GEOTECHNICAL INVESTIGATION REPORT

FOR STORM WATER DRAINAGE SCHEME OF

MUZAFFARPUR CITY

CLIENT

DARASHAW AND COMPANY
PRIVATE LIMITED,
HYDERABAD

SIRI GEOSOLUTIONS PVT LTD

An ISO 9001-2008 Company

OFFICE 419, 4th Floor, kubera Towers , Narayanaguda, HYDERABAD -500 029

PHONE: +91-9493372677, www.sirigeosolutions.com

Email. info@sirigeosolutions.ccom, consultancy.geo@gmail.com

CONTENTS

Annexure

1 INTRODUCTION

M/s Darashaw and Company Private Limited, Hyderabad has entrusted the work to conducting geotechnical investigations for the proposed detailed project report for Storm Water Drainage Scheme in Muzaffarpur City in Bihar to M/s Siri GeoSolutions Pvt Ltd., Hyderabad.

Objective of the geotechnical investigation is to ascertain sub-soil parameters for appropriate design of the foundation system.

2 SCOPE OF WORK

The scope of work in Muzaffarpur Municipal Corporation is to make specified number of standard geotechnical auger boreholes and trial pits at specified location as per the specifications and direction given by the client.

The detailed scope of work includes the following

- Making one standard geotechnical auger boreholes and two trial pits at specified locations shown by the client.
- Auger drilling through soil strata upto ten meters or refusal as pre client directions.
- Conducting standard penetration test at 1.5m depth intervals.
- Collecting disturbed and undisturbed soil samples.
- Conducting relevant field and laboratory tests.
- Submitting comprehensive geotechnical report which covering all field works, laboratory test results and recommendations for the foundation system

3 FIELD WORK

Field investigations were carried out during the month of October 2014. Brief methodologies of boring and other field works are given below.

3.1 Auger Boring

Exploratory boreholes of 100mm diameter were drilled in soil strata by screw type auger. The description of sub soil stratum with SPT 'N' values at regular intervals were recorded in the bore logs and presented in Annexure -II.

Details of boreholes, depth of exploration levels are presented in the table below.

Sl No.	Location	No. of Boreholes	BH No.	Depth of Explored (m)
1	Ref Annexure-1	1	BH-1	10.00

3.2 Sampling

Both disturbed and undisturbed representative soil samples were collected wherever possible during boring and subsequently sent to laboratory for visual examination and laboratory tests.

3.3 Standard Penetration Test

In borehole, standard penetration tests were conducted at 1.5m interval or change in strata as per Indian Standard, IS:2131-1981and split spoon sampler used conformed to the Indian Standard, IS:9640-1980. These tests were performed by driving the sampler with 63.5kg hammer falling from a height of 75cm. Number of blows required to effect each 15cm penetration is recorded .The first 15cm penetration is considered to be the seating drive. The sum of the total blows required for a second and third 15cm (total 30cm) penetration is termed the penetration resistance SPT' N' value and the same is reported.

When the number of blows exceeded 50 to penetrate the first or second 15cm length of the sampler, the SPT N is regarded as more than 100 as described in IS 2131 - 1981. The test is terminated in such case and a record of penetration of the sampler under 50 blows is made. SPT refusal is recorded when there is no penetration of the sampler at any stage and also when a rebound of the sounding system is recorded. Field SPT'N' values are given in bore logs in Annexure- II.

3.4 Trial Pit

Test pits of 1.0m x 1.0m x 2.50m deep were excavated at specified locations as per direction of client specifications. The purposes of the test pits are visually examine the sub soil stratum. The locations of test pits are tabulated below.

Sl. No	Trial Pit	Location	Depth of pit (m)
1	TP-1	Ref Annexure-1	2.50
2	TP-2	Ref Annexure-1	2.50

4 LABORATORY TESTS

Laboratory tests were carried out on soil samples as per the relevant Indian Specifications. Details of various tests conducted are presented below.

A) Tests on soil samples:

The following tests have been performed for soil samples:

- Moisture contents;
- Grain size analysis tests
- Atterberg's limits-liquid limit and plastic limit;
- Triaxial Compression tests;

On sandy samples grain size distribution analysis test were conducted using both dry and wet sieve analysis techniques. These tests are completed primarily to classify and to find out the gradation characteristics.

In general on clayey samples Atterberg's Limit tests are conducted to derive the engineering characteristic.

The laboratory test results of soil sample are given in Annexure -III.

5 SUBSOIL CONDITION

One auger borehole and two trial pits were drilled at proposed project site. The borehole and trial pits were terminated as per the direction of Engineer in-charge the depth is indicated at bottom of bore log. Details of the SPT"N" values conducted at various depths are presented in individual bore logs with IS classification in Annexure-II.

From the field observations and laboratory test results the brief descriptions of the various stratums are presented below.

Stratum-I (clayey silty)

The top stratum is comprised to grayish yellow clayey silt till the borehole termination. The SPT 'N' values are vary from 2 to 8. As per grain size and Atterberg limit values this soil can be classified CL as per IS classification. The similar clayey silt stratum was observed in trail pits.

6 DESIGN METHODOLOGY

The safe bearing capacity is arrived based on the shear failure criteria and settlement criteria. The estimated safe bearing capacity is calculated as per IS: 6403-1981 code and IS: 8009 (Part-1)-1976 with available soil profile.

A properly designed foundation has to satisfy two limit states.

1) Limit state of collapse (ie., Shear strength)

2) Limit state of serviceability (ie., Settlement)

Shear Criteria

The first criterion is depending on shear strength. The calculations are based on bearing capacity equation as recommended by IS:6403 (with factor of Safety 2.5) which takes care of L/B ratio (shape), foundation depth etc., along with other parameters.

The intensity of loading at the base of the foundation, which would cause shear failure of the soil support, is termed as ultimate bearing capacity (UBC).

The following equation is used to calculate ultimate bearing capacity,

$$UBC = C*Nc*Sc*dc + q * Nq * Sq * dq + 0.5 * B * \gamma * N\gamma * S\gamma * d\gamma * W'$$

Safe bearing capacity (SBC) is the maximum intensity of loading that the foundation will safely carry without the risk of shear failure of soil irrespective of any settlement that may occur. Safe bearing capacity can be obtained by dividing the UBC with suitable factor of safety (2.5).

$$SBC = UBC/2.5$$

Settlement Criteria:

The intensity of loading that will cause a permissible settlement or specified settlement of the structure is termed as allowable bearing pressure.

The elastic settlement of granular soil and consolidated settlement of cohesive soils are calculated using SPT 'N' values and laboratory test results. Settlement is predicted using IS: 8009 (part-1)-1976.

A typical calculation for estimating the bearing capacity of foundation is given in annexure-IV

7 FOUNDATION RECOMMENDATIONS

Based on the field and laboratory tests the following recommendations are given

- Open foundations are recommended in the form of isolated footing
- The recommended safe bearing capacity is 5t/m^2. This is based on the isolated footing of width 2.0m at 2.0m depth below the natural ground level. The actual size would be based on the structural loads.
- The recommended depth of foundations should at 2.0m below natural ground level.

- All foundation works should be done in dry condition only and foundation pits should be filled with well compacted morum
- Foundation should rest on 100mm thick 1:4:8 concrete mat

M. Chandrasekhar Babu

Director

Annexure – I
BH/TP Location Plan

Annexure – II
Field Borehole Logs

Siri GeoSolutions Pvt Ltd
Civil & Geotechnical Engineering Services

Project : **Geotechnical Investigation Report for Storm Water Drainage Scheme of Muzaffarpur City**

BOREHOLE RECORD

Boring Method	: Auger Drilling	Bore Hole No.	: BH-1
Boring Diameter	: 100 mm	R.L	: N/A
Depth of GWT	: 6.0m	Location	: Ref Annexure-1
Structure	: -	Date Commenced	: : 19.08.2014
Boring Equipment	: Screw Type Auger	Date Completed	: 19.08.2014

Depth (m)	Sample / In-situ Tests		SPT 'N' Value				Depth (BGL) (m)	Description	RL (m)	Log	Remarks / Other Tests
	Depth (m)	Type	15	30	45	N					
1.00											
	1.50 - 1.95	SPT	1	1	1	2					
2.00											
3.00	3.00 - 3.45	UDS									
4.00											
	4.50 - 4.95	SPT	1	1	2	3					
5.00								Greyish yellow clayey silt(CL)			
6.00	6.00 - 6.45	SPT	2	3	2	5					
7.00											
	7.50 - 7.95	SPT	2	3	4	7					
8.00											
9.00	9.00 - 9.45	UDS									
10.00	10.00 - 10.45	SPT	1	4	4	8	10.00		-10.00		
								Borehole Terminated			
11.00											
12.00											
13.00											
14.00											
15.00											
16.00											

SPT : Standard Penetration Test
UDS : Undistrubed Sample
GWT : Ground Water Table

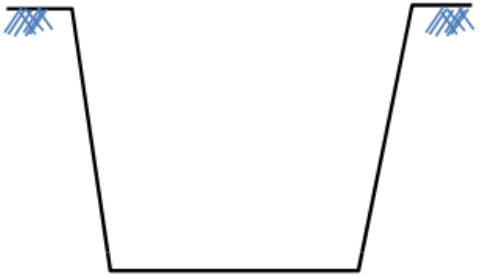
CR : Core Recovery
RQD : Rock Quality Designation
RP: Rate of Penetration

Client:
M/s. Darashaw and Company
Private Limited, Hyderabad

Geotechnical Consultant:
M/s. Siri GeoSolutions Pvt Lid.,
Hyderabad.

