Appendix 13.6 Drawings

Title	Drawing No.	Title	Drawing No.
SEWERAGE FACILITIES		**DRAINAGE FACILITIES**	
GENERAL		**GENERAL**	
GENERAL PLAN OF SEWERAGE FACILITIES	SGE-01	GENERAL PLAN OF DRAINAGE FACILITIES	DGE-01
TRUNK AND BRANCH SEWER		**DRAINAGE FACILITIES**	
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION		**GENERAL**	
PLAN (1/10 ~ 10/10)	TSL-01~10	TYPICAL CROSS SECTION	DG-01
PROFILE -TRUNK SEWER- (1/3 ~ 3/3)	TSL-11~13	DETAIL OF COVER	DG-02
PROFILE -BRANCH SEWER- (1/2 ~ 2/2)	TSL-14~15	**PLAN & PROFILE**	
DETAIL OF MANHOLE (UP TO 48" DIA SEWER) (1/2 ~ 2/2)	TSL-16~17	CENTRAL DRAIN (1/3 - 3/3)	DP-01~03
DETAIL OF MANHOLE (FOR 54" DIA SEWER) (1/2 ~ 2/2)	TSL-18~19	DIL MUHAMMAD ROAD DRAIN	DP-04
DETAIL OF DROP MANHOLE	TSL-20	GOVERNER HOUSE DRAIN (REHABILITATION) (1/2 - 2/2)	DP-05~06
TRUNK SEWER ALONG CANTONMENT DRAIN		ART COUNCIL DRAIN	DP-07
PLAN (1/8 ~ 8/8)	TSC-01~08	ALLAMA IQBAL ROAD DRAIN (1/4 -4/4)	DP-08~11
PROFILE (1/9 ~ 9/9)	TSC-9~17	WAPDA HOUSE DRAIN	DP-12
DETAIL OF MANHOLE (UP TO 48" DIA SEWER) (1/2 ~ 2/2)	TSC-18~19	LAWRENCE ROAD DRAIN	DP-13
DETAIL OF MANHOLE (FOR 54" DIA SEWER) (1/2 ~ 2/2)	TSC-20~21	NICHOLSON ROAD DRAIN	DP-14
DETAIL OF DROP MANHOLE	TSC-22	POONCH ROAD DRAIN	DP-15
DISPOSAL STATION (NEW GULSHAN-E-RAVI DISPOSAL STATION)		CHAUBURJI DRAIN	DP-16
GENERAL LAYOUT PLAN	DS-01	NEW SAMANABAD DRAIN	DP-17
DETAL PLAN	DS-02	MORRHE SAMANABAD DRAIN	DP-18
SECTION (1/2 ~ 2/2)	DS-03~04	MULTAN ROAD DRAIN & OLD BUND ROAD (1/2 - 2/2)	DP-19~20
COLLECTOR CHANNEL		ALMUMATAZ ROAD DRAIN	DP-21
PLAN & PROFILE (1/11 ~ 11/11)	CC-01~11	SODEWAL DRAIN	DP-22
TYPICAL CROSS SECTION	CC-12	GULGASHT DRAIN	DP-23
LIFT STATION		NASIR BAGH DRAIN	DP-24
DETAL PLAN	LS-01	MALL ROAD DRAIN	DP-25
SECTION	LS-02	QUEENS ROAD DRAIN	DP-26
WASTEWATER TREATMENT PLANT		SHAHRA AWANE TIJARAT ROAD DRAIN (1/3 - 3/3)	DP-27~29
General Layout Plan	WWTP-1	GOLF ROAD DRAIN	DP-30
Flow Diagram	WWTP-2	KINNAIRD DRAIN	DP-31
Hydraulic Profile	WWTP-3	SHAH JAMAL DRAIN	DP-32
Plan & Section (Receiving Chamber/Screen)	WWTP-4	GULSHAN-E-RAVI DRAIN (1/3 - 3/3)	DP-33~35
Plan & Section (Anaerobic Pond)	WWTP-5	SANDA ROAD DRAIN	DP-36
Plan & Section (Trickling Filter Basin)	WWTP-6	KRISHAN NAGAR DRAIN (1/2 - 2/2)	DP-37~38
Plan & Section (Sedimentation Pond)	WWTP-7	REWAZ GARDEN DRAIN	DP-39

APPENDIX 13.6.1 SEWERAGE FACILITIES

LEGEND

- EXISTING CANAL & DRAIN
- EXISTING PUMPING STATION
- PROPOSED TRUNK SEWER
- PROPOSED BRANCH SEWER
- PROPOSED PUMPING STATION
- PROPOSED TREATMENT PLANT

RIVER RAVI

3.0 x 1.8 m
L=1,490 m
S=1/4000

5.5 x 1.8 m
L=2,750 m
S=1/4000

10.0 x 2.2 m
L=3,150 m
S=1/3500

CHOTTA RAVI DRAINAGE PS

BHATTI GATE DS

MAIN OUTFALL 1~3 DS

COLLECTOR CHANNEL

LAKSHMI DRAIN

Ø54"
L=4,783 ft
S=0.00061
SANDA ROAD SEWER

Ø36"
L=899 ft
S=0.0007
THORNTON ROAD TO MCLEOD ROAD

Ø42"
L=2,270 ft
S=0.0006
MONTGOMARY ROAD SEWER

Ø24"
L=3,391 ft
S=0.0015
EMPRESS ROAD SEWER

Ø30"
L=1,350 ft
S=0.0017~0.006
MUHAMMAD NAGAR LS TO GARHI SHAHU CHOWK

Ø15"
L=480 ft
S=0.003~0.01
GHAZI MOHALLA LS TO GARHI SHAHU BAZAR

Ø36"
L=2,450 ft
S=0.0009
DAVIS ROAD SEWER

Ø84"
L=5,409 ft
S=0.00049

Ø72"
L=1,965 ft
S=0.00032

Ø60"
L=3,025 ft
S=0.00050

Ø48"
L=2,721 ft
S=0.00048

Ø24"
L=2,709 ft
S=0.00130

Ø84"
L=900 ft
S=0.00026

Ø60"
L=750 ft
S=0.00040

Ø30"
L=1,356 ft
S=0.00131

Ø90"
L=3,068 ft
S=0.00061

Ø90"
L=4,880 ft
S=0.00077

NEW GULSHAN -E-RAVI DS
(Total Capacity = 520 Cfs)

GULSHAN -E-RAVI DS

TRUNK SEWER FROM LAREX COLONY

TRUNK SEWER ALONG CANTONMENT DRAIN

Ø42"
L=2,500 ft
S=0.00120

Ø48"
L=4,500 ft
S=0.00090

Ø54"
L=2,580 ft
S=0.00085

12' x 8'
L=8,275 ft
S=0.00040

8' x 6'
L=7,000 ft
S=0.00055

7' x 6'
L=1,500 ft
S=0.00065

6' x 6'
L=3,000 ft
S=0.00075

Ø78"
L=4,325 ft
S=0.00070

Ø66"
L=2,025 ft
S=0.00070

Ø54"
L=4,850 ft
S=0.00085

Ø48"
L=2,025 ft
S=0.00090

LIFT STATION (pumping station)
(Total Capacity = 920 Cfs)

SOUTH WEST WWT

MULTAN ROAD DS

BABU SABU DRAINAGE PS

L'AHORE BYPASS

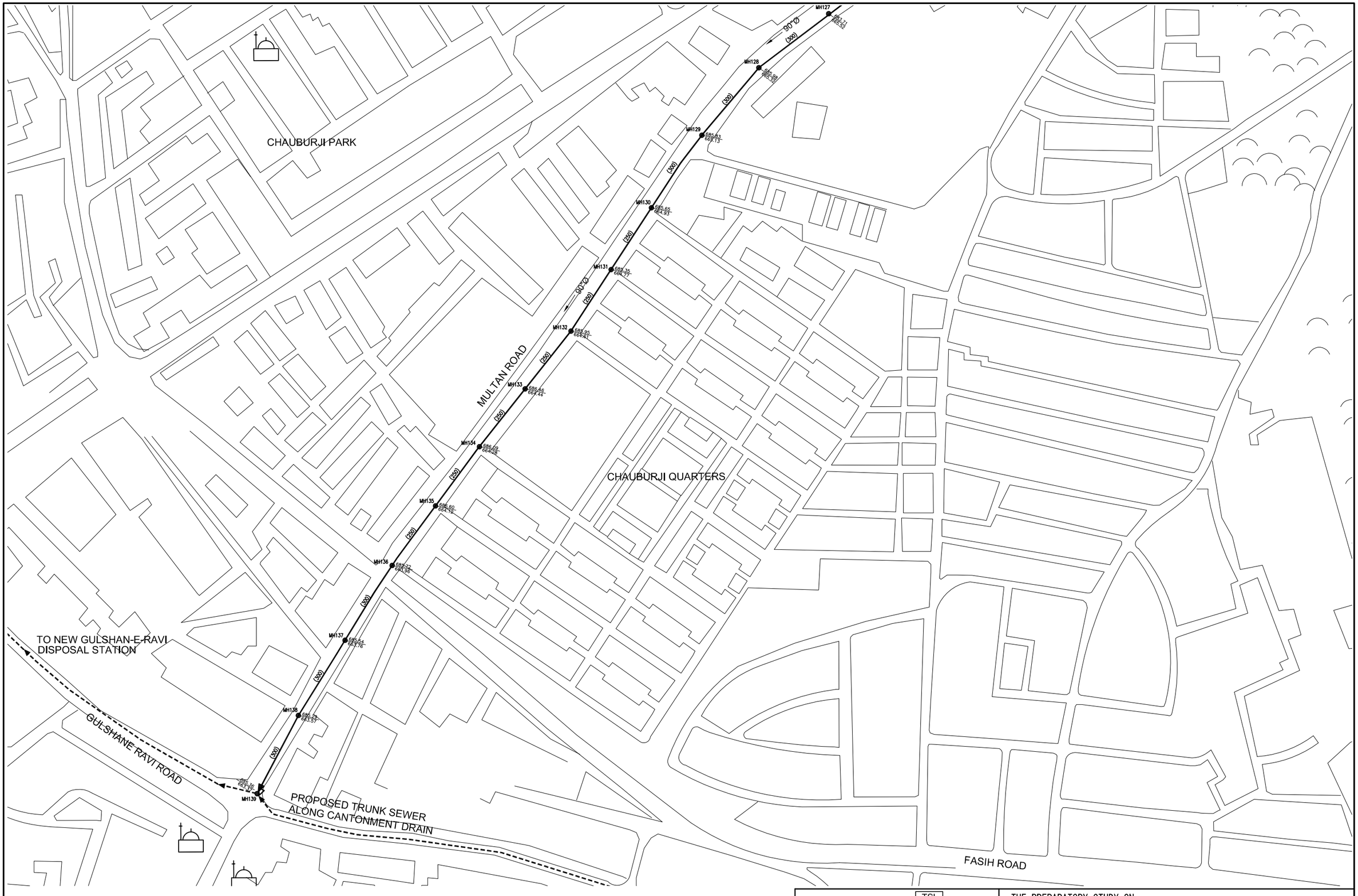
CANTONMENT DRAIN

A.I.T. DRAIN

GULBERG DRAIN NO.1

GULBERG DRAIN NO.2

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
SEWERAGE FACILITIES	SCALE	
GENERAL PLAN OF SEWERAGE FACILITIES	DWG No.	SGE-01



TSL 04 | TSL 05 | TSL 08 | TSL 07 | TSL 06 | TSL 10 | TSL 03 | TSL 09 | TSL 02 | TSL 01

INDEX OF DWG. No.

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	—
PLAN (1/10)	DWG No.	TSL-01

RAM NAGAR

LOWER

MH116 686.12 667.29

(300)

MH117 687.00 667.14

(300)

MH118 684.63 666.99

(300)

MH119 685.23 666.83

(300)

MH120 684.33 666.68

(300)

MH121 684.04 666.53

90°Ø

(90)

MH122 684.09 666.49

(300)

MH123 684.51 666.30

90°Ø

(300)

MH124 684.50 666.10

(300)

MH125 684.51 665.91

(300)

MH126 684.72 665.72

(300)

MH127 684.71 665.52

90°Ø

(300)

MH128 684.99 665.39

(300)

MH129 685.82 665.13

CHOBURJI CHOWK

BAHAWALPUR ROAD

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THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	—
PLAN (2/10)	DWG No.	TSL-02

MAO COLLEGE

REWAZ GARDENS

RAM NAGAR

LYTTON ROAD

LOWER MALL

54"Ø

84"Ø

90"Ø

96"Ø

MH110.14 (125) MH110.13 (126) MH110.12 (126) MH110.11 (191) MH110.10 (126) MH110.9 (125) MH110.8 (125) MH110.7 (160) MH110.6 (200) MH110.5 (200) MH110.4 (200) MH110.3 (170) MH110.2 (115) MH110.1 (115) MH110

MH110 (600) MH111 (300) MH112 (300) MH113 (300) MH114 (300) MH115 (300) MH116 (300) MH117

MH109 (150) MH108 (200) MH107 (200) MH106 (140) MH105 (200)

688.49 672.03 MH105
688.40 671.98 MH106
688.28 671.90 MH107
688.15 671.83 MH108
688.08 671.76 MH109
688.02 668.02 MH110
688.02 667.89 MH112
688.77 667.74 MH113
687.00 667.59 MH114
686.87 667.44 MH115
686.12 667.29 MH116
687.00 667.14 MH117

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TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	—
PLAN (3/10)	DWG No.	TSL-03

PUNJAB UNIVERSITY

MAYO HOSPITAL

MCL

MUSEUM

LOWER MALL

GPO

O COLLEGE

STATE BANK

SHAHRAE- QUAIDE - AZAM

MH87 692.90 673.54

MH88 692.80 673.64

MH89 692.70 673.74

MH90 692.60 673.84

MH91 692.50 673.94

MH92 692.40 674.04

MH93 692.28 674.16

MH94 692.18 674.26

MH95 692.11 674.33

MH96 692.28 674.50

MH97 692.38 674.60

MH98 692.24 674.46

MH99 692.38 674.60

MH100 692.26 674.48

MH101 692.12 674.34

MH102 688.81 672.23

MH103 688.65 672.07

MH104 688.49 671.91

MH105 688.40 671.82

MH106 688.28 671.70

MH107 688.15 671.57

MH108 687.98 671.40

MH109 687.88 671.30

MH110 687.68 671.10

MH110.1 687.58 671.00

MH110.2 687.48 670.90

MH110.3 687.28 670.70

MH111 686.98 670.40

(200) (300) (225) (120) (300) (102) (226) (225) (300) (191) (392) (300) (95) (300) (200) (225) (140) (200) (200) (140) (280) (115) (170) (200) (80)

84"Ø

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LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	—
PLAN (4/10)	DWG No.	TSL-04

HOSPITAL

HALL ROAD

LAKSHMI CHOWK

NATIONAL HOTEL

ABDUL KARIM ROAD

MCLEOD ROAD

MONTGOMARY ROAD

HALL ROAD

SHAHRAE- QUAIDE - AZAM

STATE BANK

BEADEN ROAD

H1

H

G

F

F1

MH86.6 — MH86.5 — MH86.4 — MH86.3 — MH86.2 — MH86.1 — MH86 — MH87 — MH88 — MH89

MH85 — MH84 — MH83 — MH82 — MH81 — MH80 — MH79 — MH78 — MH77 — MH76 — MH75 — MH74 — MH73 — MH72 — MH71 — MH70 — MH69

MH74.12 — MH74.11 — MH74.10 — MH74.9 — MH74.8 — MH74.7 — MH74.6 — MH74.5 — MH74.4 — MH74.3 — MH74.2 — MH74.1

36"Ø — 84"Ø — 72"Ø — 42"Ø — 60"Ø

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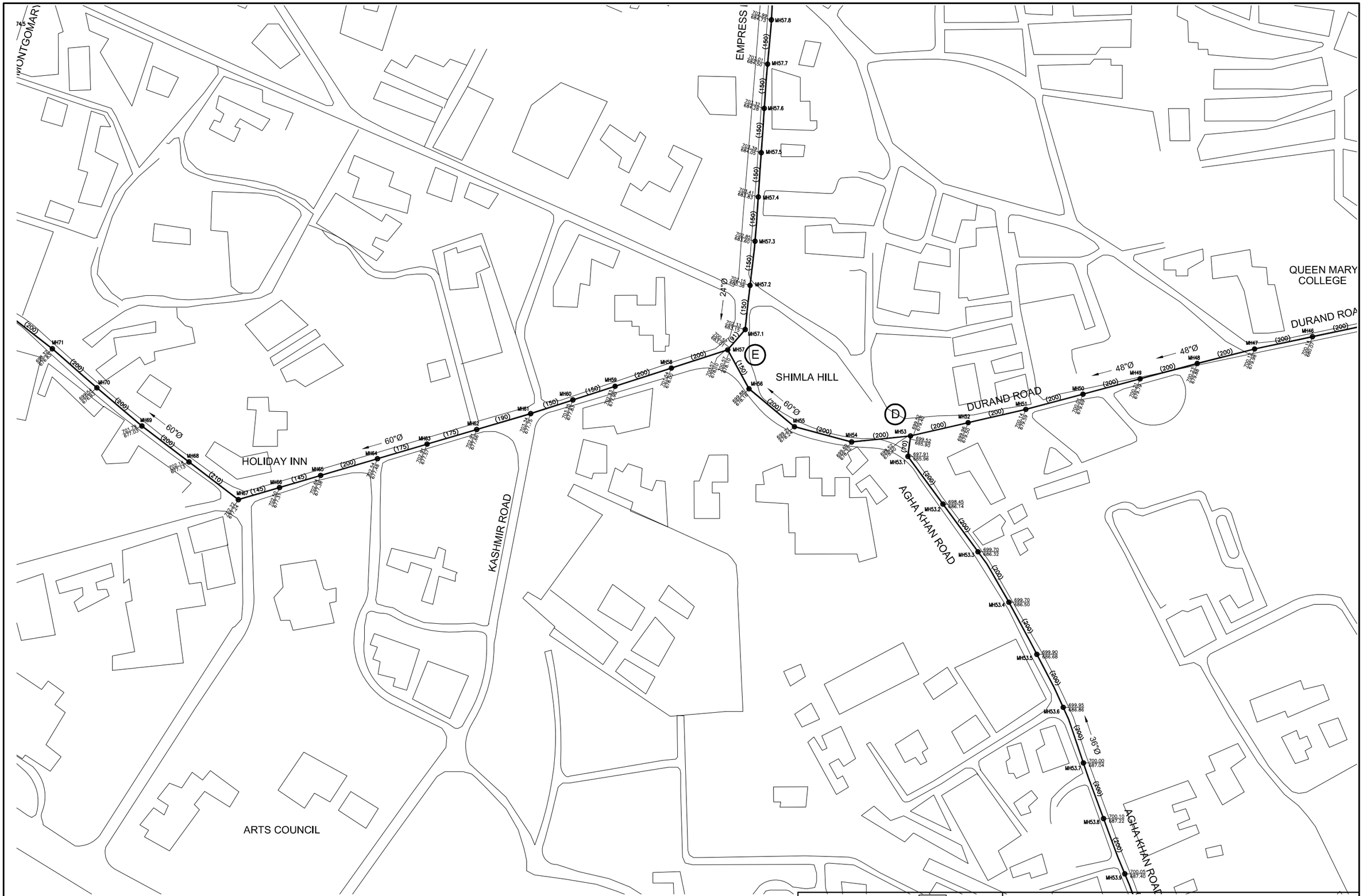
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION

SCALE —

PLAN (5/10)

DWG No. TSL-05



TSL 04 | TSL 05 | TSL 08 | TSL 07 | TSL 06 | TSL 10 | TSL 03 | TSL 09 | TSL 02 | TSL 01

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TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	—
PLAN (6/10)	DWG No.	TSL-06

MUHAMMAD NAGAR
LIFT STATION

RAILWAY COLONY

GHAZI MUHALLAH
LIFT STATION

QUEEN MARY
COLLEGE

DURAND ROAD

LAREX COLONY
LIFT STATION

ALLA

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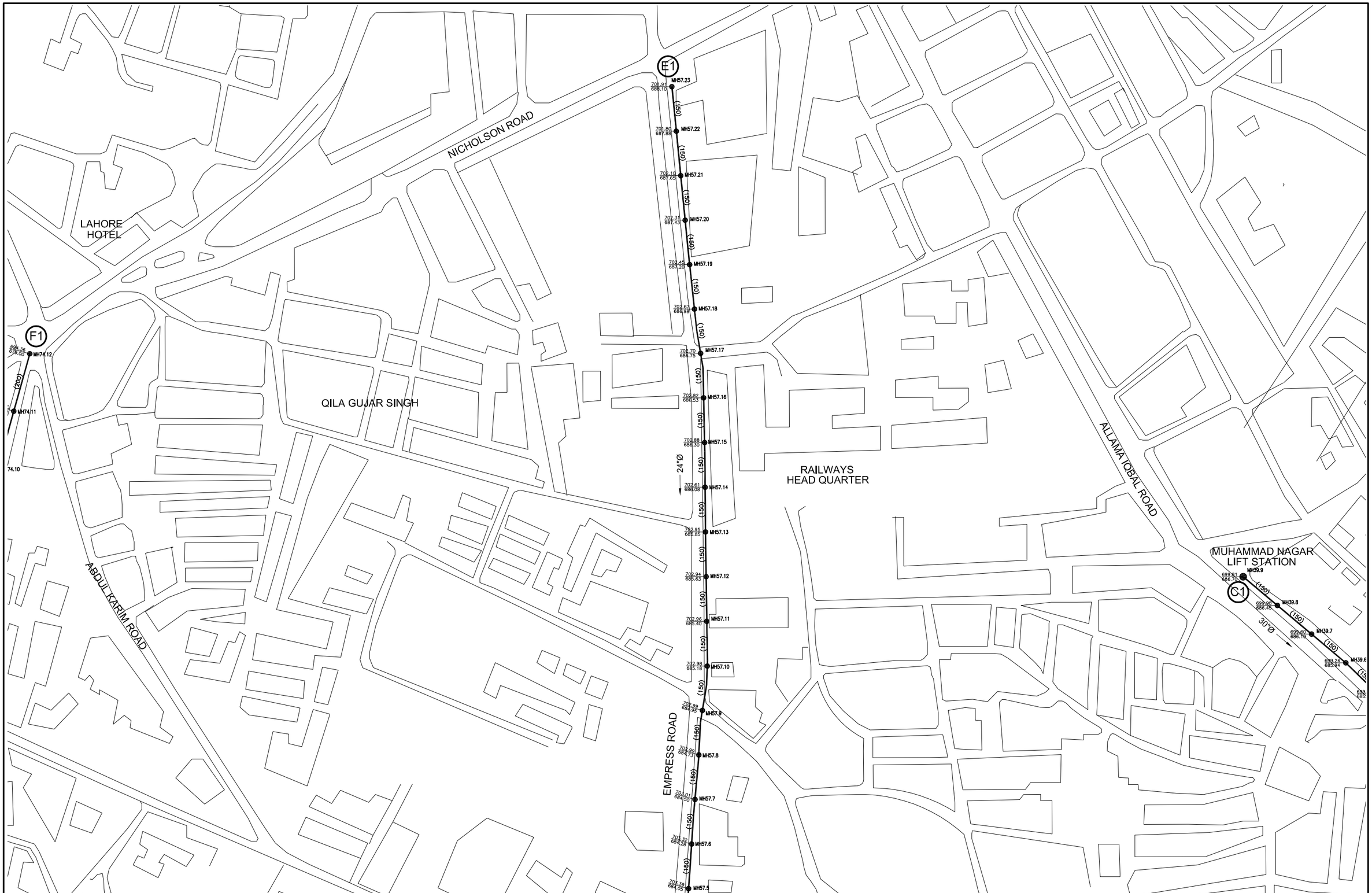
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	—
PLAN (7/10)	DWG No.	TSL-07


F1
MH74.12
MH74.11
74.10
(200)
F1
MH57.23
MH57.22
MH57.21
MH57.20
MH57.19
MH57.18
MH57.17
MH57.16
MH57.15
MH57.14
MH57.13
MH57.12
MH57.11
MH57.10
MH57.9
MH57.8
MH57.7
MH57.6
MH57.5
(150)
24"Ø
NICHOLSON ROAD
LAHORE HOTEL
QILA GUJAR SINGH
ABDUL KARIM ROAD
EMPRESS ROAD
RAILWAYS HEAD QUARTER
ALLAMA IQBAL ROAD
MUHAMMAD NAGAR LIFT STATION
C1
MH39.9
MH39.8
MH39.7
MH39.6
30"Ø
TSL 01
TSL 02
TSL 03
TSL 04
TSL 05
TSL 06
TSL 07
TSL 08
TSL 09
TSL 10
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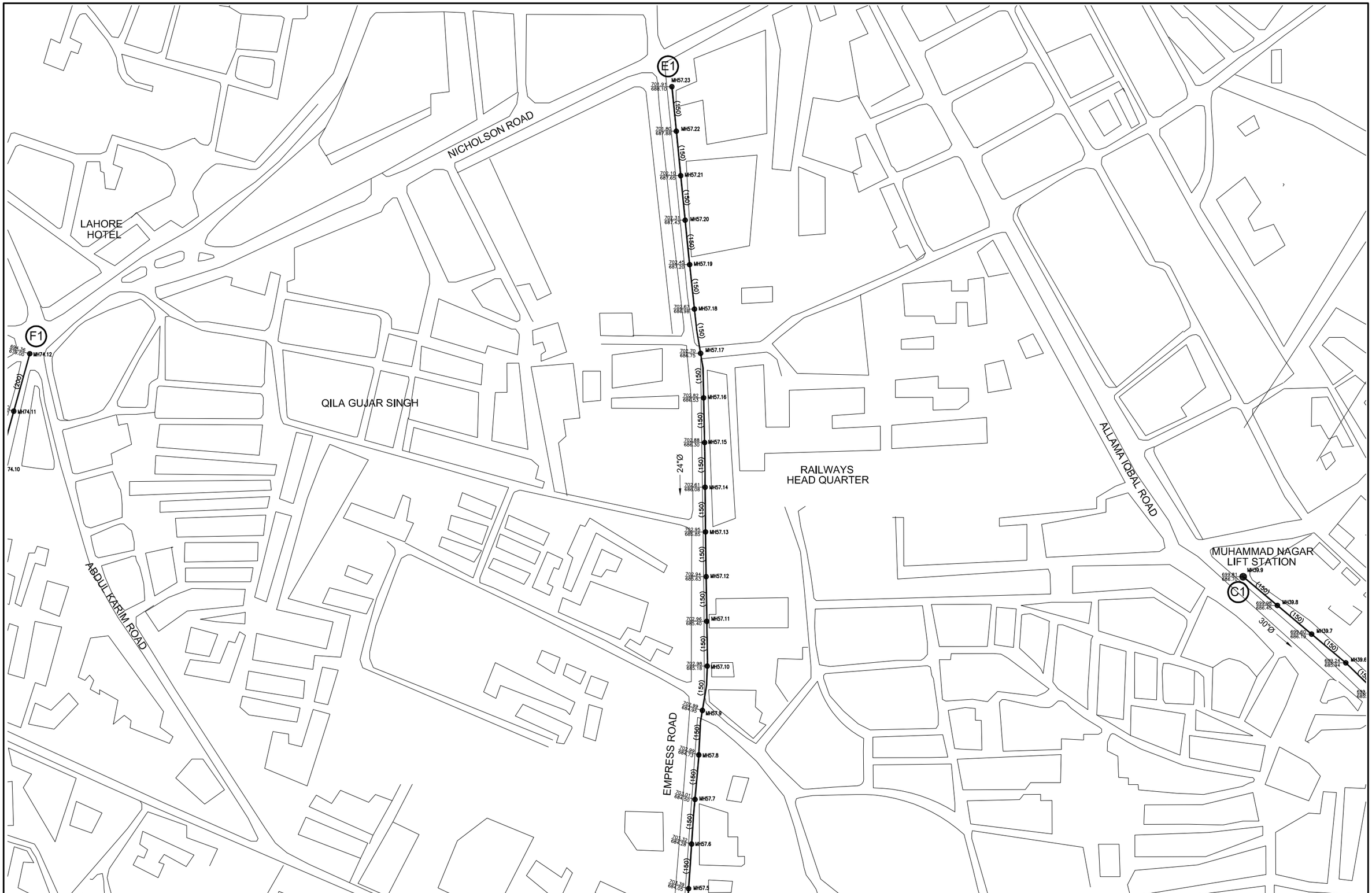
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION
SCALE
—
PLAN (8/10)
DWG No.
TSL-08


F1
MH74.12
MH74.11
74.10
(200)
F1
MH57.23
MH57.22
MH57.21
MH57.20
MH57.19
MH57.18
MH57.17
MH57.16
MH57.15
MH57.14
MH57.13
MH57.12
MH57.11
MH57.10
MH57.9
MH57.8
MH57.7
MH57.6
MH57.5
(150)
24"Ø
NICHOLSON ROAD
LAHORE HOTEL
QILA GUJAR SINGH
ABDUL KARIM ROAD
EMPRESS ROAD
RAILWAYS HEAD QUARTER
ALLAMA IQBAL ROAD
MUHAMMAD NAGAR LIFT STATION
C1
MH39.9
MH39.8
MH39.7
MH39.6
30"Ø
TSL 01
TSL 02
TSL 03
TSL 04
TSL 05
TSL 06
TSL 07
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SCALE
—
PLAN (8/10)
DWG No.
TSL-08

QUEEN MARY COLLEGE

DURAND ROAD

SHIMLA HILL

KASHMIR ROAD

AGHA KHAN ROAD

NCIL

GOVERNOR'S HOUSE

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TSL 01 | TSL 02 | TSL 03 | TSL 04 | TSL 05 | TSL 06 | TSL 07 | TSL 08 | TSL 09 | TSL 10

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TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	—
PLAN (9/10)	DWG No.	TSL-09

KRISHAN NAGAR

MAO COLLEGE

SANDA ROAD

RAJ GARH

REWAZ GARDENS

11

MH110.33 (150) MH110.32 (125) MH110.31 (180) MH110.30 (100) MH110.29 (130) MH110.28 (190) MH110.27 (110) MH110.26 (200) MH110.25 (198) MH110.24 (96) MH110.23 (104) MH110.22 (200) MH110.21 (128) MH110.20 (107) MH110.19 (106) MH110.18 (143) MH110.17 (143) MH110.16 (143) MH110.15 (126) MH110.14 (125) MH110.13 (126) MH110.12 (126) MH110.11 (191) MH110.10 (126) MH110.9 (125) MH110.8 (125) MH110.7 (160) MH110.6 (200) MH110.5 (200) MH110.4 (200) MH110.3 (170) MH110.2

54"Ø

54"Ø

54"Ø

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THE PREPARATORY STUDY ON
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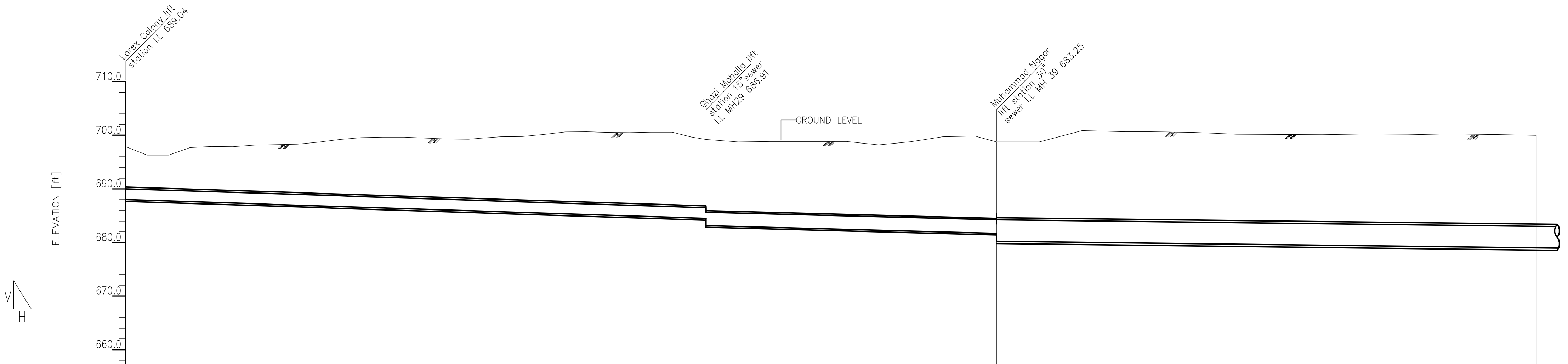
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	—
PLAN (10/10)	DWG No.	TSL-10



LINE	A~B												
SEWER DIA. (INCH)	24												
SLOPE (ft/ft)	0.0013												
GROUND LEVEL (FT.)	697.87	696.29	696.29	697.69	697.89	697.86	698.15	698.24	698.34	698.72	699.22	699.54	699.64
INVERT ELEVATION (FT.)	688.00	687.87	687.74	687.61	687.48	687.35	687.22	687.09	686.96	686.83	686.70	686.57	686.44
CHAINAGE (FT.)	0	100	200	300	400	500	600	700	800	900	1000	1100	1200
MANHOLE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13

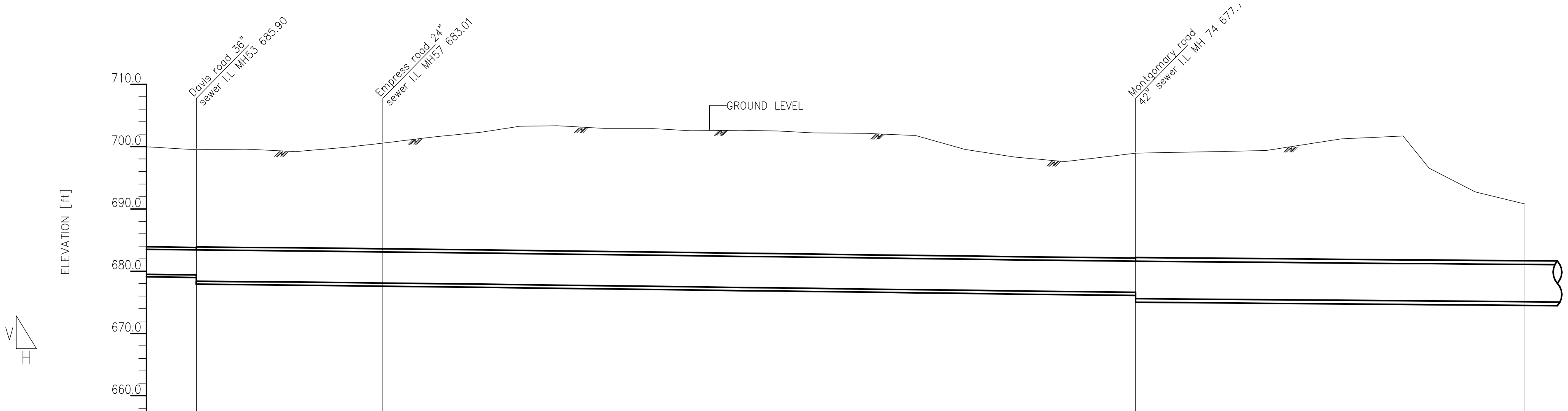
LINE													
SEWER DIA. (INCH)													
SLOPE (ft/ft)													
GROUND LEVEL (FT.)	699.66	699.46	699.32	699.26	699.48	699.74	699.78	700.15	700.63	700.64	700.52	700.48	700.59
INVERT ELEVATION (FT.)	686.31	686.18	686.05	685.92	685.84	685.72	685.59	685.46	685.33	685.20	685.07	684.94	684.81
CHAINAGE (FT.)	1300	1400	1500	1600	1663	1751	1851	1951	2051	2151	2251	2351	2451
MANHOLE NUMBER	14	15	16	17	18	19	20	21	22	23	24	25	26

LINE				B~C									
SEWER DIA. (INCH)				30									
SLOPE (ft/ft)				0.00131									
GROUND LEVEL (FT.)	700.59	699.67	699.22	698.74	698.85	698.85	698.85	698.82	698.22	698.80	699.74	699.86	698.76
INVERT ELEVATION (FT.)	684.68	684.57	684.48 683.48	683.78	683.59	683.45	683.32	683.12	682.93	682.73	682.53	682.34	681.71 680.71
CHAINAGE (FT.)	2551	2639	2709	2859	3009	3112	3215	3365	3515	3665	3815	3965	4065
MANHOLE NUMBER	27	28	29	30	31	32	33	34	35	36	37	38	39

LINE	C~D												
SEWER DIA. (INCH)	48												
SLOPE (ft/ft)	0.00048												
GROUND LEVEL (FT.)	698.76	700.86	700.66	700.64	700.54	700.21	700.14	700.12	700.23	700.21	700.01	700.14	699.96
INVERT ELEVATION (FT.)	680.61	680.52	680.42	680.36	680.27	680.17	680.07	679.98	679.88	679.79	679.69	679.59	679.50
CHAINAGE (FT.)	4265	4465	4665	4786	4986	5186	5386	5586	5786	5986	6186	6386	6586
MANHOLE NUMBER	40	41	42	43	44	45	46	47	48	49	50	51	52

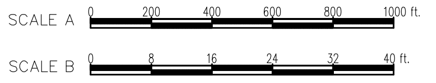
PLOFILE (Manhole No. fr. MH1 to MH52)

H: SCALE A V: SCALE B



LINE	CD		D~E				E~F								
SEWER DIA. (INCH)	48		60				60								
SLOPE (ft/ft)	0.00048		0.0004				0.0005								
GROUND LEVEL (FT.)	699.96	699.52	699.60	699.21	699.88	700.57	701.54	702.33	703.25	703.34	702.91	702.91	702.54	702.64	702.50
INVERT ELEVATION (FT.)	679.50	679.40 678.40	678.32	678.24	678.16	678.10	678.00	677.90	677.83	677.75	677.66	677.57	677.48	677.38	677.31
CHAINAGE (FT.)	6586	6786	6986	7186	7386	7536	7736	7936	8086	8236	8426	8601	8776	8976	9121
MANHOLE NUMBER	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66

LINE									F~G						
SEWER DIA. (INCH)									72						
SLOPE (ft/ft)									0.00032						
GROUND LEVEL (FT.)	702.22	702.14	701.79	699.54	698.32	697.58	698.54	698.96	699.12	699.37	701.22	701.72	696.53	692.72	690.80
INVERT ELEVATION (FT.)	677.24	677.13	677.03	676.93	676.83	676.73	676.63	676.59 675.59	675.52	675.42	675.32	675.24	675.21	675.15	675.09
CHAINAGE (FT.)	9266	9476	9676	9876	10076	10276	10476	10561	10786	11086	11386	11636	11741	11926	12126
MANHOLE NUMBER	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81

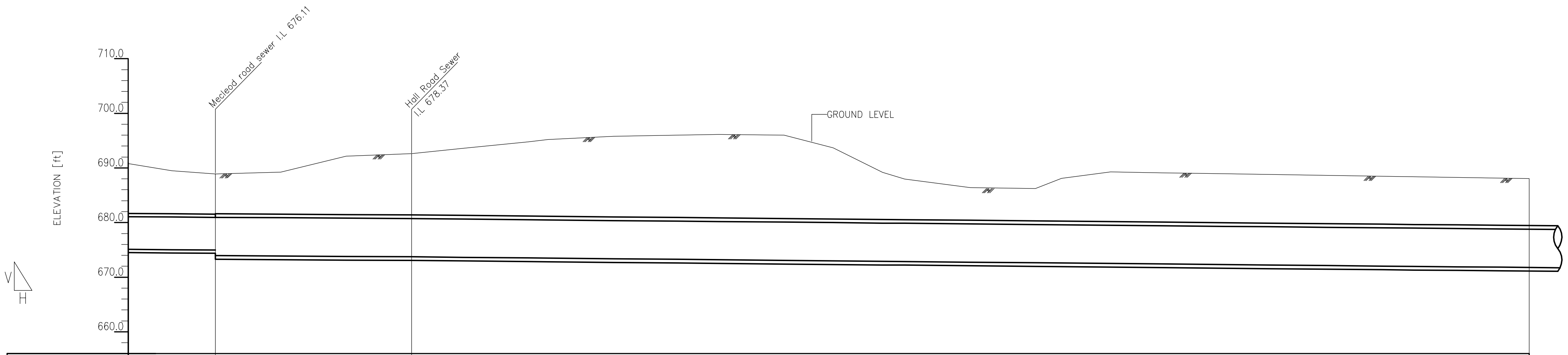


PLOFILE (Manhole No. fr. MH52 to MH81)

H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	SEE SCALE BAR
PROFILE -TRUNK SEWER- (1/3)	DWG No.	TSL-11

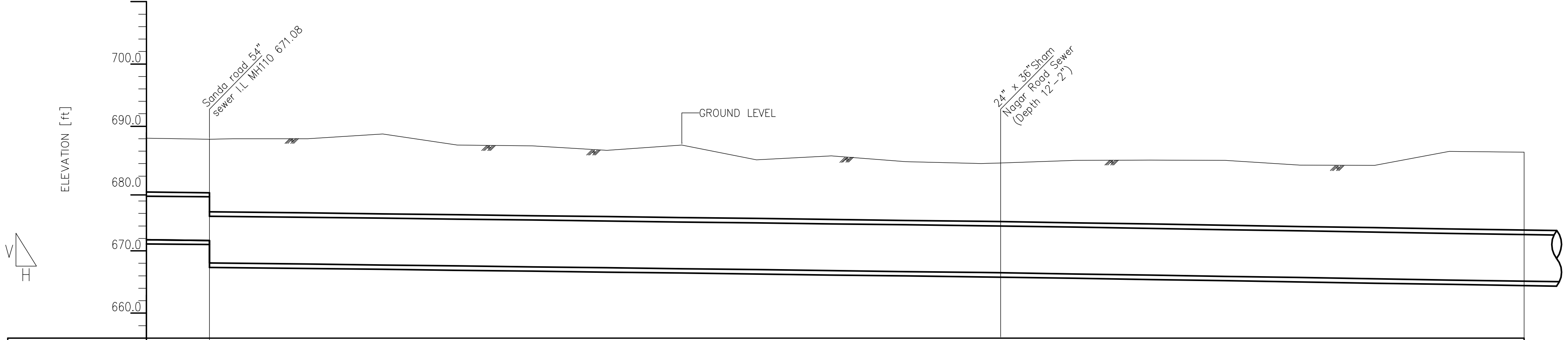


LINE	FG			G~H			H~I								
SEWER DIA. (INCH)	72			84											
SLOPE (ft/ft)	0.00032			0.00026			0.00049								
GROUND LEVEL (FT.)	690.80	689.51	688.89	689.25	692.15	692.61	693.60	694.80	695.20	695.80	696.01	696.12	696.00	693.67	689.21
INVERT ELEVATION (FT.)	675.09	675.02	674.96 673.96	673.88	673.80	673.73	673.61	673.46	673.42	673.27	673.13	673.04	672.89	672.78	672.67
CHAINAGE (FT.)	12126	12326	12526	12826	13126	13426	13662	13962	14052	14352	14644	14835	15135	15361	15587
MANHOLE NUMBER	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95

LINE														
SEWER DIA. (INCH)														
SLOPE (ft/ft)														
GROUND LEVEL (FT.)	687.98	686.39	686.23	688.09	689.26	689.12	688.94	688.81	688.65	688.49	688.40	688.28	688.15	688.07
INVERT ELEVATION (FT.)	672.62	672.47	672.32	672.27	672.16	672.05	671.90	671.80	671.67	671.54	671.47	671.38	671.28	671.21
CHAINAGE (FT.)	15689	15989	16289	16409	16634	16859	17159	17359	17622	17885	18025	18225	18425	18555
MANHOLE NUMBER	96	97	98	99	100	101	102	103	104	105	106	107	108	109

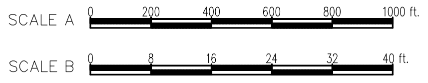
PLOFILE (Manhole No. fr. MH81 to MH109)

H: SCALE A V: SCALE B



LINE	H~I		I~J								
SEWER DIA. (INCH)	84		90								
SLOPE (ft/ft)	0.00049		0.00061								
GROUND LEVEL (FT.)	688.07	687.90	688.02	688.02	688.77	687.00	686.87	686.12	687.00	684.63	685.23
INVERT ELEVATION (FT.)	671.21	671.08 667.49	667.45	667.26	667.08	666.90	666.71	666.53	666.35	666.16	665.98
CHAINAGE (FT.)	18555	18835	18903	19203	19503	19803	20103	20403	20703	21003	21303
MANHOLE NUMBER	109	110	111	112	113	114	115	116	117	118	119

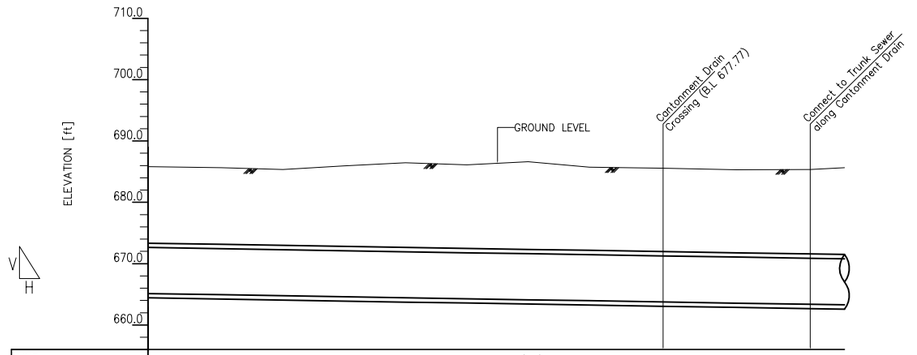
LINE										
SEWER DIA. (INCH)										
SLOPE (ft/ft)				0.00077						
GROUND LEVEL (FT.)	684.33	684.04	684.09	684.51	684.59	684.51	683.75	683.71	685.98	685.83
INVERT ELEVATION (FT.)	665.80	665.62	665.55	665.32	665.09	664.86	664.63	664.40	664.17	663.94
CHAINAGE (FT.)	21603	21903	21983	22283	22583	22883	23183	23483	23783	24083
MANHOLE NUMBER	120	121	122	123	124	125	126	127	128	129



PLOFILE (Manhole No. fr. MH109 to MH129)

H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	SEE SCALE BAR
PROFILE -TRUNK SEWER- (2/3)	DWG No.	TSL-12



LINE	I~J									
SEWER DIA. (INCH)	90									
SLOPE (ft/ft)	0.00077									
GROUND LEVEL (FT.)	685.83	685.65	685.35	685.95	686.46	686.09	686.60	685.72	685.54	685.29	685.36
INVERT ELEVATION (FT.)	663.94	663.71	663.51	663.32	663.13	662.94	662.74	662.55	662.32	662.09	663.37
CHAINAGE (FT.)	24083	24383	24633	24883	25133	25383	25633	25883	26183	26483	26783
MANHOLE NUMBER	129	130	131	132	133	134	135	136	137	138	139

PLOFILE (Manhole No. fr. MH129 to MH139)

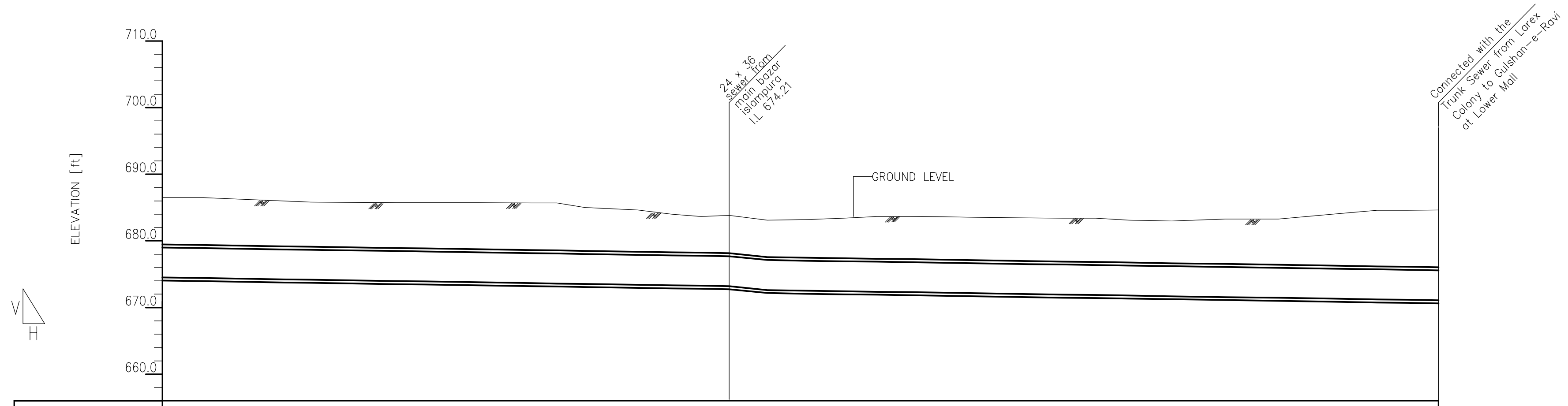
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 8 16 24 32 40 ft.

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

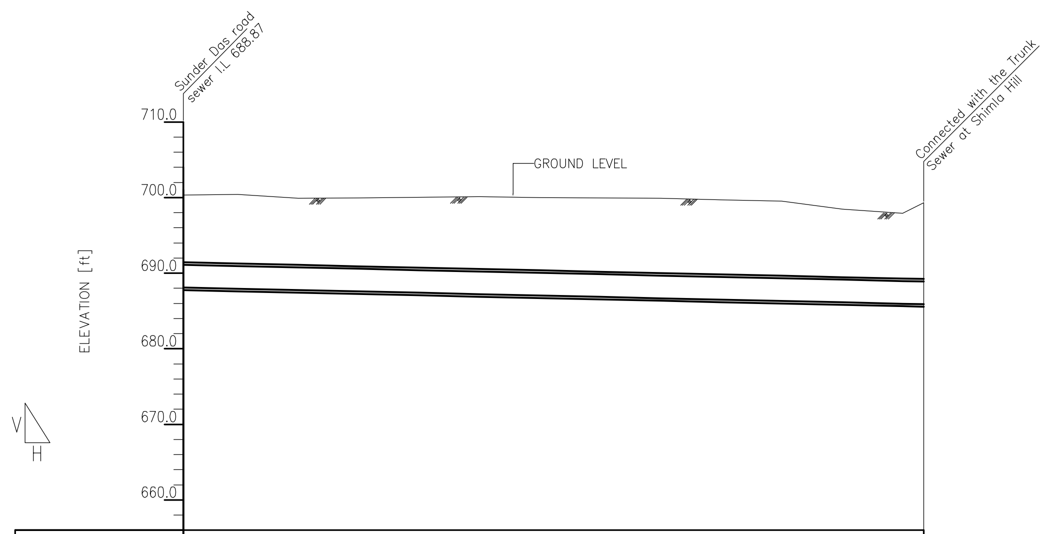
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	SEE SCALE BAR
PROFILE -TRUNK SEWER- (3/3)	DWG No.	TSL-13



LINE	I1~I																																	
SEWER DIA. (INCH)	54																																	
SLOPE (ft/ft)	0.00061																																	
GROUND LEVEL (FT.)	686.50	686.48	686.29	686.00	685.81	685.76	685.75	685.72	685.71	685.69	685.68	685.00	684.63	684.00	683.64	683.81	683.11	683.20	683.40	683.67	683.67	683.60	683.52	683.43	683.42	683.42	683.10	682.98	683.28	683.28	684.00	684.58	684.60	684.63
INVERT ELEVATION (FT.)	674.50	674.41	674.33	674.22	674.16	674.08	673.97	673.90	673.78	673.66	673.60	673.53	673.41	673.33	673.27	673.20	672.62	672.53	672.44	672.37	672.29	672.21	672.14	672.02	671.94	671.87	671.79	671.69	671.57	671.45	671.33	671.22	671.15	671.08
CHAINAGE (FT.)	0	150	275	455	555	685	875	985	1185	1383	1479	1583	1783	1911	2018	2124	2267	2410	2553	2679	2804	2930	3056	3247	3373	3498	3623	3783	3983	4183	4383	4553	4668	4783
MANHOLE NUMBER	110.33	110.32	110.31	110.30	110.29	110.28	110.27	110.26	110.25	110.24	110.23	110.22	110.21	110.20	110.19	110.18	110.17	110.16	110.15	110.14	110.13	110.12	110.11	110.10	110.9	110.8	110.7	110.6	110.5	110.4	110.3	110.2	110.1	110

SANDA ROAD SEWER
PLOFILE (Manhole No. fr. MH110.33 to MH110)

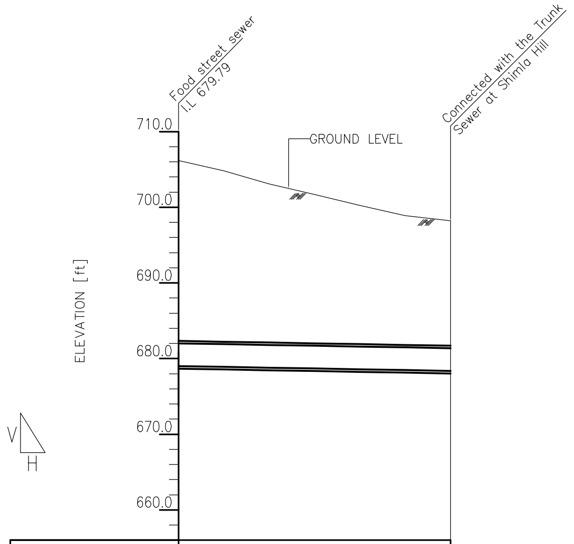
H: SCALE A V: SCALE B



LINE	DI~D														
SEWER DIA. (INCH)	36														
SLOPE (ft/ft)	0.0009														
GROUND LEVEL (FT.)	700.33	700.40	699.90	699.95	700.05	700.10	700.00	699.95	699.90	699.70	699.70	698.45	697.91	699.52
INVERT ELEVATION (FT.)	688.10	687.94	687.76	687.58	687.40	687.22	687.04	686.86	686.68	686.50	686.32	686.14	685.96	685.90
CHAINAGE (FT.)	0	180	380	580	780	980	1180	1380	1580	1780	1980	2180	2380	2450
MANHOLE NUMBER	53.13	53.12	53.11	53.10	53.9	53.8	53.7	53.6	53.5	53.4	53.3	53.2	53.1	53

DAVIS ROAD SEWER
PLOFILE (Manhole No. fr. MH53.13 to MH53)

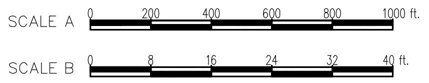
H: SCALE A V: SCALE B



LINE	HI~H						
SEWER DIA. (INCH)	36						
SLOPE (ft/ft)	0.0007						
GROUND LEVEL (FT.)	706.15	704.81	703.06	701.67	700.26	698.89	698.23
INVERT ELEVATION (FT.)	679.00	678.90	678.79	678.69	678.58	678.48	678.37
CHAINAGE (FT.)	0	149	299	449	599	749	899
MANHOLE NUMBER	86.6	86.5	86.4	86.3	86.2	86.1	86

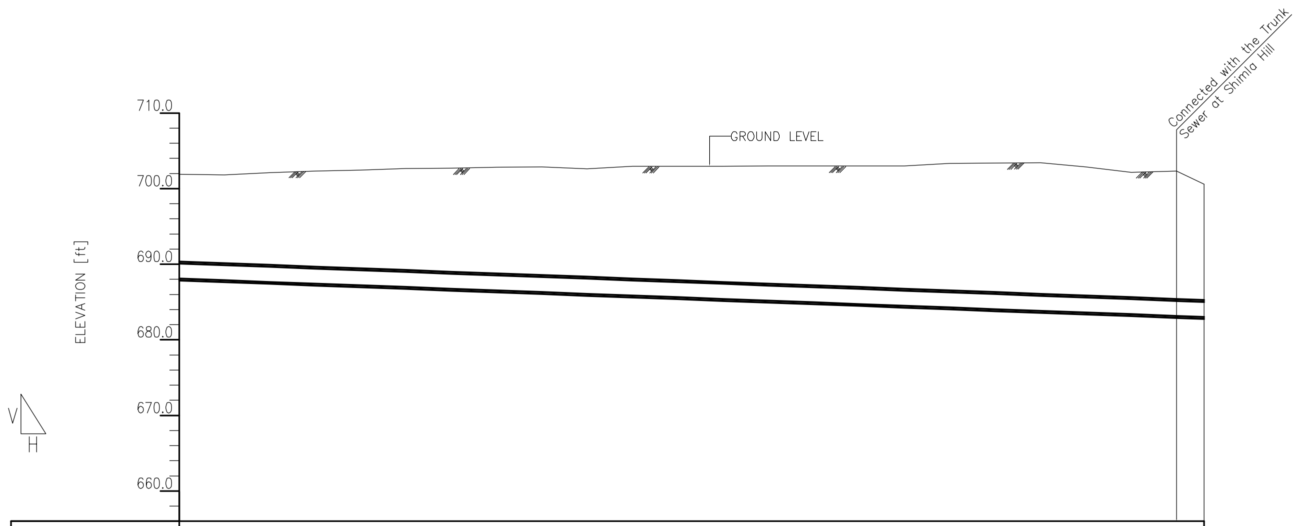
THRONTON ROAD TO MCLEOD ROAD
PLOFILE (Manhole No. fr. MH86.6 to MH86)

H: SCALE A V: SCALE B



THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

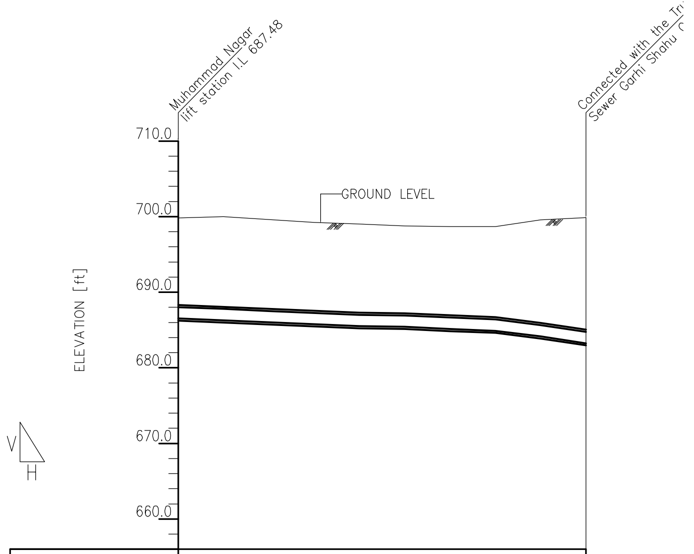
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	SEE SCALE BAR
PROFILE -BRANCH SEWER- (1/2)	DWG No.	TSL-14



LINE	E1~E																							
SEWER DIA. (INCH)	24																							
SLOPE (ft/ft)	0.0015																							
GROUND LEVEL (FT.)	701.91	701.80	702.10	702.31	702.45	702.67	702.70	702.82	702.88	702.61	702.95	702.94	702.96	702.98	702.99	702.99	703.01	703.32	703.39	703.41	702.85	702.15	702.33	700.57
INVERT ELEVATION (FT.)	688.10	687.88	687.65	687.43	687.20	686.98	686.75	686.53	686.30	686.08	685.85	685.63	685.40	685.18	684.95	684.73	684.50	684.28	684.05	683.83	683.60	683.38	683.15	683.01
CHAINAGE (FT.)	0	150	300	450	600	750	900	1050	1200	1350	1500	1650	1800	1950	2100	2250	2400	2550	2700	2850	3000	3150	3300	3391
MANHOLE NUMBER	57.23	57.22	57.21	57.20	57.19	57.18	57.17	57.16	57.15	57.14	57.13	57.12	57.11	57.10	57.09	57.08	57.07	57.06	57.05	57.04	57.03	57.02	57.01	57

EMPRESS ROAD SEWER
PLOFILE (Manhole No. fr. MH57.23 to MH57)

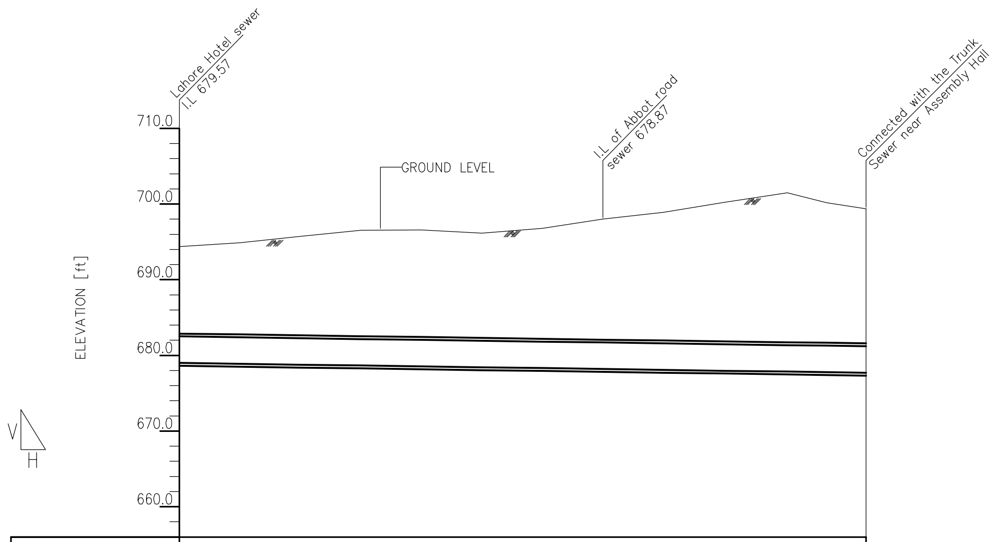
H: SCALE A V: SCALE B



LINE	CI~C									
SEWER DIA. (INCH)	30									
SLOPE (ft/ft)	0.0017							0.0018	0.0050	0.0060
GROUND LEVEL (FT.)	699.81	699.98	699.60	699.24	699.01	698.76	698.69	698.66	699.56	699.86
INVERT ELEVATION (FT.)	686.70	684.45	686.19	685.94	685.68	685.43	685.17	684.90	684.15	683.25
CHAINAGE (FT.)	100	250	400	550	700	850	1000	1150	1300	1450
MANHOLE NUMBER	39.9	39.8	39.7	39.6	39.5	39.4	39.3	39.2	39.1	39

MUHAMMAD NAGAR LS TO GARHI SHAHU CHAWK
PLOFILE (Manhole No. fr. MH39.9 to MH39)

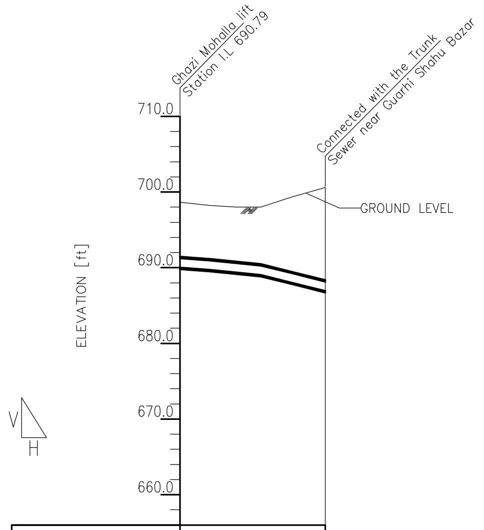
H: SCALE A V: SCALE B



LINE	FI~F												
SEWER DIA. (INCH)	42												
SLOPE (ft/ft)	0.0006												
GROUND LEVEL (FT.)	694.36	694.90	695.72	696.51	696.59	696.17	696.78	698.02	698.91	700.22	701.48	700.15	699.37
INVERT ELEVATION (FT.)	679.00	678.89	678.77	678.66	678.54	678.43	678.32	678.20	678.09	677.97	677.85	677.78	677.71
CHAINAGE (FT.)	0	200	400	600	800	1000	1200	1400	1600	1800	2010	2140	2270
MANHOLE NUMBER	74.12	74.11	74.0	74.9	74.8	74.7	74.6	74.5	74.4	74.3	74.2	74.1	74

MONTGOMARY ROAD SEWER
PLOFILE (Manhole No. fr. MH74.12 to MH74)

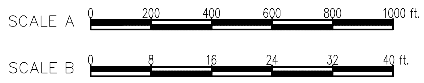
H: SCALE A V: SCALE B



LINE	B1~B					
SEWER DIA. (INCH)	15					
SLOPE (ft/ft)	0.0030	0.00040			0.0100	
GROUND LEVEL (FT.)	698.63	698.21	698.01	698.01	699.32	700.59
INVERT ELEVATION (FT.)	690.00	689.70	689.36	689.03	688.03	686.91
CHAINAGE (FT.)	0	100	184	268	368	480
MANHOLE NUMBER	29.5	29.4	29.3	29.2	29.1	29

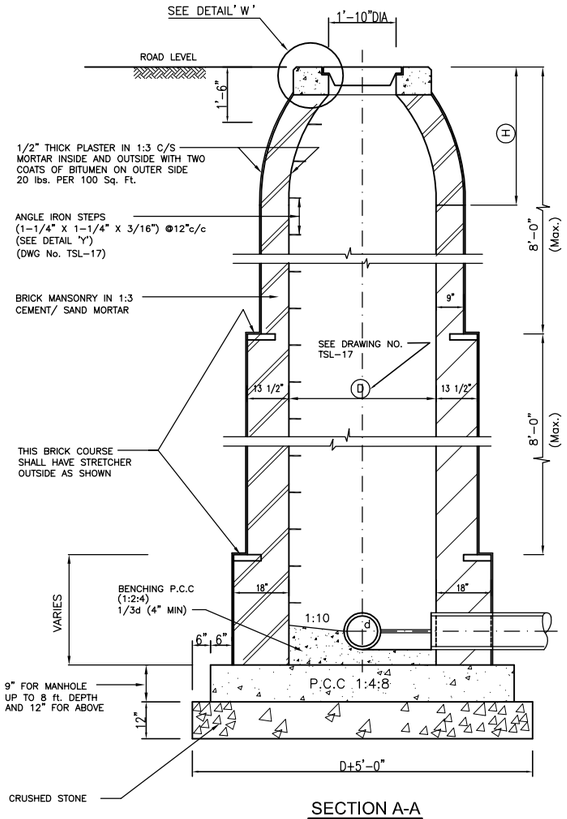
GHAZI MOHALLA LS TO GARHI SHAHU BAZAR
PLOFILE (Manhole No. fr. MH29.5 to MH29)

H: SCALE A V: SCALE B

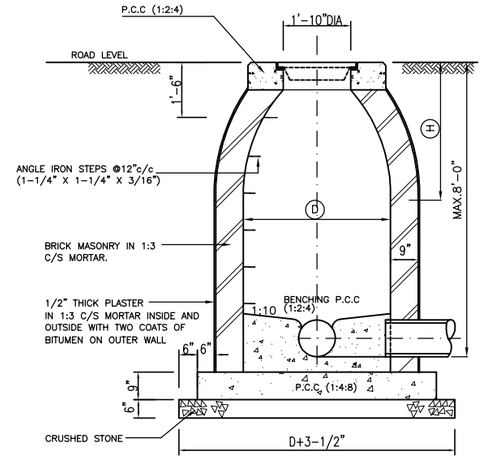


THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

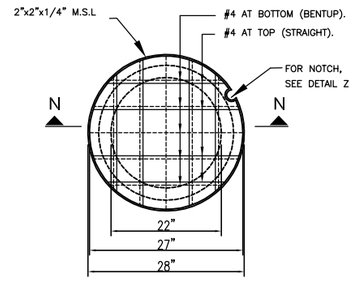
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	SEE SCALE BAR
PROFILE -BRANCH SEWER- (2/2)	DWG No.	TSL-15



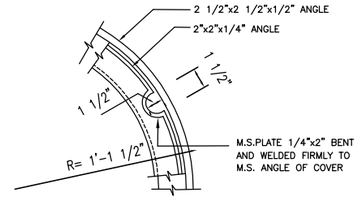
SECTION A-A



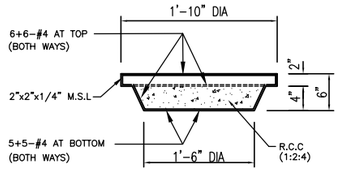
SECTION B-B



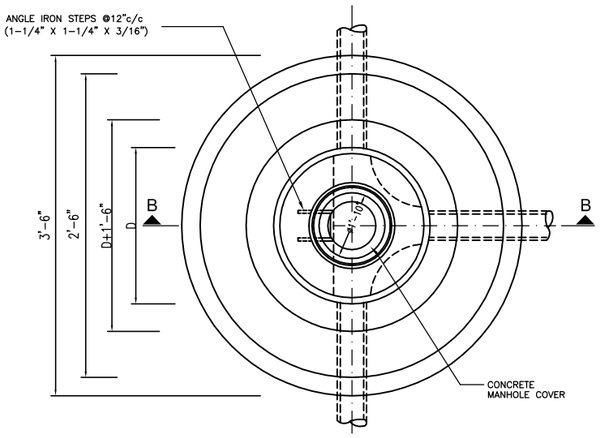
DETAIL OF MANHOLE COVER



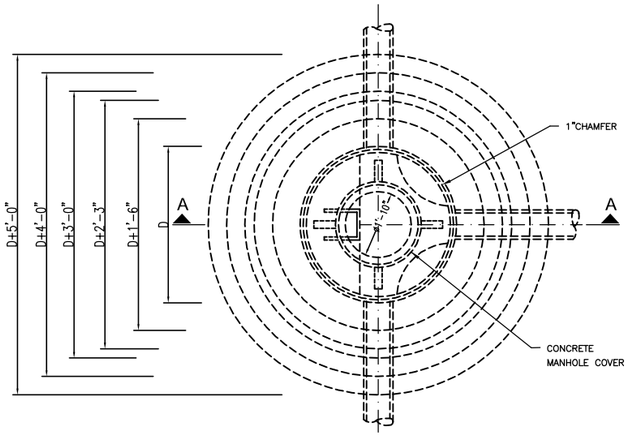
DETAIL OF NOTCH
DETAIL-Z



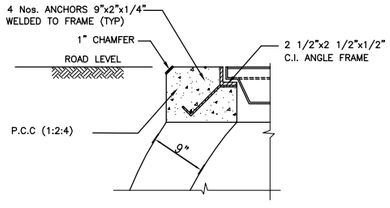
SECTION N-N



TYPICAL SEWER MANHOLE PLAN
(FOR DEPTH ≤ 8.Ft.)

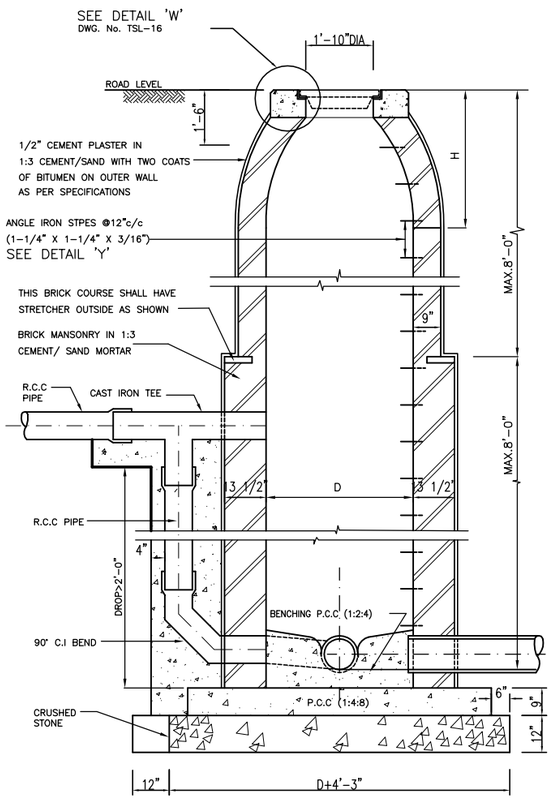


TYPICAL SEWER MANHOLE PLAN
(FOR DEPTH ≥ 8.Ft.)

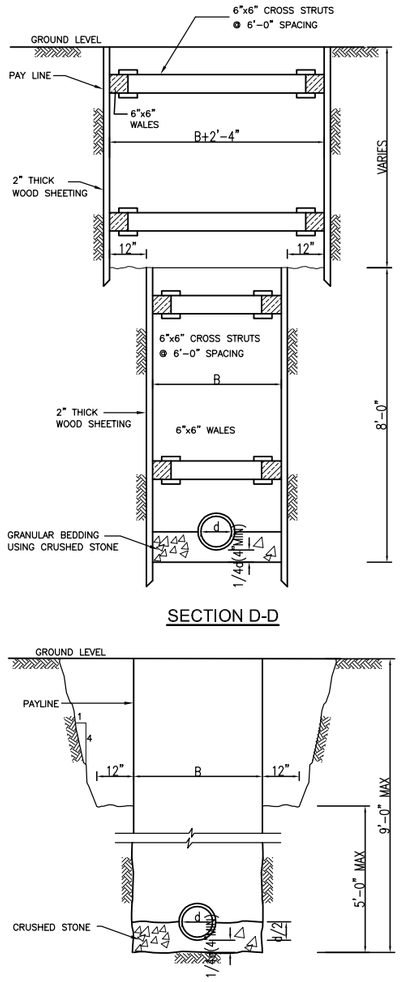


DETAIL-'W'

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	
DETAIL OF MANHOLE (UP TO 48" DIA SEWER) (1/2)	DWG No.	TSL-16

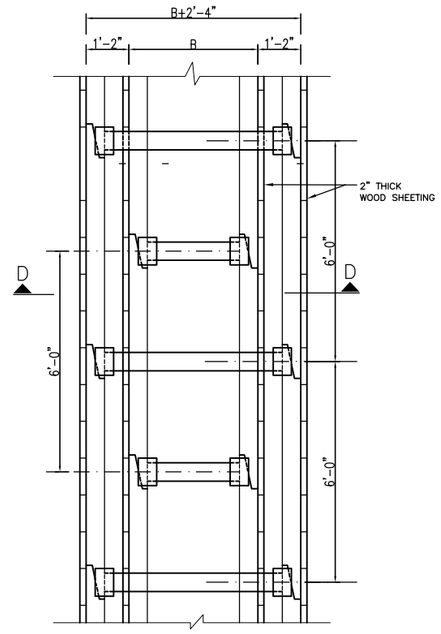


SECTION E-E

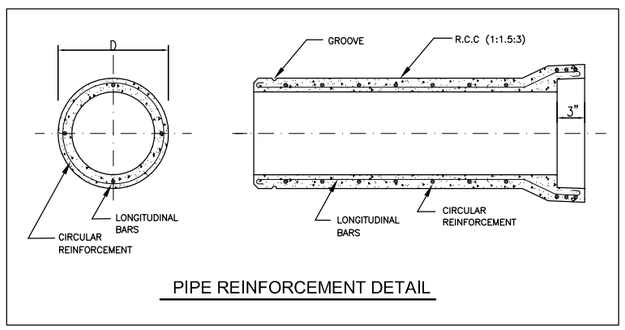


SECTION D-D

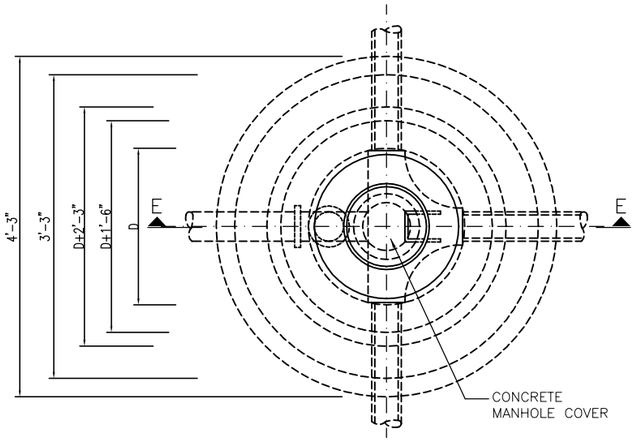
SECTION OF TRENCH WITHOUT
TIMBERING AND BRACING



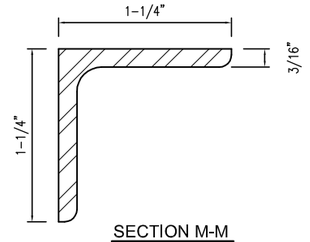
PLAN OF TRENCH
WITH TIMBERING AND BRACING



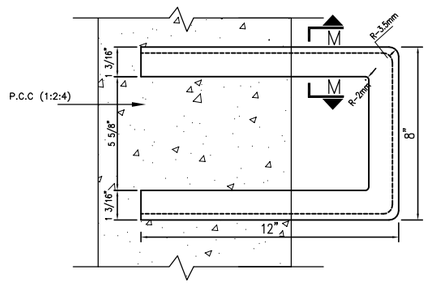
PIPE REINFORCEMENT DETAIL



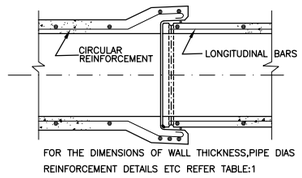
PLAN
TYPICAL DETAIL OF DROP MANHOLE



SECTION M-M



PLAN OF ANGLE IRON STEP
DETAIL (Y)



FOR THE DIMENSIONS OF WALL THICKNESS,PIPE DIAS
REINFORCEMENT DETAILS ETC REFER TABLE:1

SPECIFIC SOCKET
AND SPIGOT JOINT AND
REINFORCEMENT DETAIL

TABLE :1

RECOMMENDED R.C.C PIPES OF 8Ft. BARREL LENGTH
(WALL THICKNESS AND REINFORCEMANT DETAILS)

SR. NO.	PIPE INNER DIA.	WALL THICKNESS	SIZE OF RING BARS	NOS.OF CIRCULAR RINGS		NO.OF RINGS FOR BELL	STAIRGHT BARS		
				INNER CAUGE	OUTER CAUGE		DIA.	NO.OF BARS INNER CAUGE	NO.OF BARS OUTER CAUGE
1	9"	1"	5/32"	27	–	2	5/32"	6	–
2	12"	2"	5/32"	27	–	2	5/32"	6	–
3	15"	2 1/4"	5/32"	40	–	2	5/32"	6	–
4	18"	2 1/2"	3/16"	39	–	2	3/16"	6	–

PIPES MENTIONED IN TABLE–1 SHALL HAVE CLASS III BEDDING AND WALL TYPE "B" WITH REQUIRED STRENGTH EQUAL TO 4000 PSI AS PER ASTM 76–79 STANDARDS .

TABLE :2

RECOMMENDED R.C.C PIPES OF 8Ft. BARREL LENGTH
(WALL THICKNESS AND REINFORCEMANT DETAILS)

SR. NO.	PIPE INNER DIA.	WALL THICKNESS	SIZE OF RING BARS	NOS.OF CIRCULAR RINGS		NO.OF RINGS FOR BELL	STAIRGHT BARS		
				INNER CAUGE	OUTER CAUGE		DIA.	NO.OF BARS INNER CAUGE	NO.OF BARS OUTER CAUGE
5	24"	3"	1/4"	42	–	2	1/4"	6	–
6	30"	3 1/2"	5/16"	35	–	2	1/4"	8	–
7	36"	4"	1/4"	46	29	3	1/4"	8	8
8	42"	4 1/2"	5/16"	34	22	3	1/2"	8	8
9	48"	5"	5/16"	41	26	3	1/2"	8	8

PIPES MENTIONED IN TABLE–2 SHALL HAVE CLASS IV BEDDING AND WALL TYPE "B" WITH REQUIRED STRENGTH EQUAL TO 4000 PSI AS PER ASTM 76–79 STANDARDS .

TABLE -3

SEHEDULE OF TRENCH

SR. NO.	PIPE INSIDE DIA.	TRENCH Ⓑ WITH TIMBERING	WIDTH Ⓑ WITHOUT TIMBERING
1	9"	2'–3"	3'–0"
2	12"	2'–8"	3'–0"
3	15"	3'–0"	3'–6"
4	18"	3'–3"	3'–10"
5	24"	3'–10"	4'–6"
6	30"	4'–5"	5'–2"
7	36"	5'–8"	5'–7"
8	42"	6'–4"	6'–0"
9	48"	6'–11"	7'–4"

TABLE -4

SCHEDULE OF MANHOLE

SR. NO.	PIPE DIA. (inch)	Ⓓ	Ⓗ
1	9 TO 21	4'–0"	3'–6"
2	24 TO 30	5'–0"	4'–0"
3	33 TO 42	6'–6"	4'–6"
4	45 TO 54	7'–6"	5'–0"
5	60 TO 66	8'–0"	6'–0"
6	72 TO 78	9'–0"	7'–0"
7	84 TO 90	10'–0"	8'–0"

NOTE:-

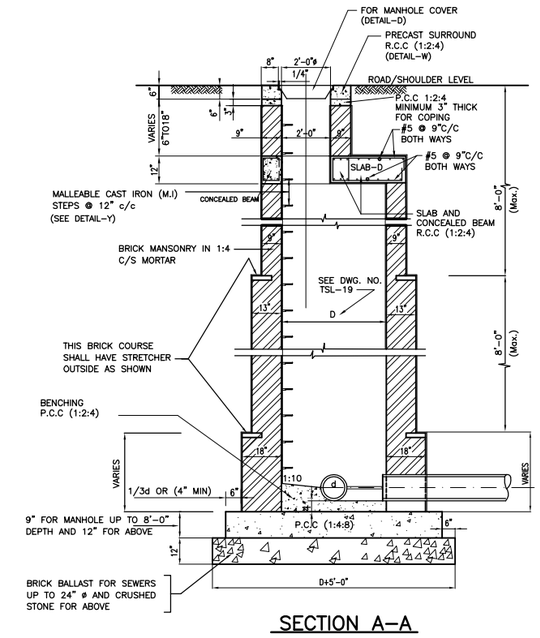
1. THE WEIGHT OF THE STEEL CAGE TO BE APPROVED BY THE SITE ENGINEER BASED UPON THE NUMBER OF BAR AS MENTIONED IN THE ABOVE TABLE.
2. CONCRETE STRENGTH GIVEN IN DRAWING IS 28 DAYS CYLINDER STRENGTH
3. MIX DESIGN SHOULD BE CARRIED OUT TO ACHIEVE THE REQUIRED CONCRETE STRENGTH AS GIVEN BELOW.

RATIO	REQUIRED STRENGTH
1:1.5:3	3750 PSI
1:2:4	3000 PSI
1:4:8	1000 PSI

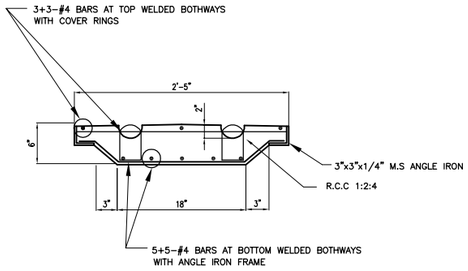
4. RATIO MENTIONED ON DRAWINGS IS SUBJECT TO CHANGE DEPENDING UPON THE MIX DESIGN REQUIREMENTS. THE ULTIMATE AIM SHOULD BE TO ACHIEVE THE REQUIRED STRENGTH.

