRC decision on complaint. Once the complaint is received at PMU along with GRC proceedings, it will be registered in PMU and the complainant will be informed by PMU staff accordingly. The GRC record and complainants’ claim will be scrutinized and the complainant will be advised to produce any additional record in favor of his claim. After thorough review and scrutiny of the available record ESSU/PMU can visit the field to meet the complainant, collect additional information and evidence if required. Once the investigations are completed the PMU/ESSU shall get its recommendations approved by member committee and forward these to the

Project Director of Mauripur to Y-Junction Expressway and the complainant accordingly within 30 days of receipt of the complaint. If still the grievance remains unaddressed, the complainant may directly approach the Court of Law as and when desired.

9.5 CONSTITUTION AND FUNCTION OF THE GRC

548. The primary objective of the Project based GRC is to provide a mechanism for mediating grievances and cutting down on lengthy litigation. It will be a public forum for raising concerns and invoking conflict resolution system available within the project for addressing LAR related and other social or environmental grievances adequately. The GRCs will continue to function, for the benefit of the DPs, during and after implementation of LARP till completion of the project.

549. The GRC will be headed by the Project Director, with members mentioned in the composition of the GRC. The member of the GRC could be increased, decreased and replaced at the time of the notification of GRC, according to the requirement and nature of grievances.

550. For redress of grievances, the GRC will meet at least once in a month. For the purpose of social safeguards, the GRC will review grievances involving all resettlement grievances including, compensation, relocation, and other assistance. GRC will perform following functions:

551. Record grievances of DPs; categorize and acknowledge the DPs about receipt of grievances; investigate the issue and summon aggrieved persons/parties to produce the evidence and explain their claims; and resolve the grievances within stipulated time frame preferably in 30 days;

552. Communicate its decisions and recommendations on all resolved disputes to Project executors and the aggrieved persons for implementation and follow the implementation progress;

553. Develop an information dissemination system and acknowledge the aggrieved parties about the development regarding their grievance and decision of PIU and PMU level;

554. Maintain a complaint register accessible to the all stakeholders with brief information about complaints and GRC decision with status report; and

555. Maintain complete record of all complaints received by the GRC with actions taken.

556. The GRC at PMU level will be composed following key members, but not limited to:

• Project Director/ Representative (PMU);	Chairman/Convener
• Director Technical (PMU);	Member
• Environmental/ Social Safeguards Expert (PMU);	Member
• Representative of Project Implementation Consultant; and	Member

557. The 50% quorum of the finalized GRC will have authority to conduct the meeting and take decisions accordingly.

9.6 INFORMATION DISSEMINATION AND COMMUNITY OUTREACH

558. In synchronization with on-going consultative process the grievance redress mechanism will also develop an information dissemination system to inform the DPs about their rights under the notational statutes and Environmental Social Management System (ESMS) provisions, ADB's SPS 2009, and approved LARP for the project. The DPs will be informed about the GRM, its functioning, complaint process to GRC and Environment Social Safeguards Unit (ESSU) at PMU, contact details of the focal members of the GRM at both levels. The GRC will send acknowledgement to complainants about receipt of complaint and to inform him about its site visit plan to ensure complainant is present during site visit, and provide update on the progress made to resolve his complaint/ grievance. Besides this formal communication, the Resettlement Specialist, Land staff and the social mobilizers of PMU in the field will maintain a close liaison with the complainants through DPCs at Site level and provide them the requisite information on the GRM and updates about the status of complaints under process with GRC or the ESSU whatsoever the case may be.

559. The aggrieved DP(s) will be kept informed about the actions on his/her complaint throughout the grievance resolution process and the aggrieved persons will be facilitated to attend and participate in the proceedings at different levels of grievance resolution process. Grievance flow mechanism and resolution process is summarized in the **Table 9.1** and **Figure 9.1.**

560. The typical grievances associated with the environmental and social aspects of the proposed project are likely to include but not limited the following:

- Land Acquisition
- Dust, noise and air pollution from construction activities;
- Intensive schedule of construction activities;
- Traffic movement;
- Water pollution;
- Waste (Construction & Municipal) disposal;
- Tree cutting; and
- Open dumping of construction material

Table 9.1: Grievance Redressal Process

Land/Crop Compensation Grievances	Project/ Other Grievances
• First, complaint resolution will be attempted at site (field level) through the involvement of the PIU/informal committee. • If unsettled, grievance can be lodged to the GRC or DO (Revenue)/LAC to proceed under law and communicate decision in least possible time. • GRC will acknowledge the complaint within 5 days of complaint and after initial review and consultation with the LAC, within 15 days of receipt of complaint, the GRC will clarify the legal course of action and guide aggrieved persons to approach appropriate legal forum. PIU will coordinate with the land administration authorities including District Collector and LAC to request early resolution of the issue/complaint. • In case grievance pertains to awarded compensation, the complainant will be clarified on the process set out in Section 18 to 22 of the LAA 1894.	• First, complaints resolution will be attempted at site (field level) through the involvement of the PMU/informal committee. • If unresolved, a grievance will be lodged to the GRC, which will acknowledge receipt of the complaint within 5 days. • The GRC will conduct fact finding in 15 days of receipt of complaint and after review of fact findings reports and hearing the DPs in person will conclude its recommendations in 30 days of receipt of complaint. In case GRC could not decide in stipulated time, the reasons if any will be recorded and the grievance will be resolved in next 30 days. • If the complainant is not satisfied, he can pursue further by submitting to the appropriate court of law.