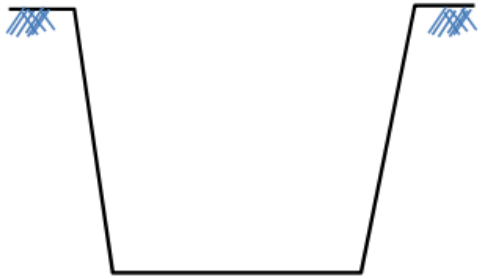
	Siri GeoSolutions Private Limited **Civil & Geotechnical Engineering Services**	**Trial Pit- Data Sheet**
Project	**Geotechnical Investigation Report for Storm Water Drainage Scheme for Muzaffarpur Municipal Corporation.**	

Location- Trial Pit -TP-01

Depth (m)	Description of strata	Sample Type	Sample Depth	Section	Log	Remarks
1.00	Greyish yellow clayey silt	DS	1.00			
2.00		DS	2.00			
		UDS	2.50			
3.00						

Trila Pit-TP01

Location- Trial Pit -TP-02

Depth (m)	Description of strata	Sample Type	Sample Depth	Section	Log	Remarks
1.00	Greyish yellow clayey silt	DS	1.00			
2.00		DS	2.00			
		DS	2.50			
3.00						

Trila Pit-TP02

Annexure-III
Laboratory Test Results

Project: Geotechnical Investigation Report for Storm Water Drainage Scheme of Muzaffarpur City

Laboratory Test Results

Borehole	Depth (m)	Type of sample	SPT "N"	Soil Description	IS Classification	NMC (%)	Atterberg's Limits		Grain Size Distribution (%)						Specific Gravity	Density (kN/m3)		Shear Test	
							w_L	w_P	Gravel	Sand			Silt & Clay			Bulk	Dry	C (kPa)	φ'
										Coarse	Medium	Fine	M	C					
BH-01	1.50	SPT	2	Greyish yellow clayey silt	CL				0	0	0	2	98						
	3.00	UDS	-			19.5	Non Plastic		0	0	1	2	68	29	2.66	17.90	14.98	16.30	8.00
	4.50	SPT	3						0	0	2	7	97						
	6.00	SPT	5			17.4	Non Plastic		0	0	0	5	89						
	7.50	SPT	7						0	0	1	8	91						
	9.00	UDS	-			18.6	Non Plastic		0	0	4	10	65	18	2.67	18.50	15.60	32.60	12.00
	10.00	SPT	8						0	0	7	12	84						
TP-1	1.00	DS		Greyish yellow clayey silt	CI				0	0	2	6	92						
	2.00	DS							0	0	1	5	94						
	2.50	UDS				15.0			0	0	4	5	69	22		18.20	15.83	14.90	6.30
TP-02	1.00	DS		Greyish yellow clayey silt	CI				0	0	0	12	88						
	2.00	DS				11.6			0	0	0	9	91						
	2.50	DS							0	0		7	92						

Client:
M/s. Darashaw and Company
Private Limited, Hyderabad

Geotechnical Consultant:
M/s. Siri GeoSolutions Pvt Lid.,
Hyderabad.

Project:
Geotechnical Investigation Report for Storm Water Drainage Scheme of Muzaffarpur City

Soil - Chemical Analysis - Results

Soil-Chemical Analysis-Results						
Location	Depth (m)	Color	Odor	PH (10% suspension)	Chloride content %	Sulphate as SO_3 (%)
TP-1	2	Grayish	Characteristic Soil odor	7.62	0.17	0.22

Water - Chemical Analysis - Results

Water-Chemical Analysis-Results			
Location	PH (10% suspension)	Chloride Content mg/l	Sulphate as SO_3 (%)
BH-1	7.63	79	213

Annexure-IV
SBC Calculations

SIRI GEOSOLUTIONS PVT LTD

Civil & Geotechnical Engineering Services

Bearing Capacity Based on Shear Criteria

(Based on IS: 6403-1981)

Bore hole number	=	BH-1	
Ground water table location from FGL/NGL	=	0 m	
Unit weight of soil (γ)	=	1.8 t/m2	
Submerged unit of soil (γ')	=	0.8 t/m2	
Type of footing :	=	Square footing	
Width of footing (B)	=	2 m	
Length of footing(L)	=	2 m	
Depth of footing from NGL (D_f)	=	2 m	
Average N value at base of footing	=		
Angle of internal friction at that depth (φ)	=	8 deg.	(Lab results)
Cohesion (C)	=	1.6 t/m2	
If f value is in between local & general shear failure. As per IS: 6403 - 1981 the SBC value is interpolate between			
f value for General shear failure	=	36 deg	
φ value for Local shear failure	=	29 deg.	
Local shear failure :			
$\varphi' = \tan^{-1}((2/3)\tan\varphi)$	=	5 deg.	
Cohesion (C) C'	=	1.07 t/m2	
Bearing capacity factors (IS: 6403-1981, table 1) :			
Nc'	=	6.49	
Nq'	=	1.57	
Nγ'	=	0.45	
Shape factors for square footing (IS:6403-1981,table 1):			
Sc	=	1.3	
S_q	=	1.2	
Sγ	=	0.8	

SIRI GEOSOLUTIONS PVT LTD

Civil & Geotechnical Engineering Services

Bearing Capacity Based on Shear Criteria

(Based on IS: 6403-1981)

Inclination factors (IS:6403-1981)

$i_c = i_q = i\gamma = 1$

Depth factors(IS : 6403-1981,cl:5,1.2.2)

$d_c = 1+0.2 *(D_f/b)\ (N_\varphi)^{1/2}$

$d_q = d_\gamma = 1$ for $\varphi < 10^0$

$d_q = d_\gamma = 1+0.1 * (D_f/B)(N_\varphi)^{1/2}$ for $\varphi > 10^0$

Where,

$N\varphi = \tan^2(45+\varphi/2)$ = 1.19

Therefore,

d_c = 1.22

d_q = 1

d_γ = 1

Over burden pressure ($q = \gamma' * D_f$) = 1.6 t/m2

Factor of safety (F.S) = 2.5

Based on shear failure criteria Ultimate bearing capacity (UBC)

for local shear failure as per IS:6403 - 1981:

$UBC=2/3*C' *N_c' * S_c * d_c *i_c+q*(N_q' - 1)* S_q * d_q * i_q + 0.5 *B*\gamma * N_\gamma' * S_\gamma * d_\gamma * i_\gamma *w$

= 17.88 t/m2

Safe bearing capacity as per shear criteria,

(SBC)local = UBC/F.S = **7.15** t/m2

Recommended SBC = **5** t/m^2

SIRI GEOSOLUTIONS PVT LTD

Civil & Geotechnical Engineering Services

BEARING CAPACITY BASED ON SETTLEMENT CRITERIA

(Based on IS: 8009 (Part-1)-1976)

Type of foundation		=	**Square footing**
Unit weight of soil (γ)		=	1.8 t/m^3
Width of foundation (B)		=	2 m
Length of foundation (L)		=	2 m
Depth of foundation from NGL (D_f)		=	2.0 m
Bearing pressure at founding level (q)		=	5 t/m^2
Depth of pressure bulb (1.50*B)	H	=	3.0 m

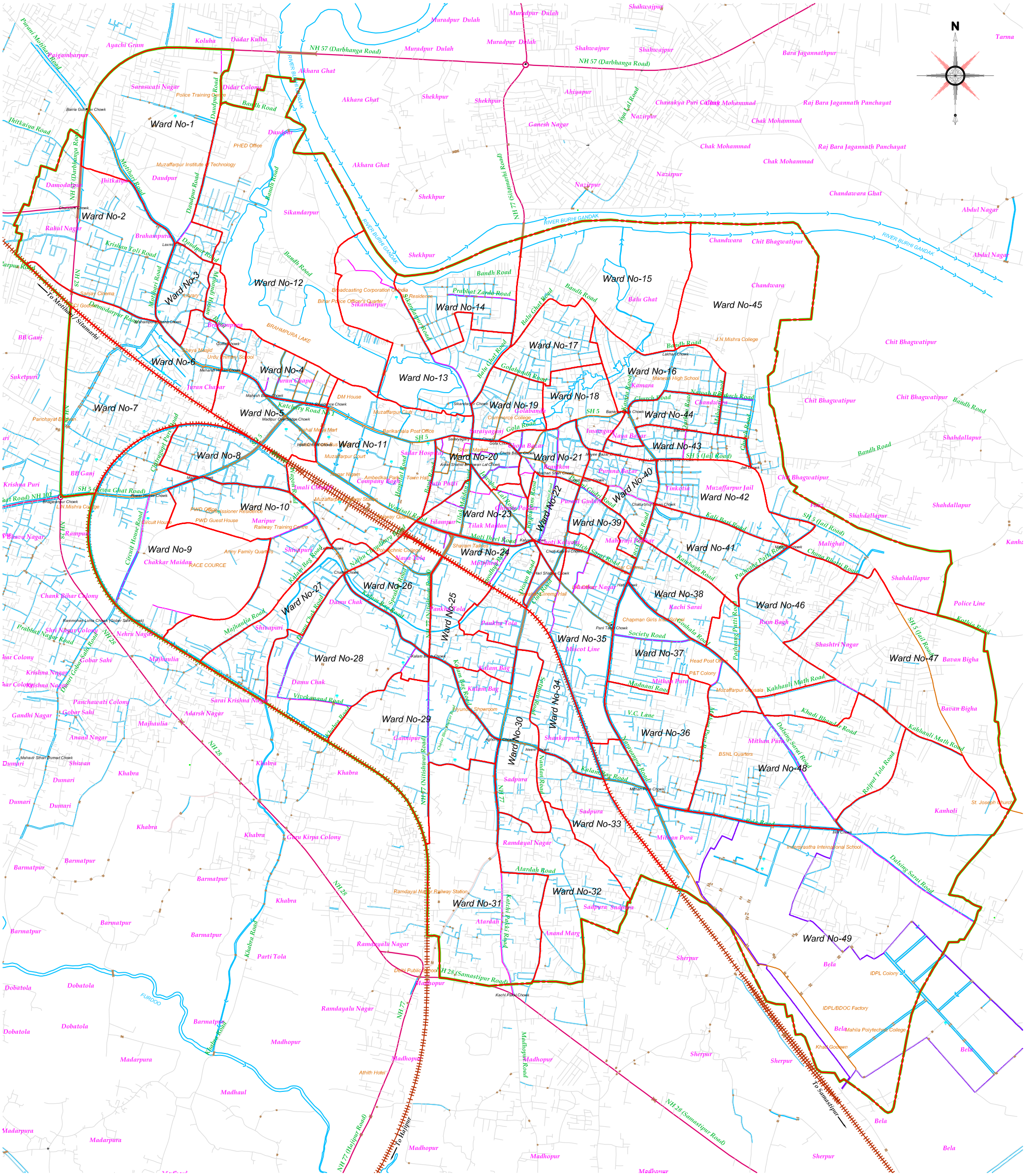
Bearing capacity Based on Settlement

Immediate settlement = $H*\Delta p/E_s$

where E_s = Elastic modulus of sand
H = Depth of sand layer
Δp = Incrimental pressure at centre of layer