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

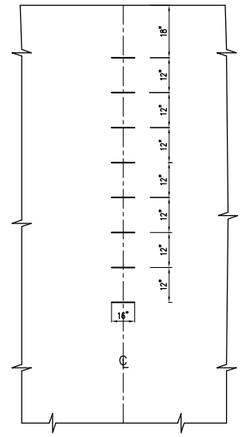
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	
DETAIL OF MANHOLE (UP TO 48" DIA SEWER) (2/2)	DWG No.	TSL-17



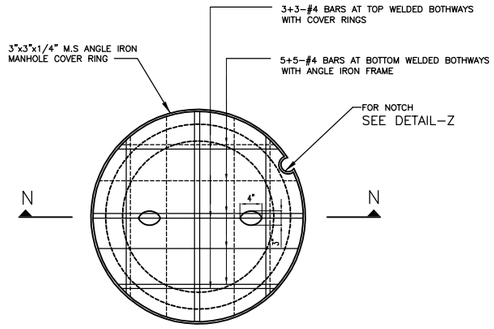
SECTION A-A



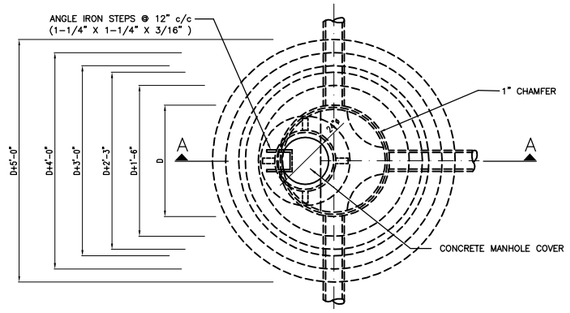
SECTION N-N



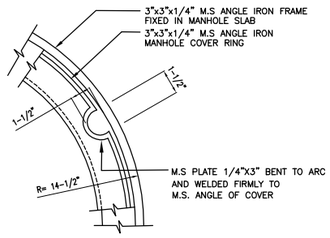
SKETCH OF SINGLE LADDER
INSIDE OF MANHOLE
(FOR DEPTH ≤ 8 FEET)



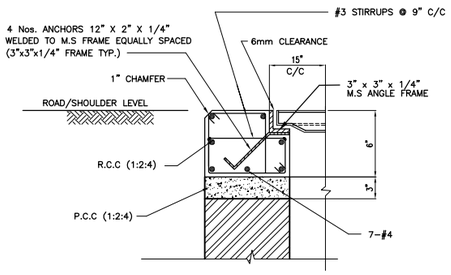
DETAIL D
MANHOLE COVER PLAN



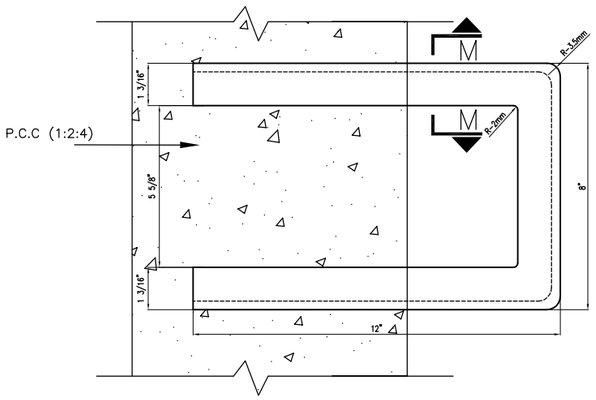
TYPICAL SEWER MANHOLE PLAN
(FOR DEPTH ≥ 8'-0" ≤ 20'-0")



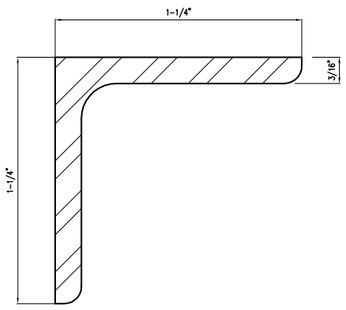
DETAIL Z



DETAIL-W

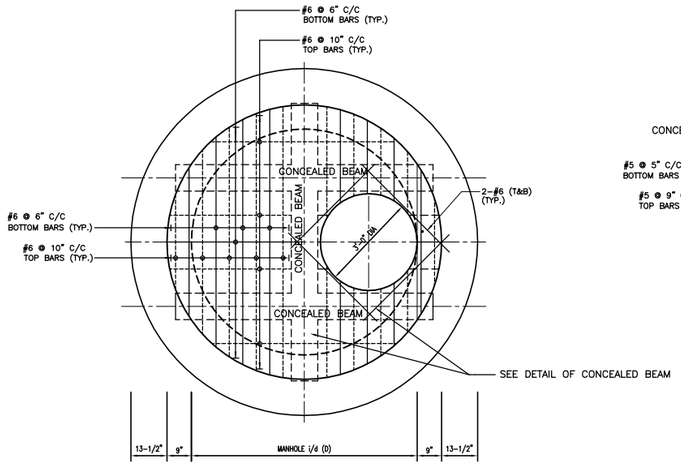


PLAN OF ANGLE IRON STEP
DETAIL-Y

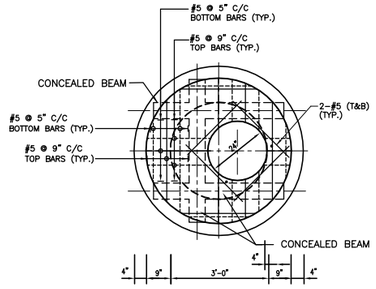


SECTION M-M

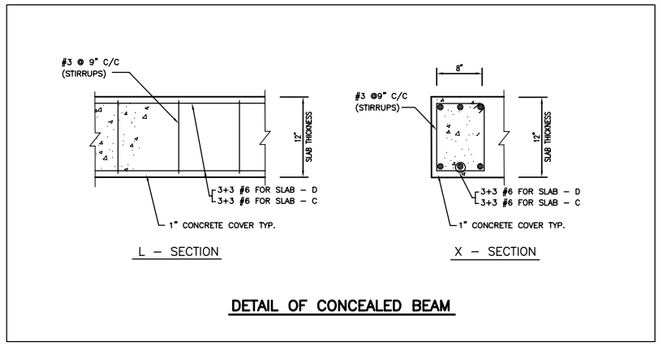
THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	
DETAIL OF MANHOLE (FROM 54" UP TO 90"DIA SEWER) (1/2)	DWG No.	TSL-18



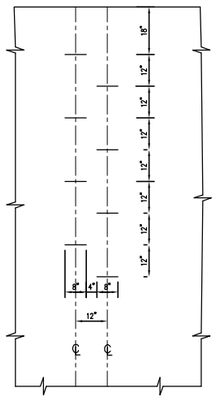
MANHOLE SLAB – C
(REINFORCEMENT DETAILS)



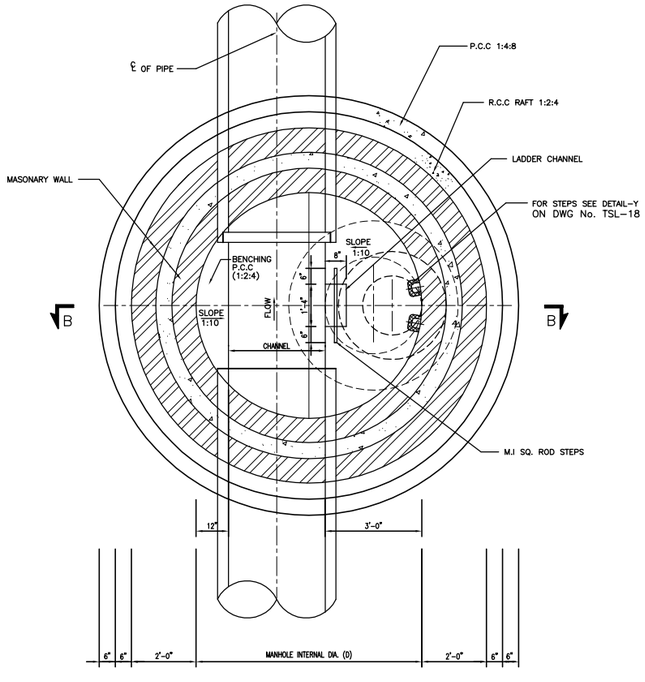
MANHOLE SLAB – D
(REINFORCEMENT DETAILS)



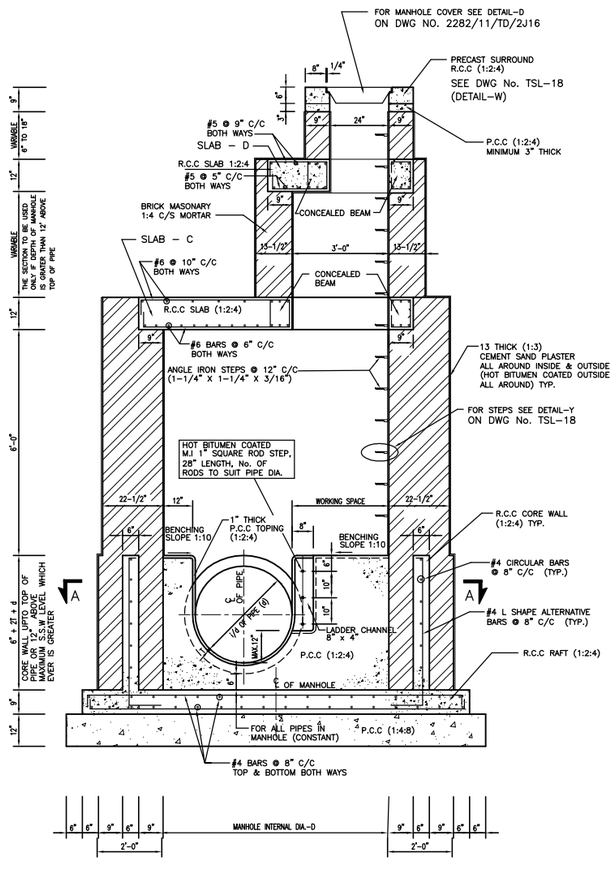
DETAIL OF CONCEALED BEAM



SKETCH OF MONKEY LADER
INSIDE OF MANHOLE
(FOR DEPTH >8 FEET)



SECTIONAL PLAN A–A
TYPICAL SEWER MANHOLE PLAN
(FOR DEPTH ≥ 20 ≤ 30 FEET)



SECTION B–B
(FOR DEPTH ≥ 20 ≤ 30 FEET)

NOTES:–

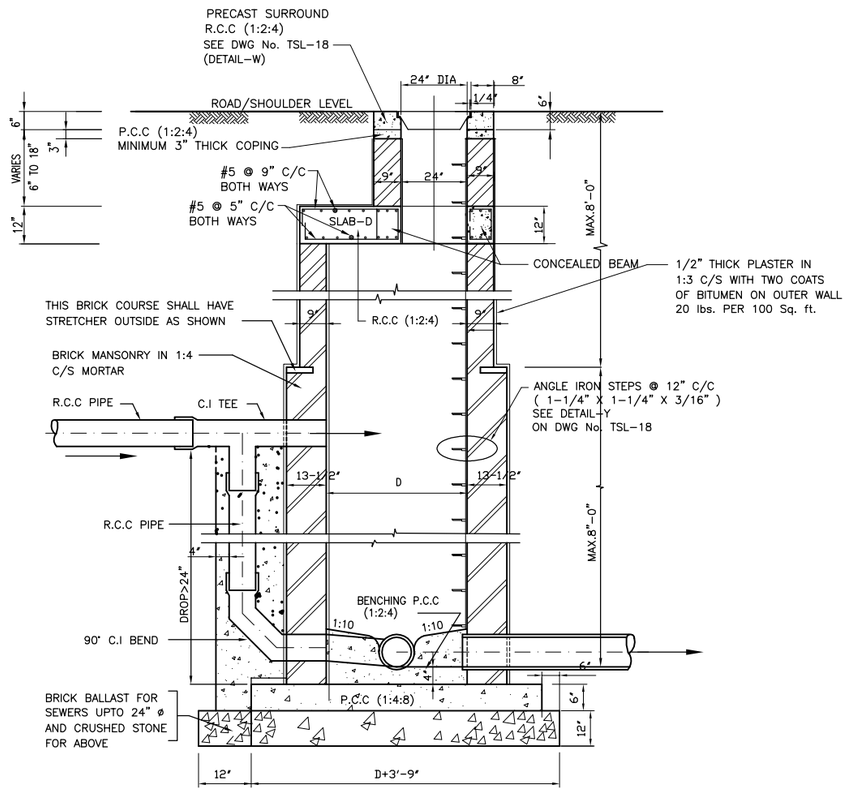
1. ALL DIMENSIONS ARE IN INCHES.
2. PRE CAST SECTION SHALL BE REINFORCED CONCRETE COMPLYING WITH BS–5911 PART–1, 1981
3. FIRST JOINT ON ALL PIPES SHALL BE 18" Max. OUTSIDE OF MANHOLE FACE. SUCH PIPES PIECES SHALL BE USED AT SITE AS UNIT PIECES.
4. D, DENOTES INSIDE DIAMETER OF MANHOLE.
5. d, DENOTES INSIDE DIAMETER OF SEWER.
6. WEIGHT OF ANGLE IRON STEP IS 1.68 kg.
7. IN PAVEMENT SURFACES, TOP OF MANHOLE SHALL BE FLUSHED WITH THE SURFACE. IN OPEN AND CULTIVATED AREAS, TOP OF MANHOLE SHALL BE 12" ABOVE THE GROUND LEVEL.
8. FILLING MATERIAL SHOULD BE FREE FROM LUMPS, STONES AND ROOTS, ETC., CAREFULLY COMPACTED AROUND THE PIPE.
9. GRANULAR BEDDING MATERIAL TO BE USED.
10. USE M.S BARS WITH MINIMUM YIELD STRENGTH OF 40,000 Psi
11. WEIGHT OF THE STEEL CAGE SHOULD BE APPROVED BY THE ENGINEER BASED UPON THE NUMBER OF BARS AS MENTIONED IN TABLE–1 OF DWG No. TSL–20
12. DROP MANHOLE WILL BE PROVIDED IF THE INVERT LEVEL DIFFERE OF THE INLET AND OUTLET SEWER IS MORE THAN 2Ft. WITH THE PRIOR APPROVAL OF THE ENGINEER.
13. THE CONTRACTOR SHALL COORDINATE/ PREPARE THE NECESSARY DRAWINGS AND DOCUMENTS FOR SUBMISSION AND PRIOR APPROVAL OF RAILWAY, IRRIGATION OR ANY OTHER CONCERNED DEPARTMENT WHERE REQUIRED.
14. MIX DESIGN SHOULD BE CARRIED OUT TO ACHIEVE THE REQUIRED CONCRETE STRENGTH AS GIVEN BELOW.

RATIO	REQUIRED STRENGTH
1:1.5:3	3750 PSI
1:2:4	3000 PSI
1:4:8	1000 PSI

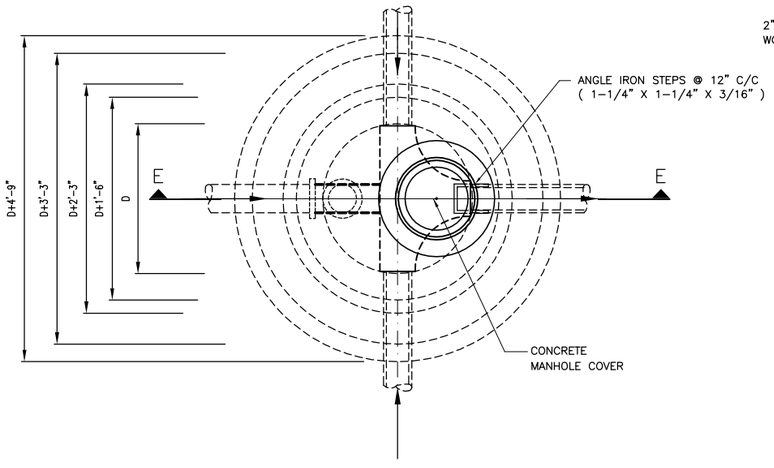
15. RATIO MENTIONED ON DRAWINGS IS SUBJECT TO CHANGEDEPENDING UPON THE MIX DESIGN REQUIREMENTS. THE ULTIMATE AIM SHOULD BE TO ACHIEVE THE REQUIRED STRENGTH.

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

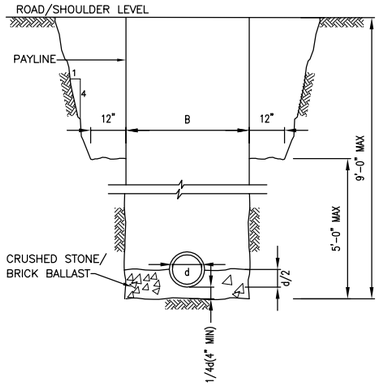
TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	
DETAIL OF MANHOLE (FROM 54" UP TO 90"DIA SEWER) (2/2)	DWG No.	TSL-19



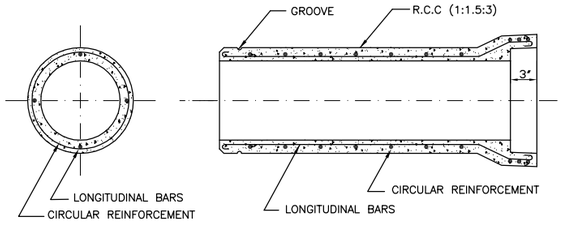
SECTION E-E



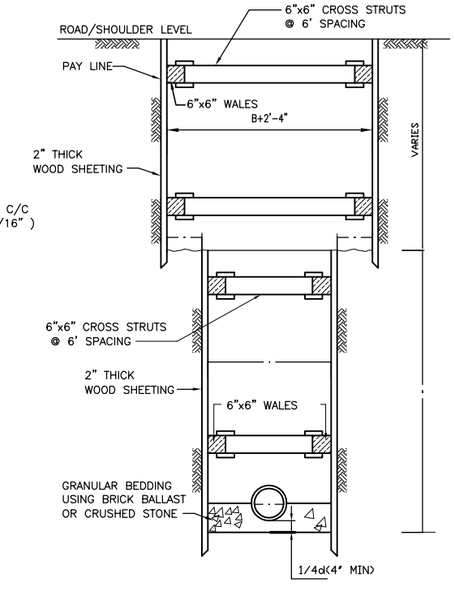
PLAN
TYPICAL SEWER DROP MANHOLE



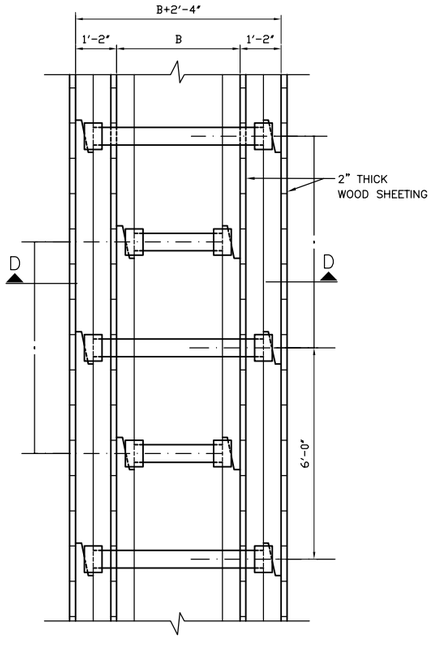
SECTION OF TRENCH
WITHOUT TIMBERING AND BRACING



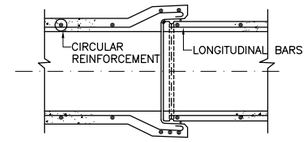
PIPE REINFORCEMENT DETAIL



SECTION D-D



PLAN
TRENCH WITH TIMBERING AND BRACING



SPECIFIC SOCKET AND SPIGOT JOINT
AND REINFORCEMENT DETAIL

THE DIMENSIONS OF WALL THICKNESS, PIPE DIAS, REINFORCEMENT DETAILS ETC. REFER TABLE-1

TABLE :1

RECOMMENDED R.C.C PIPES OF 8Ft. BARREL LENGTH (WALL THICKNESS AND REINFORCEMANT DETAILS)

SR. NO.	PIPE INNER DIA.	WALL THICKNESS	SIZE OF RING BARS	NOS.OF CIRCULAR RINGS		NO.OF RINGS FOR BELL	STAIRGHT BARS		
				INNER CAUGE	OUTER CAUGE		DIA.	NO.OF BARS	
								INNER CAUGE	OUTER CAUGE
1	54"	5 1/2"	5/16"	49	31	3	1/2"	8	8
2	60"	6"	3/8"	40	25	3	1/2"	8	8
3	72"	7"	3/8"	54	34	3	1/2"	8	8
4	84"	8"	5/8"	15	16	3	1/2"	8	8

PIPES MENTIONED IN TABLE-1 SHALL HAVE CLASS IV BEDDING AND WALL TYPE "B" WITH REQUIRED STRENGTH EQUAL TO 4000 PSI AS PER ASTM 76-79 STANDARDS .

TABLE :2

RECOMMENDED R.C.C PIPES OF 8Ft. BARREL LENGTH (WALL THICKNESS AND REINFORCEMANT DETAILS)

SR. NO.	PIPE INNER DIA.	WALL THICKNESS	SIZE OF RING BARS	NOS.OF CIRCULAR RINGS		NO.OF RINGS FOR BELL	STAIRGHT BARS		
				INNER CAUGE	OUTER CAUGE		DIA.	NO.OF BARS	
								INNER CAUGE	OUTER CAUGE
1	90"	8 1/2"	5/8"	16	18	3	1/2"	8	8

PIPES MENTIONED IN TABLE-2 SHALL HAVE CLASS III BEDDING AND WALL TYPE "B" WITH REQUIRED STRENGTH EQUAL TO 5000 PSI AS PER ASTM 76-79 STANDARDS .

TABLE -3

SEHEDULE OF TRENCH

SR. NO.	PIPE INSIDE DIA.	TRENCH Ⓑ WITH TIMBERING	WIDTH Ⓑ WITHOUT TIMBERING
1	54"	7'-10"	8'-0"
2	60"	8'-2"	8'-6"
3	72"	9'-6"	–
4	84"	10'-9"	–
5	90"	11'-4"	–

TABLE -4

SCHEDULE OF MANHOLE

SR. NO.	PIPE DIA. (inch)	Ⓓ	Ⓗ
1	9 TO 21	4'-0"	3'-6"
2	24 TO 30	5'-0"	4'-0"
3	33 TO 42	6'-6"	4'-6"
4	45 TO 54	7'-6"	5'-0"
5	60 TO 66	8'-0"	6'-0"
6	72 TO 78	9'-0"	7'-0"
7	84 TO 90	10'-0"	8'-0"

NOTE:-

1. FOR NOTES REFER DRAWING NO. 2282/11/TD/2J16
2. THE STRENGTH TEST REQUIREMENTS IN POUNDS-FORCE PER LINEAR FOOT OF PIPE UNDER THE THREE-EDGE-BEARING METHOD SHALL BE EITHER THE D-LOAD (TEST LOAD EXPRESSED IN POUNDS FORCE PER LINEAR FOOT OF DIAMETER) TO PRODUCE A 0.1 INCH CRACK, OR THE D-LOAD TO PRODUCE THE 0.01-INCH CRACK AND ULTIMATE LOAD AS SPECIFIED BELOW, MULTIPLIED BY THE INTERNAL DIAMETER OF THE PIPE IN FEET.
   D-LOAD TO PRODUCE A 0.01 INCH CRACK = 1350
   D-LOAD TO PRODUCE THE ULTIMATE LOAD = 2000
3. MIX DESIGN SHOULD BE CARRIED OUT TO ACHIEVE THE REQUIRED CONCRETE STRENGTH AS GIVEN BELOW.

RATIO	REQUIRED STRENGTH
1:1.5:3	3750 PSI
1:2:4	3000 PSI
1:4:8	1000 PSI

4. RATIO MENTIONED ON DRAWINGS IS SUBJECT TO CHANGE DEPENDING UPON THE MIX DESIGN REQUIREMENTS. THE ULTIMATE AIM SHOULD BE TO ACHIEVE THE REQUIRED STRENGTH.

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK AND BRANCH SEWER FROM LAREX COLONY TO NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	
DETAIL OF DROP MANHOLE	DWG No.	TSL-20

PANJ PIR

GULSHAN-E-RAVI

MH1 MH2 MH3 MH4 MH5 MH6 MH7 MH8 MH9 MH10 MH11

(425') (500') (500') (500') (500') (500') (500') (500') (500') (500')

LINE A

GULSHAN-E-RAVI ROAD

12'X8'

(350')

EXISTING

PROPOSED

GULSHAN-E-RAVI
DISPOSAL STATION

GULSHAN-E-RAVI

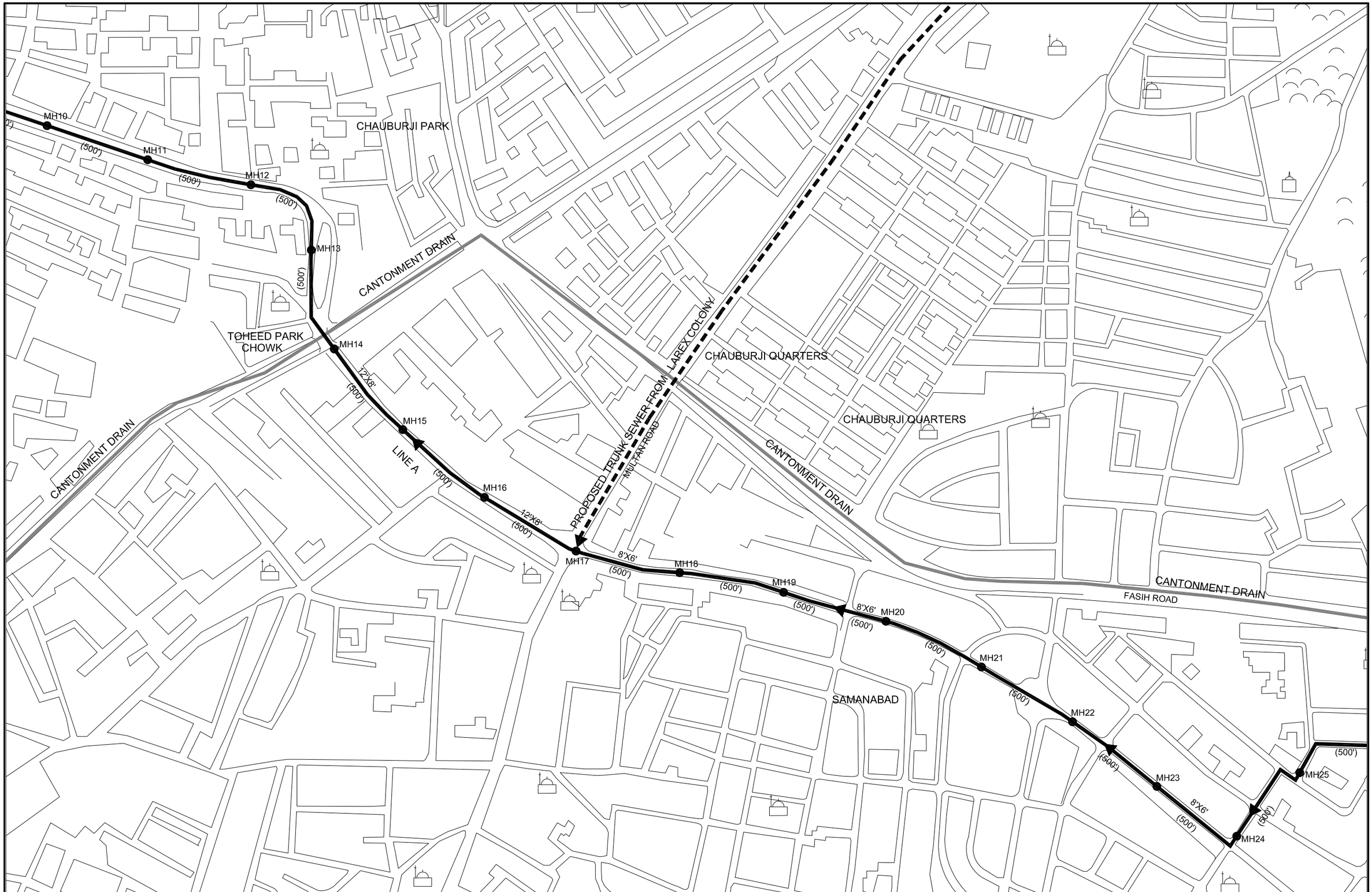
CANTONMENT DRAIN

INDEX OF DWG. No.

TSC-01 TSC-02 TSC-03 TSC-04 TSC-05 TSC-06 TSC-07 TSC-08

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	—
PLAN (1/8)	DWG No.	TSC-01

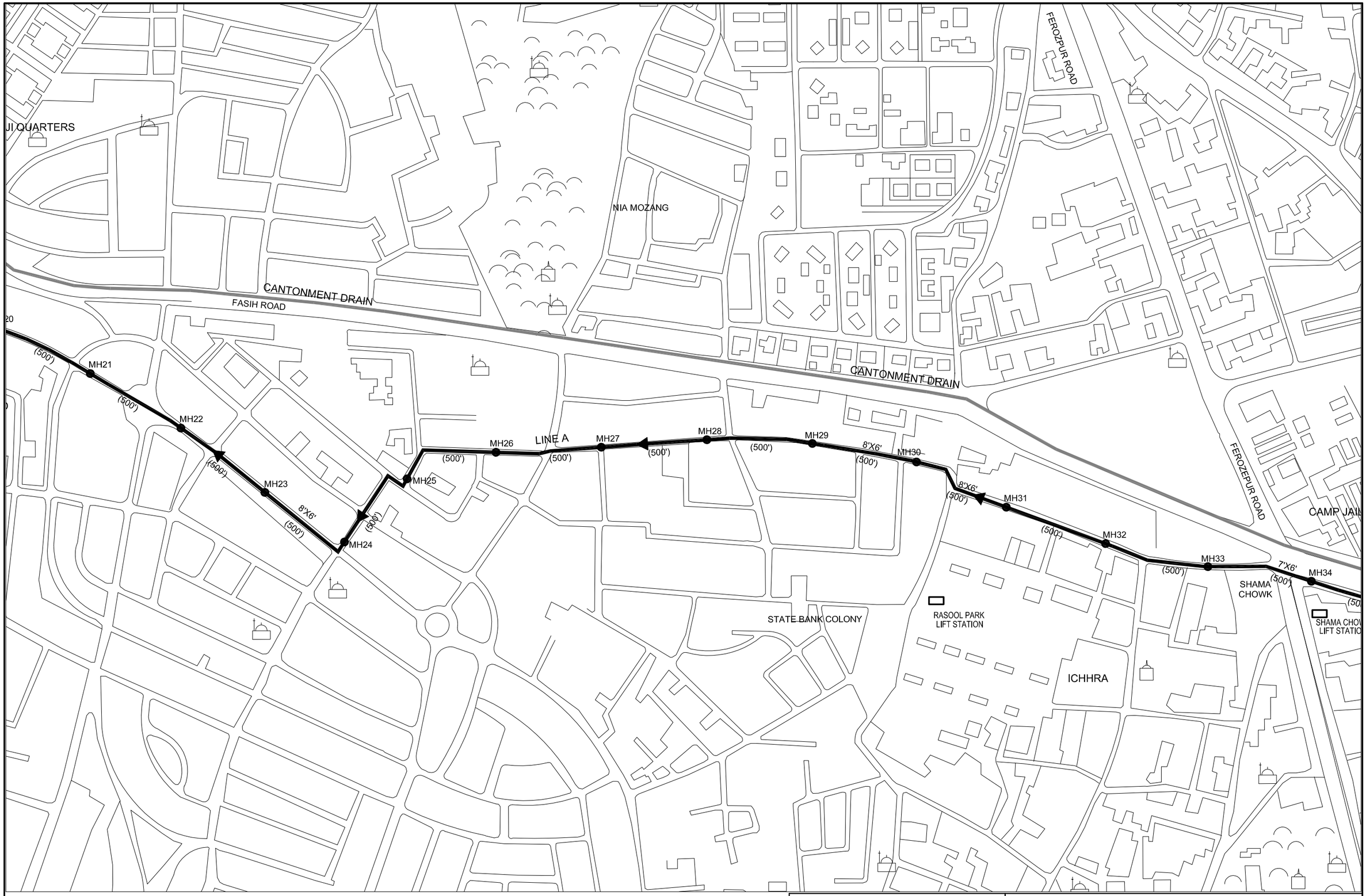


TSC-01 TSC-02 TSC-03 TSC-04 TSC-05 TSC-06 TSC-07 TSC-08

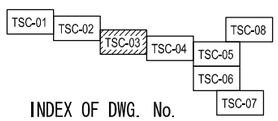
INDEX OF DWG. No.

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	—
PLAN (2/8)	DWG No.	TSC-02

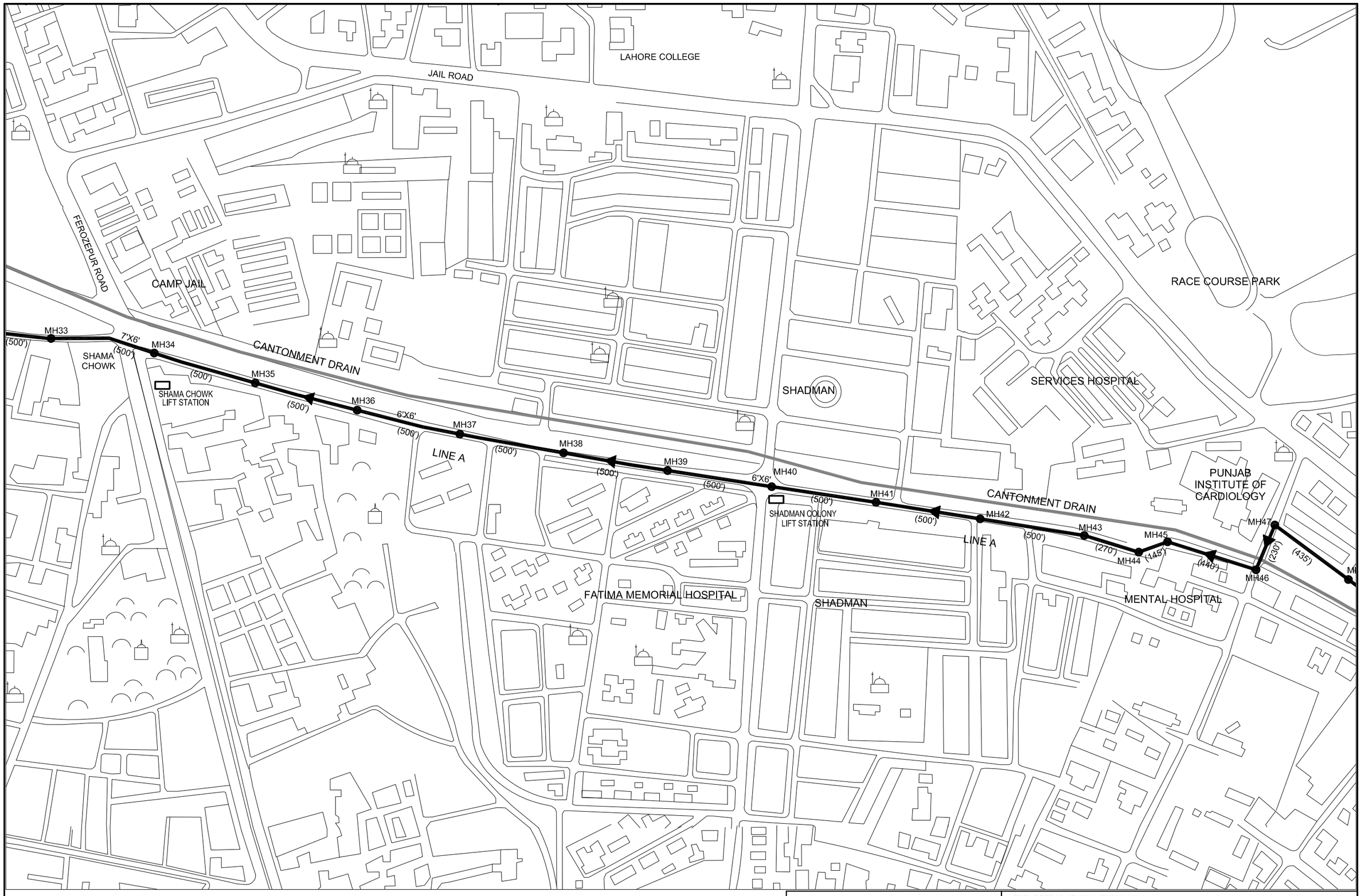


INDEX OF DWG. No.

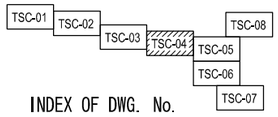


THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	—
PLAN (3/8)	DWG No.	TSC-03



INDEX OF DWG. No.



THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	—
PLAN (4/8)	DWG No.	TSC-04

CE COURSE PARK

PUNJAB INSTITUTE OF CARDIOLOGY

KINNAIRD COLLEGE

STATE GUEST HOUSE

GYMKHANA CLUB

GRAVE YARD

CANAL PARK

LAHORE BRANCH CANAL

JAIL ROAD

MALL ROAD

ZAFAR ALI ROAD

CANTONMENT DRAIN

LINE A.1

LINE A

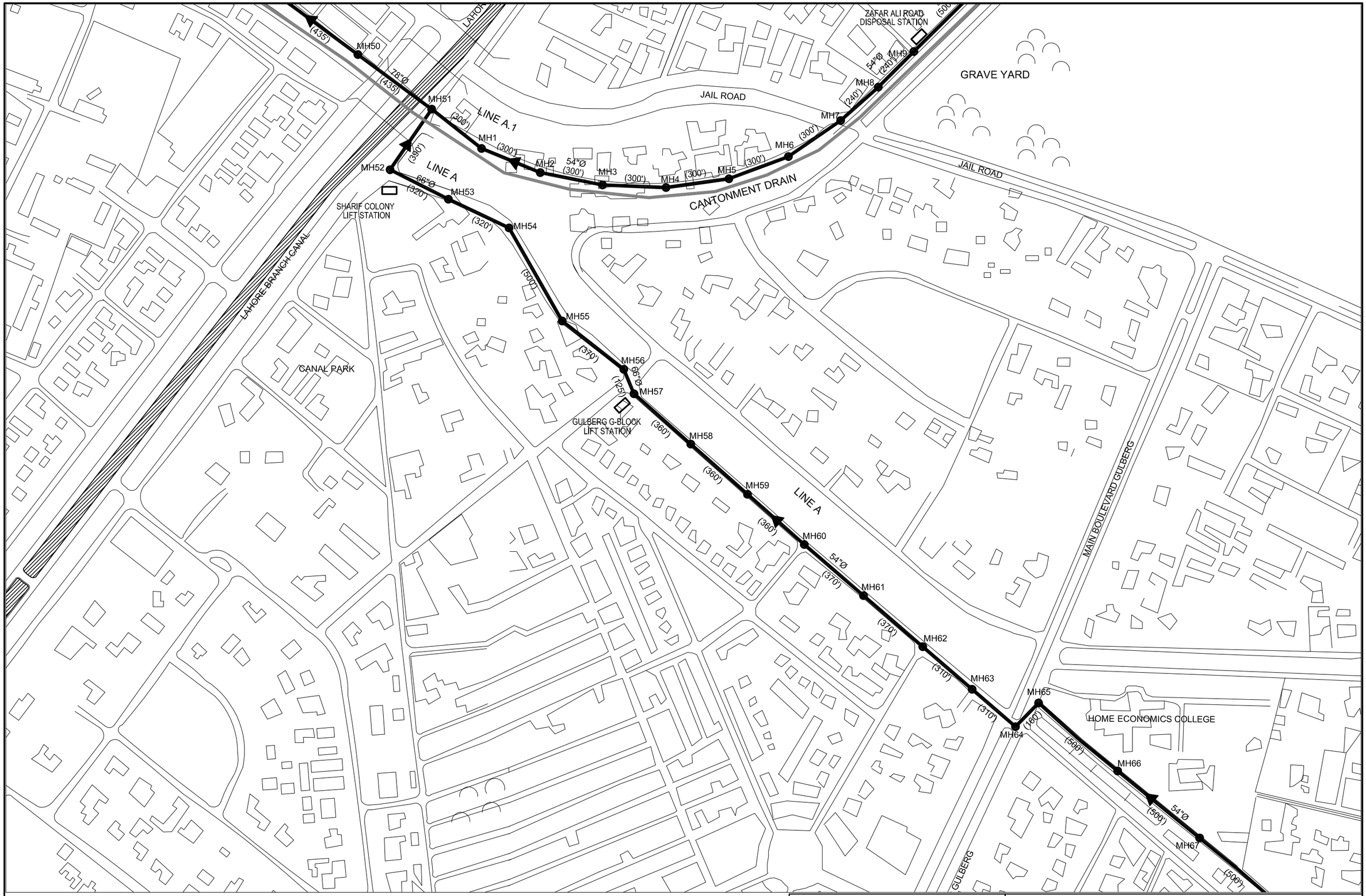
MH16
48"Ø (400')
MH15
(400')
MH14
(400')
MH13
(400')
MH12
(500')
MH11
(500')
MH10
(500')
ZAFAR ALI ROAD DISPOSAL STATION
54"Ø (240')
MH9
(240')
MH8
(240')
MH7
(300')
MH6
(300')
MH5
(300')
MH4
(300')
MH3
(300')
54"Ø (300')
MH2
(300')
MH1
(300')
MH51
(300')
MH52
(360')
66"Ø (320')
SHARIF COLONY LIFT STATION
MH53
(320')
MH54
(500')
MH55
(370')
MH56
66"Ø (125')
MH57
GULBERG G-BLOCK LIFT STATION
(360')
MH50
78"Ø (435')
(435')
MH49
(435')
MH48
(230')
MH47
(440')
MH46

INDEX OF DWG. No.

TSC-01 TSC-02 TSC-03 TSC-04 TSC-05 TSC-06 TSC-07 TSC-08

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	—
PLAN (5/8)	DWG No.	TSC-05

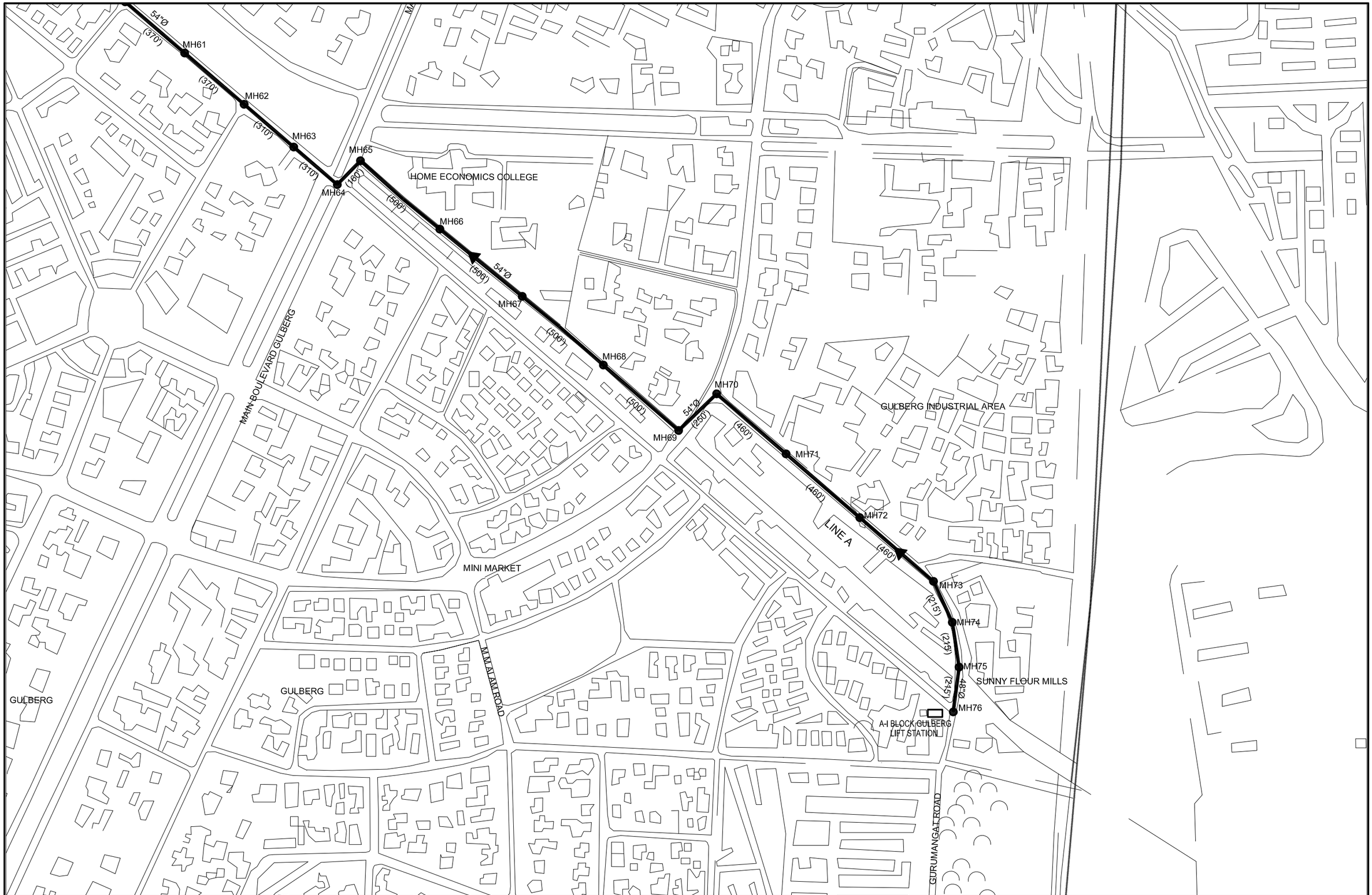


TSC-01 TSC-02 TSC-03 TSC-04 TSC-05 TSC-06 TSC-07 TSC-08

INDEX OF DWG. No.

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	—
PLAN (6/8)	DWG No.	TSC-06

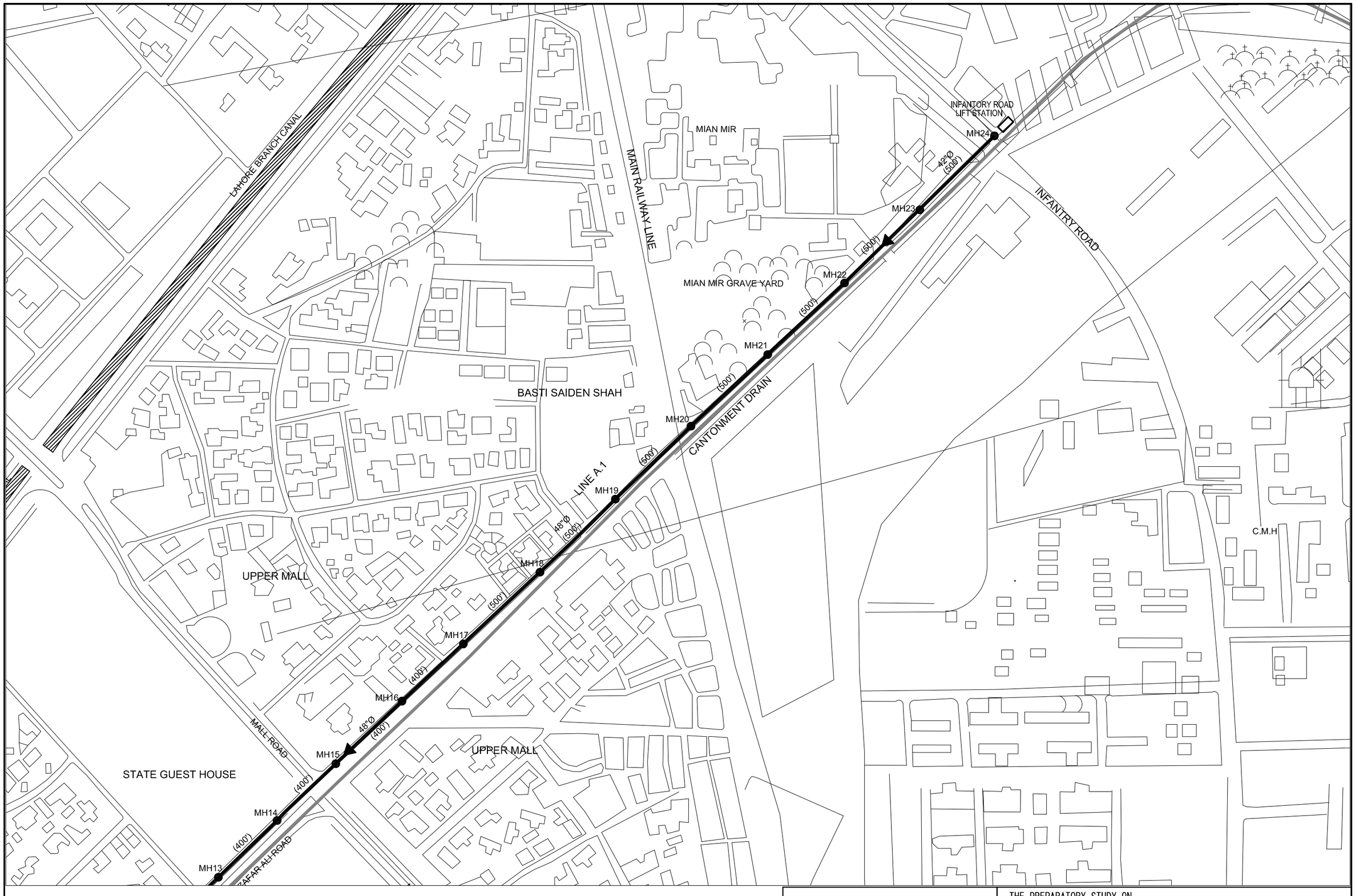


INDEX OF DWG. No.

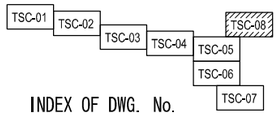
TSC-01 TSC-02 TSC-03 TSC-04 TSC-05 TSC-06 TSC-07 TSC-08

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	—
PLAN (7/8)	DWG No.	TSC-07

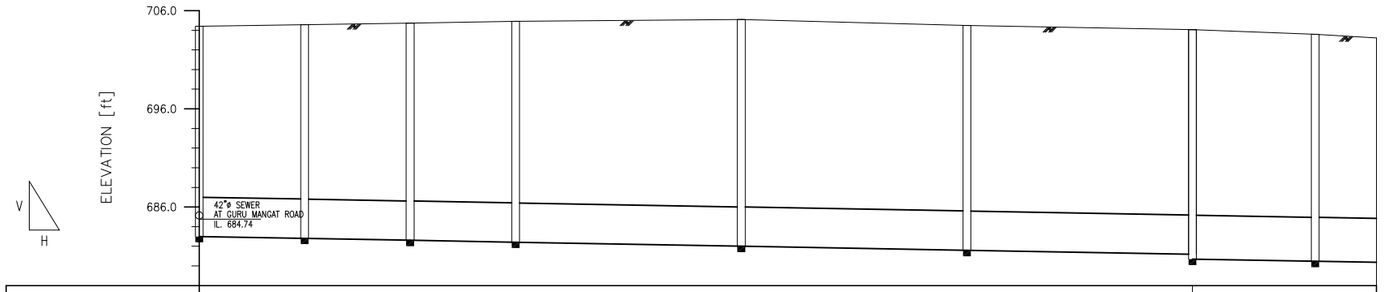


INDEX OF DWG. No.



THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

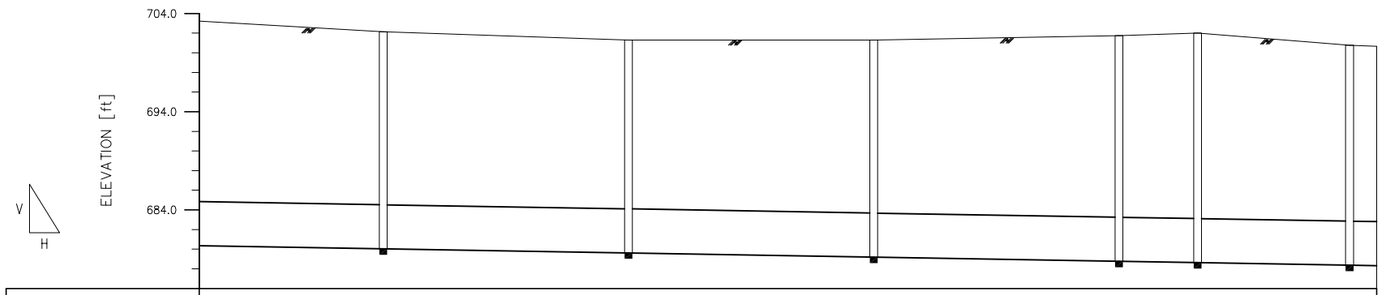
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	—
PLAN (8/8)	DWG No.	TSC-08



SIZE. (inch / BxH ft)	48"ø						54"ø	
SLOPE (ft/ft)	0.00090						0.00085	
GROUND LEVEL (FT.)	704.40	704.57	704.73	704.91	705.09	704.49	704.07	703.60
INVERT ELEVATION (FT.)	683.00	682.81	682.61	682.42	682.01	681.59	681.18 680.68	680.47
CHAINAGE (FT.)	0+000	0+215	0+430	0+645	1+105	1+565	2+025	2+275
MANHOLE NUMBER	MH76	MH75	MH74	MH73	MH72	MH71	MH70	MH69

PLOFILE (Manhole No. fr. MH76 to MH69)

H: SCALE A V: SCALE B



SIZE. (inch / BxH ft)	54"ø					
SLOPE (ft/ft)	0.00085					
GROUND LEVEL (FT.)	702.14	701.31	701.31	701.74	702.00	700.77
INVERT ELEVATION (FT.)	680.04	679.62	679.19	678.77	678.63	678.37
CHAINAGE (FT.)	2+775	3+275	3+775	4+275	4+435	4+745
MANHOLE NUMBER	MH68	MH67	MH66	MH65	MH64	MH63

SCALE A 0 100 200 300 400 500 ft.

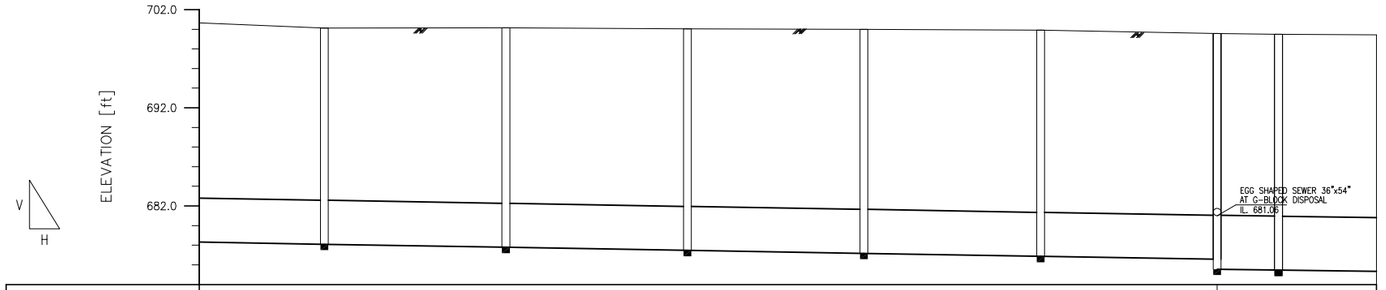
SCALE B 0 5 10 15 20 25 ft.

PLOFILE (Manhole No. fr. MH69 to MH63)

H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

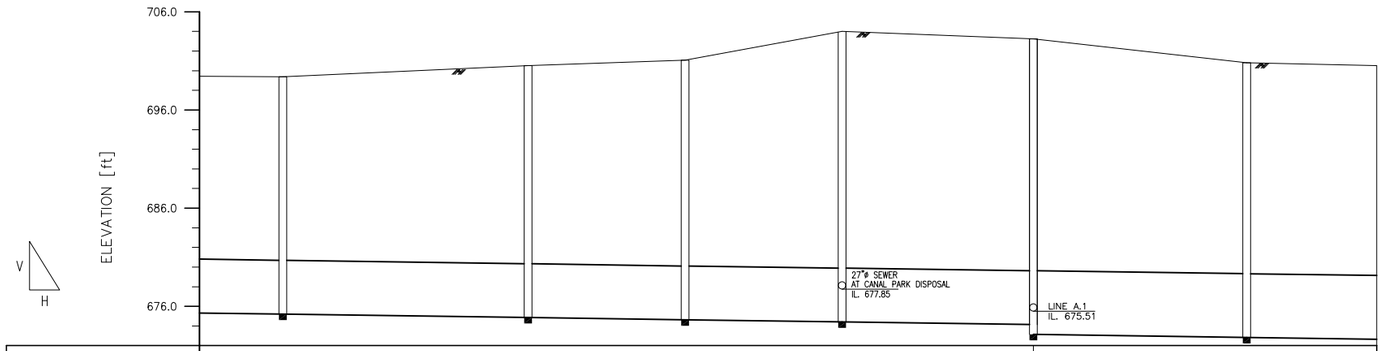
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	SEE SCALE BAR
PROFILE (1/9)	DWG No.	TSC-09



SIZE. (inch / BxH ft)	54"ø					66"ø	
SLOPE (ft/ft)	0.00085					0.00070	
GROUND LEVEL (FT.)	700.12	700.15	700.05	700.00	699.90	699.56	699.49
INVERT ELEVATION (FT.)	678.10	677.79	677.47	677.17	676.86	676.56 675.56	675.47
CHAINAGE (FT.)	5+055	5+425	5+795	6+155	6+515	6+875	7+000
MANHOLE NUMBER	MH62	MH61	MH60	MH59	MH58	MH57	MH56

PLOFILE (Manhole No. fr. MH63 to MH56)

H: SCALE A V: SCALE B



SIZE. (inch / BxH ft)	66"ø					78"ø	
SLOPE (ft/ft)	0.00070						
GROUND LEVEL (FT.)	699.38	700.52	701.08	704.00	703.24	700.82	
INVERT ELEVATION (FT.)	675.21	674.86	674.63	674.41	674.14 673.14	672.83	
CHAINAGE (FT.)	7+370	7+870	8+190	8+510	**8+900**	9+335	
MANHOLE NUMBER	MH55	MH54	MH53	MH52	**MH51**	MH50	

SCALE A 0 100 200 300 400 500 ft.

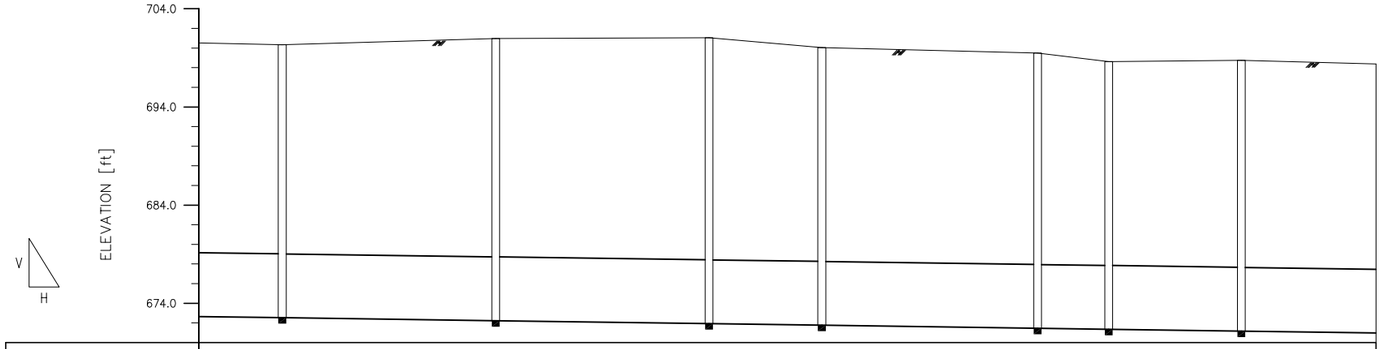
SCALE B 0 5 10 15 20 25 ft.

PLOFILE (Manhole No. fr. MH56 to MH50)

H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

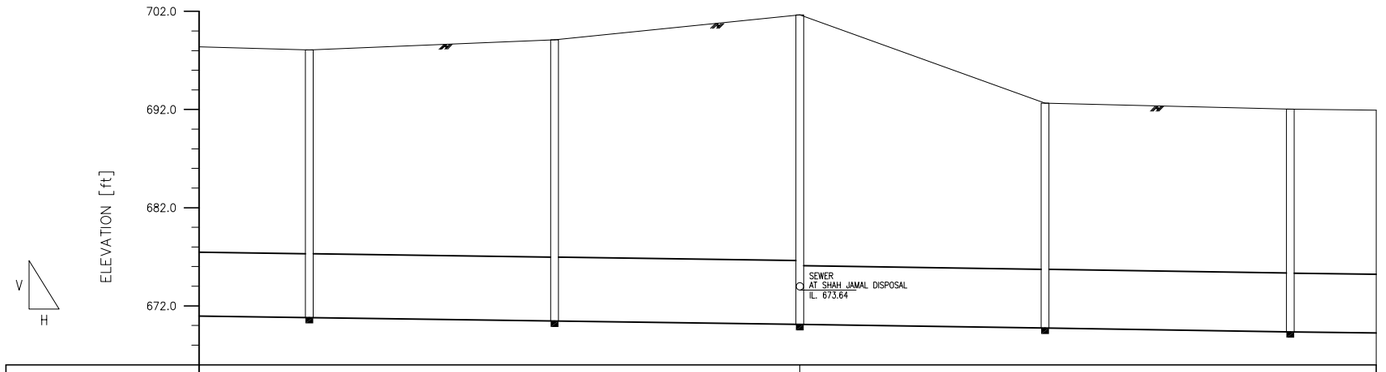
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	SEE SCALE BAR
PROFILE (2/9)	DWG No.	TSC-10



SIZE. (inch / BxH ft)	78"ø						
SLOPE (ft/ft)	0.00070						
GROUND LEVEL (FT.)	700.33	700.96	701.05	700.05	699.50	698.62	698.76
INVERT ELEVATION (FT.)	672.53	672.22	671.92	671.76	671.45	671.35	671.16
CHAINAGE (FT.)	9+770	10+205	10+640	10+870	11+310	11+455	11+725
MANHOLE NUMBER	MH49	MH48	MH47	MH46	MH45	MH44	MH43

PLOFILE (Manhole No. fr. MH50 to MH43)

H: SCALE A V: SCALE B



SIZE. (inch / BxH ft)	78"ø		6'X6'		
SLOPE (ft/ft)	0.00070		0.00075		
GROUND LEVEL (FT.)	698.08	699.10	701.64	692.65	692.05
INVERT ELEVATION (FT.)	670.81	670.46	670.11	669.74	669.36
CHAINAGE (FT.)	12+225	12+725	13+225	13+725	14+225
MANHOLE NUMBER	MH42	MH41	MH40	MH39	MH38

SCALE A 0 100 200 300 400 500 ft.

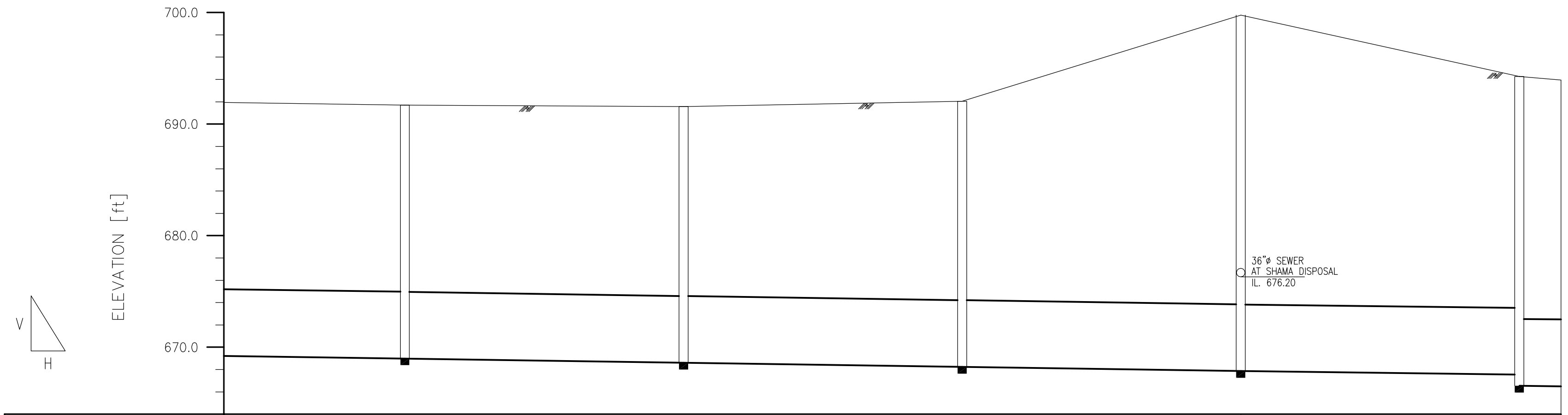
SCALE B 0 5 10 15 20 25 ft.

PLOFILE (Manhole No. fr. MH43 to MH38)

H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

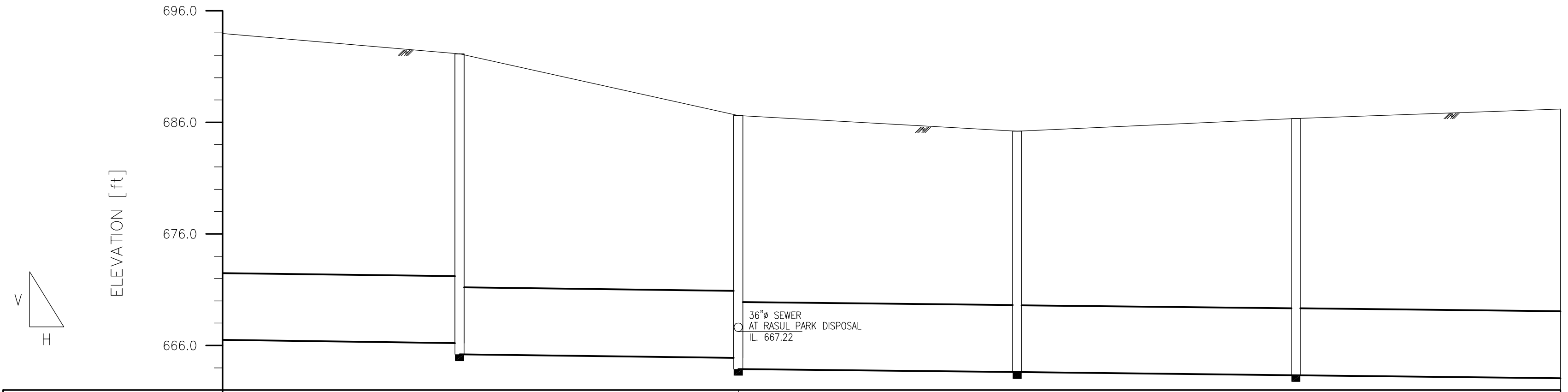
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	SEE SCALE BAR
PROFILE (3/9)	DWG No.	TSC-11



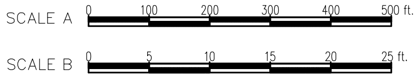
SIZE. (inch / BxH ft)	6'X6'			7'X6'	
SLOPE (ft/ft)	0.00075			0.00065	
GROUND LEVEL (FT.)	691.70	691.58	692.05	699.78	694.27
INVERT ELEVATION (FT.)	668.99	668.61	668.24	667.86	667.54 666.54
CHAINAGE (FT.)	14+725	15+225	15+725	16+225	16+725
MANHOLE NUMBER	MH37	MH36	MH35	MH34	MH33

PLOFILE (Manhole No. fr. MH38 to MH33)

H: SCALE A V: SCALE B



SIZE. (inch / BxH ft)	7'X6'	8'X6'		
SLOPE (ft/ft)	0.00065	0.00055		
GROUND LEVEL (FT.)	692.13	686.59	685.20	686.35
INVERT ELEVATION (FT.)	666.21 665.21	664.89 663.89	663.61	663.34
CHAINAGE (FT.)	17+225	17+725	18+225	18+725
MANHOLE NUMBER	MH32	MH31	MH30	MH29

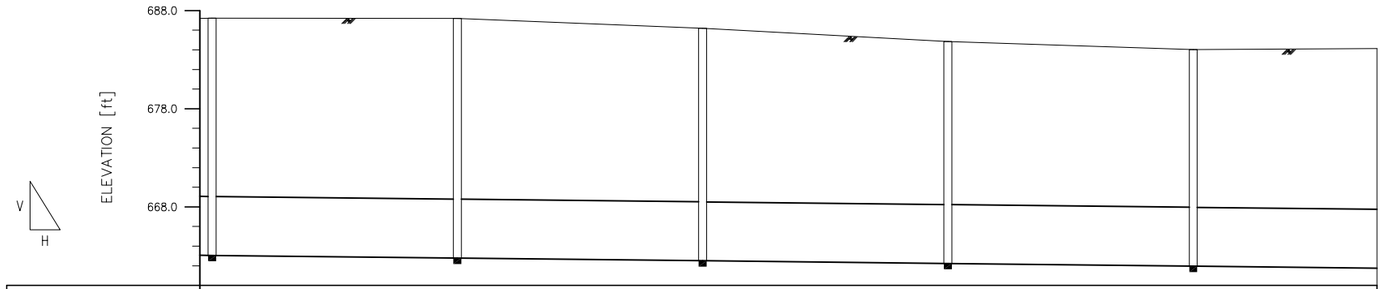


PLOFILE (Manhole No. fr. MH33 to MH29)

H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

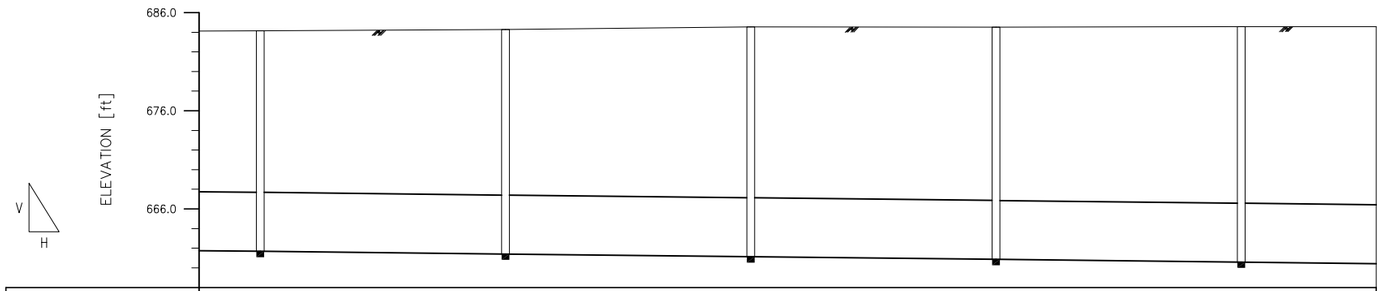
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	SEE SCALE BAR
PROFILE (4/9)	DWG No.	TSC-12



SIZE. (inch / BxH ft)	8'X6'				
SLOPE (ft/ft)	0.00055				
GROUND LEVEL (FT.)	687.23	687.20	686.18	684.84	684.03
INVERT ELEVATION (FT.)	663.06	662.79	662.51	662.24	661.96
CHAINAGE (FT.)	19+225	19+725	20+225	20+725	21+225
MANHOLE NUMBER	MH28	MH27	MH26	MH25	MH24

PLOFILE (Manhole No. fr. MH29 to MH24)

H: SCALE A V: SCALE B



SIZE. (inch / BxH ft)	8'X6'				
SLOPE (ft/ft)	0.00055				
GROUND LEVEL (FT.)	684.15	684.29	684.53	684.51	684.58
INVERT ELEVATION (FT.)	661.69	661.41	661.14	660.86	660.59
CHAINAGE (FT.)	21+725	22+225	22+725	23+225	23+725
MANHOLE NUMBER	MH23	MH22	MH21	MH20	MH19

SCALE A 0 100 200 300 400 500 ft.

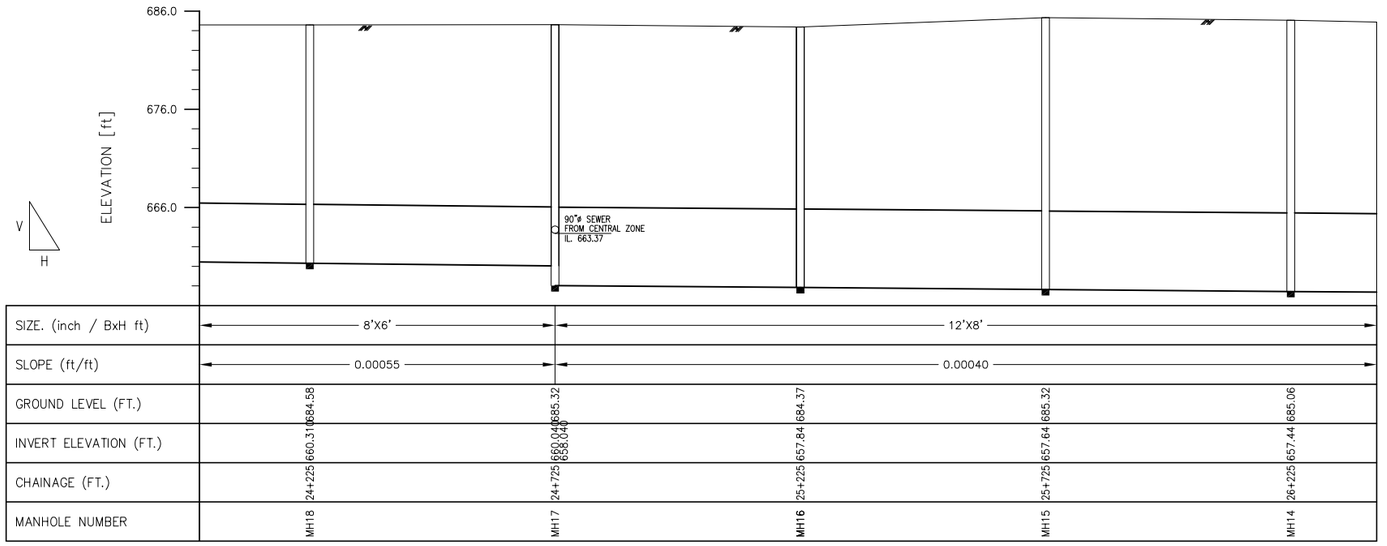
SCALE B 0 5 10 15 20 25 ft.

PLOFILE (Manhole No. fr. MH24 to MH19)

H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

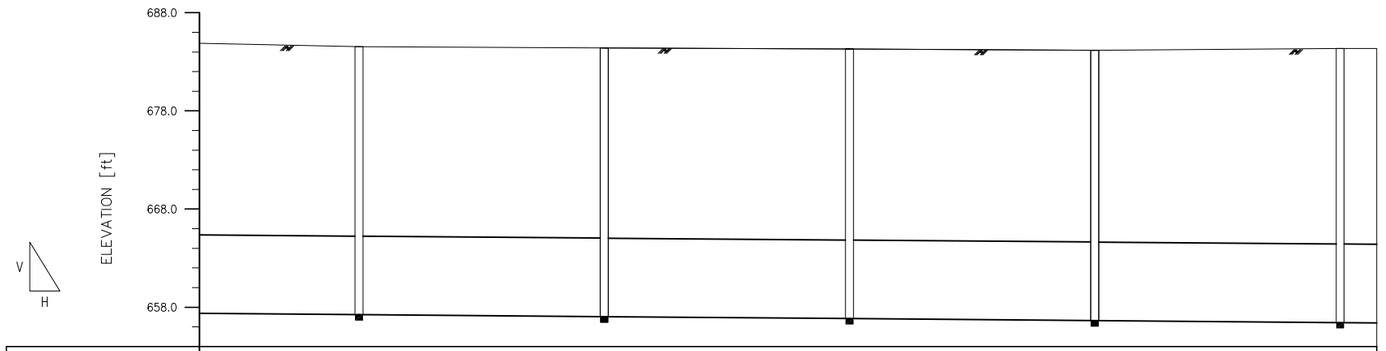
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	SEE SCALE BAR
PROFILE (5/9)	DWG No.	TSC-13



SIZE. (inch / BxH ft)	8'X6'		12'X8'		
SLOPE (ft/ft)	0.00055		0.00040		
GROUND LEVEL (FT.)	684.58	685.32	684.37	685.32	685.06
INVERT ELEVATION (FT.)	660.31	660.040 658.040	657.84	657.64	657.44
CHAINAGE (FT.)	24+225	24+725	25+225	25+725	26+225
MANHOLE NUMBER	MH18	MH17	MH16	MH15	MH14

PLOFILE (Manhole No. fr. MH19 to MH14)

H: SCALE A V: SCALE B



SIZE. (inch / BxH ft)	12'X8'				
SLOPE (ft/ft)	0.00040				
GROUND LEVEL (FT.)	684.53	684.40	684.31	684.18	684.37
INVERT ELEVATION (FT.)	657.24	657.04	656.84	656.64	656.44
CHAINAGE (FT.)	26+725	27+225	27+725	28+225	28+725
MANHOLE NUMBER	MH13	MH12	MH11	MH10	MH9

SCALE A 0 100 200 300 400 500 ft.

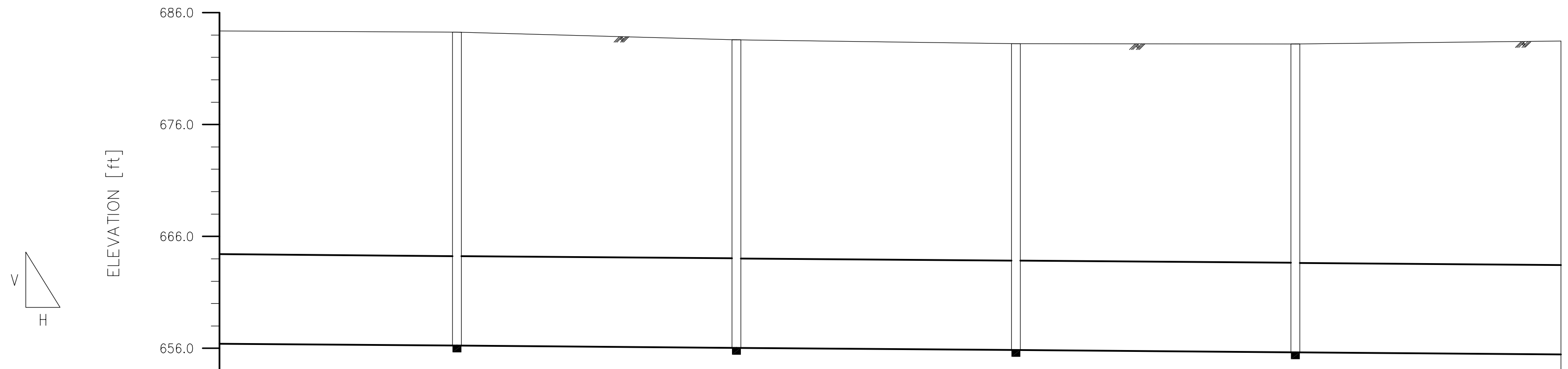
SCALE B 0 5 10 15 20 25 ft.

PLOFILE (Manhole No. fr. MH14 to MH9)

H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

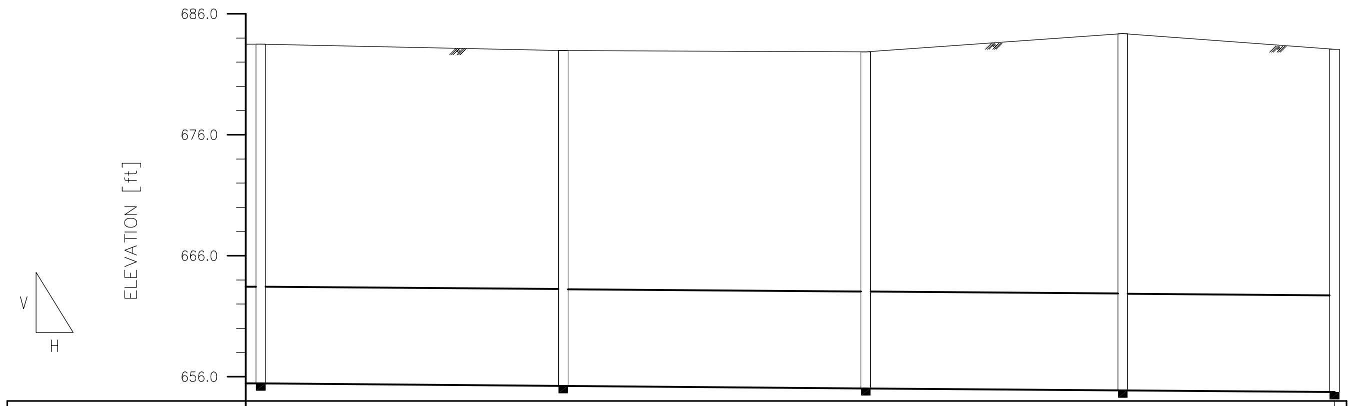
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	SEE SCALE BAR
PROFILE (6/9)	DWG No.	TSC-14



SIZE. (inch / BxH ft)	12'X8'			
SLOPE (ft/ft)	0.00040			
GROUND LEVEL (FT.)	684.27	683.56	683.23	683.21
INVERT ELEVATION (FT.)	656.24	656.04	655.84	655.64
CHAINAGE (FT.)	29+225	29+725	30+225	30+725
MANHOLE NUMBER	MH8	MH7	MH6	MH5

PLOFILE (Manhole No. fr. MH9 to MH5)

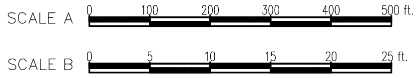
H: SCALE A V: SCALE B



SIZE. (inch / BxH ft)	12'X8'				
SLOPE (ft/ft)	0.00040				
GROUND LEVEL (FT.)	683.49	682.96	682.86	684.37	683.05
INVERT ELEVATION (FT.)	655.44	655.24	655.04	654.87	654.73
CHAINAGE (FT.)	31+225	31+725	32+225	32+650	33+000
MANHOLE NUMBER	MH4	MH3	MH2	MH1	DS

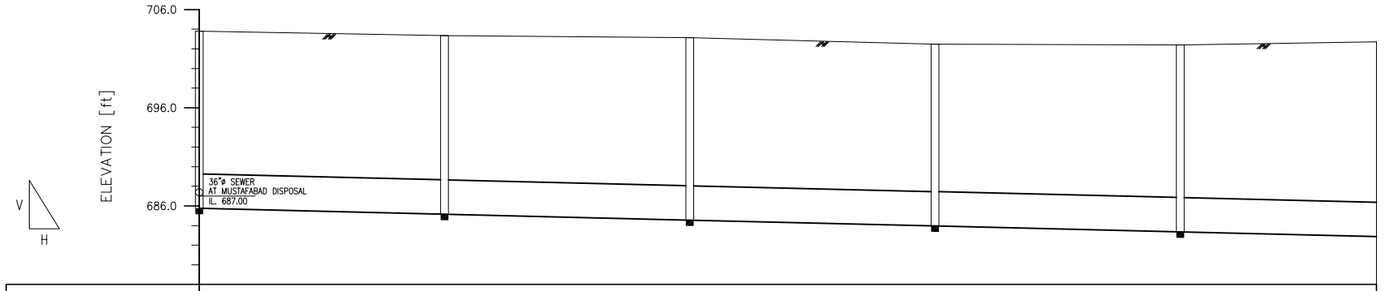
PLOFILE (Manhole No. fr. MH5 to MH DS)

H: SCALE A V: SCALE B



THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

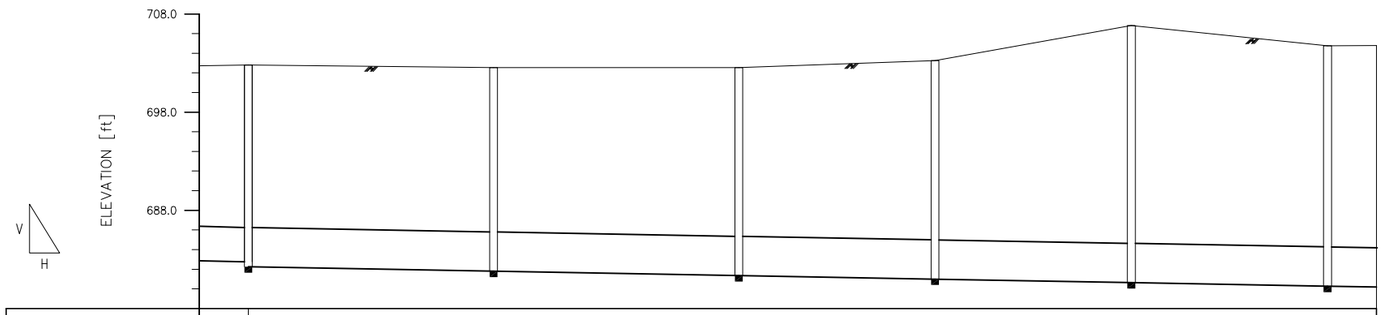
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	SEE SCALE BAR
PROFILE (7/9)	DWG No.	TSC-15



SIZE. (inch / BxH ft)	42"ø					
SLOPE (ft/ft)	0.00120					
GROUND LEVEL (FT.)	703.80	703.34	703.15	702.48	702.39	
INVERT ELEVATION (FT.)	685.75	685.15	684.55	683.95	683.35	
CHAINAGE (FT.)	0+000	0+500	1+000	1+500	2+000	
MANHOLE NUMBER	MH24	MH23	MH22	MH21	MH20	

PLOFILE (Manhole No. fr. MH24 to MH20)

H: SCALE A V: SCALE B



SIZE. (inch / BxH ft)	42	48"ø					
SLOPE (ft/ft)	0.00120	0.000900					
GROUND LEVEL (FT.)	702.81	702.53	702.53	703.25	706.82	704.77	
INVERT ELEVATION (FT.)	682.75 682.25	681.80	681.35	680.99	680.63	680.27	
CHAINAGE (FT.)	2+500	3+000	3+500	3+900	4+300	4+700	
MANHOLE NUMBER	MH19	MH18	MH17	MH16	MH15	MH14	

SCALE A 0 100 200 300 400 500 ft.

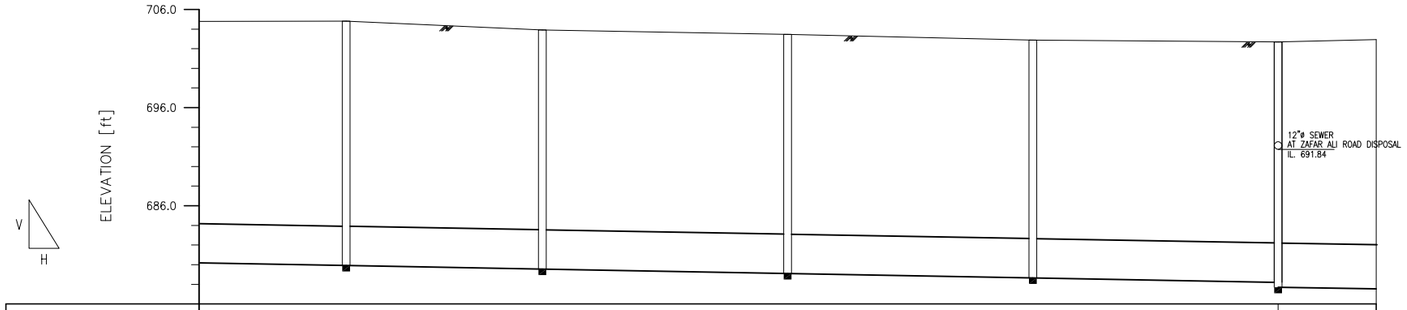
SCALE B 0 5 10 15 20 25 ft.

PLOFILE (Manhole No. fr. MH20 to MH14)

H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

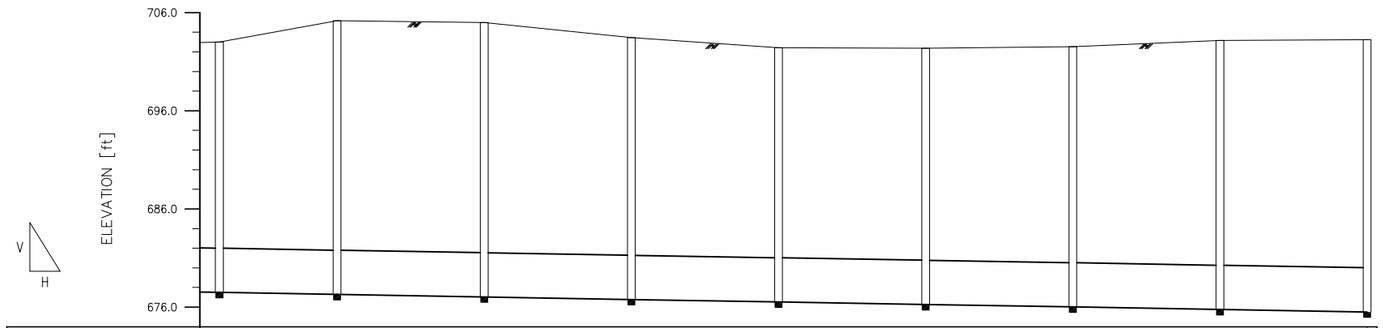
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	SEE SCALE BAR
PROFILE (8/9)	DWG No.	TSC-16



SIZE. (inch / BxH ft)	48"ø					54
SLOPE (ft/ft)	0.000900					0.00085
GROUND LEVEL (FT.)	704.80	703.92	703.47	702.88	702.70	
INVERT ELEVATION (FT.)	679.91	679.55	679.10	678.65	678.20	677.70
CHAINAGE (FT.)	5+100	5+500	6+000	6+500	7+000	
MANHOLE NUMBER	MH13	MH12	MH11	MH10	MH9	

PLOFILE (Manhole No. fr. MH14 to MH9)

H: SCALE A V: SCALE B



SIZE. (inch / BxH ft)	54"ø							
SLOPE (ft/ft)	0.00085							
GROUND LEVEL (FT.)	702.99	705.16	704.99	703.44	702.41	702.37	702.53	703.15	703.24
INVERT ELEVATION (FT.)	677.50	677.29	677.04	676.78	676.53	676.27	676.02	675.76	675.51
CHAINAGE (FT.)	7+240	7+480	7+780	8+080	8+380	8+680	8+980	9+280	9+580
MANHOLE NUMBER	MH8	MH7	MH6	MH5	MH4	MH3	MH2	MH1	MH51

SCALE A 0 100 200 300 400 500 ft.

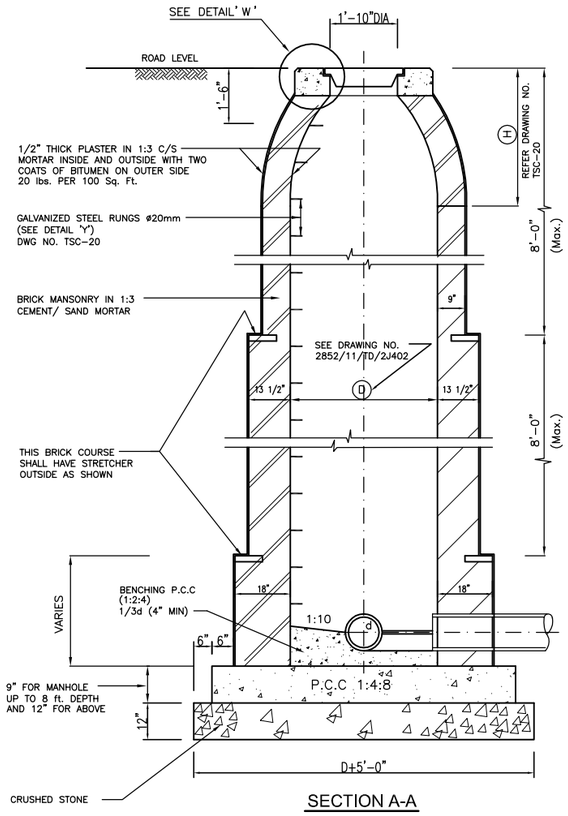
SCALE B 0 5 10 15 20 25 ft.