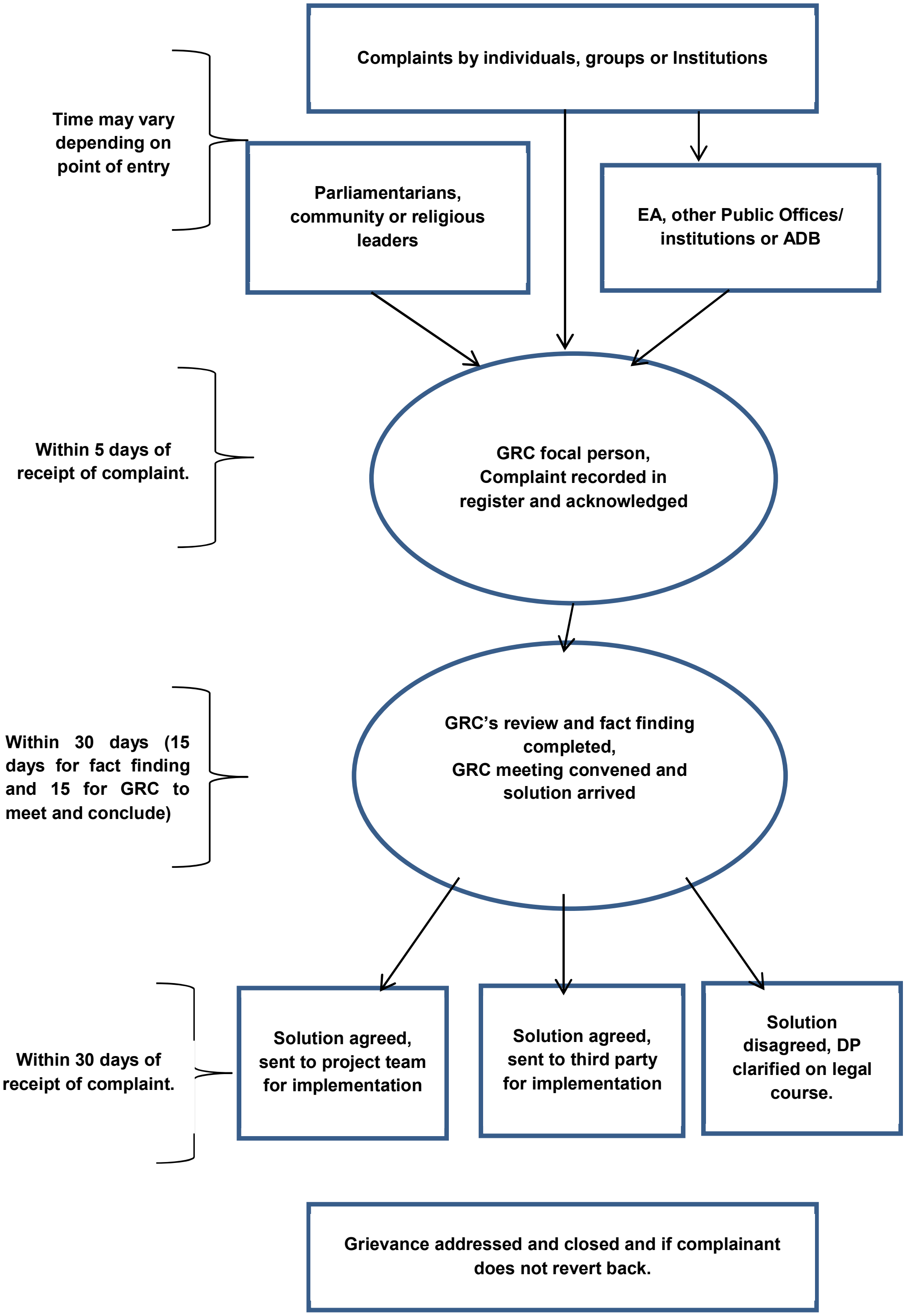


Figure 9.1: Grievance Resolution Flow Mechanism with Time Frame

10 CONCLUSION AND RECOMMENDATIONS

10.1 GENERAL

561. This report has been prepared in accordance with the requirements of Sindh Environmental Protection Act, 2014. Sindh Environmental Protection Agency (SEPA) (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, 2014, the proposed project falls under category E (Transportation) of Schedule II, which requires EIA before commencement of construction and also to fulfil requirements of international financial institutions.

10.2 CONCLUSIONS

562. After utilizing the environmental and social tools and analysis of the observed/recorded data for the EIA Study, it has been determined that the implementation of the proposed project will have many beneficial impacts on population residing around the project area and the daily road users/ travelers using the proposed ICI intersection. Presently, ICI intersection remains congested almost throughout the day, thus indicating the need of management of overall traffic load, which will be substantially improved through the proposed project.

563. No significant negative impact is foreseen during the operation stage of the project. The proposed construction of right-turn flyover for traffic towards ICI Bridge (West Wharf) will facilitate the freight traffic that comes from all over the country to Karachi Port and to reduce the traffic coming from / going to Lyari Expressway and Mauripur Road. The construction of this right-turn flyover will also reduce the traffic congestion at Jinnah Bridge, thereby facilitating smooth flow of traffic in and around the vicinity of the project and will benefit the people of Karachi. It will have a significant positive impact on air quality and traffic related pollution.

564. Major beneficial impacts of the proposed project are:

- Smooth traffic flow of the of the area, thereby facilitating the people of Karachi and business community;
- Provide the direct access to West Wharf for movement of their very important logistics timely at their destination
- Provide an additional passage to the heavy and light vehicles;
- Reduction of noise and air pollution;
- Less time will be required for travelling and reaching the destination;
- During the construction phase, local labour will be accommodated in the construction activities;
- Less fuel consumption will be another positive impact of the project in and around the project area; and
- Reduction in the number of accidents due to the traffic congestions.

565. Apart from the beneficial impacts of the project, the proposed project has some

adverse environmental and social impacts during construction phase. Most of the adverse impacts during construction are of a temporary nature except some land acquisition which is a permanent impact. These potential impacts can be avoided or mitigated by adopting suitable mitigation or remedial measures and judicious compensation as mentioned in this EIA Report. The major Environmental adverse impacts based on the findings of detailed EIA study will be:

566. One of the major project related impact will be the land acquisition. The land required for the proposed project is 684 sq.m that comprises of government land;

- Daily commute of the business community, Pakistan Navy, residents and students of the project area will be difficult during the construction phase due to construction activities. Moreover, improper traffic management may result in traffic jams on Mauripur Road and ICI bridge which will also cause inconvenience for port heavy traffic;
- Public utilities like electric poles, sewerage line, water line, light poles, underground electric cable, sui gas pipeline etc., may be affected and will create disruption of public services and economics;
- Generation of solid waste including construction and hazardous waste during construction phase will cause nuisance to the residents if not properly managed;
- Health risks and work safety problems may result at the workplace/camps if the working conditions provide unsafe and/or unfavorable working environment due to storage, handling and transport of construction materials and malfunctioning in operation of construction machinery and equipment;
- Air quality will be deteriorated during construction phase of interchange due to construction activities (operation of construction machinery, dust emissions, vehicular movement, etc.) which results in increase air and noise pollution along with associated health risks. During construction, the continuous operation of machinery and movement of heavy trucks/vehicles and construction activities may generate gaseous emissions, dust, noise/vibration which may severely affect the health of local residents, businessmen and the students during the study hours;
- During the operation phase of the proposed interchange, movement of vehicles and usage of pressure horns will create noise which will be a hazard for the surrounding local residents;
- Traffic management can influence both the speed and acceleration and deceleration patterns of vehicles. Acceleration and deceleration result in incomplete combustion and emissions of CO, NOx, and carbon-based particulate matter. Speed and acceleration also influence CO2 emissions. Improper traffic management during the operation phase may also increase the risk of road accidents in the project area; and
- Improper implementation of EMP may lead to incidents/ accidents which may cause serious health, safety and environment risks.

10.3 RECOMMENDATIONS

567. Following recommendations must be taken care prior to any of the decision about the proposed project:

- Adequate budget shall be provided in the project cost for the compensation to the affected people as per Land Acquisition Act, 1894. During detail design stage, land acquisition shall be worked out and RAP will be prepared as per resettlement framework;

- A proper traffic management/diversion plan must be formulated by the Contractor in consultation with Karachi Traffic Police Department and conveyed to the road users;
- Health and safety plan for the workers must be strictly followed and implemented during the construction phase;
- Use of horn should be strictly prohibited in the close proximity of sensitive receptors;
- Tree plantation/Land scape must be planned and implemented during operational phase by Local Government & HTP Department and Directorate of Parks and Horticulture-KMC;
- Monitoring of air, noise and water quality should be done according to the devised schedule in the EMP and compared with the SEQS;
- Operation and maintenance of the drainage structures and road wear and tear must be done periodically with respect to best management practices; and
- Proper implementation of EMP should be ensured during all phases of the proposed project. All personnel staff, employees and contractors/s should undertake appropriate training prior to construction to ensure they are aware of the on-site responsibilities in respect of all environmental and social issues. In addition, EMP should be a part of contract document of Contractor/s. Moreover, the cost for environmental management, monitoring and training has been estimated which should be included in overall Project Cost.

568. After thorough review of impact analysis and possible solutions, it has been concluded that the proposed Project is environmentally viable due to its low and controllable negative impacts on physical, ecological and social environment. The majority of these impacts are temporary in nature but in the long term, the project will improve overall environment of the area in terms of reduced travel time and cost, and efficient transport will directly contribute to the economic development and further increase in trade and services along the road section.

569. Overall, the impacts related to construction phase of the project could be minimized by the implementation of the proper mitigation measures.