Type of soil		=	Silty clay / clayey silt
Depth of layer (H)		=	3.0 m
Increase in pressure	Δp	=	q * B * L / (B+z)*((L+z)
	Δp	=	1.63 t/m^2
	E_s	=	250 t/m^2 (based on shultz & & Muhs curves)
settlement of layer		=	19.6 mm

Total settlement	=	19.6	mm
Depth correction factor	=	1.00	(as per Fig.12 of IS:8009-pt1)
Rigidity factor	=	0.8	(as per clause 9.5.2 of IS 8009-pt1)
Corrected settlement	=	16	mm



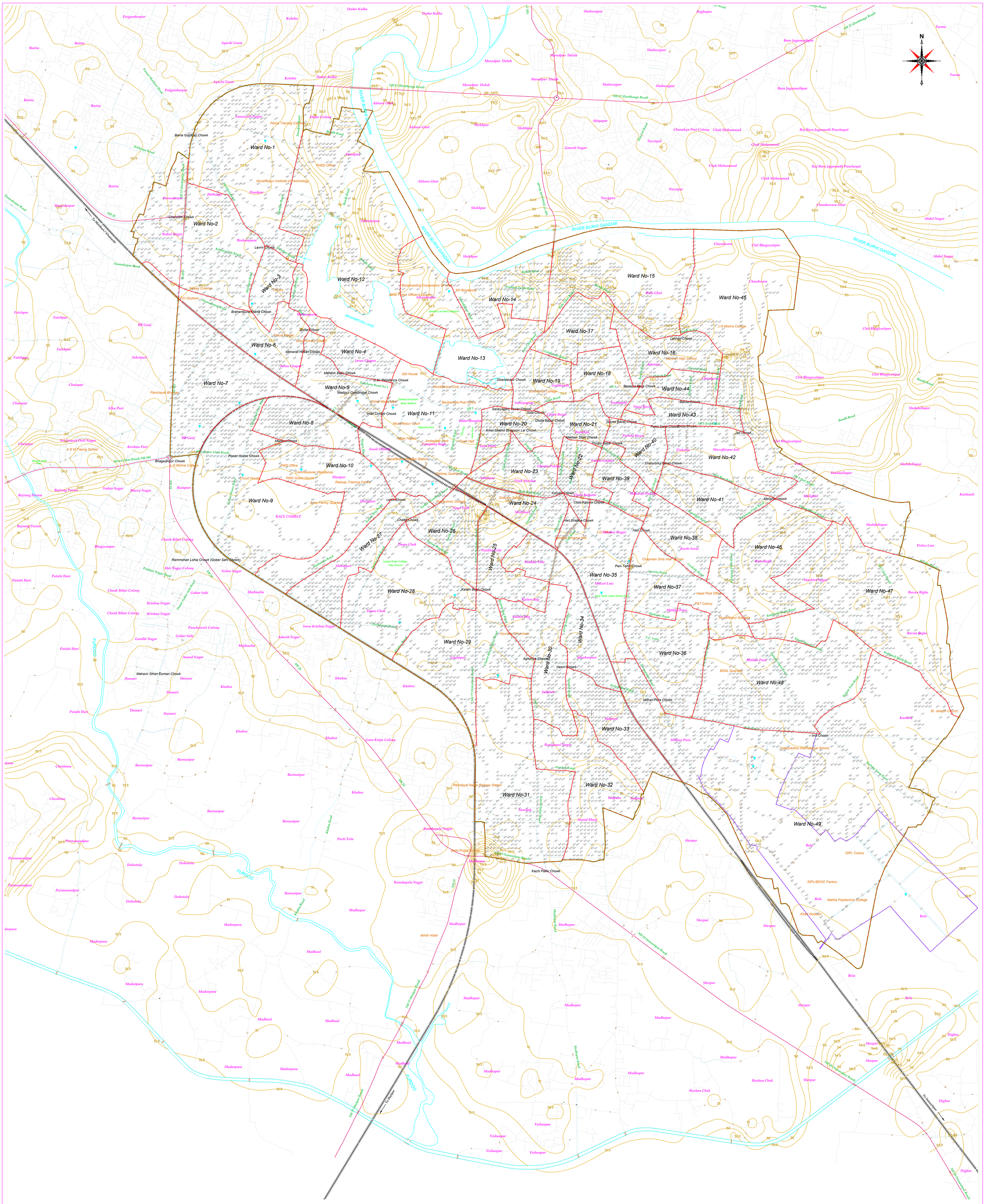
LEGEND:

- MUNICIPAL BOUNDARY
- WARD BOUNDARY
- STATE HIGHWAY
- MAIN ROAD
- NATIONAL HIGHWAY
- OTHER ROAD
- RAILWAY NETWORK
- DRAIN/CANAL/RIVER
- BRIDGE/FLYOVER
- OVER HEAD TANKS

NOTES :–

1. ALL DIMENSIONS ARE IN mm AND LEVELS IN METER.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED. DIMENSIONS ARE NOT TO BE SCALED.
3. DETAILS SHOWN ARE TENTATIVE AND WILL BE FINALISED DURING DETAILED ENGINEERING.

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED



LEGEND:

MUNICIPAL BOUNDARY	🟩
WARD BOUNDARY	🟥
NATIONAL HIGHWAY	—
OTHER ROADS	—
CONTOUR	53
RAILWAY NETWORK	++++++++
WATER BODY	≈
DRAIN	→
BRIDGE/FLYOVER	▭
OVER HEAD TANKS	▼

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW
1926
ALL ABOUT TRUST

OFFICE OF ORIGIN
CHENNAI
8/2, UINQUE STERLING APPT.
3RD CROSS STREET,
STERLING RD,NUNGAMBAKKAM
TEL.28267910/28235951-53

CLIENT
BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD., PATNA

DATE
12.10.2013

ENGINEERING CONSULTANT
DARASHAW & CO.PVT.LTD

HEAD OFFICE
12th FLOOR, REGENT CHAMBERS,
NARIMAN POINT,
MUMBAI – 400021

DRAWN
Anwar

PROJECT
PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE SCHEME IN MUZAFFARPUR, BIHAR

CHECKED
S.Avvaru

TITLE
TOPOGRAPHICAL SURVEY DRAWING OF MUZFFARPUR CITY

APPROVED
T.A.Mohan

DRG. NO. BUIDCO/MZF/02

REV. R0

SCALE 1:10000

SHEET A0

ZONE-1

ZONE-2

ZONE-3

ZONE-4

ZONE-5

ZONE-6

ZONE-7

RIVER BURHI GANDAK

NH 77 (Nitishwar Road)

NH 57 (Darbhanga Road)

NH 28 (Samastipur Road)

LEGEND:

- MUNICIPAL BOUNDARY
- NATIONAL HIGHWAY
- OTHER ROADS
- CONTOUR
- RAILWAY NETWORK
- WATER BODY
- DRAIN
- BRIDGE/FLYOVER
- OVER HEAD TANKS
- SLUICE GATE

EXISTING STORM WATER DRAINAGE ZONES

ZONE-1	457.50 Hect
ZONE-2	269.00 Hect
ZONE-3	143.50 Hect
ZONE-4	484.00 Hect
ZONE-5	437.00 Hect
ZONE-6	367.00 Hect
ZONE-7	312.00 Hect

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW
ALL ABOUT TRUST

OFFICE OF ORIGIN
CHENNAI
8/2, UNQUE STERLING APPT. 3RD CROSS STREET, STERLING RD,NUNGAMBAKKAM TEL.28267910/28235951-53

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD., PATNA

DATE: 12.10.2013

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD

HEAD OFFICE: 12th FLOOR, REGENT CHAMBERS, NARIMAN POINT, MUMBAI – 400021

DRAWN: Anwar

PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE SCHEME IN MUZAFFARPUR, BIHAR