PLOFILE (Manhole No. fr. MH9 to MH51)

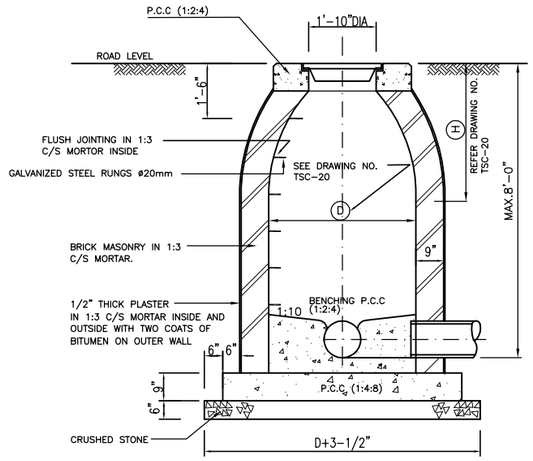
H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

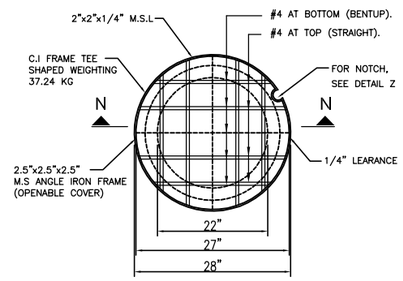
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	SEE SCALE BAR
PROFILE (9/9)	DWG No.	TSC-17



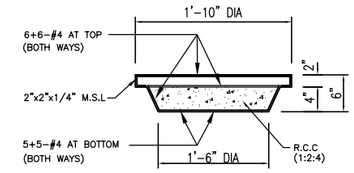
SECTION A-A



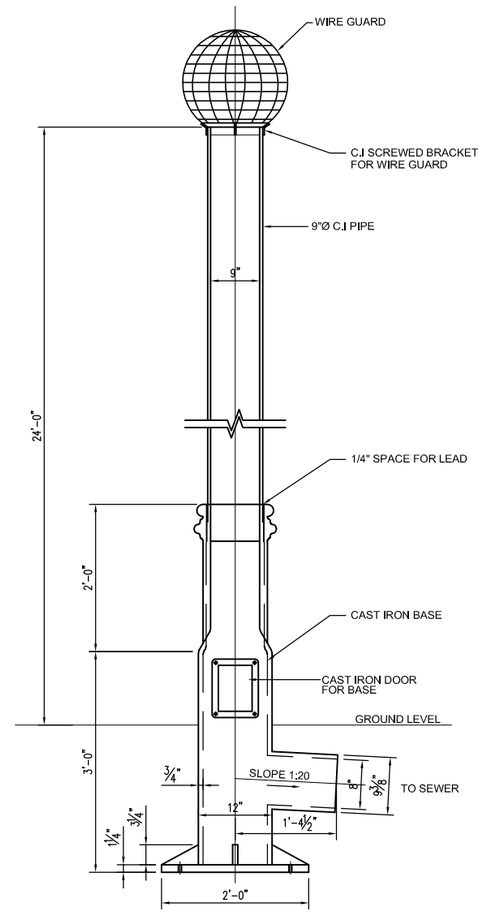
SECTION B-B



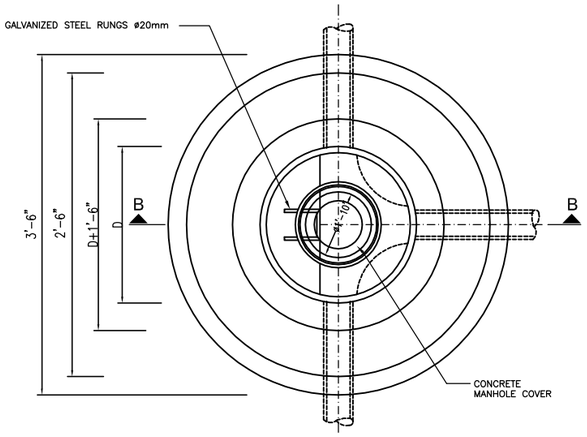
PLAN OF 22" DIA MANHOLE COVER



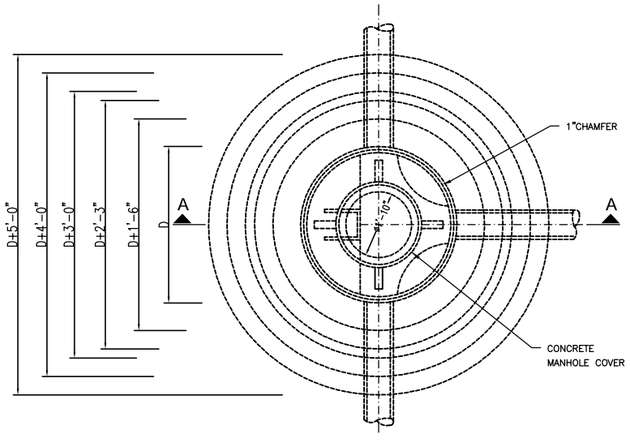
SECTION N-N



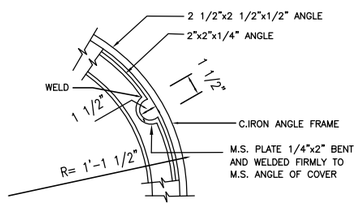
CROSS SECTION OF VENTILATION SHAFT



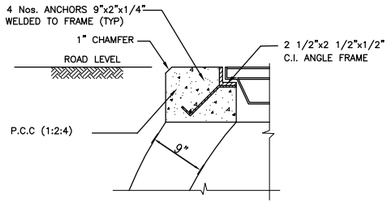
TYPICAL SEWER MANHOLE PLAN
(FOR DEPTH ≤ 8.Ft.)



TYPICAL SEWER MANHOLE PLAN
(FOR DEPTH ≥ 8.Ft.)

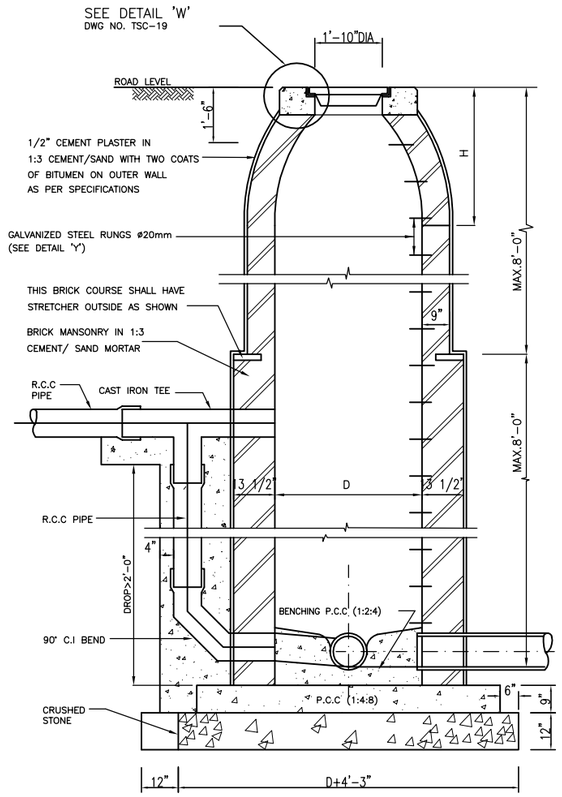


DETAIL OF NOTCH
DETAIL-Z

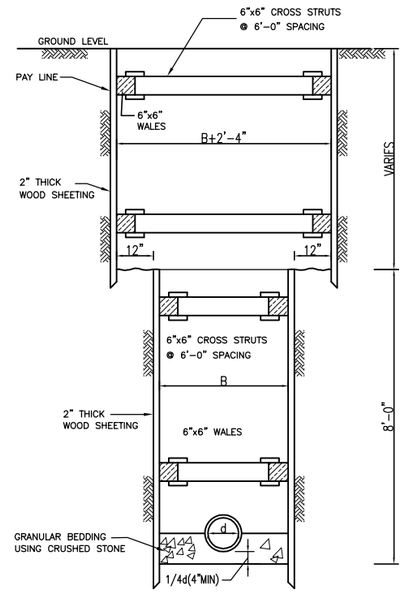


DETAIL-'W'

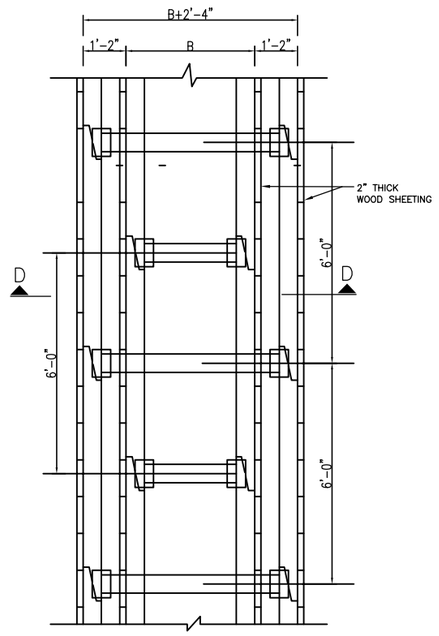
THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	
DETAIL OF MANHOLE (UP TO 48" DIA SEWER) (1/2)	DWG No.	TSC-18



SECTION E-E



SECTION D-D



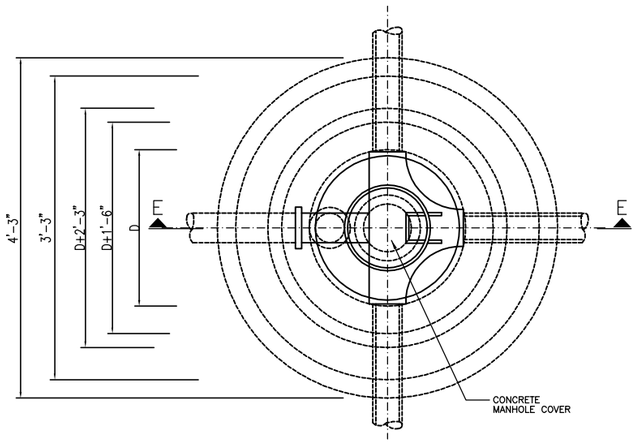
PLAN OF TRENCH
WITH TIMBERING AND BRACING

TABLE - 1			
SEHEDULE OF TRENCH			
SR. NO.	PIPE INSIDE DIA.	TRENCH Ⓑ WITH TIMBERING	WIDTH Ⓑ WITHOUT TIMBERING
1	42"	6'-4"	6'-0"
2	48"	6'-11"	7'-4"

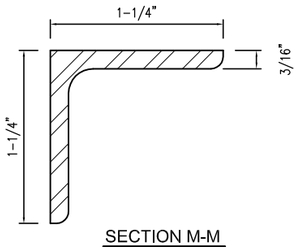
TABLE - 2			
SCHEDULE OF MANHOLE			
SR. NO.	PIPE DIA. (inch)	Ⓓ	Ⓗ
1	36 TO 42	7'-0"	5'-0"
2	48 TO 54	8'-0"	6'-0"
3	60 TO 72	9'-0"	7'-0"
4	78	10'-0"	8'-0"

TABLE - 3								
RECOMMENDED R.C.C PIPES OF 2500mm BARREL LENGTH (WALL THICKNESS AND REINFORCEMANT DETAILS)								
SR. NO.	PIPE INNER DIA.	WALL THICKNESS	SIZE OF RING BARS	NOS.OF CIRCULAR RINGS		NO.OF RINGS FOR BELL	STRAIGHT BARS	
				INNER CAUGE	OUTER CAUGE		DIA.	NO.OF BARS
								INNER CAUGE / OUTER CAUGE
1	42"	4 1/2"	3/8"	25	21	2	1/2"	8 / 8
2	48"	5"	3/8"	30	23	2	1/2"	8 / 8

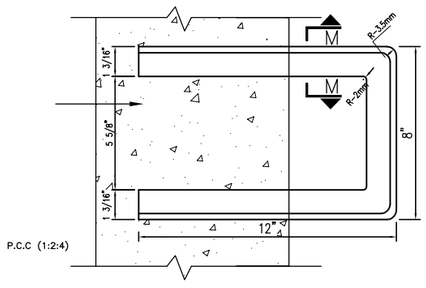
PIPES MENTIONED IN TABLE-3 SHALL BE CLASS IV AND WALL TYPE "B" WITH REQUIRED STRENGTH EQUAL TO 4000 PSI AS PER ASTM C76 STANDARDS .



PLAN
TYPICAL DETAIL OF DROP MANHOLE

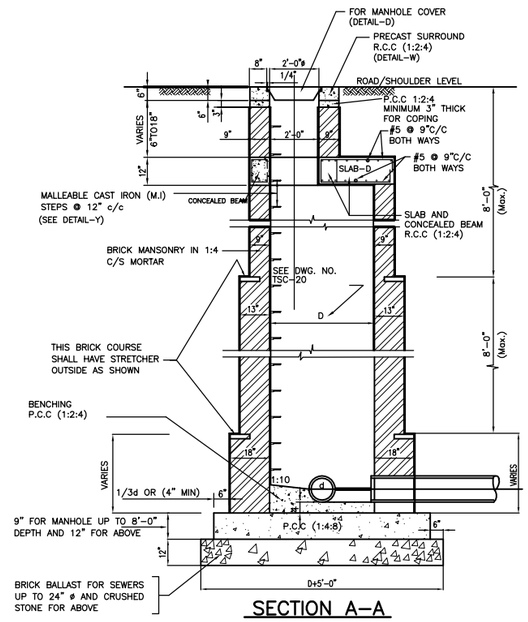


SECTION M-M

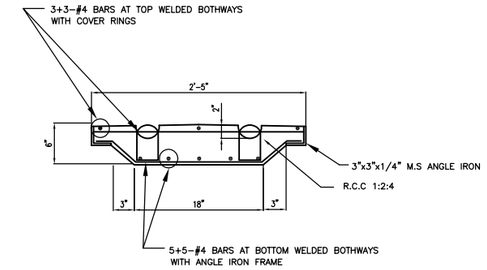


PLAN OF ANGLE IRON STEP
DETAIL (Y)

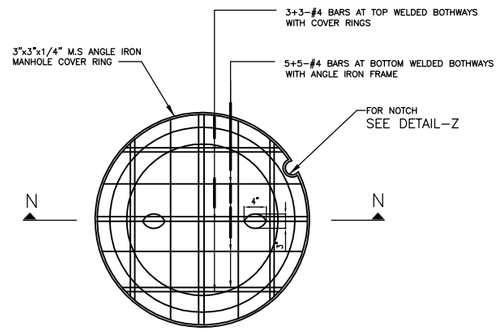
THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	
DETAIL OF MANHOLE (UP TO 48" DIA SEWER) (2/2)	DWG No.	TSC-19



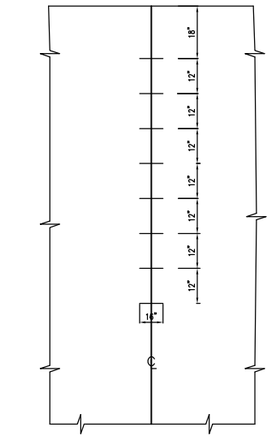
SECTION A-A



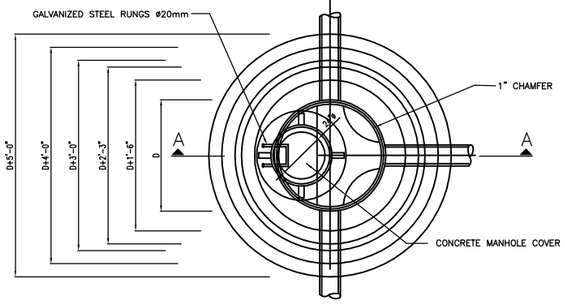
SECTION N-N



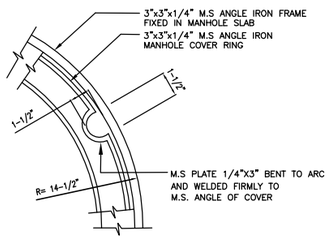
DETAIL D
MANHOLE COVER PLAN



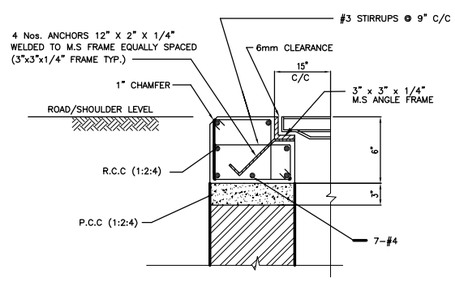
SKETCH OF SINGLE LADDER
INSIDE OF MANHOLE
(FOR DEPTH ≤ 8 FEET)



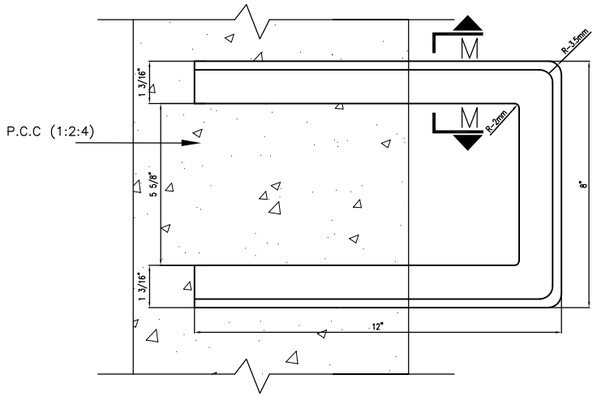
TYPICAL SEWER MANHOLE PLAN
(FOR DEPTH ≥ 8'-0" ≤ 20'-0")



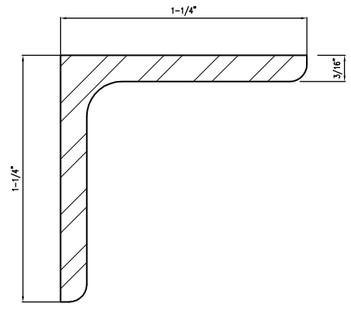
DETAIL Z



DETAIL-W

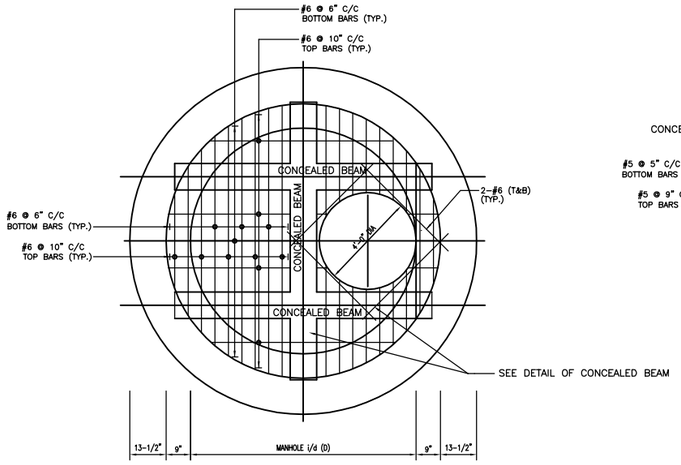


PLAN OF ANGLE IRON STEP
DETAIL-Y

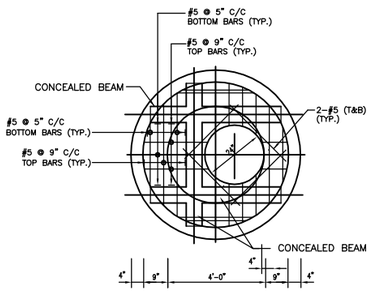


SECTION M-M

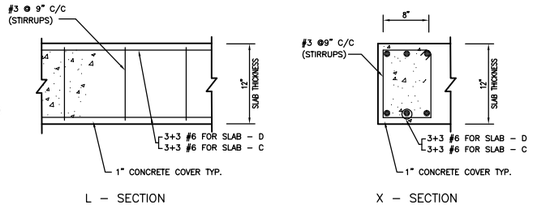
THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	
DETAIL OF MANHOLE (FROM 54" UP TO 90"DIA SEWER) (1/2)	DWG No.	TSC-20



MANHOLE SLAB – C
(REINFORCEMENT DETAILS)



MANHOLE SLAB – D
(REINFORCEMENT DETAILS)



DETAIL OF CONCEALED BEAM

TABLE - 1

SEHEDULE OF TRENCH

SR. NO.	PIPE INSIDE DIA.	TRENCH Ⓑ WITH TIMBERING	WIDTH Ⓑ WITHOUT TIMBERING
1	54"	7'–10"	8'–0"
2	66"	8'–10"	–
3	78"	10'–2"	–

TABLE - 2

SCHEDULE OF MANHOLE

SR. NO.	PIPE DIA. (inch)	Ⓓ	Ⓗ
1	48 TO 54	8'–0"	6'–0"
2	60 TO 72	9'–0"	7'–0"
3	78	10'–0"	8'–0"

TABLE - 3

RECOMMENDED R.C.C PIPES OF 2500mm BARREL LENGTH (WALL THICKNESS AND REINFORCEMANT DETAILS)

SR. NO.	PIPE INNER DIA.	WALL THICKNESS	SIZE OF RING BARS	NOS.OF CIRCULAR RINGS		NO.OF RINGS FOR BELL	STRAIGHT BARS		
							DIA.	NO.OF BARS	
				INNER CAUGE	OUTER CAUGE			INNER CAUGE	OUTER CAUGE
1	54"	5 1/2"	3/8"	36	27	2	1/2"	8	8
2	66"	6 1/2"	1/2"	28	21	2	1/2"	8	8
3	78"	8 1/4"	1/2"	29	22	2 1/2	1/2"	9	9

- 54" I/D PIPES MENTINED IN TABLE–3 SHALL BE CLASS IV AND WALL TYPE "B" WITH REQUIRED STRENGTH EQUAL TO 4000 PSI AS PER ASTM C76 STANDARDS .
- 66" I/D PIPES MENTINED IN TABLE–3 SHALL BE CLASS IV AND WALL TYPE "B" WITH REQUIRED STRENGTH EQUAL TO 5000 PSI AS PER ASTM C76 STANDARDS .
- 78" I/D PIPES MENTINED IN TABLE–3 SHALL BE CLASS IV AND WALL TYPE "C" WITH REQUIRED STRENGTH EQUAL TO 5000 PSI AS PER ASTM C76 STANDARDS .

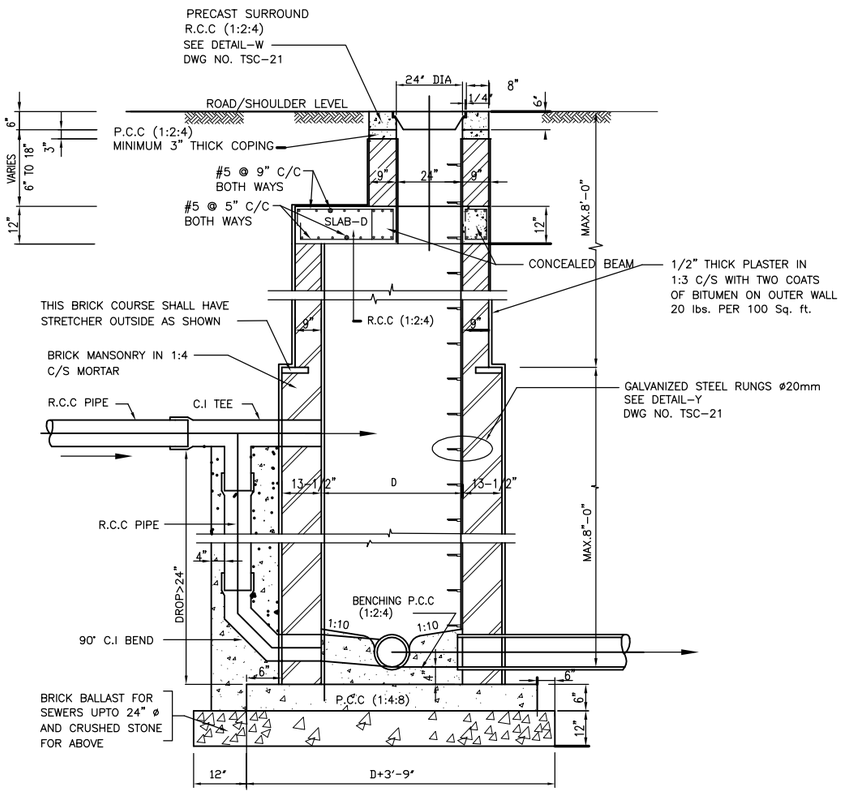
SECTIONAL PLAN A–A
TYPICAL SEWER MANHOLE PLAN
(FOR DEPTH ≥ 20 ≤ 30 FEET)

SECTION B–B
(FOR DEPTH ≥ 20 ≤ 30 FEET)

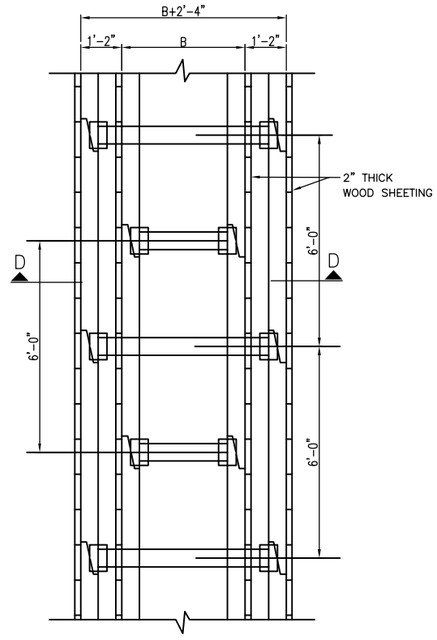
SKETCH OF MONKEY LADER
INSIDE OF MANHOLE
(FOR DEPTH >8 FEET)

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

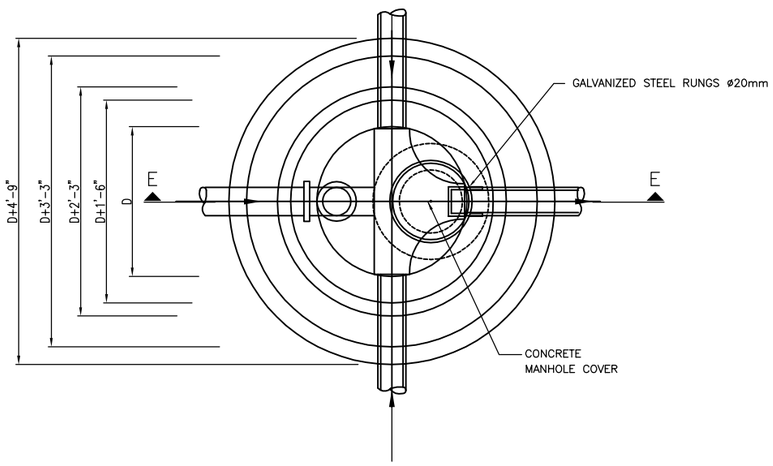
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	
DETAIL OF MANHOLE (FROM 54" UP TO 90"DIA SEWER) (1/2)	DWG No.	TSC-21



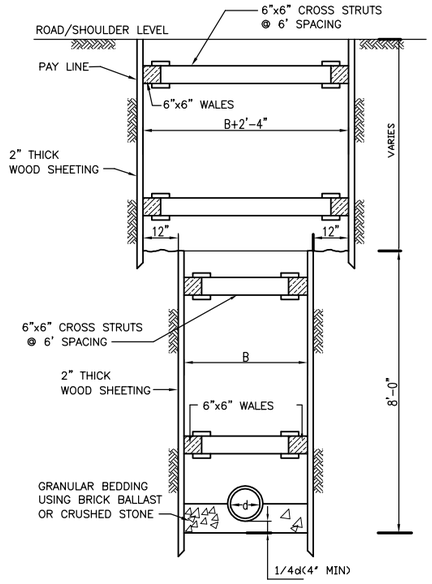
SECTION E–E



PLAN
TRENCH WITH TIMBERING AND BRACING

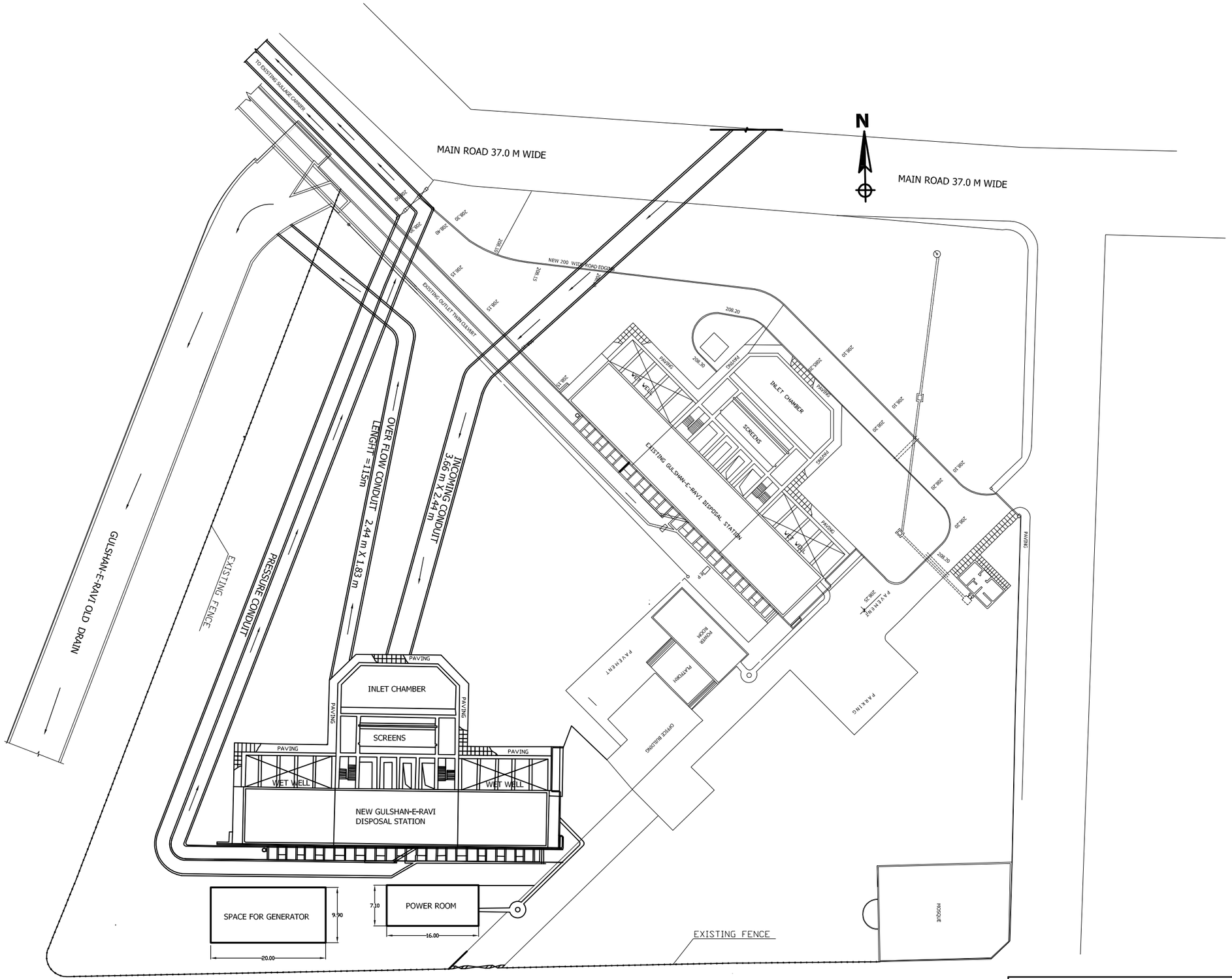


PLAN
TYPICAL SEWER DROP MANHOLE

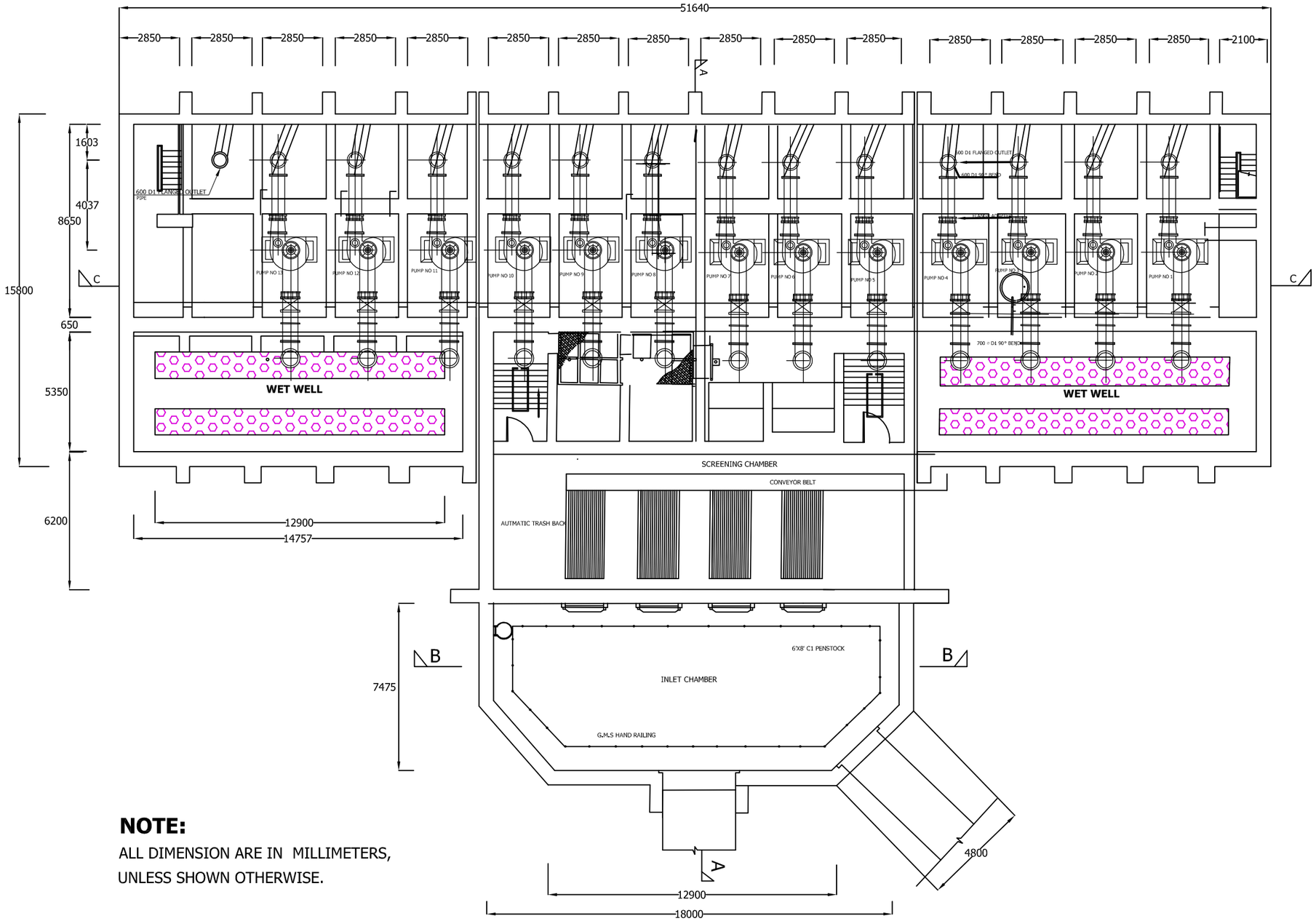


SECTION D–D

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
TRUNK SEWER ALONG CANTONMENT DRAIN	SCALE	
DETAIL OF DROP MANHOLE	DWG No.	TSC-22



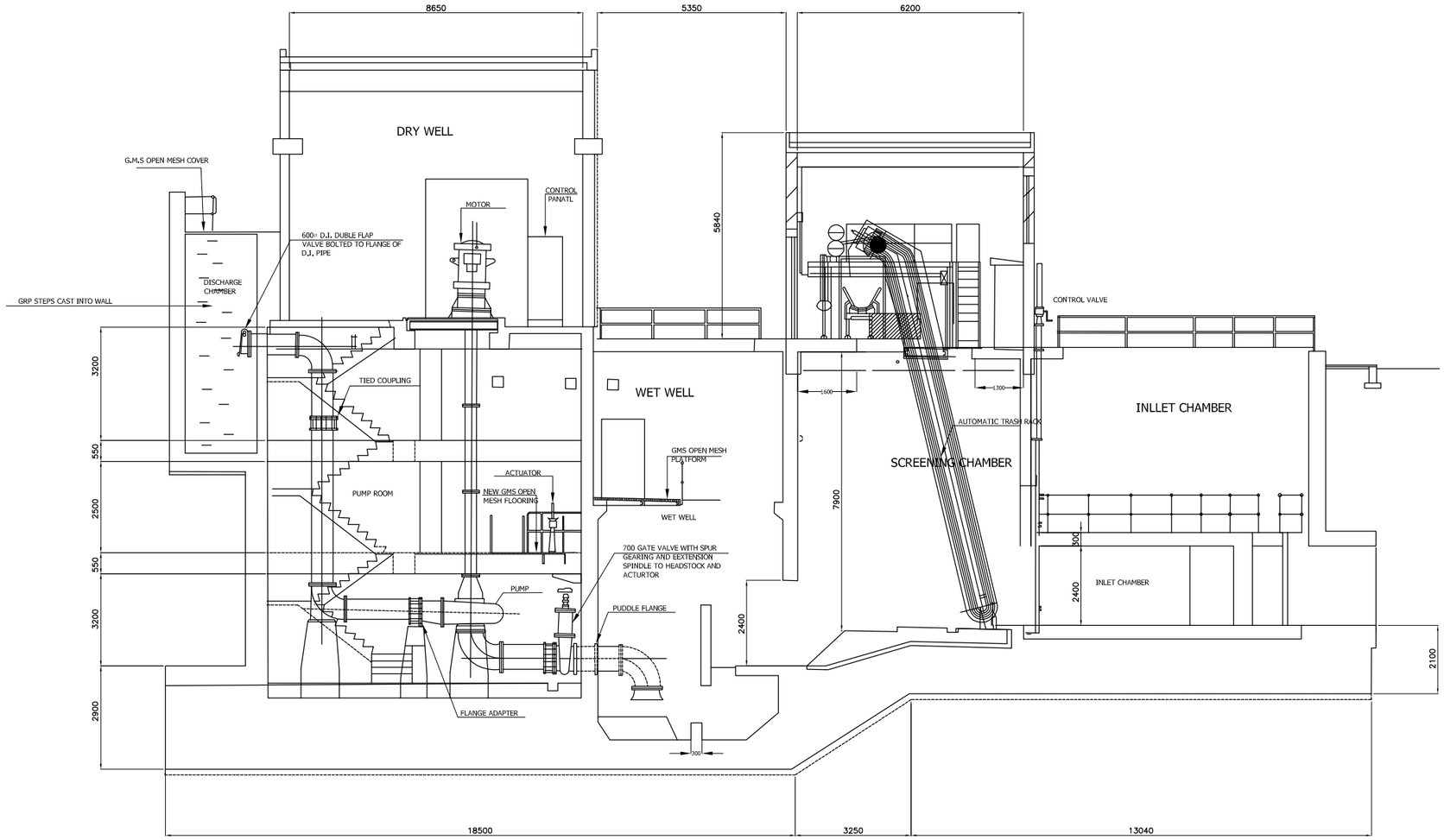
THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	1:200
GENERAL LAYOUT PLAN	DWG No.	DS-01



NOTE:

ALL DIMENSION ARE IN MILLIMETERS,
UNLESS SHOWN OTHERWISE.

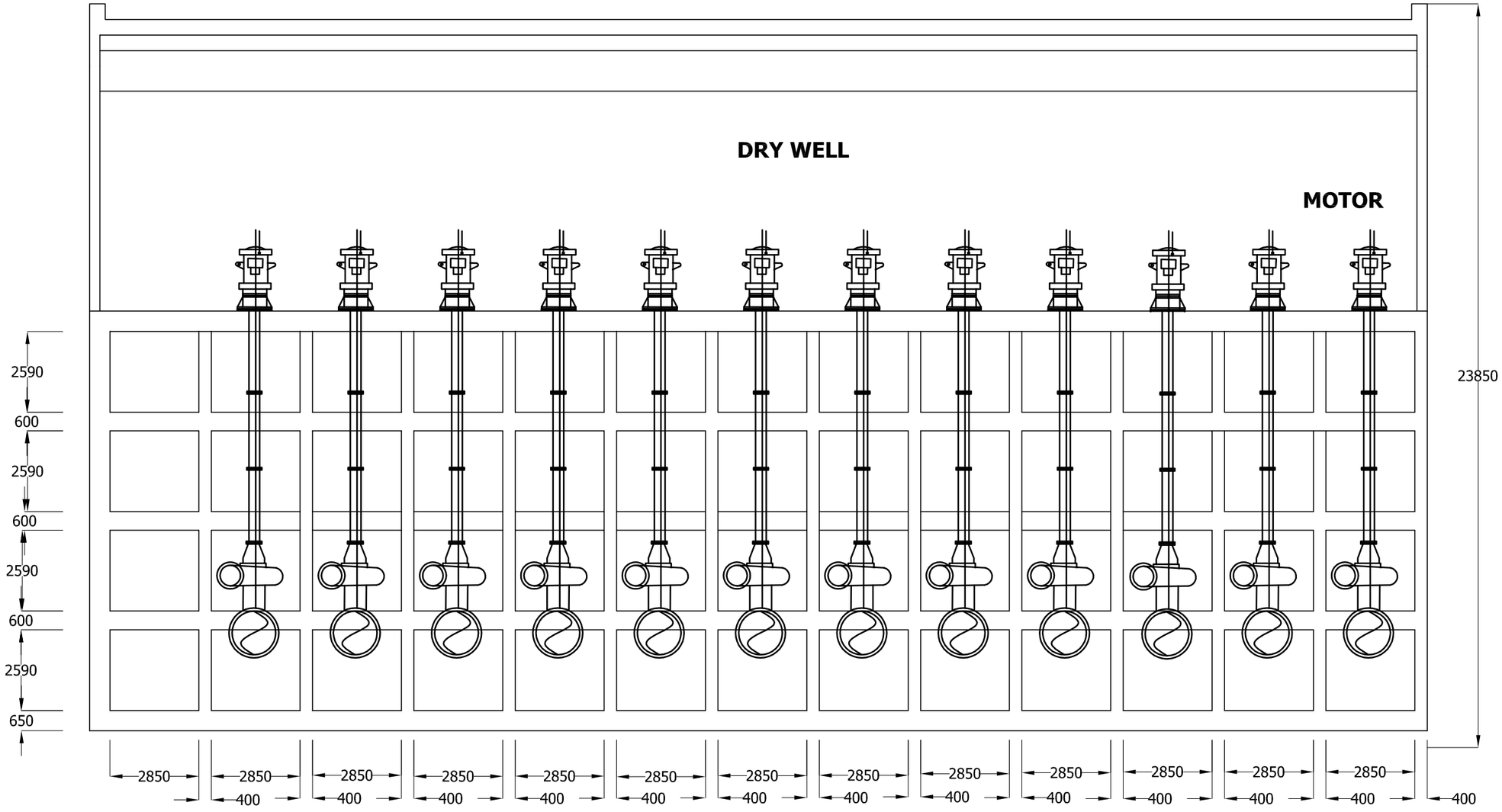
THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	1:200
DETAIL PLAN	DWG No.	DS-02



SECTION A-A

NOTE:
ALL DIMENSION ARE IN MILLIMETERS,
UNLESS SHOWN OTHERWISE.

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	1:150
SECTION	DWG No.	DS-03



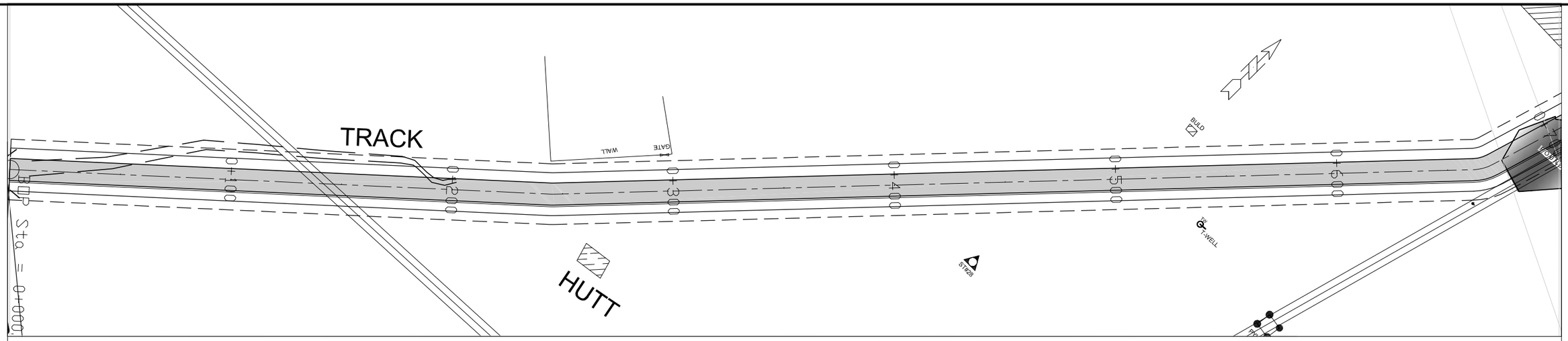
SECTION C-C

NOTE

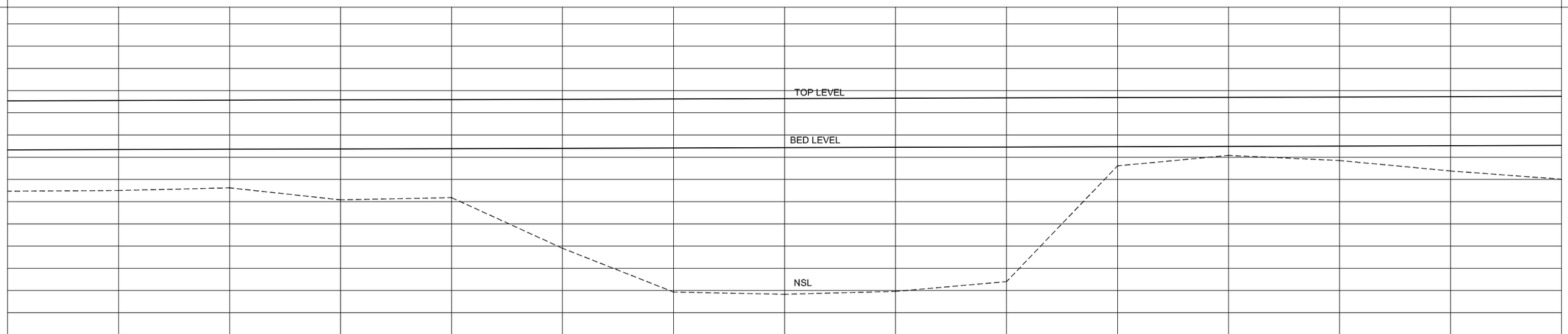
ALL DIMENSIONS ARE IN MILLIMETERS.

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
NEW GULSHAN-E-RAVI DISPOSAL STATION	SCALE	1:150
SECTION (2/2)	DWG No.	DS-04

PLAN



PROFILE



CHAINAGE	0+000	0+050	0+100	0+150	0+200	0+250	0+300	0+350	0+400	0+450	0+500	0+550	0+600	0+650	0+700
TOP LEVEL	199.52	199.54	199.55	199.57	199.58	199.59	199.61	199.62	199.64	199.65	199.67	199.68	199.70	199.71	199.72
BED LEVEL	197.32	197.34	197.35	197.37	197.38	197.39	197.41	197.42	197.44	197.45	197.47	197.48	197.50	197.51	197.52
NSL	195.47	195.50	195.62	195.08	195.18	192.90	190.93	190.83	190.96	191.40	196.61	197.08	196.85	196.38	196.01

LEGEND -PLAN-

- CENTER LINE
- BOUNDARY LINE OF WASA LAND
- PROPOSED COLLECTOR CHANNEL
- PROPOSED MAINTENANCE ROAD

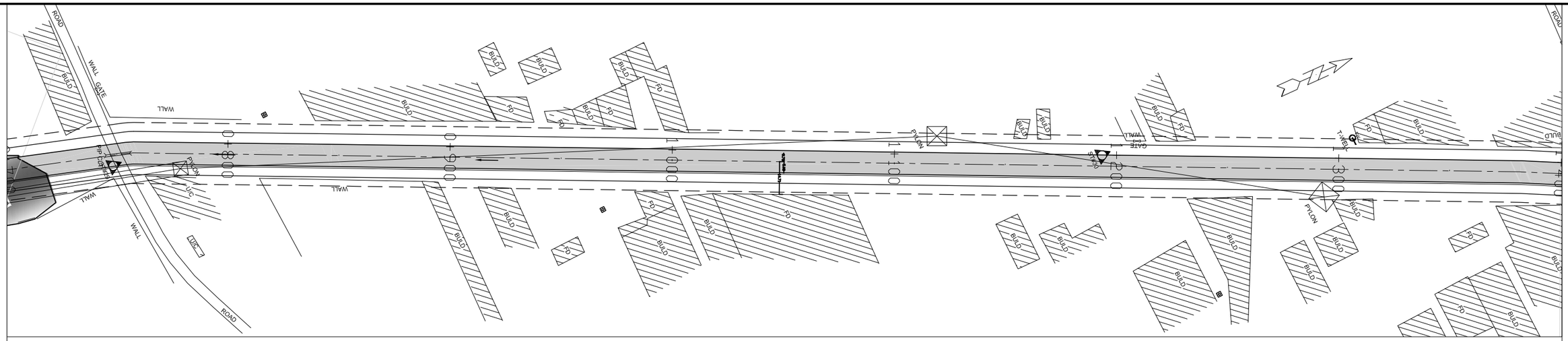
LEGEND -PROFILE-

- NSL
- PROPOSED ELEVATION OF COLLECTOR CHANNEL

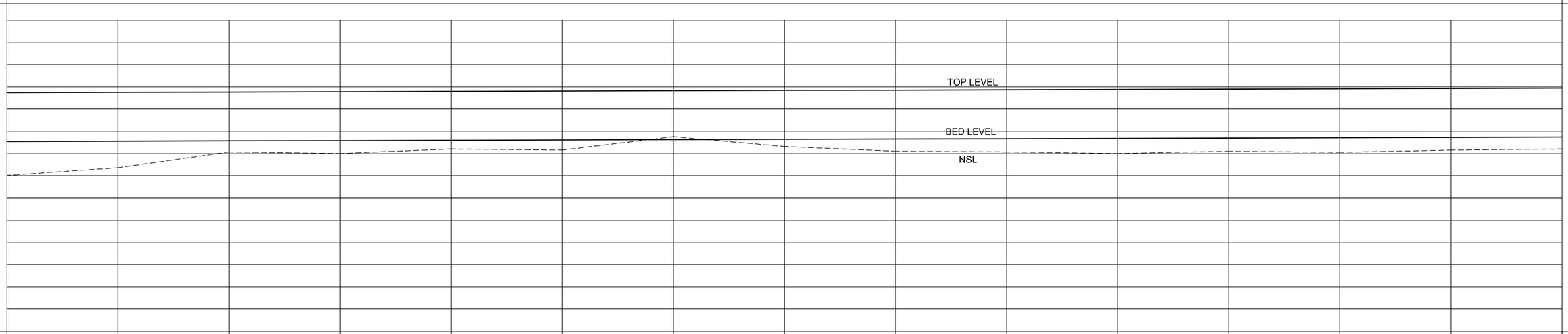
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

COLLECTOR CHANNEL	SCALE	
PLAN & PROFILE (1/11)	DWG No.	CC-01

PLAN



PROFILE



CHAINAGE	0+700	0+750	0+800	0+850	0+900	0+950	1+000	1+050	1+100	1+150	1+200	1+250	1+300	1+350	1+400	
TOP LEVEL	199.72	199.74	199.75	199.77	199.78	199.80	199.81	199.83	199.84	199.86	199.87	199.88	199.90	199.91	199.93	
BED LEVEL	197.52	197.53	197.55	197.57	197.58	197.60	197.61	197.63	197.64	197.66	197.67	197.68	197.70	197.71	197.73	
NSL	196.01	196.36	197.07	197.00	197.20	197.15	197.75	197.31	197.10	197.07	197.00	197.10	197.05	197.15	197.20	

LEGEND -PLAN-

- CENTER LINE
- BOUNDARY LINE OF WASA LAND
- PROPOSED COLLECTOR CHANNEL
- PROPOSED MAINTENANCE ROAD

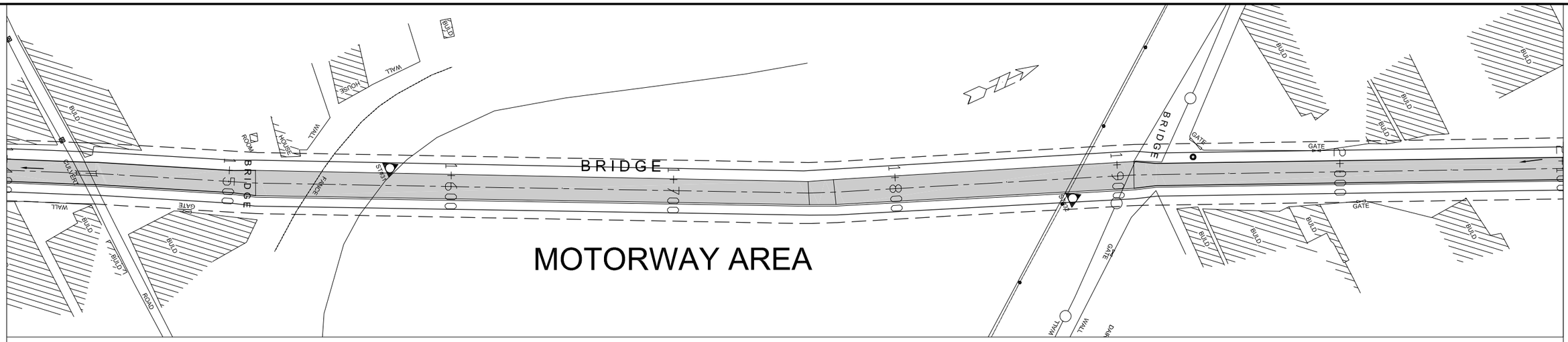
LEGEND -PROFILE-

- NSL
- PROPOSED ELEVATION OF COLLECTOR CHANNEL

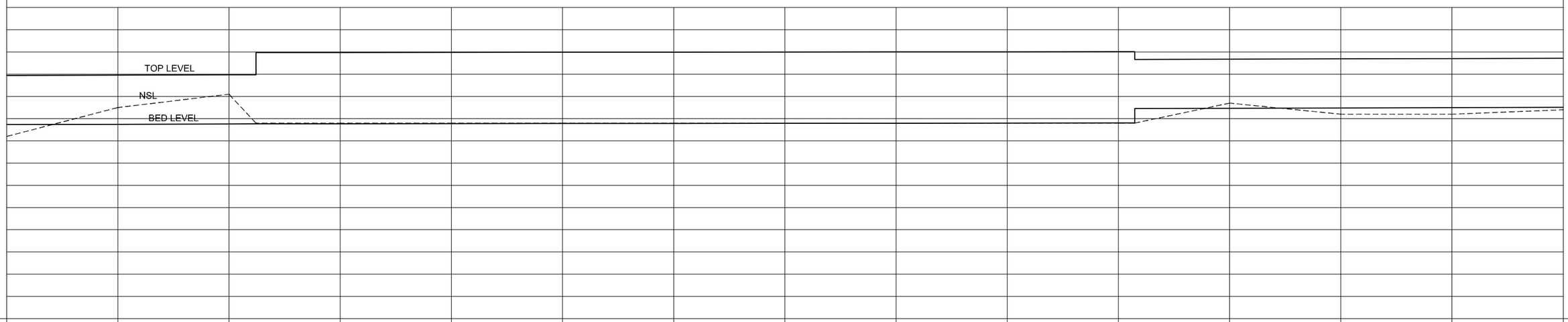
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

COLLECTOR CHANNEL	SCALE	
PLAN & PROFILE (2/11)	DWG No.	CC-02

PLAN



PROFILE



CHAINAGE	1+400	1+450	1+500	1+512.10	1+550	1+600	1+650	1+700	1+750	1+800	1+850	1+900	1+907.30	1+950	2+000	2+050	2+100
TOP LEVEL	199.93	199.94	199.96	199.96 200.96	200.96	200.97	200.97	200.98	200.98	200.99	200.99	201.00	200.65 201.00	200.66	200.68	200.69	200.71
BED LEVEL	197.73	197.74	197.76	197.76	197.76	197.77	197.77	197.78	197.78	197.79	197.79	197.80	198.45	197.80 198.46	198.48	198.49	198.51
NSL	197.20	198.50	199.10	197.80	197.80	197.80	197.80	197.80	197.80	197.80	197.80	197.80	197.80	198.70	198.20	198.20	198.40

LEGEND -PLAN-

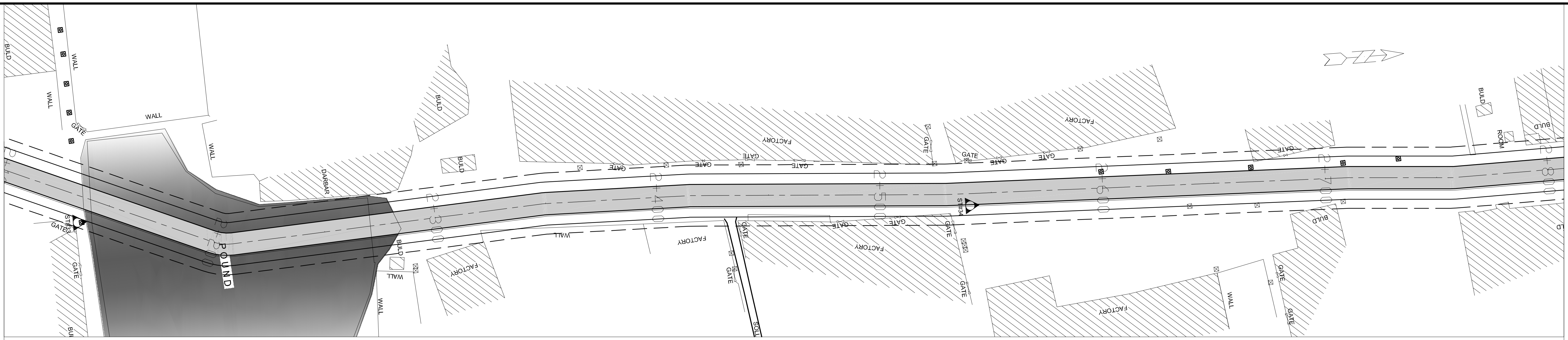
- CENTER LINE
- BOUNDARY LINE OF WASA LAND
- PROPOSED COLLECTOR CHANNEL
- PROPOSED MAINTENANCE ROAD

LEGEND -PROFILE-

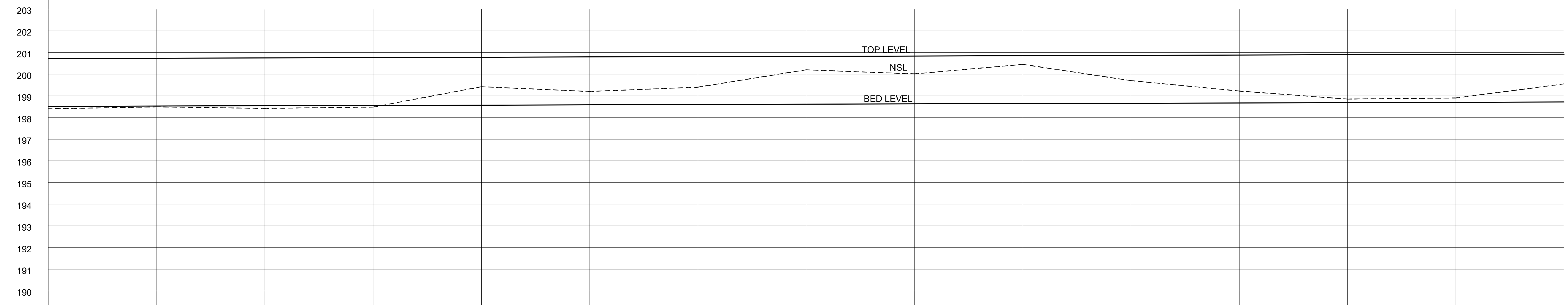
- NSL
- PROPOSED ELEVATION OF COLLECTOR CHANNEL

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

COLLECTOR CHANNEL	SCALE	
PLAN & PROFILE (3/11)	DWG No.	CC-03



PLAN



PROFILE

TOP LEVEL	200.71	200.72	200.73	200.75	200.76	200.78	200.79	200.81	200.82	200.84	200.85	200.87	200.88	200.89	200.91
BED LEVEL	198.51	198.52	198.53	198.55	198.56	198.58	198.59	198.61	198.62	198.64	198.65	198.67	198.68	198.69	198.71
NSL	198.40	198.49	198.42	198.48	199.42	199.20	199.40	200+20	200+01	200+45	199.70	199.22	198.85	198.90	199.55
CHAINAGE	2+100	2+150	2+200	2+250	2+300	2+350	2+400	2+450	2+500	2+550	2+600	2+650	2+700	2+750	2+800

LEGEND -PLAN-

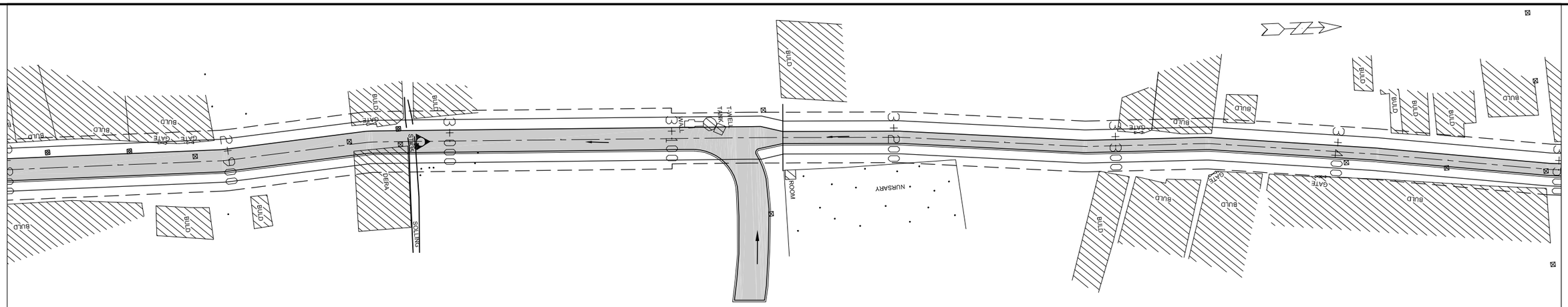
CENTER LINE	— - —
BOUNDARY LINE OF WASA LAND	— — —
PROPOSED COLLECTOR CHANNEL	▬
PROPOSED MAINTENANCE ROAD	———

LEGEND -PROFILE-

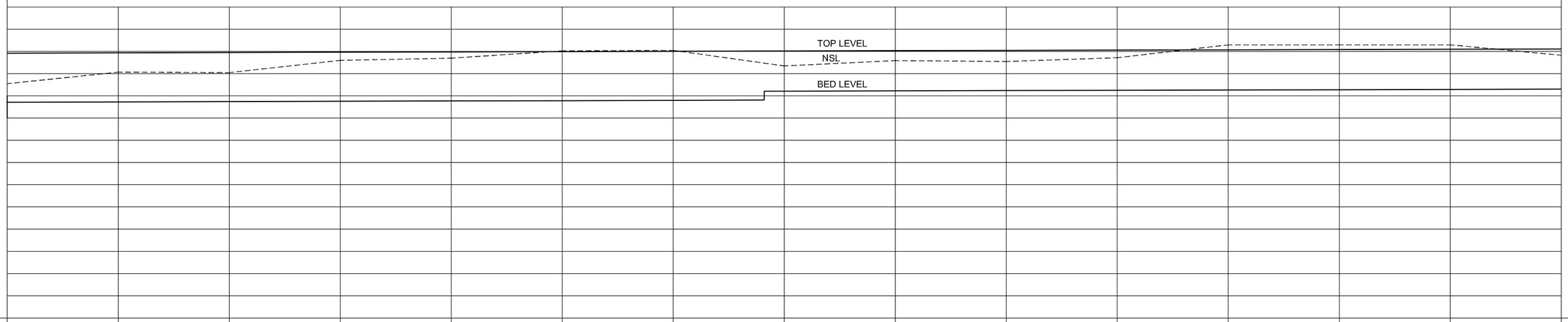
NSL	- - - -
PROPOSED ELEVATION OF COLLECTOR CHANNEL	———

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
COLLECTOR CHANNEL	SCALE	
PLAN & PROFILE (4/11)	DWG No.	CC-04

PLAN



PROFILE



CHAINAGE	2+800	2+850	2+900	2+950	3+000	3+050	3+100	3+150	3+200	3+250	3+300	3+350	3+400	3+450	3+500
TOP LEVEL	200.91	200.92	200.94	200.95	200.97	200.98	201.00	201.01	201.02	201.03	201.05	201.06	201.07	201.08	201.10
BED LEVEL	198.71	198.72	198.74	198.75	198.77	198.78	198.80	198.81	199.21 199.22	199.23	199.25	199.26	199.27	199.28	199.30
NSL	199.55	200.07	200.05	200.60	200.70	201.03	201.05	200.35	200.59	200.55	200.72	201.30	201.30	201.30	200.83

LEGEND -PLAN-

- CENTER LINE
- BOUNDARY LINE OF WASA LAND
- PROPOSED COLLECTOR CHANNEL
- PROPOSED MAINTENANCE ROAD

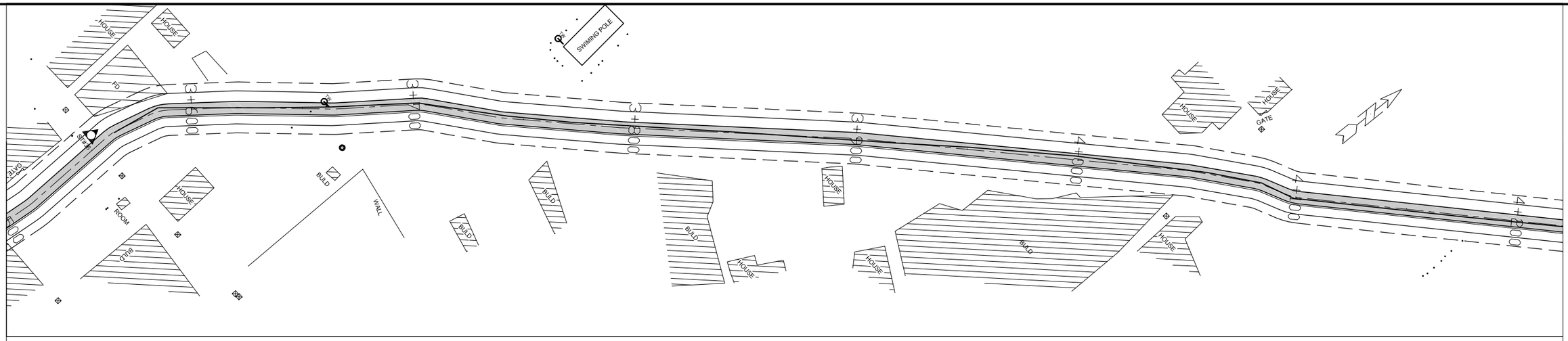
LEGEND -PROFILE-

- NSL
- PROPOSED ELEVATION OF COLLECTOR CHANNEL

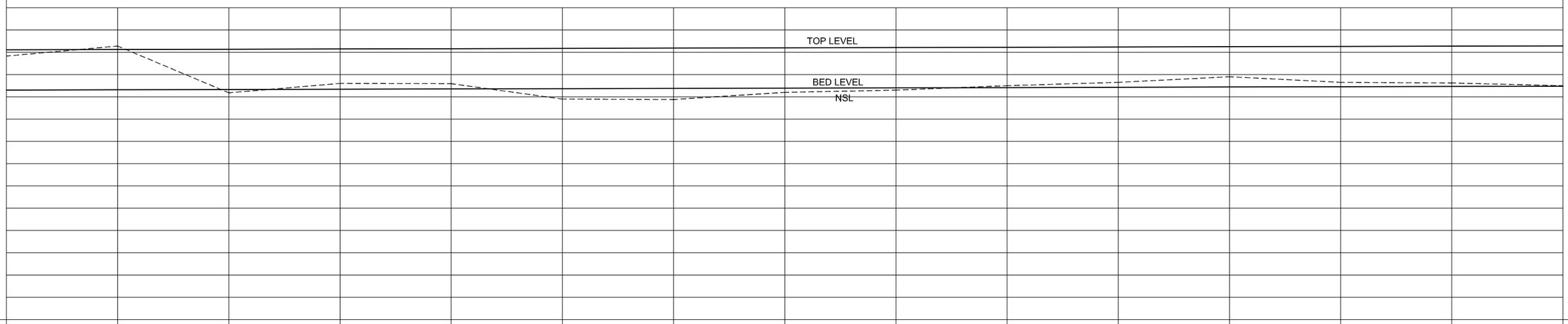
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

COLLECTOR CHANNEL	SCALE	
PLAN & PROFILE (5/11)	DWG No.	CC-05

PLAN



PROFILE



CHAINAGE	3+500	3+550	3+600	3+650	3+700	3+750	3+800	3+850	3+900	3+950	4+000	4+050	4+100	4+150	4+200	
TOP LEVEL	201.10	201.11	201.12	201.13	201.15	201.16	201.17	201.18	201.20	201.21	201.22	201.23	201.25	201.26	201.27	
BED LEVEL	199.30	199.31	199.32	199.33	199.35	199.36	199.37	199.38	199.40	199.41	199.42	199.43	199.45	199.46	199.47	
NSL	200.83	201.28	199.18	199.60	199.59	198.90	198.88	199.20	199.30	199.50	199.65	199.90	199.65	199.62	199.50	

LEGEND -PLAN-

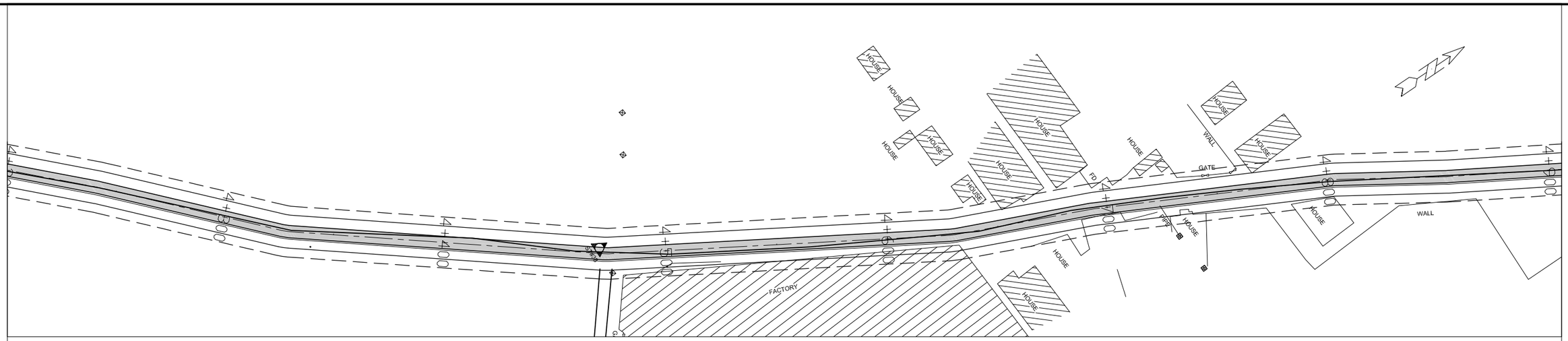
- CENTER LINE
- BOUNDARY LINE OF WASA LAND
- PROPOSED COLLECTOR CHANNEL
- PROPOSED MAINTENANCE ROAD

LEGEND -PROFILE-

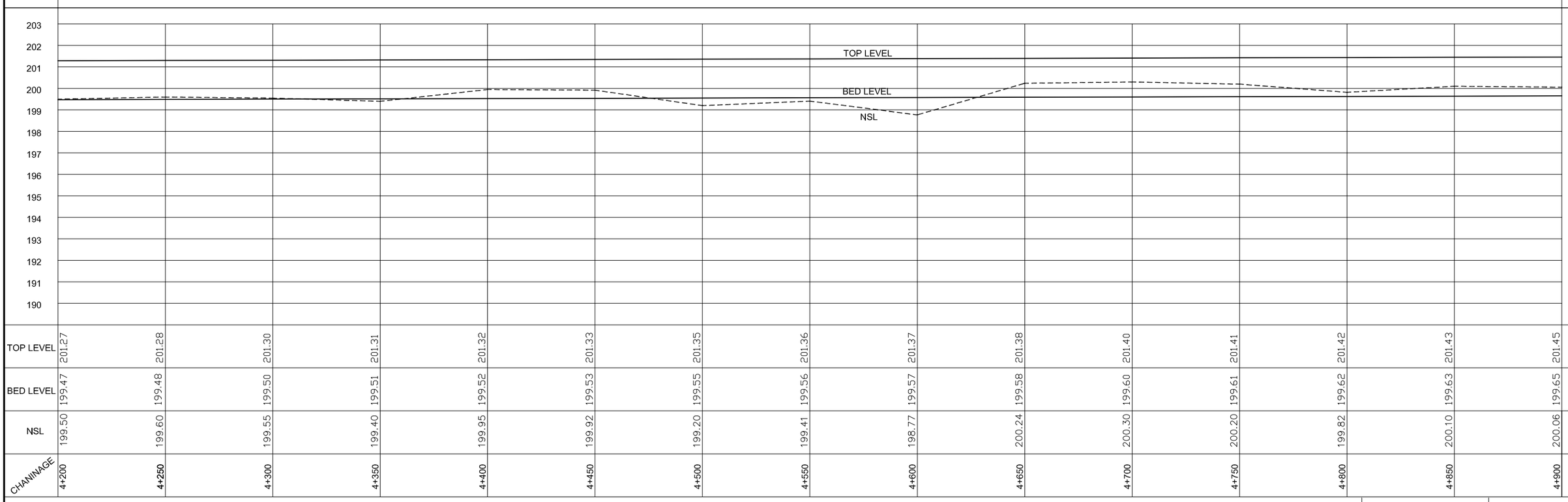
- NSL
- PROPOSED ELEVATION OF COLLECTOR CHANNEL

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

COLLECTOR CHANNEL	SCALE	
PLAN & PROFILE (6/11)	DWG No.	CC-06



PLAN



PROFILE

CHAINAGE	4+200	4+250	4+300	4+350	4+400	4+450	4+500	4+550	4+600	4+650	4+700	4+750	4+800	4+850	4+900	
TOP LEVEL	201.27	201.28	201.30	201.31	201.32	201.33	201.35	201.36	201.37	201.38	201.40	201.41	201.42	201.43	201.45	
BED LEVEL	199.47	199.48	199.50	199.51	199.52	199.53	199.55	199.56	199.57	199.58	199.60	199.61	199.62	199.63	199.65	
NSL	199.50	199.60	199.55	199.40	199.95	199.92	199.20	199.41	198.77	200.24	200.30	200.20	199.82	200.10	200.06	

LEGEND -PLAN-

- CENTER LINE
- BOUNDARY LINE OF WASA LAND
- PROPOSED COLLECTOR CHANNEL
- PROPOSED MAINTENANCE ROAD

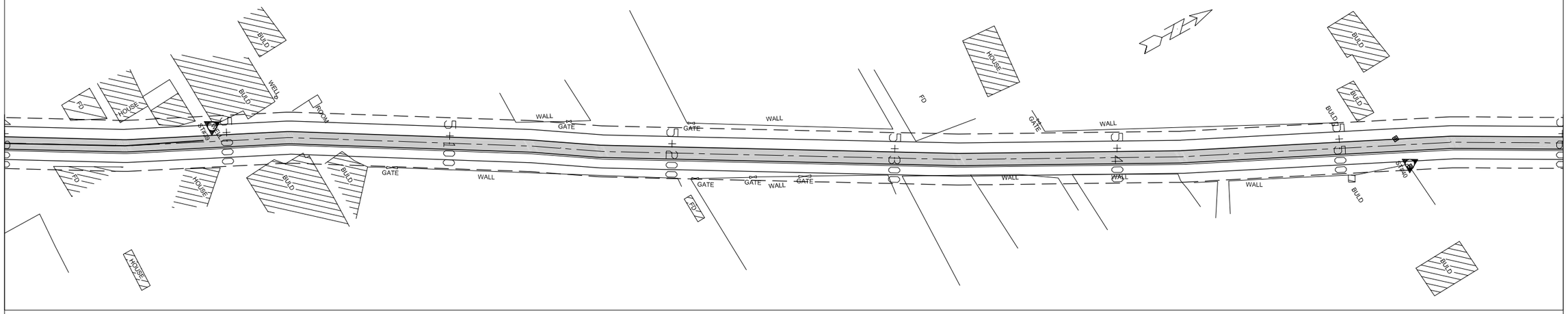
LEGEND -PROFILE-

- NSL
- PROPOSED ELEVATION OF COLLECTOR CHANNEL

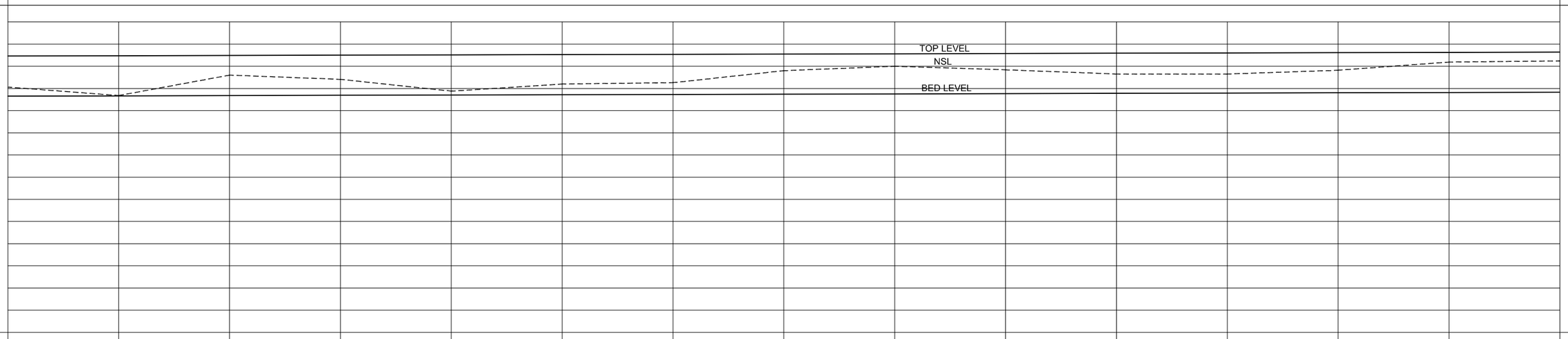
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

COLLECTOR CHANNEL	SCALE	
PLAN & PROFILE (7/11)	DWG No.	CC-07

PLAN



PROFILE



CHAINAGE	4+900	4+950	5+000	5+050	5+100	5+150	5+200	5+250	5+300	5+350	5+400	5+450	5+500	5+550	5+600
TOP LEVEL	201.45	201.46	201.47	201.48	201.50	201.51	201.52	201.53	201.55	201.56	201.57	201.58	201.60	201.61	201.62
BED LEVEL	199.65	199.66	199.67	199.68	199.70	199.71	199.72	199.73	199.75	199.76	199.77	199.78	199.80	199.81	199.82
NSL	200.06	199.68	200.60	200.41	199.88	200.20	200.26	200.80	201.00	200.84	200.65	200.65	200.82	201.19	201.24

LEGEND -PLAN-

- CENTER LINE
- BOUNDARY LINE OF WASA LAND
- PROPOSED COLLECTOR CHANNEL
- PROPOSED MAINTENANCE ROAD

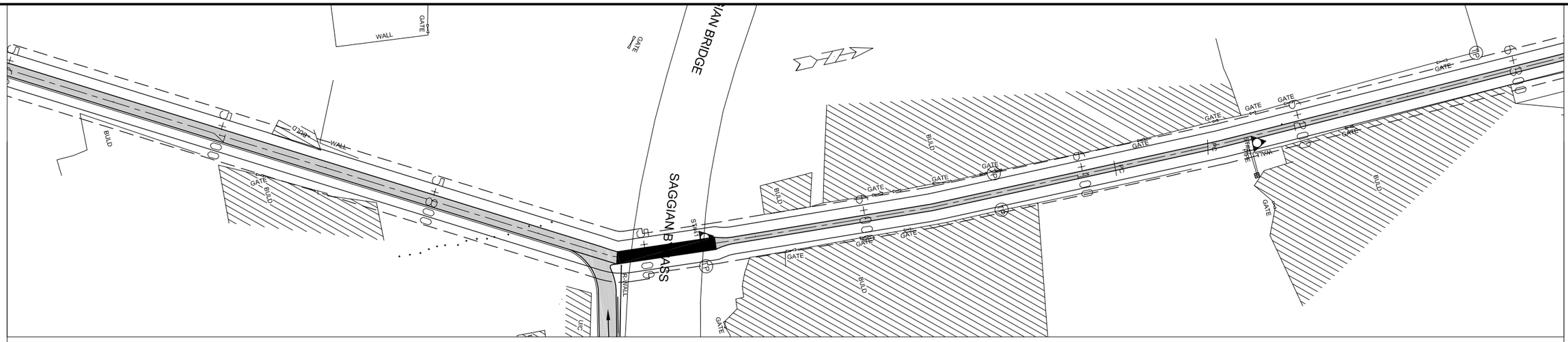
LEGEND -PROFILE-

- NSL
- PROPOSED ELEVATION OF COLLECTOR CHANNEL

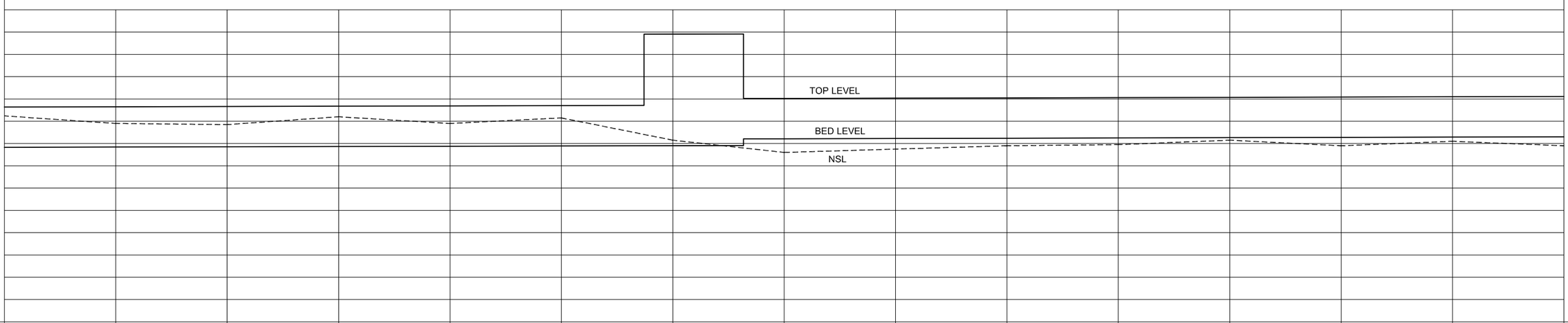
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

COLLECTOR CHANNEL	SCALE	
PLAN & PROFILE (8/11)	DWG No.	CC-08

PLAN



PROFILE



CHAINAGE	5+600	5+650	5+700	5+750	5+800	5+850	5+900	5+950	6+000	6+050	6+100	6+150	6+200	6+250	6+300	
TOP LEVEL	201.62	201.63	201.65	201.66	201.67	201.68	204.89 201.69	202.00 204.90 202.01	202.02	202.03	202.05	202.06	202.07	202.08	202.10	
BED LEVEL	199.82	199.84	199.85	199.86	199.87	199.88	199.89	199.90 199.89	200.22	200.23	200.25	200.26	200.27	200.28	200.30	
NSL	201.24	200.90	200.85	201.20	200.90	201.15	204.96 200.15	199.60	199.90	199.90	199.95	200.15	199.90	200.10	199.90	

LEGEND -PLAN-

- CENTER LINE
- BOUNDARY LINE OF WASA LAND
- PROPOSED COLLECTOR CHANNEL
- PROPOSED MAINTENANCE ROAD

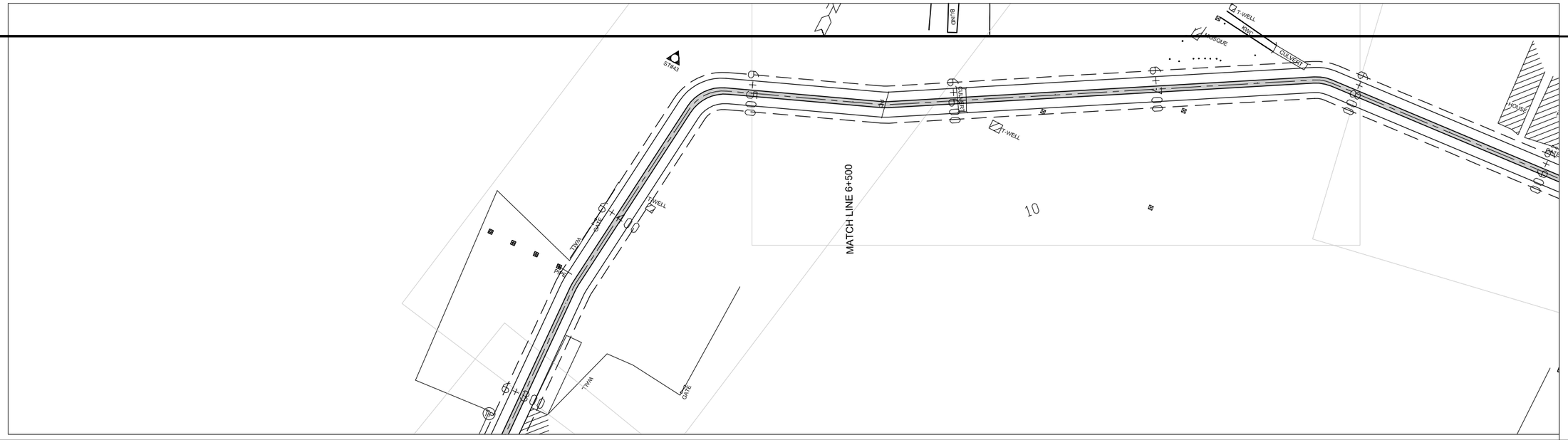
LEGEND -PROFILE-

- NSL
- PROPOSED ELEVATION OF COLLECTOR CHANNEL

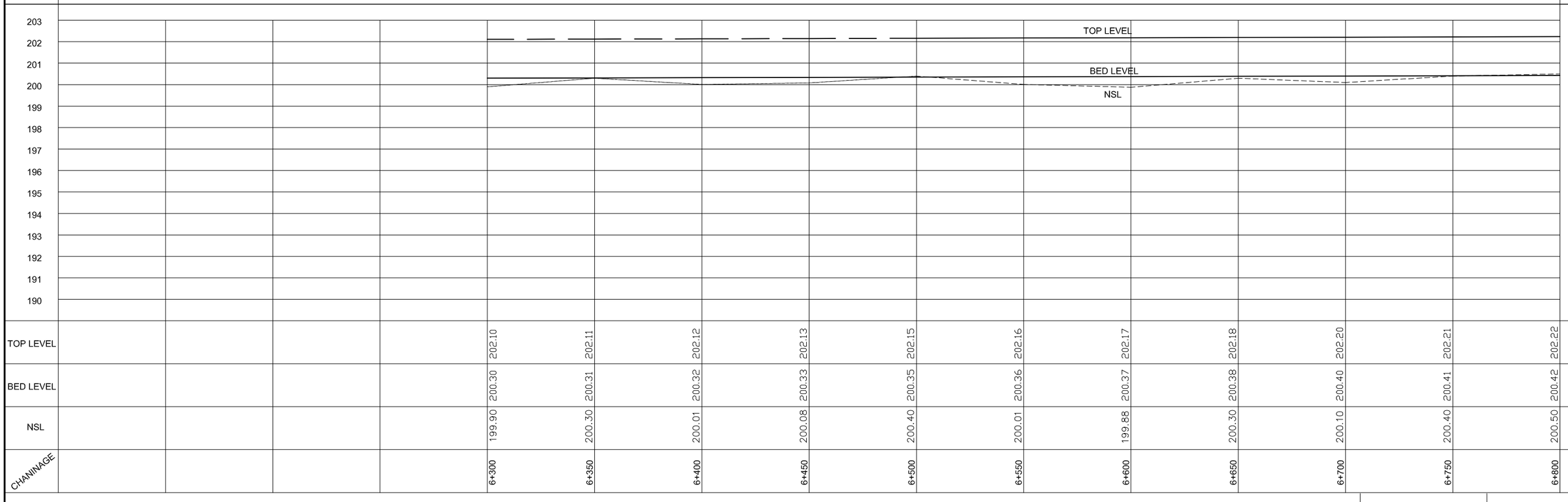
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