LOCAL GOVERNMENT DEPARTMENT
GOVERNMENT OF SINDH

LOCAL GOVERNMENT &HTP DEPARTMENT GOVT OF SINDH

FEASIBILITY STUDY AND TRANSACTION ADVISORY SERVICES, ‘URBAN ROAD INITIATIVES INKARACHI’ PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

INTERCHANGE AT ICI BRIDGE

Volume 02 of 02

JUNE, 2021

National Engineering Services Pakistan (Pvt) Limited
1C, Block N, Model Town Ext, Lahore 54700, Pakistan
Phone: +92-42-99090000 Ext 200 Fax:+92-42-99231950
Email: geotech@nespak.com.pk, info@nespak.com.pk
http://www.nespak.com.pk

ANNEX-I

NATIONAL ENGINEERING SERVICES PAKISTAN (Pvt.) LIMITED

ANALYTICAL REPORT

KH20-03653 R0

Prepared for

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT) LIMITED

SGS E-Data
Understanding your Environment

https://edata.sgs.com

SGS - ENGAGE

JUST INTIME INFO ON YOUR
RESULTS AVAILABLE ON THE WEB
https://engage.sgs.com

TE-GL-[EHS]LAB-LIMS-001v3.1.3

ANALYTICAL REPORT KH20-03653 R0

First Page

Client	National Engineering Services Pakistan (Pvt)
Addres	West Wharf,
Contac	Project Manager
t Cell	+92 42 35204178
Email	wa@nespak.com.p
Projec	Environmental
Order	Boss.
Matrix/sample	Water

Manager	Iqbal Ashraf
Laborator	Chemical & Environmental Laboratory
y Address	H-3/3, Sector 5, Korangi Industrial Area Karachi 74900,
Telephon	+92 21-35121388-97
e Fax	+92-21-35121329
Email	Karachi.environment@sgs.com
SGS Reference	5208952
Received	27/11/2020
Analysis Started	27/11/2020
Analysis	10/12/2020
Completed	10/12/2020
Approved	10/12/2020
Date Reported	

CLIENT DETAILS

LABORATORY DETAILS

SIGNATORIES

Iqbal Ashraf	Zeeshan	Adnan
Deputy Manager	Deputy Manager Laboratory	

COMMENTS

The lab is accredited in accordance with ISO 17025 with accreditation number LAB

This report is not valid for any negotiation. The remaining portion of the sample(s) will be disposed after one week unless otherwise instructed (Condition Apply).

TABLE OF CONTENTS

Sample List

			pH in water	Color	Odor in Water	Taste in Water	Turbidity	Hardness	Total Dissolved Solids	Metals in Water by ICPOES	Mercury in Water	Chloride	Cyanide in Water	Fluoride	Nitrate in Water	Nitrite in Water	Total Phenolics in Water	Total Suspended Solids	Temperature	COD	BOD5	Oil & Grease	Anionic Detergent (MBAS) in Water	Sulphate in water	Sulfide in water	Ammonia by Titration	Residual Chlorine by Iodometric Method	Organo Chloro Pesticides	Total coliform	
KH20-03653	001	ICI Inter Change Point 01 (Waste Water)	X						X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X			
	002	ICI Inter Change Point 02 (Drinking water)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X								X	X	X	X

RESULTS

		Sample n°	KH20-03653-001	KH20-03653-002
		Sample Name	ICI Inter Change Point 01	ICI Inter Change Point 02
		Sample Matrix	Waste Water	Drinking Water
Parameter	Units	RL	Result	Result
[APHA 4500 H+ B 23rd Edition]				
pH @ 25 C	pH	0.1	07.30	07.34
[APHA 2120 C 23rd Edition]				
*True Color	Pt/Co Colour	5	-	5.00
[APHA 2150 A 23rd Edition]				
*Odor	---	-	-	Odorless
[APHA 2160 A 23rd Edition]				
*Taste	---	-	-	Sweet
[APHA 2130 B 23rd Edition]				
*Turbidity	NTU	0.2	-	3.0
[APHA 2340 A,B 23rd Edition]				
Total Hardness	mg/L	0.05	-	184.53
[APHA 2540 C 23rd Edition]				
Total Dissolved Solids	mg/L	5	8252.00	352.00
[APHA 3120 B 23rd Edition]				
Aluminium, Al	mg/L	0.005	-	0.017
Antimony, Sb	mg/L	0.005	-	<0.005
*Arsenic, As	mg/L	0.005	<0.005	<0.005
*Barium, Ba	mg/L	0.005	0.150	0.047
*Boron, B	mg/L	0.005	1.400	0.093
Cadmium, Cd	mg/L	0.003	<0.003	<0.003
Total Chromium(Cr+3 + Cr+6)	mg/L	0.005	0.025	<0.005
Copper, Cu	mg/L	0.005	0.160	0.007
Lead, Pb	mg/L	0.005	0.033	<0.005
Manganese, Mn	mg/L	0.005	0.270	0.023
Nickel, Ni	mg/L	0.005	0.006	<0.005
Zinc, Zn	mg/L	0.005	0.330	0.250
*Selenium, Se	mg/L	0.005	<0.005	<0.005
Total Iron (Fe+2 + Fe+3)	mg/L	0.005	4.300	-
*Silver, Ag	mg/L	0.005	<0.005	-
*Total toxic Metals	mg/L	-	1.80	-
[APHA 3112 B 23rd Edition]				
* Mercury, Hg	mg/L	0.001	<0.001	<0.001
[APHA 4500 CL B 23rd Edition]				
Chloride	mg/L	5	4013.69	95.24
[APHA 4500 CN E 23rd Edition]				
*Cyanide	mg/L	0.01	<0.01	<0.01
[APHA 4500 F C 23rd Edition]				
*Fluoride by ISE	mg/L	0.05	0.32	0.10
[APHA 4500 NO3 B 23rd Edition]				
*Nitrate Nitrogen, NO3 as N	mg/L	0.003	-	0.100
[APHA 4500 NO2 B 23rd Edition]				
*Nitrite Nitrogen, NO2 as N	mg/L	0.003	-	<0.003
[APHA 5530 B & C 23rd Edition]				
*Total Phenols	mg/L	0.002	0.016	<0.002
[APHA 2540 D 23rd Edition]				
Total Suspended Solids	mg/L	5	238.00	-
[Temperature]				
*Temperature at the Field	°C	-	26.4	23.1
[APHA 5220 D 23rd Edition]				
Chemical Oxygen Demand	mg/L	5	1480.00	-
[APHA 5210 D 23rd Edition]				
Biochemical Oxygen Demand (BOD5)	mg/L	2	511.00	-
[USEPA 1664 B]				
*Oil & Grease	mg/L	1	74.50	-
[APHA 5540 C 23rd Edition]				
*Anionic Surfactants as MBAS	mg/L	0.1	0.33	-

RESULTS

		Sample n°	KH20-03653-001	KH20-03653-002
		Sample Name	Korangi Link Road Point 01	Korangi Link Road Point 02
		Sample Matrix	Waste Water	Drinking Water
Parameter	Units	RL	Result	Result
[APHA 4500 SO4 C 23rd Edition]				
Sulphate (SO4^{2-})	mg/L	5	257.60	-
[APHA 4500 S F 23rd Edition]				
* Sulfide	mg/L	1	<1.00	-
[APHA 4500 NH3 B, C 23rd Edition]				
* Ammonia	mg/L	1	128.98	-
[APHA 4500 CL B 23rd Edition]				
* Residual Chlorine	mg/L	1	<1.00	<1.00
Organo Chloro Pesticides [EPA 3510 + USEPA 8081]				
* Chloro Pesticides	µg/L	1	-	<1.00
[0005 + APHA 9222 B 23rd Edition]				
Total Coliforms	cfu/100mL	1	-	TNTC
[0005 + APHA 9222 D 23rd Edition]				
Faecal Coliform (E.Coli)	cfu/100mL	1	-	Absent

FOOTNOTES

^ Performed by external SGS laboratory.