CHECKED: S.Avvaru

TITLE: EXISTING STORM WATER DRAINAGE NETWORK IN MUZFFARPUR CITY

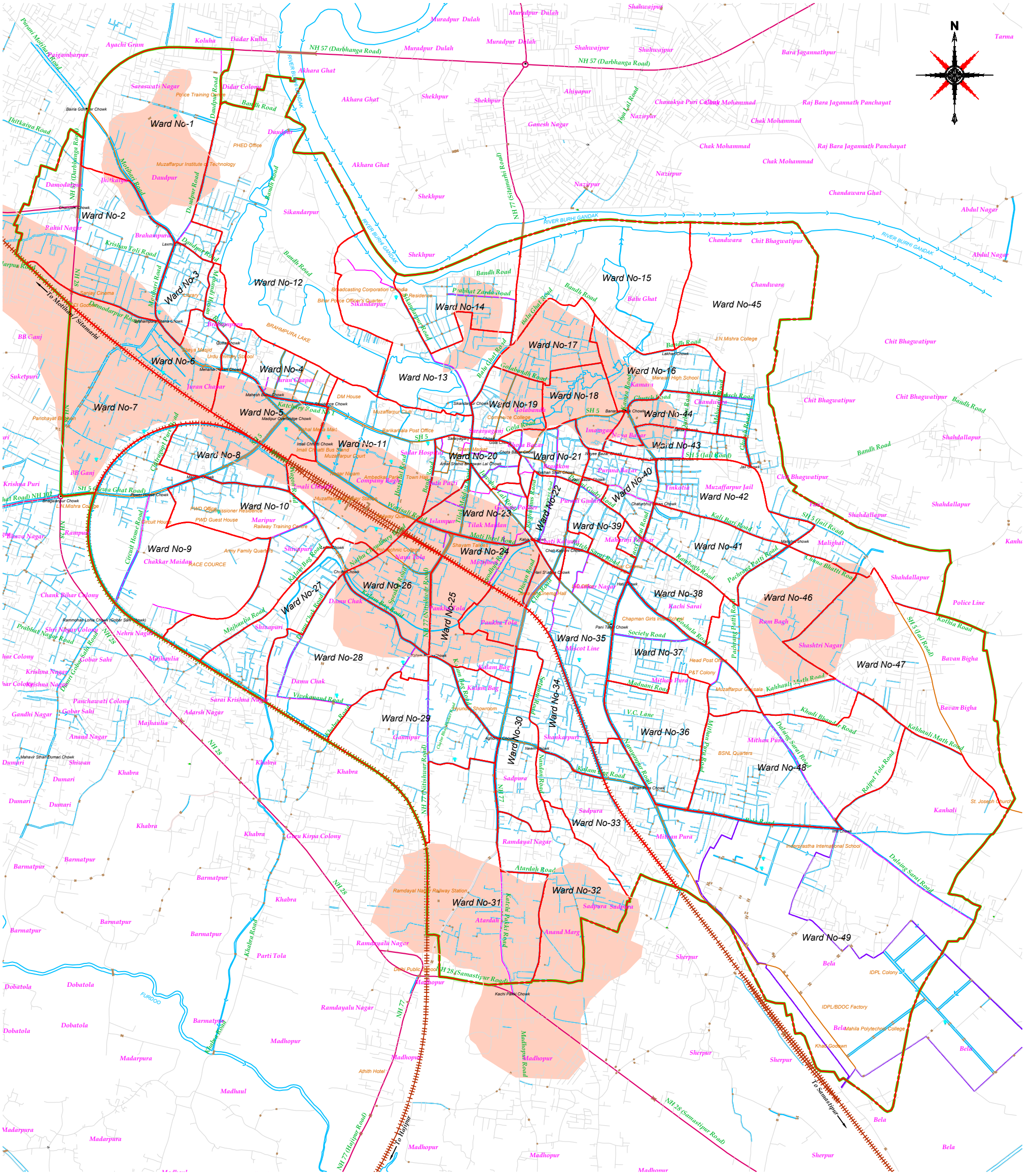
APPROVED: T.A.Mohan

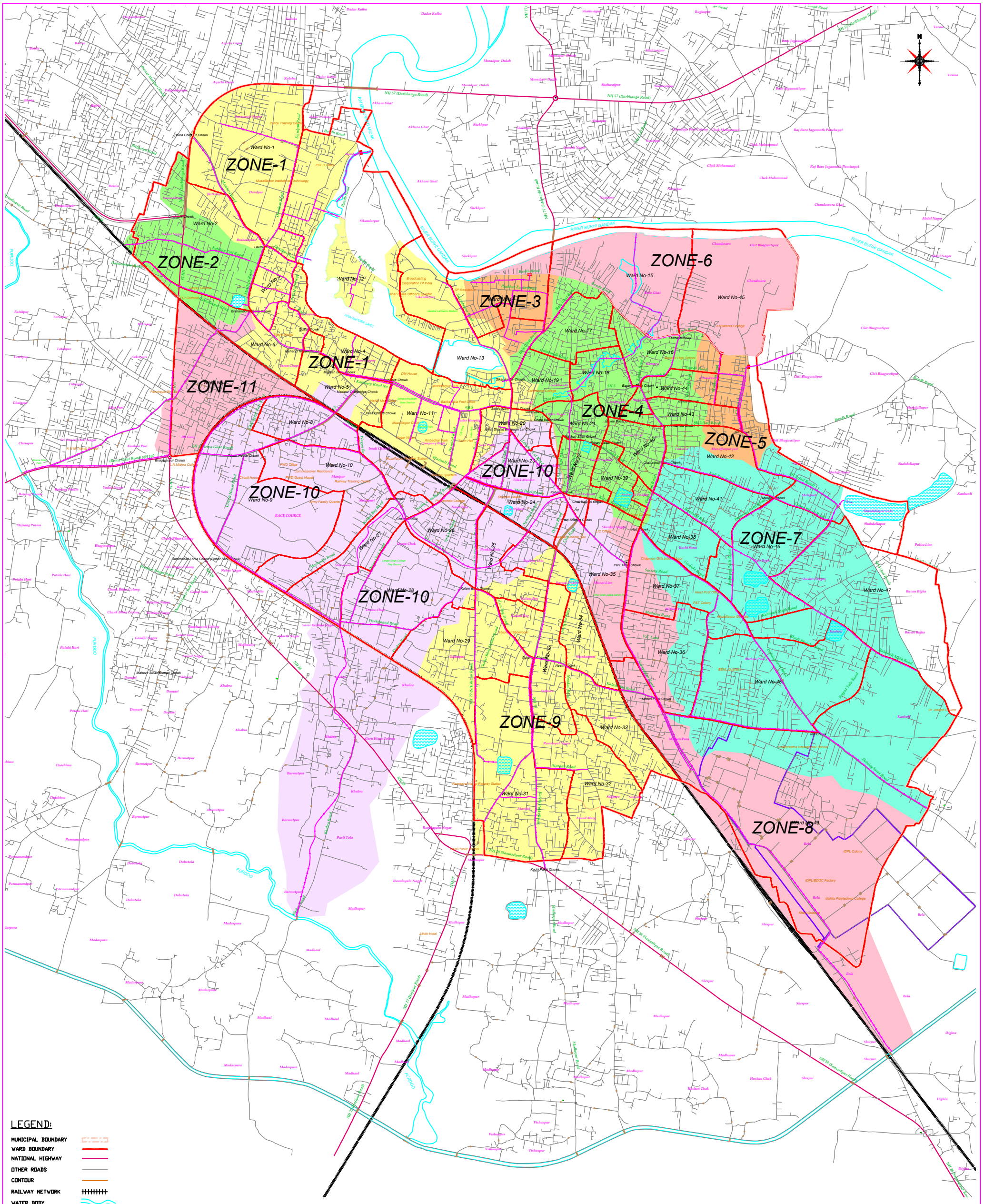
DRG. NO. DCPL–BUIDCO\MZF\SWD\03

REV. R0

SCALE: 1:10000

SHEET: A0


N
Ward No-1
Ward No-2
Ward No-3
Ward No-4
Ward No-5
Ward No-6
Ward No-7
Ward No-8
Ward No-9
Ward No-10
Ward No-11
Ward No-12
Ward No-13
Ward No-14
Ward No-15
Ward No-16
Ward No-17
Ward No-18
Ward No-19
Ward No-20
Ward No-21
Ward No-22
Ward No-23
Ward No-24
Ward No-25
Ward No-26
Ward No-27
Ward No-28
Ward No-29
Ward No-30
Ward No-31
Ward No-32
Ward No-33
Ward No-34
Ward No-35
Ward No-36
Ward No-37
Ward No-38
Ward No-39
Ward No-40
Ward No-41
Ward No-42
Ward No-43
Ward No-44
Ward No-45
Ward No-46
Ward No-47
Ward No-48
Ward No-49
NH 57 (Darbhanga Road)
NH 77 (Nitishwar Road)
NH 28 (Samastipur Road)
NH 28
NH 102
SH 5 (Jail Road)
RIVER BURHI GANDAK
BRAHMPURA LAKE
Muradpur Dulah
Shahwajpur
Tarma
Bara Jagannathpur
Akhara Ghat
Shekhpur
Ahiyapur
Ganesh Nagar
Nazirpur
Chak Mohammad
Raj Bara Jagannath Panchayat
Chandawara Ghat
Abdul Nagar
Chandwara
Chit Bhagwatipur
Balu Ghat
Sikandarpur
Broadcasting Corporation Of India
Bihar Police Officer's Quarter
Brahmpura
Daudpur
Saraswati Nagar
Didar Colony
Police Training Centre
Ayachi Gram
Koluha
Dadar Kulba
Jaigambarpur
Purani Motihari Road
Ihitkaiya Road
Motihari Road
Daudpur Road
Bandh Road
PHED Office
Muzaffarpur Institute of Technology
Damodarpur
Ihitkaiya
Bahadurpur
Krishan Troli Road
Dehlipur Road
Mehsauri Road
Sanjay Cinema
Damodarpur Road
Brahmpura Thana Chowk
Laxmi Chowk
Quilla Chowk
Sabeya Masjid
Urdu Primary School
Mehanda Ghat Chowk
Turan Chapar
Mahesh Bathan Chowk
Katchary Road
Madipur Overbridge Chowk
Imali Chhatti Bus Stand
Muzaffarpur Court
Ambedkar Park
Company Bagh
Town Hall
Sadar Hospital
Hospital Road
Bata Road
Kutchi Pucci
Muzaffarpur Jail
Muzaffarpur Club
Parikarnala Post Office
Saraiyaganj Gola Road
Commerce College
Gobharahi
Imamganj
Nasa Bazar
Chhota Bazar Chowk
Jail Chowk
Purana Bazar
Tinkatia
Purani Gudri
Chhoti Kalyani
Kalyani Chowk
Malighat
Kali Bari Road
Maharaji Nagar
Ramdayalu Nagar
Ramdayal Nagar
Atardah
Anand Marg
Sadpura
Mithan Pura
Kachi Pakki Chowk
Kachi Pakki Road
Madhopur
Parti Tola
Dobatola
Barmatpur
Khabra
Goru Kirpa Colony
Adarsh Nagar
Majhaulia
Sarai Krishna Nagar
Panchawati Colony
Gobar Sahi
Krishna Nagar
Nehru Nagar
Shri Nagar Colony
Chank Bihar Colony
Chakkar Maidan
RACE COURCE
Circuit House
Circuit House Road
Army Family Quarters
Shivapuri
Maripur
Railway Training Centre
PWD Guest House
PWD Office
Commissioner Residence
Lohia Chowk
Chhatrapati Shivaji Road
Kalam Bag Road
Kalam Bag
Danu Chak
Danu Chak Road
Majhaulia Road
Vivekanand Road
Gandhi Nagar
Anand Nagar
Shivaan
Dumari
Mahavir Sthan Dumari Chowk
Gurudwara Road
Gaighat Road
Gaighat
Ramnagar
Ramnagar Road
Bhawad Nagar
Bhagwanpur Chowk
Power House Chowk
Panchayat Bhawan
Krishna Puri
BB Ganj
Suketpuri
Turan Chapar
Jhakhra Road
Parti Tola
Dobatola
Barmatpur
Khabra
Madhaul
Madarpura
Furdoo
Ramdayalu Nagar
Madhopur
Athith Hotel
Delhi Public School
Ramdayal Nagar Railway Station
Sherpur
Bela
IDPL Colony
IDPL/BDOC Factory
Mahila Polytechnic College
Khadi Godown
Shahdallapur
Police Line
Kothia Road
Shashtri Nagar
Ram Bagh
Bavan Bigha
Kahlwatil Math Road
Khadi Bhandar Road
Dalsing Sarai Road
Raipur Tola Road
St. Joseph Church
Kanholi
Indraprastha International School
Pachrukhi Patti Road
Rambagh Road
Kachi Sarai
Chapman Girls Inter School
Society Road
Mahadeo Sthan
Mahadeo Sthan Road
Mithan Pura
Muzaffarpur Gausala
Head Post Office
P&T Colony
BSNL Quarters
Mahadeo Sthan Chowk
Mithanpura Chowk
Kalam Bag Road
Kalam Bag Chowk
Hyundai Showroom
Agnoo Chowk
Neem Chowk
Shahkarpuri
Nawtanpatti Road
Nawtanpatti
Sadpura
Sadpura Sadpura
Ramdayal Nagar
Atardah Road
Ramdayalu Nagar Railway Station
Kachi Pakki Chowk
Madhopur Road
Sherpur
Bela
IDPL Colony
IDPL/BDOC Factory
Mahila Polytechnic College
Khadi Godown
Shahdallapur
Police Line
Kothia Road
Shashtri Nagar
Ram Bagh
Bavan Bigha
Kahlwatil Math Road
Khadi Bhandar Road
Dalsing Sarai Road
Raipur Tola Road
St. Joseph Church
Kanholi
Indraprastha International School
Pachrukhi Patti Road
Rambagh Road
Kachi Sarai
Chapman Girls Inter School
Society Road
Mahadeo Sthan
Mahadeo Sthan Road
Mithan Pura
Muzaffarpur Gausala
Head Post Office
P&T Colony
BSNL Quarters
Mahadeo Sthan Chowk
Mithanpura Chowk
Kalam Bag Road
Kalam Bag Chowk
Hyundai Showroom
Agnoo Chowk
Neem Chowk
Shahkarpuri
Nawtanpatti Road
Nawtanpatti
Sadpura
Sadpura Sadpura
Ramdayal Nagar
Atardah Road
Ramdayalu Nagar Railway Station
Kachi Pakki Chowk
Madhopur Road
Sherpur
Bela
IDPL Colony
IDPL/BDOC Factory
Mahila Polytechnic College
Khadi Godown
To Motihari / Sitamarhi
To Samastipur
To Hajipur
NH 77 (Hajipur Road)
NH 28 (Samastipur Road)
LEGEND:
MUNICIPAL BOUNDARY
WARD BOUNDARY
STATE HIGHWAY
MAIN ROAD
NATIONAL HIGHWAY
OTHER ROAD
RAILWAY NETWORK
DRAIN/CANAL/RIVER
BRIDGE/FLYOVER
OVER HEAD TANKS
LOW LYING AREAS
NOTES :-
1. ALL DIMENSIONS ARE IN mm AND LEVELS IN METER.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED. DIMENSIONS ARE NOT TO BE SCALED.
3. DETAILS SHOWN ARE TENTATIVE AND WILL BE FINALISED DURING DETAILED ENGINEERING.
DATE
NO.
REVISION
DRAWN
CHECKED
APPROVED
DARASHAW 1925
OFFICE OF ORIGIN
CHENNAI
B/2, UNIQUE STERLING APPT. 360 CROSS STREET, STERLING RD,NUNGAMBAKKAM TEL:28287910/28234961-63
CLIENT
BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD., PATNA
DATE
4.11.2013
ENGINEERING CONSULTANT
DARASHAW & CO.PVT.LTD
HEAD OFFICE
12th FLOOR, REGENT CHAMBERS, NARIMAN POINT, MUMBAI – 400021
DRAWN
Anwar
PROJECT
PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE SCHEME IN MUZAFFARPUR, BIHAR
CHECKED
S.Avvaru
TITLE
MAP SHOWING LOW LYING AREAS IN MUZAFFARPUR MUNICIPAL CORPORATION
APPROVED
T.A.Mohan
DRG. NO. DCPL–BUIDCO\MZF\SWD\04
REV. R0
SCALE
1:25000
SHEET
A3
NOTE:- THIS DRAWING IS THE SOLE PROPERTY OF THE DARASHAW & CO. PVT LTD. INDIA, IT IS SUBJECT TO THEIR RECALL AND MUST NOT BE LENT OR COPIED OR REPRODUCED WITHOUT THEIR WRITTEN PERMISSION NOR USED FOR ANY PURPOSE OTHER THAN, FOR WHICH IT IS ISSUED.