COLLECTOR CHANNEL	SCALE	
PLAN & PROFILE (9/11)	DWG No.	CC-09

PLAN



PROFILE



CHAINAGE	6+300	6+350	6+400	6+450	6+500	6+550	6+600	6+650	6+700	6+750	6+800
TOP LEVEL	202.10	202.11	202.12	202.13	202.15	202.16	202.17	202.18	202.20	202.21	202.22
BED LEVEL	200.30	200.31	200.32	200.33	200.35	200.36	200.37	200.38	200.40	200.41	200.42
NSL	199.90	200.30	200.01	200.08	200.40	200.01	199.88	200.30	200.10	200.40	200.50

LEGEND -PLAN-

- CENTER LINE
- BOUNDARY LINE OF WASA LAND
- PROPOSED COLLECTOR CHANNEL
- PROPOSED MAINTENANCE ROAD

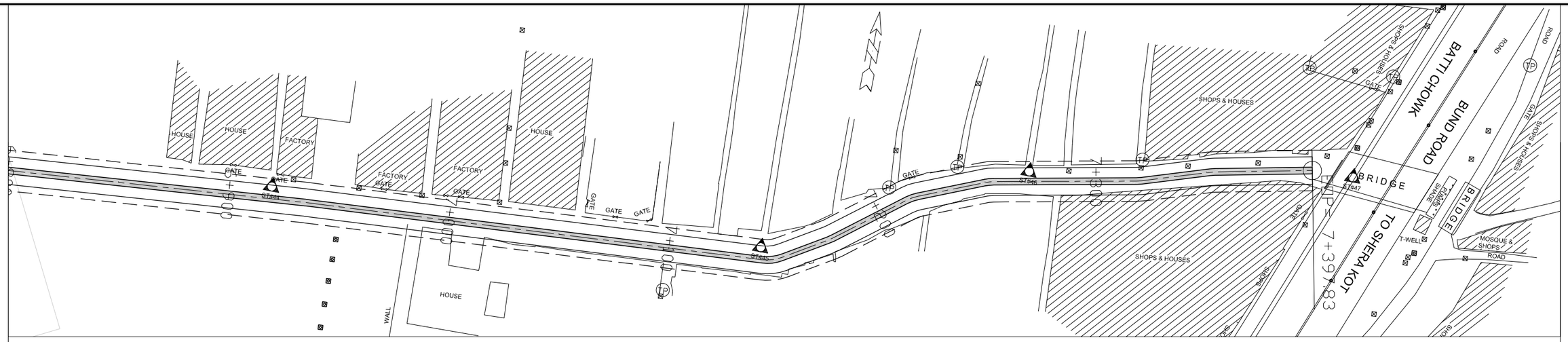
LEGEND -PROFILE-

- NSL
- PROPOSED ELEVATION OF COLLECTOR CHANNEL

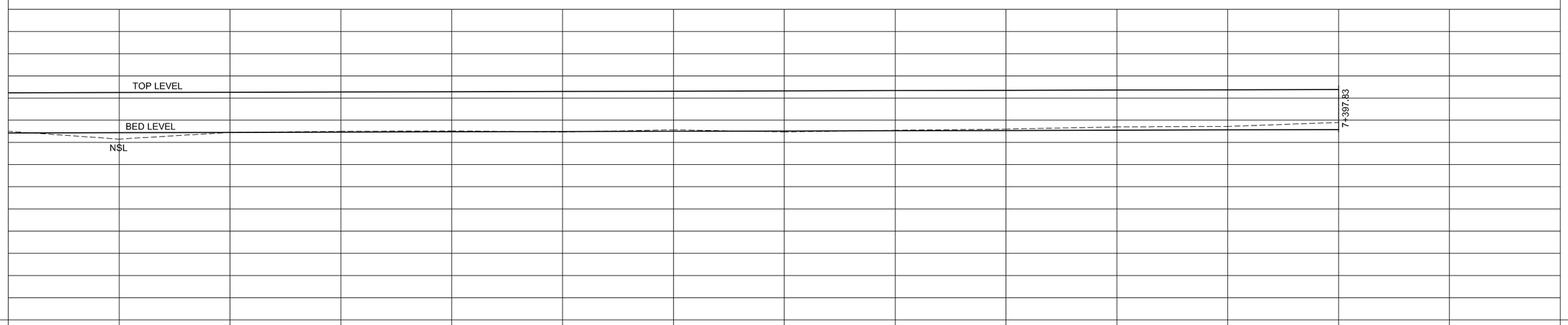
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

COLLECTOR CHANNEL	SCALE	
PLAN & PROFILE (10/11)	DWG No.	CC-10

PLAN



PROFILE



CHAINAGE	6+800	6+850	6+900	6+950	7+000	7+050	7+100	7+150	7+200	7+250	7+300	7+350	7+397.83			
TOP LEVEL	202.22	202.23	202.25	202.26	202.27	202.28	202.30	202.31	202.32	202.33	202.35	202.36	202.37			
BED LEVEL	200.42	200.43	200.45	200.46	200.47	200.48	200.50	200.51	200.52	200.53	200.55	200.56	200.57			
NSL	200.50	200.15	200.45	200.50	200.52	200.47	200.57	200.47	200.55	200.60	200.70	200.72	200.90			

LEGEND -PLAN-

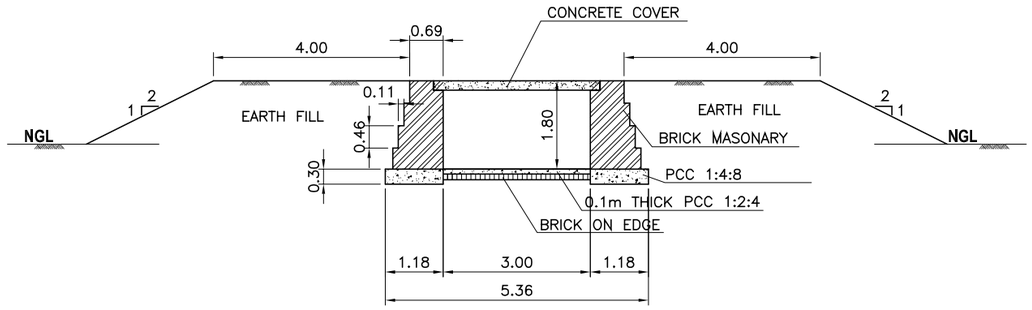
- CENTER LINE
- BOUNDARY LINE OF WASA LAND
- PROPOSED COLLECTOR CHANNEL
- PROPOSED MAINTENANCE ROAD

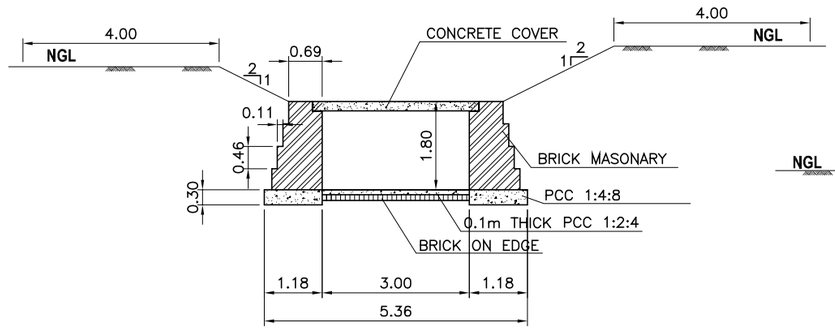
LEGEND -PROFILE-

- NSL
- PROPOSED ELEVATION OF COLLECTOR CHANNEL

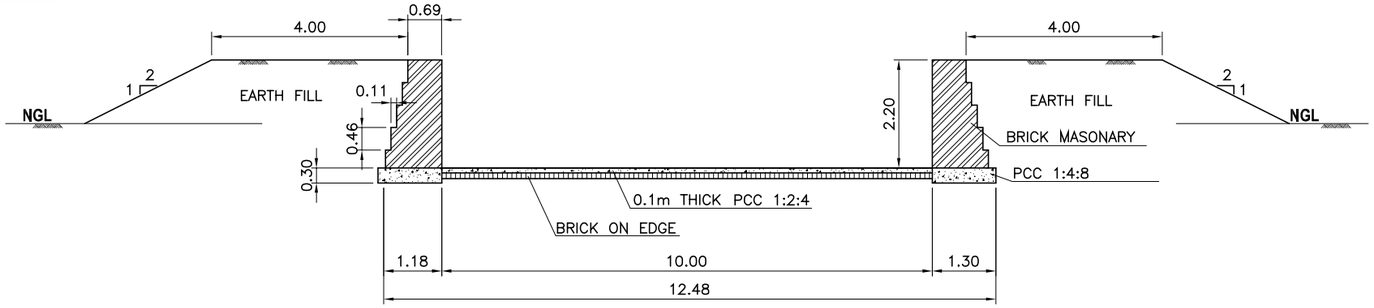
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

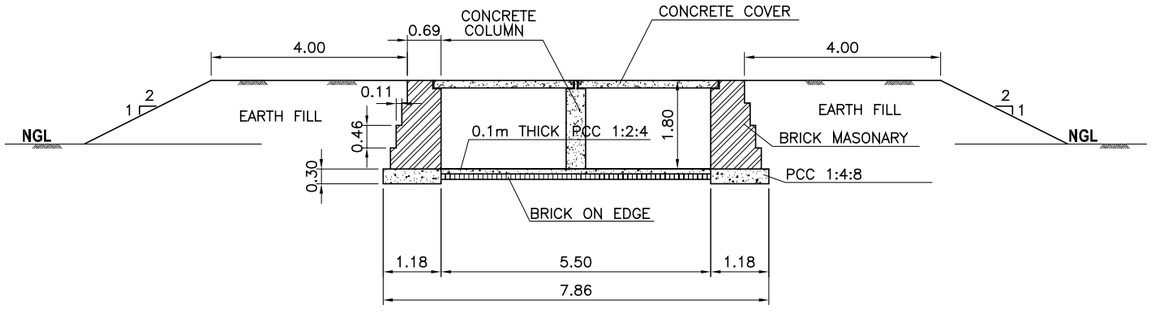
COLLECTOR CHANNEL	SCALE	
PLAN & PROFILE (11/11)	DWG No.	CC-11

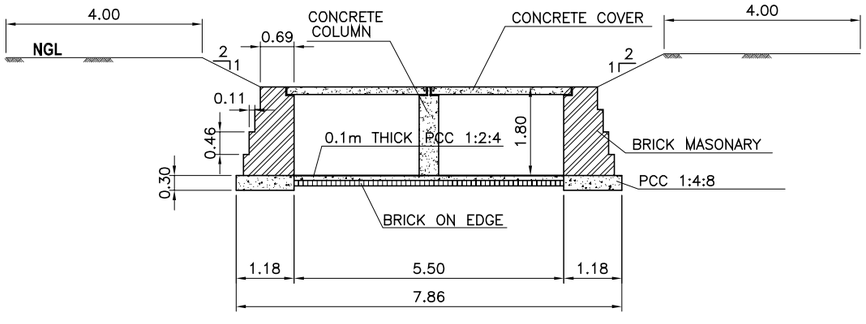




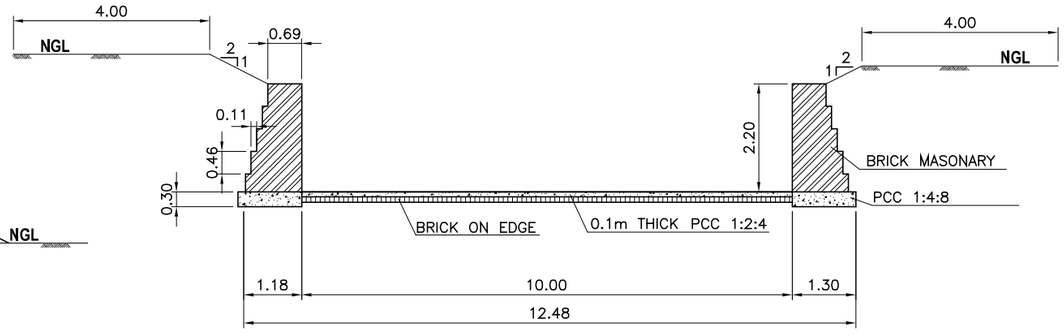
TYPICAL CROSS SECTION (W3.0 x H1.8 m)
(From CHOTTA RAVI PS To MAIN OUTFALL DS)





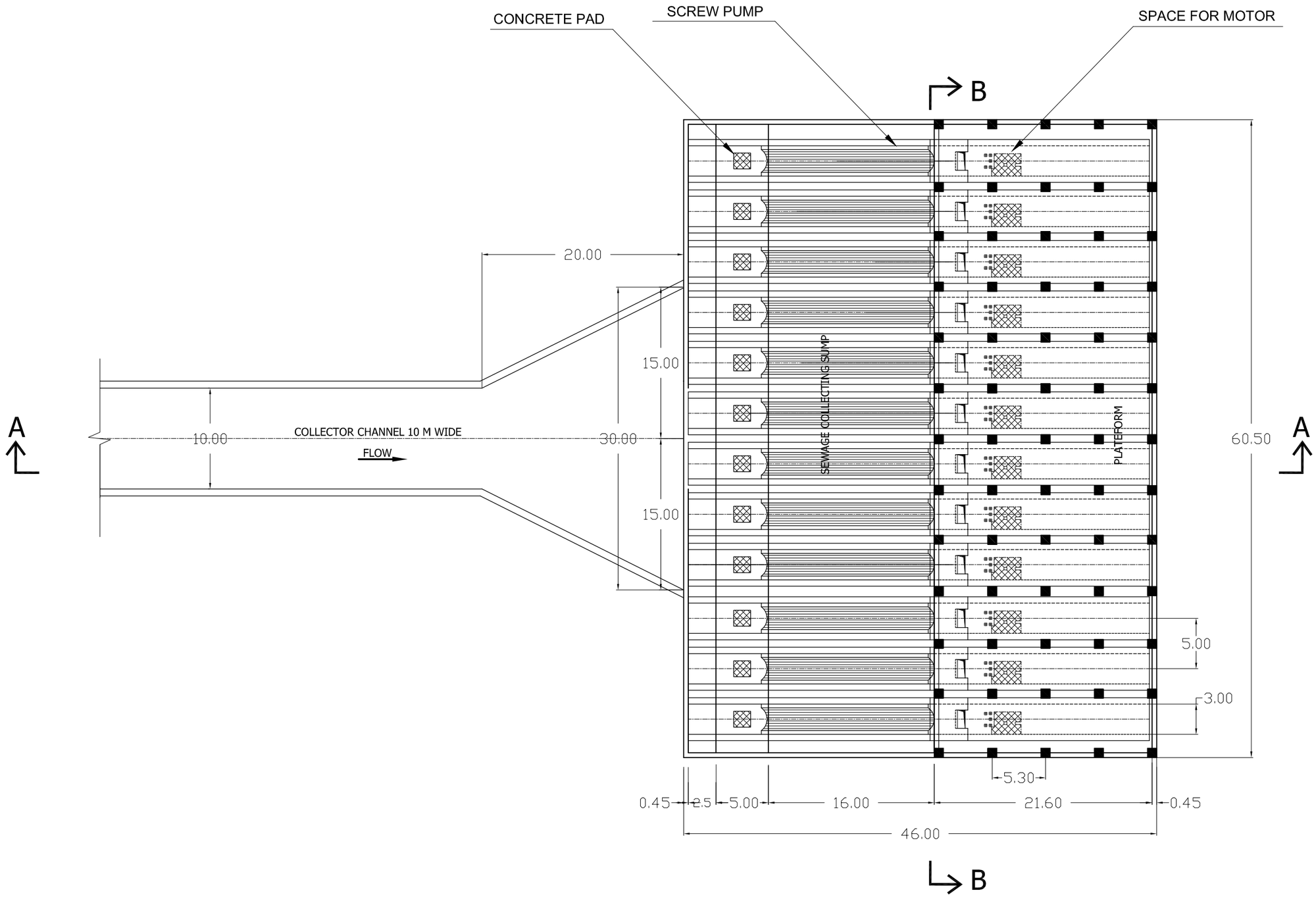


TYPICAL CROSS SECTION (W5.5 x H1.8 m)
(From MAIN OUTFALL DS To GULSHAN-E-RAVI DS)

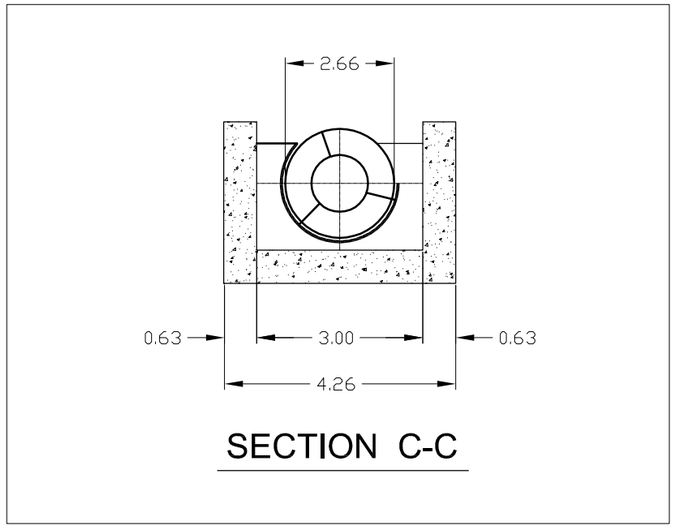


TYPICAL CROSS SECTION (W10.0 x H2.2 m)
(From GULSHAN-E-RAVI DS To WWTP)

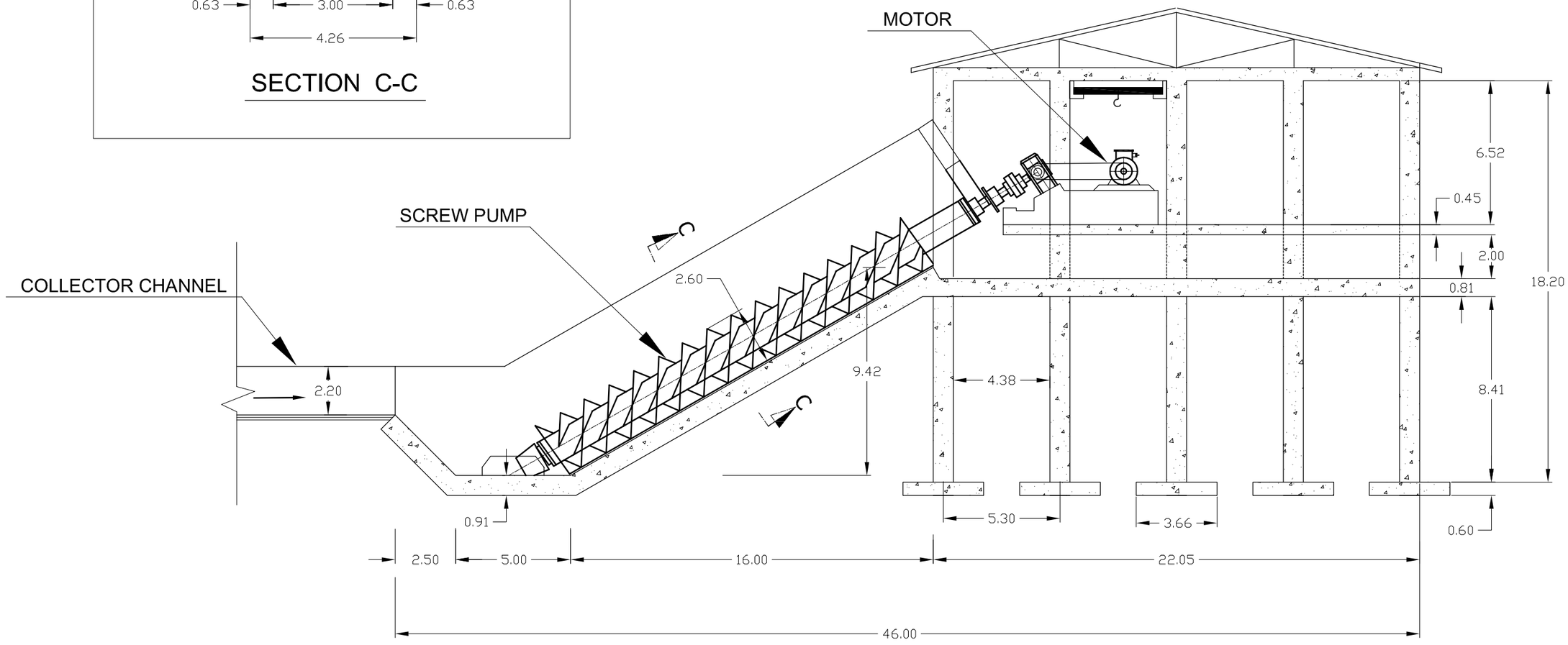
THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
COLLECTOR CHANNEL	SCALE	1:150
TYPICAL CROSS SECTION	DWG No.	CC-12



THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
LIFT STATION	SCALE	1:200
DETAIL PLAN	DWG No.	LS-01



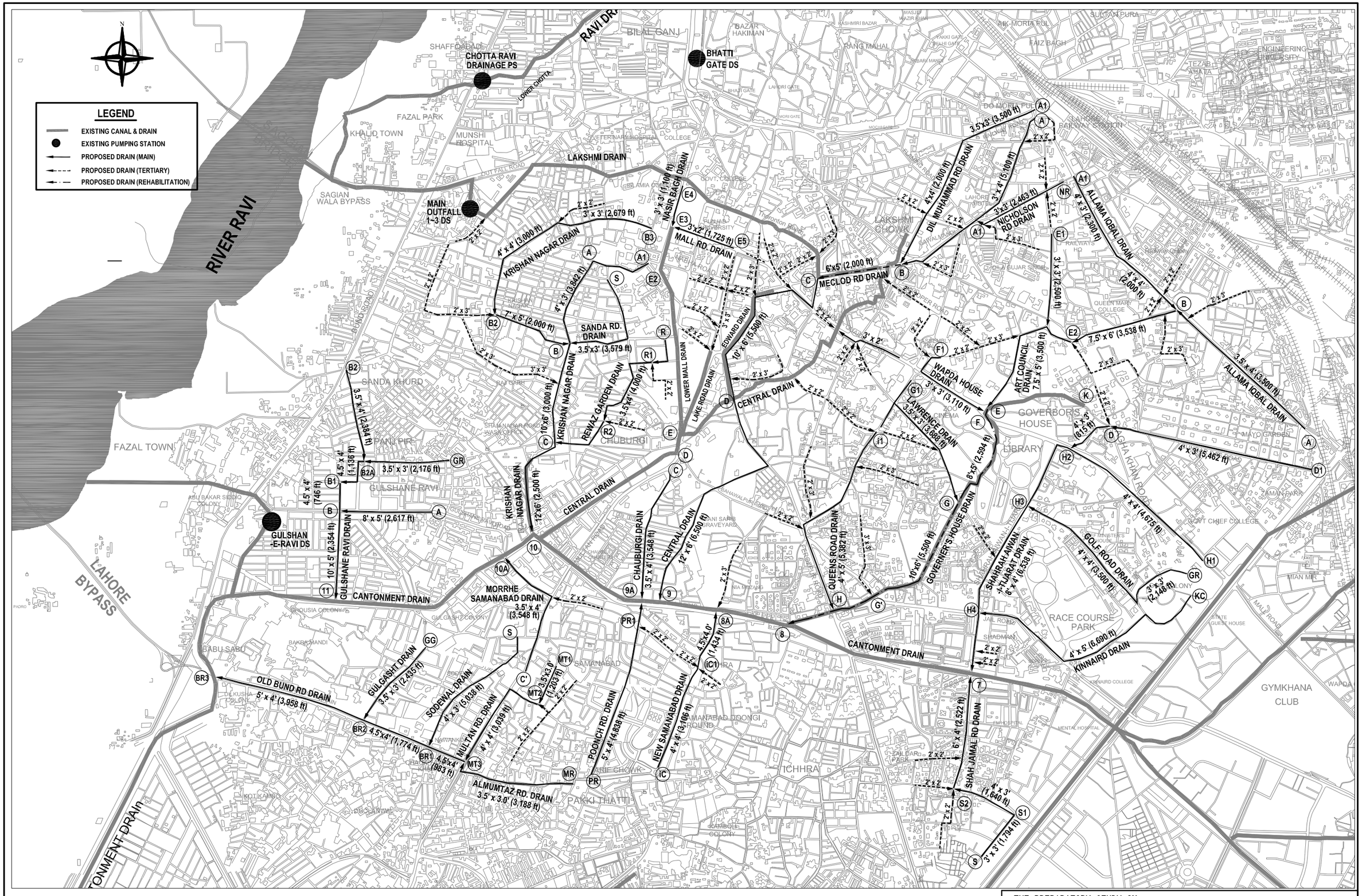
SECTION C-C

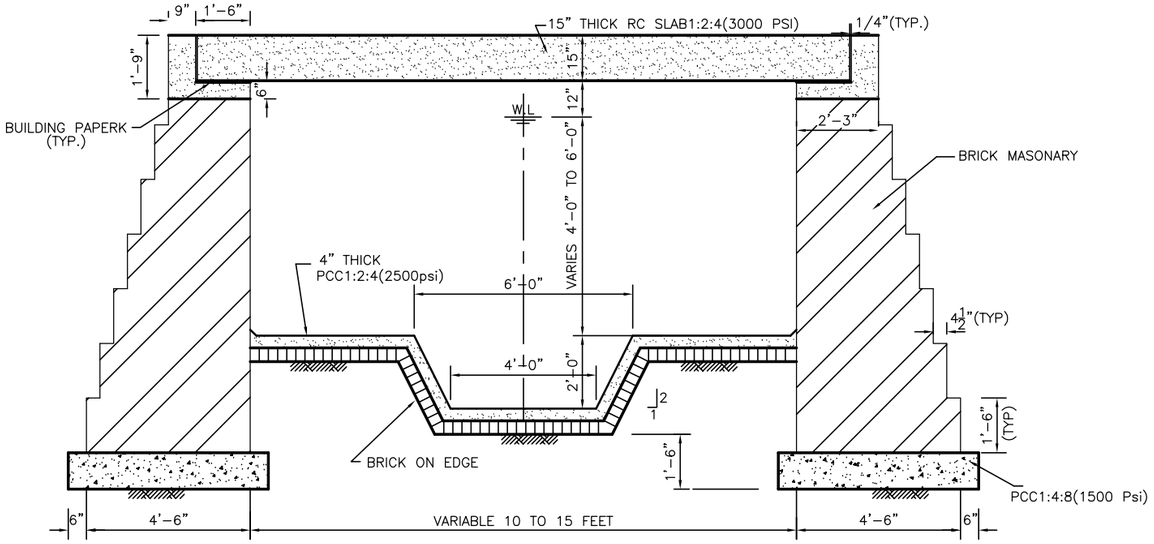


SECTION A-A

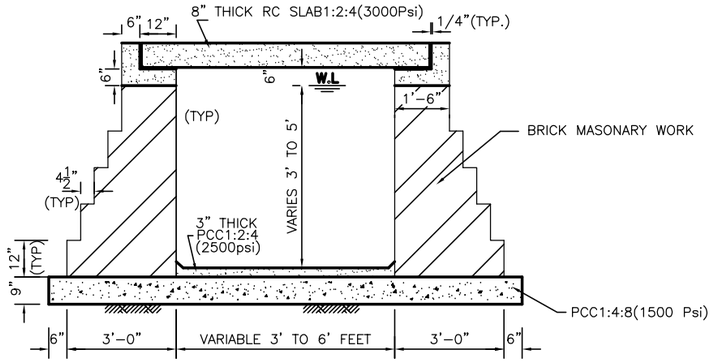
THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
LIFT STATION	SCALE	1:200
SECTION	DWG No.	LS-02

APPENDIX 13.6.2 DRAINAGE FACILITIES

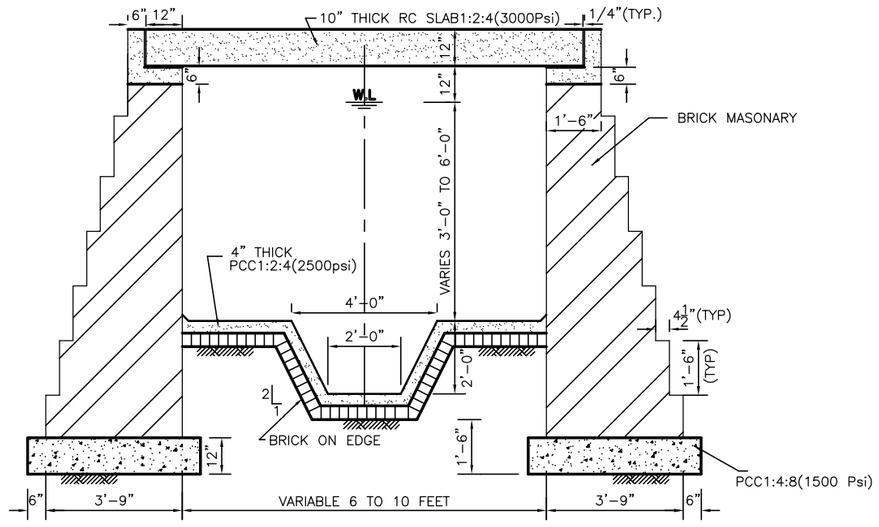

LEGEND
EXISTING CANAL & DRAIN
EXISTING PUMPING STATION
PROPOSED DRAIN (MAIN)
PROPOSED DRAIN (TERTIARY)
PROPOSED DRAIN (REHABILITATION)
RIVER RAVI
CHOTTA RAVI DRAINAGE PS
BHATTI GATE DS
MAIN OUTFALL 1~3 DS
GULSHAN -E-RAVI DS
LAKSHMI DRAIN
KRISHAN NAGAR DRAIN
4' x 4' (3,000 ft)
3' x 3' (2,679 ft)
SANDA RD. DRAIN
3.5'x3' (3,579 ft)
REWAZ GARDEN DRAIN
3.5'x4' (4,000 ft)
LOWER MALL DRAIN
EDWARD DRAIN
10' x 6' (5,500 ft)
CENTRAL DRAIN
LAKE ROAD DRAIN
NASIR BAGH DRAIN
3' x 3' (1,100 ft)
MALL RD. DRAIN
3'x2' (1,725 ft)
MECLOD RD DRAIN
6'x5' (2,000 ft)
DIL MUHAMMAD RD DRAIN
4'x4' (2,000 ft)
3.5'x3' (3,500 ft)
NICHOLSON RD DRAIN
3'x3' (2,463 ft)
3'x4' (5,100 ft)
ALLAMA IQBAL DRAIN
4' x 3' (2,009 ft)
3' x 3' (2,500 ft)
4' x 4' (2,000 ft)
7.5' x 6' (3,538 ft)
3.5' x 4' (3,500 ft)
WAPDA HOUSE DRAIN
3' x 3' (3,110 ft)
LAWRENCE DRAIN
3.5'x3' (3,668 ft)
8'x5' (2,584 ft)
ART COUNCIL DRAIN
7.5' x 5' (3,500 ft)
4' x 3' (5,462 ft)
4' x 3' (815 ft)
4' x 4' (4,675 ft)
GOVERNER'S HOUSE DRAIN
10'x6' (5,500 ft)
QUEENS ROAD DRAIN
4' x 5' (5,382 ft)
SHAHRAH AIWAN -E-TIJARAT DRAIN
8' x 4' (6,538 ft)
GOLF ROAD DRAIN
4' x 4' (3,500 ft)
3' x 3' (2,148 ft)
KINNAIRD DRAIN
4' x 5' (6,690 ft)
SHAH JAMAL RD DRAIN
6' x 4' (2,522 ft)
4' x 3' (1,640 ft)
3' x 3' (1,794 ft)
CENTRAL DRAIN
12' x 6' (6,500 ft)
CHAUBURGI DRAIN
3.5' x 4' (3,548 ft)
KRISHAN NAGAR DRAIN
10'x6' (3,000 ft)
12'x6' (2,500 ft)
MORRHE SAMANABAD DRAIN
3.5' x 4' (3,548 ft)
NEW SAMANABAD DRAIN
4' x 4' (3,106 ft)
4.5'x4.0' (1,434 ft)
POONCH RD. DRAIN
5' x 4' (4,838 ft)
MULTAN RD. DRAIN
4' x 4' (3,039 ft)
3.5'x3.0' (1,203 ft)
ALMUMTAZ RD. DRAIN
3.5' x 3.0' (3,188 ft)
GULGASHT DRAIN
3.5' x 3' (2,435 ft)
SODEWAL DRAIN
4' x 3' (5,038 ft)
OLD BUND RD DRAIN
5' x 4' (3,958 ft)
4.5'x4' (1,774 ft)
4.5'x4' (983 ft)
CANTONMENT DRAIN
3.5' x 3' (2,176 ft)
4.5' x 4' (1,136 ft)
4.5' x 4' (746 ft)
8' x 5' (2,617 ft)
10' x 5' (2,354 ft)
GULSHANE RAVI DRAIN
3.5' x 4' (2,384 ft)
4' x 3' (3,842 ft)
7' x 5' (2,000 ft)
2' x 2'
2' x 3'
3' x 2'
3' x 3'
FAZAL PARK
KHALID TOWN
MUNSHI HOSPITAL
SAGIAN WALA BYPASS
SHAFFOCAD
BILAL GANJ
BAZAR HAKIMAN
RANG MAHAL
FAIZ BAGH
SUKTAM PURA
ENGINEERING UNIVERSITY
TEZAB MANDI
RAILWAY STATION
LAKSHMI CHOWK
GOVT. COLLEGE
PUNJAB UNIVERSITY
QUEEN MARY COLLEGE
GOVERNOR'S HOUSE
LIBRARY
ZOO
CINEMA
ASSEMBLY
RACE COURSE PARK
GYMKHANA CLUB
GOVT CHIEF COLLEGE
MINISTER'S HOUSE
STATE GUEST HOUSE
KINNAIRD COLLEGE
MAYO GARDEN
SHAH KHAN ROAD
ZAMAN PARK
MIAN MIR
SANDA KHURD
FAZAL TOWN
PANJ PIR
GULSHANE RAVI
ABU BAKAR SIDDIQ COLONY
LAHORE BYPASS
GHOUSIA COLONY
GULGASHT COLONY
BABU SABO
BAKRA MANDI
DILKUSHA COLONY
KOT KAMBO
DHOKANWAL
SAMANABAD
SAMANABAD DOONGI GROUND
ICHHRA
ARIF CHOWK
PARKI THATTIS
KAMBOH COLONY
MENTAL HOSPITAL
EM HOSPITAL
JAIL ROAD
SHADMAN
CANTONMENT DRAIN
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT
DRAINAGE FACILITIES
SCALE
GENERAL PLAN OF DRAINAGE FACILITIES
DWG No.
DGE-01



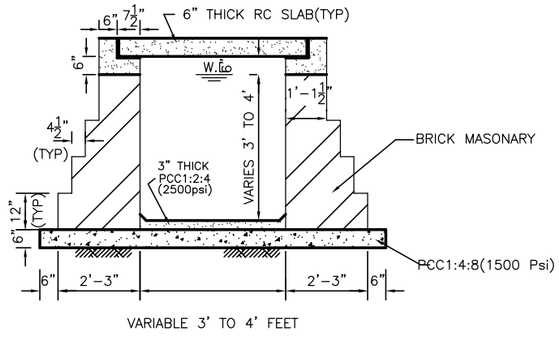
TYPICAL SECTION FOR 10 TO 15 FEET BED WIDTH
DRAIN SECTION ALONG THE ROAD



TYPICAL SECTION FOR 3 TO 6 FEET BED WIDTH
DRAIN SECTION ALONG THE ROAD



TYPICAL SECTION FOR 6 TO 10 FEET BED WIDTH
DRAIN SECTION ALONG THE ROAD



VARIABLE 3' TO 4' FEET

TYPICAL SECTION FOR 3 TO 4 FEET BED WIDTH
DRAIN SECTION UNDER FOOTPATH

NOTES

1. ALL DIMENSIONS ARE IN FEET AND INCHES AND LEVELS ARE IN FEET, UNLESS OTHERWISE SHOWN.
2. THE MINIMUM COMPRESSIVE CYLINDER STRENGTH OF BLINDING CONCRETE SHALL BE 1500 psi AT 28 DAYS.
3. THE MINIMUM COMPRESSIVE CYLINDER STRENGTH OF STRUCTURAL CONCRETE SHALL BE 3000 psi AT 28 DAYS.
4. ALL REINFORCING STEEL SHALL BE DEFORMED BARS CONFORMING TO ASTM-A615 GRADE 40 HAVING A MINIMUM YIELD STRENGTH OF 40,000 psi.
5. LAP LENGTH SHALL BE 42 DIA OF BARS.
6. CLEAR COVER TO REINFORCEMENT SHALL BE AS FOLLOWS:
   FOUNDATION = 2 INCH
   SLAB = BOTTOM 3/4 INCH
   SLAB = TOP 1/2 INCH
7. THE BED OF FOUNDATION SHOULD BE THOROUGHLY COMPACTED PRIOR TO LAYING FOUNDATION. ANY LOOSE,WET,SOFT SOIL PATCHES SHOULD BE REPLACED WITH WELL COMPACTED SELECTED FILL MATERIAL.
8. FOUNDATION SIZE SHOWN ARE BASED ON A BEARING CAPACITY OF 0.75 T/ft^2. THIS VALUE SHOULD BE VERIFIED AND GEOTECHNICAL ENGINEER SHOULD INSPECT AND VERIFY EXCAVATED BED BEFORE PLACEMENT OF FOUNDATION.
9. ALL MASONARY SHOULD BE EXECUTED WITH FIRST CLASS APPROVED BRICKS AND SHALL BE LAID IN (1:5) CEMENT SAND MORTAR.
10. FLUSH POINTING IN (1:3) CEMENT:SAND MORTAR SHALL BE CARRIED IN BRICK MASONARY ON THE WATER SIDE ABOVE THE DRAIN BED LEVEL.
11. THE CONTRACTOR SHALL PREPARE BAR BENDING SCHEDULES AND SUBMIT THESE FOR APPROVAL OF THE ENGINEER.
12. BACKFILLING AROUND FOUNDATION AND UNDER THE DRAINS SHALL BE DONE IN LAYERS NOT EXCEEDING 8 INCHES THICKNESS.
13. EXPANSION JOINT IN DUCK SLAB SHOULD BE PROVIDED AT EVERY 50 FEET.
13. MIX DESIGN SHOULD BE CARRIED OUT TO ACHIEVE THE REQUIRED CONCRETE STRENGTH AS GIVEN BELOW.

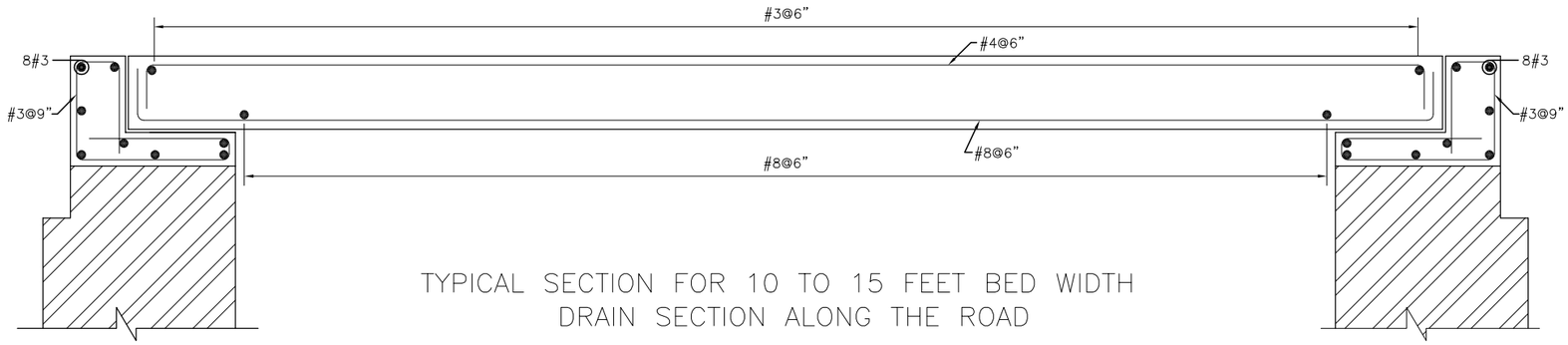
RATIO	REQUIRED STRENGTH
1:1.5:3	3750 PSI
1:2:4	3000 PSI
1:4:8	1500 PSI

14. RATIO MENTIONED ON DRAWINGS IS SUBJECT TO CHANGE DEPENDING UPON THE MIX DESIGN REQUIREMENTS. THE ULTIMATE AIM SHOULD BE TO ACHIEVE THE REQUIRED STRENGTH.

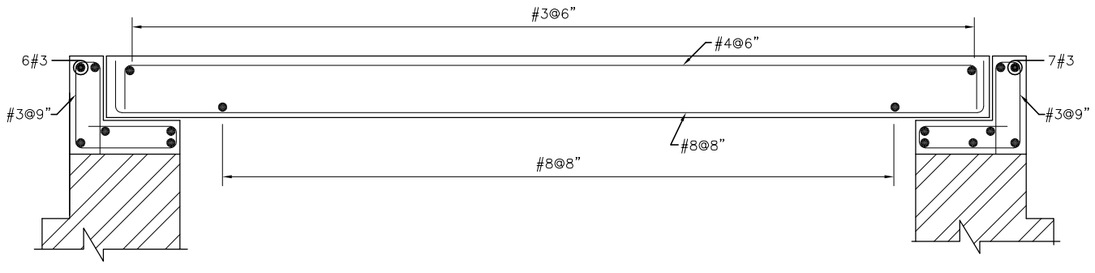
SCALE 1"=4'-0"
(UNLESS OTHERWISE NOTED)

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

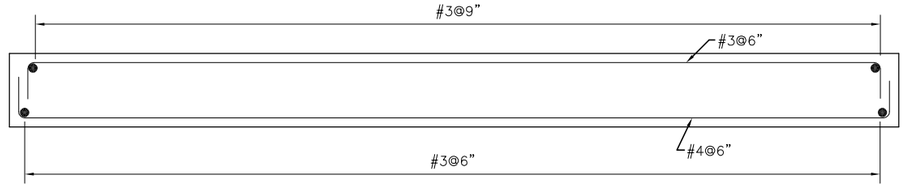
DRAINAGE FACILITIES	SCALE	
TYPICAL CROSS SECTION	DWG No.	DG-01



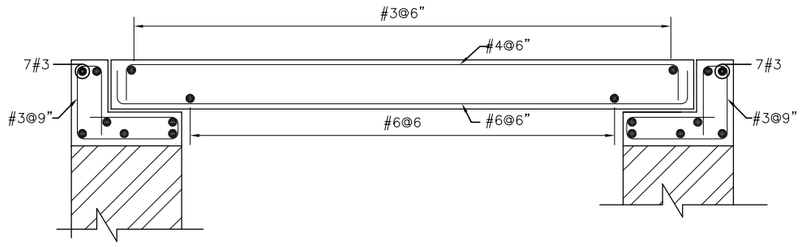
TYPICAL SECTION FOR 10 TO 15 FEET BED WIDTH
DRAIN SECTION ALONG THE ROAD



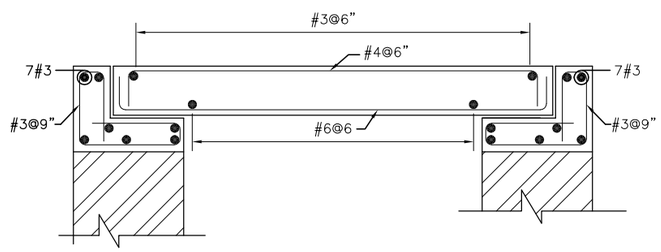
TYPICAL SECTION FOR 6 TO 10 FEET BED WIDTH
DRAIN SECTION ALONG THE ROAD



FOOT PATH



TYPICAL SECTION FOR 3 TO 6 FEET BED WIDTH
DRAIN SECTION ALONG THE ROAD

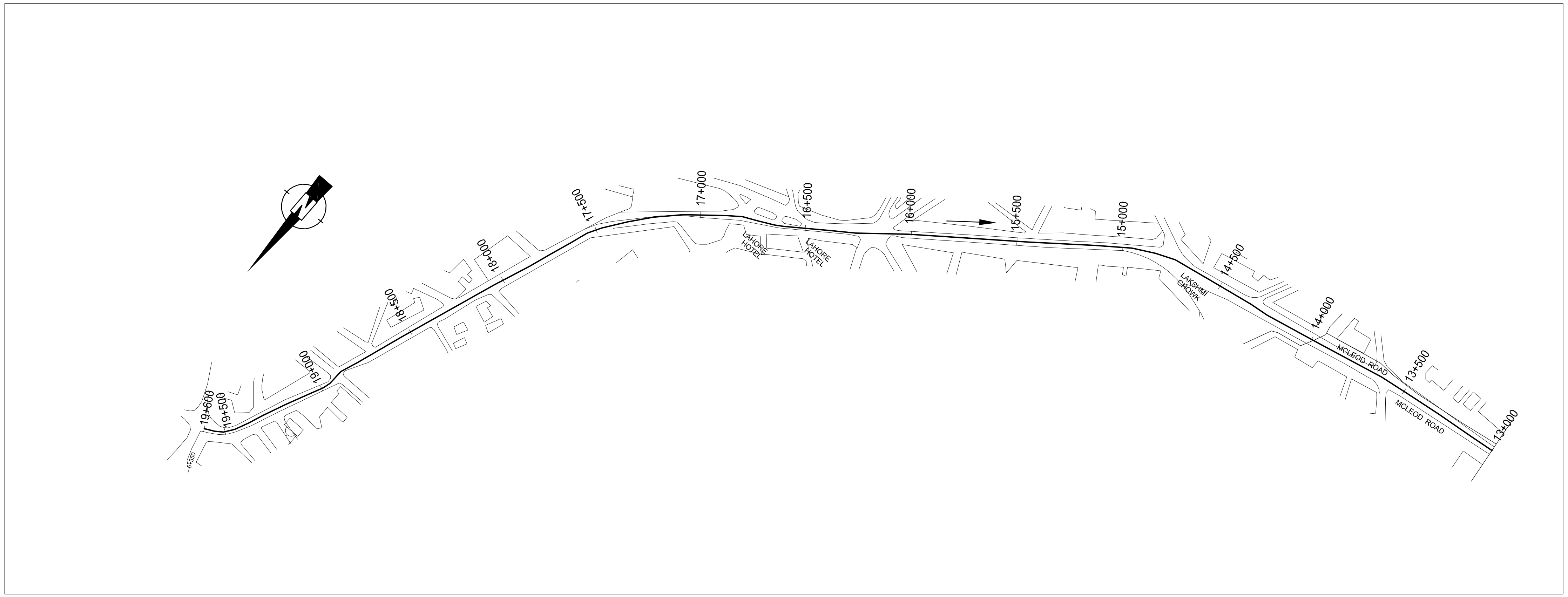


TYPICAL SECTION FOR 3 TO 4 FEET BED WIDTH
DRAIN SECTION UNDER FOOTPATH

NOTES

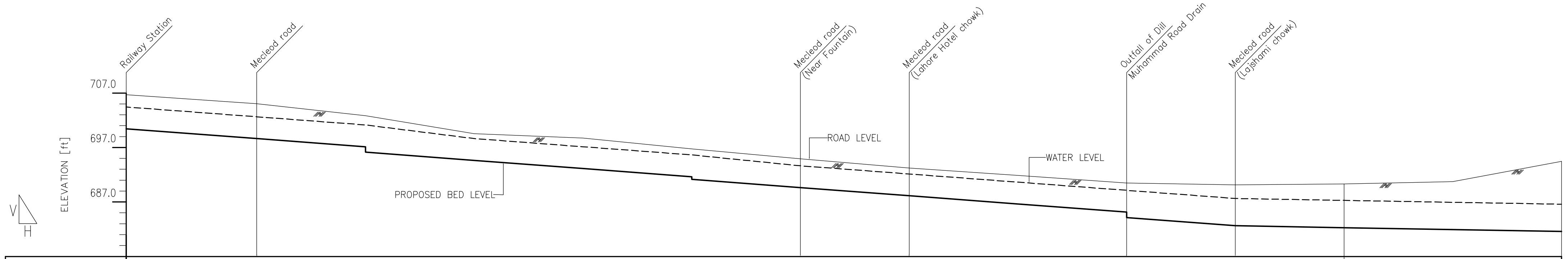
1. ALL DIMENSIONS ARE IN FEET AND INCHES AND LEVELS ARE IN FEET, UNLESS OTHERWISE SHOWN.

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
DRAINAGE FACILITIES	SCALE	
DETAIL OF COVER	DWG No.	DG–02

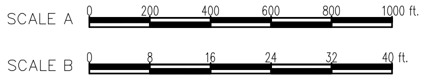


PLAN (19+600 - 13+000)

H: SCALE A V: SCALE B



LINE	A~B											B~C		
SIZE (BxH ft)	3.0 x 4.0											6.0 x 5.0		
SLOPE (ft/ft)	0.003										0.0007			
ROAD LEVEL (FT.)	706.69	705.04	702.84	699.52	698.72	696.76	694.93	693.22	691.87	690.50	690.13	690.32	690.75	694.44
WATER LEVEL (FT.)	704.44	702.64	696.14 701.14	698.64	697.14	695.64	693.64	692.14	690.64	689.14	687.64	687.29	686.94	686.59
PROPOSED BED LEVEL (FT.)	700.44	698.64	697.14 696.14	694.64	693.14	691.64 691.14	689.64	688.14	686.64	685.14 684.14	682.64	682.29	681.94	681.59
CHAINAGE (FT.)	19600	19000	18500	18000	17500	17000	16500	16000	15500	15000	14500	14000	13500	13000

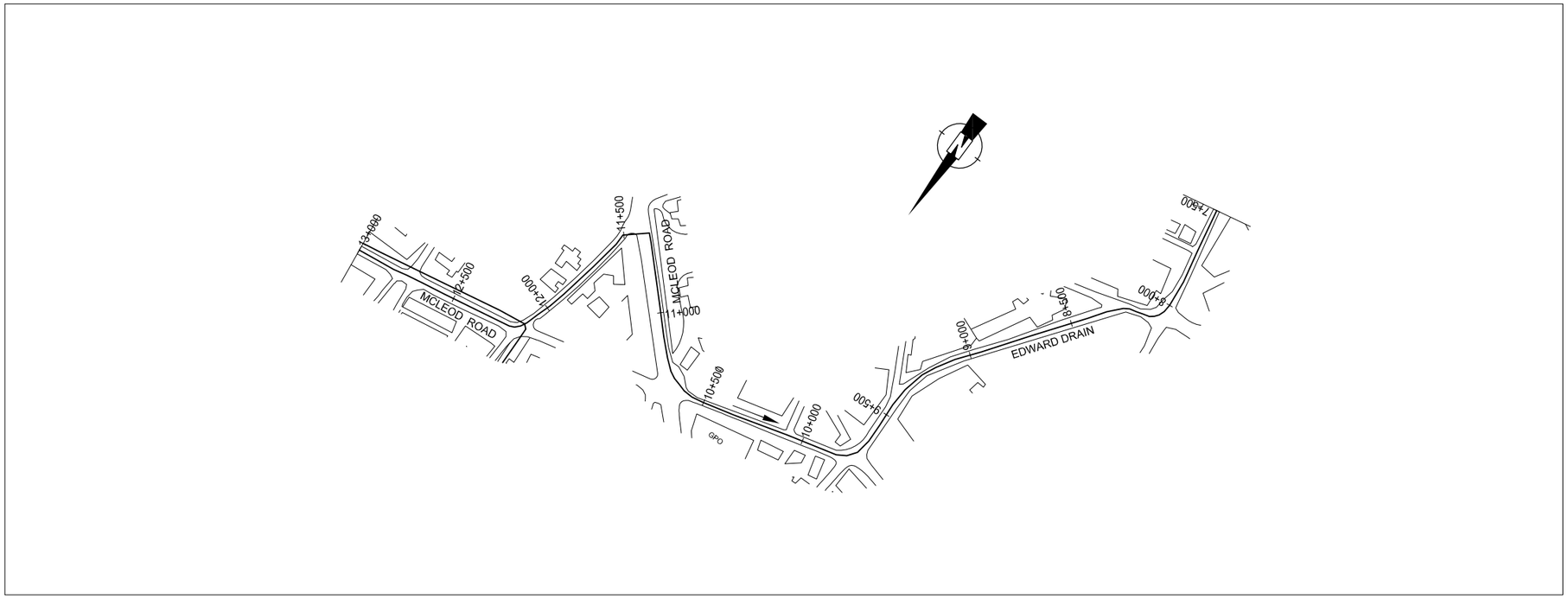


PLOFILE (19+600 - 13+000)

H: SCALE A V: SCALE B

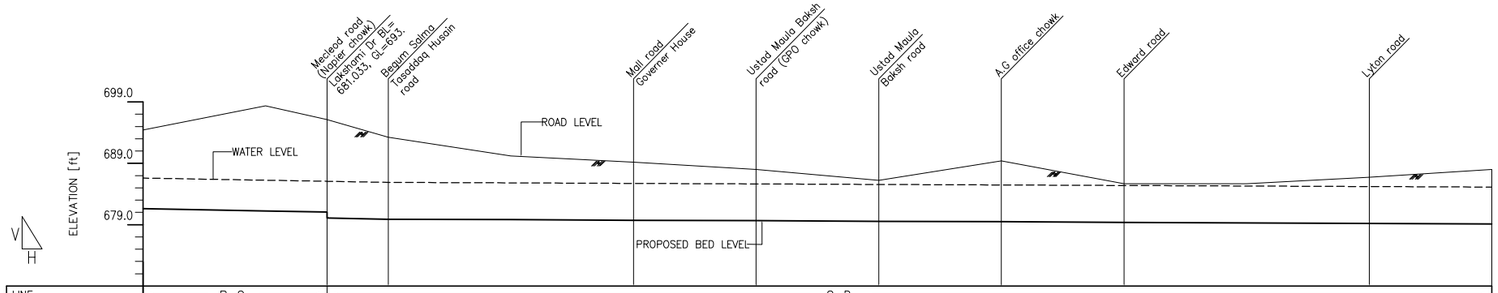
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
CENTRAL DRAIN (1/3)	DWG No.	DP-01



PLAN (13+000 - 7+500)

H: SCALE A V: SCALE B



LINE	B~C			C~D									
SIZE (BxH ft)	6.0 x 5.0			10.0 x 6.0									
SLOPE (ft/ft)	0.0007			0.00017									
ROAD LEVEL (FT.)	694.44	698.37	696.12	693.23	690.18	689.20	687.98	686.23	689.41	685.67	685.68	686.71	687.98
WATER LEVEL (FT.)	686.59	686.24	686.07	685.89	685.81	685.72	685.64	685.55	685.47	685.38	685.30	685.21	685.13
PROPOSED BED LEVEL (FT.)	681.59	681.24	681.07	679.89	679.81	679.72	679.64	679.55	679.47	679.38	679.30	679.21	679.13
CHAINAGE (FT.)	13000	12500	12250	12000	11500	11000	10500	10000	9500	9000	8500	8000	7500

SCALE A 0 200 400 600 800 1000 ft.

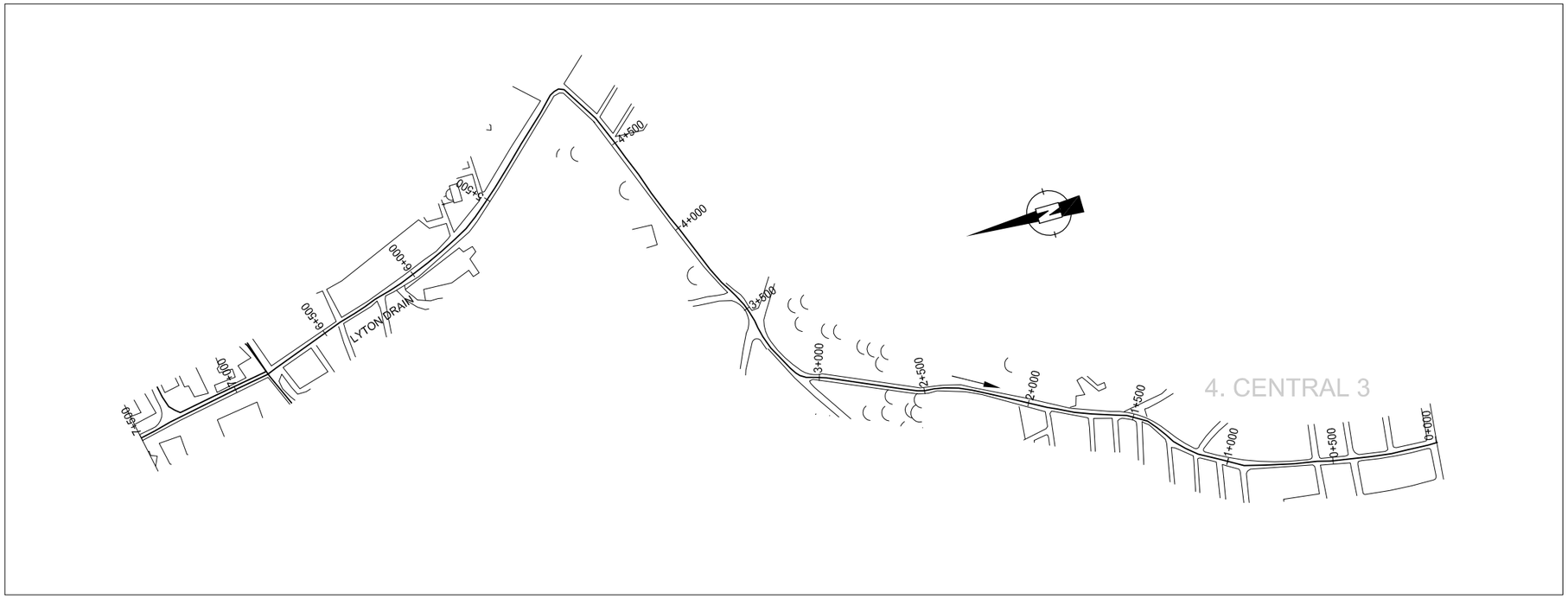
SCALE B 0 8 16 24 32 40 ft.

PLOFILE (13+000 - 7+500)

H: SCALE A V: SCALE B

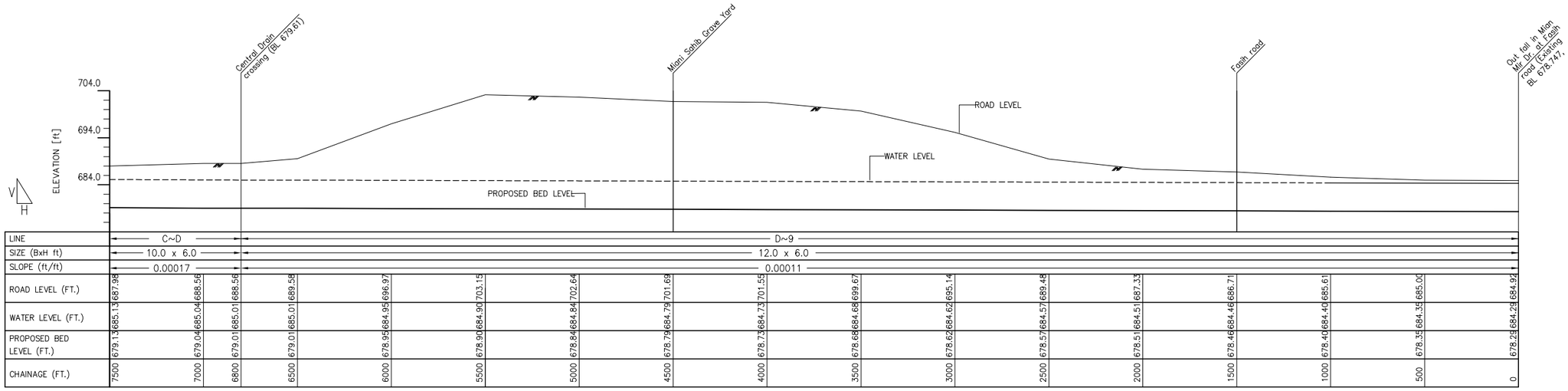
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
CENTRAL DRAIN (2/3)	DWG No.	DP-02



PLAN (7+500 - 0+000)

H: SCALE A V: SCALE B



LINE	C~D																					
SIZE (BxH ft)	10.0 x 6.0																					
SLOPE (ft/ft)	0.00017																					
ROAD LEVEL (FT.)	687.98	688.56	688.56	689.58	696.97	703.15	702.64	701.69	701.55	699.67	695.14	689.48	687.33	686.71	685.61	685.00	684.92					
WATER LEVEL (FT.)	685.13	685.04	685.01	685.01	684.95	684.90	684.84	684.79	684.73	684.68	684.62	684.57	684.51	684.46	684.40	684.35	684.29					
PROPOSED BED LEVEL (FT.)	679.13	679.04	679.01	679.01	678.95	678.90	678.84	678.79	678.73	678.68	678.62	678.57	678.51	678.46	678.40	678.35	678.29					
CHAINAGE (FT.)	7500	7000	6800	6500	6000	5500	5000	4500	4000	3500	3000	2500	2000	1500	1000	500	0					
LINE	C~D	D~9																				
SIZE (BxH ft)	10.0 x 6.0	12.0 x 6.0																				
SLOPE (ft/ft)	0.00017	0.00011																				

PLOFILE (7+500 - 0+000)

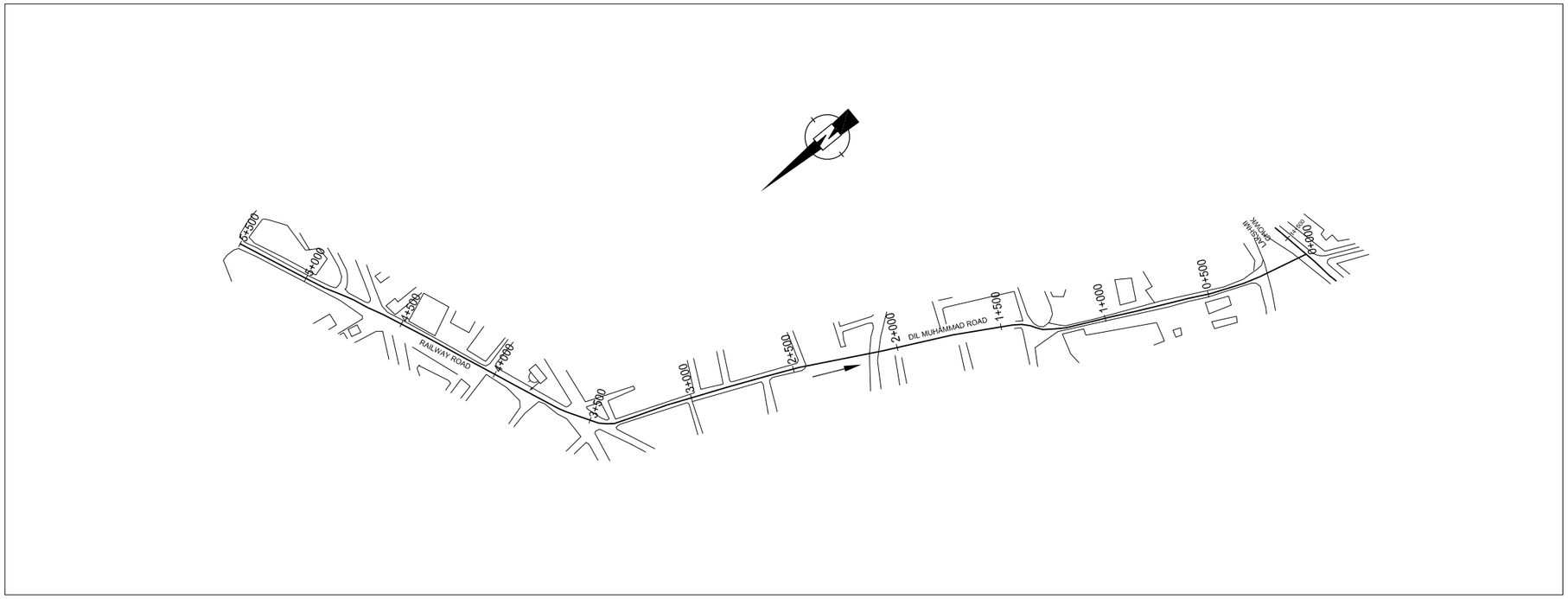
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 8 16 24 32 40 ft.

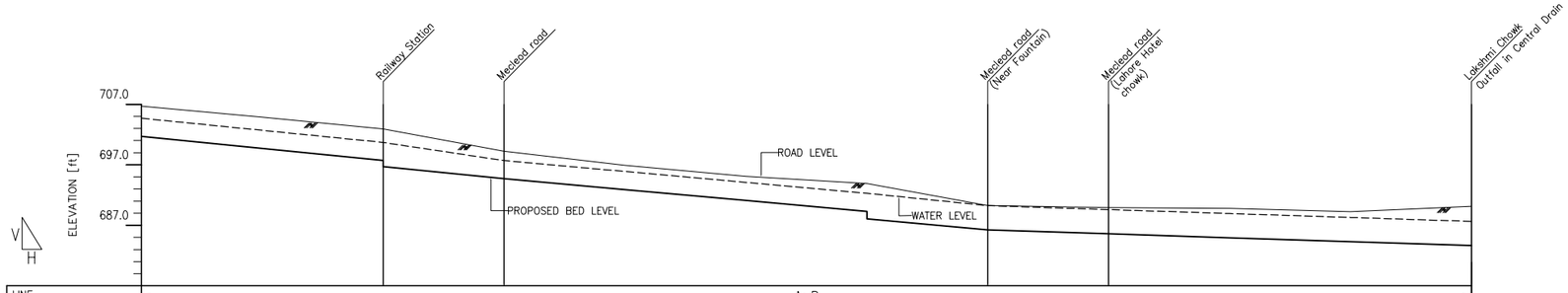
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
CENTRAL DRAIN (3/3)	DWG No.	DP-03



PLAN (5+500 - 0+000)

H: SCALE A V: SCALE B



LINE	A~B											
SIZE (BxH ft)	3.5 x 3.0							4.0 x 4.0				
SLOPE (ft/ft)	0.0040			0.0036				0.0013				
ROAD LEVEL (FT.)	706.69	704.85	702.90	699.25	696.90	695.10	693.90	690.26	690.24	689.93	689.81	689.24	690.13
WATER LEVEL (FT.)	704.69	702.69	700.69	697.69	695.89	694.09	692.29	690.24	689.59	689.59	688.94	688.29	687.64
PROPOSED BED LEVEL (FT.)	701.69	699.69	697.69	696.69	694.69	692.89	691.09	689.29	688.04	686.24	685.59	684.94	684.29	683.64
CHAINAGE (FT.)	5500	5000	4500	4000	3500	3000	2500	2000	1500	1000	500	0

SCALE A 0 200 400 600 800 1000 ft.

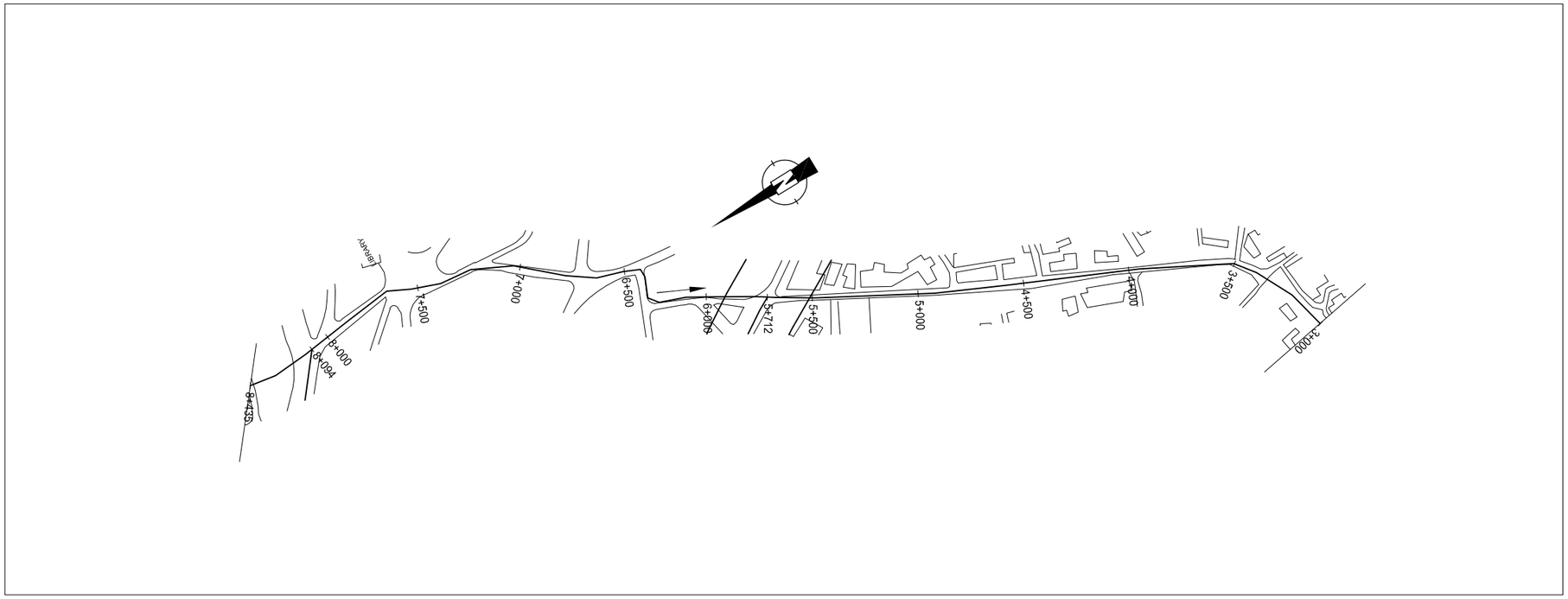
SCALE B 0 8 16 24 32 40 ft.

PLOFILE (5+500 - 0+000)

H: SCALE A V: SCALE B

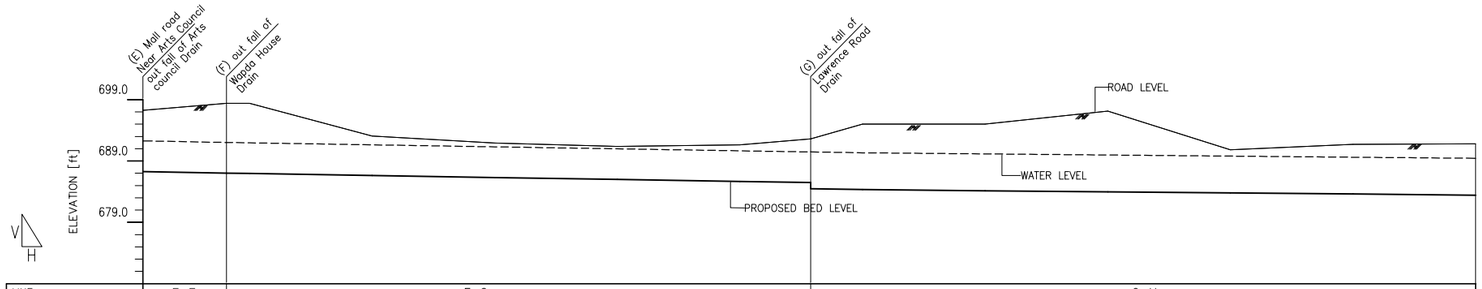
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
DIL MUHAMMAD ROAD DRAIN	DWG No.	DP-04



PLAN (8+435 - 3+000)

H: SCALE A V: SCALE B



LINE	E~F	F~G	G~H
SIZE (BxH ft)	7.5x5.0	8.0 x 5.0	10.0 x 6.0
SLOPE (ft/ft)	0.00075	0.00065	0.00036
ROAD LEVEL (FT.)	697.28	698.39	698.39	693.06	691.92	691.36	692.62	695.02	697.13	690.83	691.73	691.81
WATER LEVEL (FT.)	692.28	692.02	691.96	691.64	691.31	690.99	690.66	691.62	690.48	690.16	695.02	695.02	697.98	690.80	689.62	689.44
PROPOSED BED LEVEL (FT.)	687.28	687.02	686.96	686.64	686.31	685.99	685.66	685.66	685.48	684.48	684.34	684.16	683.98	683.80	683.62	683.44
CHAINAGE (FT.)	8435	8094	8000	7500	7000	6500	6000	5712	5500	5000	4500	4000	3500	3000

PLOFILE (8+435 - 3+000)

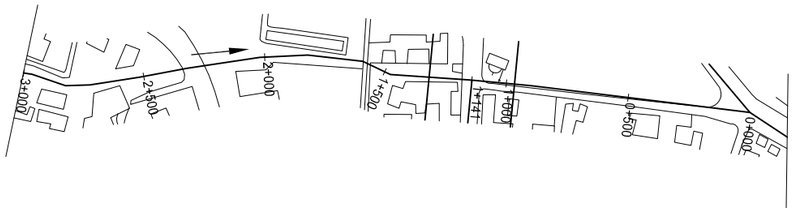
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 8 16 24 32 40 ft.

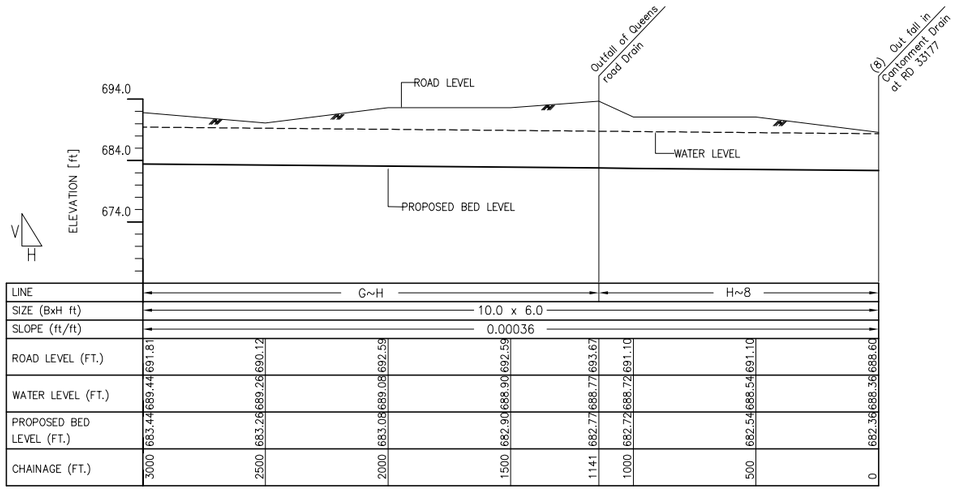
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
GOVERNER HOUSE DRAIN (REHABILITATION) (1/2)	DWG No.	DP-05



PLAN (3+000 - 0+000)

H: SCALE A V: SCALE B



LINE	G~H					H~8		
SIZE (BxH ft)	10.0 x 6.0							
SLOPE (ft/ft)	0.00036							
ROAD LEVEL (FT.)	691.81	690.12	692.59	692.59	693.67	691.10	691.10	688.60
WATER LEVEL (FT.)	689.44	689.26	689.08	688.90	688.77	688.72	688.54	688.36
PROPOSED BED LEVEL (FT.)	683.44	683.26	683.08	682.90	682.77	682.72	682.54	682.36
CHAINAGE (FT.)	3000	2500	2000	1500	1141	1000	500	0

PLOFILE (3+000 - 0+000)

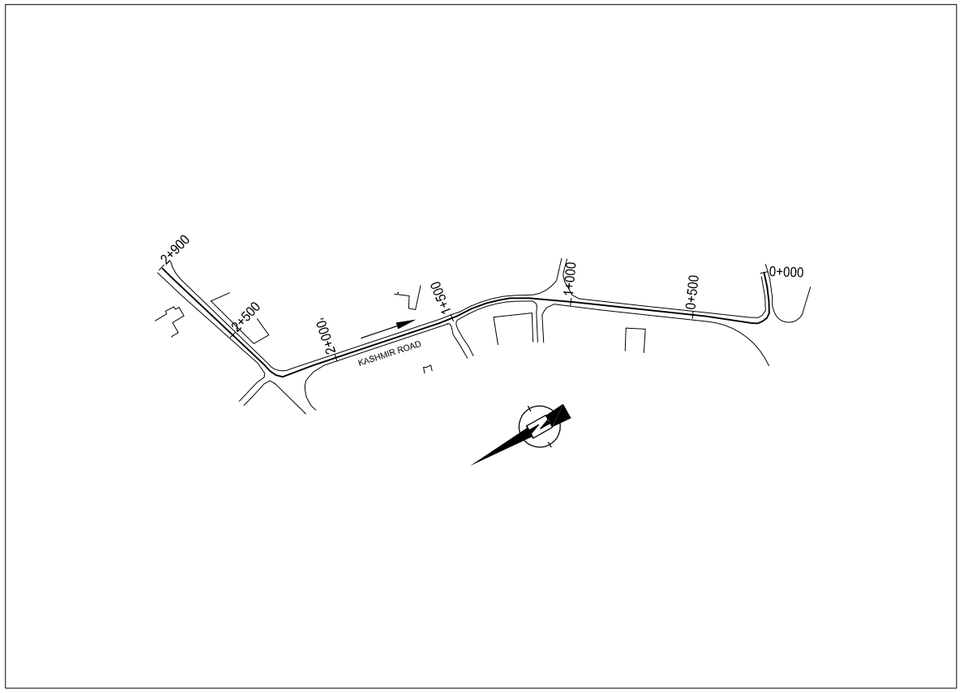
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 8 16 24 32 40 ft.

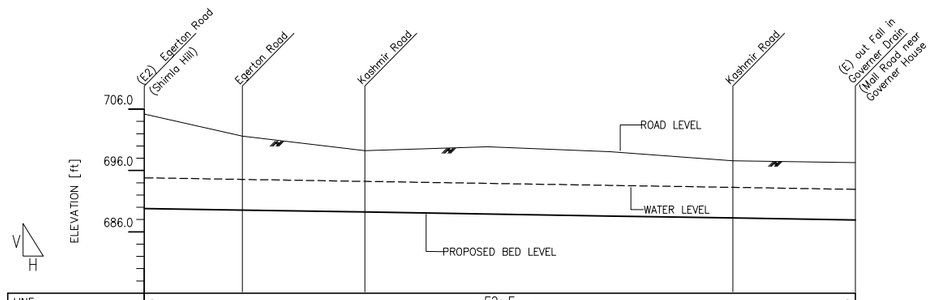
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
GOVERNER HOUSE DRAIN (REHABILITATION) (2/2)	DWG No.	DP-06



PLAN (2+900 - 0+000)

H: SCALE A V: SCALE B



LINE	E2~E						
SIZE (BxH ft)	7.5 x 5.0						
SLOPE (ft/ft)	0.00065						
ROAD LEVEL (FT.)	705.19	701.61	699.22	699.88	699.05	697.60	697.28
WATER LEVEL (FT.)	694.28	694.02	693.69	693.37	693.04	692.72	692.39
PROPOSED BED LEVEL (FT.)	689.28	689.02	688.69	688.37	688.04	687.72	687.39
CHAINAGE (FT.)	2900	2500	2000	1500	1000	500	0

PLOFILE (2+900 - 0+000)

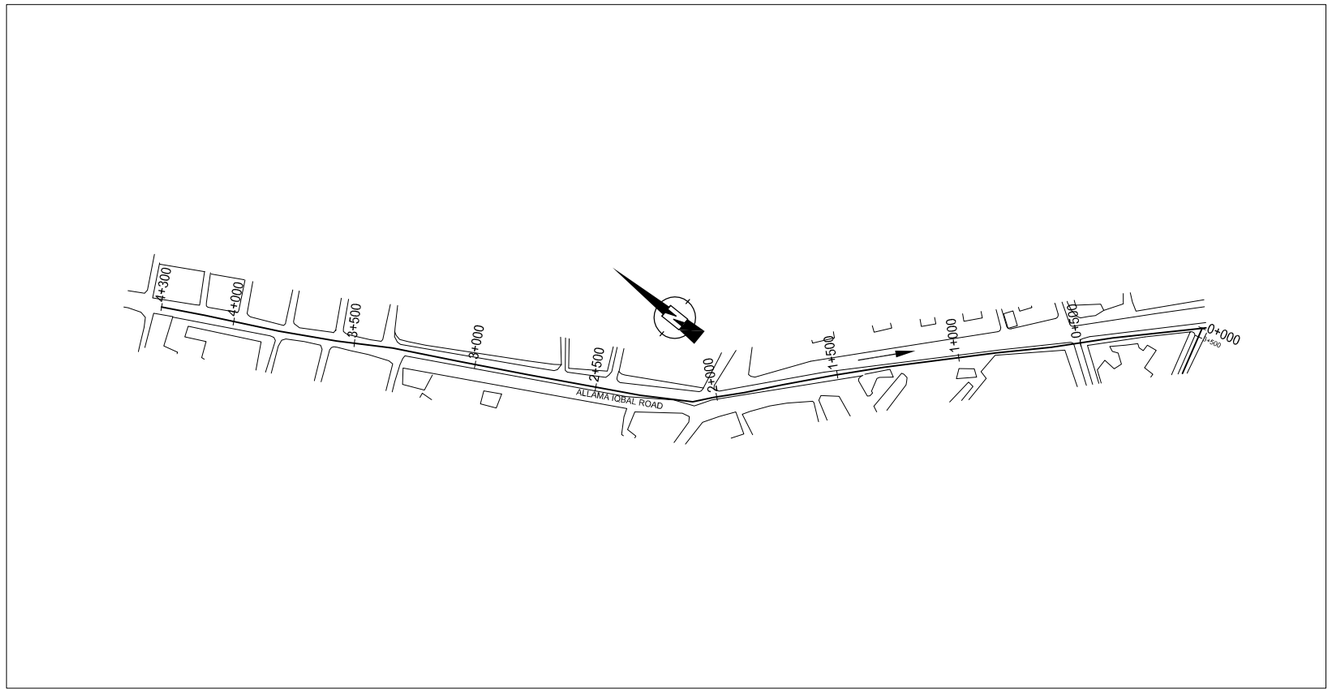
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 8 16 24 32 40 ft.

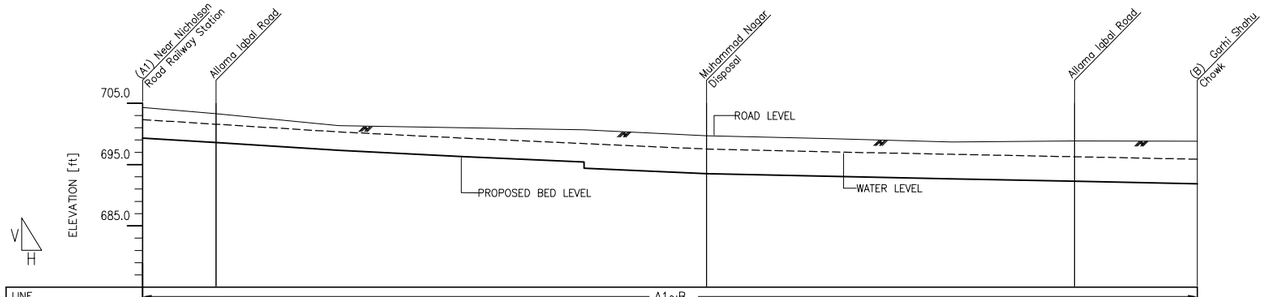
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
ART COUNCIL DRAIN	DWG No.	DP-07



PLAN (4+300 - 0+000)

H: SCALE A V: SCALE B



LINE	A1~B																
SIZE (BxH ft)	4.0 x 3.0												4.0 x 4.0				
SLOPE (ft/ft)	0.0025			0.0020			0.0018			0.0009			0.0008				
ROAD LEVEL (FT.)	704.32	703.30	701.57	701.34	700.32	701.01	700.68	699.68	699.52	699.24	698.66	697.07	698.85	697.27	696.27	698.82	697.87
WATER LEVEL (FT.)	702.32	701.57	700.32	700.32	699.32	699.32	698.42	697.52	697.52	697.07	696.67	695.87	696.27	695.87	695.87	695.87	695.87
PROPOSED BED LEVEL (FT.)	699.32	698.57	697.32	697.32	696.32	696.32	695.42	694.42	693.52	693.07	692.67	692.27	692.27	692.27	692.27	691.87	691.87
CHAINAGE (FT.)	4300	4000	3500	3000	2500	2000	1500	1000	500	0							

SCALE A 0 200 400 600 800 1000 ft.

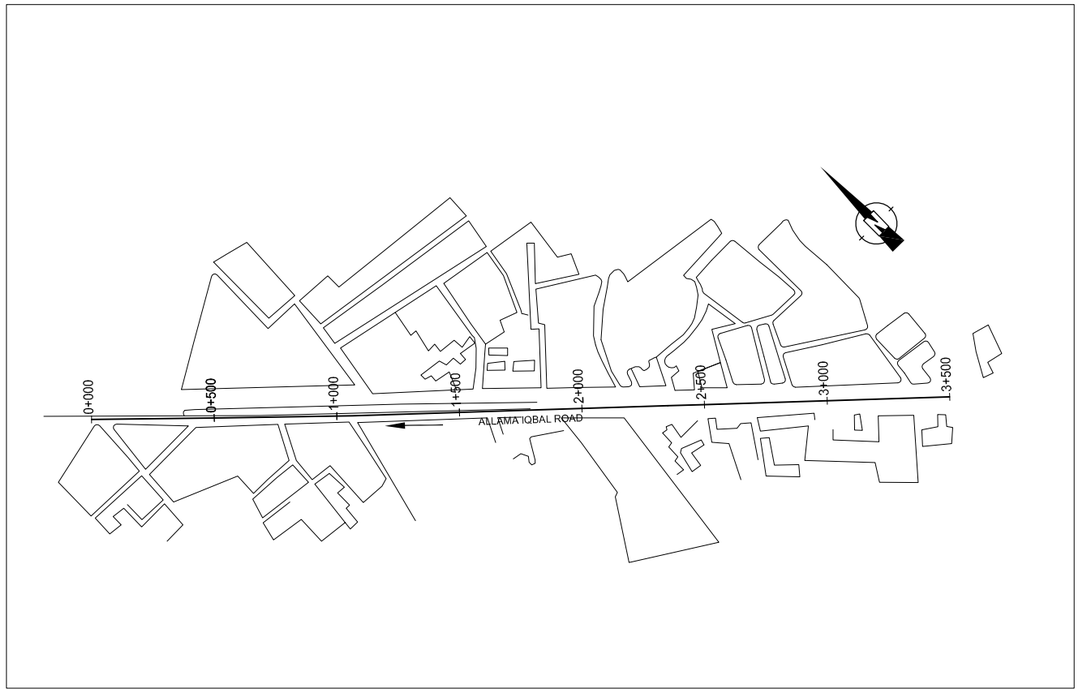
SCALE B 0 8 16 24 32 40 ft.