^^ Performed by

outside laboratory. RL

Reporting Limit.

↑ Raised Limit of Reporting.

↓ Lowered Limit of Reporting.

IS	Insufficient sample
L	for analysis.
N	Sample listed, but
R	not received.
N	The sample was not analysed
A	for this analyte Resultto be
N	validated
V	Parameter not yet analysed
L	
T	
B	
A	

ACCREDITATION NOTES

* This analysis is not covered by the scope of accreditation.

The results contained in the following report refer only to the sample tested.
This Report or a copy thereof will be retained by the Company for a period of 10 years.
Comparison of the results with the respective limits, when present, does not take into account the uncertainty of the estimated extent. Any results out of range are marked in red.

The recovery where provided,is to be understood comprised within the specific acceptability limits. Unless otherwise stated the result is to be understood not corrected for recovery obtained.

This report must not be reproduced, except infull.

--- End of the analytical report ---

SGS Ref.: 5208952
Ambient Air Quality Monitoring
NESPAK
Report Date: 04-Dec-2020

Ambient Air Quality Monitoring Report

NESPAK

Point # 01, Karama Mosque

Meteorological Data

Client / Account : **Nespak**

Location : **West Wharf, Karachi.**

Sampling Point ID : **Karama Mosque**

Date of Intervention : **23-24 Nov, 2020**

Time (Hrs)	Temperature	Wind Direction	Wind Speed	Humidity	Atmospheric Pressure (mm-Hg)
	˚C		m/s	%	
16:00	28.2	SW	1.8	52.0	759.9
17:00	30.9	SW	0.4	53.0	760.1
18:00	23.1	SW	1.8	59.0	760.4
19:00	24.2	SW	0.9	63.0	761.3
20:00	23.9	SW	0.9	65.0	761.6
21:00	23.8	SW	0.9	64.0	761.7
22:00	23.7	SW	0.4	64.0	761.6
23:00	22.9	SW	0.1	67.0	761.5
0:00	23.4	S	0.9	65.0	761.0
1:00	23.2	S	0.4	66.0	761.2
2:00	23.5	S	1.8	64.0	761.1
3:00	23.2	W	2.7	65.0	761.1
4:00	22.9	W	1.5	68.0	761.0
5:00	22.7	S	2.3	63.0	761.0
6:00	22.6	S	0.8	59.0	761.0
7:00	21.8	SW	1.3	62.0	761.7
8:00	22.2	SW	4.0	53.0	762.1
9:00	23.1	S	4.0	45.0	762.5
10:00	24.7	S	3.6	42.0	762.7
11:00	25.2	S	3.1	39.0	762.4
12:00	25.9	S	3.6	39.0	762.2
13:00	26.7	S	4.0	37.0	762.2
14:00	26.3	SW	3.6	34.0	761.4
15:00	26.2	S	2.6	36.0	761.3

Ambient Air Quality Monitoring
NESPAK
Report Date: 04-Dec-2020

Meteorological Data

Client / Account : **Nespak**
Location : **West Wharf, Karachi.**
Sampling Point ID : **Karama Mosque**
Date of Intervention : **23-24 Nov, 2020**

Time (Hrs)	Temperature	Wind Direction	Wind Speed	Humidity	Atmospheric Pressure (mm-Hg)
	˚C		m/s	%	
16:00	28.2	SW	1.8	52.0	759.9
17:00	30.9	SW	0.4	53.0	760.1
18:00	23.1	SW	1.8	59.0	760.4
19:00	24.2	SW	0.9	63.0	761.3
20:00	23.9	SW	0.9	65.0	761.6
21:00	23.8	SW	0.9	64.0	761.7
22:00	23.7	SW	0.4	64.0	761.6
23:00	22.9	SW	0.1	67.0	761.5
0:00	23.4	S	0.9	65.0	761.0
1:00	23.2	S	0.4	66.0	761.2
2:00	23.5	S	1.8	64.0	761.1
3:00	23.2	W	2.7	65.0	761.1
4:00	22.9	W	1.5	68.0	761.0
5:00	22.7	S	2.3	63.0	761.0
6:00	22.6	S	0.8	59.0	761.0
7:00	21.8	SW	1.3	62.0	761.7
8:00	22.2	SW	4.0	53.0	762.1
9:00	23.1	S	4.0	45.0	762.5
10:00	24.7	S	3.6	42.0	762.7
11:00	25.2	S	3.1	39.0	762.4
12:00	25.9	S	3.6	39.0	762.2
13:00	26.7	S	4.0	37.0	762.2
14:00	26.3	SW	3.6	34.0	761.4
15:00	26.2	S	2.6	36.0	761.3

Client / Account : **Nespak**

Location : **West Wharf, Karachi.**

Sampling Point ID : **Karama Mosque**

Date of Intervention : **23-24 Nov, 2020**

Sr. #	Time	CO (mg/m^3)	NO (µg/m^3)	NO$_2$ (µg/m^3)	NO$_x$ (µg/m^3)	SO$_2$ (µg/m^3)
1	16:00	3.3	9.8	0.0	9.8	4.3
2	17:00	3.2	9.6	0.1	9.7	4.0
3	18:00	4.6	9.4	0.1	9.5	5.4
4	19:00	1.0	8.9	0.2	9.1	4.5
5	20:00	2.8	8.6	0.1	8.7	4.3
6	21:00	1.0	8.4	0.0	8.4	4.5
7	22:00	1.0	7.6	0.2	7.8	6.6
8	23:00	1.5	10.1	0.0	10.1	6.2
9	0:00	1.0	10.2	0.0	10.2	6.6
10	1:00	2.3	10.3	0.0	10.3	6.7
11	2:00	5.2	10.2	0.0	10.2	5.0
12	3:00	3.8	9.8	0.0	9.8	4.3
13	4:00	1.7	9.6	0.0	9.6	4.4
14	5:00	2.9	9.1	0.0	9.1	4.1
15	6:00	2.8	9.0	0.0	9.0	4.3
16	7:00	6.7	9.6	0.0	9.6	4.4
17	8:00	1.8	9.1	0.0	9.1	5.4
18	9:00	2.9	9.8	0.0	9.8	4.9
19	10:00	2.2	8.9	0.0	8.9	5.9
20	11:00	1.7	8.6	0.1	8.7	7.1
21	12:00	1.6	8.4	0.2	8.6	7.2
22	13:00	1.4	10.1	0.0	10.1	2.3
23	14:00	1.6	10.2	0.1	10.3	3.1
24	15:00	1.8	10.1	0.1	10.2	3.3
24 Hours Average		2.5	9.4	0.1	9.4	5.0