LEGEND:

MUNICIPAL BOUNDARY
WARD BOUNDARY
NATIONAL HIGHWAY
OTHER ROADS
CONTOUR
RAILWAY NETWORK
WATER BODY
DRAIN
BRIDGE/FLYOVER
OVER HEAD TANKS

PROPOSED STORM WATER DRAINAGE ZONES

ZONE-1	370.70 Hect
ZONE-2	70.54 Hect
ZONE-3	33.43 Hect
ZONE-4	198.30 Hect
ZONE-5	41.87 Hect
ZONE-6	143.33 Hect
ZONE-7	492.36 Hect
ZONE-8	280.40 Hect
ZONE-9	315.36 Hect
ZONE-10	459.26 Hect
ZONE-11	74.11 Hect

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW 1926

OFFICE OF ORIGIN
CHENNAI
8/2, UINQUE STERLING APPT.
3RD CROSS STREET,
STERLING RD,NUNGAMBAKKAM
TEL.28267910/28235951-53

CLIENT BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD., PATNA

DATE 12.10.2013

ENGINEERING CONSULTANT
DARASHAW & CO.PVT.LTD

HEAD OFFICE
12th FLOOR, REGENT CHAMBERS,
NARIMAN POINT,
MUMBAI – 400021

DRAWN Anwar

PROJECT PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE SCHEME IN MUZAFFARPUR, BIHAR

CHECKED S.Avvaru

TITLE PROPOSED STORM WATER DRAINAGE ZONES IN MUZFFARPUR CITY

APPROVED T.A.Mohan

DRG. NO. DCPL–BUIDCO\MZF\SWD\05 REV. R0

SCALE NTS SHEET A3

ZONE-1

ZONE-2

ZONE-3

ZONE-4

ZONE-5

ZONE-6

ZONE-7

ZONE-8

ZONE-9

ZONE-10

ZONE-11

MANI KAMAAN

MANI KAMAAN

RIVER BURHI GANDAK

RIVER BURHI GANDAK

RIVER BURHI GANDAK

Burhi Gandak

NH 57 (Darbhanga Road)

NH 57 (Darbhanga Road)

SCALE

200 0 100 200 400 800

N

LEGEND:

MUNICIPAL BOUNDARY	
NATIONAL HIGHWAY	
OTHER ROADS	
CONTOUR	
RAILWAY NETWORK	
WATER BODY	
PROPOSED DRAINS	
BRIDGE/FLYOVER	
OVER HEAD TANKS	
NODE ID	MD5
GROUND LEVEL	+52.10
INVERT LEVEL	+48.32
DRAIN LENGTH	606m
DRAIN WIDTH	5.0m
PROPOSED STP LOCATIONS	

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW

ENGINEERS PVT. LTD.
ALL ABOUT WATER

OFFICE OF ORIGIN
CHENNAI
B/G (MADE STERLING APPT.
NO.1, SIVAGNANAM ST,
STERLING ESTATE,NUNGAMBAKKAM
TEL:2825 7910/2822 5985/~57

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD., PATNA

DATE: 26.11.2017

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD

HEAD OFFICE
12th FLOOR, REGENT CHAMBERS,
NARIMAN POINT,
MUMBAI – 400021

DRAWN: Anwar

PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE SCHEME IN MUZAFFARPUR, BIHAR

CHECKED: S.Avvaru

TITLE: PROPOSED STORM WATER DRAINAGE NETWORK IN MUZFFARPUR CITY

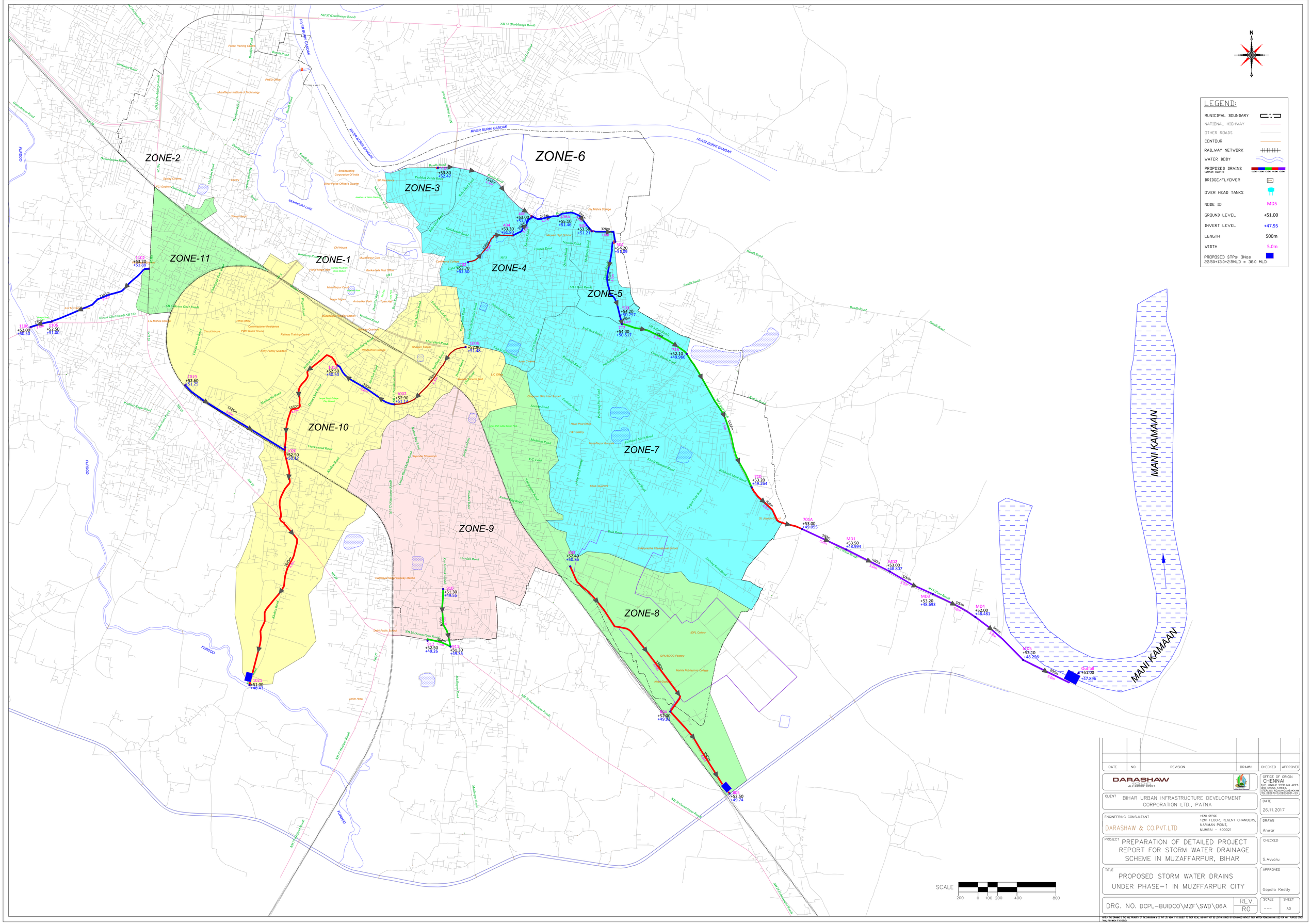
APPROVED: Gopala Reddy

DRG. NO. DCPL–BUIDCO\MZF\SWD\06

REV. R0

SCALE: 1:10000

SHEET: A0



LEGEND:

MUNICIPAL BOUNDARY
NATIONAL HIGHWAY
OTHER ROADS
CONTOUR
RAILWAY NETWORK
WATER BODY
PROPOSED DRAINS (DRAIN WIDHT) 🟥 (2.5M) 🟦 (3.0M) 🟩 (3.5M) 🟥 (4.0M) 🟪 (5.0M)
BRIDGE/FLYOVER
OVER HEAD TANKS
NODE ID MD5
GROUND LEVEL +51.00
INVERT LEVEL +47.95
LENGTH 500m
WIDTH 5.0m
PROPOSED STPs: 3Nos 22.50+13.0+2.5MLD = 38.0 MLD 🟦

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW
1926
ALL ABOUT TRUST

BUIDCo
Building Better Tomorrow

OFFICE OF ORIGIN
CHENNAI
8/2, UINQUE STERLING APPT.
3RD CROSS STREET,
STERLING RD,NUNGAMBAKKAM
TEL.28267910/28235951-53

CLIENT
BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD., PATNA

DATE
26.11.2017

ENGINEERING CONSULTANT
DARASHAW & CO.PVT.LTD

HEAD OFFICE
12th FLOOR, REGENT CHAMBERS,
NARIMAN POINT,
MUMBAI – 400021

DRAWN
Anwar

PROJECT
PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE SCHEME IN MUZAFFARPUR, BIHAR

CHECKED
S.Avvaru

TITLE
PROPOSED STORM WATER DRAINS UNDER PHASE–1 IN MUZFFARPUR CITY

APPROVED
Gopala Reddy

DRG. NO. DCPL–BUIDCO\MZF\SWD\06A

REV.
R0

SCALE

SHEET
A0

ZONE-1
ZONE-2
ZONE-3
ZONE-4
ZONE-5
ZONE-6
ZONE-7
ZONE-8
ZONE-9
ZONE-10
ZONE-11
MANI KAMAAN

LEGEND:

MUNICIPAL BOUNDARY	
NATIONAL HIGHWAY	
OTHER ROADS	
CONTOUR	
RAILWAY NETWORK	
WATER BODY	
PROPOSED DRAINS MAIN TYPE	COVERED / UNCOVERED
BRIDGE/FLYOVER	
OVER HEAD TANKS	
NODE ID	MD5
GROUND LEVEL	+51.00
INVERT LEVEL	+47.95
LENGTH	500m
WIDTH	5.0m
PROPOSED STPs: 3Nos 22.50+13.0+2.5MLD = 38.0 MLD	

LENGTH OF UNCOVERED DRAIN:16724mtr

LENGTH COVERED DRAINS: 5685mtr

LENGTH COVERED DRAINS: 22409mtr

SCALE 200 0 100 200 400 800

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW
ALL ABOUT TYPES!

OFFICE OF ORIGIN
CHENNAI
B.O. UNIQUE STERLING APPT.
3RD CROSS STREET,
TEYNAMPET, KOTTURPURAM
TEL: 24349991/24351951-53

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD., PATNA

DATE: 26.11.2017

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD
HEAD OFFICE
12th FLOOR, REGENT CHAMBERS,
NARIMAN POINT,
MUMBAI – 400021

DRAWN: Anwar

PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE SCHEME IN MUZAFFARPUR, BIHAR