PLOFILE (4+300 - 0+000)

H: SCALE A V: SCALE B

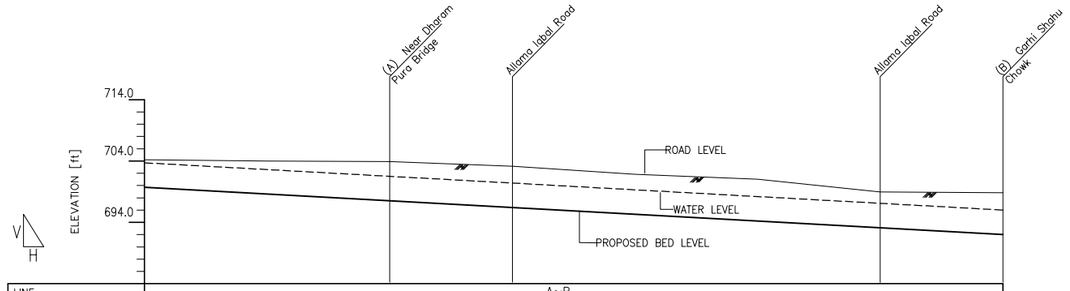
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
ALLAMA IQBAL ROAD DRAIN (1/4)	DWG No.	DP-08



PLAN (3+500 - 0+000)

H: SCALE A V: SCALE B



LINE	A~B							
SIZE (BxH ft)	3.5 x 4.0							
SLOPE (ft/ft)	0.0022							
ROAD LEVEL (FT.)	704.20	704.00	703.92	703.15	701.84	701.04	698.94	698.82
WATER LEVEL (FT.)	703.70	702.60	701.50	700.40	699.30	698.20	697.10	696.00
PROPOSED BED LEVEL (FT.)	699.70	698.60	697.50	696.40	695.30	694.20	693.10	692.00
CHAINAGE (FT.)	3500	3000	2500	2000	1500	1000	500	0

PLOFILE (3+500 - 0+000)

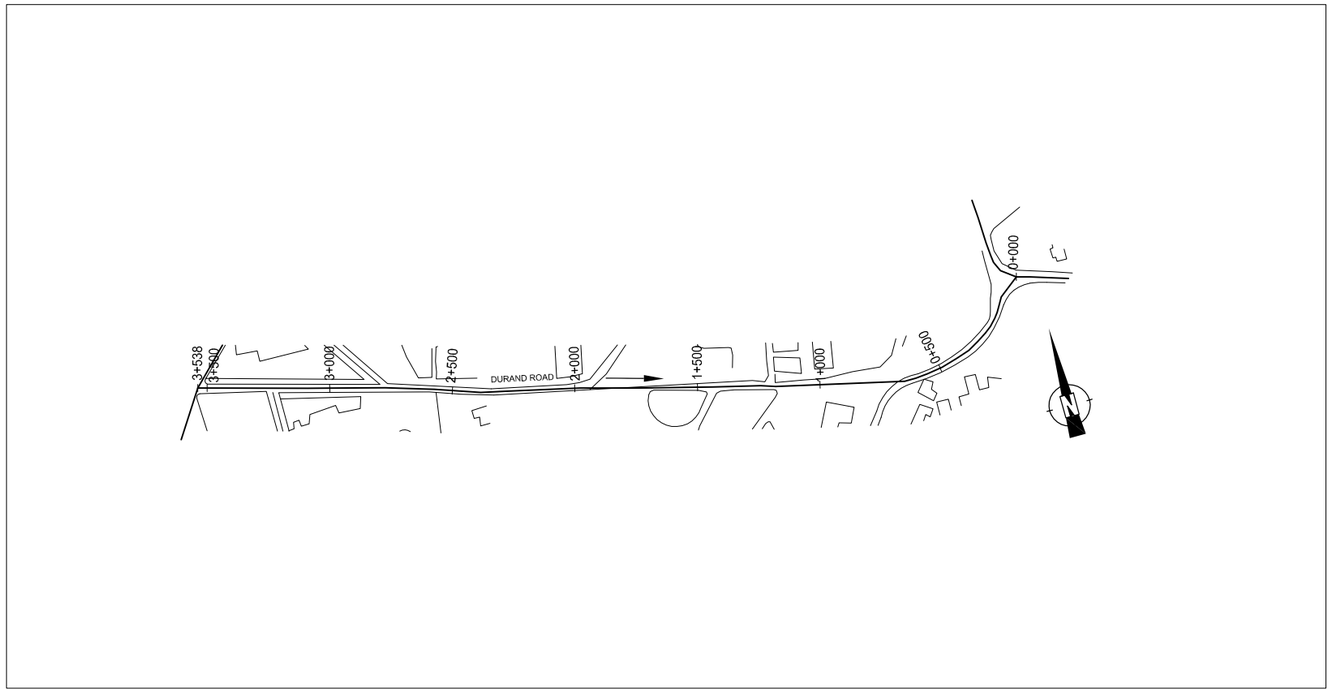
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 8 16 24 32 40 ft.

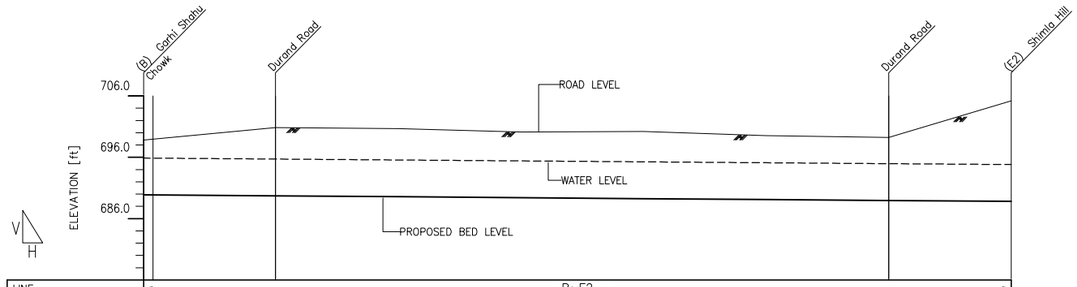
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
ALLAMA IQBAL ROAD DRAIN (2/4)	DWG No.	DP-09



PLAN (3+538 - 0+000)

H: SCALE A V: SCALE B



LINE	B~E2							
SIZE (BxH ft)	7.5 x 6.0							
SLOPE (ft/ft)	0.0003							
ROAD LEVEL (FT.)	698.82	700.86	700.66	700.12	700.21	699.52	699.21	705.19
WATER LEVEL (FT.)	695.87	695.63	695.40	695.18	694.95	694.73	694.50	694.28
PROPOSED BED LEVEL (FT.)	690.87	690.63	690.40	690.18	689.95	689.73	689.50	689.28
CHAINAGE (FT.)	3538	3000	2500	2000	1500	1000	500	0

PLOFILE (3+538 - 0+000)

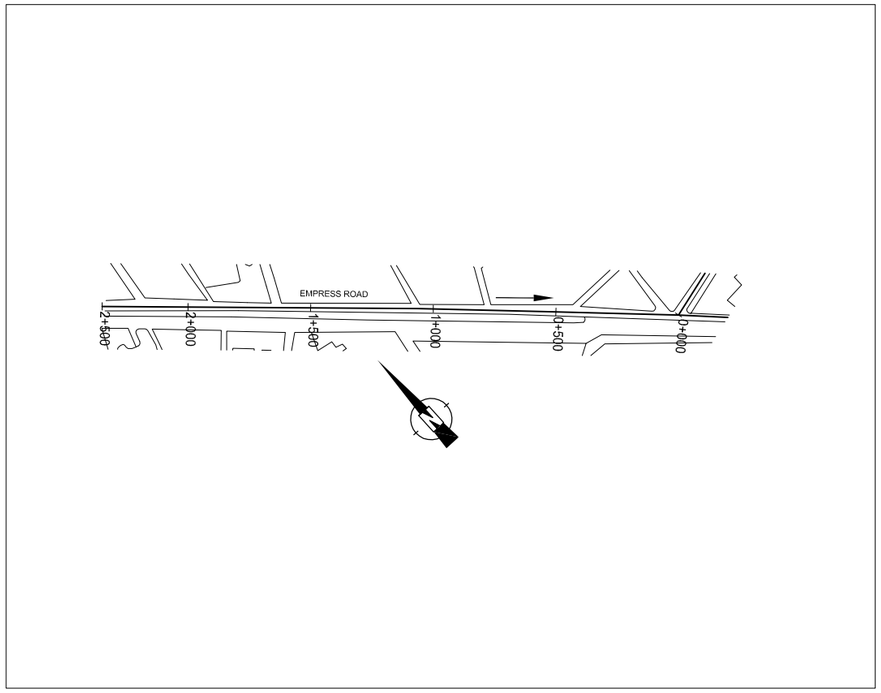
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 8 16 24 32 40 ft.

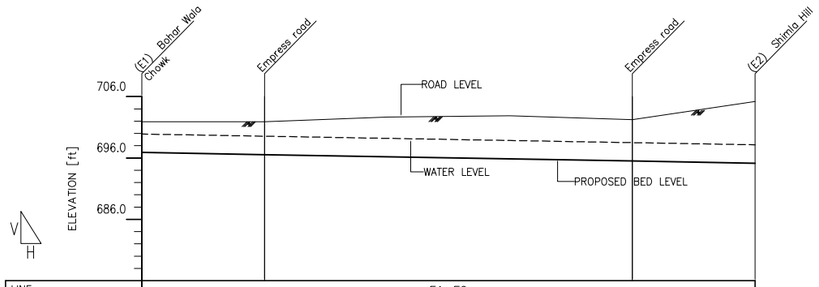
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
ALLAMA IQBAL ROAD DRAIN (3/4)	DWG No.	DP-10



PLAN (2+500 - 0+000)

H: SCALE A V: SCALE B



LINE	E1~E2					
SIZE (BxH ft)	3.0 x 3.0					
SLOPE (ft/ft)	0.0007					
ROAD LEVEL (FT.)	701.90	701.91	702.69	702.88	702.24	705.19
WATER LEVEL (FT.)	699.90	699.55	699.20	698.85	698.50	698.15
PROPOSED BED LEVEL (FT.)	696.90	696.55	696.20	695.85	695.50	695.15
CHAINAGE (FT.)	2500	2000	1500	1000	500	0

PLOFILE (2+500 - 0+000)

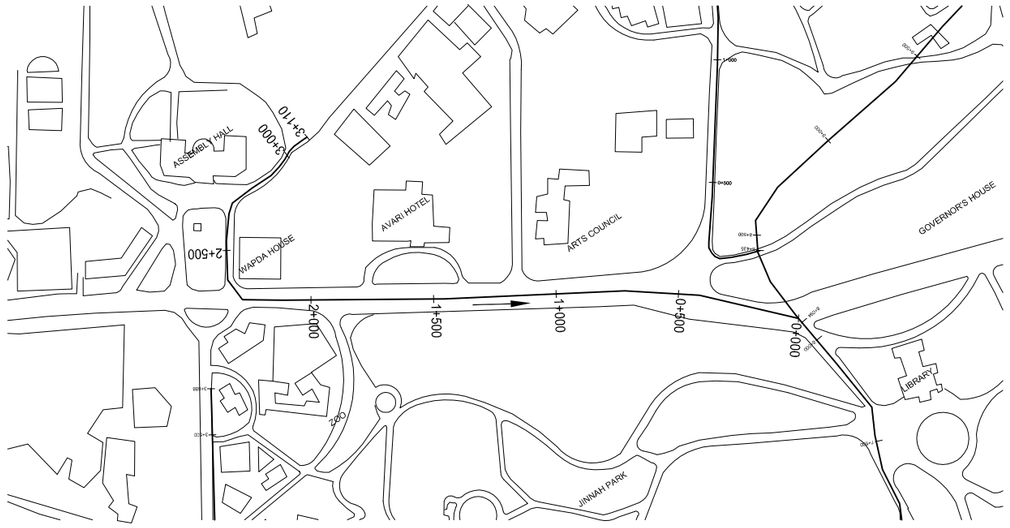
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 8 16 24 32 40 ft.

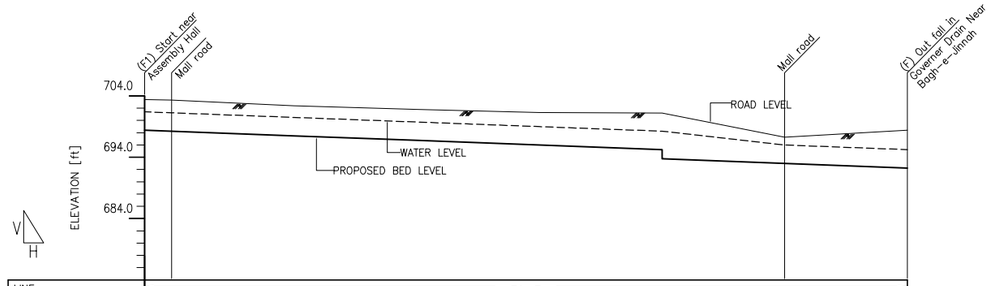
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
ALLAMA IQBAL ROAD DRAIN (4/4)	DWG No.	DP-11



PLAN (3+110 - 0+000)

H: SCALE A V: SCALE B



LINE	F1~F							
SIZE (BxH ft)	3.0 x 3.0							
SLOPE (ft/ft)	0.00150							
ROAD LEVEL (FT.)	703.40	703.30	702.37	701.80	701.30	701.18	697.28	698.39
WATER LEVEL (FT.)	701.40	701.24	700.49	699.74	698.99	698.24	695.99	695.24
PROPOSED BED LEVEL (FT.)	698.40	698.24	697.49	696.74	695.99	695.24	692.99	692.24
CHAINAGE (FT.)	3110	3000	2500	2000	1500	1000	500	0

PLOFILE (3+110 - 0+000)

H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

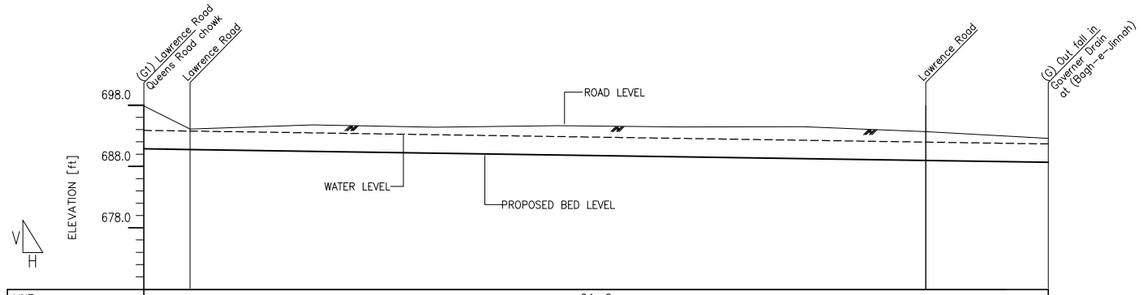
SCALE B 0 8 16 24 32 40 ft.

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
WAPDA HOUSE DRAIN	DWG No.	DP-12

PLAN (3+688 - 0+000)

H: SCALE A V: SCALE B



LINE	G1~G									
SIZE (BxH ft)	3.5 x 3.0									
SLOPE (ft/ft)	0.00060									
ROAD LEVEL (FT.)	697.92	694.15	694.83	694.42	694.69	694.48	694.50	693.71	692.62	
WATER LEVEL (FT.)	693.92	693.81	693.51	693.21	692.91	692.61	692.31	692.01	691.71	
PROPOSED BED LEVEL (FT.)	690.92	690.81	690.51	690.21	689.91	689.61	689.31	689.01	688.71	
CHAINAGE (FT.)	3688	3500	3000	2500	2000	1500	1000	500	0	

SCALE A 0 200 400 600 800 1000 ft.

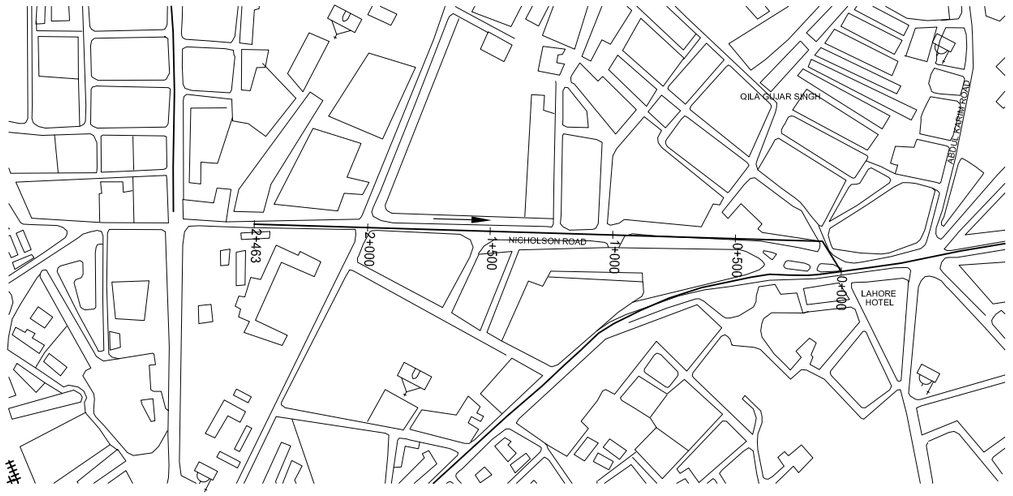
SCALE B 0 8 16 24 32 40 ft.

PLOFILE (3+688 - 0+000)

H: SCALE A V: SCALE B

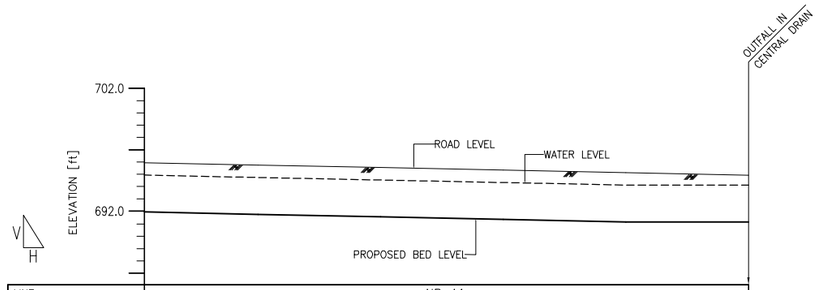
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
LAWRENCE ROAD DRAIN	DWG No.	DP-13



PLAN (2+463 - 0+000)

H: SCALE A V: SCALE B



LINE	NR~A1				
SIZE (BxH ft)	3.0 x 3.0				
SLOPE (ft/ft)	0.000410				
ROAD LEVEL (FT.)	695.94	695.75	695.54	695.34	695.13	694.93
WATER LEVEL (FT.)	694.94	694.73	694.53	694.32	694.12	694.12
PROPOSED BED LEVEL (FT.)	691.94	691.73	691.53	691.32	691.12	691.12
CHAINAGE (FT.)	2+463	2+000	1+500	1+000	0+500	0+000

PLOFILE (2+463 - 0+000)

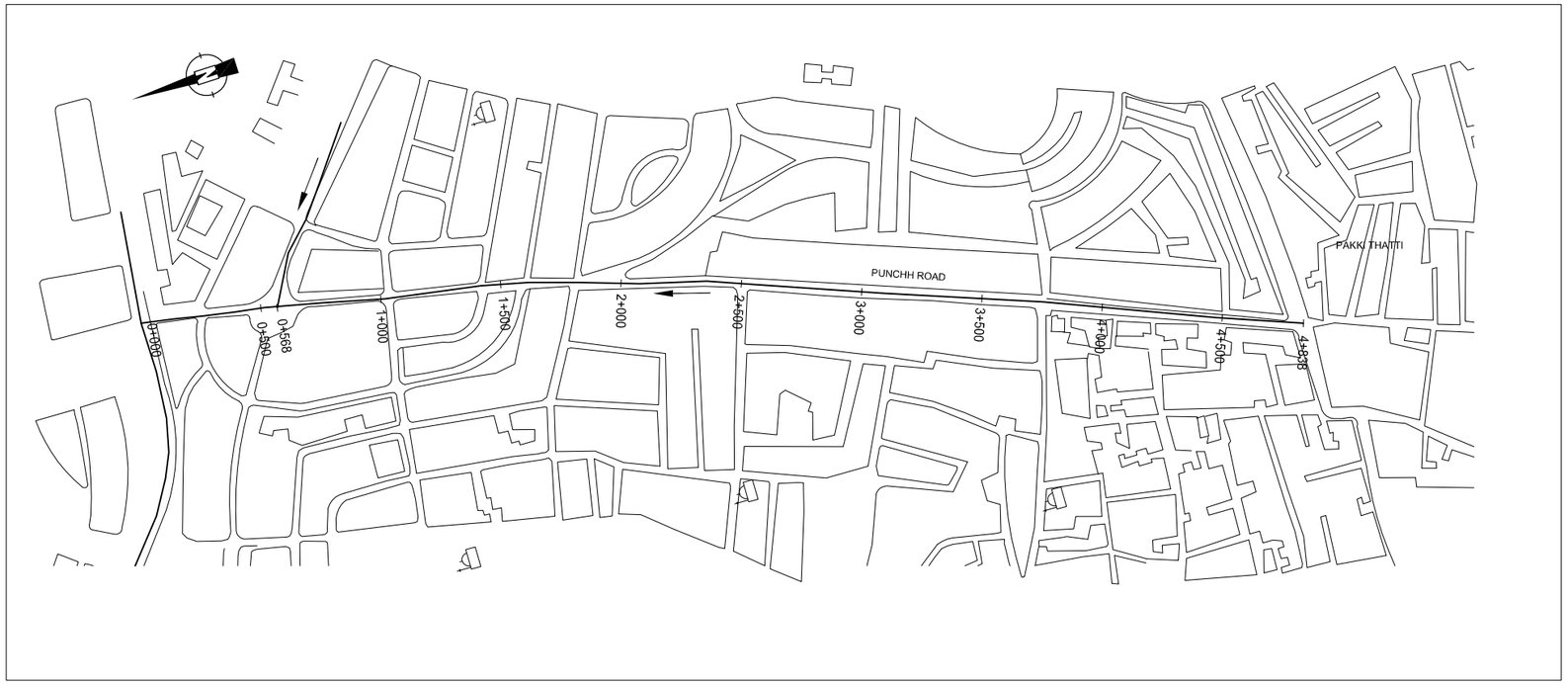
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

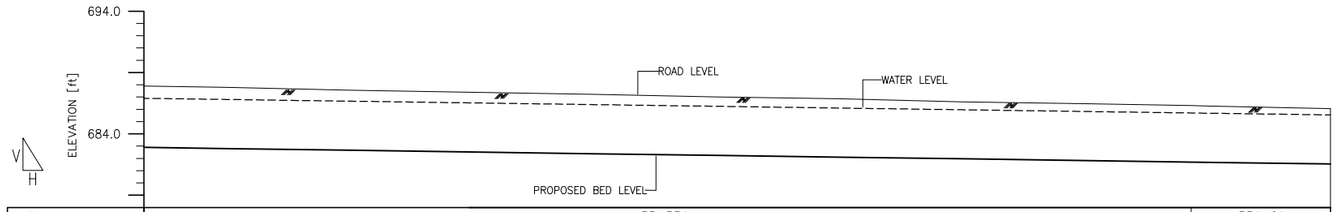
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
NICHOLSON ROAD DRAIN	DWG No.	DP-14



PLAN (4+838 - 0+000)

H: SCALE A V: SCALE B



LINE	PR~PR1									PR1~9A	
SIZE (BxH ft)	5.0 x 4.0									5.0 x 4.0	
SLOPE (ft/ft)	0.000280										
ROAD LEVEL (FT.)	687.89	687.80	687.55	687.39	687.21	687.01	686.85	686.61	686.46	686.30	686.27	686.06
WATER LEVEL (FT.)	686.89	686.80	686.66	686.52	686.38	686.24	686.10	685.96	685.82	685.70	685.68	685.54
PROPOSED BED LEVEL (FT.)	682.89	682.80	682.66	682.52	682.38	682.24	682.10	681.96	681.82	681.70	681.68	681.54
CHAINAGE (FT.)	4+838	4+500	4+000	3+500	3+000	2+500	2+000	1+500	1+000	0+568	0+500	0+000

PLOFILE (4+838 - 0+000)

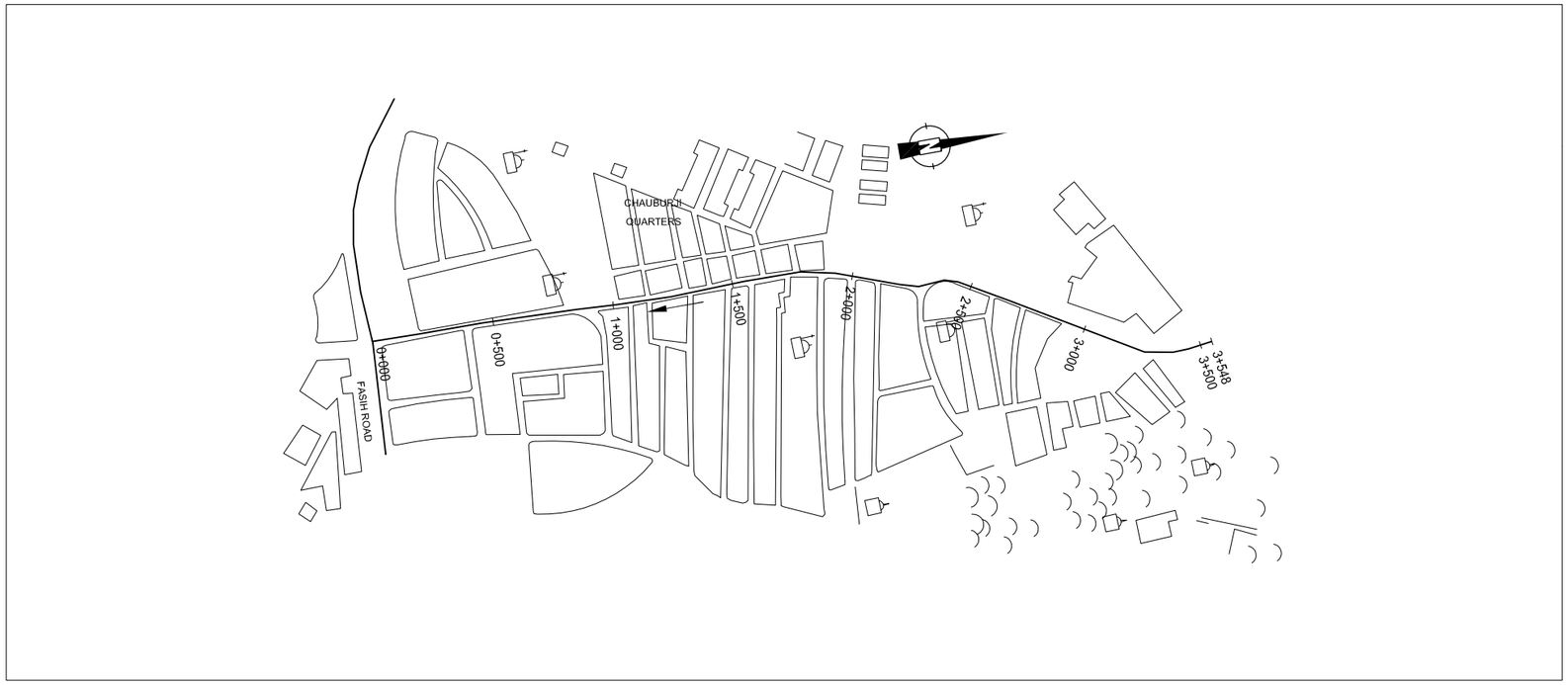
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

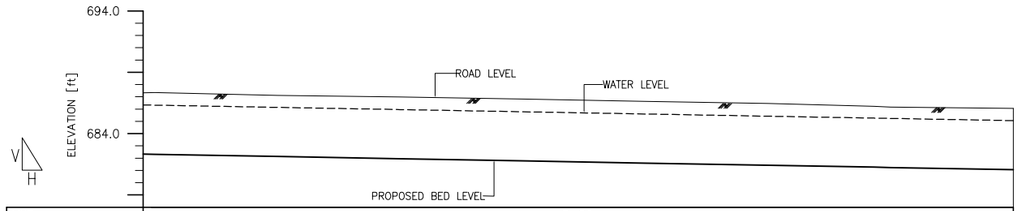
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
POONCH ROAD DRAIN	DWG No.	DP-15



PLAN (3+548 - 0+000)

H: SCALE A V: SCALE B



LINE	C~9A							
SIZE (BxH ft)	3.5 x 4.0							
SLOPE (ft/ft)	0.000360							
ROAD LEVEL (FT.)	687.33	687.11	686.98	686.82	686.62	686.45	686.22	686.06
WATER LEVEL (FT.)	686.33	686.14	685.96	685.78	685.60	685.42	685.26	685.06
PROPOSED BED LEVEL (FT.)	682.33	682.14	681.96	681.78	681.60	681.42	681.26	681.06
CHAINAGE (FT.)	3+548	3+000	2+500	2+000	1+500	1+000	0+568	0+000
	3+500						0+500	

SCALE A 0 200 400 600 800 1000 ft.

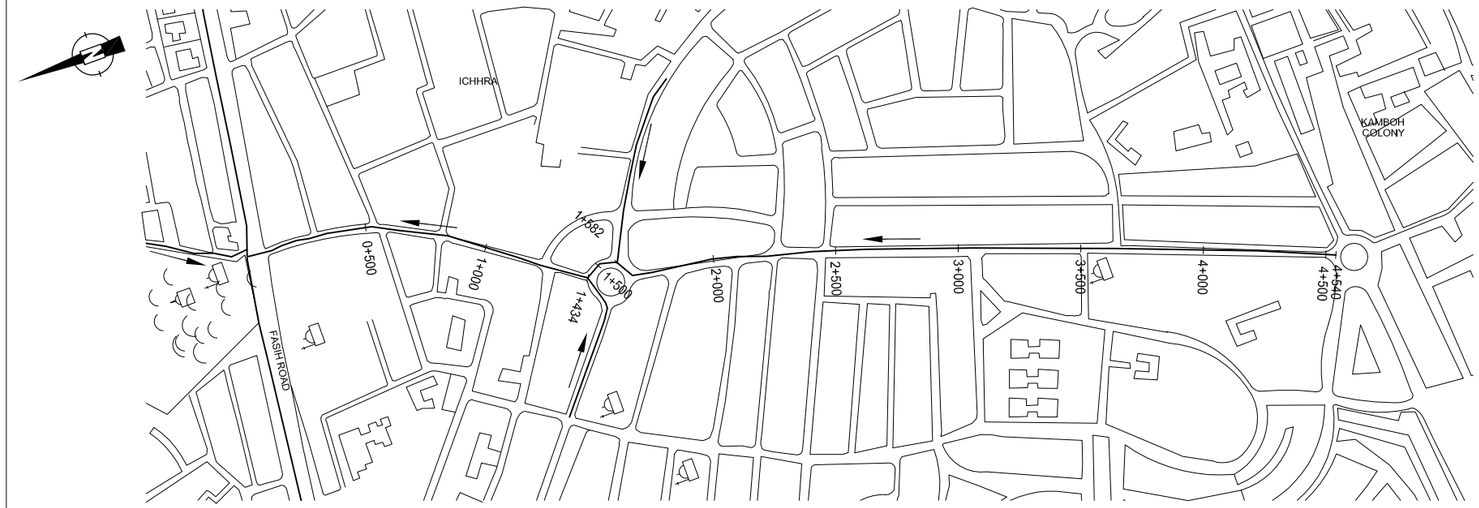
SCALE B 0 4 8 12 16 20 ft.

PLOFILE (3+548 - 0+000)

H: SCALE A V: SCALE B

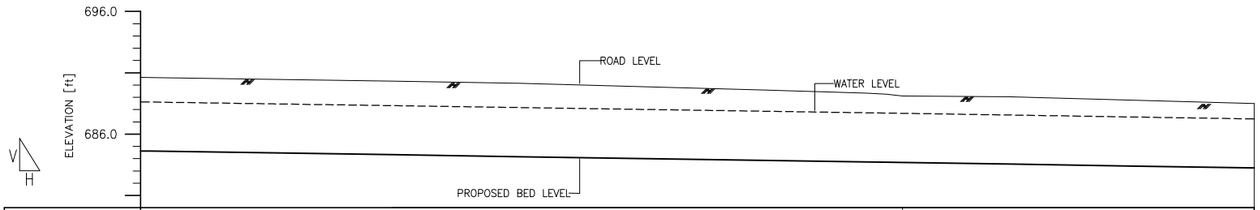
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
CHAUBURJI DRAIN	DWG No.	DP-16



PLAN (4+540 - 0+000)

H: SCALE A V: SCALE B



LINE	IC~IC1							IC1~8A		
SIZE (BxH ft)	4.0 x 4.0							4.5 x 4.0		
SLOPE (ft/ft)	0.000300							0.000320		
ROAD LEVEL (FT.)	690.62	690.61	690.46	690.30	690.15	689.87	689.60	689.34	689.26	689.11	689.05	688.77	688.50
WATER LEVEL (FT.)	688.62	688.61	688.46	688.31	688.16	688.01	687.86	687.74	687.71	687.69	687.55	687.39	687.23
PROPOSED BED LEVEL (FT.)	684.62	684.61	684.46	684.31	684.16	684.01	683.86	683.74	683.71	683.69	683.55	683.39	683.23
CHAINAGE (FT.)	4+540	4+500	4+000	3+500	3+000	2+500	2+000	1+582	1+500	1+434	1+000	0+500	0+000

PLOFILE (4+540 - 0+000)

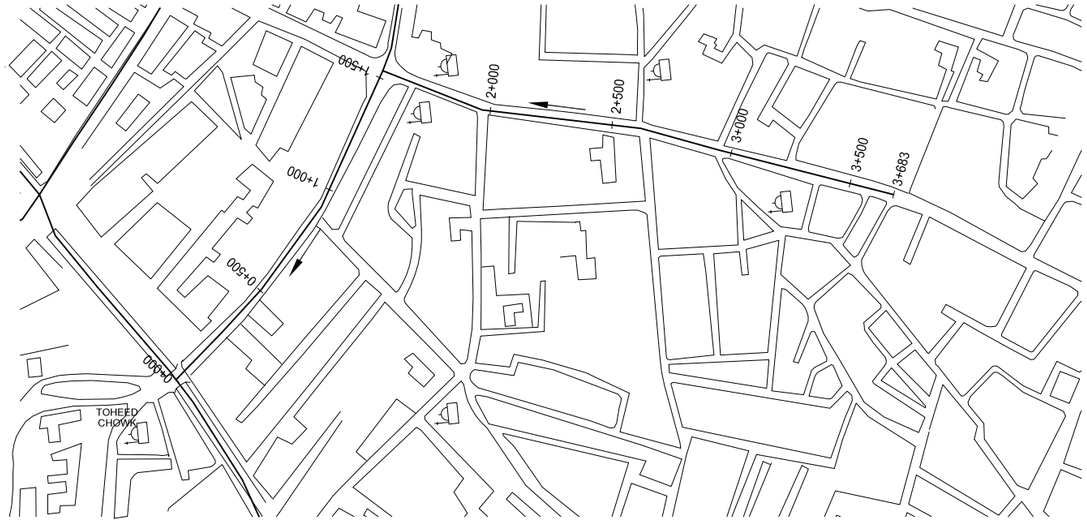
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

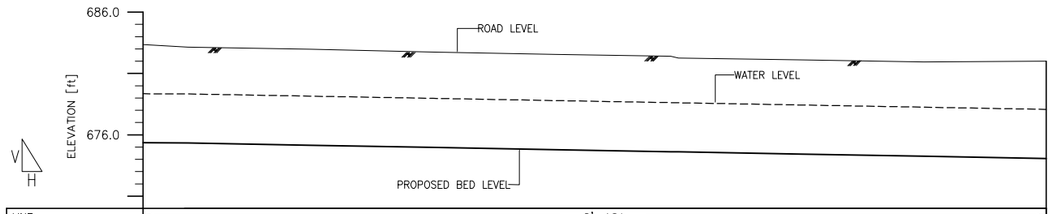
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
NEW SAMANABAD DRAIN	DWG No.	DP-17



PLAN (3+683 - 0+000)

H: SCALE A V: SCALE B



LINE	C'~10A								
SIZE (BxH ft)	3.5 x 4.0								
SLOPE (ft/ft)	0.000360								
ROAD LEVEL (FT.)	683.35	683.15	682.98	682.74	682.56	682.41	682.25	682.12	681.95	682.00
WATER LEVEL (FT.)	679.35	679.33	679.15	678.97	678.79	678.62	678.61	678.43	678.25	678.07
PROPOSED BED LEVEL (FT.)	675.35	675.33	675.15	674.97	674.79	674.62	674.61	674.43	674.25	674.07
CHAINAGE (FT.)	3+683	3+500	3+000	2+500	2+000	1+531	1+500	1+000	0+500	0+000

SCALE A 0 200 400 600 800 1000 ft.

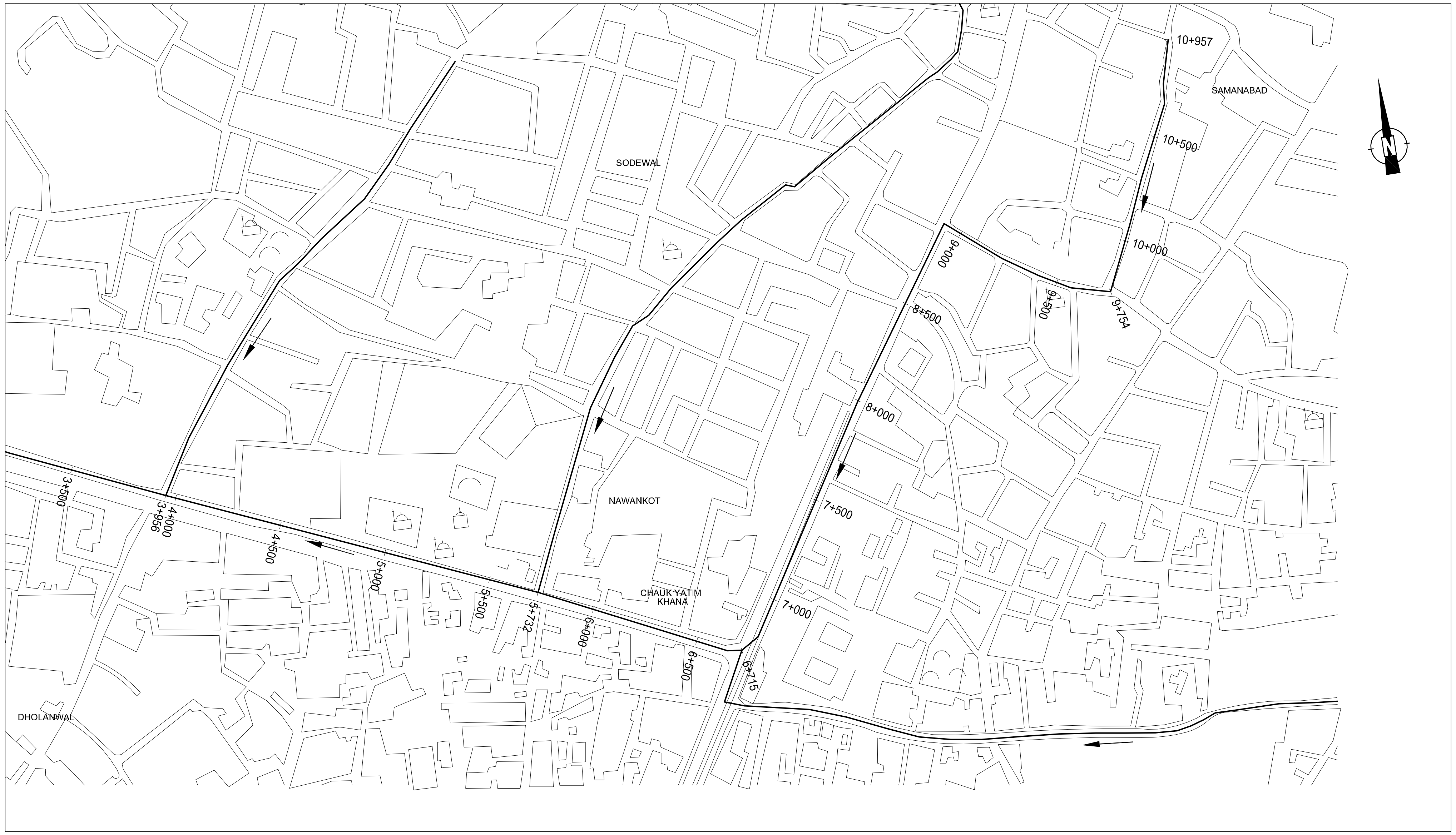
SCALE B 0 4 8 12 16 20 ft.

PLOFILE (3+683 - 0+000)

H: SCALE A V: SCALE B

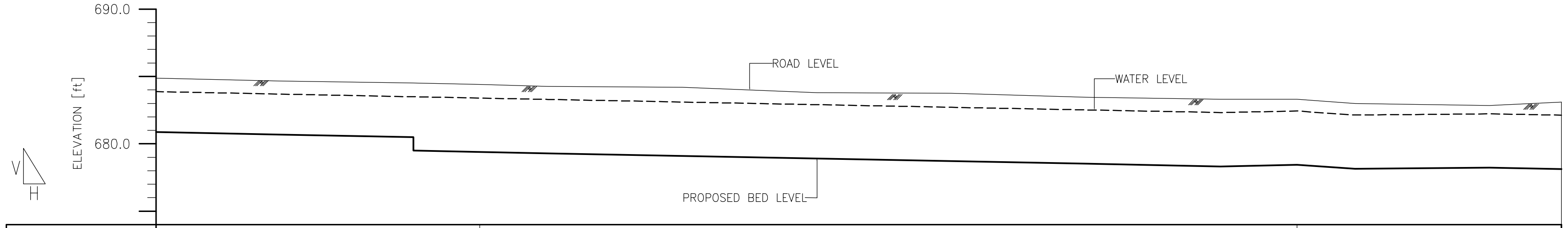
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
MORRHE SAMANABAD DRAIN	DWG No.	DP-18



PLAN (10+957 - 5+732)

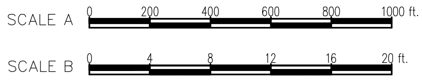
H: SCALE A V: SCALE B



LINE	MT1~MT2				MT2~MT3							MT3~BR1		
SIZE (BxH ft)	3.5 x 3.0				4.0 x 4.0							4.5 x 4.0		
SLOPE (ft/ft)	0.000400				0.000390							0.000370		
ROAD LEVEL (FT.)	684.87	684.67	684.52	684.41	684.26	684.20	683.80	683.75	683.45	683.31	683.31	683.00	682.84	683.09
WATER LEVEL (FT.)	683.87	683.69	683.49	683.39	683.29	683.10	682.90	682.71	682.51	682.32	682.43	682.13	682.22	682.12
PROPOSED BED LEVEL (FT.)	680.87	680.69	679.49 680.49	679.39	679.29	679.10	678.90	678.71	678.51	678.32	678.43	678.13	678.22	678.12
CHAINAGE (FT.)	10+957	10+500	10+000	9+754	9+500	9+000	8+500	8+000	7+500	7+000	6+715	6+500	6+000	5+732

PLOFILE (10+957 - 5+732)

H: SCALE A V: SCALE B

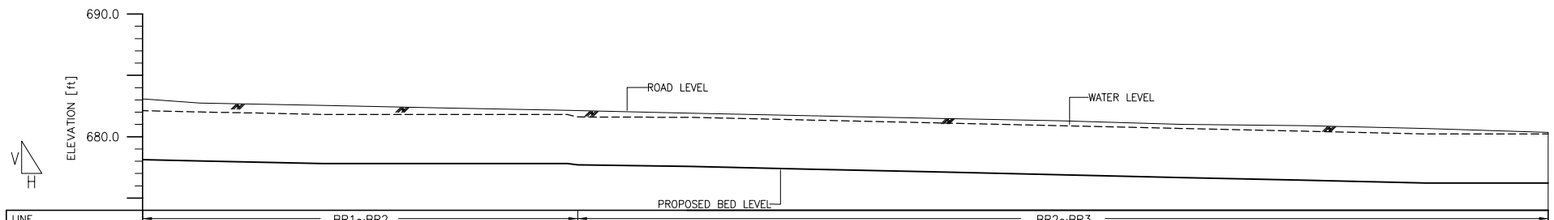


THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
MULTAN ROAD DRAIN & OLD BUND ROAD (1/2)	DWG No.	DP-19

PLAN (5+732 - 0+000)

H: SCALE A V: SCALE B



LINE	BR1~BR2					BR2~BR3							
SIZE (BxH ft)	4.5 x 4.0					5.0 x 4.0							
SLOPE (ft/ft)	0.000400					0.000450							
ROAD LEVEL (FT.)	683.09	682.74	682.54	682.34	682.13	681.92	681.70	681.49	681.31	681.01	680.90	680.67	680.35
WATER LEVEL (FT.)	682.12	682.02	681.82	681.82	681.61	681.57	681.35	681.12	680.90	680.67	680.45	680.22	680.22
PROPOSED BED LEVEL (FT.)	678.12	678.02	677.82	677.82	677.71	677.57	677.35	677.12	676.90	676.67	676.45	676.22	676.22
CHAINAGE (FT.)	5+732	5+500	5+000	4+500	4+000	3+958	3+500	3+000	2+500	2+000	1+500	1+000	0+500	0+000

PLOFILE (5+732 - 0+000)

H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

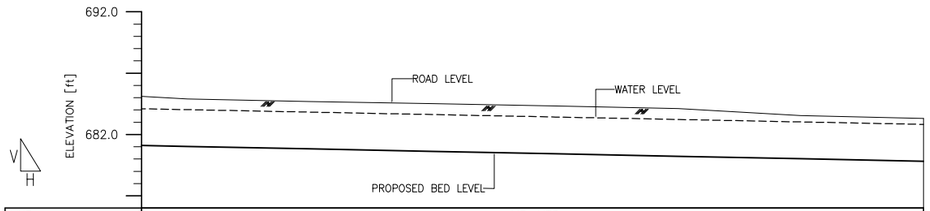
SCALE B 0 4 8 12 16 20 ft.

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
MULTAN ROAD DRAIN & OLD BUND ROAD (2/2)	DWG No.	DP-20

PLAN (3+188 - 0+000)

H: SCALE A V: SCALE B



LINE	MR~MT3						
SIZE (BxH ft)	3.5 x 3.0						
SLOPE (ft/ft)	0.000400						
ROAD LEVEL (FT.)	685.10	684.89	684.69	684.51	684.32	684.12	683.54	683.31
WATER LEVEL (FT.)	684.10	684.02	683.82	683.62	683.42	683.22	683.02	682.82
PROPOSED BED LEVEL (FT.)	681.10	681.02	680.82	680.62	680.42	680.22	680.02	679.82
CHAINAGE (FT.)	3+188	3+000	2+500	2+000	1+500	1+000	0+500	0+000

PLOFILE (3+188 - 0+000)

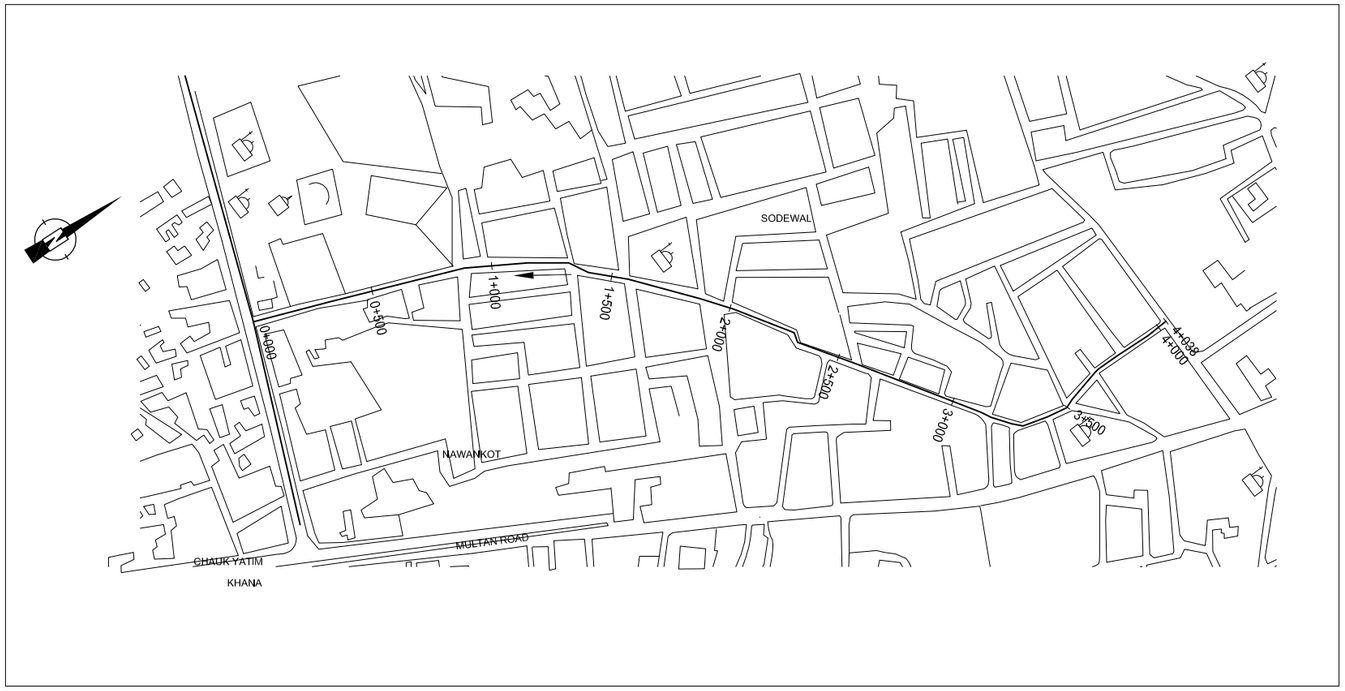
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

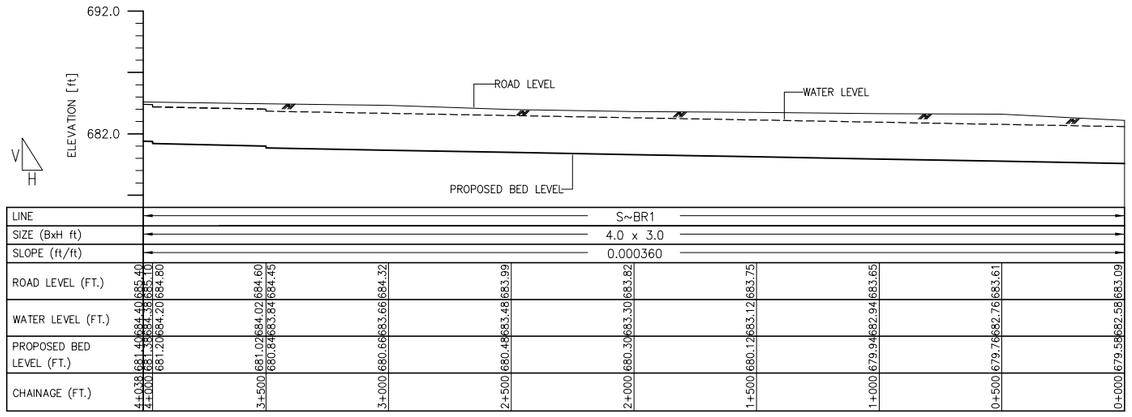
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
ALMUMATAZ ROAD DRAIN	DWG No.	DP-21



PLAN (4+038 - 0+000)

H: SCALE A V: SCALE B



LINE	S~BR1								
SIZE (BxH ft)	4.0 x 3.0								
SLOPE (ft/ft)	0.000360								
ROAD LEVEL (FT.)	684.40	684.40	684.60	684.32	683.99	683.82	683.75	683.65	683.61	683.09
WATER LEVEL (FT.)	684.40	684.40	684.02	683.66	683.48	683.30	683.12	682.94	682.76	682.58
PROPOSED BED LEVEL (FT.)	681.40	681.40	680.84	683.84	680.48	680.30	680.12	679.94	679.76	679.59
CHAINAGE (FT.)	4+038	4+000	3+500	3+000	2+500	2+000	1+500	1+000	0+500	0+000

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

PLOFILE (4+038 - 0+000)

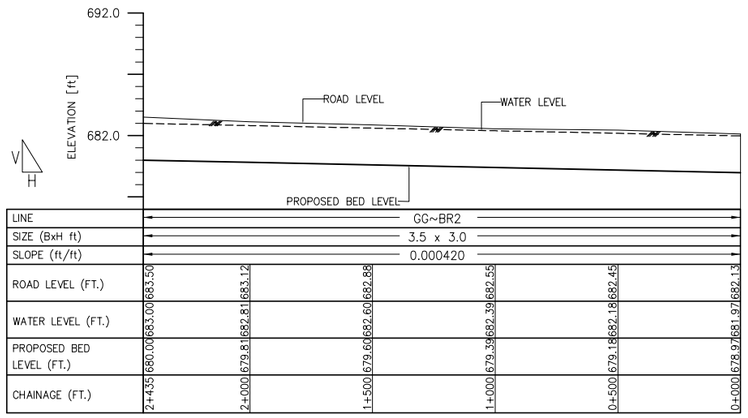
H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
SODEWAL DRAIN	DWG No.	DP-22

PLAN (2+435 - 0+000)

H: SCALE A V: SCALE B



LINE	GG~BR2					
SIZE (BxH ft)	3.5 x 3.0					
SLOPE (ft/ft)	0.000420					
ROAD LEVEL (FT.)	683.50	683.12	682.88	682.55	682.45	682.13
WATER LEVEL (FT.)	683.00	682.81	682.60	682.39	682.18	681.97
PROPOSED BED LEVEL (FT.)	680.00	679.81	679.60	679.39	679.18	678.97
CHAINAGE (FT.)	2+435	2+000	1+500	1+000	0+500	0+000

SCALE A 0 200 400 600 800 1000 ft.

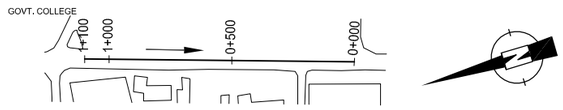
SCALE B 0 4 8 12 16 20 ft.

PLOFILE (2+435 - 0+000)

H: SCALE A V: SCALE B

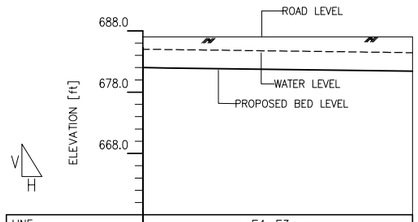
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
GULGASHT DRAIN	DWG No.	DP-23



PLAN (1+100 - 0+000)

H: SCALE A V: SCALE B



LINE	E4~E3			
SIZE (BxH ft)	3.0 x 3.0			
SLOPE (ft/ft)	0.000510			
ROAD LEVEL (FT.)	687.00	687.00	687.00	687.00
WATER LEVEL (FT.)	685.00	684.95	684.69	684.44
PROPOSED BED LEVEL (FT.)	682.00	681.95	681.69	681.44
CHAINAGE (FT.)	1100	1000	500	0

PLOFILE (1+100 - 0+000)

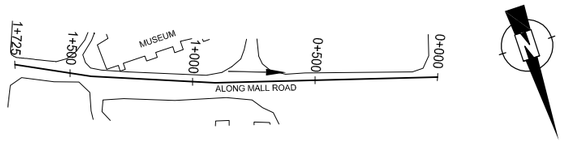
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 8 16 24 32 40 ft.

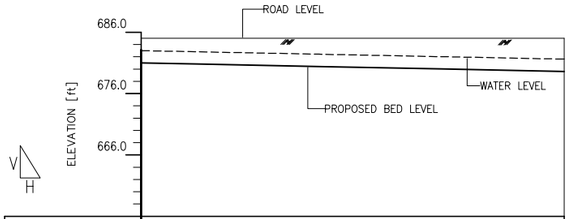
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
NASIR BAGH DRAIN	DWG No.	DP-24



PLAN (1+725 - 0+000)

H: SCALE A V: SCALE B



LINE	E5~E3				
SIZE (BxH ft)	3.0 x 2.0				
SLOPE (ft/ft)	0.000800				
ROAD LEVEL (FT.)	685.00	685.00	685.00	685.00	685.00
WATER LEVEL (FT.)	683.00	682.82	682.42	682.02	681.62
PROPOSED BED LEVEL (FT.)	681.00	680.82	680.42	680.02	679.62
CHAINAGE (FT.)	1725	1500	1000	500	0

PLOFILE (1+725 - 0+000)

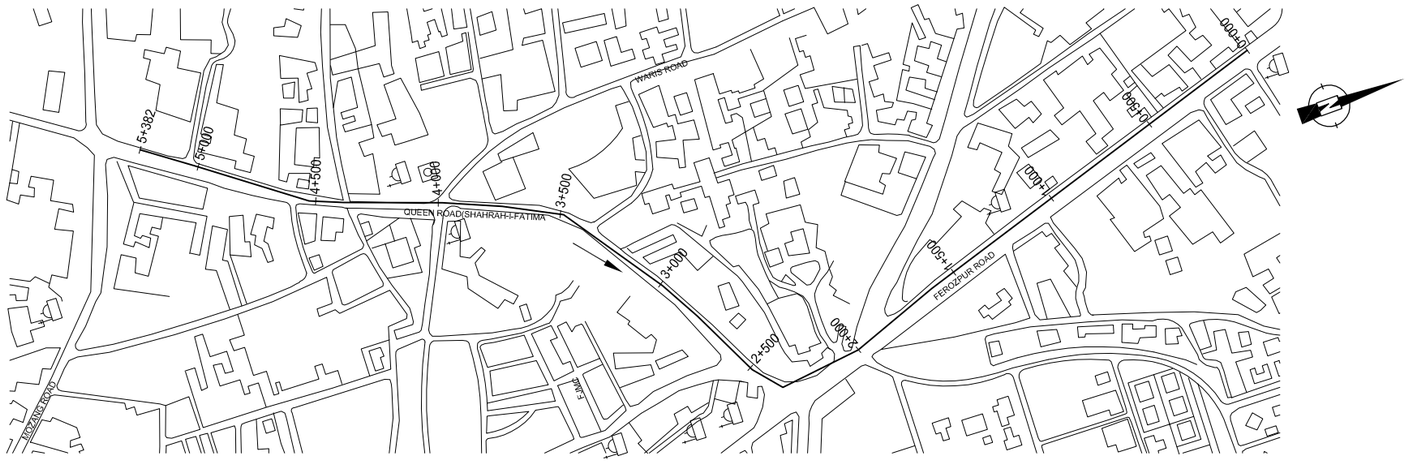
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 8 16 24 32 40 ft.

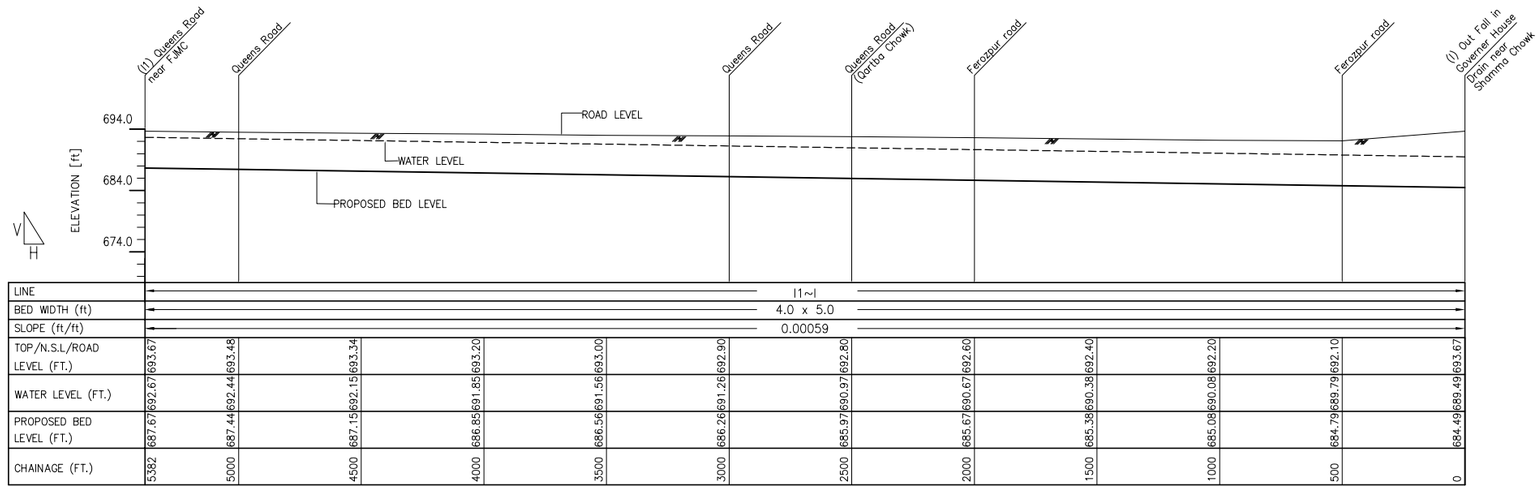
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
MALL ROAD DRAIN	DWG No.	DP-25



PLAN (5+382 - 0+000)

H: SCALE A V: SCALE B



LINE	I1~I												
BED WIDTH (ft)	4.0 x 5.0												
SLOPE (ft/ft)	0.00059												
TOP/N.S.L/ROAD LEVEL (FT.)	693.67	693.48	693.34	693.20	693.00	692.90	692.80	692.60	692.40	692.20	692.10	693.67	
WATER LEVEL (FT.)	692.67	692.44	692.15	691.85	691.56	691.26	690.97	690.67	690.38	690.08	689.79	689.49	
PROPOSED BED LEVEL (FT.)	687.67	687.44	687.15	686.85	686.56	686.26	685.97	685.67	685.38	685.08	684.79	684.49	
CHAINAGE (FT.)	5382	5000	4500	4000	3500	3000	2500	2000	1500	1000	500	0	

SCALE A 0 200 400 600 800 1000 ft.

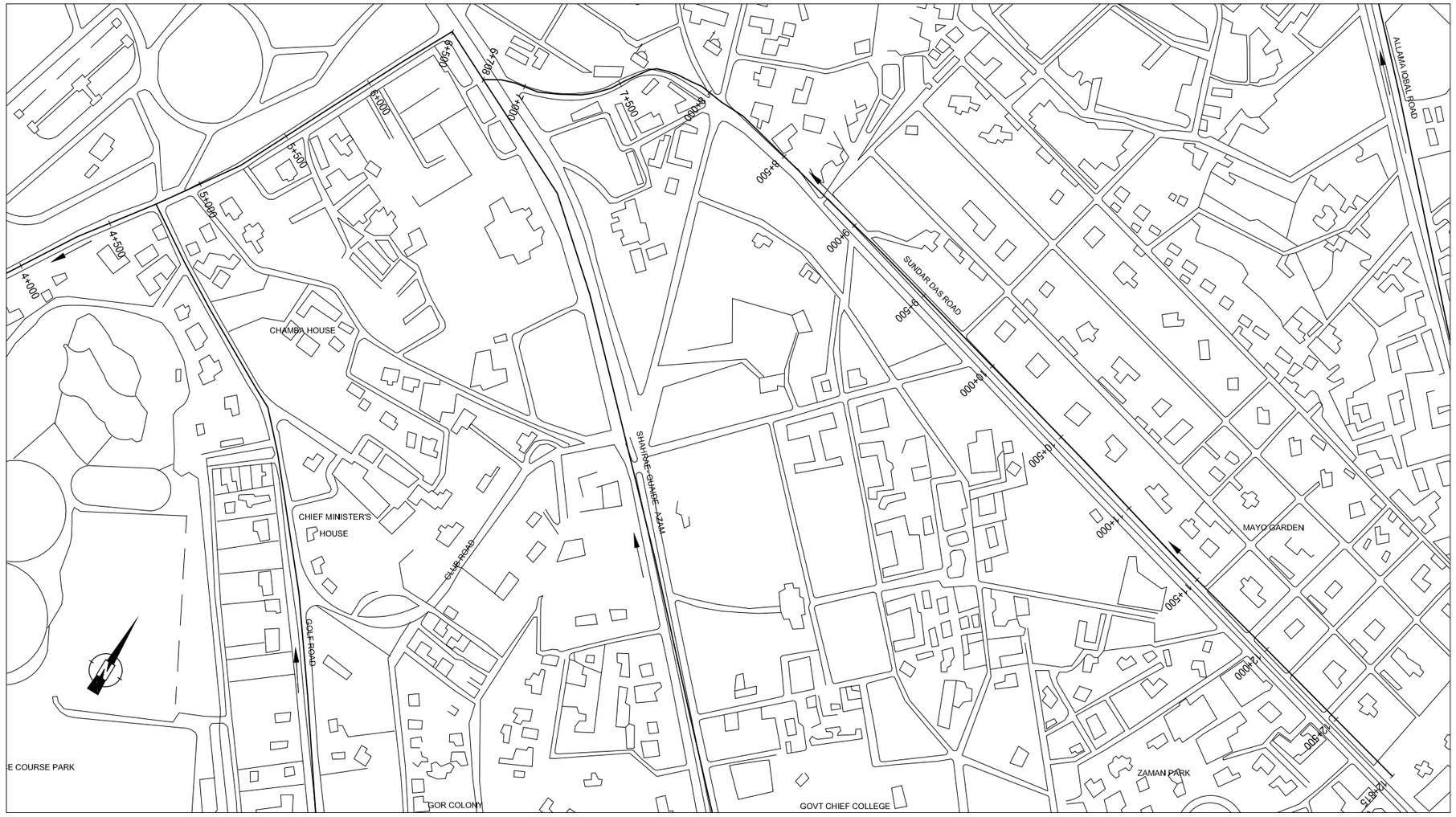
SCALE B 0 8 16 24 32 40 ft.

PLOFILE (5+382 - 0+000)

H: SCALE A V: SCALE B

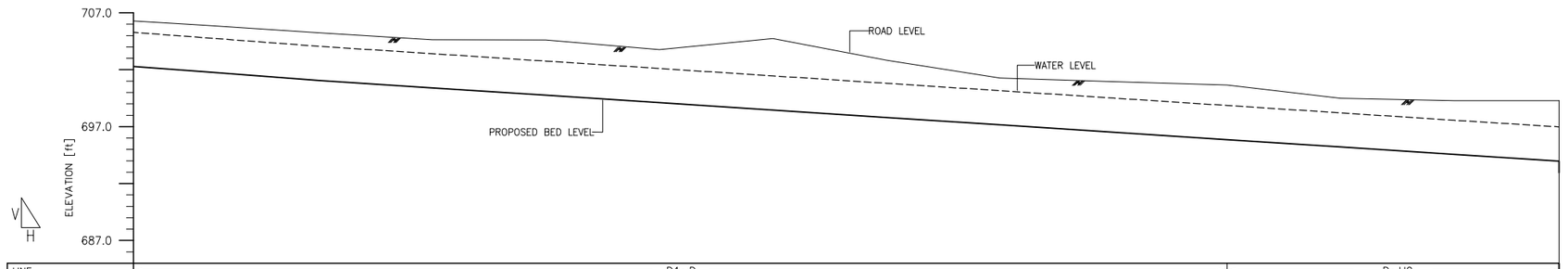
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
QUEENS ROAD DRAIN	DWG No.	DP-26



PLAN (12+815 - 6+708)

H: SCALE A V: SCALE B



LINE	D1~D																					D~H2		
SIZE (BxH ft)	4.0 x 3.0																					4.0 x 3.0		
SLOPE (ft/ft)	0.001500																					0.001300		
ROAD LEVEL (FT.)	706.28	705.90	705.25	704.63	704.62	704.06	703.77	704.75	702.83	701.27	700.96	700.65	699.50	699.00	698.28									
WATER LEVEL (FT.)	705.28	704.81	704.06	703.41	702.76	702.11	701.46	700.81	700.16	699.51	698.86	698.21	697.56	697.18										
PROPOSED BED LEVEL (FT.)	702.28	701.81	701.06	700.41	699.76	699.11	698.46	697.81	697.16	696.51	695.86	695.21	694.56	693.18										
CHAINAGE (FT.)	12+815	12+500	12+000	11+500	11+000	10+500	10+000	9+500	9+000	8+500	8+000	7+500	7+000	6+708										

PLOFILE (12+815 - 6+708)

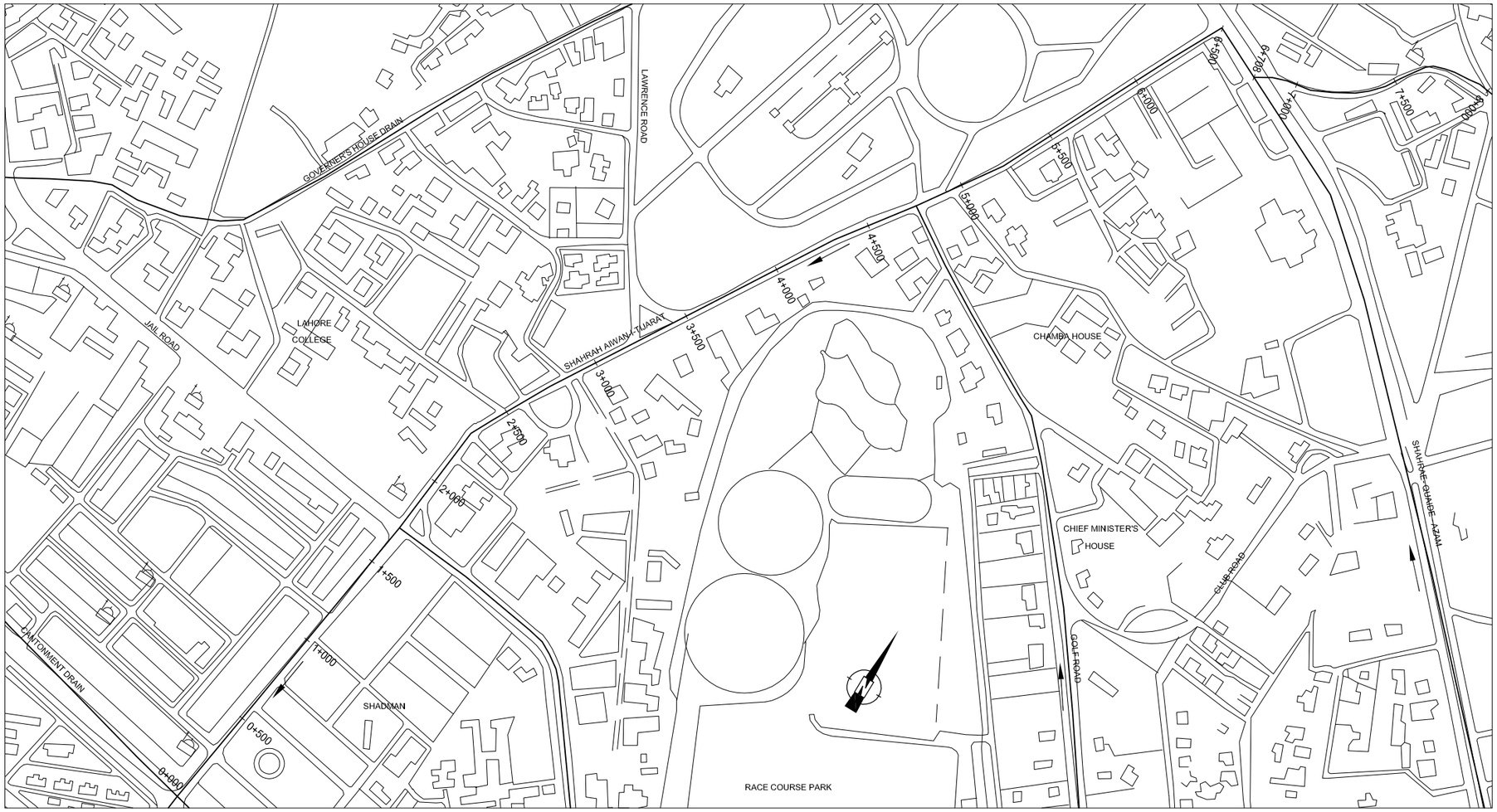
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

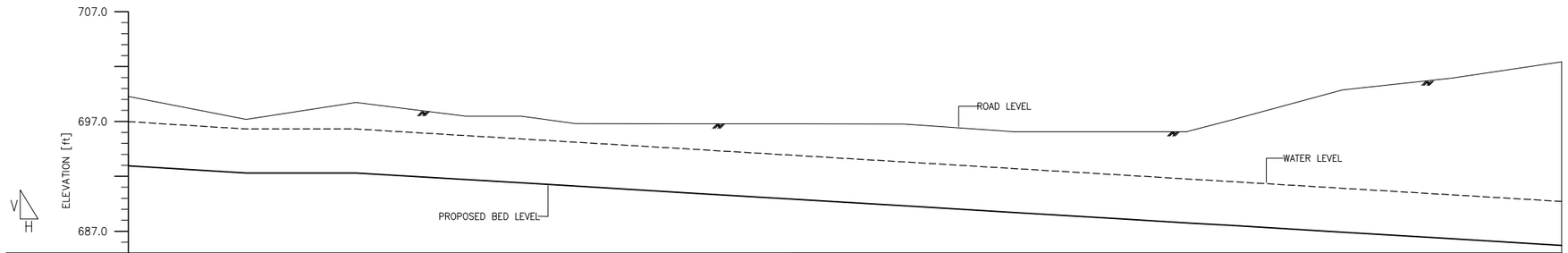
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
SHAHRAH AWANE TIJARAT ROAD DRAIN (1/3)	DWG No.	DP-27



PLAN (6+708 - 0+000)

H: SCALE A V: SCALE B



LINE	H2~H3								H3~H4										H4~7					
SIZE (BxH ft)	8.0 x 4.0								8.0 x 4.0										8.0 x 4.0					
SLOPE (ft/ft)	0.001200								0.001200										0.001200					
ROAD LEVEL (FT.)	699.28	698.56	697.19	696.30	698.73	695.70	697.48	694.80	696.81	694.50	696.78	693.90	696.78	693.30	696.76	692.70	696.07	692.10	696.07	691.50	697.17	691.16	699.87	690.30
WATER LEVEL (FT.)	697.18	696.90	694.18	692.30	695.70	691.10	694.80	690.50	694.50	690.90	693.90	689.30	693.30	689.30	692.70	688.70	692.10	688.10	691.50	687.50	691.16	686.90	690.30	686.30
PROPOSED BED LEVEL (FT.)	693.18	692.90	692.30	691.70	691.10	690.50	690.80	689.90	690.50	689.90	689.30	688.70	689.30	688.70	688.10	687.50	688.10	687.50	687.50	686.90	690.90	686.30	685.70	685.10
CHAINAGE (FT.)	6+708	6+500	6+000	5+500	5+000	4+746	4+500	4+000	3+500	3+000	2+500	2+000	1+711	1+500	1+000	0+500	0+000							

PLOFILE (6+708 - 0+000)

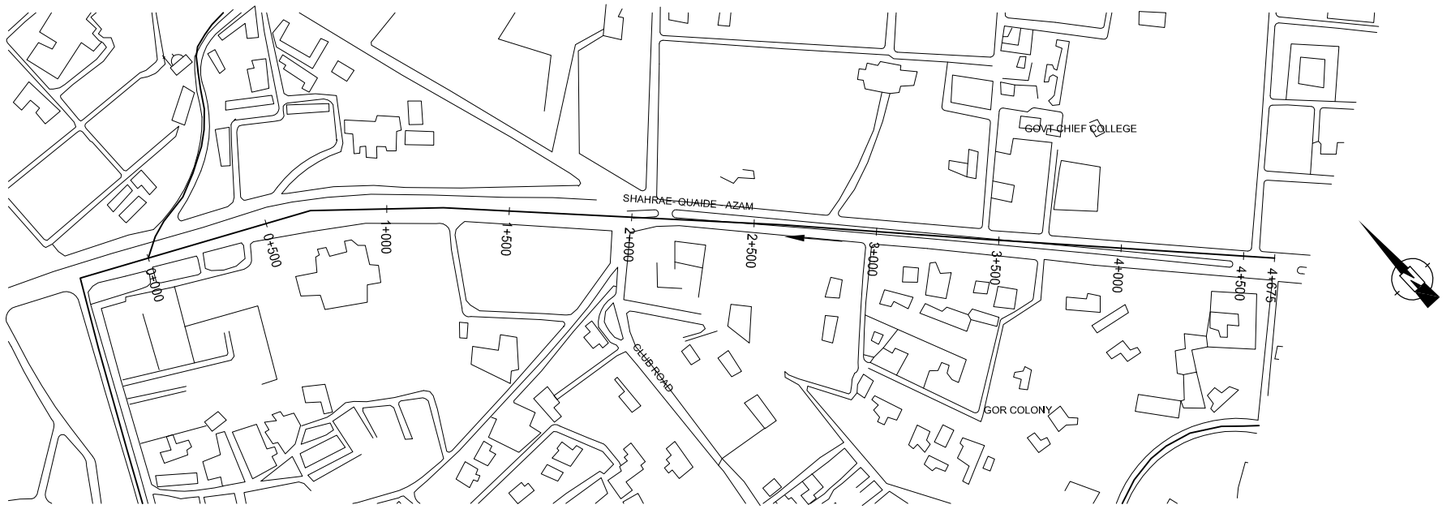
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

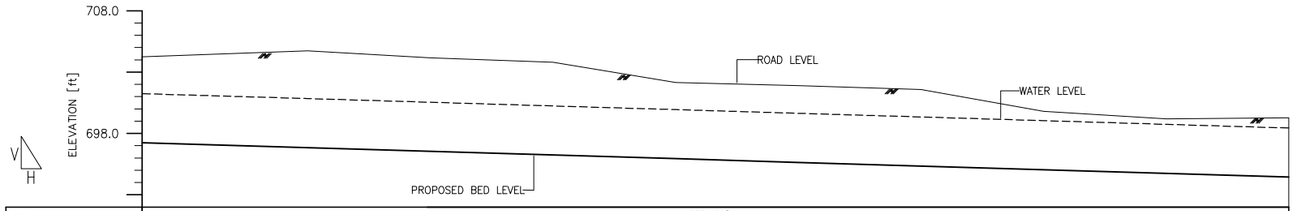
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
SHAHRAH AWANE TIJARAT ROAD DRAIN (2/3)	DWG No.	DP-28



PLAN (4+675 - 0+000)

H: SCALE A V: SCALE B



LINE	H1~H2								
SIZE (BxH ft)	4.0 x 4.0								
SLOPE (ft/ft)	0.000600								
ROAD LEVEL (FT.)	704.24	704.73	704.84	704.16	704.54	703.80	704.24	702.16	702.90	701.57	701.34	699.81	699.04	699.18	698.74	699.28	698.44
WATER LEVEL (FT.)	701.24	700.84	700.54	700.24	699.94	699.64	699.34	699.04	698.74	698.44
PROPOSED BED LEVEL (FT.)	697.24	696.84	696.54	696.24	695.94	695.64	695.34	695.04	694.74	694.44
CHAINAGE (FT.)	4+675	4+000	3+500	3+000	2+500	2+000	1+500	1+000	0+500	0+000

PLOFILE (4+675 - 0+000)

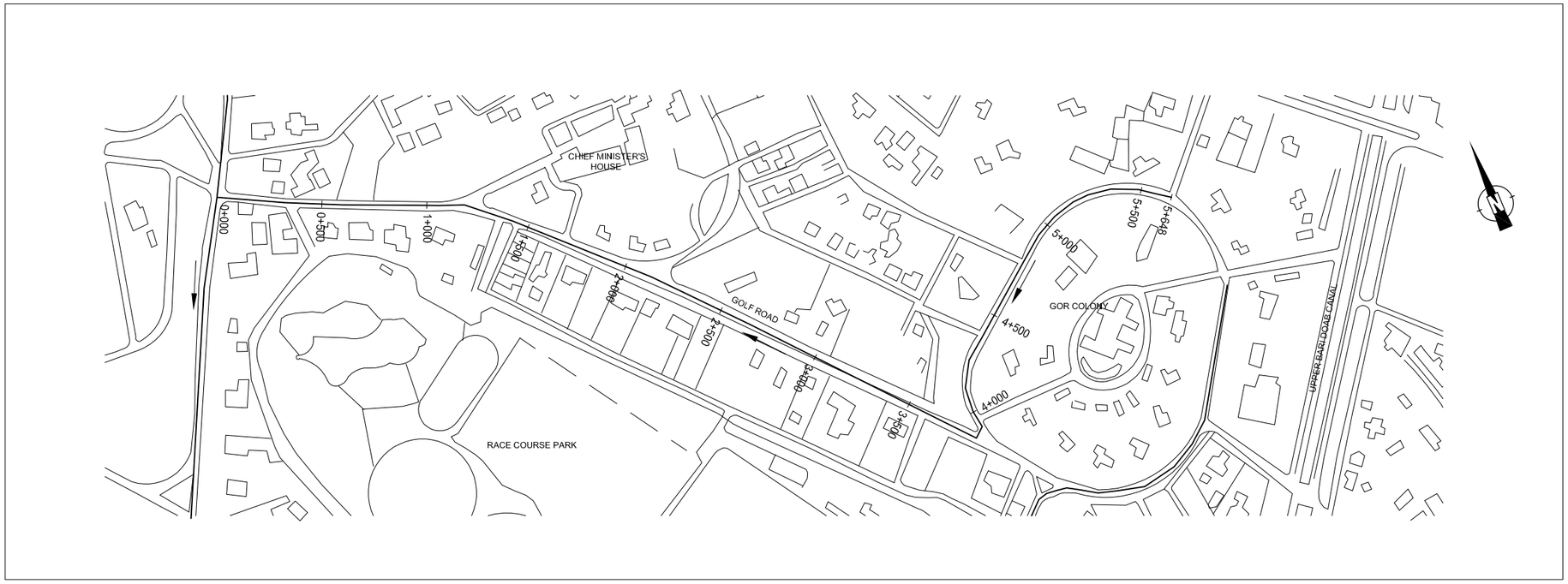
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

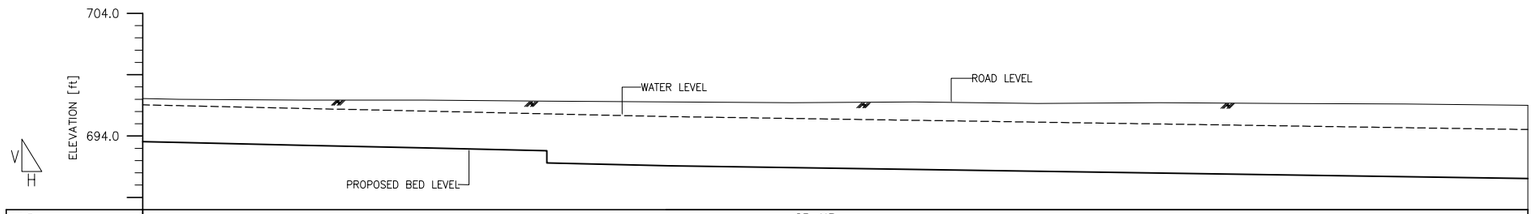
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
SHAHRAH AWANE TIJARAT ROAD DRAIN (3/3)	DWG No.	DP-29



PLAN (5+648 - 0+000)

H: SCALE A V: SCALE B



LINE	GR~H3																			
SIZE (BxH ft)	3.0 x 3.0								4.0 x 4.0											
SLOPE (ft/ft)	0.000450								0.000300											
ROAD LEVEL (FT.)	697.05	696.99	696.92	696.93	696.84	696.78	696.71	696.78	696.65	696.72	696.65	696.61	696.50							
WATER LEVEL (FT.)	696.55	696.48	696.25	696.03	695.80	695.58	695.43	695.28	695.13	694.98	694.83	694.68	694.53							
PROPOSED BED LEVEL (FT.)	693.55	693.48	693.25	693.03	692.80	691.80	691.58	691.43	691.28	691.13	690.98	690.83	690.68	690.53						
CHAINAGE (FT.)	5+648	5+500	5+000	4+500	4+000	3+500	3+000	2+500	2+000	1+500	1+000	0+500	0+000							

SCALE A 0 200 400 600 800 1000 ft.

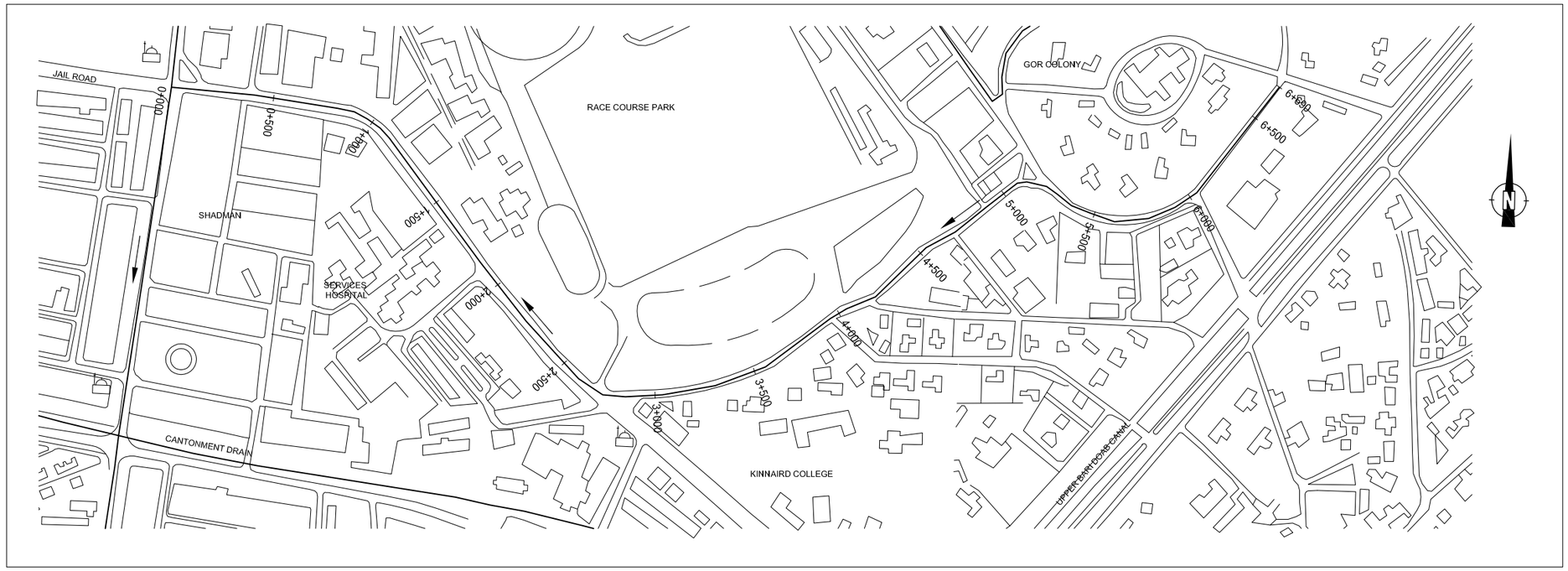
SCALE B 0 4 8 12 16 20 ft.