Client / Account : **Nespak**

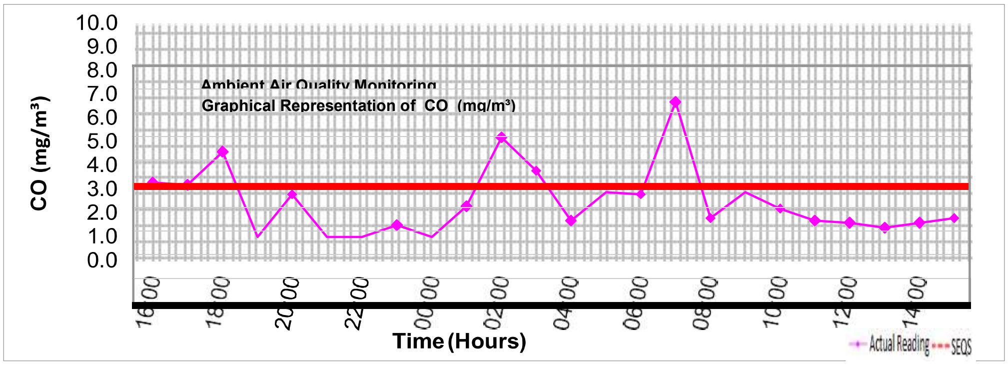
Location : **West Wharf, Karachi.**

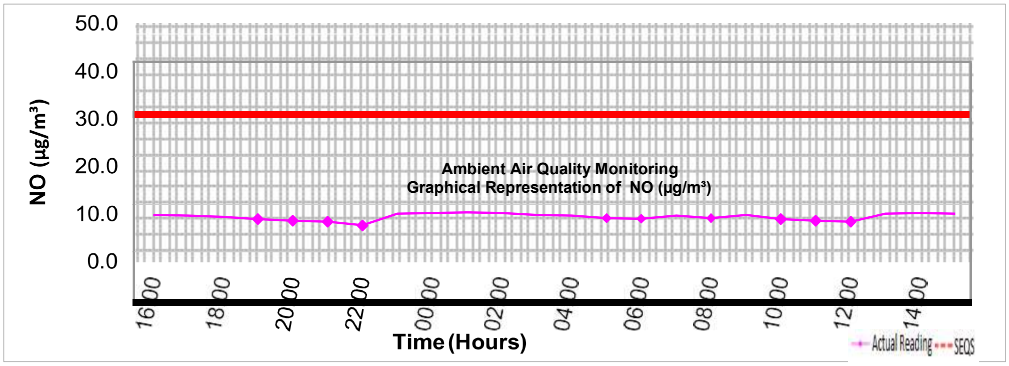
Sampling Point ID : **Karama Mosque**

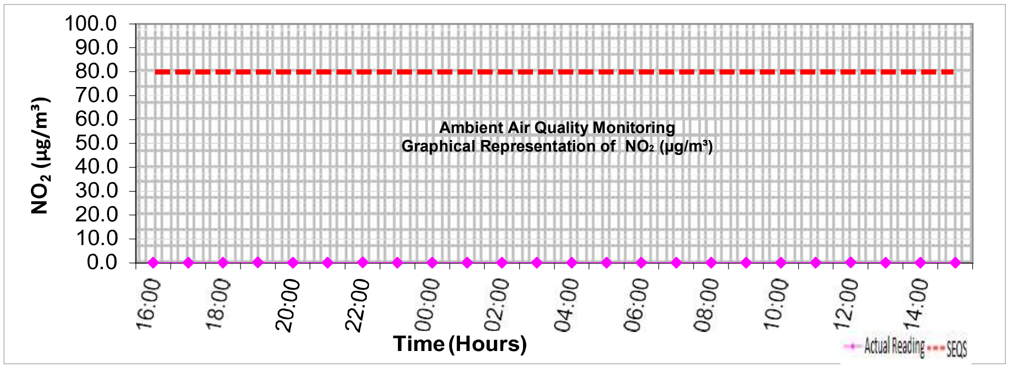
Date of Intervention : **23-24 Nov, 2020**

Sr. #	Time	O_3 (ppb)	TSP (µg/m^3)	PM$_{10}$ (µg/m^3)	PM$_{2.5}$ (µg/m^3)
1	16:00	16.0	476.8	356.6	63.5
2	17:00	11.0	522.8	393.1	20.8
3	18:00	23.0	492.3	390.1	70.3
4	19:00	31.0	501.1	351.1	81.2
5	20:00	26.0	428.1	362.1	71.3
6	21:00	21.0	476.1	356.1	63.2
7	22:00	12.0	522.1	393.1	70.8
8	23:00	15.0	510.7	382.5	66.2
9	0:00	25.0	440.1	340.4	67.8
10	1:00	28.0	553.4	433.4	74.9
11	2:00	35.0	429.4	330.5	62.2
12	3:00	28.0	526.4	405.6	67.7
13	4:00	26.0	490.0	383.5	69.5
14	5:00	15.0	683.0	501.9	116.4
15	6:00	19.0	806.5	596.1	121.4
16	7:00	14.1	857.4	445.1	70.3
17	8:00	18.2	675.4	430.4	67.4
18	9:00	22.4	648.3	448.4	68.4
19	10:00	16.8	748.3	504.3	73.6
20	11:00	24.7	755.0	604.1	70.4
21	12:00	33.8	445.0	335.3	53.4
22	13:00	28.0	435.0	311.4	49.4
23	14:00	44.0	439.0	342.4	49.6
24	15:00	44.0	414.0	318.0	45.6
24 Hours Average		24.0	553.2	404.8	68.1