CHECKED: S.Anwaru

TITLE: COVERED & UN_COVERED DRAIN DETAILS UNDER PHASE–1 IN MUZFFARPUR CITY

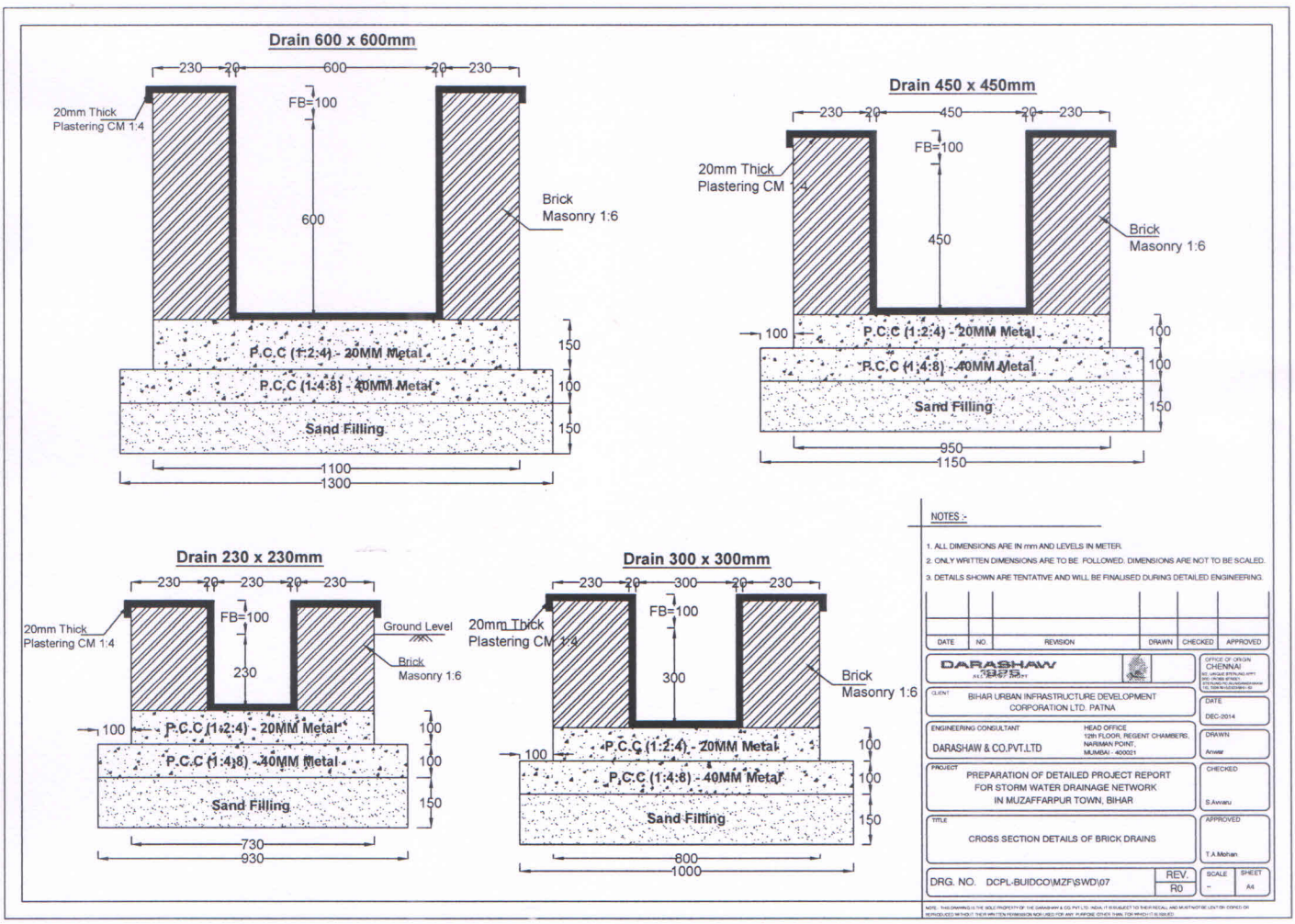
APPROVED: Gopala Reddy

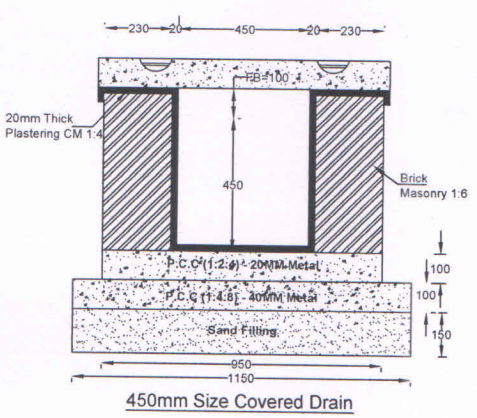
DRG. NO. DCPL–BUIDCO\MZF\SWD\06B

REV. R0

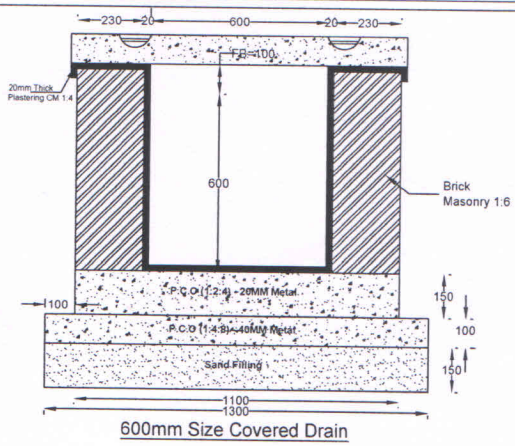
SCALE: ---

SHEET: A3

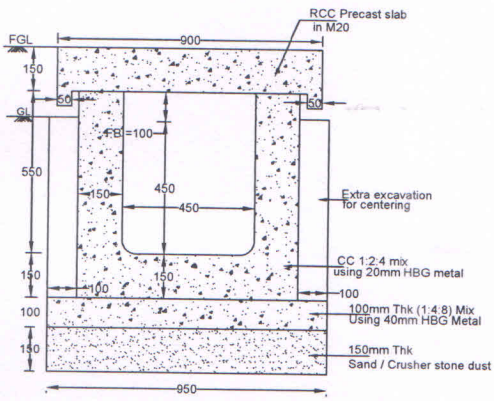

Drain 600 x 600mm
230
20
600
20
230
FB=100
20mm Thick
Plastering CM 1:4
Brick
Masonry 1:6
600
P.C.C (1:2:4) - 20MM Metal
P.C.C (1:4:8) - 40MM Metal
Sand Filling
150
100
150
1100
1300
Drain 450 x 450mm
230
20
450
20
230
FB=100
20mm Thick
Plastering CM 1:4
Brick
Masonry 1:6
450
100
P.C.C (1:2:4) - 20MM Metal
P.C.C (1:4:8) - 40MM Metal
Sand Filling
100
100
150
950
1150
Drain 230 x 230mm
230
20
230
20
230
FB=100
20mm Thick
Plastering CM 1:4
Ground Level
Brick
Masonry 1:6
230
100
P.C.C (1:2:4) - 20MM Metal
P.C.C (1:4:8) - 40MM Metal
Sand Filling
100
100
150
730
930
Drain 300 x 300mm
230
20
300
20
230
FB=100
20mm Thick
Plastering CM 1:4
Brick
Masonry 1:6
300
100
P.C.C (1:2:4) - 20MM Metal
P.C.C (1:4:8) - 40MM Metal
Sand Filling
100
100
150
800
1000
NOTES :-
1. ALL DIMENSIONS ARE IN mm AND LEVELS IN METER.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED. DIMENSIONS ARE NOT TO BE SCALED.
3. DETAILS SHOWN ARE TENTATIVE AND WILL BE FINALISED DURING DETAILED ENGINEERING.
DATE
NO.
REVISION
DRAWN
CHECKED
APPROVED
DARASHAW
OFFICE OF ORIGIN
CHENNAI
CLIENT
BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD. PATNA
DATE
DEC-2014
ENGINEERING CONSULTANT
DARASHAW & CO.PVT.LTD
HEAD OFFICE
12th FLOOR, REGENT CHAMBERS,
NARIMAN POINT,
MUMBAI - 400021
DRAWN
Anwar
PROJECT
PREPARATION OF DETAILED PROJECT REPORT
FOR STORM WATER DRAINAGE NETWORK
IN MUZAFFARPUR TOWN, BIHAR
CHECKED
S.Awaru
TITLE
CROSS SECTION DETAILS OF BRICK DRAINS
APPROVED
T.A.Mohan
DRG. NO. DCPL-BUIDCO\MZF\SWD\07
REV.
R0
SCALE
--
SHEET
A4



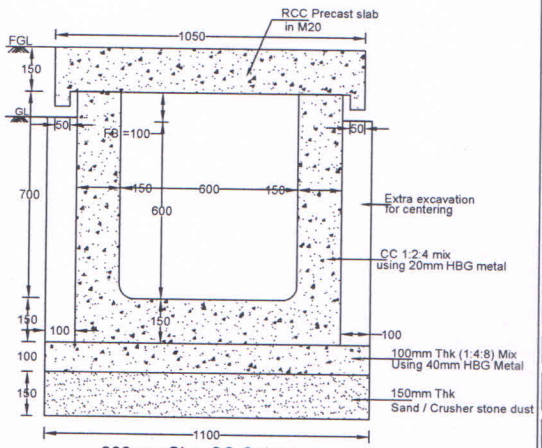
450mm Size Covered Drain



600mm Size Covered Drain



450mm Size CC Culvert



600mm Size CC Culvert

NOTES:

1.All dimensions are in millimeters unless otherwise noted.
2.Cement proposed shall be of OPC 43/53 grade.
3.Expansion joints of 20mm shall be provided at 20m intervals.
4.Earthwork excavation over and above standard depths are to be arrived from L.S & C.S.
5.Provide for raising drain walls with CC/FAL-G brick work wherever necessary.
6.In all concrete items coarse aggregate shall be 20mm unless otherwise specified.

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW

OFFICE OF ORIGIN: CHENNAI

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD. PATNA

DATE: DEC 2014

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD
HEAD OFFICE: 12th FLOOR, REGENT CHAMBERS, NARIMAN POINT, MUMBAI 400021

DRAWN: Anwar

PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE NETWORK IN MUZAFFARPUR TOWN, BIHAR

CHECKED: S.Arvanu

TITLE: CROSS SECTION DETAILS OF COVERED DRAINS & CC CULVERTS

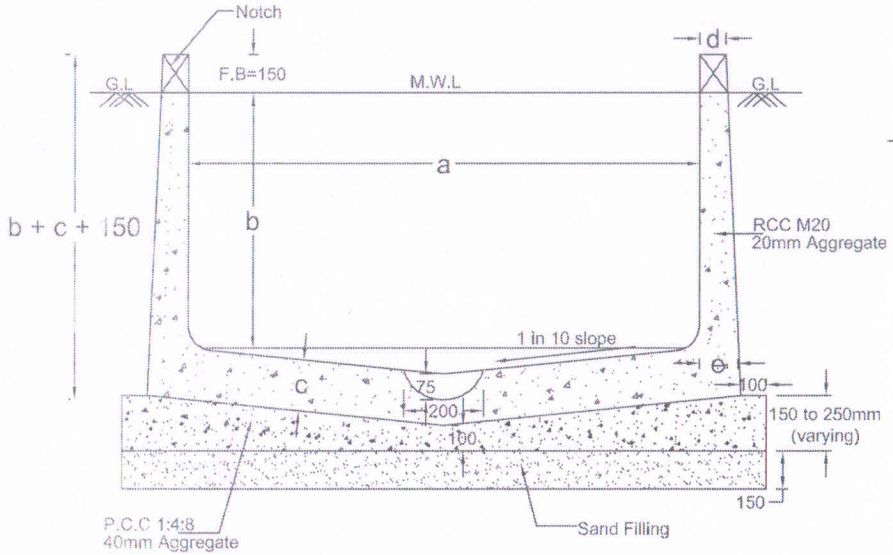
APPROVED: T.A.Mohan

DRG. NO. DCPL-BUIDCO\MZF\SWD\06

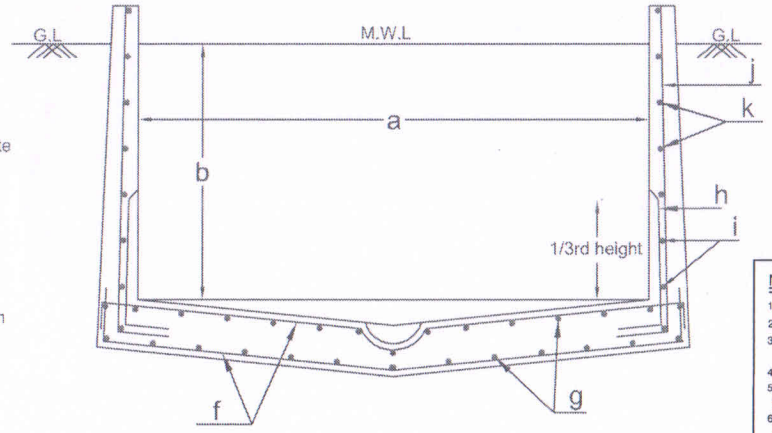
REV. R0

SCALE

SHEET A4



CROSS SECTION OF RCC DRAIN

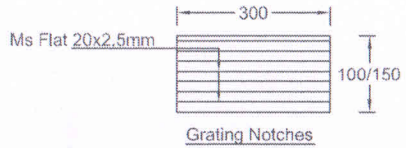


REINFORCEMENT DETAILS OF RCC DRAIN

NOTES

1. ALL DIMENSIONS ARE IN mm AND LEVELS ARE IN m.
2. CEMENT PROPOSED SHALL BE OF OPC 43/53 GRADE.
3. GRADE OF STEEL SHALL BE Fe415 HYSD BAR CONFORMING TO IS: 1786, LATEST EDITION.
4. CLEAR COVER TO ANY REINFORCEMENT SHALL BE 40mm.
5. 300 mm WIDE NOTCHES WITH GRATING TO BE PROVIDED @ 3.0M. c/c WHERE G.L. IS BELOW TOP LEVEL OF WALL.
6. GENTLE SLOPE OF GROUND TO BE PROVIDED TOWARDS DRAINS WHERE G.L. IS ABOVE THE TOP LEVEL OF WALL.
7. WEEP HOLE AND GRADED STONE AGGREGATE FILTER MATERIAL SHOULD BE PROIDED AS PER MORTH SPECIFICATION CLAUSE NO. 2706 & 2504.
8. AVERAGE HEIGHT OF THE WALLS(H) ARE PROVIDED AS PER THE AVERAGE N.G.L. & IT MAY BE CHANGED AS PER SITE CONDITION.
9. EXPANSION JOINTS OF 20MM SHALL BE PROVIDED AT 20M INTERVALS.
10. MIN. LAP/DEVELOPMENT LENGTHS RECOMMENDED FOR REINFORCEMENT.

BAR DIA	Development Length (Ld)
8Ø	400
10Ø	500
12Ø	600
16Ø	800
20Ø	1000
25Ø	1250



Grating Notches

S.No	Drain Size		Bottom Slab Thickness	Wall Thickness		Bottom Slab Reinforcement on both faces		Wall Reinforcement at outer edge			
								Up to 1/3rd height		Above 1/3rd height	
	Width	Depth		Top	Bottom	Main Reinf	Distr Reinf	Main Reinf	Distr Reinf	Main Reinf	Distr Reinf
	a	b	c	d	e	f	g	h	i	j	k
1	<= 1500	750	150	100	150	8dia @ 180 c/c	8dia @ 190 c/c	10dia @ 140 c/c	10dia @ 140 c/c	10dia @ 280 c/c	8dia @ 200 c/c
2	<= 1200	900	200	100	200	8dia @ 140 c/c	8dia @ 140 c/c	10dia @ 110 c/c	10dia @ 110 c/c	10dia @ 220 c/c	8dia @ 150 c/c
3	<= 2000	1000	200	100	200	8dia @ 125 c/c	8dia @ 140 c/c	10dia @ 110 c/c	10dia @ 110 c/c	10dia @ 220 c/c	8dia @ 150 c/c

NOTES :-

1. ALL DIMENSIONS ARE IN mm AND LEVELS IN METER.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED. DIMENSIONS ARE NOT TO BE SCALED.
3. DETAILS SHOWN ARE TENTATIVE AND WILL BE FINALISED DURING DETAILED ENGINEERING.