PLOFILE (5+648 - 0+000)

H: SCALE A V: SCALE B

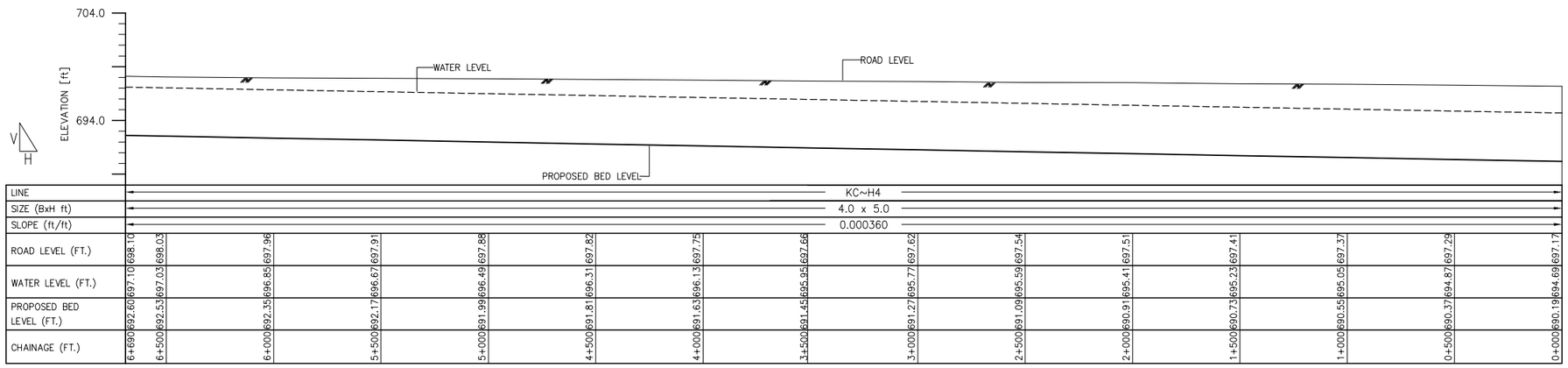
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
GOLF ROAD DRAIN	DWG No.	DP-30



PLAN (6+690 - 0+000)

H: SCALE A V: SCALE B



LINE	KC~H4																				
SIZE (BxH ft)	4.0 x 5.0																				
SLOPE (ft/ft)	0.000360																				
ROAD LEVEL (FT.)	698.10	698.03	697.96	697.91	697.88	697.82	697.75	697.66	697.62	697.54	697.51	697.41	697.37	697.29	697.17						
WATER LEVEL (FT.)	697.10	697.03	696.85	696.67	696.49	696.31	696.13	695.95	695.77	695.59	695.41	695.23	695.05	694.87	694.69						
PROPOSED BED LEVEL (FT.)	692.60	692.53	692.35	692.17	691.99	691.81	691.63	691.45	691.27	691.09	690.91	690.73	690.55	690.37	690.19						
CHAINAGE (FT.)	6+690	6+500	6+000	5+500	5+000	4+500	4+000	3+500	3+000	2+500	2+000	1+500	1+000	0+500	0+000						

PLOFILE (6+690 - 0+000)

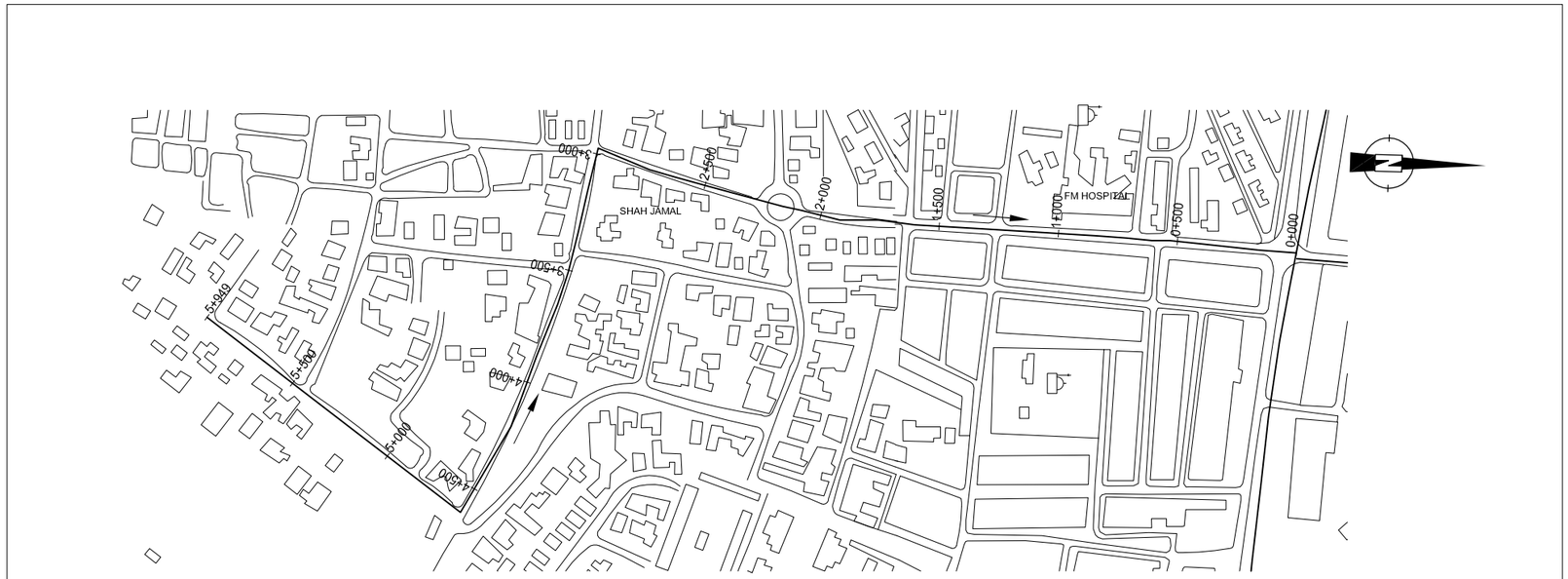
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

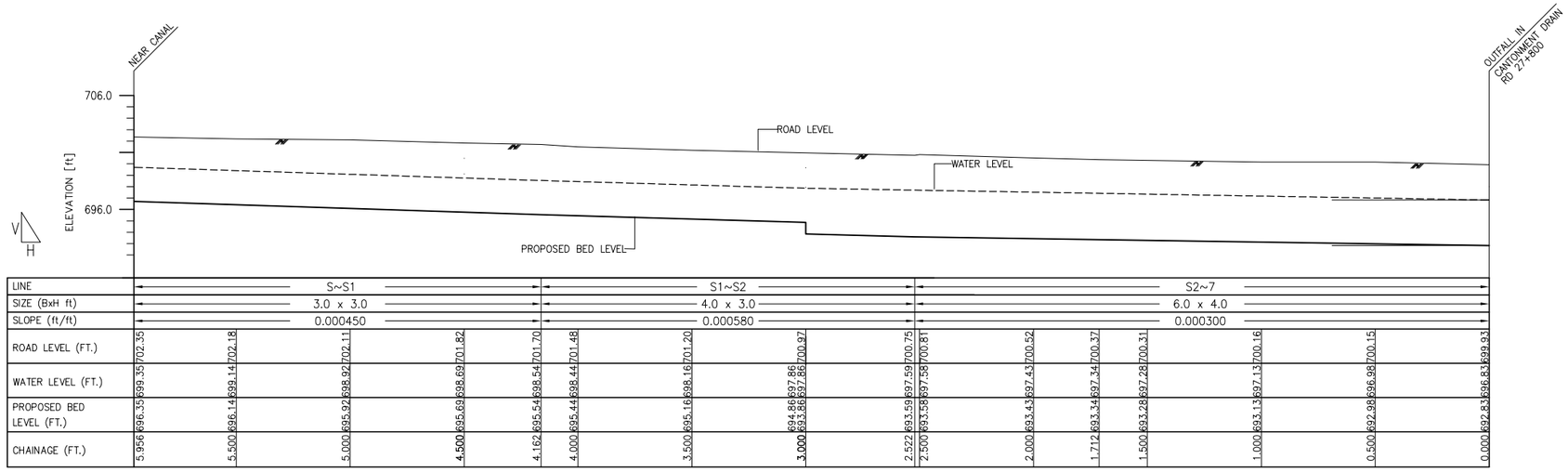
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
KINNAIRD DRAIN	DWG No.	DP-31



PLAN (5+956 - 0+000)

H: SCALE A V: SCALE B



LINE	S~S1					S1~S2					S2~7				
SIZE (BxH ft)	3.0 x 3.0					4.0 x 3.0					6.0 x 4.0				
SLOPE (ft/ft)	0.000450					0.000580					0.000300				
ROAD LEVEL (FT.)	702.35	702.18	702.11	701.82	701.70	701.48	701.20	697.86	700.75	700.81	700.52	700.37	700.31	700.16	700.15	699.93
WATER LEVEL (FT.)	699.35	699.14	698.92	698.69	698.54	698.44	698.16	697.86	697.59	697.58	697.43	697.34	697.28	697.13	696.98	696.83
PROPOSED BED LEVEL (FT.)	696.35	696.14	695.92	695.69	695.54	695.44	695.16	694.86	693.59	693.58	693.43	693.34	693.28	693.13	692.98	692.83
CHAINAGE (FT.)	5.956	5.500	5.000	4.500	4.162	4.000	3.500	3.000	2.522	2.500	2.000	1.712	1.500	1.000	0.500	0.000

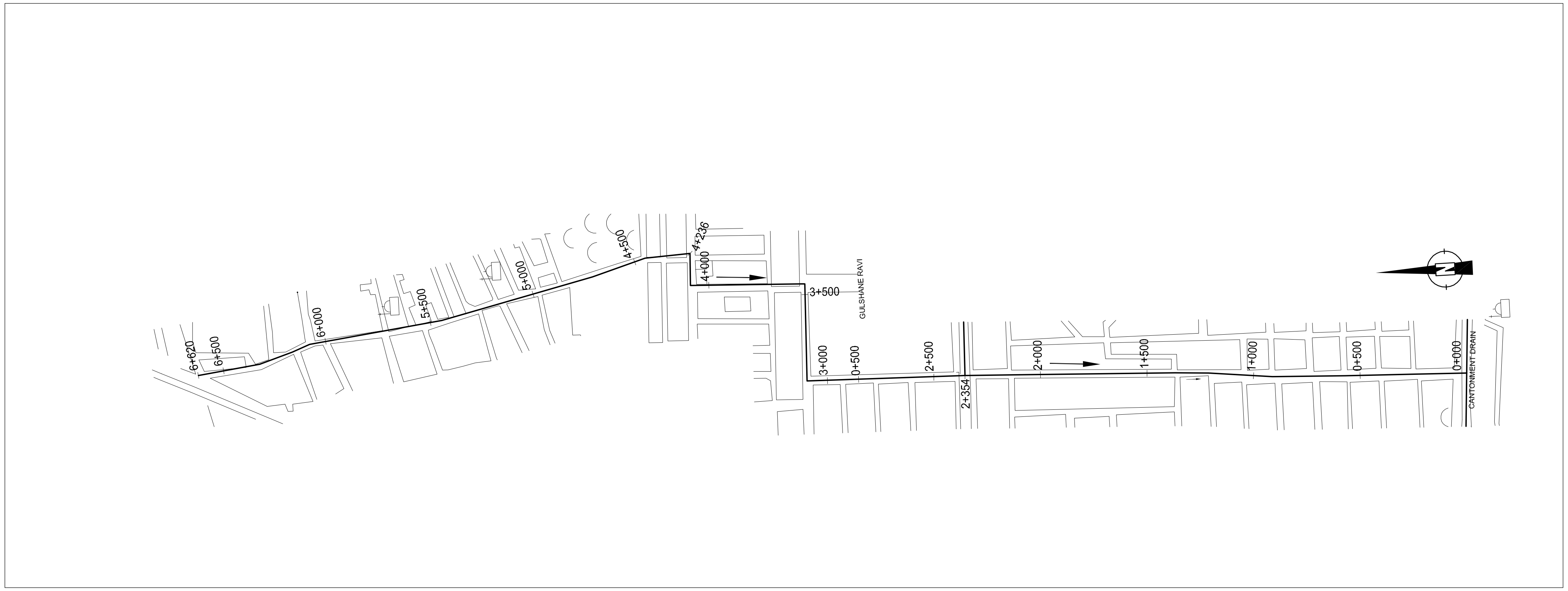
SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

PLOFILE (5+956 - 0+000)

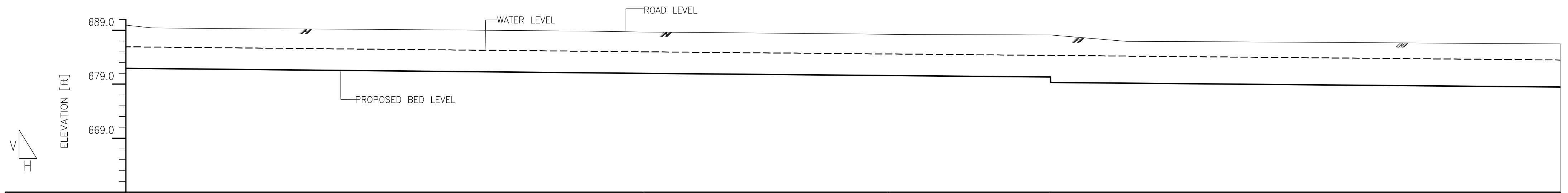
H: SCALE A V: SCALE B

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
PLAN & PROFILE	SCALE	SEE SCALE BAR
SHAH JAMAL DRAIN	DWG No.	DP-32

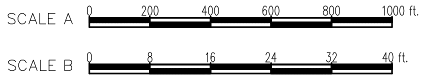


PLAN (6+620 - 0+000)

H: SCALE A V: SCALE B



LINE	B2~B2A							B2A~B1			B1~B		B~11				
SIZE (BxH ft)	3.5 x 4.0							4.5 x 4.0					10.0 x 5.0				
SLOPE (ft/ft)	0.000350							0.000400					0.000360				
ROAD LEVEL (FT.)	689.92	689.42	689.25	689.17	689.00	688.85	688.65	688.57	688.41	688.35	688.22	688.15	688.10	687.85	687.72	687.64	687.37	687.25
WATER LEVEL (FT.)	685.92	685.87	685.70	685.52	685.35	685.17	685.08	684.99	684.79	684.63	684.59	684.39	684.33 684.33	684.20	684.02	683.84	683.66	683.48
PROPOSED BED LEVEL (FT.)	681.92	681.87	681.70	681.52	681.35	681.17	681.08	680.99	680.79	680.63	680.59	680.39	680.33 679.33	679.20	679.02	678.84	678.66	678.48
CHAINAGE (FT.)	6620	6500	6000	5500	5000	4500	4236	4000	3500	3100	3000	2500	2354	2000	1500	1000	500	0

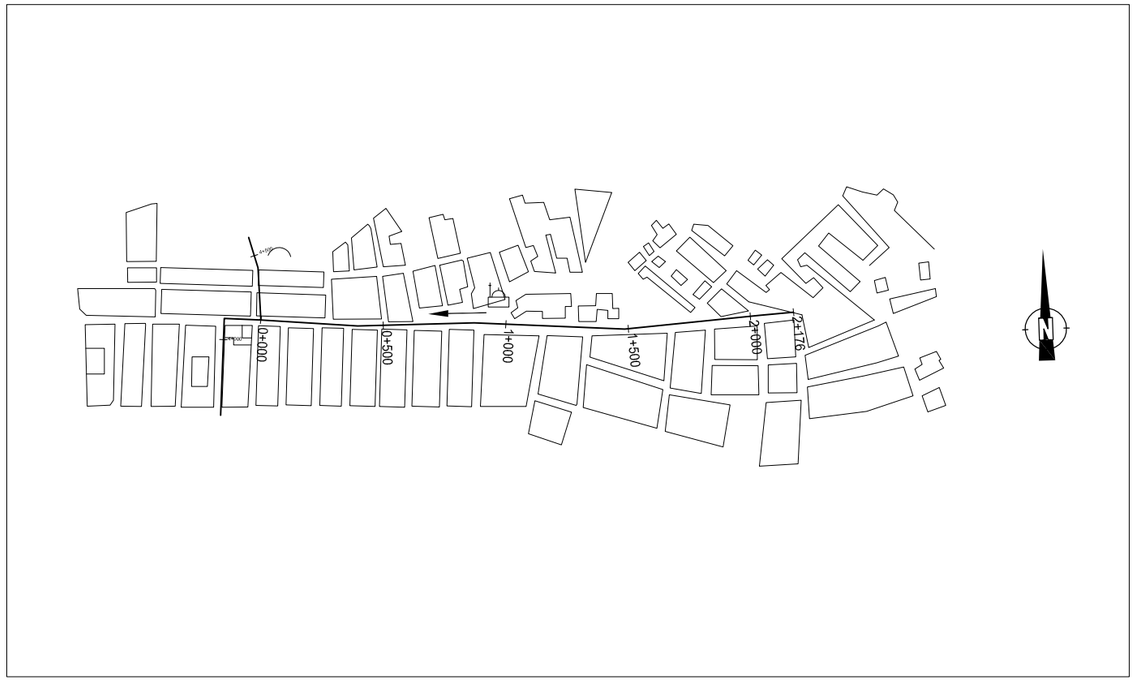


PLOFILE (6+620 - 0+000)

H: SCALE A V: SCALE B

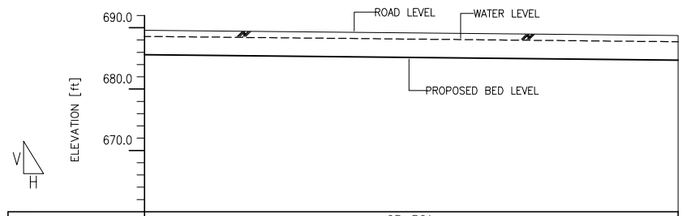
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
GULSHAN-E-RAVI DRAIN (1/3)	DWG No.	DP-33



PLAN (2+176 - 0+000)

H: SCALE A V: SCALE B



LINE	GR~B2A					
SIZE (BxH ft)	3.5 x 3.0					
SLOPE (ft/ft)	0.00040					
ROAD LEVEL (FT.)	689.58	689.51	689.31	689.11	688.91	688.71
WATER LEVEL (FT.)	688.58	688.51	688.31	688.11	687.91	684.71
PROPOSED BED LEVEL (FT.)	685.58	685.51	685.31	685.11	684.91	684.71
CHAINAGE (FT.)	2176	2000	1500	1000	500	0

PLOFILE (2+176 - 0+000)

H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

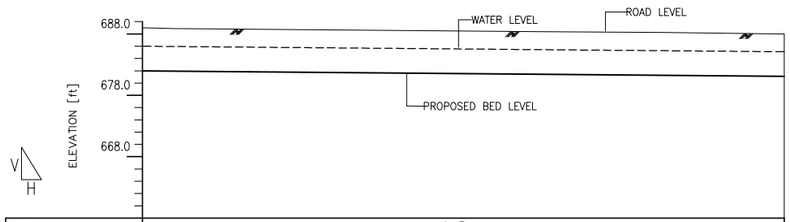
SCALE B 0 8 16 24 32 40 ft.

THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
GULSHAN-E-RAVI DRAIN (2/3)	DWG No.	DP-34

PLAN (2+617 - 0+000)

H: SCALE A V: SCALE B



LINE	A~B						
SIZE (BxH ft)	8.0 x 5.0						
SLOPE (ft/ft)	0.00034						
ROAD LEVEL (FT.)	688.99	688.88	688.70	688.52	688.36	688.25	688.06
WATER LEVEL (FT.)	686.99	686.95	686.78	686.61	686.44	686.27	686.10
PROPOSED BED LEVEL (FT.)	681.99	681.95	681.78	681.61	681.44	681.27	681.10
CHAINAGE (FT.)	2617	2500	2000	1500	1000	500	0

PLOFILE (2+617 - 0+000)

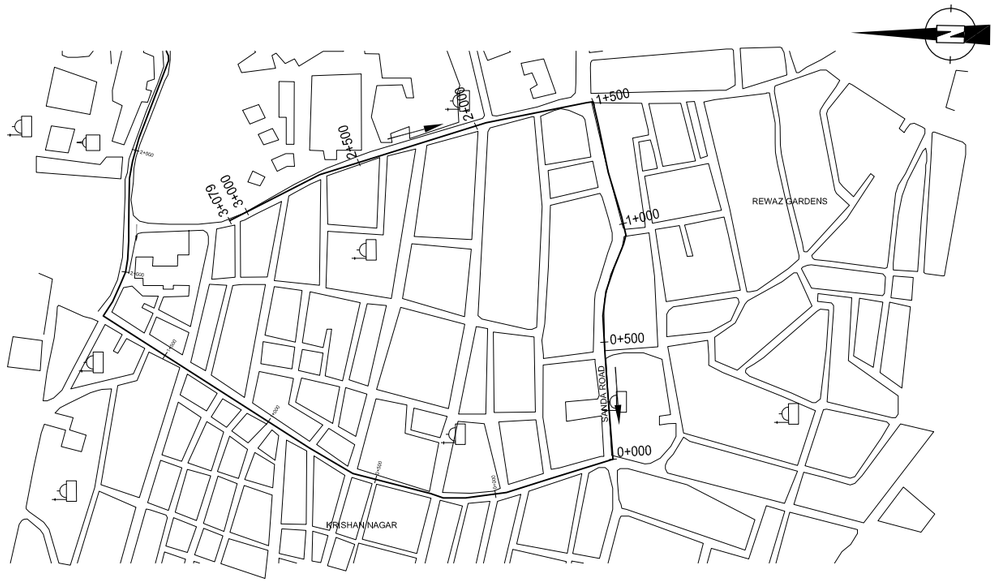
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 8 16 24 32 40 ft.

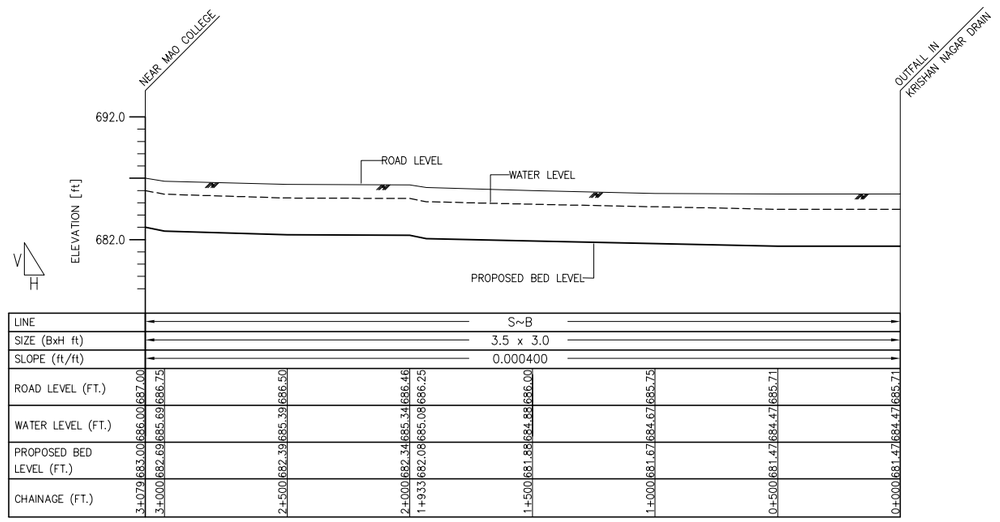
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
GULSHAN-E-RAVI DRAIN (3/3)	DWG No.	DP-35



PLAN (3+079 - 0+000)

H: SCALE A V: SCALE B



LINE	S~B						
SIZE (BxH ft)	3.5 x 3.0						
SLOPE (ft/ft)	0.000400						
ROAD LEVEL (FT.)	687.00	686.75	686.50	686.46	686.25	686.00	685.75	685.71	685.71
WATER LEVEL (FT.)	686.00	685.69	685.39	685.34	685.08	684.88	684.67	684.47	684.47
PROPOSED BED LEVEL (FT.)	683.00	682.69	682.39	682.34	682.08	681.88	681.67	681.47	681.47
CHAINAGE (FT.)	3+079	3+000	2+500	2+000	1+933	1+500	1+000	0+500	0+000

PLOFILE (3+079 - 0+000)

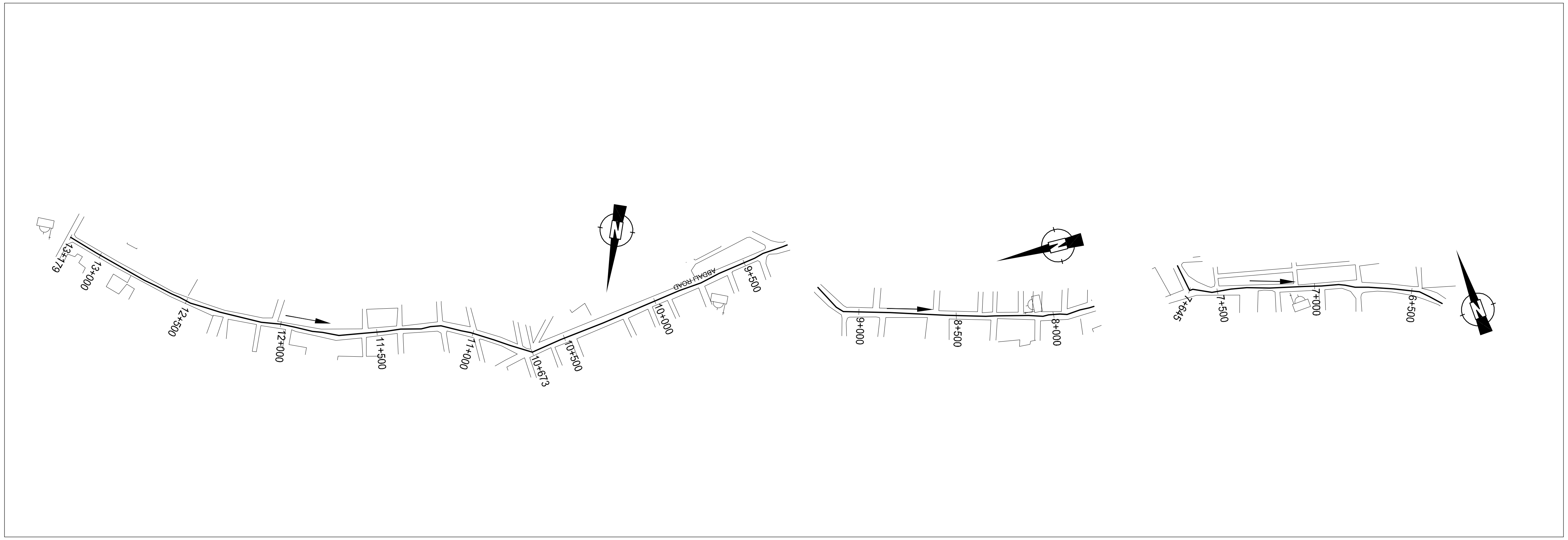
H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

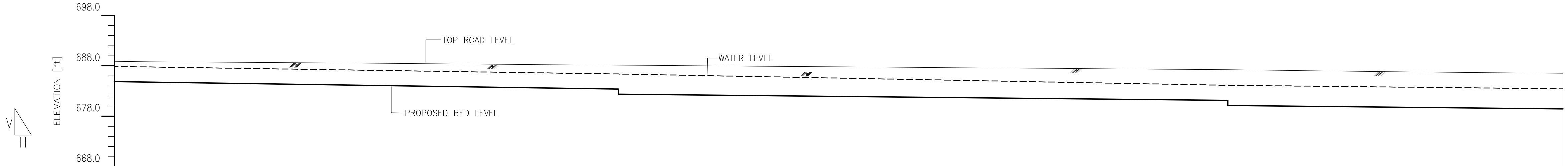
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
SANDA ROAD DRAIN	DWG No.	DP-36



PLAN (13+179 - 6+000)

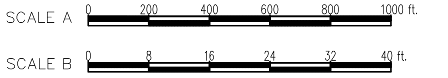
H: SCALE A V: SCALE B



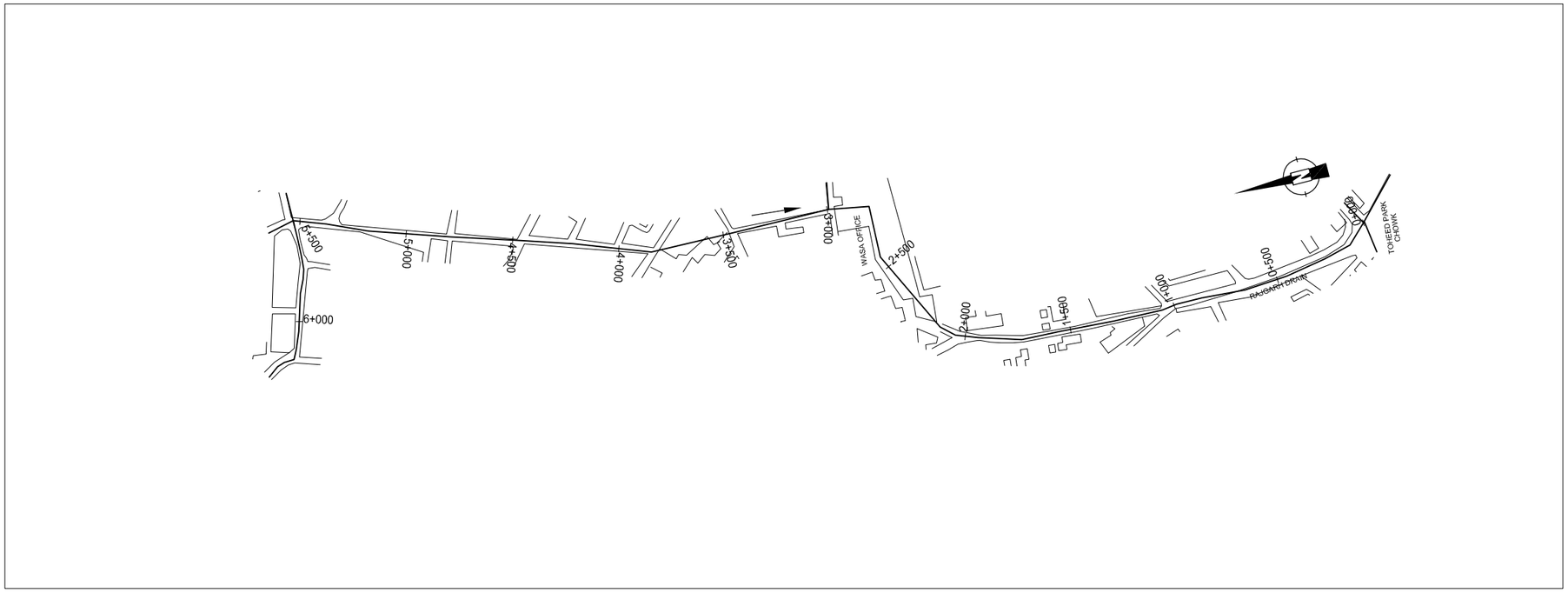
LINE	B3~B2															B2~B				
SIZE (BxH ft)	3.0 x 3.0							4.0 x 4.0								7.0 x 5.0				
SLOPE (ft/ft)	0.00060							0.00040								0.00042				
ROAD LEVEL (FT.)	688.88	688.83	688.67	688.53	688.38	688.23	688.13		688.08	687.93	687.78	687.63	687.48	687.33	687.23		687.17	686.90	686.70	686.52
WATER LEVEL (FT.)	687.88	687.78	687.48	687.18	686.88	686.58	686.38	686.38	686.28	686.08	685.88	685.68	685.48	685.28	685.14	685.14	685.08	684.87	684.66	684.45
PROPOSED BED LEVEL (FT.)	684.88	684.78	684.48	684.18	683.88	683.58	683.38	682.38	682.28	682.08	681.88	681.68	681.48	681.28	681.14	680.14	680.08	679.87	679.66	679.45
CHAINAGE (FT.)	13179	13000	12500	12000	11500	11000	10672		10500	10000	9500	9000	8500	8000	7645		7500	7000	6500	6000

PLOFILE (13+179 - 6+000)

H: SCALE A V: SCALE B

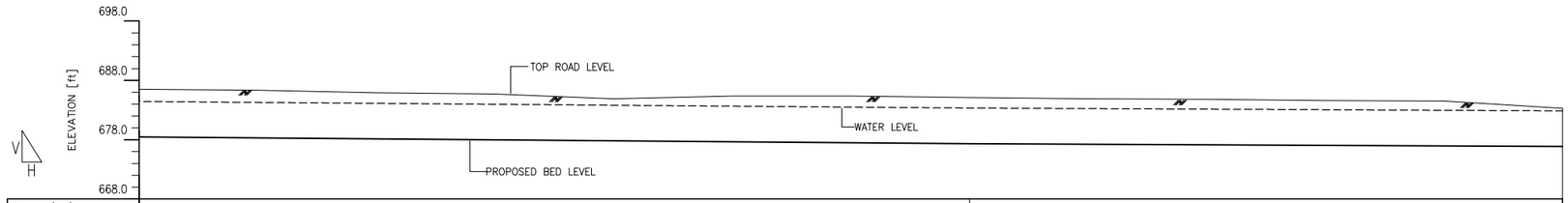


THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
PLAN & PROFILE	SCALE	SEE SCALE BAR
KRISHAN NAGAR DRAIN (1/2)	DWG No.	DP-37



PLAN (6+000 - 0+000)

H: SCALE A V: SCALE B



REACH (cfs)	B~C								C~10					
BED WIDTH (ft)	10.0 x 6.0								12.0 x 6.0					
SLOPE (ft/ft)	0.00030								0.000187					
TOP/N.S.L/ROAD LEVEL (FT.)	686.52	686.32	685.90	685.70	684.91	685.75	685.35	685.11	684.91	684.81	684.61	684.51	683.30	
WATER LEVEL (FT.)	684.45	684.24	684.09	684.94	683.79	683.64	683.49	683.34	683.24	683.15	683.06	682.96	682.87	
PROPOSED BED LEVEL (FT.)	679.45 678.45	678.24	678.09	677.94	677.79	677.64	677.49	677.34	677.24	677.15	677.06	676.96	676.87	
REDUCE DISTANCE (FT.)	6000	5500	5000	4500	4000	3500	3000	2500	2000	1500	1000	500	0	

SCALE A 0 200 400 600 800 1000 ft.

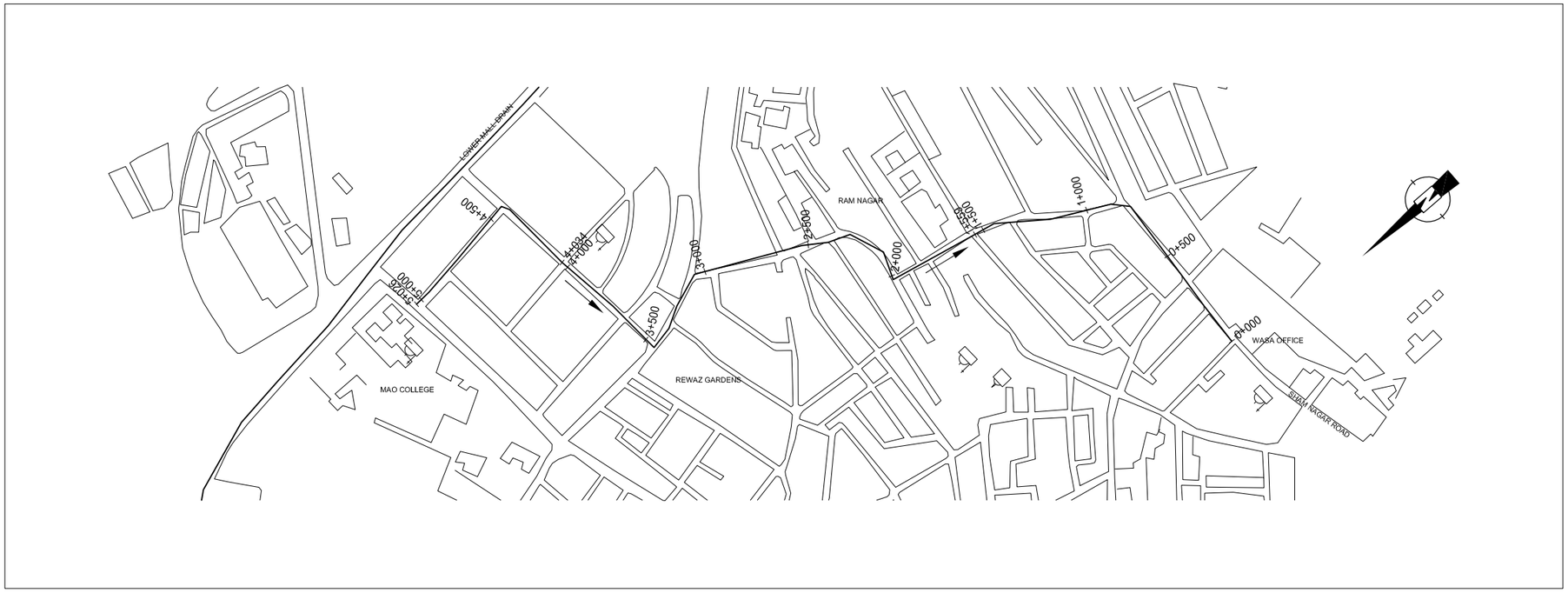
SCALE B 0 8 16 24 32 40 ft.

PLOFILE (6+000 - 0+000)

H: SCALE A V: SCALE B

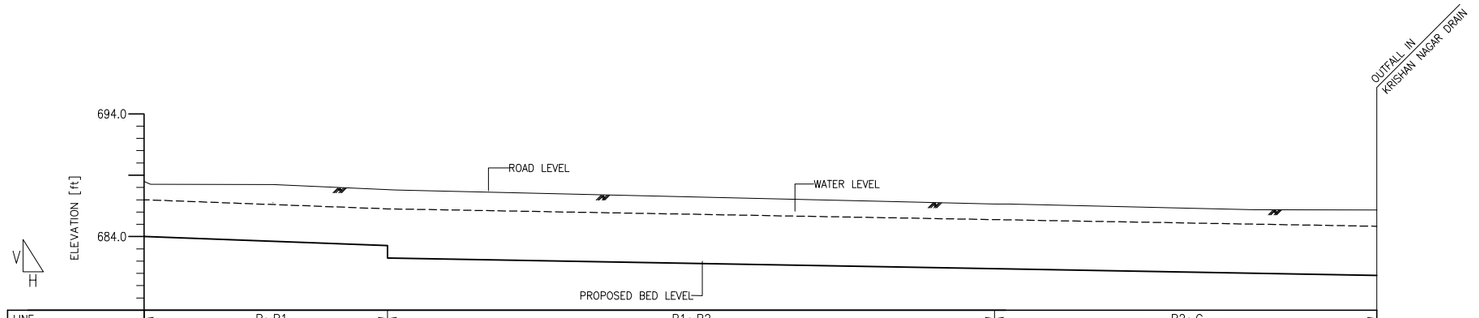
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
KRISHAN NAGAR DRAIN (2/2)	DWG No.	DP-38



PLAN (5+031 - 0+000)

H: SCALE A V: SCALE B



LINE	R~R1			R1~R2							R2~C				
SIZE (BxH ft)	2.0 x 3.0			3.5 x 4.0							3.5 x 4.0				
SLOPE (ft/ft)	0.00072			0.00035							0.00035				
ROAD LEVEL (FT.)	688.48	688.25	688.25	688.02	687.79	687.56	687.33	687.10	686.87	686.64	686.41	686.18	686.16		
WATER LEVEL (FT.)	686.98	686.96	686.60	686.26	686.24	686.06	685.89	685.71	685.54	685.36	685.19	685.01	684.84		
PROPOSED BED LEVEL (FT.)	683.98	683.96	683.60	683.26 682.26	682.24	682.06	681.89	681.71	681.54	681.36	681.19	681.01	680.84		
CHAINAGE (FT.)	5+031	5+000	4+500	4+034	4+000	3+500	3+000	2+500	2+000	1+559	1+500	1+000	0+500	0+000	

PLOFILE (5+031 - 0+000)

H: SCALE A V: SCALE B

SCALE A 0 200 400 600 800 1000 ft.

SCALE B 0 4 8 12 16 20 ft.

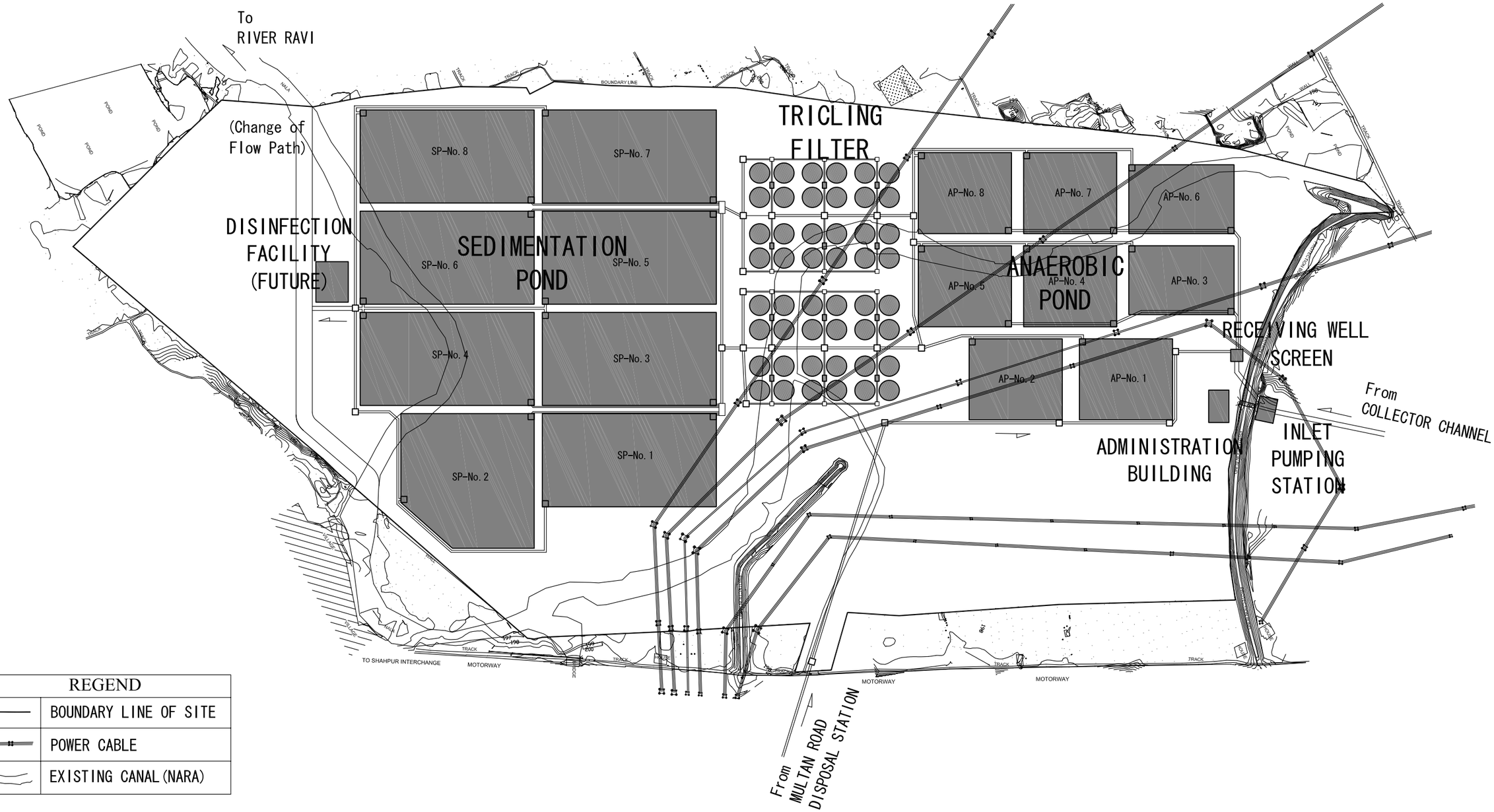
THE PREPARATORY STUDY ON
LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT

PLAN & PROFILE	SCALE	SEE SCALE BAR
REWAZ GARDEN DRAIN	DWG No.	DP-39

APPENDIX 13.6.3 WASTEWATER TREATMENT PLANT

GENERAL LAYOUT PLAN OF SOUTH WEST WWTP

SCALE:1/10,000



REGEND	
———	BOUNDARY LINE OF SITE
═══	POWER CABLE
～～～	EXISTING CANAL(NARA)

0 500m 1km

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
South West WASTEWATER TREATMENT PLANT	SCALE	1:10,000
WWTP General Layout Plan	DWG No.	WWTP-1

LEGEND	
SYMBOL	NAME
——	SEWAGE
—D—	SLUDGE (DEWATERED)
Ⓟ	PUMP
Ⓜ	MOTOR

Target Year

2035

Design Population

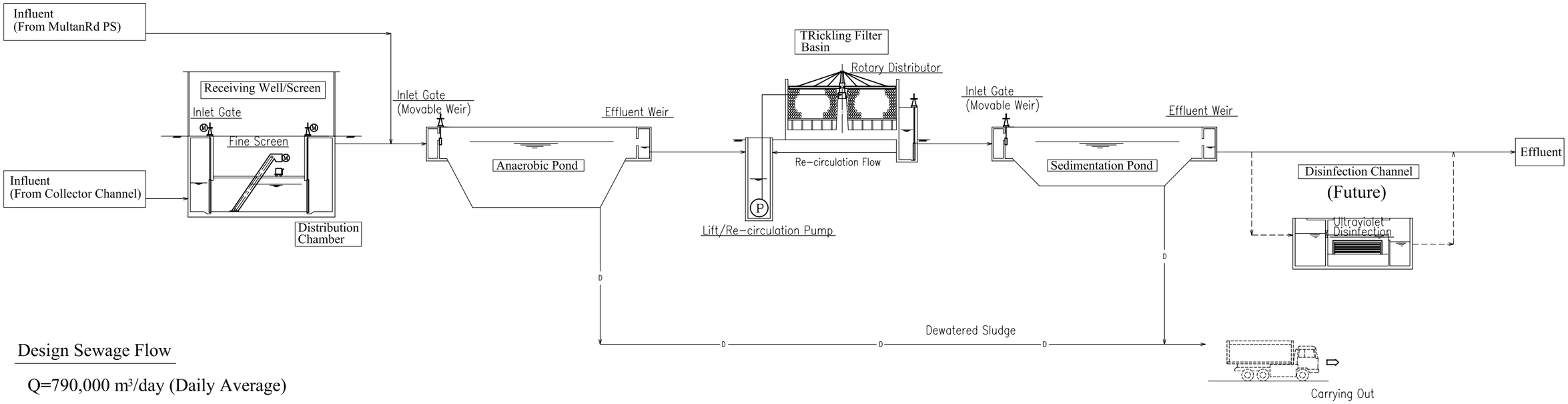
3,890,000

Treatment Process

Trickling Filter Process

(InletPS→Receiving Well/Screen→Anaerobic Pond→Trickling Filter→
→Sedimentation Pond→Disinfection Tank(Future)→Outflow)

FLOW DIAGRAM



Design Sewage Flow

Q=790,000 m³/day (Daily Average)

Item	m³/day	m³/hr	m³/min	m³/sec
Daily Average Flow Total	790,000	32,916.7	548.61	9.144
from Collector Channel	599,000	24,958.3	415.97	6.933
from MultanRd PS	191,000	7,958.3	132.64	2.211
Peak Flow Total	2,401,000	100,041.7	1,667.36	27.789
from Collector Channel	1,828,362	76,181.8	1,269.70	21.162
from MultanRd PS	572,638	23,859.9	397.67	6.628

Design Sewage Quality

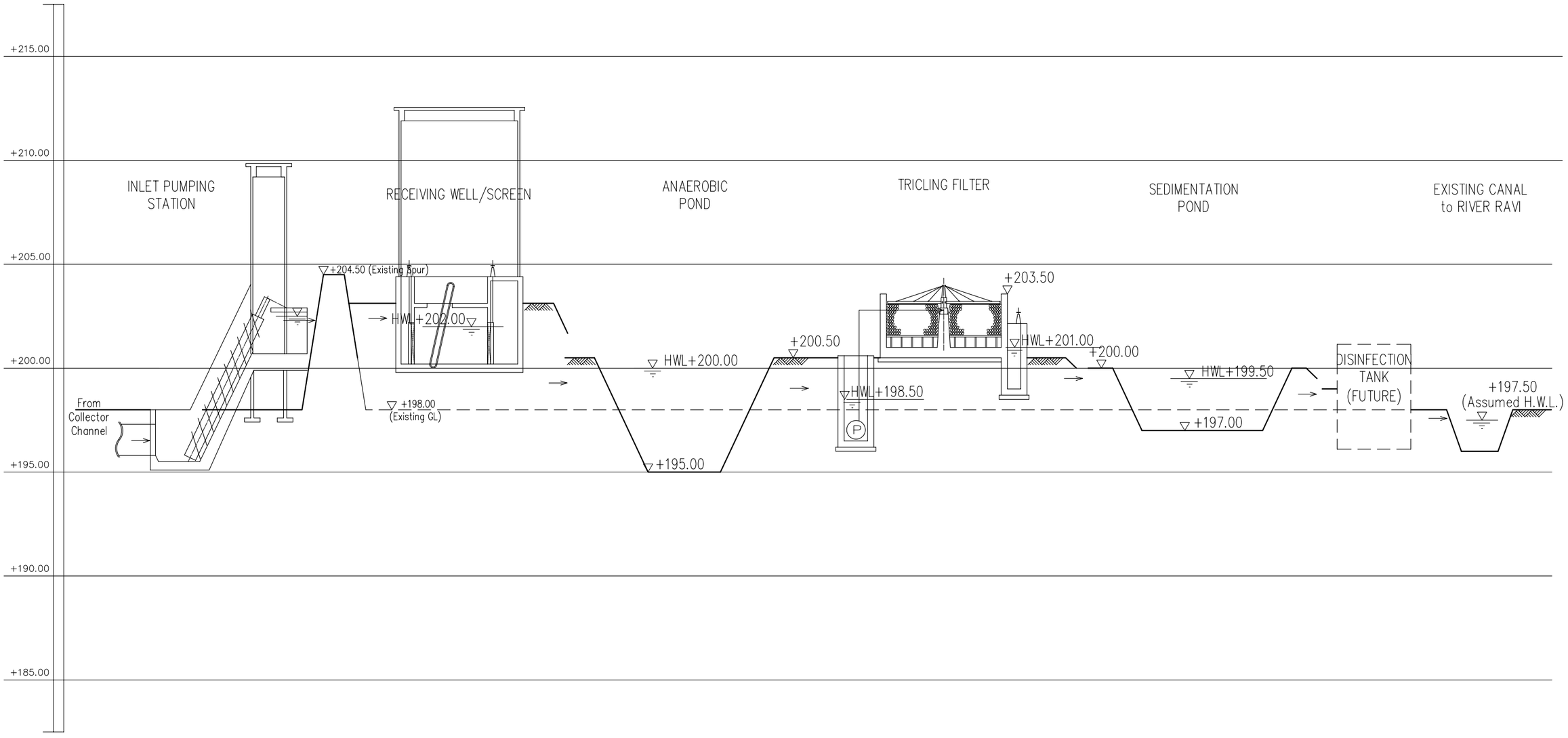
Item	Influent (mg/l)	Effluent (mg/l)	Removal rate (%)
BOD	250	50	80
SS	350	70	80

MAIN EQUIPMENT

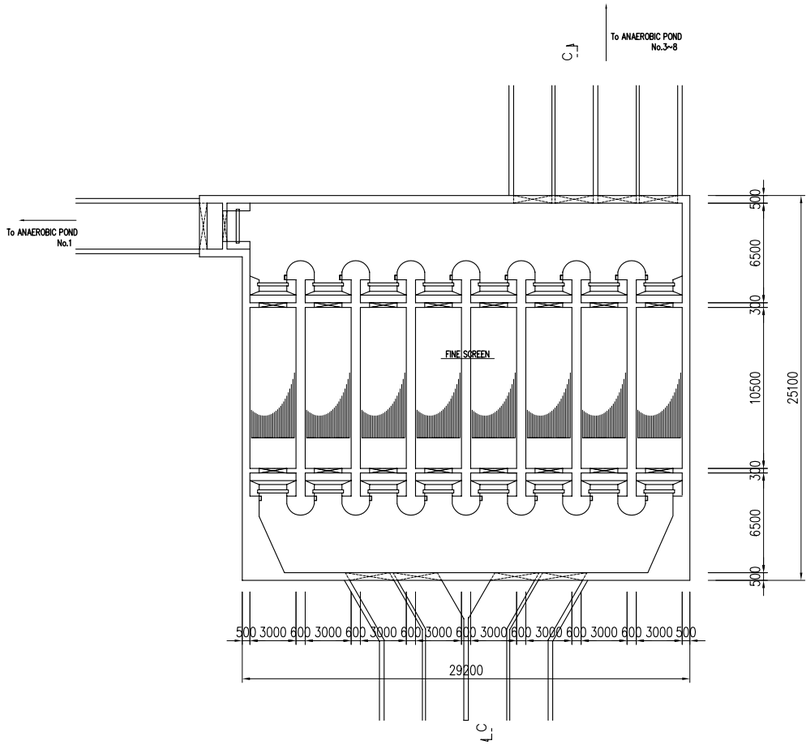
NO.	1	2	3	4	5
FACILITY	Receiving Well / Screen	Anaerobic Pond 8 Ponds	Trickling Filter 48 Basins	Sedimentation Pond 8 Ponds	Disinfection Tank (Future)
EQUIPMENT NAME	Fine Screen	–	Lift / Re-circulation Pump	–	
SPECIFICATIONS	Automatic Bar Screen W2.5m x OP .20mm		Submersible Sewage Pump Dia.500mm x 34m³/min x 10m		
POWER	0.65 kW		75 kW		
QUANTITY	8		48		
REMARKS			1 unit/basin		

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
South West WASTEWATER TREATMENT PLANT	SCALE	Non
Flow Diagram	DWG No.	WWTP-2

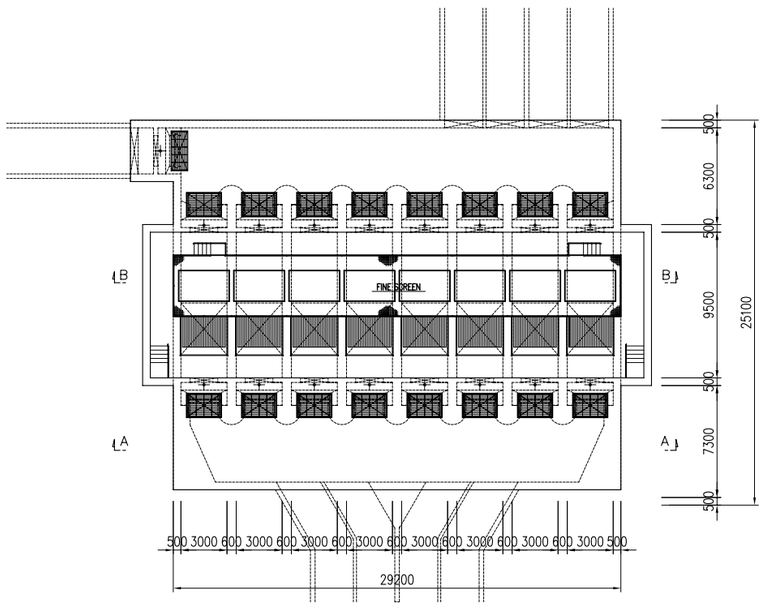
HYDRAULIC PROFILE



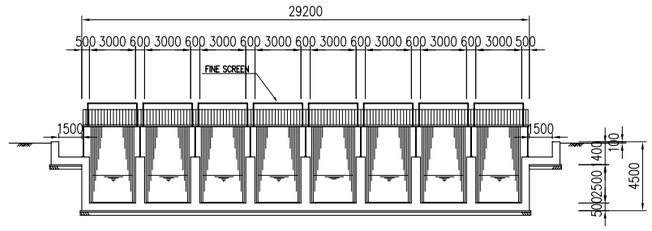
THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
South West WASTEWATER TREATMENT PLANT	SCALE	H= NON V=1:200
WWTP HYDRAULIC PROFILE	DWG No.	WWTP-3



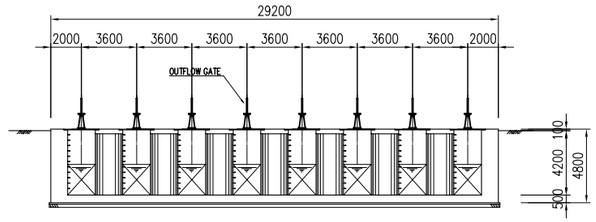
BF PLAN



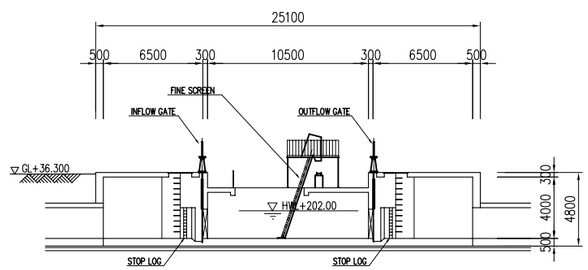
GF PLAN



A–A SECTION

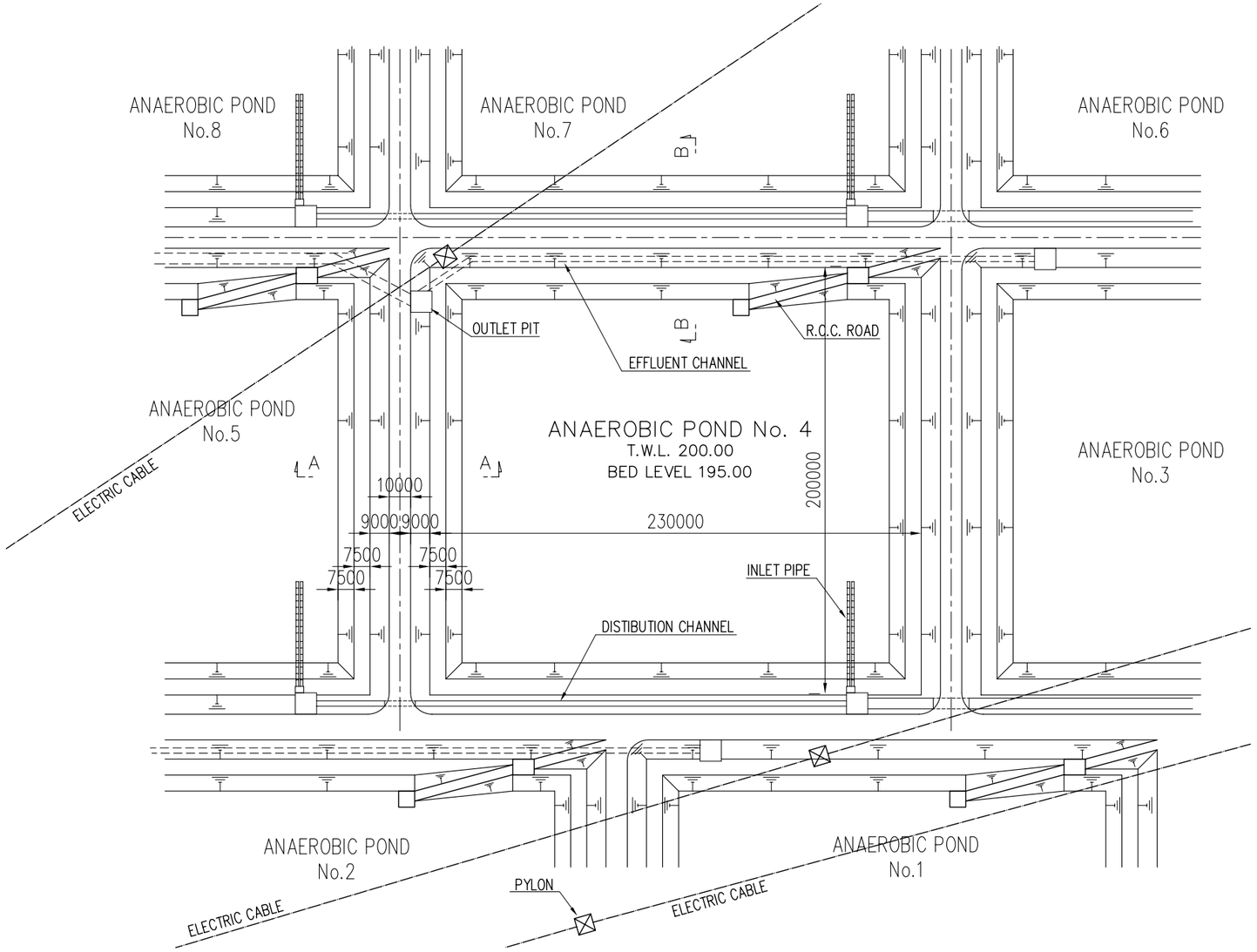


B–B SECTION

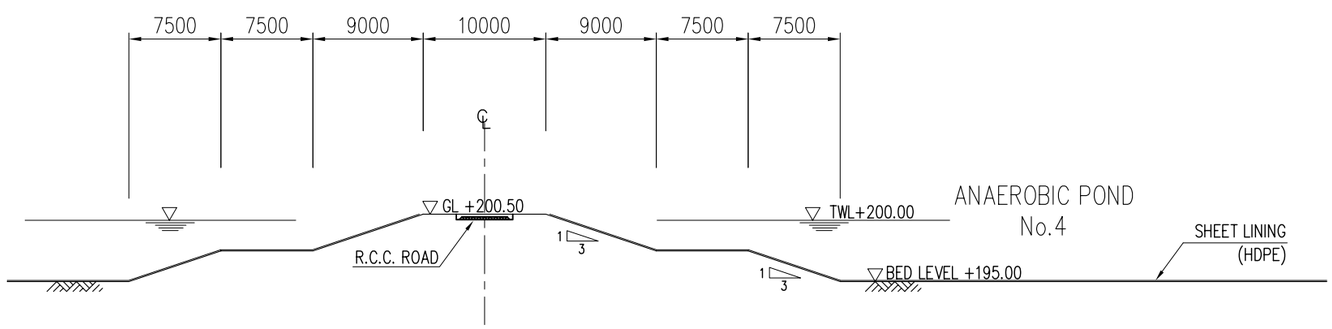


C–C SECTION

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
South West WASTEWATER TREATMENT PLANT	SCALE	1:200
PLAN & SECTION (Screen Facility)	DWG No.	WWTP-4



PLAN S=1\2500



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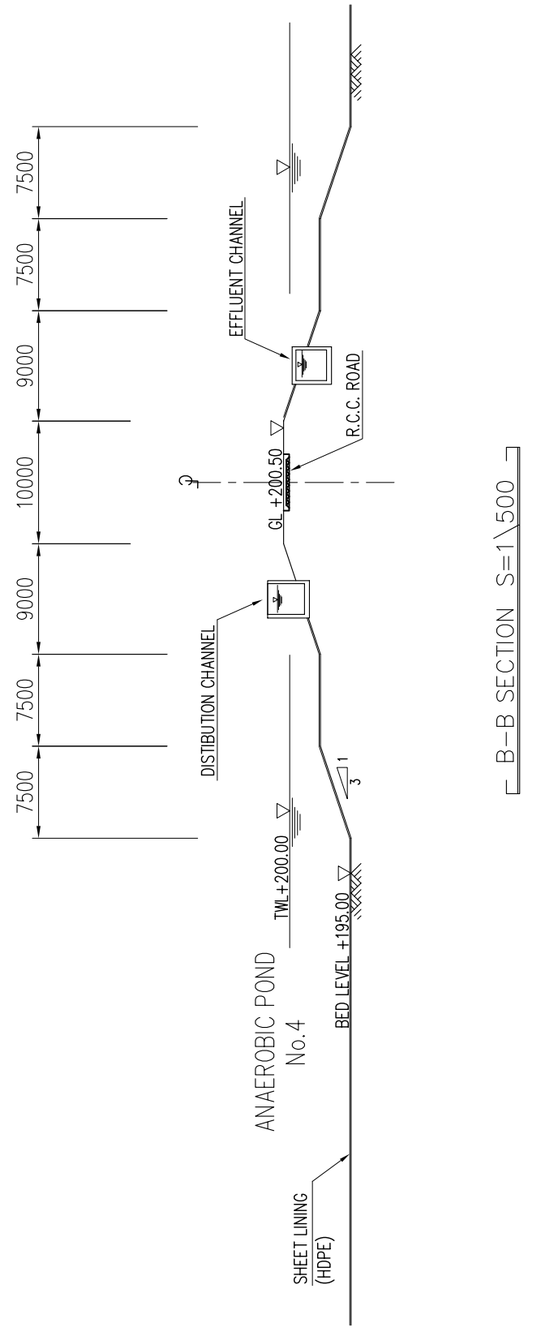
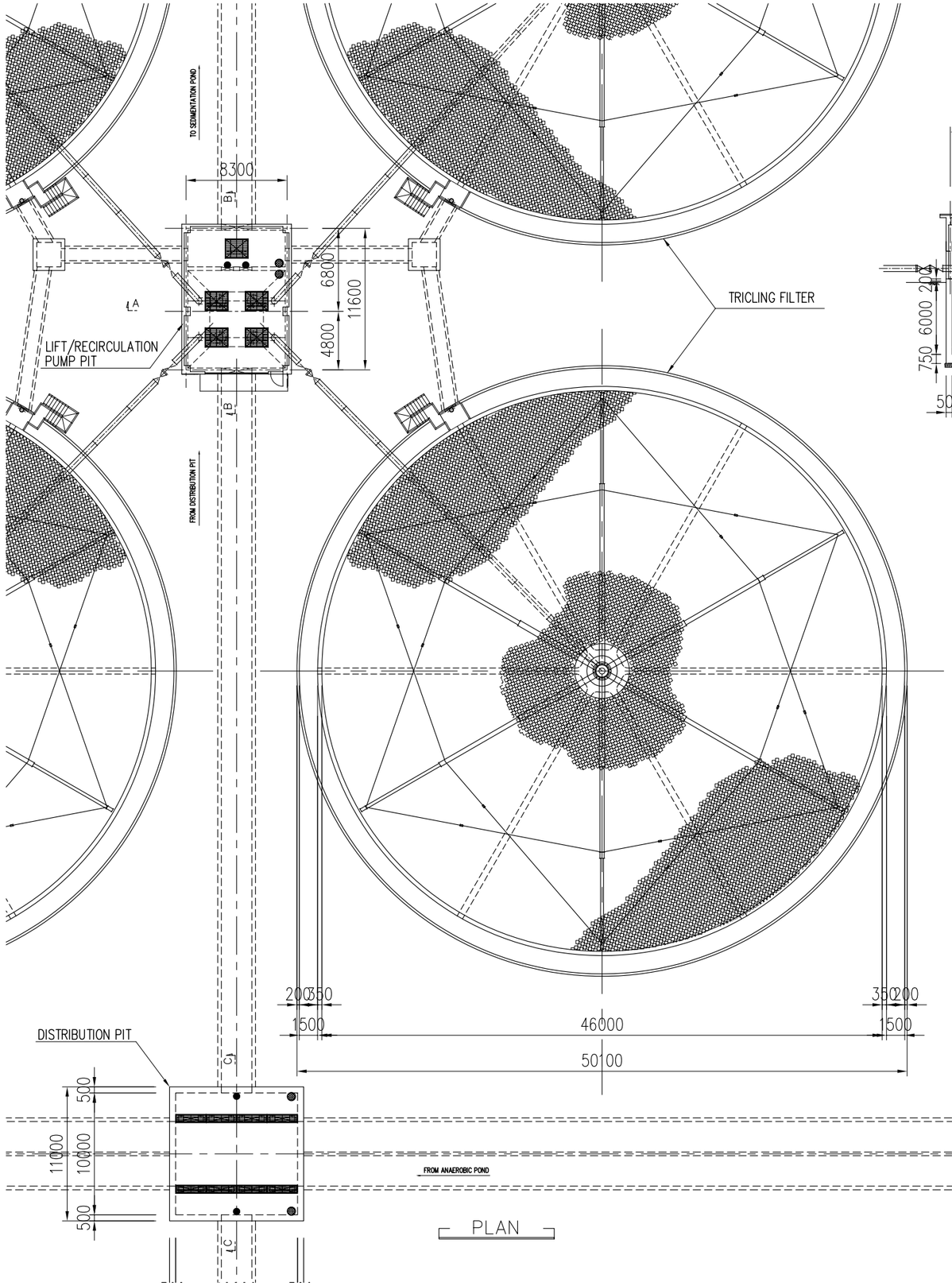
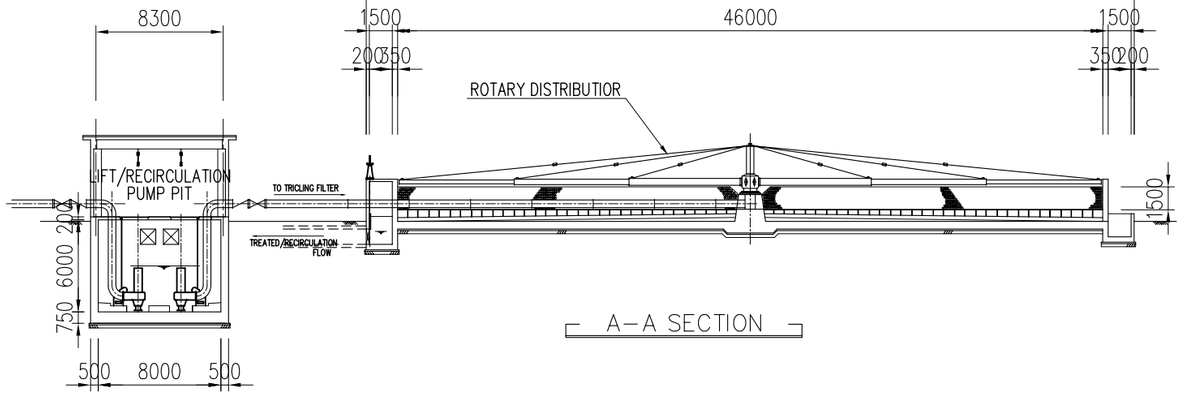


B-B SECTION S=1\500

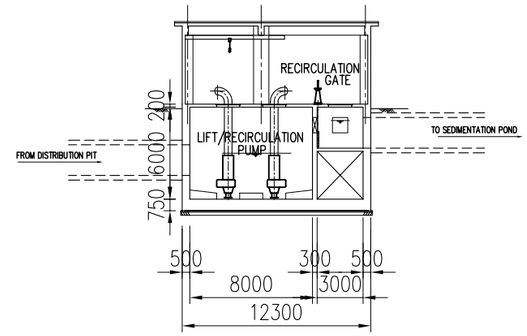
THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
South West WASTEWATER TREATMENT PLANT	SCALE	1:2500 1:500
PLAN & SECTION (Anaerobic Pond)	DWG No.	WWTP-5



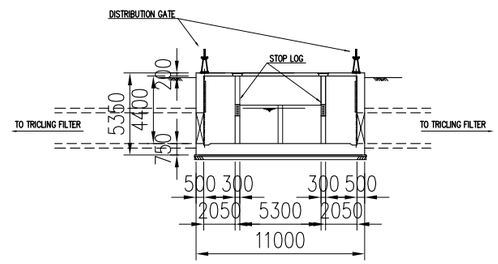
PLAN



A–A SECTION

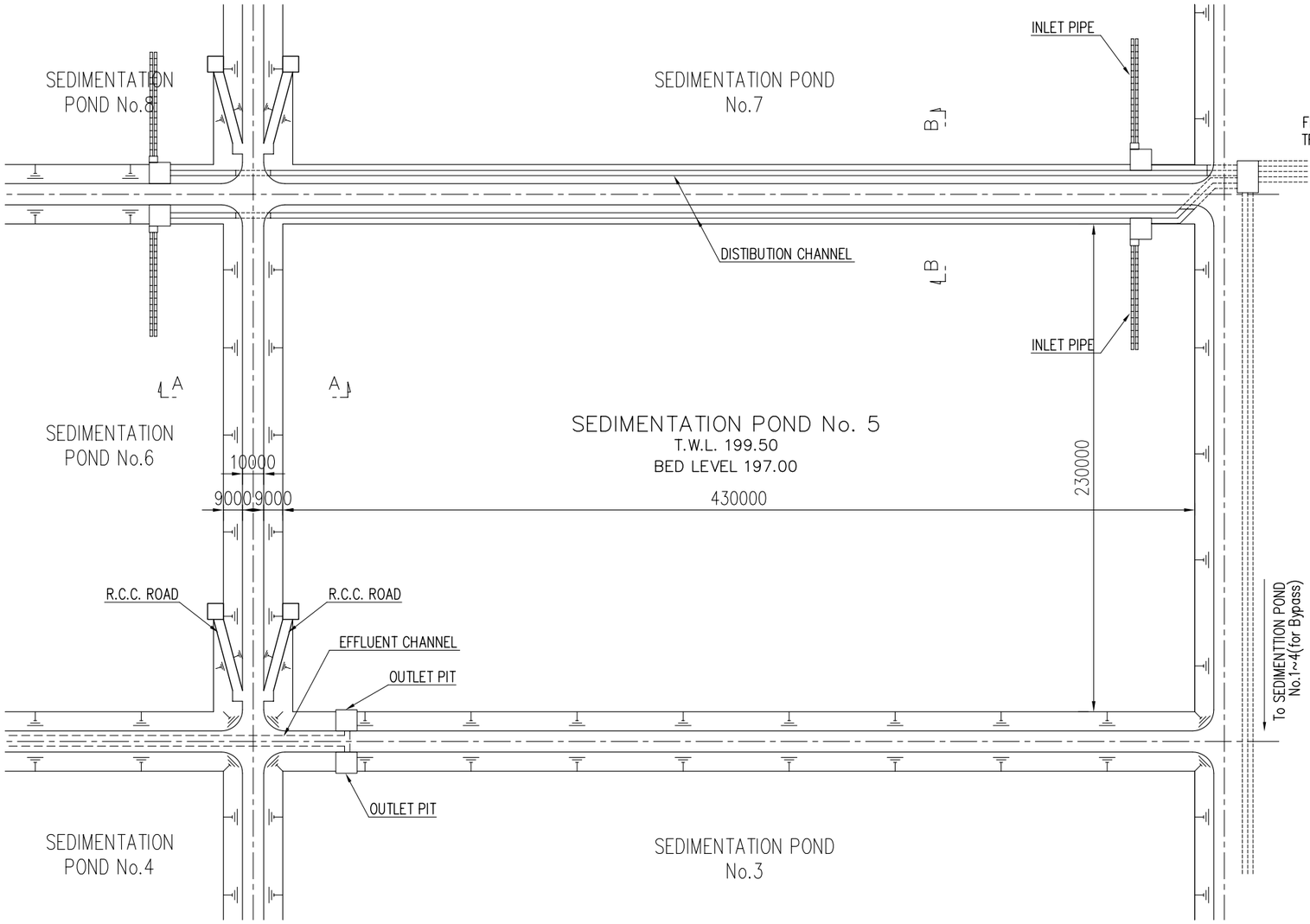


B–B SECTION

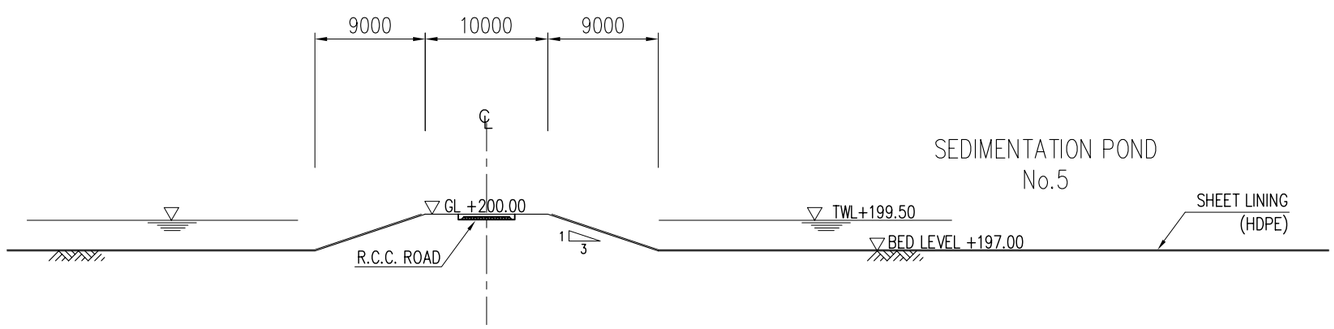


C–C SECTION

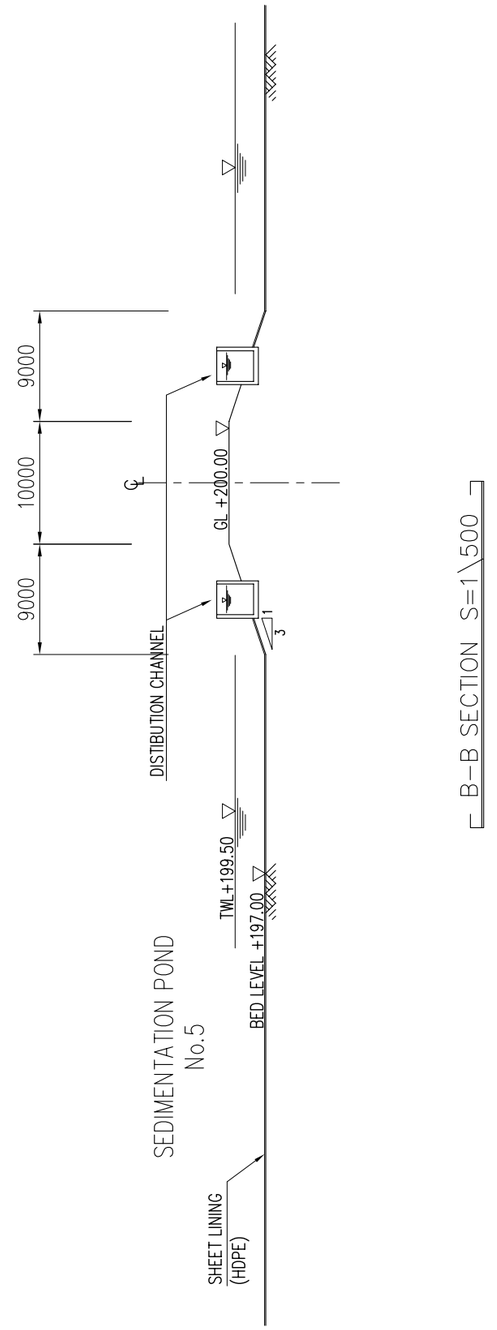
THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
South West WASTEWATER TREATMENT PLANT	SCALE	1:400
PLAN & SECTION (Trickling Filter)	DWG No.	WWTP-6



PLAN S=1\2500



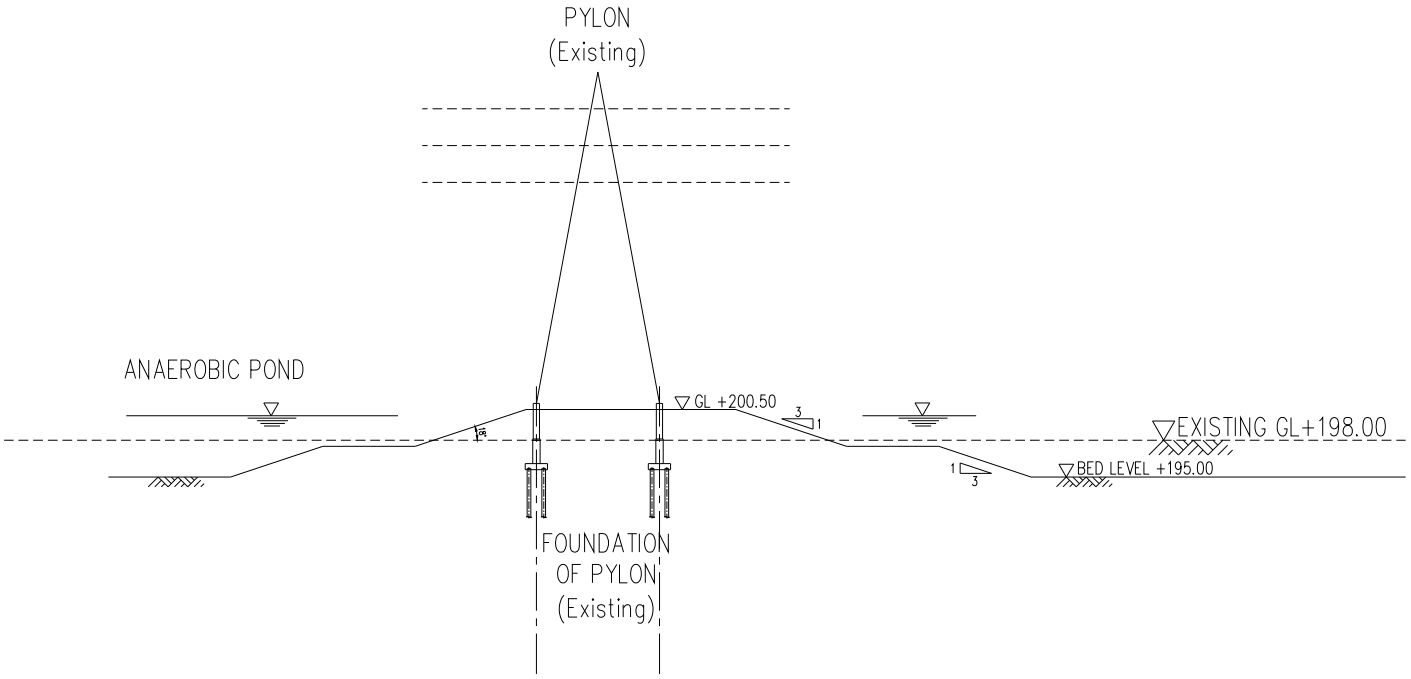
A–A SECTION S=1\500



B–B SECTION S=1\500

THE PREPARATORY STUDY ON LAHORE WATER SUPPLY, SEWERAGE AND DRAINAGE IMPROVEMENT PROJECT		
South West WASTEWATER TREATMENT PLANT	SCALE	1:2000
PLAN & SECTION (Sedimentation Pond)	DWG No.	WWTP-7

Appendix 13.7 Typical Drawing of Existing Pylon in WWTP Site



Appendix 13.8 Result of Topographic Survey and Soil investigation

Contents

SURVEY REPORT

1. Introduction

South West Waste Water Treatment Plant Wasa, Lahore survey task was given to Alfa Engineering Company. A credible survey and mapping was required in digital format for the planning and design of Waste Water Treatment Plant & Collector channel. A location map of the area is shown in Appendix – A

2. Scope of Surveying and Mapping

The Topographic survey of the land required for the construction of Waste water Treatment Plant and the collector channel is required. This land has already been acquired by WASA, Lahore.

WWTP

The extent of survey land already acquired by WASA was shown by the "Patwari" to the survey team, who is the government representative from the revenue department. Patwari responsibility is to mark the exact boundaries of the land owned by WASA.

Measurement of land by Patwari is not based on Co-ordinates system or X, Y, Z values in Pakistan but the Patwari just defines the length & width of the piece of land after identification through their own method (Khasra numbers) from record books and measures in Acres / Kanals & Marlas with respect to their books record.

Similarly in our case Patwari identified the location on ground for the occupied land which was surveyed using the latest survey techniques available. The area of land surveyed assigned the coordinates as per National Grid system of Pakistan, Survey of Pakistan. The coordinates of WWTP are shown as Appendix – B.

The area shown by the Patwari on ground surveyed is approx. 7300 Kanals which is based on the basic unit of measurement which is Marla and is 225 Sq. ft in Lahore, Pakistan.
The survey is carried out with the close liaison of Patwari & WASA department.

THE COLLECTOR CHANNEL

The length of the collector channel to be surveyed is 7.0 Kms. A 30 m wide corridor for the collector channel is already acquired by WASA. The Topography survey of the channel was carried. A close coordination was made with WASA reps and Patwari during the survey.

- Establishment of horizontal and vertical control points
- Preparation of topographic survey Plan at Mapping scale : 1:500
  (1:5,000 in WWTP site)

  Plane and longitudinal profile
  Horizontal scale: 1:1000
  Vertical scale: 1:100

3. Equipment Used

The instruments used for this job are listed hereunder:

- Leveling Instrument; B2- No.616822
  PANTAX No.936159
- Electronic Total Stations;
  Sokkia Set 630r No.29800
  Sokkia Set 630r No.130598
  Sokia set 610 No 29654

4. Calibration of Survey Instruments

All instruments calibration checked by Sokia Company before start the site work.

5. Survey Control Points

Permanent survey / traverse points have been established at closed interval in form concrete blocks cast in situ with Steel Bar & Some in steel rods / nails driven into ground at edge of existing road or parapet wall of concrete structures, painted red and marked with engraved triangle. The list of bench marks / control points with coordinates is shown in Appendix – C.

5.1 Horizontal Control

5.1.1 Reference Datum

The control point of National Grid of Pakistan is not available in the vicinity of project area, so GPS is used for the determination of grid coordinate value by applying GPS INDIAN GRID – I, as a reference.

5.1.2 Units of Measurement

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

5.1.3 Electronic Distance Measurement (EDM) Equipment

Electronic Distance Measurement (EDM) equipment has been used at the project site for this work.

5.1.4 Electronic Distance Measurement (EDM) Traversing

A closed loop EDM traversing was used to establish horizontal controls in the area using total stations with an accuracy rating of ± 5 mm + 5 ppm or better.

All traverse distances were measured in two directions (forward and back) and mean distance adopted provided the two agreed to an accuracy limit of1:12,000 or better. The field horizontal distances were used in computation of coordinates.

The horizontal angle were measured on two zeros (four pointing each way) on face left and right position of the instrument. Mean of the four (4) angles was used in traverse computation provided the maximum spread of angles was not more than 20 seconds of arc.

The computations were carried out on computer using appropriate software and minimum acceptable loop closure accuracy to be achieved was 1:12,000. The distances measured in field were the horizontal distances because the instruments used have built-in facility to convert the field slope distance to horizontal. The measured distance were corrected for various geodetic corrections and used in the traverse computations.

5.2 Vertical Control

5.2.1 Reference Datum

The control point of National Grid of Pakistan is not available in the vicinity of project area, so GPS is used for the determination of datum value by applying WGS 84 datum as a reference datum.

5.2.2 Units of Measurement

Metric units are the unit of measurement.

5.2.3 BM Stations

Forty Seven (47) horizontal control stations were used as BM stations which were established at safe and stable locations. The datum of the survey is based on WGS 84 which is taken as the basis for the Z – value of the project. The Coordinates of Forty Seven (47) BM Stations are shown in Appendix C & F.

5.2.4. Bench Mark Leveling

The leveling and check leveling were carried out using automatic leveling instruments of quality and compatible metric leveling staves.

The minimum acceptable leveling accuracy for out and back runs was aimed to be $\pm$ 12 mm $\sqrt{k}$ where k is distance in kilometers and same accuracy level was maintained through out Bench Mark leveling process. The BM levels are shown in Appendix- D & E

6. Topographic Survey Data Acquisition

Bulk of the topographic field survey data was acquired using electronic total stations Built in Memory. The data was down loaded to the computer at site and processed into digital format (Pt no, x, y, z, description).

7. Survey Data Processing

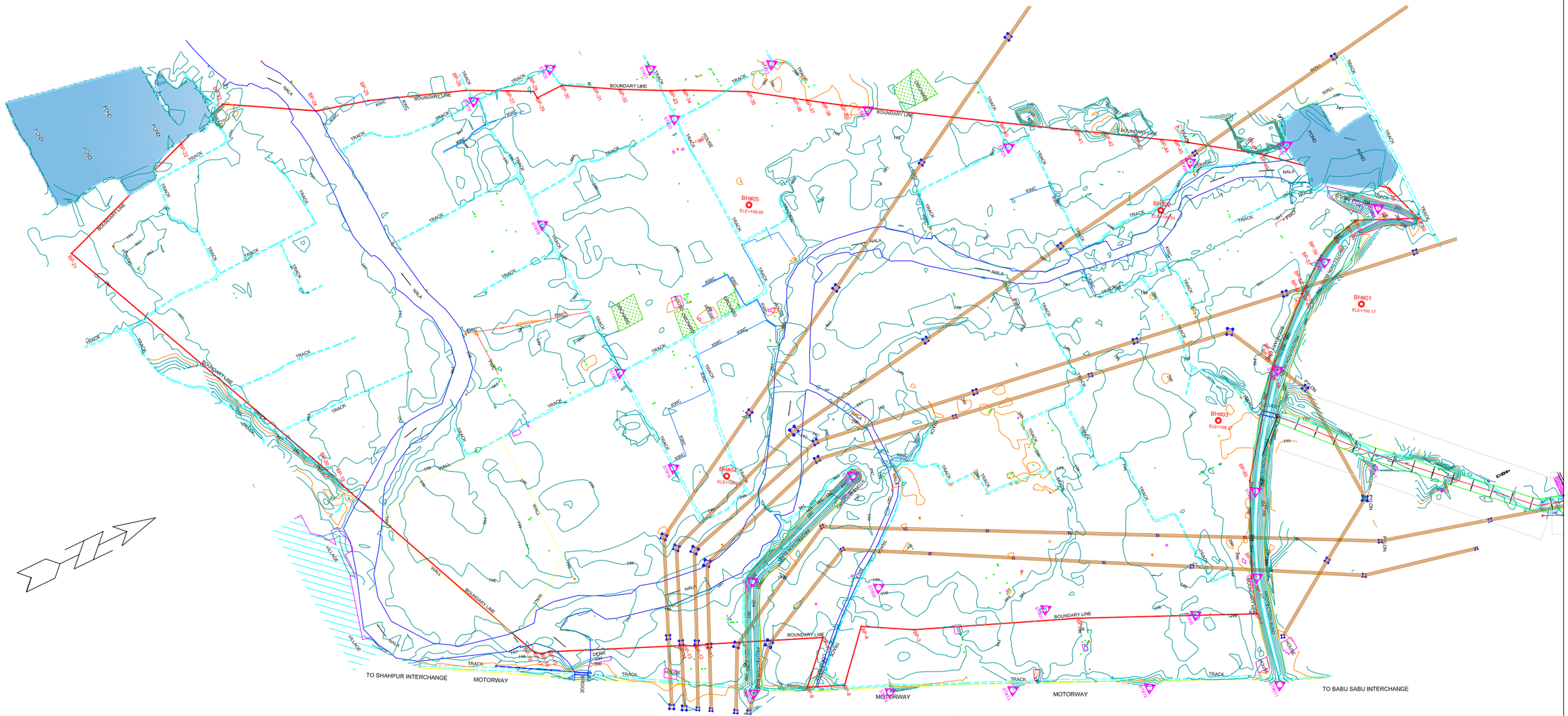
Traverse Computation

The traverse field survey data is computer processed using in house developed computer software and small misclosure adjusted among the traverse legs using Bowditch method of adjustment.