Graphical Representation

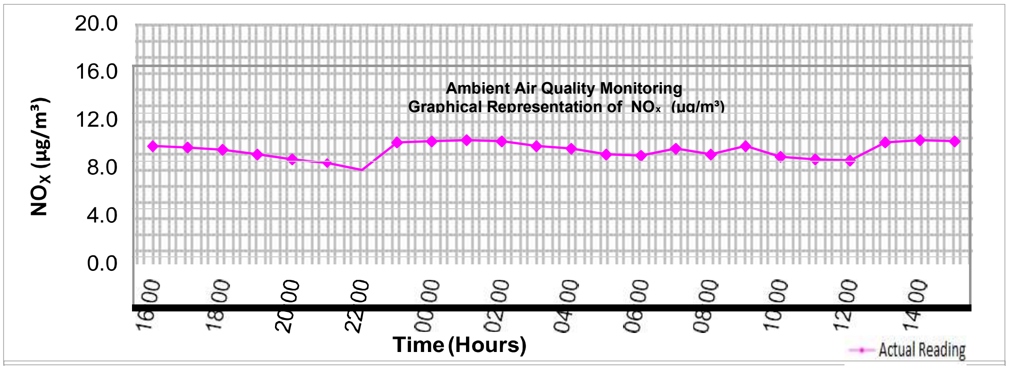


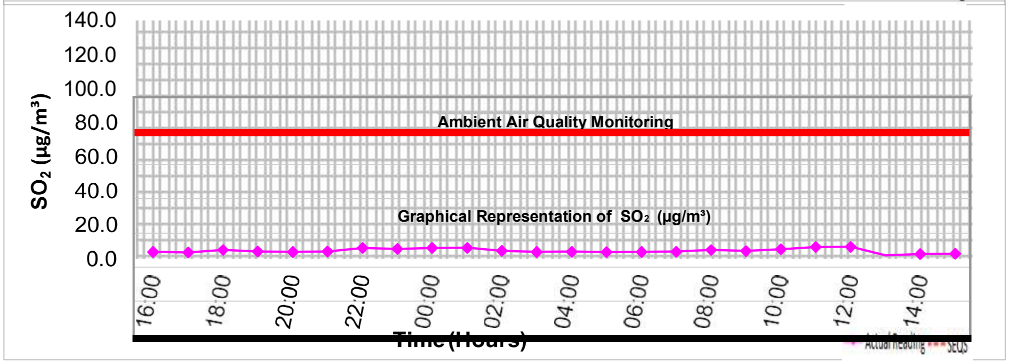


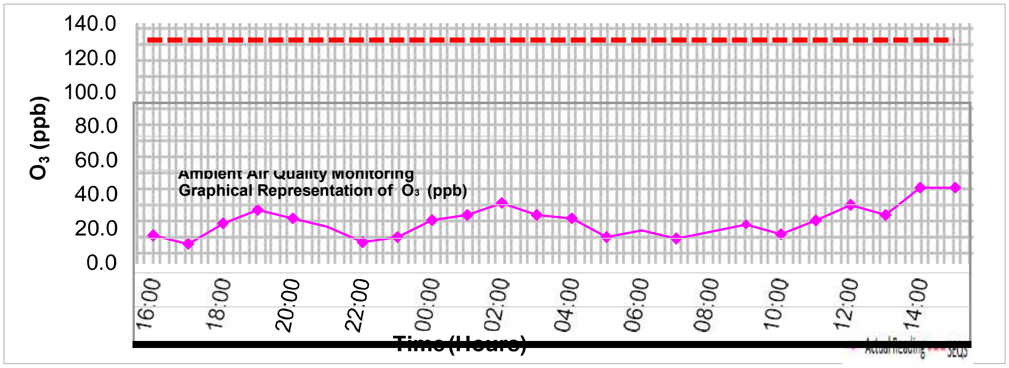


NESPAK

Graphical Representation

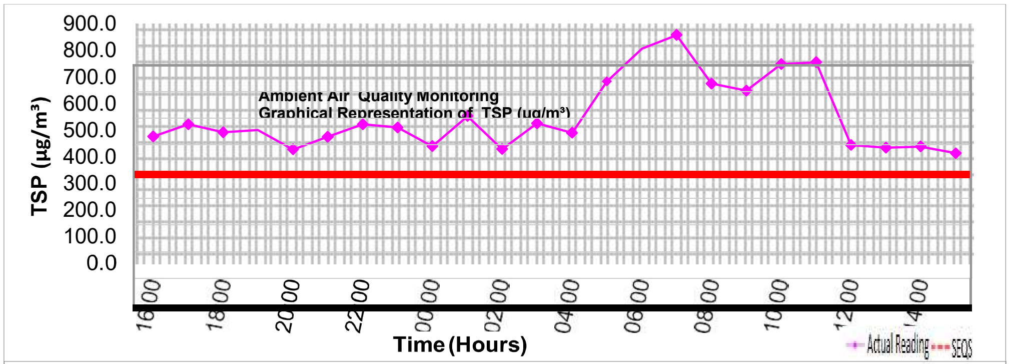


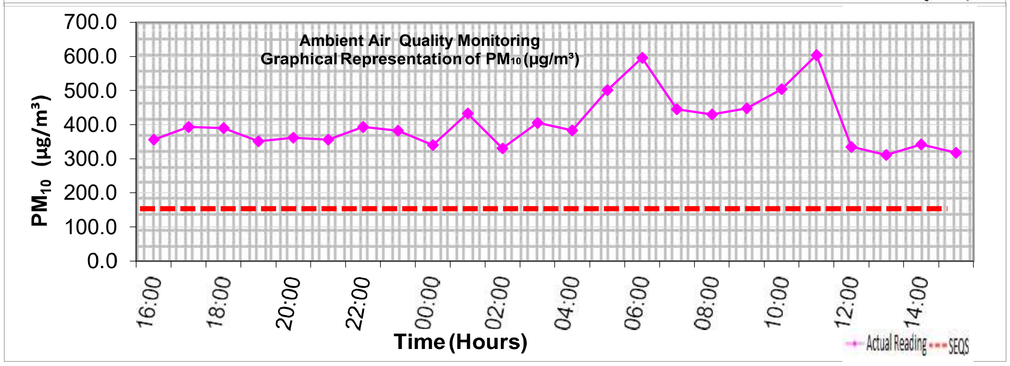


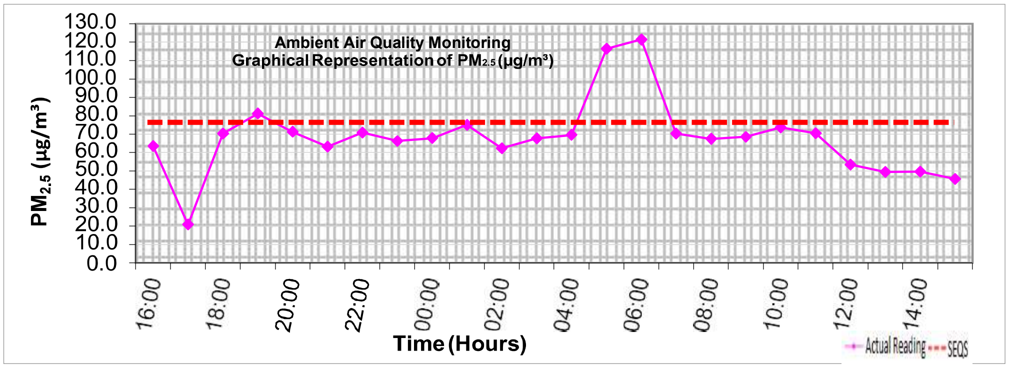


Nespak

Graphical Representation







Average Results

Client / Account	:	**Nespak**
Location	:	**West Wharf, Karachi.**
Sampling Point ID	:	**Karama Mosque**
Date of Intervention	:	**23-24 Nov, 2020**

Parameters	Unit	Duration	Average Concentration	SEQS Limits
Carbon Monoxide (CO)	mg/m^3	24 Hours	2.5	5.0*
Nitrogen Dioxide (NO_2)	µg/m^3	24 Hours	0.1	80**
Nitrogen Oxide (NO)	µg/m^3	24 Hours	9.4	40**
Sulfur Dioxide (SO_2)	µg/m^3	24 Hours	5.0	120**
Total Suspended Particulate (TSP)	µg/m^3	24 Hours	553.2	500**
Particulate Matter (PM_{10})	µg/m^3	24 Hours	404.8	150**
Particulate Matter ($PM_{2.5}$)	µg/m^3	24 Hours	68.1	75**
Ozone (O_3)	ppb	01 Hour	24.0	130***
Lead (Pb)	µg/m^3	24 Hours	<1.0	1.5**

SEQS : Sindh Environmental Quality Standards
µg/m^3 : micro grams per
cubic meter mg/m^3 :
miligram per meter cube.
ppm : part per million
ND : Not Detected
* SEQS limit of CO as per 8 hours
** SEQS limit for 24 hours
*** SEQS Limit of Ozone as per 1 hour measurement

Ambient Air Quality Monitoring Report
NESPAK
Point # 02, Infront of ICI

Meteorological Data

Client / Account : **Nespak**
Location : **West Wharf, Karachi.**
Sampling Point ID : **Infront of ICI**
Date of Intervention : **24-25 Nov, 2020**

Time (Hrs)	Temperature	Wind Direction	Wind Speed	Humidity	Atmospheric Pressure (mm-Hg)
	˚C		m/s	%	
16:00	28.7	NW	8.9	33.0	759.1
17:00	26.6	NW	20.6	31.0	759.7
18:00	24.9	NW	4.9	32.0	760.5
19:00	23.0	NW	4.9	37.0	761.0
20:00	22.3	NW	4.9	39.0	761.5
21:00	21.5	NW	4.9	43.0	762.0
22:00	20.6	NW	5.8	50.0	762.5
10:00	19.1	NW	3.6	59.0	764.2
11:00	23.8	NW	4.9	54.0	763.5
12:00	20.9	NW	6.3	50.0	763.1
13:00	22.8	NW	5.8	47.0	762.1
14:00	24.3	NW	5.4	41.0	761.4
15:00	23.8	NW	5.6	42.0	761.8

23:00 - 09:00 value 0.0 Due to rain

Meteorological Data

Client / Account : **Nespak**
Location : **West Wharf, Karachi.**
Sampling Point ID : **Infront of ICI**
Date of Intervention : **24-25 Nov, 2020**