Topographical Survey Data Processing

Electronic total stations used for topo survey had electronic data recording facility and same was used for bulk of the field work, however, some data was recorded manually on data forms and manually entered in the computer for processing.

The data was computer processed to create DTM and computer aided mapping carried out at 1:500 scale. The mapping was field verified and maps finalized.



LEGEND:-

CONTROL POINT
BLD
MOSQUE
PYLON
ROAD
TELEPHONE POLE
ELECTRIC POLE
GRAVEYARD
HAND PUMP
WALL
MAIN HOLE
BOUNDARY
LIGHT POLE
K W C
NALLAH

NOTE:-

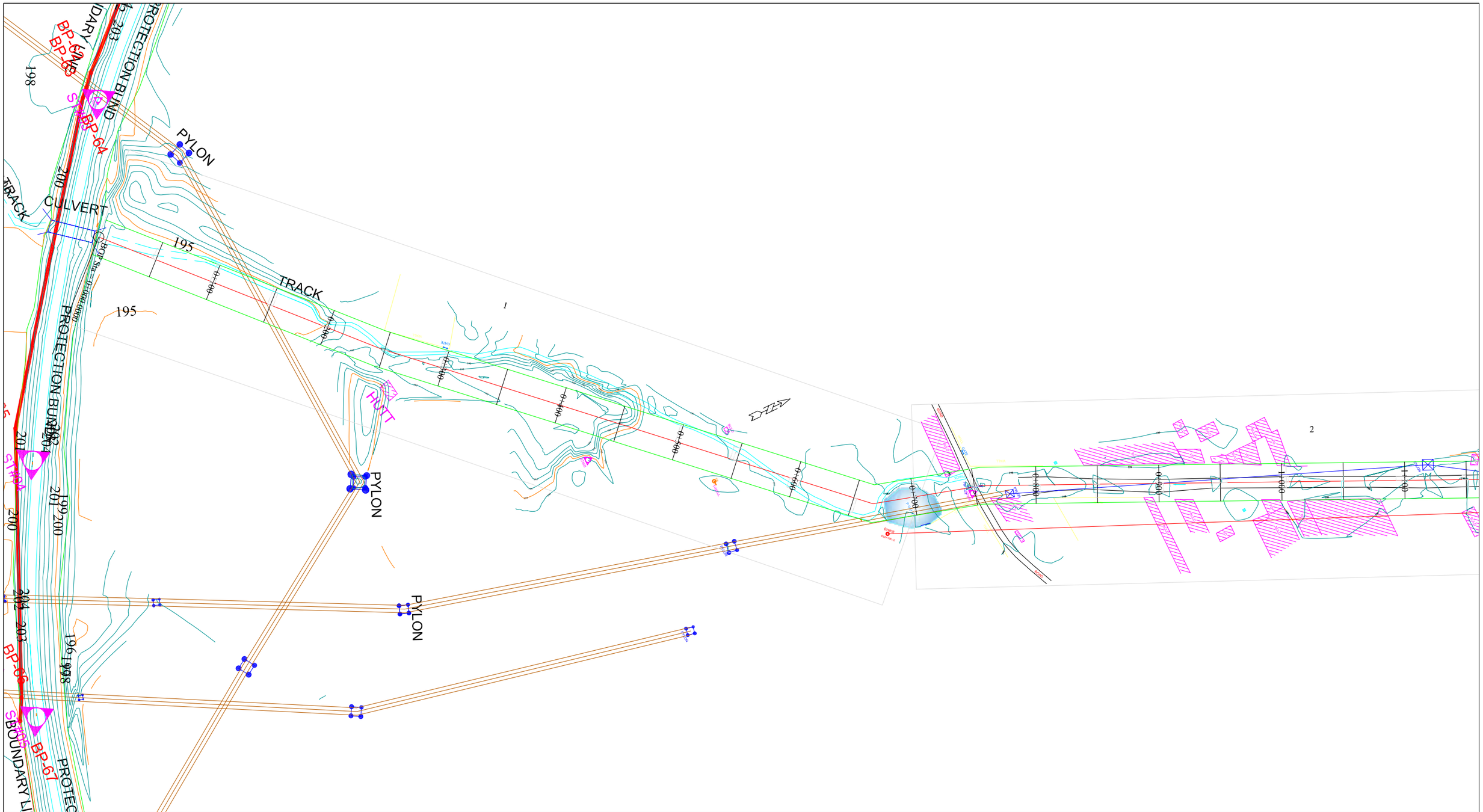
Government of the Punjab
WASA - LAHORE

SOUTH WASTE WATER TREATMENT PLANT
SOUTH WEST WWT PLANT LAHORE
DIGITAL TOPOGRAPHIC SURVEY

Dwg. No.	SBP/00		Rev. -
Designed By :	KAMRAN		Scale : 1:5000
Checked By :	M.TARIQ		Date : JUNE.,2009
Approved	Date	Ref. :	

CONSULTANTS
JICA

CONTRACTOR
ALFA ENGINEERING SERVICES



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SOUTH WEST WWT PLANT LAHORE

DIGITAL TOPOGRAPHIC SURVEY

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		Designed By : KAMRAN	Scale : 1:5000
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Approved	Date	Ref. :	

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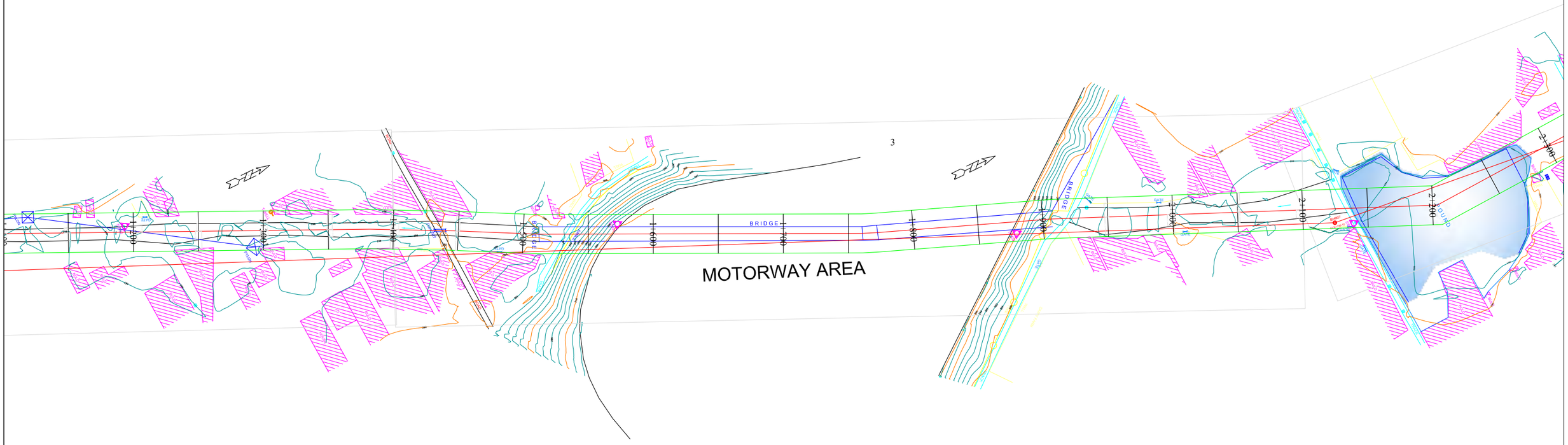

LEGEND:-

CONTROL POINT

BLD

MOSQUE

PYLON

ROAD

TELEPHONE POLE

ELECTRIC POLE

GRAVEYARD

HAND PUMP

WALL

MAIN HOLE

BOUNDARY

LIGHT POLE

K W C

NALLAH

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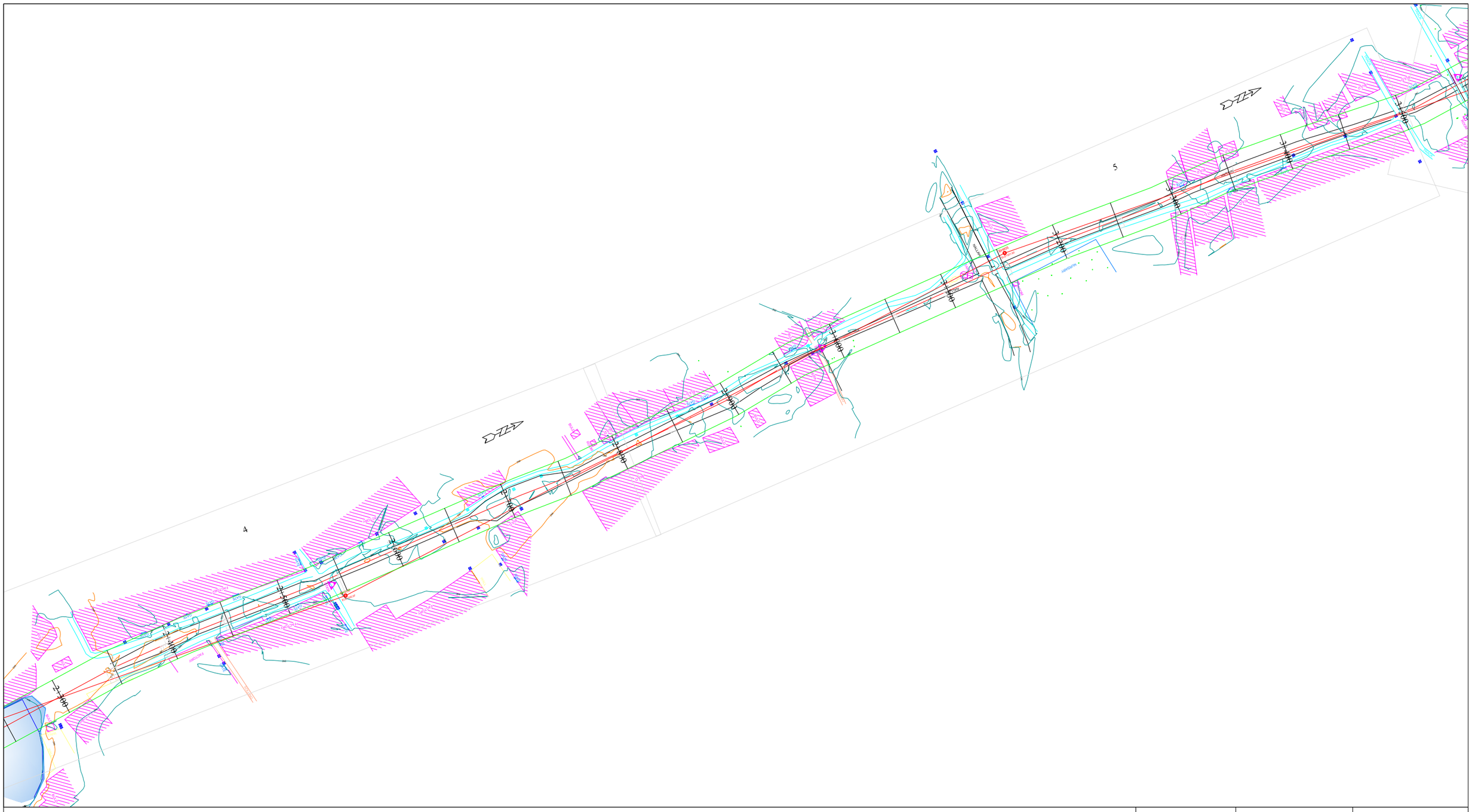

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Approved	Date	Ref. :		

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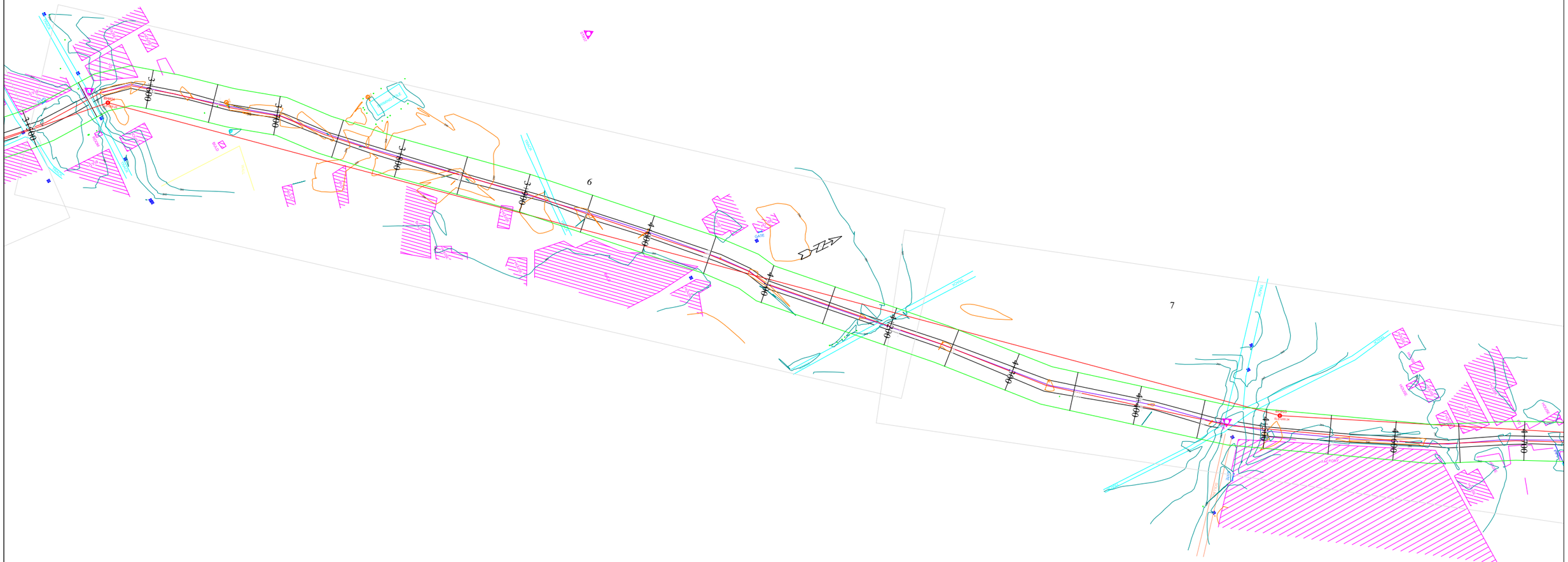

LEGEND:-

CONTROL POINT

BLD

MOSQUE

PYLON

ROAD

TELEPHONE POLE

ELECTRIC POLE

GRAVEYARD

HAND PUMP

WALL

MAIN HOLE

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Approved | Date

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Checked By : M.TARIQ | Date : JUNE.,2009

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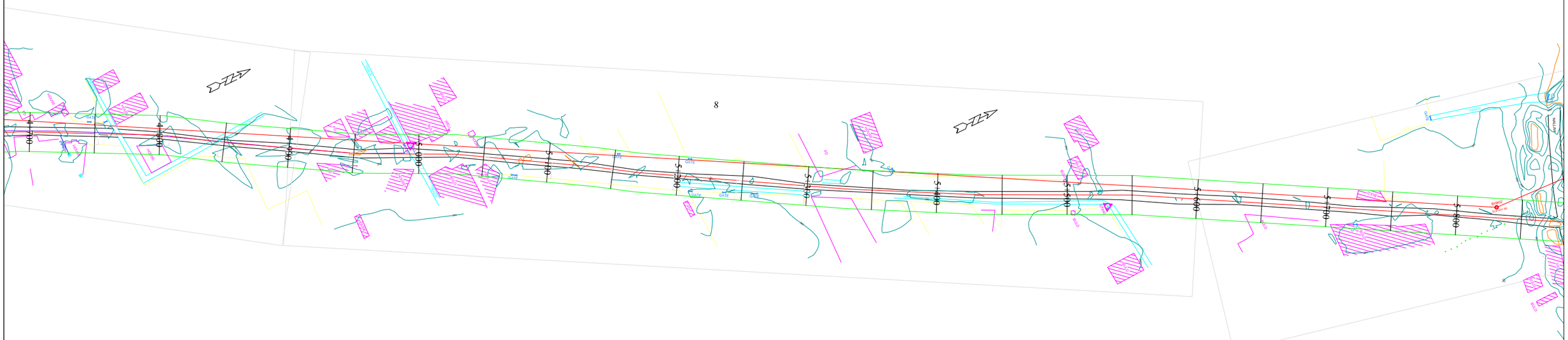

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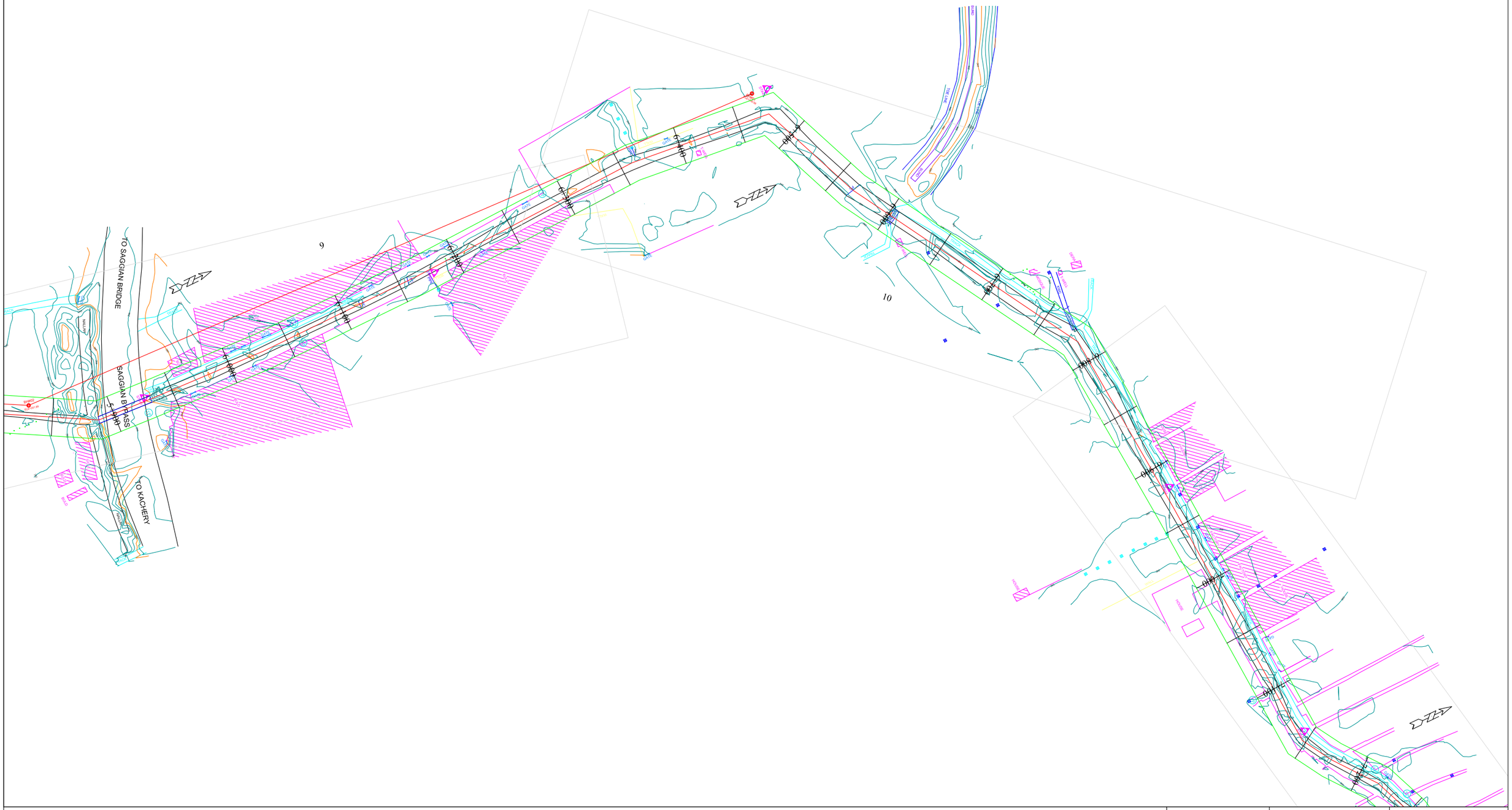

LEGEND:-

CONTROL POINT	ST △	ROAD	═	WALL	
BLD	▨	TELEPHONE POLE	TP	MAIN HOLE	◈
MOSQUE	🕌	ELECTRIC POLE	⊠EP	BOUNDARY	―
PYLON	◘	GRAVEYARD	∩ ∩ ∩	LIGHT POLE	○
		HAND PUMP	◎	K W C	―
				NALLAH	═

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SOUTH WEST WWT PLANT LAHORE
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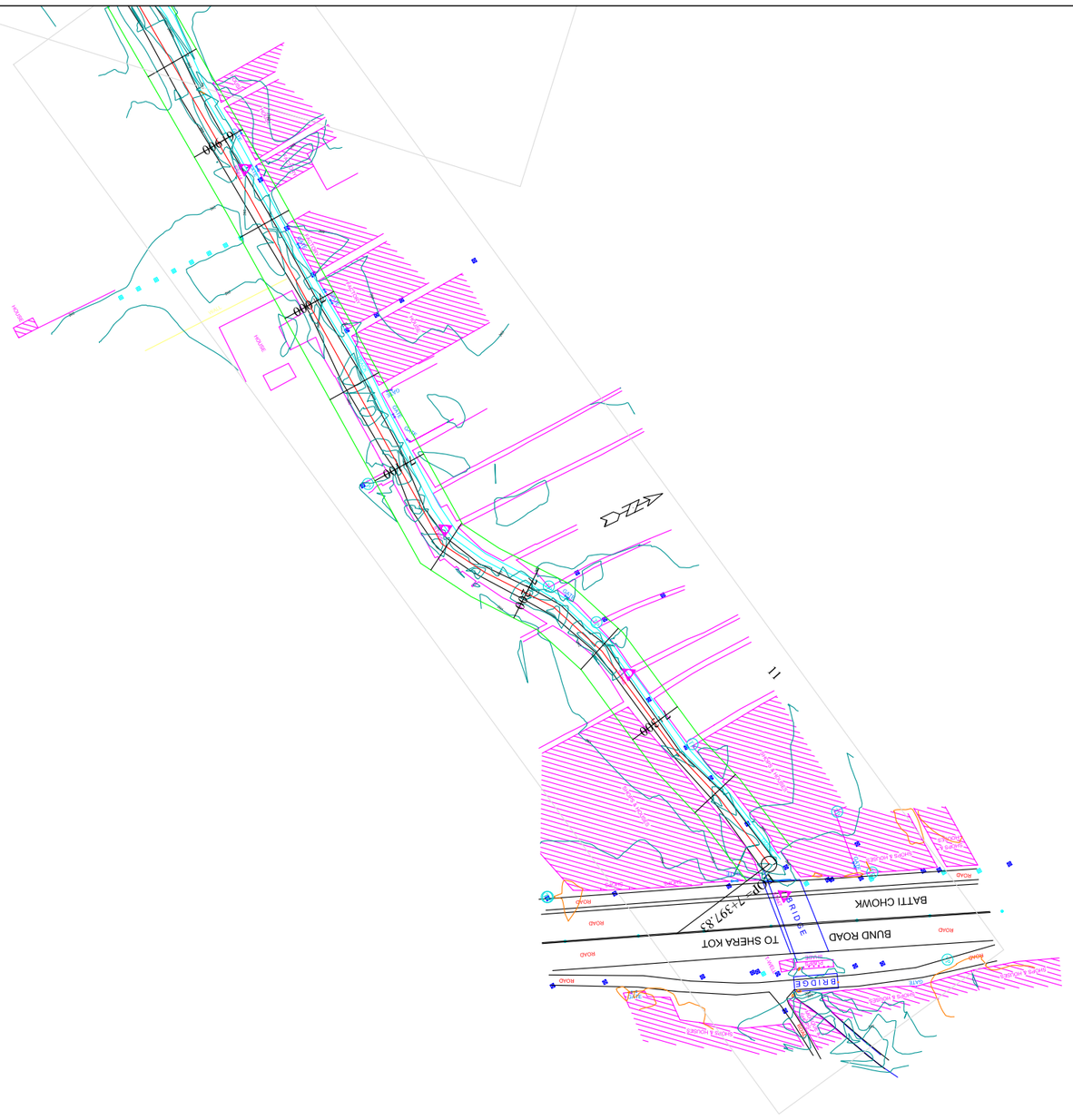

LEGEND:-

CONTROL POINT
BLD
MOSQUE
PYLON
ROAD
TELEPHONE POLE
ELECTRIC POLE
GRAVEYARD
HAND PUMP
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Checked By : M.TARIQ | Date : JUNE.,2009

Ref. :

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Annex – B

WTTP SOUTH WASA

BOUNDARY CORNER COORDINATE LIST

Sr.No	EASTING	NORTHING	REMARKS
1	3336204.977	823813.1359	
2	3336026.046	823416.0611	
3	3335879.509	823047.8822	
4	3335817.032	822936.3633	
5	3335817.032	822936.3633	DUPLICATE
6	3335927.715	822838.3047	
7	3335927.715	822838.3047	DUPLICATE
8	3335927.715	822838.3047	DUPLICATE
9	3335893.184	822755.324	
10	3335800.705	822841.2335	
11	3335693.056	822578.9067	
12	3335686.244	822554.8939	
13	3335672.77	822530.5941	
14	3335667.822	822518.7621	
15	3335544.987	822230.2322	
16	3335540.526	822211.0781	
17	3335531.354	822196.4501	
18	3335510.969	822187.5558	
19	3334962.199	821951.9352	
20	3334915.11	821934.3581	
21	3334172.892	821604.6511	
22	3334048.904	821957.8653	
23	3334005.976	822091.7298	
24	3334119.575	822289.9432	
25	3334151.275	822412.7249	
26	3334231.455	822636.5793	
27	3334275.708	822726.5871	
28	3334305.192	822783.8361	
29	3334323.062	822784.6772	
30	3334321.399	822852.128	
31	3334360.421	822920.234	
32	3334391.158	822974.1217	
33	3334447.425	823083.5796	
34	3334460.08	823113.4233	
35	3334530.778	823251.5537	

36	3334594.237	823345.3426	
37	3334611.515	823371.0936	
38	3334633.847	823404.2903	
39	3334658.522	823441.6401	
40	3334859.582	823764.0287	
41	3334960.499	823926.2158	
42	3334997.829	823988.6839	
43	3335035.877	824049.2885	
44	3335069.824	824103.5332	
45	3335087.028	824133.302	
46	3335206.627	824305.7754	
47	3335203.238	824301.7532	
48	3335413.532	824547.7855	
49	3335413.532	824547.7855	DUPLICATE
50	3335511.642	824582.1688	
51	3335511.642	824582.1688	DUPLICATE
52	3335449.969	824441.4489	
53	3335449.969	824441.4489	DUPLICATE
54	3335456.674	824419.2753	
55	3335466.689	824379.6099	
56	3335496.625	824323.2136	
57	3335512.684	824301.211	
58	3335545.421	824259.1743	
59	3335549.825	824253.5629	
60	3335553.126	824249.788	
61	3335554.483	824248.3183	
62	3335672.593	824118.9439	
63	3335681.85	824110.628	
64	3335688.266	824104.0449	
65	3335906.493	823938.0921	
66	3336105.831	823847.6264	
67	3336122.577	823838.5037	

Annex – C

TRAVERSE SHEET FOR WASTE WATER TRAETMENT PLANT

STATION		ANGLE			ANGLE	BEARING	DISTT	NORTHING	EASTING
FROM	TO	DEG	MIN	SEC		DEC-DEG	M	m	m
Loop-1									
	1							**824,505.000**	**3,335,447.000**
1	**2**					**160.239**	**184.955**	824,330.937	3,335,509.534
2	3	159	9	0	159.1500	139.3885	285.030	824,114.559	3,335,695.068
3	4	166	36	4	166.6011	125.9896	298.124	823,939.370	3,335,936.287
4	5	168	54	6	168.9017	114.8913	208.657	823,851.547	3,336,125.562
5	11	168	46	32	168.7756	103.6668	266.240	823,788.641	3,336,384.263
11	12	280	46	46	280.7794	204.4463	315.227	823,501.674	3,336,253.810
12	13	180	16	19	180.2719	204.7182	331.593	823,200.463	3,336,115.152
13	14	180	0	35	180.0097	204.7279	297.418	822,930.317	3,335,990.739
14	15	180	32	36	180.5433	205.2713	329.658	822,632.209	3,335,850.007
15	9	269	30	31	269.5086	294.7799	270.704	822,745.670	3,335,604.228
9	16	146	9	39	146.1608	260.9407	334.776	822,692.957	3,335,273.628
16	17	185	31	50	185.5306	266.4713	264.778	822,676.660	3,335,009.352
17	18	181	34	54	181.5817	268.0529	405.172	822,662.894	3,334,604.414
18	19	178	35	18	178.5883	266.6413	341.956	822,642.860	3,334,263.045
19	20	276	4	11	276.0697	2.7110	200.761	822,843.396	3,334,272.541
20	21	203	13	6	203.2183	25.9293	243.253	823,062.162	3,334,378.906
21	22	244	3	22	244.0561	89.9854	134.106	823,062.196	3,334,513.012
22	23	86	17	24	86.2900	356.2754	270.375	823,332.000	3,334,495.449
23	24	234	52	57	234.8825	51.1579	258.985	823,494.429	3,334,697.166
24	25	169	22	47	169.3797	40.5377	352.037	823,761.970	3,334,925.972
25	26	169	51	38	169.8606	30.3982	441.230	824,142.544	3,335,149.237
26	27	165	20	52	165.3478	15.7460	237.005	824,370.655	3,335,213.554
27	1	224	15	53	224.2647	60.0107	269.147	824,505.185	3,335,446.668
1	2	280	12	57	280.2158	160.2266	184.957	824,331.133	3,335,509.239
Loop-2									
5	6	239	22	50	239.3806	174.2718	173.800	823,678.615	3,336,142.908
6	7	213	35	30	213.5917	207.8635	363.585	823,357.183	3,335,972.981
7	8	185	10	44	185.1789	213.0424	408.233	823,014.974	3,335,750.388
8	9	175	27	29	175.4581	208.5004	306.406	822,745.701	3,335,604.182
9	10	310	49	4	310.8178	339.3182	353.194	823,076.133	3,335,479.441

Annex – D

LEVEL SHEET FOR WASTE WATER TREATMENT PLANT
SOUTH WEST SITE

FROM	TO	RUN	CLOSE	DIFFER	ELEVATION
	ST01				205.00
ST01	**ST02**	-0.215	0.215	**-0.215**	**204.785**
ST02	**ST03**	0.177	-0.181	**0.179**	**204.964**
ST03	**ST04**	-0.084	0.084	**-0.084**	**204.880**
ST04	**ST05**	-0.081	0.083	**-0.082**	**204.798**
ST05	**ST06**	-6.314	6.317	**-6.316**	**198.483**
ST06	**ST07**	-0.228	0.225	**-0.227**	**198.256**
ST07	**ST08**	0.626	-0.625	**0.626**	**198.882**
ST08	**ST09**	5.379	-5.376	**5.378**	**204.259**
ST09	**ST10**	-0.024	0.02	**-0.022**	**204.237**
	ST5				**204.798**
ST5	**ST11**	-0.202	0.20	**-0.201**	**204.597**
ST11	**ST12**	0.028	-0.03	**0.029**	**204.626**
ST12	**ST13**	-0.303	0.305	**-0.304**	**204.322**
ST13	**ST14**	-0.074	0.078	**-0.076**	**204.246**
ST14	**ST15**	-0.056	0.055	**-0.056**	**204.191**
ST15	**ST9**	0.076	-0.075	**0.076**	**204.266**
ST9	**ST16**	-4.808	4.809	**-4.809**	**199.458**
ST16	**ST17**	-0.118	0.119	**-0.119**	**199.339**
ST17	**ST18**	-0.11	0.114	**-0.112**	**199.227**
ST18	**ST19**	0.177	-0.177	**0.177**	**199.397**
ST19	**ST20**	-0.126	0.123	**-0.125**	**199.273**
ST20	**ST21**	0.55	-0.552	**0.551**	**199.824**
ST21	**ST22**	-0.106	0.108	**-0.107**	**199.717**
ST22	**ST23**	0.663	-0.66	**0.662**	**200.378**
ST23	**ST24**	-0.804	0.803	**-0.804**	**199.575**
ST24	**ST25**	-0.914	0.913	**-0.914**	**198.661**
ST25	**ST26**	1.465	-1.465	**1.465**	**200.126**
ST26	**ST27**	-2.932	2.934	**-2.933**	**197.193**
ST27	**ST01**	7.803	-7.807	**7.805**	**204.998**

Annex – E

LEVEL SHEET FOR COLECTOR CHANNAL7 KM

FROM	TO	RUN	CLOSE	DIFFER	ELEVATION
	ST3				204.964
ST3	**ST28**	-8.225	8.226	**-8.226**	**196.739**
ST28	**ST29**	2.06	-2.06	**2.060**	**198.799**
ST29	**ST30**	0.229	-0.229	**0.229**	**199.028**
ST30	**ST31**	10.77	-10.77	**10.769**	**209.797**
ST31	**ST32**	-4.226	4.225	**-4.226**	**205.571**
ST32	**ST33**	-5.724	5.721	**-5.723**	**199.849**
ST33	**ST34**	1.625	-1.623	**1.624**	**201.473**
ST34	**ST35**	0.754	-0.751	**0.753**	**202.225**
ST35	**ST36**	1.084	-1.087	**1.086**	**203.311**
ST36	**ST37**	-3.568	3.564	**-3.566**	**199.745**
ST37	**ST38**	3.729	-3.731	**3.730**	**203.475**
ST38	**ST39**	-2.054	2.058	**-2.056**	**201.419**
ST39	**ST40**	0.376	-0.372	**0.374**	**201.793**
ST40	**ST41**	3.791	-3.792	**3.792**	**205.584**
ST41	**ST42**	-4.274	4.273	**-4.274**	**201.311**
ST42	**ST43**	0.696	-0.7	**0.698**	**202.009**
ST43	**ST44**	1.48	-1.479	**1.480**	**203.488**
ST44	**ST45**	-0.2	0.197	**-0.199**	**203.290**
ST45	**ST46**	-0.726	0.725	**-0.726**	**202.564**
ST46	**ST47**	2.05	-2.047	**2.049**	**204.613**

Annex – F

TRAVERSE SHEET FOR COLLECTOR CHANNEL

STATION		ANGLE			ANGLE	BEARING	DISTT	NORTHING	EASTING
FROM	TO	DEG	MIN	SEC		DEC-DEG	M	m	m
	3							**824,114.559**	**3,335,695.068**
3	**28**					**62.0157**	**494.267**	824,346.484	3,336,131.543
28	29	148	38	15	148.6375	30.6532	314.156	824,616.743	3,336,291.712
29	30	172	56	24	172.9400	23.5932	445.077	825,024.617	3,336,469.850
30	31	181	52	43	181.8786	25.4718	378.88	825,366.668	3,336,632.793
31	32	181	35	19	181.5886	27.0604	307.35	825,640.372	3,336,772.616
32	33	176	56	1	176.9336	23.9940	259.351	825,877.312	3,336,878.079
33	34	159	31	14	159.5206	3.5145	400.523	826,277.082	3,336,902.632
34	35	176	24	56	176.4156	-0.0699	446.342	826,723.423	3,336,902.087
35	36	182	43	56	182.7322	2.6623	566.002	827,288.814	3,336,928.378
36	37	196	30	14	196.5039	19.1662	386.562	827,653.949	3,337,055.290
37	38	217	49	49	217.8303	56.9965	574.564	827,966.909	3,337,537.140
38	39	151	27	7	151.4519	28.4484	522.423	828,426.247	3,337,786.006
39	40	182	16	37	182.2769	30.7254	538.153	828,888.858	3,338,060.961
40	41	174	10	24	174.1733	24.8987	391.566	829,244.029	3,338,225.816
41	42	157	28	8	157.4689	2.3676	251.944	829,495.758	3,338,236.224
42	43	174	26	55	174.4486	-3.1838	303.069	829,798.359	3,338,219.392
43	44	253	34	22	253.5728	70.3890	451.63	829,949.941	3,338,644.825
44	45	196	16	28	196.2744	86.6634	222.231	829,962.875	3,338,866.679
45	46	157	10	41	157.1781	63.8415	125.779	830,018.325	3,338,979.575
46	47	196	48	11	196.8031	80.6445	145.991	830,042.057	3,339,123.624
47	CP1	359	39	19	359.6553	260.2998	150.312	830,016.731	3,338,975.461
CP1	CP2	164	29	42	164.4950	244.7948	119.012	829,966.048	3,338,867.781
CP2	CP3	198	21	18	198.3550	263.1498	414.686	829,916.587	3,338,456.055
CP3	CP4	138	37	43	138.6286	221.7784	359.92	829,648.185	3,338,216.258
CP4	42	130	45	52	130.7644	172.5429	153.708	829,495.777	3,338,236.206
42	CP5	190	27	11	190.4531	182.9959	284.277	829,211.889	3,338,221.349
CP5	CP6	205	34	37	205.5769	208.5729	392.482	828,867.208	3,338,033.634
CP6	CP7	179	31	56	179.5322	208.1051	450.974	828,469.410	3,337,821.184
CP7	CP8	181	51	49	181.8636	209.9687	576.364	827,970.107	3,337,533.275
CP8	37	206	34	7	206.5686	236.5373	573.16	827,654.070	3,337,055.119
37	CP9	142	56	23	142.9397	199.4770	387.238	827,288.992	3,336,926.002
CP9	CP10	163	8	14	163.1372	182.6143	575.228	826,714.363	3,336,899.765
CP10	CP11	177	43	3	177.7175	180.3318	437.896	826,276.474	3,336,897.230
CP11	CP12	182	55	37	182.9269	183.2587	399.987	825,877.134	3,336,874.493
CP12	CP13	200	38	33	200.6425	203.9012	256.951	825,642.217	3,336,770.386
CP13	CP14	183	13	40	183.2278	207.1290	304.009	825,371.655	3,336,631.759
CP14	CP15	178	31	46	178.5294	205.6584	406.429	825,005.303	3,336,455.773
CP15	CP16	176	49	50	176.8306	202.4890	419.782	824,617.444	3,336,295.204
CP16	ST3	207	35	23	207.5897	230.0787	783.193	824,114.842	3,335,694.553
ST3	ST28	11	56	11	11.9364	62.0151	494.264	824,346.770	3,336,131.023

Summary of Geographic Survey

Contents

1. Borehole Logs

Location of borehole logs are shown in the Topographic survey drawings.

<WWTP BH-01>

PROJECT: Waste Water Treatment Plant.

LOCATION: Babu Sabu to Saggian Interchange.

BORE HOLE NO. : BH-01

SHEET NO. : 1 of 1

WATER TABLE : 6.0 M

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows	S.P.T. CURVE (10 20 30 40 50 60 70)
	1	◆		Gray Loose to Medium Dense Fine Sand Trace Mica Trace Concretion		04	
	2	◆				05	
	3	◆				04	
	4	◆				10	
	5	◆				13	
	6	◆	t			09	
	7	◆				11	
	8	◆				13	
	9	◆				13	
	10	◆				10	
	11	◆				13	
	12	◆				15	
	13	◆				15	
	14	◆				14	
	15	◆				15	

◆ Disturbed Sample

⌘ Undisturbed Sample

↓ S.P.T.

t Water Table

Z Drill Core Sample

⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 01-06-2009

Date of Completion 01-06-2009

<WWTP BH-02>

PROJECT: Waste Water Treatment Plant.	BORE HOLE NO. : BH-02
LOCATION: Babu Sabu to Saggian Interchange.	SHEET NO. : 1 of 1
	WATER TABLE : 10.0 M

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows
	1	◆		Light Brown Very Loose Silty Sand Trace Mica		03
	2	◆		Brown Very Soft Clayey Silt Low Plastic		00
	3	◆				04
	4	◆		Gray Loose to Medium Dense Silty Sand Trace Mica Trace Concretion		05
	5	◆				06
	6	◆				07
	7	◆				17
	8	◆				14
	9	◆				17
	10	◆	t			10
	11	◆				23
	12	◆				21
	13	◆				24
	14	◆				24
	15	◆				28

S.P.T. CURVE: 10 20 30 40 50 60 70

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 02-06-2009

Date of Completion 02-06-2009

<WWTP BH-03>

PROJECT: Waste Water Treatment Plant.

LOCATION: Babu Sabu to Saggian Interchange.

BORE HOLE NO. : BH-03
SHEET NO. : 1 of 1
WATER TABLE : 9.5 M

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows
	1	◆		Brown Very Soft Clayey Silt		02
	2	◆		Gray Loose Sandy Silt Trace Mica		06
	3	◆				08
	4	◆		Gray Loose to Medium Dense Silty Sand Trace Mica		07
	5	◆				06
	6	◆				10
	7	◆				11
	8	◆		Gray Loose Sandy Silt Trace Mica		08
	9	◆	t			21
	10	◆				23
	11	◆		Gray Medium Dense Silty Sand Trace Mica		24
	12	◆				26
	13	◆				18
	14	◆				19
	15	◆				21

S.P.T. CURVE: 10 20 30 40 50 60 70

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 02-06-2009
Date of Completion 02-06-2009

<WWTP BH-04>

PROJECT: Waste Water Treatment Plant.

LOCATION: Babu Sabu to Saggian Interchange.

BORE HOLE NO. : BH-04
SHEET NO. : 1 of 1
WATER TABLE : 10.5 M

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows
	1	◆		Light Gray Very Loose to Loose Sandy Silt Trace Mica		03
	2	◆				05
	3	◆				08
	4	◆				06
	5	◆				07
	6	◆				07
	7	◆		Gray Loose to Medium Dense Silty Sand Trace Mica Trace Concretion		08
	8	◆				08
	9	◆				08
	10	◆	t			09
	11	◆				12
	12	◆				15
	13	◆				19
	14	◆				18
	15	◆				17

S.P.T. CURVE: 10 20 30 40 50 60 70

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 03-06-2009
Date of Completion 03-06-2009

<WWTP BH-05>

PROJECT: Waste Water Treatment Plant.

LOCATION: Babu Sabu to Saggian Interchange.

BORE HOLE NO. : BH-05
SHEET NO. : 1 of 1
WATER TABLE : 10.0 M

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows
	1	◆		Gray Loose to Medium Dense Silty Fine Sand Trace Mica Trace Concretion		02
	2	◆				07
	3	◆				04
	4	◆				06
	5	◆				07
	6	◆				09
	7	◆				07
	8	◆				09
	9	◆	t			03
	10	◆				09
	11	◆				11
	12	◆				15
	13	◆				18
	14	◆				20
	15	◆				15

S.P.T. CURVE: 10 20 30 40 50 60 70

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 03-06-2009
Date of Completion 03-06-2009

<Collector Channel BH-01>

PROJECT: Waste Water Treatment Plant (Collateral Channel).	BORE HOLE NO. : BH-01
LOCATION: Babu Sabu to Saggian Interchange.	SHEET NO. : 1 of 1
	WATER TABLE : N.E

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows	S.P.T. CURVE (10 20 30 40 50 60 70)
	1	◆		Gray Very Loose Silty Sand Trace Mica	++++	01	
	2	◆				04	
	3	◆				06	
	4	◆		Gray Loose to Medium Dense Silty Fine Sand Trace Mica Trace Concretion		06	
	5	◆				11	
	6	◆				14	
	7	◆				15	
	8	◆				15	
	9	◆				16	
	10	◆				16	

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 08-06-2009

Date of Completion 08-06-2009

<Collector Channel BH-02>

PROJECT: Waste Water Treatment Plant (Collateral Channel).	BORE HOLE NO. : BH-02
LOCATION: Babu Sabu to Saggian Interchange.	SHEET NO. : 1 of 1
	WATER TABLE : N.E

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows	S.P.T. CURVE (10 20 30 40 50 60 70)
	1	◆		Brown Soft Clayey Silt Low Plastic		04	
	2	◆		Gray Very Loose Sandy Silt Trace Mica		04	
	3	◆		Gray Loose to Medium Dense Silty Fine Sand Trace Mica Trace Concretion		06	
	4	◆				05	
	5	◆				06	
	6	◆				07	
	7	◆				07	
	8	◆				09	
	9	◆				11	
	10	◆				13	

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 06-06-2009

Date of Completion 06-06-2009

<Collector Channel BH-03>

PROJECT: Waste Water Treatment Plant (Collateral Channel).
LOCATION: Babu Sabu to Saggian Interchange.

BORE HOLE NO. : BH-03
SHEET NO. : 1 of 1
WATER TABLE : N.E

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows	S.P.T. CURVE (10 20 30 40 50 60 70)
	1	◆		Gray Loose Silty Sand Trace Mica		03	
	2	◆		Gray Loose Sandy Silt Trace Mica		05	
	3	◆		Gray Loose to Medium Dense Fine Sand Trace Mica Trace Concretion		03	
	4	◆				05	
	5	◆				07	
	6	◆				10	
	7	◆				08	
	8	◆				09	
	9	◆				08	
	10	◆				09	

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 06-06-2009
Date of Completion 06-06-2009

<Collector Channel BH-04>

PROJECT: Waste Water Treatment Plant (Collateral Channel).
LOCATION: Babu Sabu to Saggian Interchange.

BORE HOLE NO. : BH-04
SHEET NO. : 1 of 1
WATER TABLE : 9.0 M

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows	S.P.T. CURVE
	1	◆		Gray Very Loose Sandy Silt Trace Mica		01	
	2	◆				01	
	3	◆		Gray Loose to Medium Dense Silty Sand Trace Mica		05	
	4	◆				12	
	5	◆				15	
	6	◆				17	
	7	◆				13	
	8	◆				14	
	9	◆	t			07	
	10	◆				08	

S.P.T. CURVE: 10 20 30 40 50 60 70

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 05-06-2009
Date of Completion 05-06-2009

<Collector Channel BH-05>

PROJECT: Waste Water Treatment Plant (Collateral Channel).
LOCATION: Babu Sabu to Saggian Interchange.

BORE HOLE NO. : BH-05
SHEET NO. : 1 of 1
WATER TABLE : N.E

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows	S.P.T. CURVE (10 20 30 40 50 60 70)
	1	◆		Gray Loose Silty Fine Sand Trace Mica		05	
	2	◆				07	
	3	◆				11	
	4	◆				05	
	5	◆				04	
	6	◆				10	
	7	◆				07	
	8	◆				10	
	9	◆				08	
	10	◆				08	

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 06-06-2009
Date of Completion 06-06-2009

<Collector Channel BH-06>

PROJECT: Waste Water Treatment Plant (Collateral Channel).	BORE HOLE NO. : BH-06
CLIENT: Babu Sabu to Saggian Interchange.	SHEET NO. : 1 of 1
	WATER TABLE : 08.0 M

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows	S.P.T. CURVE (10 20 30 40 50 60 70)
	1	◆		Gray Very Loose to Medium Dense Silty Fine Sand Trace Mica		01	
	2	◆				03	
	3	◆				04	
	4	◆				08	
	5	◆				12	
	6	◆				13	
	7	◆				15	
	8	◆	t			13	
	9	◆				15	
	10	◆				16	
	11	◆				18	
	12	◆				17	
	13	◆				19	
	14	◆				17	
	15	◆				16	
	16	◆				19	
	17	◆				19	
	18	◆				19	
	19	◆				21	
	20	◆				20	

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 08-06-2009

Date of Completion 08-06-2009

<Collector Channel BH-07>

PROJECT: Waste Water Treatment Plant (Collateral Channel).	BORE HOLE NO. : BH-07
CLIENT: Babu Sabu to Saggian Interchange.	SHEET NO. : 1 of 1
	WATER TABLE : 11.0 M

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows
	1	◆		Light Brown Very Loose Sandy Silt		02
	2	◆		Gray Very Loose to Medium Dense Silty Fine Sand Trace Mica, Trace Concretion		05
	3	◆				06
	4	◆				07
	5	◆				07
	6	◆				08
	7	◆				08
	8	◆				16
	9	◆				17
	10	◆				12
	11	◆	t			14
	12	◆				13
	13	◆				14
	14	◆				14
	15	◆				15
	16	◆				12
	17	◆				24
	18	◆				26
	19	◆				28
	20	◆				29

S.P.T. CURVE: 10 20 30 40 50 60 70

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 05-06-2009

Date of Completion 05-06-2009

<Collector Channel BH-08>

PROJECT: Waste Water Treatment Plant (Collateral Channel).	BORE HOLE NO. : BH-08
CLIENT: Babu Sabu to Saggian Interchange.	SHEET NO. : 1 of 1
	WATER TABLE : 10.5 M

Reduced Level	Depth (in mtr.)	Sample	Thick-ness	Strata Encountered	Legend	S.P.T. No. of Blows
	1	◆		Gray Very Loose to Medium Dense Silty Fine Sand Trace Mica	++++	06
	2	◆			++++	04
	3	◆			..... ++++	05
	4	◆			.... ++++	08
	5	◆			.....	07
	6	◆			..... ++++	09
	7	◆			..... ++++	08
	8	◆			.... ++++	10
	9	◆			.....	15
	10	◆	t		..... ++++	19
	11	◆			.... ++++	19
	12	◆			.....	18
	13	◆			..... ++++	17
	14	◆			..... ++++	17
	15	◆			.... ++++	19
	16	◆			.....	16
	17	◆			..... ++++	15
	18	◆			.... ++++	16
	19	◆			....	17
	20	◆			++++	15

S.P.T. CURVE: 10 20 30 40 50 60 70

◆ Disturbed Sample
⌘ Undisturbed Sample
↓ S.P.T.
t Water Table
Z Drill Core Sample
⊠ Vane Shear Test

REMARKS:

Tested By: Rauf Ahmad

Checked By: _____

Date of Commencement 08-06-2009

Date of Completion 08-06-2009

2. Empirical Values for φ, q_u, D_r and Unit Weight of Soils based on the SPT

GRANULAR SOILS					
Description	Very Loose	Loose	Medium	Dense	Very Dense
Relative Density, D_r	0-0.15	0.15-0.35	0.35-0.65	0.65-0.85	0.85-1.00
Standard Penetration Test value, N	0-4	5-10	11-30	31-50	51-UP
Approximate angle of internal friction, ϕ (degree)	25-28	28-30	30-35	35-40	38-43
Approximate range of moist unit weight, γ (pcf)	70-100	90-115	110-130	110-140	130-150
Submerged unit weight, γ_{sub}	60	55-65	60-70	65-85	75

COHESIVE SOILS						
Description	Very Soft	Soft	Firm	Stiff	Very Stiff	Hard
Unconfined compressive strength, q_u (tsf)	0-0.25	0.25-0.5	0.5-1.0	1.0-2.0	2.0-4.0	4.0-UP
Standard Penetration Test value, N	0-2	3-4	5-8	9-16	17-32	33-UP
Approx. range of saturated unit weight, γ_{sat} (pcf)	100-120		100-130	120-140		130*

3. Laboratory Test Results

Depth (m)	Soil Classification			Atterberg's Limit			Moisture Content	Direct Shear	
	Gravel %	Sand %	Silt & Clay %	LL		PI		C kPa	ϕ^o
Waste Water Treatment Plant									
Borehole No. 01									
01	--	83	17	Non-Plastic			7.4	--	--
02	--	83	17	Non-Plastic			8.2	--	--
03	--	87	13	Non-Plastic			9.1	3.2	20.8
04	--	89	11	Non-Plastic			14.4	--	--
05	--	72	28	Non-Plastic			16.3	--	--
06	--	54	46	Non-Plastic			19.6	--	--
07	--	67	33	Non-Plastic			21.1	--	--
08	--	78	22	Non-Plastic			22.1	--	--
09	--	81	19	Non-Plastic			19.8	--	--
10	--	89	11	Non-Plastic			20.6	--	--
11	--	90	10	Non-Plastic			18.6	--	--
12	--	86	14	Non-Plastic			20.2	--	--
13	--	89	11	Non-Plastic			19.7	--	--
14	--	90	10	Non-Plastic			20.3	--	--
15	--	87	13	Non-Plastic			21.4	--	--
Borehole No. 02									
01	--	61	39	Non-Plastic			6.7	--	--
02	--	06	94	27	19	08	8.1	--	--
03	--	64	36	Non-Plastic			7.6	--	--
04	--	82	18	Non-Plastic			8.8	3.0	21.6
05	--	84	16	Non-Plastic			8.2	--	--
06	--	79	21	Non-Plastic			9.3	--	--
07	--	73	27	Non-Plastic			14.1	--	--
08	--	59	41	Non-Plastic			16.2	--	--
09	--	71	29	Non-Plastic			17.4	--	--
10	--	65	35	Non-Plastic			22.4	--	--
11	--	68	32	Non-Plastic			20.6	--	--
12	--	71	29	Non-Plastic			22.7	--	--
13	--	75	25	Non-Plastic			21.6	--	--
14	--	80	20	Non-Plastic			22.7	--	--
15	--	81	19	Non-Plastic			23.3	--	--

Cont.

Depth (m)	Soil Classification			Atterberg's Limit			Moisture Content	Direct Shear	
	Gravel %	Sand %	Silt & Clay %	LL		PI		C kPa	ϕ^o
Waste Water Treatment Plant									
Borehole No. 03									
01	--	10	90	Non-Plastic			11.6	--	--
02	--	39	61	Non-Plastic			14.4	--	--
03	--	59	41	Non-Plastic			13.7	--	--
04	--	55	45	Non-Plastic			17.6	--	--
05	--	62	38	Non-Plastic			18.1	--	--
06	--	58	42	Non-Plastic			20.2	2.8	22.1
07	--	56	44	Non-Plastic			22.6	--	--
08	--	38	62	Non-Plastic			23.7	--	--
09	--	53	47	Non-Plastic			25.7	--	--
10	--	54	46	Non-Plastic			21.6	--	--
11	--	72	28	Non-Plastic			22.9	--	--
12	--	76	24	Non-Plastic			24.2	--	--
13	--	61	39	Non-Plastic			26.1	--	--
14	--	68	32	Non-Plastic			24.7	--	--
15	--	72	28	Non-Plastic			26.1	--	--
Borehole No. 04									
01	--	49	51	Non-Plastic			10.4	--	--
02	--	40	60	Non-Plastic			12.7	--	--
03	--	84	16	Non-Plastic			14.1	--	--
04	--	88	12	Non-Plastic			16.7	--	--
05	--	84	16	Non-Plastic			14.6	--	--
06	--	86	14	Non-Plastic			18.7	--	--
07	--	81	19	Non-Plastic			16.9	--	--
08	--	78	22	Non-Plastic			17.8	2.5	20.6
09	--	74	26	Non-Plastic			22.1	--	--
10	--	82	18	Non-Plastic			26.1	--	--
11	--	86	14	Non-Plastic			24.1	--	--
12	--	90	10	Non-Plastic			23.1	--	--
13	--	92	08	Non-Plastic			24.6	--	--
14	--	93	07	Non-Plastic			26.4	--	--
15	--	91	09	Non-Plastic			25.7	--	--

Cont.

Depth (m)	Soil Classification			Atterberg's Limit			Moisture Content	Direct Shear	
	Gravel %	Sand %	Silt & Clay %	LL		PI		C kPa	ϕ^o
Waste Water Treatment Plant									
Borehole No. 05									
01	--	61	39	Non-Plastic			9.1	--	--
02	--	74	26	Non-Plastic			7.6	--	--
03	--	81	19	Non-Plastic			12.1	--	--
04	--	79	21	Non-Plastic			14.7	--	--
05	--	66	34	Non-Plastic			16.6	--	--
06	--	78	22	Non-Plastic			19.7	--	--
07	--	81	19	Non-Plastic			22.7	--	--
08	--	87	13	Non-Plastic			20.6	--	--
09	--	84	16	Non-Plastic			24.1	3.4	19.7
10	--	82	18	Non-Plastic			25.1	--	--
11	--	88	12	Non-Plastic			26.1	--	--
12	--	86	14	Non-Plastic			24.9	--	--
13	--	91	09	Non-Plastic			23.7	--	--
14	--	88	12	Non-Plastic			26.4	--	--
15	--	89	11	Non-Plastic			25.7	--	--
Collector Channel									
Borehole No. 01									
01	--	85	15	Non-Plastic			6.2	--	--
02	--	90	10	Non-Plastic			7.4	--	--
03	--	97	03	Non-Plastic			8.9	3.5	19.4
04	--	94	06	Non-Plastic			10.4	--	--
05	--	96	04	Non-Plastic			11.8	--	--
06	--	94	06	Non-Plastic			12.4	--	--
07	--	96	04	Non-Plastic			14.9	--	--
08	--	95	05	Non-Plastic			16.1	--	--
09	--	93	07	Non-Plastic			18.7	--	--
10	--	97	03	Non-Plastic			19.9	--	--

Cont.

Depth (m)	Soil Classification			Atterberg's Limit			Moisture Content	Direct Shear	
	Gravel %	Sand %	Silt & Clay %	LL		PI		C kPa	ϕ^o
Collector Channel									
Borehole No. 02									
01	--	07	93	Non-Plastic			6.4	--	--
02	--	39	61	Non-Plastic			6.9	--	--
03	--	88	12	Non-Plastic			7.6	--	--
04	--	94	06	Non-Plastic			7.2	--	--
05	--	93	07	Non-Plastic			8.6	2.5	20.6
06	--	91	09	Non-Plastic			9.3	--	--
07	--	95	05	Non-Plastic			10.7	--	--
08	--	92	08	Non-Plastic			14.1	--	--
09	--	89	11	Non-Plastic			17.6	--	--
10	--	87	13	Non-Plastic			19.3	--	--
Borehole No. 03									
01	--	67	33	Non-Plastic			7.4	--	--
02	--	42	58	Non-Plastic			6.1	--	--
03	--	95	05	Non-Plastic			8.8	--	--
04	--	95	05	Non-Plastic			9.1	--	--
05	--	93	07	Non-Plastic			12.4	--	--
06	--	93	07	Non-Plastic			14.7	--	--
07	--	92	08	Non-Plastic			16.8	2.1	22.5
08	--	90	10	Non-Plastic			18.4	--	--
09	--	91	09	Non-Plastic			17.1	--	--
10	--	93	07	Non-Plastic			19.8	--	--
Borehole No. 04									
01	--	44	56	Non-Plastic			8.6	--	--
02	--	48	52	Non-Plastic			8.2	--	--
03	--	77	23	Non-Plastic			10.4	--	--
04	--	85	15	Non-Plastic			11.7	--	--
05	--	86	14	Non-Plastic			14.1	--	--
06	--	88	12	Non-Plastic			13.9	--	--
07	--	84	16	Non-Plastic			16.4	--	--
08	--	89	11	Non-Plastic			18.8	--	--
09	--	86	14	Non-Plastic			24.1	--	--
10	--	89	11	Non-Plastic			22.4	2.2	23.1

Cont.

Depth (m)	Soil Classification			Atterberg's Limit			Moisture Content	Direct Shear	
	Gravel %	Sand %	Silt & Clay %	LL		PI		C kPa	ϕ^o
Collector Channel									
Borehole No. 05									
01	--	88	12	Non-Plastic			5.3	--	--
02	--	92	08	Non-Plastic			8.1	--	--
03	--	91	09	Non-Plastic			6.9	--	--
04	--	79	21	Non-Plastic			7.6	--	--
05	--	76	14	Non-Plastic			8.7	--	--
06	--	88	12	Non-Plastic			9.1	--	--
07	--	92	08	Non-Plastic			13.1	--	--
08	--	89	11	Non-Plastic			15.7	--	--
09	--	91	09	Non-Plastic			16.9	--	--
10	--	94	06	Non-Plastic			17.4	--	--
Borehole No. 06									
01	--	95	05	Non-Plastic			5.7	--	--
02	--	93	07	Non-Plastic			8.3	--	--
03	--	95	05	Non-Plastic			7.9	--	--
04	--	97	03	Non-Plastic			8.3	--	--
05	--	86	14	Non-Plastic			9.2	--	--
06	--	91	09	Non-Plastic			9.6	--	--
07	--	94	06	Non-Plastic			8.2	--	--
08	--	96	04	Non-Plastic			9.3	--	--
09	--	97	03	Non-Plastic			16.6	--	--
10	--	96	04	Non-Plastic			21.2	--	--
11	--	97	03	Non-Plastic			23.4	--	--
12	--	93	07	Non-Plastic			22.9	--	--
13	--	91	09	Non-Plastic			21.7	--	--
14	--	90	10	Non-Plastic			23.1	--	--
15	--	97	03	Non-Plastic			19.4	--	--
16	--	96	04	Non-Plastic			20.7	--	--
17	--	94	06	Non-Plastic			19.6	--	--
18	--	93	07	Non-Plastic			21.2	--	--
19	--	90	10	Non-Plastic			20.1	--	--
20	--	78	22	Non-Plastic			19.1	--	--

Cont.

Depth (m)	Soil Classification			Atterberg's Limit			Moisture Content	Direct Shear	
	Gravel %	Sand %	Silt & Clay %	LL		PI		C kPa	ϕ^o
Collector Channel									
Borehole No. 07									
01	--	47	53	Non-Plastic			6.1	--	--
02	--	54	46	Non-Plastic			7.2	--	--
03	--	91	09	Non-Plastic			6.8	--	--
04	--	85	15	Non-Plastic			8.3	--	--
05	--	88	12	Non-Plastic			8.6	--	--
06	--	91	09	Non-Plastic			9.8	--	--
07	--	87	13	Non-Plastic			10.2	--	--
08	--	84	16	Non-Plastic			16.4	--	--
09	--	88	12	Non-Plastic			16.8	--	--
10	--	90	10	Non-Plastic			19.4	--	--
11	--	86	14	Non-Plastic			22.9	--	--
12	--	89	11	Non-Plastic			24.1	--	--
13	--	81	09	Non-Plastic			21.7	--	--
14	--	88	12	Non-Plastic			23.1	--	--
15	--	89	11	Non-Plastic			24.2	--	--
16	--	87	13	Non-Plastic			23.6	--	--
17	--	89	11	Non-Plastic			24.8	--	--
18	--	90	10	Non-Plastic			22.4	--	--
19	--	92	08	Non-Plastic			22.7	--	--
20	--	91	09	Non-Plastic			24.6	--	--
Borehole No. 08									
01	--	79	21	Non-Plastic			7.1	--	--
02	--	94	06	Non-Plastic			8.9	--	--
03	--	84	16	Non-Plastic			7.9	--	--
04	--	81	19	Non-Plastic			8.2	--	--
05	--	78	22	Non-Plastic			9.7	--	--
06	--	91	09	Non-Plastic			13.7	--	--
07	--	94	06	Non-Plastic			16.2	--	--
08	--	96	04	Non-Plastic			19.2	--	--
09	--	94	06	Non-Plastic			22.4	--	--
10		96	04	Non-Plastic			18.2	--	--

Cont.

Depth (m)	Soil Classification			Atterberg's Limit			Moisture Content	Direct Shear	
	Gravel %	Sand %	Silt & Clay %	LL		PI		C kPa	ϕ^o
Collector Channel									
Borehole No. 08									
11	--	97	03	Non-Plastic			18.2	--	--
12	--	94	06	Non-Plastic			19.3		
13	--	95	05	Non-Plastic			17.4	--	--
14	--	94	06	Non-Plastic			21.1	--	
15	--	96	04	Non-Plastic			22.4	--	--
16	--	93	07	Non-Plastic			19.2	--	--
17	--	97	03	Non-Plastic			18.2	--	--
18	--	95	05	Non-Plastic			19.6	--	--
19	--	95	05	Non-Plastic			18.6	--	--
20	--	96	04	Non-Plastic			19.7	--	--

4. Permeability Test Results

Location	Borehole No	Test Depth (m)	Hydraulic Conductivity (cm/sec)
Wastewater Treatment Plant	BH-1	6.0	.000303
	BH-2	10.0	.000184
	BH-3	5.0	.000819
	BH-4	7.0	.000255
	BH-5	4.0	.000178
Collector Channel	BH-1	5.0	.000884
	BH-2	2.5	.000160
	BH-3	3.0	.000485
	BH-4	3.0	.000794
	BH-5	2.0	.000420
	BH-6	4.0	.000185
	BH-7	6.0	.000441
	BH-8	3.0	.000262

5. Field Density Test Results

Pit No.	Field Dry Density gms/cc	Moisture Content %	Compaction %
Waste Water Treatment Plant			
01	1.313	8.1	7.4
02	1.794	7.2	74.7
03	1.559	11.8	79.3
04	1.334	10.8	74.7
05	1.395	9.9	78.5
Collector Channel			
01	1.322	6.2	75.7
02	1.337	7.9	75.2

03	1.390	8.2	77.4
04	1.340	9.1	76.2
05	1.229	5.8	72.9
06	1.362	7.2	77.3
07	1.304	7.2	73.4
08	1.372	6.8	78.6

Appendix 14.1 Direct Construction Cost

Cost Breakdown

(Direct Construction cost)

US $	= yen	92.53
PK･Rupee	= yen	1.26

Water Supply

Item	Unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			yen	PK･Rupee	yen	PK･Rupee	yen
Installation of Customer meters	LS	1	1,170,400,000	203,280,000	1,170,400,000	203,280,000	1,426,532,800
Installation of Chlorinators for Tubewells	LS	1	19,600,020	376,200	19,600,020	376,200	20,074,032
Installation of Bulk flow meters for Tubewells	LS	1	138,551,800	122,116,300	138,551,800	122,116,300	292,418,338
Equipments for UFW control	LS	1	55,580,000	0	55,580,000	0	55,580,000
Total					1,384,131,820	325,772,500	1,794,605,170

Sewerage

Item	Unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			yen	PK･Rupee	yen	PK･Rupee	yen
Laying of Sewers	LS	1	0	2,047,581,536	0	2,047,581,536	2,579,952,735
Disposal Station	LS	1	541,495,000	282,686,165	541,495,000	282,686,165	897,679,568
Collector Channel	LS	1	0	917,591,002	0	917,591,002	1,156,164,663
Lift Station for WWTP	LS	1	304,416,000	235,211,125	304,416,000	235,211,125	600,782,018
Wastewater Treatment Plant	LS	1	7,745,680,000	4,105,159,491	7,745,680,000	4,105,159,491	12,918,180,959
Total					8,591,591,000	7,588,229,319	18,152,759,942

Drainage

Item	Unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			yen	PK･Rupee	yen	PK･Rupee	yen
Construction of Deainage System	LS	1	0	2,460,505,528	0	2,460,505,528	3,100,236,965
Improvement and Rehabilitation of Drainage System	LS	1	0	229,200,044	0	229,200,044	288,792,055
Total					0	2,689,705,572	3,389,029,021

Management

Item	Unit	Quantity	Unit Price		Cost		Total
			Foreign	Local	Foreign	Local	
			yen	PK･Rupee	yen	PK･Rupee	yen
Procurement of O&M Equipment	LS	1	699,911,090	7,065,000	699,911,090	7,065,000	708,812,990
O&M Monitaring System	LS	1	873,800,000	0	873,800,000	0	873,800,000
Office System	LS	1	451,800,000	0	451,800,000	0	451,800,000
Billing System	LS	1	385,200,000	0	385,200,000	0	385,200,000
Mapping System	LS	1	288,700,000	0	288,700,000	0	288,700,000
Total					2,699,411,090	7,065,000	2,708,312,990

Grand Total (Direct Construction cost)					12,675,133,910	10,610,772,391	26,044,707,123

ROUGH COST ESTIMATE
FOR
WATER SUPPLY SYSTEM

Sr.No.	DESCRIPTION	AMOUNT (2009)			
		(¥)	(Rs)	CD(Rs)	Rs Total
1	Installation of Customer meters	1,170,400,000	203,280,000	234,080,000	437,360,000
2	Installation of Chlorinators for Tubewells	19,600,020	376,200	837,900	1,214,100
3	Installation of Bulk flow meters for Tubewells	138,551,800	122,116,300	27,585,200	149,701,500
4	Equipments for UFW control	55,580,000	0	3,776,500	3,776,500
TOTAL		**1,384,131,820**	**325,772,500**	**266,279,600**	**592,052,100**

	Amount(￥)	Amount(Rs)
GRAND TOTAL	**1,384,131,820**	**592,052,100**
Say Rs.(Million)	**1,384.13**	**592.05**

	Exchange Rate(￥/Rs)	
GRAND TOTAL (￥)	**1.26**	**¥2,130,117,466**

ROUGH COST ESTIMATE
FOR
LAYING OF SEWERS

Sr.No.	DESCRIPTION	AMOUNT (Rs.) 2009	AMOUNT (Rs.) 2005	PROPORTION 2009/2005
i) Trunk sewer from Larex Colony to Gulshan-e-Ravi Pump Station				
1	Sewer from Larex Colony to Gulshan-e-Ravi Pump Station	658,554,086	425,374,475	1.55
Cost of shifting/relocation of existing services(25%)		164,638,522	106,343,619	1.55
Total Cost for Trunk Sewers		**823,192,608**	**531,718,094**	**1.55**
ii) Branch sewer from Larex Colony to Gulshan-e-Ravi Pump Station				
1	Sewer From Ghazi Mohallah Lift Station to Garhi Shahu Bazar	810,014	545,678	1.48
2	Sewer From Muhammad Nagar Lift Station to Garhi Shahu Chowk	7,683,816	5,242,732	1.47
3	Davis Road Sewer	11,052,997	6,385,633	1.73
4	Empress Road Sewer	8,827,116	5,657,238	1.56
5	Montgomary Sewer	15,403,328	9,318,937	1.65
6	Sewer From Thronton Road to Mcload Road	4,925,369	2,846,147	1.73
7	Sanda Road Sewer	40,223,860	22,243,976	1.81
	Sub-Total for Branch Sewerage System	**88,926,500**	**52,240,340**	**1.70**
Cost of shifting/relocation of existing services(25%)		22,231,625	13,060,085	1.70
Total Cost for Branch Sewers		**111,158,125**	**65,300,425**	**1.70**
iii) Trunk sewer along Cantonment Drain			**June 2009**	
1	Sewer along Cantonment Drain	890,584,642	894,890,203	1.00
Cost of shifting/relocation of existing services(25%)		222,646,161	(10%) 89,489,020	2.49
Total Cost for Trunk Sewers		**1,113,230,803**	**984,379,223**	**1.13**
GRAND TOTAL		**2,047,581,536**	**1,581,397,742**	**1.29**
Say Rs.(Million)		**2,047.58**	**1,581.40**	**1.29**

	Exchange Rate(¥/Rs)	Amount(Rs)	Amount(¥)
GRAND TOTAL (¥)	**1.35**	**2,047,581,536**	**2,764,235,074**

ROUGH COST ESTIMATE
FOR
CONSTRUCTION OF NEW GULSHAN-E-RAVI DISPOSAL STATION

Sr.No.	DESCRIPTION	AMOUNT (2009)			
		(¥)	(Rs)	CD(Rs)	Rs Total
1	EXCAVATION	0	2,433,063	0	2,433,063
2	CONCRETE	0	87,633,120	0	87,633,120
3	REINFORCEMENT	0	73,848,000	0	73,848,000
4	METAL WORK	0	4,825,000	0	4,825,000
5	BUILDING WORKS FOR PUMP STATION	0	7,492,725	0	7,492,725
6	BUILDING FOR TRANSFORMER ROOM & OFFICES	0	6,555,923	0	6,555,923
7	LAYING OF CABLE UNDERGROUND	0	263,334	0	263,334
8	PROVIDING & INSTALLATION OF EQUIPMENT	541,495,000	80,135,000	107,440,000	187,575,000
9	Payable to LESCO for Electric Connection	0	2,000,000	0	2,000,000
10	Providing / Installation PLC / Monitoring System	0	2,500,000	0	2,500,000
11	Provision for overflow including Construction of Box Drain from Wet Well to Gulshan-e-Ravi Drain & Gate	0	10,000,000	0	10,000,000
12	Re-modeling of Gulshan-e-Ravi Disposal Station Sullage Carrier	0	5,000,000	0	5,000,000
TOTAL		**541,495,000**	**282,686,165**	**107,440,000**	**390,126,165**

	Amount(¥)	Amount(Rs)
GRAND TOTAL	**541,495,000**	**390,126,165**
Say Rs.(Million)	**541.50**	**390.13**

	Exchange Rate(¥/Rs)	
GRAND TOTAL (¥)	**1.26**	**¥1,033,053,968**

ROUGH COST ESTIMATE
FOR
CONSTRUCTION OF COLLECTOR CHANNEL

Sr.No.	DESCRIPTION	AMOUNT (Rs.) 2009	RECITAL
1	EARTH WORK	29,767,810	
2	TEMPORARY WORKS	7,000,000	
3	REMOVAL WORKS	12,000,000	
4	MAINTENANCE ROAD	38,220,000	
5	COLLECTOR CHANNEL	169,582,231	
6	BOX CULVERTS	76,500,000	
7	COVERING OF CHANNEL FOR 3.0M WIDTH CHANNEL	33,326,762	
8	COVERING OF CHANNEL FOR 5.5M WIDTH CHANNEL	147,361,065	
9	COVERING OF CHANNEL FOR 10.0M WIDTH CHANNEL	375,833,134	
10	Provision for Overflows at the Junction of Main Out Fall Disposal Station & Gulshan-e-Ravi Sullage Carriers	8,000,000	
11	Provision for Extension and Overflows at the Junction of Multan Rd. Sullage Carriers	20,000,000	
GRAND TOTAL		**917,591,002**	
Say Rs.(Million)		**917.59**	

	Exchange Rate(¥/Rs)	Amount(Rs)	Amount(¥)
GRAND TOTAL (¥)	**1.26**	**917,591,002**	**1,156,164,663**

ROUGH COST ESTIMATE
FOR
CONSTRUCTION OF LIFT STATION

Sr.No.	DESCRIPTION	AMOUNT (2009)			
		(¥)	(Rs)	CD(Rs)	Rs Total
1	EXCAVATION	0	664,642	0	664,642
2	CONCRETE	0	53,839,132	0	53,839,132
3	REINFORCEMENT	0	52,292,496	0	52,292,496
4	METAL WORK	0	300,000	0	300,000
5	BUILDING WORKS FOR PUMP STATION	0	10,344,855	0	10,344,855
6	PROVIDING & INSTALLATION OF EQUIPMENT	304,416,000	112,770,000	60,400,000	173,170,000
7	Payable to LESCO for Electric Connection	0	5,000,000	0	5,000,000
TOTAL		**304,416,000**	**235,211,125**	**60,400,000**	**295,611,125**

	Amount(¥)	Amount(Rs)
GRAND TOTAL	**304,416,000**	**295,611,125**
Say Rs.(Million)	**304.42**	**295.61**

	Exchange Rate(¥/Rs)	
GRAND TOTAL (¥)	**1.26**	**¥676,886,018**

1 Rs=	**1.26**	**JPY**	Customer Duty (A)	**20%**
1 US$=	**92.53**	**JPY**	Customer Duty (B)	**20%**

Wastewater Treatment Plant Q= 790,000 m^3/day

Items	Specification	Unit	Qty	FC Portion (Yen)		LC Portion (Rs)		Reference
				Unit Price	Amount	Unit Price	Amount	
[Direct Cost]								
<Civil/Building work>								
Receiving Chamber/Screen		pc	1		0		18,056,247	
Anaerobic Pond		pc	1		580,800,000		965,303,680	
Trickling Filter basin		pc	1		4,224,000,000		1,742,184,950	
Sedimentation Pond		pc	1		1,336,500,000		779,115,550	
Administration building		pc	1		0		40,000,000	
Others (land improvement etc.)		pc	1		0		531,699,064	Above of 15%
Sub-Total					**6,141,300,000**		**4,076,359,491**	
<Mechanical/Erectrical work>								
Mechanical works		pc	1		1,770,400,000		28,800,000	
Electrical works		pc	1		1,416,320,000		0	
Sub-Total					**3,186,720,000**		**28,800,000**	
Direct Cost-Total					**9,328,020,000**		**4,105,159,491**	
				Custom Duty	(1582340000)			1,255,825,397 Rs
	Direct Cost-Total (excl. Custom duty)				**7,745,680,000**			
								5,360,984,888
Cost of shifting/relocation of under ground services								**5,360,985,000**
25.0%								
Sub-Total								
Contingencies								
3.0%								
Sub-Total								
Departmental Charges								
4.0%								
Sub-Total								
Construction Supervision								
2.0%								
Sub-Total								
Grand Total Cost					**7,745,680,000**	Yen	**4,105,159,491**	excl.Custom duty
Grand Total Cost (roundup)	**Rs**				**6,147,366,000**	Rs	**4,105,160,000**	1,000 roundup
Grand Total Cost (FC+LC)	**Rs**			**10,252,526,000**				

Items	Specification	Unit	Qty	FC Portion (Yen)		LC Portion (Rs)		Reference
				Unit Price	Amount	Unit Price	Amount	
1) Receiving Chamber/Screen								
Gravel		m^3	140		0	3,245	454,300	
Concrete for leveling		m^3	70		0	3,245	227,150	
Reinforced concrete	with Formwork	m^3	900		0	10,000	9,000,000	
Rebar fabrication and assembly		t	72		0	72,685	5,233,320	
Building work		m^2	300		0	5,000	1,500,000	
miscellaneous work		Ls	1		0		1,641,477	Above of 10%
Total Cost (Receiving Chamber/Screen)					0		18,056,247	
				Custom Duty				
2) Anaerobic Pond								
Excavation		m^3	1,584,000		0	105	166,320,000	
Embankment	with compaction	m^3	574,560		0	105	60,328,800	
Slope protection		m^2	33,600		0	1,500	50,400,000	
Liner sheet for seepage		m^2	387,200	1,500	580,800,000		0	
Distribution/Discharge Pit		Nos	16		0	3,000,000	48,000,000	
Inlet structure		Nos	8		0	2,000,000	16,000,000	
Distribution channel(1)	2500×2000×4 lane	m	500		0	200,000	100,000,000	
Distribution channel(2)	2500×2000×2 lane	m	2,000		0	100,000	200,000,000	
Distribution channel(3)	2500×2000	m	3,000		0	50,000	150,000,000	
Road pavement	R.C.C	m	1,500		0	15,000	22,500,000	
Road pavement	Crushed stone	m	6,400		0	10,000	64,000,000	
miscellaneous work		Ls	1		0		87,754,880	Above of 10%
Total Cost (Anaerobic Pond)					580,800,000		965,303,680	
				Custom Duty	(116160000)			
3) Trickling Filter basin								
Land grading	with compaction	m^3	1,200,000		0	105	126,000,000	
Gravel		m^3	17,400		0	3,245	56,463,000	
Concrete for leveling		m^3	8,700		0	3,245	28,231,500	
Reinforced concrete	with Formwork	m^3	75,100		0	10,000	751,000,000	
Rebar fabrication and assembly		t	6,000		0	72,685	436,110,000	
Building work		m^2	7,200		0	5,000	36,000,000	
Distribution channel(2)	2500×2000×2 lane	m	500		0	100,000	50,000,000	
Distribution channel(3)	2500×2000	m	2,000		0	50,000	100,000,000	
Filter media	Plastic media	m^3	132,000	32,000	4,224,000,000		0	
miscellaneous work		Ls	1		0		158,380,450	Above of 10%
Total Cost (Trickling Filter Basin)					4,224,000,000		1,742,184,950	
				Custom Duty	(844800000)			

Items	Specification	Unit	Qty	FC Portion (Yen)		LC Portion (Rs)		Reference
				Unit Price	Amount	Unit Price	Amount	
4) Sedimentation Pond								
Excavation		m^3	1,822,500		0	105	191,362,500	
Embankment	with compaction	m^3	345,600		0	105	36,288,000	
Slope protection		m^2	54,000		0	1,500	81,000,000	
Liner sheet for seepage		m^2	891,000	1,500	1,336,500,000		0	
Distribution/Discharge Pit		Nos	16		0	3,000,000	48,000,000	
Inlet structure		Nos	8		0	2,000,000	16,000,000	
Distribution channel(3)	2500×2000	m	4,000		0	50,000	200,000,000	
Road pavement	R.C.C	m	4,000		0	15,000	60,000,000	
Road pavement	Crushed stone	m	7,200		0	10,000	72,000,000	
Effluent channel		m	400		0	10,000	4,000,000	
miscellaneous work		Ls	1		0		70,465,050	Above of 10%
Total Cost (Sedimentation Pond)					1,336,500,000		779,115,550	
				Custom Duty	(267300000)			
5) Administration building								
Building work		m^2	4,000		0	10,000	40,000,000	
Total Cost (Administration Buiding)					0		40,000,000	
				Custom Duty				
7) Mechanical & Electrical works								
[Mechanical Equipment]								
Receiving Chamber/Screen facility								
Automatic Trash Rake System		Nos	8	12,500,000	100,000,000		0	
Mechanically Operated Pin Stock Gates		Nos	16	1,500,000	24,000,000		0	
Trickling filter basin facility								
Rotary Distributor		Nos	48	20,000,000	960,000,000		0	
Submersible Pump		Nos	48	10,000,000	480,000,000		0	
Non return Valve	600mm	Nos	48	1,800,000	86,400,000		0	
Sluice Valve	600mm	Nos	48	2,000,000	96,000,000		0	
Inlet pipe	CIP D=600mm	m	1,440		0	20,000	28,800,000	
Anaerobic/Sedimentation Pond								
Mechanically Operated Pin Stock Gates		Nos	16	1,500,000	24,000,000		0	
Total Cost (Mechanical Equioment)					1,770,400,000		28,800,000	
				Custom Duty	(354080000)			
[Electrical Equipment]								
Power receiving , Transforming equipment,								
Operating facility (control center, relay)		Ls	1		1,416,320,000		0	80% of Mechanical Equipment
Instrumentation facility, Supervisory control facility								
Total Cost (Electrical Equipment)					1,416,320,000		0	
				Custom Duty				

ROUGH COST ESTIMATE
FOR
NEW CONSTRUCTION OF DRAINAGE SYSTEM

Sr.No.	DESCRIPTION	AMOUNT (Rs.) 2009	AMOUNT (Rs.) 2005	PROPORTION 2009/2005
i) Drainage A				
1	Central Drain	446,448,177	224,472,131	1.99
2	Dil Muhammad Road Drain	32,499,509	21,656,819	1.50
3	Art Council Drain	57,830,467	39,280,232	1.47
4	Allama Iqubal Road Drain	114,113,725	78,392,670	1.46
5	WAPDA House Drain	12,089,718	7,451,861	1.62
6	Lawrence Road Drain	15,376,143	9,433,957	1.63
7	Nicholson Road Drain	9,461,294	5,843,837	1.62
8	Poonch Road Drain	45,305,230	31,378,384	1.44
9	Chauburji Drain	16,212,078	10,084,024	1.61
10	New Samanabad Drain	40,172,279	28,458,255	1.41
11	Morrhe Samanabad Drain	17,145,048	9,874,176	1.74
12	Multan Road Drain	40,415,413	28,181,151	1.43
13	Almumtaz Road Drain	12,810,826	7,832,505	1.64
14	Old Bund Road Drain	52,482,529	37,309,602	1.41
15	Sodewal Drain	13,705,872	9,278,862	1.48
16	Gulgasht Drain	10,020,957	5,963,474	1.68
17	Nasir Bagh Drain	4,273,199	2,632,755	1.62
18	Mall Road Drain	5,909,860	3,609,957	1.64
Total Cost of Package A for Drainage System		**946,272,324**	**561,134,652**	**1.69**
Cost of shifting/relocation of existing services(25%)		236,568,081	(10%) 56,113,465	4.22
Total Cost of Package A for Drainage		**1,182,840,405**	**617,248,117**	**1.92**
ii) Drainage B				
19	Queens Road Drain	51,009,785	35,949,132	1.42
20	Shahra Awan Tijarat Road Drain	179,482,653	127,176,434	1.41
21	Golf Road Drain	37,542,917	25,654,133	1.46
22	Kinnaird Drain	48,589,514	30,406,558	1.60
23	Shahjamal Drain	46,205,776	32,012,145	1.44
24	Gulshan Ravi Drain	124,628,182	85,201,787	1.46
25	Sanda Road Drain	12,763,036	7,545,411	1.69
26	Krishan Nagar Drain	210,463,105	144,035,569	1.46
27	Rewaz Garden Drain	23,681,606	14,737,855	1.61
28	Tertiary Drain (L=74,646ft)	287,765,524	177,177,070	1.62
Total Cost of Package B for Drainage System		**1,022,132,098**	**679,896,094**	**1.50**
Cost of shifting/relocation of existing services(25%)		255,533,025	(10%) 67,989,609	3.76
Total Cost of Package B for Drainage		**1,277,665,123**	**747,885,703**	**1.71**
GRAND TOTAL		**2,460,505,528**	**1,365,133,820**	**1.80**
Say Rs.(Million)		**2,460.51**	**1,365.13**	**1.80**

	Exchange Rate(¥/Rs)	Amount(Rs)	Amount(¥)
GRAND TOTAL (¥)	**1.35**	**2,460,505,528**	**3,321,682,463**

ROUGH COST ESTIMATE
FOR
IMPROVEMENT AND REHABILITATION OF DRAINAGE SYSTEM

Sr.No.	DESCRIPTION	AMOUNT (Rs.) 2009	AMOUNT (Rs.) 2005	PROPORTION 2009/2005
1	Central Drain	30,628,311	15,399,776	1.99
2	Governor House Drain	152,731,724	106,102,492	1.44
Total Cost of Drainage System		**183,360,035**	**121,502,268**	**1.51**
Cost of shifting/relocation of existing services(25%)		45,840,009	(10%) 12,150,227	3.77
GRAND TOTAL		**229,200,044**	**133,652,495**	**1.71**
Say Rs.(Million)		**229.20**	**133.65**	**1.71**

	Exchange Rate(¥/Rs)	Amount(Rs)	Amount(¥)
GRAND TOTAL (¥)	**1.35**	**229,200,044**	**309,420,059**

ROUGH COST ESTIMATE
FOR
PROCUREMENT OF OPERATION & MAINTENANCE EQUIPMENT

Sr.No.	DESCRIPTION	AMOUNT (2009)			
		(¥)	(Rs)	CD(Rs)	Rs Total
1	Dewatering Equipment	43,473,000	600,000	15,010,000	15,610,000
2	Water Supply Equipment and Sewer Cleaning Equipment (Vehicles)	500,198,000	0	351,960,000	351,960,000
3	Drainage Equipment (Nothing for Phase 1)	0	0	0	0
4	Dredging Equipment Repair Shop (Nothing for Phase 1)	0	0	0	0
5	Water Meter Repier Shop Equipment	29,232,000	0	5,800,000	5,800,000
6	Water Quality analyzer	95,842,090	6,465,000	12,892,500	19,357,500
7	Vehicles for Employees' Transportation (WASA Head Office and Water Meter Repaire Workshop)	9,756,000	0	3,870,000	3,870,000
8	Measuring Instrument on the Site	21,410,000	0	2,065,000	2,065,000
TOTAL		**699,911,090**	**7,065,000**	**391,597,500**	**398,662,500**