Sr. #	Time	CO (mg/m^3)	NO (µg/m^3)	NO_2 (µg/m^3)	NO_x (µg/m^3)	SO_2 (µg/m^3)
1	16:00	3.2	9.6	0.0	9.6	4.4
2	17:00	3.2	9.4	0.1	9.5	4.6
3	18:00	3.1	9.0	0.1	9.1	4.3
4	19:00	6.1	8.6	0.0	8.6	6.4
5	20:00	2.6	8.2	0.0	8.2	3.1
6	21:00	2.4	8.3	0.0	8.3	3.6
7	22:00	2.8	8.6	0.0	8.6	6.5
8	10:00	3.1	9.0	0.0	9.0	3.6
9	11:00	2.2	9.1	0.0	9.1	3.4
10	12:00	2.1	8.9	0.1	9.0	3.4
11	13:00	2.2	8.0	0.0	8.0	3.6
12	14:00	1.2	9.0	0.1	9.1	3.2
13	15:00	1.4	9.1	0.0	9.1	3.2
24 Hours Average		2.7	8.8	0.0	8.9	4.1

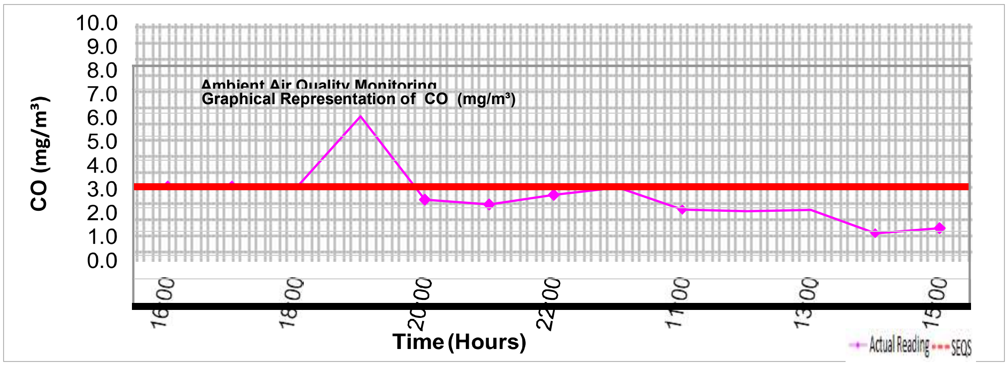
23:00 - 09:00 value 0.0 Due to rain

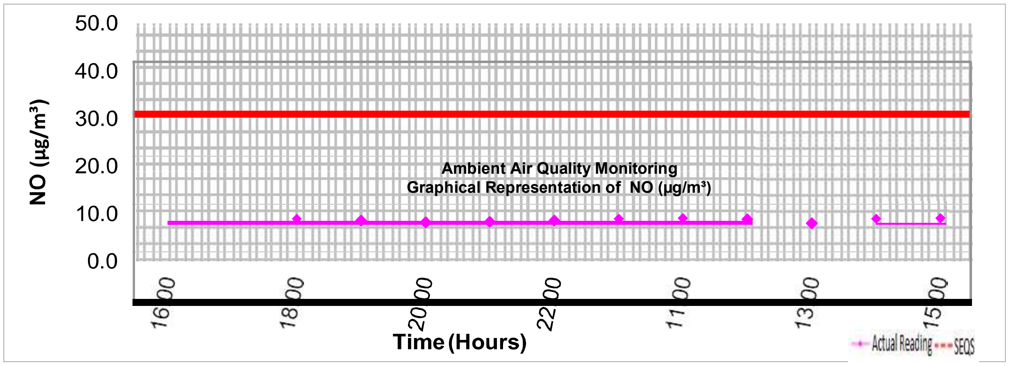
Client / Account : **Nespak**
Location : **West Wharf, Karachi.**
Sampling Point ID : **Infront of ICI**
Date of Intervention : **24-25 Nov, 2020**

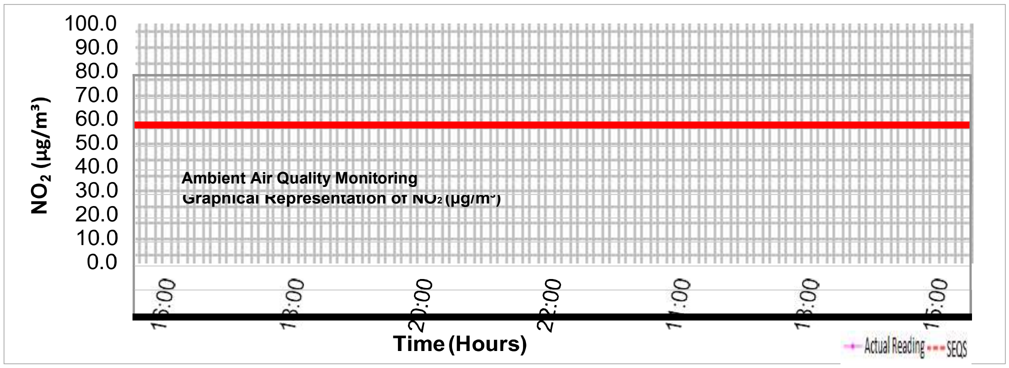
Sr. #	Time	O_3 (ppb)	TSP ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)
1	16:00	46.0	677.4	475.3	186.4
2	17:00	44.0	710.4	554.4	118.4
3	18:00	28.0	854.9	528.7	86.4
4	19:00	30.0	525.8	369.4	70.2
5	20:00	22.0	982.4	668.4	87.4
6	21:00	16.0	471.5	369.4	79.8
7	22:00	18.0	986.3	564.8	252.6
8	10:00	14.0	418.6	315.1	70.1
9	11:00	15.0	432.1	325.3	56.3
10	12:00	16.0	198.1	135.3	43.4
11	13:00	22.0	199.4	145.6	45.6
12	14:00	24.0	198.6	135.4	47.3
13	15:00	25.0	195.0	144.4	40.4
24 Hours Average		24.6	527.0	364.0	91.1

23:00 - 09:00 value 0.0 Due to rain

Graphical Representation

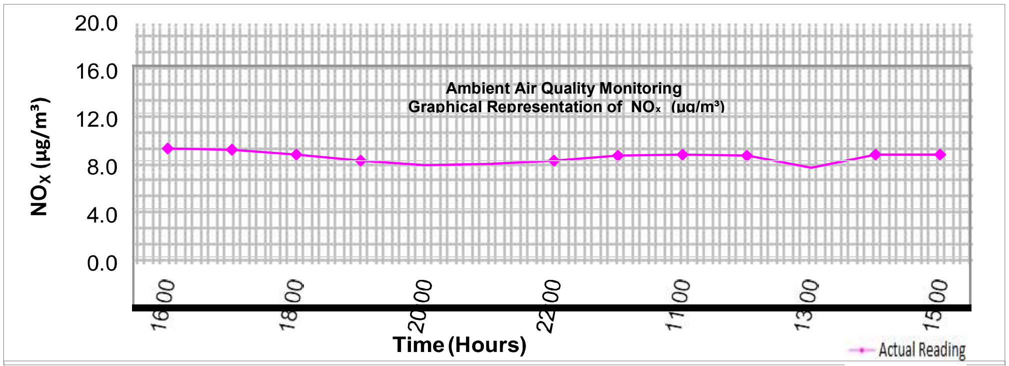


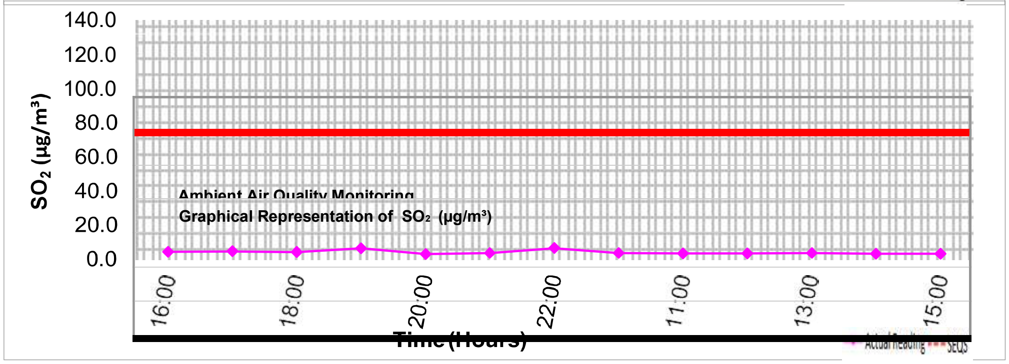


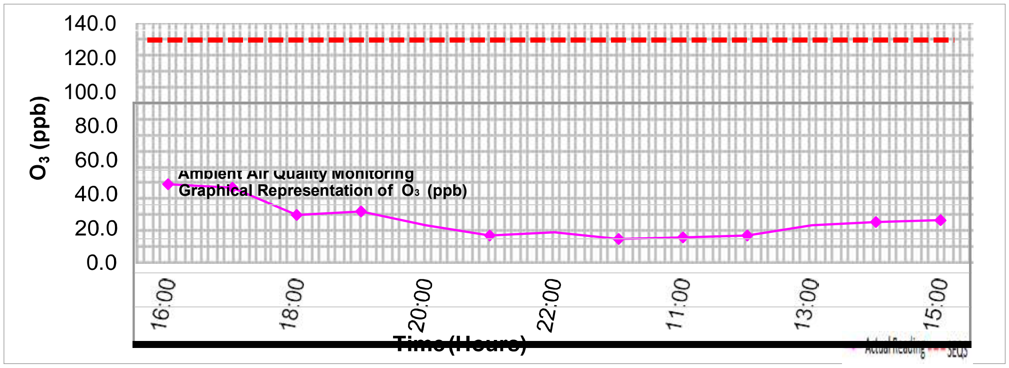


Nespak

Graphical Representation

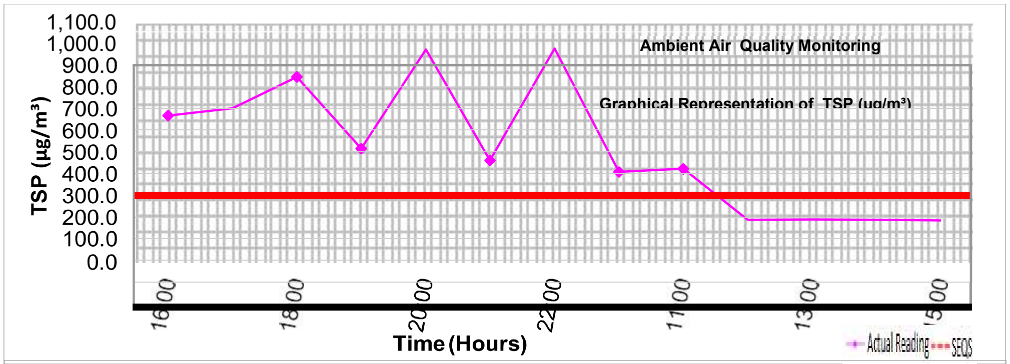


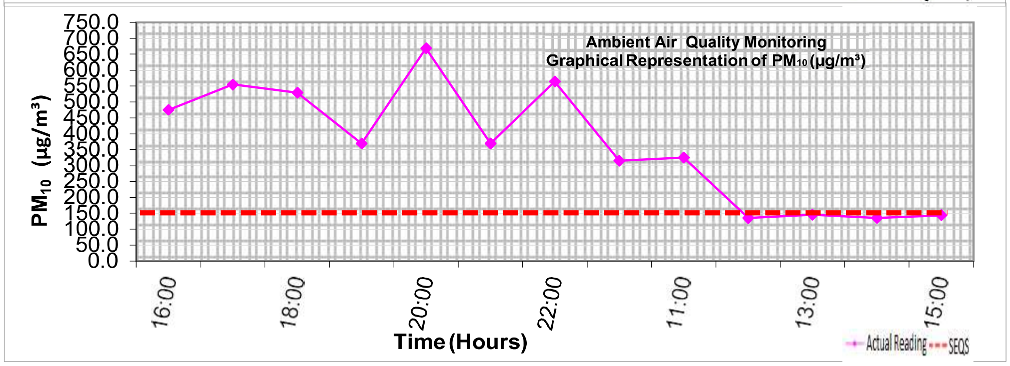


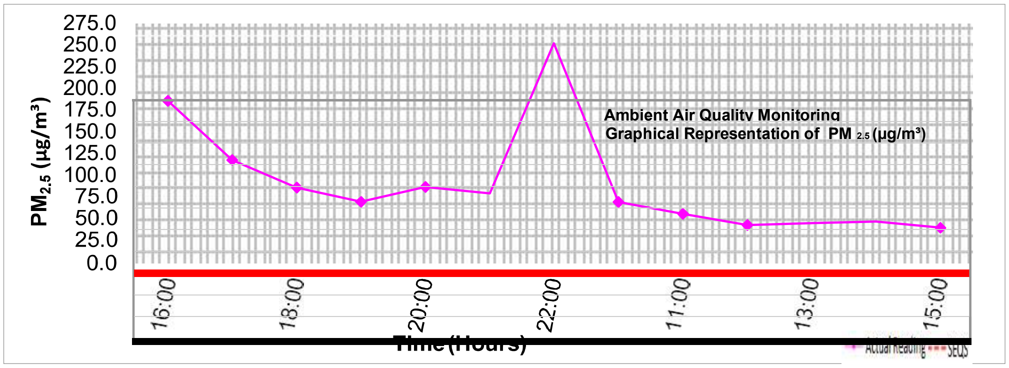


Nespak

Graphical Representation







Average Results

Client / Account	:	**Nespak**
Location	:	**West Wharf, Karachi.**
Sampling Point ID	:	**Infront of ICI**
Date of Intervention	:	**24-25 Nov, 2020**

Parameters	Unit	Duration	Average Concentration	SEQS Limits
Carbon Monoxide (CO)	mg/m^3	24 Hours	2.7	5.0*
Nitrogen Dioxide (NO_2)	µg/m^3	24 Hours	0.0	80**
Nitrogen Oxide (NO)	µg/m^3	24 Hours	8.8	40**
Sulfur Dioxide (SO_2)	µg/m^3	24 Hours	4.1	120**
Total Suspended Particulate (TSP)	µg/m^3	24 Hours	527.0	500**
Particulate Matter (PM_{10})	µg/m^3	24 Hours	364.0	150**
Particulate Matter ($PM_{2.5}$)	µg/m^3	24 Hours	91.1	75**
Ozone (O_3)	ppb	01 Hour	24.6	130***
Lead (Pb)	µg/m^3	24 Hours	<1.0	1.5**

SEQS : Sindh Environmental Quality Standards
µg/m^3 : micro grams per
cubic meter mg/m^3 :
miligram per meter cube.
ppm : part per million
ND : Not Detected
* SEQS limit of CO as per 8 hours
** SEQS limit for 24 hours
*** SEQS Limit of Ozone as per 1 hour measurement

Client / Account	:	
Location	:	**West Wharf, Karachi.**
Sampling Point ID	:	**Karama Mosque**
Date of Intervention	:	**23-24 Nov, 2020**