	Amount(¥)	Amount(Rs)
GRAND TOTAL	**699,911,090**	**398,662,500**
Say Rs.(Million)	**699.91**	**398.66**

	Exchange Rate(¥/Rs)	
GRAND TOTAL (¥)	**1.26**	**¥1,202,225,840**

US$1=JY92.53
Rs.1=JY1.26

1.26

Budget Cost 92.53 0.794 Rs/JY

Description		No. of pcs	Unit Cost			Total			Remarks
			(US$)	(JY)	(Rs)	(US$)	(JY)	(Rs)	
A	**O/M Monitoring System**								
1	Monitoring Rooms								
1-1	Central Monitoring system (Room)	1	1,063,350	98,391,776	78,088,711	1,063,350	98,391,776	78,088,711	
1-2	Local Monitoring Rooms (20Rooms, one set	20	25,650	2,373,395	1,883,646	513,000	47,467,890	37,672,929	
1-3	Other Engineering cost	1	2,797,600	258,861,928	205,445,975	2,797,600	258,861,928	205,445,975	
	Total		3,886,600	359,627,098	285,418,332	4,373,950	404,721,594	321,207,614	
2	STP (Only Data transmission System)								
2-1	Phase-1 (3 sets/stp)	1	25,650	2,373,395	1,883,646	76,950	7,120,184	5,650,939	
2-2	Phase-2(3sets/STP*5 STP)	5	25,650	2,373,395	1,883,646	384,750	35,600,918	28,254,696	
	Total		25,650	2,373,395	1,883,646	461,700	42,721,101	33,905,636	
3	Tube wells (Submersible Pumps)								
	Existing (Sub Station)	415	3,900	360,867	286,402	1,618,500	149,759,805	118,856,988	
	New(Sub station)	0	3,900	360,867	286,402	0	0	0	
	Total		3,900	360,867	286,402	1,618,500	149,759,805	118,856,988	
4	Pumping Stations								
4-1	Lifting Stations	79							
	Pumps	229	3,660	282,217	223,981	838,140	64,627,579	51,291,729	79 LSs
4-2	Drainage Pumping Stations	4							
	Pumps	24	3,660	282,217	223,981	87,840	6,773,196	5,375,552	
4-3	Deposal Stations	12							
	Pumps	80	3,660	282,217	223,981	292,800	22,577,320	17,918,508	
	Total (Pumps)	333	3,660	282,217	223,981	1,218,780	93,978,095	74,585,789	
5	Chemical Lab								
5-1	Central Lab (WT/STP/BIO:3*2)	1	148,550	13,745,332	10,908,993	148,550	13,745,332	10,908,993	
5-2	Local Lab (5-STP:2*5)	1	251,500	23,271,295	18,469,282	251,500	23,271,295	18,469,282	**O/M Monitoring System**
	Total		400,050	37,016,627	29,378,275	400,050	37,016,627	29,378,275	**¥873,800,000**
6	Office system								
6-1	Preparation of Business- Statics data (Planning & Evaluation Dep.)	1	22,200	2,054,166	1,630,290	429,000	39,695,370	31,504,262	
6-2	Preparation of Administration data (Administration Dep.)	1	22,200	2,054,166	1,630,290	333,000	30,812,490	24,454,357	
6-3	Complaint reception / update Ledger (O/M Dep.)	1	22,200	2,054,166	1,630,290	1,110,000	102,708,300	81,514,524	
6-4	Complaint reception / update Ledger (Revenue Dep.)	1	22,200	2,054,166	1,630,290	333,000	30,812,490	24,454,357	
6-5	Preparation of Financial /Accounting data (Finance Dep.)	1	22,200	2,054,166	1,630,290	333,000	30,812,490	24,454,357	
6-6	Preparation of Engineering data (Engineering Dep.)	1	22,200	2,054,166	1,630,290	666,000	61,624,980	48,908,714	
6-7	Soft ware	1	13,374	1,237,496	982,140	864,936	80,032,528	63,517,879	**Office system**
	Total		146,574	13,562,492	10,763,883	4,068,936	376,498,648	298,808,451	**¥451,800,000**
7	Billing System (560,000 connections)								
7-1	Water meter reading system								
(1)	Hardware & Accessories （31HT/Pr)	31	7,176	663,995	526,980	222,456	20,583,854	16,336,392	
(2)	(282Handy terminals + Printers ,etc)	282	7,176	663,995	526,980	2,023,632	187,246,669	148,608,467	
(3)	Software	1	72,000	6,662,160	5,287,429	72,000	6,662,160	5,287,429	
(4)	Customization	1	220,800	20,430,624	16,214,781	220,800	20,430,624	16,214,781	
(5)	Consumable goods	1	2,880	266,486	211,497	2,880	266,486	211,497	
	Sub total		310,032	28,687,261	22,767,667	2,541,768	235,189,793	186,658,566	
7-2	Office equipment for 5-town offices								
(1)	PCs	10	3,960	366,419	290,809	39,600	3,664,188	2,908,086	
(2)	Servers	10	3,960	366,419	290,809	39,600	3,664,188	2,908,086	
(3)	Printers (A4)	10	3,960	366,419	290,809	39,600	3,664,188	2,908,086	
(4)	Construction of internet /GRPS Modem	5	1,320	122,140	96,936	6,600	610,698	484,681	
	Sub total		13,200	1,221,396	969,362	125,400	11,603,262	9,208,938	
7-3	Application system	1	579,600	53,630,388	42,563,800	579,600	53,630,388	42,563,800	
7-4	Change Japanese Lang. into English	1	444,000	41,158,824	32,665,734	25,925,185	20,575,544	16,329,797	
	Sub total		1,023,600	94,789,212	75,229,534	26,504,785	74,205,932	58,893,597	Billing System (560,000 connections)
	Total		**1,346,832**	**124,697,869**	**98,966,563**	**29,171,953**	**320,998,987**	**254,761,101**	**¥385,200,000**
8	**Mapping**								
8-1	Water supply facilities management	1	2,600,000	240,578,000	190,934,921	2,600,000	240,578,000	190,934,921	
8-2	Maintenance Cost	1	0	0	0	0	0	0	**Mapping**
	Total		**2,600,000**	**240,578,000**	**190,934,921**	**2,600,000**	**240,578,000**	**190,934,921**	**¥288,700,000**
9	**G total of system**	**1**				**42,295,369**	**1,666,272,856**	**1,203,581,786**	
10	Over head (for contractor),Assumption	0.2				8,459,074	333,254,571	240,716,357	
11	**Project Cost**					**50,754,443**	**1,999,527,427**	**1,444,298,143**	**¥1,999,500,000**

Appendix 15.1 Economic Cash Flow of Water Supply Component

(Unt: JPY Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Cash Inflow:																																					
Benefit																																					
Water Suply Increase								588.7	872.4	1,165.5	1,467.9	1,673.2	1,882.2	2,095.1	2,311.7	2,532.2	2,849.8	3,171.8	3,498.0	3,828.6	4,163.5	4,569.4	4,978.9	5,391.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9
Cash Outflow:																																					
Construction																																					
Installation of Customer meters	0.0	0.0	0.0	745.0	498.6	512.6	398.1	0.0	0.0																												
Installation of Bulk flow meters for Tubewells	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																												
Equipments for UFW control	0.0	0.0	0.0	98.1	63.8	63.8	48.2	0.0	0.0																												
Physical Contingencies	0.0	0.0	0.0	35.5	23.7	24.4	19.0	0.0	0.0																												
Construction Total	0.0	0.0	0.0	878.6	586.1	600.8	465.3	0.0	0.0																												
Consulting Services																																					
Consulting Services	0.0	109.7	185.7	349.8	82.8	46.2	38.6	19.8	19.8																												
Physical Contingencies	0.0	6.0	10.4	20.0	4.9	2.8	2.4	1.3	1.3																												
Consulting Services Total	0.0	115.7	196.1	369.8	87.6	49.0	41.0	21.0	21.0																												
Share of Management Component																																					
Construction																																					
Procurement / Construction	0.0	0.0	0.0	0.0	0.0	104.1	104.1	0.0	0.0																												
Physical Contingencies	0.0	0.0	0.0	0.0	0.0	6.2	6.4	0.0	0.0																												
Construction Total	0.0	0.0	0.0	0.0	0.0	110.3	110.5	0.0	0.0																												
Consulting Services																																					
Consulting Services	0.0	6.5	1.7	1.6	0.5	0.5	0.5	0.6	0.6																												
Physical Contingencies	0.0	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0																												
Consulting Services Total	0.0	6.8	1.8	1.7	0.6	0.6	0.6	0.6	0.7																												
Share of Management Component Total	0.0	6.8	1.8	1.7	0.6	110.9	111.1	0.6	0.7																												
Replacement																																					
4 years								0.0	0.0	0.0	11.6	0.0	0.0	0.0	11.6	0.0	0.0	0.0	11.6	0.0	0.0	0.0	11.6	0.0	0.0	0.0	11.6	0.0	0.0	0.0	11.6	0.0	0.0	0.0	11.6	0.0	0.0
5 years								0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.4
8 years								0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
10 years								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,509.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,509.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,509.3
50 years								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Replacement Total								0.0	0.0	0.0	11.6	0.4	0.0	0.0	12.0	0.0	1,509.7	0.0	11.6	0.0	0.0	0.4	12.0	0.0	0.0	0.0	1,521.3	0.0	0.0	0.0	12.0	0.4	0.0	0.0	11.6	0.0	1,509.7
O&M																																					
Water Supply								71.5	72.7	73.9	75.2	75.9	76.7	77.5	78.2	79.0	79.6	80.1	80.7	81.3	81.9	82.2	82.6	83.0	83.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Share of Management Component								1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O&M Total								72.9	74.2	75.4	76.7	77.4	78.2	78.9	79.7	80.5	81.0	81.6	82.2	82.8	83.3	83.7	84.1	84.5	85.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Salvage Value																																					
4 years																																					-5.8
5 years																																					-0.4
8 years																																					-0.1
10 years																																					-1,509.3
50 years																																					-81.5
Salvage Value Total																																					-1,597.0
Cash Outflow Total	0.0	122.5	197.9	1,250.1	674.3	760.8	617.4	94.6	95.9	75.4	88.3	77.8	78.2	78.9	91.7	80.5	1,590.7	81.6	93.8	82.8	83.3	84.1	96.1	84.5	85.2	0.0	1,521.3	0.0	0.0	0.0	12.0	0.4	0.0	0.0	11.6	0.0	-87.4
Net Cash Flow:	0.0	-122.5	-197.9	-1,250.1	-674.3	-760.8	-617.4	494.1	776.5	1,090.0	1,379.6	1,595.3	1,804.0	2,016.1	2,220.0	2,451.7	1,259.1	3,090.1	3,404.2	3,745.9	4,080.2	4,485.3	4,882.8	5,307.4	5,749.7	5,834.9	4,313.6	5,834.9	5,834.9	5,834.9	5,822.9	5,834.5	5,834.9	5,834.9	5,823.3	5,834.9	5,922.3

EIRR	25.3%

Appendix 15.2 Economic Cash Flow of Sewerage Component

(Unt: JPY Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Cash Inflow:																																					
Benefit																																					
Willingness-To-Pay								991.9	1,022.7	1,054.3	1,086.8	1,109.1	1,131.7	1,154.8	1,178.3	1,202.3	1,225.2	1,248.5	1,272.2	1,296.4	1,321.0	1,343.4	1,366.2	1,389.4	1,417.7	1,417.7	1,417.7	1,417.7	1,417.7	1,417.7	1,417.7	1,417.7	1,417.7	1,417.7	1,417.7	1,417.7	1,417.7
Reduction of O&M Cost for Exisitng Lift Stations								36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9	36.9
Benefit Total								1,028.9	1,059.7	1,091.3	1,123.7	1,146.0	1,168.7	1,191.8	1,215.3	1,239.2	1,262.1	1,285.4	1,309.1	1,333.3	1,357.9	1,380.3	1,403.2	1,426.4	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6
Cash Outflow:																																					
Construction																																					
Laying of Sewers	0.0	0.0	0.0	1,021.7	454.1	454.1	340.6	0.0	0.0																												
Disposal Station	0.0	0.0	0.0	384.7	171.0	171.0	128.2	0.0	0.0																												
Collector Channel	0.0	0.0	0.0	457.8	203.5	203.5	152.6	0.0	0.0																												
Physical Contingencies	0.0	0.0	0.0	110.6	50.8	52.6	40.8	0.0	0.0																												
Construction Total	0.0	0.0	0.0	1,974.8	879.4	881.2	662.2	0.0	0.0																												
Consulting Services																																					
Consulting Services	0.0	344.7	45.4	438.1	125.9	119.9	107.2	2.1	2.1																												
Physical Contingencies	0.0	18.7	2.5	25.1	7.5	7.3	6.7	0.1	0.1																												
Consulting Services Total	0.0	363.4	47.9	463.3	133.3	127.3	114.0	2.2	2.2																												
Share of Management Component																																					
Construction																																					
Procurement of O&M Equipment	0.0	0.0	0.0	0.0	0.0	267.9	267.9	0.0	0.0																												
Physical Contingencies	0.0	0.0	0.0	0.0	0.0	16.0	16.5	0.0	0.0																												
Construction Total	0.0	0.0	0.0	0.0	0.0	284.0	284.4	0.0	0.0																												
Consulting Services																																					
Consulting Services	0.0	16.6	4.4	4.1	1.4	1.4	1.4	1.6	1.6																												
Physical Contingencies	0.0	0.9	0.2	0.2	0.1	0.1	0.1	0.1	0.1																												
Consulting Services Total	0.0	17.5	4.6	4.3	1.5	1.5	1.5	1.7	1.7																												
Share of Management Component Total	0.0	17.5	4.6	4.3	1.5	285.4	285.8	1.7	1.7																												
Replacement																																					
10 years								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5
15 years								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	587.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	587.3
20 years								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60 years								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Replacement Total								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	587.3	0.0	0.0	0.0	0.0	45.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	591.8
O&M																																					
Sewerage								130.4	131.9	133.3	134.9	135.8	136.7	137.5	138.4	139.3	139.9	140.6	141.1	141.7	142.4	142.9	143.3	143.8	144.8	144.8	144.8	144.8	144.8	144.8	144.8	144.8	144.8	144.8	144.8	144.8	144.8
Share of Management Component								3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
O&M Total								134.3	135.7	137.2	138.8	139.6	140.5	141.4	142.3	143.1	143.7	144.4	145.0	145.6	146.3	146.7	147.2	147.6	148.6	148.6	148.6	148.6	148.6	148.6	148.6	148.6	148.6	148.6	148.6	148.6	148.6
Salvage Value																																					
10 years																																					-4.5
15 years																																					-587.3
20 years																																					-20.7
60 years																																					-1,601.5
Salvage Value Total																																					-2,214.0
Cash Outflow Total	0.0	380.9	52.5	2,442.4	1,014.2	1,293.8	1,062.0	138.2	139.6	137.2	138.8	139.6	140.5	141.4	142.3	143.1	148.2	144.4	145.0	145.6	146.3	734.0	147.2	147.6	148.6	148.6	194.5	148.6	148.6	148.6	148.6	148.6	148.6	148.6	148.6	148.6	-1,473.6
Net Cash Flow:	0.0	-380.9	-52.5	-2,442.4	-1,014.2	-1,293.8	-1,062.0	890.7	920.0	954.1	984.9	1,006.3	1,028.1	1,050.4	1,073.0	1,096.1	1,113.9	1,141.0	1,164.1	1,187.7	1,211.6	646.3	1,256.0	1,278.7	1,306.0	1,306.0	1,260.2	1,306.0	1,306.0	1,306.0	1,306.0	1,306.0	1,306.0	1,306.0	1,306.0	1,306.0	2,928.2

EIRR	12.7%

Appendix 15.3 Economic Cash Flow of Drainage Component

(Unt: JPY Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Cash Inflow:																																					
Benefit																																					
Reduction of Economic Activitiy Halting								12.0	12.6	13.3	14.1	14.8	15.5	16.3	17.1	17.9	18.8	19.7	20.7	21.8	22.1	22.4	22.7	23.0	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3
Multiplier Effect								102.5	108.1	114.1	120.3	126.3	132.5	139.0	145.9	153.1	160.8	168.8	177.3	186.1	188.8	191.4	194.0	196.6	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3	199.3
Benefit Total								114.5	120.8	127.4	134.4	141.0	148.0	155.3	163.0	171.0	179.6	188.6	198.0	207.9	210.9	213.8	216.7	219.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6
Cash Outflow:																																					
Construction																																					
Construction of Drainage System	0.0	0.0	0.0	1,227.7	545.6	545.6	409.2	0.0	0.0																												
Improvement and Rehabilitation of Drainage System	0.0	0.0	0.0	114.4	50.8	50.8	38.1	0.0	0.0																												
Physical Contingencies	0.0	0.0	0.0	80.1	36.9	38.2	29.7	0.0	0.0																												
Construction Total	0.0	0.0	0.0	1,422.1	633.3	634.7	477.0	0.0	0.0																												
Consulting Services																																					
Consulting Services	0.0	237.9	0.0	284.7	87.1	57.3	197.4	20.0	20.0																												
Physical Contingencies	0.0	14.3	0.0	16.3	5.2	3.5	12.4	1.3	1.3																												
Consulting Services Total	0.0	252.3	0.0	301.0	92.3	60.9	209.8	21.2	21.3																												
Share of Management Component																																					
Construction																																					
Procurement of O&M Equipment	0.0	0.0	0.0	0.0	0.0	196.6	196.6	0.0	0.0																												
Physical Contingencies	0.0	0.0	0.0	0.0	0.0	11.8	12.1	0.0	0.0																												
Construction Total	0.0	0.0	0.0	0.0	0.0	208.3	208.6	0.0	0.0																												
Consulting Services																																					
Consulting Services	0.0	12.2	3.2	3.0	1.0	1.0	1.0	1.2	1.2																												
Physical Contingencies	0.0	0.7	0.2	0.2	0.1	0.1	0.1	0.1	0.1																												
Consulting Services Total	0.0	12.9	3.4	3.2	1.1	1.1	1.1	1.2	1.2																												
Share of Management Component Total	0.0	12.9	3.4	3.2	1.1	209.4	209.7	1.2	1.2																												
Replacement																																					
60 years								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O&M																																					
Drainage								56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4
Share of Management Component								2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
O&M Total								59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2
Salvage Value																																					
60 years																																					-1,491.2
Cash Outflow Total	0.0	265.1	3.4	1,726.3	726.7	904.9	896.5	81.7	81.7	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	-1,431.9
Net Cash Flow:	0.0	-265.1	-3.4	-1,726.3	-726.7	-904.9	-896.5	32.8	39.0	68.2	75.2	81.8	88.8	96.1	103.7	111.8	120.3	129.3	138.8	148.7	151.7	154.5	157.5	160.4	163.4	163.4	163.4	163.4	163.4	163.4	163.4	163.4	163.4	163.4	163.4	163.4	1,654.6

EIRR	0.8%

Appendix 15.4 Economic Cash Flow of Combined Components (Original)

(Unt: JPY Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Cash Inflow:																																					
Benefit																																					
Water Supply	0.0	0.0	0.0	0.0	0.0	0.0	0.0	588.7	872.4	1,165.5	1,467.9	1,673.2	1,882.2	2,095.1	2,311.7	2,532.2	2,849.8	3,171.8	3,498.0	3,828.6	4,163.5	4,569.4	4,978.9	5,391.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9
Sewerage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,028.9	1,059.7	1,091.3	1,123.7	1,146.0	1,168.7	1,191.8	1,215.3	1,239.2	1,262.1	1,285.4	1,309.1	1,333.3	1,357.9	1,380.3	1,403.2	1,426.4	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6
Drainage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	114.5	120.8	127.4	134.4	141.0	148.0	155.3	163.0	171.0	179.6	188.6	198.0	207.9	210.9	213.8	216.7	219.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6
Benefit Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,732.0	2,052.8	2,384.1	2,726.0	2,960.2	3,198.9	3,442.1	3,690.0	3,942.4	4,291.5	4,645.7	5,005.1	5,369.8	5,732.3	6,163.5	6,598.7	7,037.9	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1
Cash Outflow:																																					
Cost																																					
Water Supply	0.0	122.5	197.9	1,250.1	674.3	760.8	617.4	94.6	95.9	75.4	88.3	77.8	78.2	78.9	91.7	80.5	1,590.7	81.6	93.8	82.8	83.3	84.1	96.1	84.5	85.2	0.0	1,521.3	0.0	0.0	0.0	12.0	0.4	0.0	0.0	11.6	0.0	-87.4
Sewerage	0.0	380.9	52.5	2,442.4	1,014.2	1,293.8	1,062.0	138.2	139.6	137.2	138.8	139.6	140.5	141.4	142.3	143.1	148.2	144.4	145.0	145.6	146.3	734.0	147.2	147.6	148.6	148.6	194.5	148.6	148.6	148.6	148.6	148.6	148.6	148.6	148.6	148.6	-1,473.6
Drainage	0.0	265.1	3.4	1,726.3	726.7	904.9	896.5	81.7	81.7	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2	-1,431.9
Cost Total	0.0	768.6	253.8	5,418.7	2,415.2	2,959.6	2,576.0	314.5	317.2	271.9	286.3	276.7	277.9	279.6	293.2	282.8	1,798.1	285.3	298.0	287.6	288.9	877.4	302.5	291.3	293.1	207.9	1,774.9	207.9	207.9	207.9	219.8	208.3	207.9	207.9	219.4	207.9	-2,992.9
Net Cash Flow:	0.0	-768.6	-253.8	-5,418.7	-2,415.2	-2,959.6	-2,576.0	1,417.5	1,735.6	2,112.3	2,439.8	2,683.5	2,920.9	3,162.6	3,396.8	3,659.6	2,493.3	4,360.5	4,707.1	5,082.2	5,443.4	5,286.2	6,296.2	6,746.6	7,219.0	7,304.3	5,737.2	7,304.3	7,304.3	7,304.3	7,292.3	7,303.9	7,304.3	7,304.3	7,292.7	7,304.3	10,505.0

EIRR	15.7%

Appendix 15.5 Economic Cash Flow of Combined Components (Option 1)

(Unt: JPY Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Cash Inflow:																																					
Benefit																																					
Water Supply	0.0	0.0	0.0	0.0	0.0	0.0	0.0	588.7	872.4	1,165.5	1,467.9	1,673.2	1,882.2	2,095.1	2,311.7	2,532.2	2,849.8	3,171.8	3,498.0	3,828.6	4,163.5	4,569.4	4,978.9	5,391.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9
Sewerage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,028.9	1,059.7	1,091.3	1,123.7	1,146.0	1,168.7	1,191.8	1,215.3	1,239.2	1,262.1	1,285.4	1,309.1	1,333.3	1,357.9	1,380.3	1,403.2	1,426.4	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6
Drainage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	90.5	95.5	100.8	106.3	111.5	117.1	122.8	128.9	135.3	142.0	149.1	156.6	164.4	166.8	169.1	171.4	173.7	176.1	176.1	176.1	176.1	176.1	176.1	176.1	176.1	176.1	176.1	176.1	176.1	176.1
Benefit Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,708.1	2,027.5	2,357.5	2,697.9	2,930.7	3,167.9	3,409.6	3,655.9	3,906.6	4,253.9	4,606.3	4,963.7	5,326.3	5,688.2	6,118.8	6,553.4	6,992.0	7,465.6	7,465.6	7,465.6	7,465.6	7,465.6	7,465.6	7,465.6	7,465.6	7,465.6	7,465.6	7,465.6	7,465.6	7,465.6
Cash Outflow:																																					
Cost																																					
Water Supply	0.0	122.5	197.9	1,250.1	674.3	760.8	617.4	95.1	96.4	75.9	88.8	78.4	78.8	79.6	92.3	81.1	1,591.4	82.3	94.5	83.5	84.1	84.9	96.9	85.4	86.1	0.0	1,521.3	0.0	0.0	0.0	12.0	0.4	0.0	0.0	11.6	0.0	-87.4
Sewerage	0.0	380.9	52.5	2,442.4	1,014.2	1,293.8	1,062.0	139.4	140.9	138.5	140.2	141.1	142.0	143.0	143.9	144.9	150.0	146.3	146.9	147.6	148.4	736.2	149.4	149.9	151.0	151.0	196.8	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	-1,471.2
Drainage	0.0	263.7	3.4	1,100.9	448.2	625.8	477.0	46.1	46.7	46.0	46.5	47.1	47.7	48.3	48.8	49.4	50.0	50.6	51.3	51.9	52.5	53.2	53.8	54.5	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	-780.3
Cost Total	0.0	767.1	253.8	4,793.3	2,136.6	2,680.5	2,156.4	280.6	283.9	260.5	275.5	266.6	268.5	270.8	285.1	275.4	1,791.4	279.3	292.7	283.0	285.0	874.3	300.1	289.7	292.3	206.1	1,773.2	206.1	206.1	206.1	218.1	206.5	206.1	206.1	217.7	206.1	-2,338.9
Net Cash Flow:	0.0	-767.1	-253.8	-4,793.3	-2,136.6	-2,680.5	-2,156.4	1,427.5	1,743.6	2,097.0	2,422.4	2,664.1	2,899.4	3,138.8	3,370.8	3,631.2	2,462.5	4,327.0	4,671.0	5,043.3	5,403.2	5,244.5	6,253.3	6,702.3	7,173.3	7,259.5	5,692.4	7,259.5	7,259.5	7,259.5	7,247.5	7,259.1	7,259.5	7,259.5	7,247.9	7,259.5	9,804.4

EIRR	16.7%

Appendix 15.6 Economic Cash Flow of Combined Components (Option 2)

(Unt: JPY Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Cash Inflow:																																					
Benefit																																					
Water Supply	0.0	0.0	0.0	0.0	0.0	0.0	0.0	588.7	872.4	1,165.5	1,467.9	1,673.2	1,882.2	2,095.1	2,311.7	2,532.2	2,849.8	3,171.8	3,498.0	3,828.6	4,163.5	4,569.4	4,978.9	5,391.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9	5,834.9
Sewerage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,028.9	1,059.7	1,091.3	1,123.7	1,146.0	1,168.7	1,191.8	1,215.3	1,239.2	1,262.1	1,285.4	1,309.1	1,333.3	1,357.9	1,380.3	1,403.2	1,426.4	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6	1,454.6
Drainage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	114.5	120.8	127.4	134.4	141.0	148.0	155.3	163.0	171.0	179.6	188.6	198.0	207.9	210.9	213.8	216.7	219.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6	222.6
Benefit Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,732.0	2,052.8	2,384.1	2,726.0	2,960.2	3,198.9	3,442.1	3,690.0	3,942.4	4,291.5	4,645.7	5,005.1	5,369.8	5,732.3	6,163.5	6,598.7	7,037.9	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1	7,512.1
Cash Outflow:																																					
Cost																																					
Water Supply	0.0	131.0	200.1	1,252.1	675.0	898.3	755.1	97.2	98.5	77.3	90.1	79.7	80.0	80.8	93.5	82.3	1,592.5	83.5	95.6	84.6	85.2	86.0	97.9	86.3	87.1	0.0	1,521.3	0.0	0.0	0.0	12.0	0.4	0.0	0.0	11.6	0.0	-87.4
Sewerage	0.0	402.7	58.2	2,447.7	1,016.0	1,647.7	1,416.5	145.0	146.5	142.0	143.6	144.4	145.3	146.2	147.0	147.9	153.0	149.2	149.8	150.4	151.1	738.8	152.0	152.4	153.4	153.4	199.2	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	-1,468.8
Drainage	0.0	281.1	7.6	1,730.2	728.0	1,164.6	1,156.6	86.7	86.8	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7	-1,428.4
Cost Total	0.0	814.7	265.9	5,430.1	2,419.0	3,710.6	3,328.1	329.0	331.8	282.0	296.4	286.8	288.1	289.7	303.3	292.9	1,808.3	295.4	308.1	297.7	299.0	887.5	312.6	301.4	303.2	216.1	1,783.2	216.1	216.1	216.1	228.1	216.5	216.1	216.1	227.7	216.1	-2,984.6
Net Cash Flow:	0.0	-814.7	-265.9	-5,430.1	-2,419.0	-3,710.6	-3,328.1	1,403.0	1,721.0	2,102.1	2,429.6	2,673.3	2,910.8	3,152.4	3,386.6	3,649.4	2,483.2	4,350.3	4,697.0	5,072.1	5,433.3	5,276.0	6,286.1	6,736.5	7,208.9	7,296.0	5,728.9	7,296.0	7,296.0	7,296.0	7,284.0	7,295.6	7,296.0	7,296.0	7,284.4	7,296.0	10,496.7

EIRR	14.9%

Appendix 15.7 Financial Cash Flow of Water Supply Component

(Unt: JPY Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047
Cash Inflow:																																					
Benefit																																					
Revenue Increase of Water Supply								163.1	164.0	164.8	154.4	154.1	153.7	153.4	152.9	157.7	156.5	155.3	154.0	152.7	139.3	137.9	136.6	135.2	134.3	134.3	134.3	134.3	134.3	134.3	134.3	134.3	134.3	134.3	134.3	134.3	134.3
Cash Outflow:																																					
Construction																																					
Installation of Customer meters	0.0	0.0	0.0	767.1	513.4	528.0	410.2	0.0	0.0																												
Installation of Bulk flow meters for Tubewells	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0																												
Equipments for UFW control	0.0	0.0	0.0	104.7	68.1	68.1	51.5	0.0	0.0																												
Physical Contingencies	0.0	0.0	0.0	36.5	24.4	25.1	19.5	0.0	0.0																												
Construction Total	0.0	0.0	0.0	908.3	606.0	621.3	481.2	0.0	0.0																												
Consulting Services																																					
Consulting Services	0.0	112.0	190.1	356.6	84.7	47.3	39.5	20.0	20.0																												
Physical Contingencies	0.0	6.1	10.6	20.4	5.0	2.9	2.5	1.3	1.3																												
Consulting Services Total	0.0	118.1	200.7	377.1	89.7	50.1	41.9	21.2	21.3																												
Taxes	0.0	72.2	46.9	304.3	145.8	133.6	172.5	5.6	5.8																												
Share of Management Component																																					
Construction																																					
Procurement / Construction	0.0	0.0	0.0	0.0	0.0	104.2	104.2	0.0	0.0																												
Physical Contingencies	0.0	0.0	0.0	0.0	0.0	6.2	6.4	0.0	0.0																												
Construction Total	0.0	0.0	0.0	0.0	0.0	110.4	110.6	0.0	0.0																												
Consulting Services																																					
Consulting Services	0.0	6.6	1.7	1.6	0.5	0.5	0.5	0.6	0.6																												
Physical Contingencies	0.0	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0																												
Consulting Services Total	0.0	6.9	1.8	1.7	0.6	0.6	0.6	0.7	0.7																												
Taxes	0.0	38.2	10.3	9.9	3.5	730.7	753.4	4.5	4.7																												
Share of Management Component Total	0.0	45.1	12.1	11.6	4.0	841.6	864.6	5.2	5.3																												
Replacement																																					
4 years								0.0	0.0	0.0	14.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	14.0	0.0	0.0
5 years								0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5
8 years								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
10 years								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,865.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,865.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,865.0
50 years								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Replacement Total								0.0	0.0	0.0	14.0	0.5	0.0	0.0	14.5	0.0	1,865.5	0.0	14.0	0.0	0.0	0.5	14.5	0.0	0.0	0.0	1,879.5	0.0	0.0	0.0	14.5	0.5	0.0	0.0	14.0	0.0	1,865.5
O&M																																					
Water Supply								98.3	100.0	101.7	103.4	104.4	105.5	106.5	107.6	108.6	109.4	110.2	111.0	111.8	112.5	113.1	113.6	114.1	115.1	115.1	115.1	115.1	115.1	115.1	115.1	115.1	115.1	115.1	115.1	115.1	115.1
Share of Management Component								2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
O&M Total								100.3	102.0	103.7	105.4	106.5	107.5	108.6	109.6	110.6	111.4	112.2	113.0	113.8	114.6	115.1	115.6	116.1	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2	117.2
Salvage Value																																					
4 years																																					-7.4
5 years																																					-0.5
8 years																																					-0.1
10 years																																					-1,957.4
50 years																																					-112.2
Salvage Value Total																																					-2,077.6
Cash Outflow Total	0.0	235.4	259.7	1,601.3	845.5	1,646.7	1,560.2	132.3	134.4	103.7	119.5	107.0	107.5	108.6	124.1	110.6	1,976.9	112.2	127.0	113.8	114.6	115.6	130.1	116.1	117.2	117.2	1,996.7	117.2	117.2	117.2	131.7	117.7	117.2	117.2	131.2	117.2	-94.9
Net Cash Flow:	0.0	-235.4	-259.7	-1,601.3	-845.5	-1,646.7	-1,560.2	30.7	29.6	61.1	35.0	47.1	46.2	44.8	28.8	47.1	-1,820.4	43.1	26.9	38.9	24.7	22.4	6.4	19.0	17.2	17.2	-1,862.4	17.2	17.2	17.2	2.6	16.7	17.2	17.2	3.1	17.2	229.2

FIRR	-18.2%

Appendix 15.8 Water and Sewerage Price for Households (Original)

(Unit: Rs. Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Cost																									
Existing																									
Water Suply	3,042.5	3,541.2	4,135.7	4,846.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8
Sewerage	933.2	1,086.2	1,268.5	1,486.6	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3
Drainage	399.9	465.5	543.7	637.1	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3
Existing Cost total	4,375.6	5,092.9	5,947.9	6,970.5	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3
Additional Cost																									
Operation and Maintenance																									
Water Supply								10.7	10.8	11.0	11.2	11.3	11.4	11.6	11.7	11.8	11.9	12.0	12.0	12.1	12.2	12.3	12.3	12.4	12.5
Sewerage								577.0	583.6	590.2	596.9	600.9	604.8	608.7	612.7	616.6	619.4	622.4	625.2	628.0	630.9	633.1	635.3	637.5	641.8
Drainage								50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9
Mangement								23.1	23.4	23.7	24.0	24.3	24.6	24.9	25.2	25.5	25.8	26.1	26.4	26.7	27.1	27.4	27.7	28.1	28.4
Operation and Maintenance Cost Total								661.6	668.7	675.8	683.0	687.3	691.7	696.0	700.4	704.8	708.0	711.3	714.5	717.7	721.1	723.6	726.2	728.8	733.6
Replacement Cost																									
Water Supply								0.0	0.0	0.0	9.2	0.3	0.0	0.0	25.1	0.0	1,223.6	0.0	9.2	0.0	0.0	0.3	25.1	0.0	0.0
Sewerage								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0	0.0	471.1	0.0	0.0	0.0
Drainage								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Replacement Cost Total								0.0	0.0	0.0	9.2	0.3	0.0	0.0	25.1	0.0	1,227.7	0.0	9.2	0.0	0.0	471.4	25.1	0.0	0.0
Loan Cost																									
Repayment																									
Water Supply	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	14.1	62.1	86.9	110.5	129.0	130.1	131.2	131.2	131.2	131.2	131.2	131.2	131.2
Sewerage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.9	19.5	308.5	442.1	579.2	684.4	685.2	686.1	686.1	686.1	686.1	686.1	686.1	686.1
Drainage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	12.3	76.8	104.7	131.9	161.4	162.5	163.6	163.6	163.6	163.6	163.6	163.6	163.6
Mangement	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	4.9	5.9	6.3	74.2	143.8	144.3	144.7	144.7	144.7	144.7	144.7	144.7	144.7
Repayment Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.2	50.8	453.3	639.9	895.7	1,118.6	1,122.0	1,125.6	1,125.6	1,125.6	1,125.6	1,125.6	1,125.6	1,125.6
Interest																									
Water Supply	0.0	0.0	0.0	8.7	14.5	20.4	25.0	25.0	25.0	25.0	25.0	25.0	25.0	24.6	23.9	22.8	21.6	20.3	19.1	17.8	16.6	15.3	14.1	12.8	11.6
Sewerage	0.0	0.0	0.0	51.7	75.4	99.8	118.7	118.7	118.7	118.7	118.7	118.7	118.7	117.0	114.5	111.2	107.2	103.2	99.3	95.3	91.4	87.4	83.4	79.5	75.5
Drainage	0.0	0.0	0.0	9.9	14.5	19.2	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.5	22.0	21.4	20.6	19.9	19.1	18.3	17.6	16.8	16.0	15.3	14.5
Mangement	0.0	0.0	0.0	0.0	0.0	18.9	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	37.4	35.5	33.6	31.6	29.7	27.8	25.9	24.0	22.1	20.1
Interest Total	0.0	0.1	0.1	70.3	104.3	158.3	204.9	204.9	204.9	204.9	204.9	204.9	204.9	202.4	198.7	192.8	184.9	177.0	169.1	161.2	153.3	145.4	137.5	129.6	121.8
Loan Cost Total	0.0	0.1	0.1	70.3	104.3	158.3	204.9	204.9	204.9	204.9	204.9	242.2	255.7	655.7	838.6	1,088.5	1,303.5	1,299.0	1,294.6	1,286.8	1,278.9	1,271.0	1,263.1	1,255.2	1,247.3
Non Eligible Cost																									
Water Supply	0.0	72.2	46.9	306.1	147.0	134.8	173.5	5.6	5.8																
Sewerage	0.0	157.0	35.1	3,415.1	1,578.2	1,624.2	1,249.2	9.1	9.4																
Drainage	0.0	229.5	62.7	2,014.1	931.4	1,307.0	1,141.3	5.6	5.8																
Mangement	0.0	38.2	10.3	9.9	3.5	730.7	753.4	4.5	4.7																
Non Eligible Cost Total	0.0	496.8	155.0	5,745.2	2,660.1	3,796.7	3,317.4	24.9	25.6																
Addiitonal Cost Total	0.0	496.9	155.1	5,815.5	2,764.4	3,955.1	3,522.3	891.4	899.2	880.7	897.1	929.8	947.3	1,351.8	1,564.0	1,793.3	3,239.1	2,010.3	2,018.3	2,004.5	1,999.9	2,466.0	2,014.4	1,984.0	1,980.9
Cost Total	4,375.6	5,589.8	6,103.1	12,786.1	10,961.7	12,152.4	11,719.7	9,088.7	9,096.5	9,078.0	9,094.4	9,127.1	9,144.7	9,549.1	9,761.4	9,990.6	11,436.4	10,207.6	10,215.7	10,201.8	10,197.3	10,663.3	10,211.7	10,181.3	10,178.2
Cost Redistribution for Household Use																									
Water Supply	2,525.2	3,019.8	3,477.4	4,287.4	4,866.3	5,179.1	5,250.3	4,799.9	4,800.4	4,793.5	4,801.4	4,800.5	4,808.4	4,847.4	4,888.1	4,918.7	5,988.6	4,964.7	4,971.8	4,962.4	4,960.7	4,954.8	4,978.1	4,955.4	4,953.7
Sewerage	866.5	1,162.2	1,212.5	4,602.8	3,159.7	3,436.0	3,103.0	2,294.3	2,300.9	2,297.2	2,303.5	2,323.1	2,330.5	2,602.4	2,728.4	2,876.3	2,990.8	2,993.1	2,992.4	2,990.9	2,989.5	3,430.4	2,985.1	2,983.1	2,983.0
Drainage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	3,391.7	4,182.0	4,690.0	8,890.3	8,026.0	8,615.1	8,353.3	7,094.3	7,101.3	7,090.7	7,105.0	7,123.6	7,138.9	7,449.8	7,616.6	7,795.0	8,979.4	7,957.8	7,964.2	7,953.3	7,950.2	8,385.3	7,963.2	7,938.6	7,936.7
Water Price (Rs./1,000m3)	7,267.0	8,518.1	9,617.2	11,627.9	12,945.4	13,516.8	13,443.6	12,060.4	11,959.4	11,841.7	11,762.5	11,695.2	11,650.1	11,680.4	11,714.6	11,724.1	14,159.6	11,645.0	11,569.3	11,456.7	11,363.5	11,240.7	11,185.6	11,029.2	10,922.0
Water Cost per Capita (Rs./d)	1.6	1.9	2.1	2.5	2.8	2.9	2.8	2.5	2.4	2.4	2.4	2.3	2.3	2.3	2.2	2.2	2.6	2.1	2.1	2.0	2.0	1.9	1.9	1.8	1.8
Affordability (Rs./d)	4.5	4.6	4.8	5.0	5.1	5.3	5.5	5.7	5.9	6.1	6.3	6.5	6.8	7.0	7.2	7.5	7.8	8.0	8.3	8.6	8.9	9.2	9.5	9.9	10.2
Avaerage Water Price in 5 yrs (Rs./1,0000m3)	10,052.0					12,550.4					11,700.5					12,106.0					11,146.1				
Sewerage Price (Rs./1,000m3)	2,493.5	3,278.4	3,353.4	12,483.3	8,405.4	8,967.5	7,945.5	5,764.7	5,732.2	5,675.0	5,643.2	5,659.8	5,646.4	6,270.9	6,538.8	6,855.9	7,071.6	7,020.4	6,963.3	6,905.2	6,848.1	7,782.3	6,707.4	6,639.5	6,577.1
Sewerage Cost per Capita (Rs./d)	0.6	0.7	0.7	2.7	1.8	1.9	1.7	1.2	1.2	1.1	1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.3	1.3	1.2	1.2	1.3	1.1	1.1	1.1
Affordability (Rs./d)	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.3	2.4	2.5	2.6
Avaerage Sewerage Price in 5 yrs (Rs./1,0000	6,085.4					6,790.8					5,954.5					6,963.2					6,907.7				

Appendix 15.9 Water and Sewerage Price for Households (Option 1)

(Unit: Rs. Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Cost																									
Existing																									
Water Suply	3,042.5	3,541.2	4,135.7	4,846.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8
Sewerage	933.2	1,086.2	1,268.5	1,486.6	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3
Drainage	399.9	465.5	543.7	637.1	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3
Existing Cost total	4,375.6	5,092.9	5,947.9	6,970.5	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3
Additional Cost																									
Operation and Maintenance																									
Water Supply								10.7	10.8	11.0	11.2	11.3	11.4	11.6	11.7	11.8	11.9	12.0	12.0	12.1	12.2	12.3	12.3	12.4	12.5
Sewerage								349.4	352.1	354.7	364.3	365.9	367.6	369.2	370.8	376.4	377.6	378.9	380.1	381.3	385.4	386.3	387.2	388.2	392.2
Drainage								45.6	45.6	45.6	45.6	45.6	45.6	45.6	45.6	45.6	45.6	45.6	45.6	45.6	45.6	45.6	45.6	45.6	45.6
Mangement								23.1	23.4	23.7	24.0	24.3	24.6	24.9	25.2	25.5	25.8	26.1	26.4	26.7	27.1	27.4	27.7	28.1	28.4
Operation and Maintenance Cost Total								428.8	431.9	435.0	445.1	447.1	449.2	451.2	453.2	459.3	460.8	462.5	464.1	465.7	470.2	471.5	472.8	474.2	478.6
Replacement Cost																									
Water Supply								0.0	0.0	0.0	9.2	0.3	0.0	0.0	25.1	0.0	1,223.6	0.0	9.2	0.0	0.0	0.3	25.1	0.0	0.0
Sewerage								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0	0.0	471.1	0.0	0.0	0.0
Drainage								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Replacement Cost Total								0.0	0.0	0.0	9.2	0.3	0.0	0.0	25.1	0.0	1,227.7	0.0	9.2	0.0	0.0	471.4	25.1	0.0	0.0
Loan Cost																									
Repayment																									
Water Supply	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	14.1	62.1	86.9	110.5	129.0	130.1	131.2	131.2	131.2	131.2	131.2	131.2	131.2
Sewerage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.9	19.5	210.5	299.2	390.1	459.6	460.4	461.3	461.3	461.3	461.3	461.3	461.3	461.3
Drainage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	11.0	53.3	85.9	102.5	102.5	102.5	102.5	102.5	102.5	102.5	102.5	102.5	102.5
Mangement	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	4.9	5.9	6.3	74.2	143.8	144.3	144.7	144.7	144.7	144.7	144.7	144.7	144.7
Repayment Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9	49.4	331.7	478.2	677.2	834.9	837.2	839.6	839.6	839.6	839.6	839.6	839.6	839.6
Interest																									
Water Supply	0.0	0.0	0.0	8.7	14.5	20.4	25.0	25.0	25.0	25.0	25.0	25.0	25.0	24.6	23.9	22.8	21.6	20.3	19.1	17.8	16.6	15.3	14.1	12.8	11.6
Sewerage	0.0	0.0	0.0	32.6	47.5	63.0	74.9	74.9	74.9	74.9	74.9	74.9	74.9	73.8	72.2	70.1	67.6	65.1	62.6	60.1	57.6	55.1	52.6	50.1	47.6
Drainage	0.0	0.0	0.0	5.6	8.2	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.6	10.3	10.0	9.6	9.2	8.9	8.5	8.2	7.8	7.4	7.1	6.7
Mangement	0.0	0.0	0.0	0.0	0.0	18.9	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	37.4	35.5	33.6	31.6	29.7	27.8	25.9	24.0	22.1	20.1
Interest Total	0.0	0.1	0.1	46.9	70.2	113.1	149.0	149.0	149.0	149.0	149.0	149.0	149.0	147.3	144.7	140.3	134.3	128.3	122.2	116.2	110.2	104.1	98.1	92.1	86.1
Loan Cost Total	0.0	0.1	0.1	46.9	70.2	113.1	149.0	149.0	149.0	149.0	149.0	184.9	198.4	479.1	622.9	817.6	969.2	965.5	961.8	955.8	949.8	943.8	937.7	931.7	925.7
Non Eligible Cost																									
Water Supply	0.0	72.2	46.9	306.1	147.0	134.8	173.5	5.6	5.8																
Sewerage	0.0	157.0	35.1	2,131.6	989.3	1,016.1	778.3	8.7	9.0																
Drainage	0.0	108.0	0.0	352.6	158.5	132.8	79.4	0.0	0.0																
Mangement	0.0	38.2	10.3	9.9	3.5	730.7	753.4	4.5	4.7																
Non Eligible Cost Total	0.0	375.3	92.3	2,800.3	1,298.2	2,014.4	1,784.6	18.9	19.5																
Addiitonal Cost Total	0.0	375.4	92.4	2,847.1	1,368.4	2,127.5	1,933.6	596.7	600.4	584.1	603.3	632.3	647.6	930.3	1,101.3	1,276.8	2,657.7	1,428.0	1,435.2	1,421.5	1,420.0	1,886.7	1,435.7	1,405.9	1,404.3
Cost Total	4,375.6	5,468.3	6,040.3	9,817.7	9,565.7	10,324.8	10,131.0	8,794.0	8,797.7	8,781.4	8,800.7	8,829.7	8,844.9	9,127.6	9,298.6	9,474.2	10,855.0	9,625.4	9,632.5	9,618.8	9,617.3	10,084.0	9,633.0	9,603.2	9,601.6
Cost Redistribution for Household Use																									
Water Supply	2,525.2	3,020.2	3,477.5	4,288.4	4,866.6	5,240.1	5,310.6	4,801.1	4,801.6	4,794.6	4,802.5	4,801.6	4,809.6	4,849.0	4,889.9	4,922.4	5,994.5	4,970.9	4,977.9	4,968.4	4,966.6	4,960.2	4,984.0	4,961.2	4,959.5
Sewerage	866.5	1,162.4	1,212.6	3,393.2	2,586.9	2,830.7	2,620.2	2,040.7	2,043.5	2,036.6	2,045.6	2,062.9	2,068.1	2,247.1	2,330.0	2,435.4	2,514.7	2,516.4	2,515.6	2,514.0	2,515.1	2,956.9	2,511.2	2,509.4	2,510.4
Drainage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	3,391.7	4,182.6	4,690.1	7,681.7	7,453.5	8,070.8	7,930.9	6,841.8	6,845.1	6,831.2	6,848.1	6,864.6	6,877.7	7,096.1	7,219.8	7,357.8	8,509.2	7,487.2	7,493.5	7,482.4	7,481.7	7,917.1	7,495.2	7,470.7	7,469.9
Water Price (Rs./1,000m3)	7,267.0	8,519.4	9,617.4	11,630.6	12,946.0	13,675.9	13,598.1	12,063.3	11,962.4	11,844.5	11,765.2	11,698.1	11,653.1	11,684.4	11,718.8	11,733.0	14,173.4	11,659.4	11,583.5	11,470.7	11,377.2	11,252.9	11,198.8	11,042.2	10,934.7
Water Cost per Capita (Rs./d)	1.6	1.9	2.1	2.5	2.8	2.9	2.9	2.5	2.4	2.4	2.4	2.3	2.3	2.3	2.2	2.2	2.6	2.1	2.1	2.0	2.0	1.9	1.9	1.8	1.8
Affordability (Rs./d)	4.5	4.6	4.8	5.0	5.1	5.3	5.5	5.7	5.9	6.1	6.3	6.5	6.8	7.0	7.2	7.5	7.8	8.0	8.3	8.6	8.9	9.2	9.5	9.9	10.2
Avaerage Price in 5 yrs (Rs./1,0000m3)	10,052.9					12,613.5					11,703.8					12,119.0					11,159.0				
Sewerage Price (Rs./1,000m3)	2,493.5	3,278.9	3,353.4	9,202.7	6,881.7	7,387.8	6,709.3	5,127.4	5,091.0	5,031.1	5,011.2	5,025.8	5,010.6	5,414.7	5,583.8	5,804.9	5,945.8	5,902.3	5,853.7	5,804.0	5,761.3	6,708.0	5,642.5	5,585.2	5,535.0
Sewerage Cost per Capita (Rs./d)	0.6	0.7	0.7	2.0	1.5	1.6	1.4	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.2	1.0	0.9	0.9
Affordability (Rs./d)	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.3	2.4	2.5	2.6
Avaerage Sewerage Price in 5 yrs (Rs./1,000	5,099.8					5,850.5					5,210.9					5,862.0					5,843.4				

Appendix 15.10 Water and Sewerage Price for Households (Option 2)

(Unit: Rs. Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Cost																									
Existing																									
Water Suply	3,042.5	3,541.2	4,135.7	4,846.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8	5,699.8
Sewerage	933.2	1,086.2	1,268.5	1,486.6	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3	1,748.3
Drainage	399.9	465.5	543.7	637.1	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3	749.3
Existing Cost total	4,375.6	5,092.9	5,947.9	6,970.5	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3	8,197.3
Additional Cost																									
Operation and Maintenance																									
Water Supply								10.7	10.8	11.0	11.2	11.3	11.4	11.6	11.7	11.8	11.9	12.0	12.0	12.1	12.2	12.3	12.3	12.4	12.5
Sewerage								116.6	117.9	119.2	120.6	121.4	122.3	123.1	123.9	124.8	125.4	126.1	126.7	127.4	128.1	128.6	129.1	129.6	130.6
Drainage								50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9
Mangement								23.1	23.4	23.7	24.0	24.3	24.6	24.9	25.2	25.5	25.8	26.1	26.4	26.7	27.1	27.4	27.7	28.1	28.4
Operation and Maintenance Cost Total								201.2	203.0	204.7	206.6	207.9	209.1	210.4	211.6	212.9	213.9	215.0	216.0	217.1	218.2	219.1	220.0	220.9	222.3
Replacement Cost																									
Water Supply								0.0	0.0	0.0	9.2	0.3	0.0	0.0	25.1	0.0	1,223.6	0.0	9.2	0.0	0.0	0.3	25.1	0.0	0.0
Sewerage								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0	0.0	471.1	0.0	0.0	0.0
Drainage								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Replacement Cost Total								0.0	0.0	0.0	9.2	0.3	0.0	0.0	25.1	0.0	1,227.7	0.0	9.2	0.0	0.0	471.4	25.1	0.0	0.0
Loan Cost																									
Repayment																									
Water Supply	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	14.1	62.1	86.9	110.5	129.0	130.1	131.2	131.2	131.2	131.2	131.2	131.2	131.2
Sewerage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.9	18.1	108.3	146.4	185.5	216.7	216.8	216.9	216.9	216.9	216.9	216.9	216.9	216.9
Drainage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	12.3	76.8	104.7	131.9	161.4	162.5	163.6	163.6	163.6	163.6	163.6	163.6	163.6
Mangement	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	4.9	5.9	6.3	74.2	143.8	144.3	144.7	144.7	144.7	144.7	144.7	144.7	144.7
Repayment Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.2	49.3	253.1	344.2	502.0	650.9	653.6	656.3	656.3	656.3	656.3	656.3	656.3	656.3
Interest																									
Water Supply	0.0	0.0	0.0	8.7	14.5	20.4	25.0	25.0	25.0	25.0	25.0	25.0	25.0	24.6	23.9	22.8	21.6	20.3	19.1	17.8	16.6	15.3	14.1	12.8	11.6
Sewerage	0.0	0.0	0.0	13.5	19.7	26.1	31.0	31.0	31.0	31.0	31.0	31.0	31.0	30.6	29.9	29.0	28.0	27.0	25.9	24.9	23.9	22.8	21.8	20.8	19.7
Drainage	0.0	0.0	0.0	9.9	14.5	19.2	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.5	22.0	21.4	20.6	19.9	19.1	18.3	17.6	16.8	16.0	15.3	14.5
Mangement	0.0	0.0	0.0	0.0	0.0	18.9	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	38.3	37.4	35.5	33.6	31.6	29.7	27.8	25.9	24.0	22.1	20.1
Interest Total	0.0	0.1	0.1	32.1	48.6	84.5	117.2	117.2	117.2	117.2	117.2	117.2	117.2	116.0	114.1	110.6	105.7	100.7	95.8	90.8	85.8	80.9	75.9	70.9	66.0
Loan Cost Total	0.0	0.1	0.1	32.1	48.6	84.5	117.2	117.2	117.2	117.2	117.2	154.4	166.5	369.1	458.3	612.7	756.6	754.3	752.1	747.1	742.2	737.2	732.2	727.3	722.3
Non Eligible Cost																									
Water Supply	0.0	72.2	46.9	306.1	147.0	134.8	173.5	5.6	5.8																
Sewerage	0.0	157.0	21.1	820.6	343.5	352.4	282.5	1.1	1.1																
Drainage	0.0	229.5	62.7	2,014.1	931.4	1,307.0	1,141.3	5.6	5.8																
Mangement	0.0	38.2	10.3	9.9	3.5	730.7	753.4	4.5	4.7																
Non Eligible Cost Total	0.0	496.8	141.1	3,150.7	1,425.3	2,524.9	2,350.7	16.9	17.4																
Addiitonal Cost Total	0.0	496.9	141.2	3,182.8	1,473.9	2,609.5	2,467.9	335.3	337.6	322.0	333.1	362.6	375.7	579.5	695.0	825.6	2,198.2	969.3	977.3	964.2	960.4	1,427.7	977.3	948.1	944.6
Cost Total	4,375.6	5,589.8	6,089.1	10,153.3	9,671.2	10,806.8	10,665.3	8,532.6	8,534.9	8,519.3	8,530.4	8,560.0	8,573.0	8,776.8	8,892.4	9,022.9	10,395.5	9,166.7	9,174.7	9,161.5	9,157.7	9,625.0	9,174.6	9,145.5	9,141.9
Cost Redistribution for Household Use																									
Water Supply	2,525.2	3,019.8	3,477.5	4,288.3	4,866.5	5,221.9	5,288.2	4,802.2	4,802.7	4,795.6	4,803.6	4,802.8	4,810.8	4,850.5	4,891.6	4,926.0	5,999.6	4,976.3	4,983.3	4,973.7	4,971.9	4,965.0	4,989.2	4,966.4	4,964.6
Sewerage	866.5	1,162.2	1,199.5	2,156.9	1,961.2	2,121.9	2,067.9	1,775.1	1,776.4	1,775.7	1,777.0	1,793.6	1,796.6	1,881.3	1,917.1	1,968.2	2,010.4	2,011.5	2,010.9	2,010.2	2,009.6	2,453.1	2,007.8	2,007.0	2,006.6
Drainage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	3,391.7	4,182.0	4,677.0	6,445.2	6,827.7	7,343.7	7,356.1	6,577.3	6,579.2	6,571.3	6,580.7	6,596.4	6,607.4	6,731.8	6,808.7	6,894.3	8,009.9	6,987.7	6,994.2	6,983.9	6,981.5	7,418.1	6,997.0	6,973.4	6,971.2
Water Price (Rs./1,000m3)	7,267.0	8,518.1	9,617.2	11,630.2	12,946.0	13,628.4	13,540.6	12,066.1	11,965.2	11,847.1	11,767.9	11,700.9	11,656.0	11,687.9	11,722.9	11,741.6	14,185.5	11,672.1	11,596.0	11,482.9	11,389.3	11,263.6	11,210.5	11,053.6	10,946.0
Water Cost per Capita (Rs./d)	1.6	1.9	2.1	2.5	2.8	2.9	2.8	2.5	2.5	2.4	2.4	2.3	2.3	2.3	2.2	2.2	2.6	2.1	2.1	2.0	2.0	1.9	1.9	1.8	1.8
Affordability (Rs./d)	4.5	4.6	4.8	5.0	5.1	5.3	5.5	5.7	5.9	6.1	6.3	6.5	6.8	7.0	7.2	7.5	7.8	8.0	8.3	8.6	8.9	9.2	9.5	9.9	10.2
Avaerage Water Price in 5 yrs (Rs./1,0000m3)	10,052.6					12,594.6					11,707.0					12,130.7					11,170.5				
Sewerage Price (Rs./1,000m3)	2,493.5	3,278.4	3,317.4	5,849.6	5,217.1	5,537.8	5,295.0	4,460.1	4,425.6	4,386.6	4,353.4	4,369.6	4,352.9	4,533.4	4,594.4	4,691.4	4,753.3	4,718.0	4,679.3	4,641.0	4,603.4	5,565.2	4,511.3	4,467.0	4,424.3
Sewerage Cost per Capita (Rs./d)	0.6	0.7	0.7	1.3	1.1	1.2	1.1	0.9	0.9	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	1.0	0.8	0.7	0.7
Affordability (Rs./d)	1.1	1.2	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.3	2.4	2.5	2.6
Avaerage Sewerage Price in 5 yrs (Rs./1,0000	4,062.7					4,811.7					4,441.4					4,696.3					4,711.5				

Appendix 15.11 Cash Flow of Household Use (Original)

(Unit: Rs. Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Water Price (Rs./1,000m3)	2,833.0	4,452.6	6,072.1	7,691.7	9,311.3	12,550.4	12,550.4	12,550.4	12,550.4	12,550.4	11,700.5	11,700.5	11,700.5	11,700.5	11,700.5	12,106.0	12,106.0	12,106.0	12,106.0	12,106.0	11,146.1	11,146.1	11,146.1	11,146.1	11,146.1
Sewersge Price (Rs./1,000m3)	1,983.1	2,784.4	3,585.7	4,386.9	5,188.2	6,790.8	6,790.8	6,790.8	6,790.8	6,790.8	5,954.5	5,954.5	5,954.5	5,954.5	5,954.5	6,963.2	6,963.2	6,963.2	6,963.2	6,963.2	6,907.7	6,907.7	6,907.7	6,907.7	6,907.7
Accounted Volume (1,000m3/d)	952.0	971.3	990.6	1,010.2	1,029.9	1,049.8	1,070.0	1,090.4	1,099.7	1,109.0	1,118.3	1,124.6	1,130.8	1,137.0	1,143.2	1,149.4	1,158.7	1,168.1	1,177.4	1,186.7	1,196.0	1,207.7	1,219.3	1,231.0	1,242.6
Cash Inflow from Households																									
Water Supply Sales from Households	984	1,578	2,196	2,836	3,500	4,809	4,901	4,995	5,038	5,080	4,776	4,803	4,829	4,856	4,882	5,079	5,120	5,161	5,202	5,244	4,866	4,913	4,961	5,008	5,055
Sewerage Sales frm Households	689	987	1,297	1,618	1,950	2,602	2,652	2,703	2,726	2,749	2,431	2,444	2,458	2,471	2,485	2,921	2,945	2,969	2,992	3,016	3,015	3,045	3,074	3,104	3,133
Sales from Households Total	1,674	2,566	3,492	4,454	5,451	7,411	7,554	7,698	7,763	7,829	7,207	7,247	7,287	7,327	7,367	8,000	8,065	8,130	8,195	8,260	7,881	7,958	8,035	8,112	8,188
Cash Outflow for Households	3,391.7	4,182.0	4,690.0	8,890.3	8,026.0	8,615.1	8,353.3	7,094.3	7,101.3	7,090.7	7,105.0	7,123.6	7,138.9	7,449.8	7,616.6	7,795.0	8,979.4	7,957.8	7,964.2	7,953.3	7,950.2	8,385.3	7,963.2	7,938.6	7,936.7
Net Cash Flow for Households	-1,718.2	-1,616.4	-1,197.9	-4,436.6	-2,575.5	-1,204.3	-799.8	603.4	662.2	738.5	101.7	123.1	147.9	-123.0	-249.7	205.2	-914.4	172.2	230.6	306.4	-68.9	-427.2	71.5	173.0	251.6

Appendix 15.12 Cash Flow of Household Use (Option 1)

(Unit: Rs. Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Water Price (Rs./1,000m3)	2,833.0	4,463.1	6,093.2	7,723.2	9,353.3	12,613.5	12,613.5	12,613.5	12,613.5	12,613.5	11,703.8	11,703.8	11,703.8	11,703.8	11,703.8	12,119.0	12,119.0	12,119.0	12,119.0	12,119.0	11,159.0	11,159.0	11,159.0	11,159.0	11,159.0
Sewersge Price (Rs./1,000m3)	1,983.1	2,627.7	3,272.2	3,916.8	4,561.4	5,850.5	5,850.5	5,850.5	5,850.5	5,850.5	5,210.9	5,210.9	5,210.9	5,210.9	5,210.9	5,862.0	5,862.0	5,862.0	5,862.0	5,862.0	5,843.4	5,843.4	5,843.4	5,843.4	5,843.4
Accounted Volume (1,000m3/d)	952.0	971.3	990.6	1,010.2	1,029.9	1,049.8	1,070.0	1,090.4	1,099.7	1,109.0	1,118.3	1,124.6	1,130.8	1,137.0	1,143.2	1,149.4	1,158.7	1,168.1	1,177.4	1,186.7	1,196.0	1,207.7	1,219.3	1,231.0	1,242.6
Cash Inflow from Households																									
Water Supply Sales from Households	984	1,582	2,203	2,848	3,516	4,833	4,926	5,020	5,063	5,106	4,777	4,804	4,831	4,857	4,884	5,084	5,126	5,167	5,208	5,249	4,871	4,919	4,966	5,014	5,061
Sewerage Sales frm Households	689	932	1,183	1,444	1,715	2,242	2,285	2,328	2,348	2,368	2,127	2,139	2,151	2,163	2,174	2,459	2,479	2,499	2,519	2,539	2,551	2,576	2,601	2,625	2,650
Sales from Households Total	1,674	2,514	3,386	4,292	5,231	7,075	7,211	7,349	7,411	7,474	6,905	6,943	6,981	7,020	7,058	7,544	7,605	7,666	7,727	7,788	7,422	7,495	7,567	7,639	7,711
Cash Outflow for Households	3,391.7	4,182.6	4,690.1	7,681.7	7,453.5	8,070.8	7,930.9	6,841.8	6,845.1	6,831.2	6,848.1	6,864.6	6,877.7	7,096.1	7,219.8	7,357.8	8,509.2	7,487.2	7,493.5	7,482.4	7,481.7	7,917.1	7,495.2	7,470.7	7,469.9
Net Cash Flow for Households	-1,718.2	-1,668.9	-1,303.7	-3,389.7	-2,222.8	-996.1	-719.9	506.8	566.2	643.0	56.4	78.3	103.6	-76.5	-161.9	185.9	-904.3	178.8	233.7	305.9	-59.4	-422.5	71.7	168.5	241.6

Appendix 15.13 Cash Flow of Household Use (Option 2)

(Unit: Rs. Million)

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Water Price (Rs./1,000m3)	2,833.0	4,459.9	6,086.9	7,713.8	9,340.7	12,594.6	12,594.6	12,594.6	12,594.6	12,594.6	11,707.0	11,707.0	11,707.0	11,707.0	11,707.0	12,130.7	12,130.7	12,130.7	12,130.7	12,130.7	11,170.5	11,170.5	11,170.5	11,170.5	11,170.5
Sewersge Price (Rs./1,000m3)	1,983.1	2,454.5	2,926.0	3,397.4	3,868.8	4,811.7	4,811.7	4,811.7	4,811.7	4,811.7	4,441.4	4,441.4	4,441.4	4,441.4	4,441.4	4,696.3	4,696.3	4,696.3	4,696.3	4,696.3	4,711.5	4,711.5	4,711.5	4,711.5	4,711.5
Accounted Volume (1,000m3/d)	952.0	971.3	990.6	1,010.2	1,029.9	1,049.8	1,070.0	1,090.4	1,099.7	1,109.0	1,118.3	1,124.6	1,130.8	1,137.0	1,143.2	1,149.4	1,158.7	1,168.1	1,177.4	1,186.7	1,196.0	1,207.7	1,219.3	1,231.0	1,242.6
Cash Inflow from Households																									
Water Supply Sales from Households	984	1,581	2,201	2,844	3,511	4,826	4,919	5,013	5,055	5,098	4,779	4,805	4,832	4,858	4,885	5,089	5,131	5,172	5,213	5,254	4,876	4,924	4,971	5,019	5,066
Sewerage Sales frm Households	689	870	1,058	1,253	1,454	1,844	1,879	1,915	1,931	1,948	1,813	1,823	1,833	1,843	1,853	1,970	1,986	2,002	2,018	2,034	2,057	2,077	2,097	2,117	2,137
Sales from Households Total	1,674	2,451	3,259	4,097	4,966	6,669	6,798	6,928	6,987	7,046	6,592	6,628	6,665	6,702	6,738	7,060	7,117	7,174	7,231	7,288	6,933	7,001	7,068	7,136	7,203
Cash Outflow for Households	3,391.7	4,182.0	4,677.0	6,445.2	6,827.7	7,343.7	7,356.1	6,577.3	6,579.2	6,571.3	6,580.7	6,596.4	6,607.4	6,731.8	6,808.7	6,894.3	8,009.9	6,987.7	6,994.2	6,983.9	6,981.5	7,418.1	6,997.0	6,973.4	6,971.2
Net Cash Flow for Households	-1,718.2	-1,730.7	-1,418.1	-2,348.3	-1,862.1	-674.3	-558.2	350.3	407.6	474.7	11.1	32.0	57.6	-30.2	-70.5	165.3	-893.2	186.3	237.1	304.5	-48.3	-417.4	71.3	162.3	232.1

Appendix 16.1 Screening and Scoping for EIA/IEE

WATER AND SANITATION AGENCY (LDA)
B-block Gulberg-II Near Main Market Lahore
Phone No. 0423-5757425

No.D(P&E)/ 4011-14 Dated: 20-10-09

Director General,
Environmental Protection Agency, Punjab,
Hockey Stadium, Lahore

SUBJECT: **SCREENING AND SCOPING FOR EIA/IEE OF WATER SUPPLY, SEWERAGE/DRAINAGE IMPROVEMENT AND WASTEWATER TREATMENT PLANT PROJECTS IN LAHORE.**

Respected Madam,

WASA is planning to implement various projects, under JICA assistance, to improve the overall water supply, sewerage and drainage system of Lahore along with construction of wastewater treatment plant. The detailed cost estimation is being done by JICA consultants and will be provided to WASA by the end of December 2009. However, the particulars and tentative cost of projects are given in table below:

Sr. No.	Project Name	Brief Description	Estimated Cost/Capacity
1	Construction of trunk sewers and branch sewers in the central areas of Lahore and construction of new Gulshan-e-ravi disposal station.	i. Construction of trunk sewer from Larex Colony to Gulshn-e-ravi disposal station ii. Construction of branch sewer from Larex Colony to Gulshn-e-ravi disposal station. iii. New construction of Gulshn-e-ravi pumping station	More than Rupees 2000 million
2	Construction of South West wastewater treatment plant (WWTP) including the collector channel	i. Treatment of sewage of Lahore before disposal into River Ravi through construction of wastewater treatment plant in South West of Lahore near Babu Sabu.	More than Rupees 10,000 million

		ii. Construction of a collector channel to transport wastewater up to treatment plant site.	
3	Construction of new drains and improvement of existing drains in Lahore.	i. Construction of 32 new drains for in Lahore specially in the areas which are flooded during moon soon season ii. Improvement and rehabilitation of Governor House Drain and McLeod Road Drain	More than Rupees 2000 million
4	Reduction of unaccounted-for-water and non revenue water in public water supply through metering system and Improvement of water quality through replacement of Chlorinators at tube wells.	i. Installation of meters at 40% of water supply connection. ii. Execution of asset study and preparation of a distribution network improvement plan in the entire WASA area iii. Replacement of Chlorinators at all tube wells iv. Bulk flow meters for installation for all tube wells	Yet to be determined

It is requested to guide us whether these projects come under the schedule of IEE or EIA, so that we may prepare the study for environmental approval from your Agency. Your cooperation in this regard will be highly appreciated.

(Syed Zahid Aziz)
Director (P&E)
WASA, LDA, Lahore.

CC: DMD (Engg.),WASA, LDA
PS to MD, WASA, LDA
JICA Consultants, Tokyo Japan

Appendix 16.2 Minutes of the Public Hearing

MINUTES OF THE PUBLIC HEARING REGARDING PROPOSED PROJECT CONSTRUCTION OF SOUTH WEST WASTE WATER TREATMENT PLANT HELD ON JULY 14TH , 2007 AT SUNFORT HOTEL, LIBERTY MARKET, LAHORE

In compliance with the Section 12(3) of Pakistan Environmental Protection Act, 1997 mandatory Public Hearing of the proposed project titled "Construction of South West Sewage Treatment Plant" was convened under the chairmanship of Mr. Khalid Mahmood, Director (P&C), Environmental Protection Agency, Punjab at Sunfort Hotel, Liberty Market, Lahore on 14.07.2007.

The meeting started with recitation from the Holy Quran.

The Chair briefed about the format and procedure of the Public Hearing and explained its legal requirement under Section No.12 (3) of the Pakistan Environmental Protection Act, 1997 and opened the house for description of the project and expressing concerns and comments by the potential stakeholders on the proposed project.

Mr. Abdul Rehman Siddique Deputy Managing Director, WASA and Mr. Shakeel Ahmad Deputy Director, WASA briefly described about the project and informed the house that number of litigations is subjudice at various legal fora against WASA due to disposal of untreated effluent into river Ravi. The organization tried its level best to discharge its duties in public interests but could not implement its schemes due to financial constraints.

Mr. Salman Akhtar Khan, Environmental Consultant briefly described the salient features of the proposed project to the house besides anticipated environmental hazards associated with the project, their impacts on the environment and mitigation measures proposed by the proponent for their redressal.

Brief description of the project is as under:

(i) The proposed project is one of four sewage treatment plant proposed by WASA authorities in Lahore with financial and technical assistance of French donors
(ii) The proposed plant will draw sewage from four pumping stations of the city i.e. Chota Ravi, Main Outfall, Gulshan-e-Ravi and Multan Road
(iii) Six kilometer collector channel will be constructed to carry sewage from four pumping station to the sewage treatment plant
(iv) The plant will be constructed on land already acquired by WASA
(v) The plant will be constructed in three stages.
(vi) The first stage will have the capacity to treat 2,50,000 cubic meter sewage per day
(vii) Land requirement for the first stage will be 15.5 Hectares
(viii) The proposed plant will meet both NEQS and European Community Standards
(ix) The sludge generated during treatment will be used for production of electricity generation
(x) Anaerobic digester will be installed for gas generation and is expected to cater 53 % of the energy requirement

Participants present on the occasion raised the following concerns on the proposed project:

1. What is the total sewage discharge and its ultimate disposal?
2. What fraction of the total discharge will be treated?
3. Where in exact site of the proposed project?

(8) 23

3. Where is exact site of the proposed project?
4. How much population is going to be benefited with implementation of the proposed project?
5. What is the proximity of the proposed project from the nearest locality?
6. What will be the ultimate disposal of sludge to be generated during operation of the project?
7. WASA should clarify whether the project site falls in flood area or not? If so, what measures have been proposed to save the plant as huge investment is going to be incurred in the proposed project?
8. WASA should provide Canal/Drainage Division clearance of the site
9. Whether the plant will be capable of handling domestic and industrial effluent altogether?
10. How WASA will be able to segregate domestic and industrial effluents?
11. Has WASA conducted preliminary survey regarding identification of industries responsible for discharging untreated effluent into public sewer?
12. List/ statement prepared on the basis of above survey may be provided
13. What type link drain will be laid down for directing sewage to the proposed plant?
14. Analytical data of the inflow sewage may be provided

The Public Hearing concluded with a vote of thanks from the chair.

ASSITANT DIRECTOR (EIA)
NVIRNMENTAL PROTECTION AGENCY
PUNJAB

Ahmad 23/7/07
DIRECTOR (EIA)
ENVIRNMENTAL PROTECTION AGENCY
PUNJAB

DIRECTOR (P&C)
ENVIRNMENTAL PROTECTION AGENCY
PUNJAB
23/7/07

Appendix 16.3 Consultation Meeting Notice

WATER AND SANITATION AGENCY (LDA)

Zahoor Elahi Road, Near Main Market, B-Block Gulberg-II, Lahore
Phone: 042-9263144-43, Fax: 042-9263147

To,

1. All land users at WWT site (list attached)
2. All residents adjacent to collector channel
3. EPA representative
4. LAC WASA
5. Director WWT, WASA
6. Director P&E
7. DDO Revenue, CDGL

No.DD(P&E)/ 3975-83 Dated: 16/10/09

Subject: **Consultation Meeting Notice**

A meeting is being arranged for all the stakeholders regarding construction of the South West Wastewater Treatment Plant and collector channel to discuss the various environmental and social aspects of the project.

You are requested to attend this meeting on 19h October, 2009 at 11:30 AM at WASA Office, Kharak, Sabzazar, Lahore.

(Muhammad Tanveer)
Deputy Director (P&E)
WASA, LDA, Lahore

CC:

- JICA Consultants, Tokyo Japan
- DMD (E) WASA
- Dy. Director EPA, Govt. of the Punjab
- PS to MD WASA

Minutes of the Meeting

Public Consultation Meeting on South West Wastewater Treatment Plant
19th October, 2009.

- A public consultation meeting of all the stakeholders and concerned personnel was arranged by the WASA at 11:30am, Kharak, Sabzazar office on 19th October, 2009. Mr. Muhammad Tanveer, Dy-Director (P&E) was the representative from WASA. Other concerned governmental officials, representatives from JICA Study Team and few stakeholders were also present at the meeting.

Attendance list of officials is attached herby:

Sr. No	Name	Designation
1	M. Ijaz	WWT Division, WASA
2	Malik M. Akram	Nazim UC-118 Niaz Beg
3	M. Farooq Alam	Dy-Director, EPD
4	M. Tanveer	Dy. Director (P&E)
5	Khalid Muhammad	LAC Office, WASA
6	Rai Niaz	LAC, WASA
7	M. Iqbal Tahir	Putwaari, WASA
8	Zahid Mahmood	Putwaari, DDO (Revenue)
9	Mohson Saeed	JICA Study Team
10	Arsalan Mukhtar	JICA Study Team

Attendance list of stakeholders is as follows:

Sr. No	Name	Address
1	M. Sadiq s/o Barkat Ali	Said Pur, Multan Road, Lahore
2	M. Abbas	Jhugian Nagra, Sazazar, Lahore
3	Haji Manzoor s/o Barkat Ali	Babu Sabu, Lahore
4	Ather Awan s/o Siraj Din	Thokar Niaz Beg
5	Muhammad Munir s/o Haji Bashir	Jhugian Nagra, Lahore
6	Mukhtar Ahmed s/o M. Yaqoob	Shadewal, Lahore
7	Abdul Hafeez s/o Abdul Aziz	Main Bazar, Babu Sabu, Lahore
8	Abdul karem s/o Abdul Aziz	Babu Sabu, Lahore
9	Haji Muhammad Asif s/o Sikander	Babu Sabu, Lahore
10	Mehraj Din s/o M. Bashir	Babu Sabu, Lahore

11	Barket Ali s/o Kher Din	Babu sabu, Lahore
12	Abbas s/o Mehraj Din	Kot Muhammadi, Shah Di Khoi, Lahore
13	Farmish s/o Hasan Din	Chugian Nagra, Lahore
14	Jan Muhammad s/o Hassan Din	Niaz Beg, Lahore
15	M. Latif s/o M. Tufail	Koonj Pura, Lahore

- Representative of WASA welcomed the participants and stated the purpose of the meeting and inform the stakeholders that WASA is going to implement the construction of Wastewater Treatment Plant on the proposed site acquired by the Government during the year 1992. WASA will give notices of evacuation in July 2010 and subsequent possession taken over by WASA in November 2010. All the stakeholders were asked to express their views on this issue.

- Most of the participants gave the consent that they will evacuate the land as soon as the WASA will ask them to do so. Few persons stressed that they will evacuate the land however, they expect that some compensation will be paid for their trees and crops on the land in question.

- The representative of WASA informed the stakeholders that the occupants of the land have been using this land for cultivation of crops since 1992 inspite of the fact the WASA is the owner of this land. Therefore, the income encashed by the occupants is extra compensation. Therefore, no extra claim is acceptable in this regard, however, any aggrieved person can resort to the tribunal of LDA, which is constituted especially for such issues, or any court of law.

- Representative of DD Revenue explained that 15% excess price was paid to the owners of these lands at the time of acquiring the land which included the compensation of trees and crops altogether.

(Muhammad Tanveer)
Dy-Director (P&E)
WASA, LDA, Lahore

No. DD (P&E) 4108-13
Date: 22/10/09

CC: Director (P&E) WASA
Director (WWT) WASA
DDR (CDGL)
Dy-Director EPD, Govt. of Punjab
PS to MD, WASA
✓ JICA Consultants, Tokyo, Japan.

Appendix 16.4 Screening Form

Screening Form

Name of Project : Lahore Water Supply, Sewerage and Drainage Improvement Project

Name of Project Execution Organization : Water and Sanitation Agency(WASA), Lahore

Name of Borrower : WASA, Lahore through Government of the Punjab/ Pakistan

Please provide the name, department, job title, and contact details for the person who is responsible for filling out this form.

Name : Engr. Syed Zahid Aziz

Department and title : Planning and Evaluation Directorate, WASA / Director

Name of Company or Organization : Water and Sanitation Agency (WASA), Lahore

Telephone number : +92-42-5757425

Fax number : +92-42-9263147

E-Mail address : zaziz99@yahoo.com, pmuwasa@yahoo.com

Date : 6th October 2009

Signature :

(Syed Zahid Aziz)
Director (P&E)
WASA, LDA, Lahore.

(Matters to be noted)

1. Please note that JBIC may provide the information concerning the environmental assessment (including that in writing or orally; hereinafter referred to as the "Environmental Information") provided by the Borrower, etc. in considering the financing, investments or guarantee for a project as part of JBIC's international financial operations to the financial institutions in Japan, which also consider financing, investments or guarantee for the same project jointly or separately with JBIC (hereinafter referred to as the "Cofinancing Institutions"), whether or not any confidentiality agreement has been entered into by and between JBIC and the Borrower, etc. JBIC provides the Environmental Information to the Cofinancing Institutions for their conducting the confirmation of environmental and social consideration with respect to the project. In providing the Environmental Information, JBIC requires the Cofinancing Institutions (i) not to use the Environmental Information for any purpose other than the internal confirmation of environmental and social consideration with respect to the project, and (ii) not to disclose the Environmental Information to any third party.
2. Please note that this Screening Form or the contents thereof may be made public.

1

Questions

Q1. Please provide the address of the project site.

Address of the project site : Lahore, Pakistan

Q2. Please provide brief explanation of the project.

This project comprises of Phase 1 and Phase 2 until the year of 2020 while the target year is set to be 2035 which is just used for determining the size of facilities and system so that the period after the Phase 2, from 2021 to 2035, is not included in this project period. However, this period after Phase 2 is called as the Long-term for showing the long-term project vision.

Phase 1 includes the immediate, essential actions to improve the system as well as preparations for the following phases. In other words, it includes high-priority issues. The following shows project components (which were proposed by the JICA preparatory study team in cooperation with WASA).

Sectors	Phase 1(2010-2015)
Water supply	**1. Preparation for Using Alternative water Source for Drinking Water** **2. Reduction of Unaccounted-for-water and Non-revenue-water** **3. Improvement of Water Quality** **4. Procurement of Operation and Maintenance Equipment** **5. Consulting Services**
Sewerage	**1. Sewer – Central Area –** connecting to South West Treatment Plant **2. Disposal Station – Central Area --** connecting to South West Treatment Plant **3. Wastewater Treatment Plant– South West Area –** **4. Consulting Services**
Drainage	**1. New Construction of Drains in Central Lahore** **2. Improvement and Rehabilitation of Drain in Central Lahore** **3. Consulting Services**
Management	**1. Development of Adequate Policy and Regulatory Environment** **2. Timely Data Acquisition and Preparation of Definitive Vision and Strategies** **3. Reduction of Unaccounted-for-water and Non-revenue-water** **4. Human Resource Development and Organizational Streamlining** **5. Improvement of Customer Services** **6. Groundwater Monitoring and Regulation**

Q3. Will JBIC loan be applied to a new project or an executing project? In case of executing project, please inform the presence of strong claims by local residents.

☑ New Project
☐ Executing Project (with Claim)
☐ Executing Project (without Claim)
☐ Others (Please specify)

Q4. In case of this project, is it necessary to execute Environmental Impact Assessment (EIA) based on the laws or regulations? If necessary, please inform the progress of EIA.

☐ Required (Completed)
☑ Required (Under execution or under planning)
☐ Not Required
☐ Others (Please specify;)

Q5. In case that EIA is already completed, pleases inform whether EIA report is already approved based on the environmental assessment system or not. If EIA report is already approved, please provide the date and name of authorities of the approval.

☐ Approved (without condition)
☐ Approved (conditional)
☐ Under approval process
☑ Others (Please specify: To be submitted for approval to EPA after preparation of EIA report after receipt of draft final report about the project from JICA consultants)

Date of Approval : _____
Name of Authorities : _____

Q6. If environmental permit(s) other than EIA is required, please provide the name of required permit(s). Have you obtained required permit(s)?

☐ Obtained ☐ Required, but not obtained yet
☑ Not required ☐ Others (Please specify)

Name(s) of required permit(s) : _____

Q7. Will the loan be used for the undertaking that cannot specify the project at this stage (e.g. export or lease of machinery that has no relation with specific project, or Two Step Loan that cannot specify the project at the time of loan agreement)?

(Yes (No))

If you answered "Yes", it is not necessary to reply to the following questions.
If you answered "No", please reply to the following questions.

Q8. Are there any environmentally sensitive area shown below in and around project site?

(Yes (No))

If you answered "Yes", please select applicable items by marking, and reply to following questions.
If you answered "No", please reply to questions 9 and after.

☐ (1) National parks, protected areas designated by government (coastal areas, wetlands, habitats of minorities or indigenous populations, heritage sites, etc.)
☐ (2) Primeval forests, tropical natural forests
☐ (3) Ecologically important habitats (coral reefs, mangrove, tidal flats, etc.)
☐ (4) Habitats of endangered species of which protection is required under local laws and international agreements.
☐ (5) Areas that have risks of large scale increase in soil salinity or soil erosion
☐ (6) Desertification areas
☐ (7) Areas with special values from archaeological, historical and/or cultural viewpoints
☐ (8) Habitats of minorities, indigenous populations, nomadic people with traditional life style, or areas with special social value

Q9. Does the project involve following elements?

(Yes (No))

If you answered "Yes", please describe the scale of applicable elements, and reply to the questions 10 and after.
If you answered "No", please reply to questions 11 and after.

☐ (1) Involuntary resettlement (Number of resettlers:)
☐ (2) Pumping of groundwater (Scale: ton/year)
☐ (3) Land reclamation and/or development (Scale: ha)
☐ (4) Deforestation (Scale: ha)

Q10. Please reply to this question only in case that the project involves some of the above (1) to (4) elements. In the country where the project is planned, are there any regulations on a scale of the elements asked in question 9? If the country has such regulation, please answer whether the project satisfies the regulation or not.

☐ Regulation is applicable (☐ satisfied ☐ not satisfied) ☐ No regulation
☐ Others (Please specify)

Please reply to questions 11 and after.

Q11. Will JBIC share in the project be equal or less than 5% of the total project cost, or the total amount of JBIC loan equal or less than SDR 10 million?

(Yes / No) **(to be confirmed)**

If you answered "Yes", it is not necessary to reply to the following questions.
If you answered "No", please reply to questions 12 and after.

Q12. Does the project belong to either of the sectors that impact on the environment is deemed immaterial or is not anticipated under normal conditions (e.g. maintenance of the existing facilities, non-expansionary renovation project, acquisition of rights or interest without additional plant investment)?

(Yes / (No))

If you answered "Yes", it is not necessary to reply to following questions.
If you answered "No", please reply to the questions 13 and after.

Q13. Does the project belong to the following sectors?

(Yes / (No))

If you answered "Yes", please specify the sector by marking, and reply to questions 14 and after.
If you answered "No", it is not necessary to reply to the following questions.

- ☐ (1) Hydro power plant, Dam or water reservoir
- ☐ (2) Thermal power plant
- ☐ (3) Mines
- ☐ (4) Development of oil and gas
- ☐ (5) Pipeline
- ☐ (6) Steel industry (with large scale furnace)
- ☐ (7) No-ferrous metal refining
- ☐ (8) Petrochemical (including manufacturing of raw materials and petrochemical complex)
- ☐ (9) Terminal of oil, gas and chemicals
- ☐ (10) Petroleum refining
- ☐ (11) Paper and pulp
- ☐ (12) Manufacturing and/or transportation of hazardous substances (specified by international agreement)
- ☐ (13) Road, railway or bride
- ☐ (14) Airport
- ☐ (15) Port
- ☐ (16) Waste material processing or treatment
- ☐ (17) Treatment of sewage and/or waste water that includes hazardous substances or executed at environmentally sensitive area
- ☐ (18) Power transmission and/or distribution lines (including large scale involuntary resettlement, large scale deforestation or submarine cable)
- ☐ (19) Tourism (Construction of hotel, etc.)
- ☐ (20) Forestry or tree planting
- ☐ (21) Agriculture (large scale project and/or project including irrigation)

Q14. Please provide information on the scale of the project (project area, area of plants and buildings, production capacity, amounts of power generation, etc.) Further, pleased explain whether an execution of EIA is required on account of the large scale of the project in the country where the project is implemented.

As detailed in answer to Question No. 2

C.C.

- DMD (Engg.), WASA, Lahore
- PS to MD-WASA, Lahore

Appendix 16.5 Monitoring

- Monitoring

6. Items Requiring Monitoring

Items requiring monitoring shall be decided according to the sector and nature of the project, with reference to the following list of items.

Items

1. Permits and approvals, explanations

- Response to matters indicated by authorities

2. Anti-pollution measures

- Air quality : SO_2, No_2, CO, O_2, soot and dust, suspended particulate matter, coarse particulate, etc.
- Water quality : pH, SS (suspended solids), BOD (biochemical oxygen demand) / COD (chemical oxygen demand), DO (dissolved oxygen), total nitrogen, total phosphorus, heavy metals, hydrocarbons, phenols, cyanogen compounds, mineral oils, water temperature, etc.
- Waste
- Noise and vibration
- Odors

3. Natural environment

- Ecosystems : Impact on valuable species, countermeasures, etc

4. Social environment

- Resettlement
- Lifestyle and livelihood

NB: For air and water quality, specify whether you are monitoring emission levels or environmental levels. Also, it should be noted that the items which require monitoring will differ depending on whether the impact in question will occur during construction or during the operation of the project.