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW

OFFICE OF ORIGIN: CHENNAI

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD, PATNA

DATE: DEC-2014

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD

HEAD OFFICE: 12th FLOOR, REGENT CHAMBERS, NARIMAN POINT, MUMBAI - 400021

DRAWN: Anwar

PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE NETWORK IN MUZAFFARPUR TOWN, BIHAR

CHECKED: S.Avvaru

TITLE: CROSS SECTION DETAILS OF RCC DRAINS OF SIZE UP TO 1.0M DEPTH FOR MUZAFFARPUR TOWN

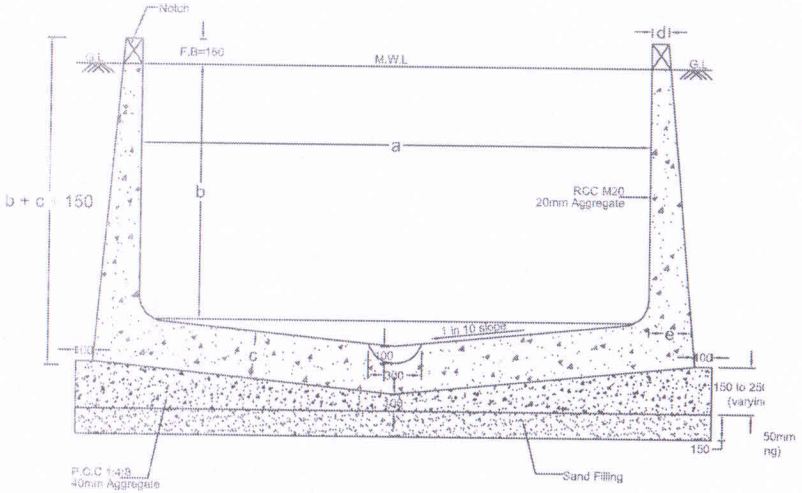
APPROVED: T.A.Mohan

DRG. NO. DCPL-BUIDCO\MZF\SWD\09(I)

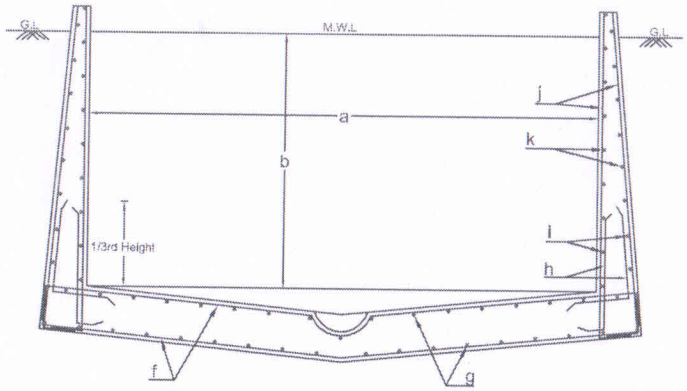
REV. R0

SCALE -

SHEET A3



CROSS SECTION OF RCC DRAIN

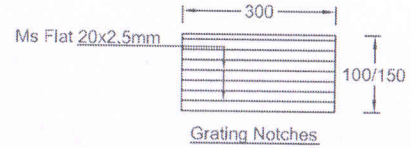


REINFORCEMENT DETAILS OF RCC DRAIN

NOTES

1. ALL DIMENSIONS ARE IN mm AND LEVELS ARE IN m.
2. CEMENT PROPOSED SHALL BE OF OPC 43/53 GRADE.
3. GRADE OF STEEL SHALL BE Fe415 HYSD BAR CONFORMING TO IS: 1786, LATEST EDITION.
4. CLEAR COVER TO ANY REINFORCEMENT SHALL BE 40mm.
5. 300 mm WIDE NOTCHES WITH GRATING TO BE PROVIDED @ 3.0M. c/c WHERE G.L. IS BELOW TOP LEVEL OF WALL.
6. GENTLE SLOPE OF GROUND TO BE PROVIDED TOWARDS DRAINS WHERE G.L. IS ABOVE THE TOP LEVEL OF WALL.
7. WEEP HOLE AND GRADED STONE AGGREGATE FILTER MATERIAL SHOULD BE PROIDED AS PER MORTH SPECIFICATION CLAUSE NO. 2706 & 2504.
8. AVERAGE HEIGHT OF THE WALLS(H) ARE PROVIDED AS PER THE AVERAGE N.G.L. & IT MAY BE CHANGED AS PER SITE CONDITION.
9. EXPANSION JOINTS OF 20MM SHALL BE PROVIDED AT 20M INTERVALS.
10. MIN. LAP/DEVELOPMENT LENGTHS RECOMMENDED FOR REINFORCEMENT.

BAR DIA	Development Length (Ld)
8	400
10	500
12	600
16	800
20	1000
25	1250



Grating Notches

S.No	Drain Size		Bottom Slab Thick ness	Wall Thickness		Bottom Slab Reinforcement on both Faces		Wall Reinforcement on both Faces			
	Width	Depth		Top	Bottom	Main Reinf	Distr Reinf	Main Reinf	Distr Reinf	Main Reinf	Distr Reinf
	a	b	c	d	e	f	g	h	i	j	k
1	<=2500	1100-1250	250	100	200	10dia @ 140 c/c	8dia @ 140 c/c	10dia @ 125 c/c	8dia @ 125 c/c	10dia @ 250 c/c	8dia @ 220 c/c
2	<=3000	1300-1500	280	100	250	10dia @ 125 c/c	8dia @ 110 c/c	10dia @ 100 c/c	8dia @ 100 c/c	10dia @ 200 c/c	8dia @ 175 c/c
3	<=3500	1750	350	100	300	10dia @ 110 c/c	8dia @ 140 c/c	10dia @ 125 c/c	8dia @ 125 c/c	12dia @ 250 c/c	10dia @ 200 c/c
4	<=4000	2000	400	100	350	12dia @ 125 c/c	10dia @ 125 c/c	12dia @ 110 c/c	10dia @ 110 c/c	12dia @ 220 c/c	10dia @ 200 c/c
5	<=5000	2500	400	100	400	12dia @ 125 c/c	10dia @ 125 c/c	12dia @ 110 c/c	10dia @ 110 c/c	12dia @ 220 c/c	10dia @ 200 c/c
6	<=5500	2750	400	100	450	12dia @ 125 c/c	10dia @ 125 c/c	12dia @ 110 c/c	10dia @ 110 c/c	12dia @ 220 c/c	10dia @ 200 c/c
7	<=6000	3000	400	100	450	12dia @ 125 c/c	10dia @ 125 c/c	12dia @ 110 c/c	10dia @ 110 c/c	12dia @ 220 c/c	10dia @ 200 c/c

NOTES :-

1. ALL DIMENSIONS ARE IN mm AND LEVELS IN METER.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED. DIMENSIONS ARE NOT TO BE SCALED.
3. DETAILS SHOWN ARE TENTATIVE AND WILL BE FINALISED DURING DETAILED ENGINEERING.

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW — OFFICE OF ORIGIN: CHENNAI

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD, PATNA

DATE: DEC-2014

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD — HEAD OFFICE: 12th FLOOR, REGENT CHAMBERS, NARIMAN POINT, MUMBAI - 400021

DRAWN: Anwar

PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE NETWORK IN MUZAFFARPUR TOWN, BIHAR

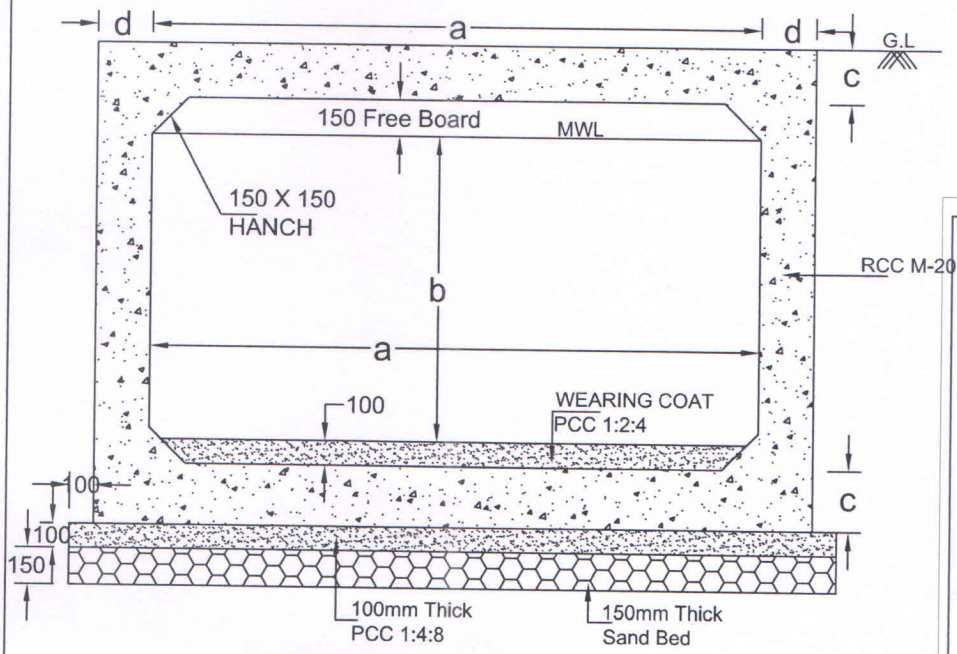
CHECKED: S.Arvaru

TITLE: CROSS SECTION DETAILS OF RCC DRAINS OF SIZE ABOVE 1.0M DEPTH FOR MUZAFFARPUR TOWN

APPROVED: T.A.Mohan

DRG. NO. DCPL-BUIDCO\MZF\SWD\09(ii) | REV. R0 | SCALE - | SHEET A3

S.No	Size of Culvert		Thickness of top slab and bottom slab	Thickness of walls	Top Slab		Bottom slab		Walls	
	Width	Depth			Main Reinf	Distr Reinf	Main Reinf	Distr Reinf	Main Reinf	Distr Reinf
	a	b	c	d	e	f	g	h	i	j
1	750	750	100	100	10dia @ 200 c/c	8dia @ 175 c/c	10dia @ 200 c/c	8dia @ 175 c/c	10dia @ 200 c/c	8dia @ 175 c/c
2	900-1000	<=1000	150	150	10dia @ 175 c/c	8dia @ 175 c/c	10dia @ 175 c/c	8dia @ 175 c/c	10dia @ 175 c/c	8dia @ 175 c/c
3	1200	<=1000	200	200	10dia @ 150 c/c	8dia @ 140 c/c	10dia @ 150 c/c	8dia @ 140 c/c	10dia @ 150 c/c	8dia @ 140 c/c
4	1500	<=1000	150	150	10dia @ 125 c/c	8dia @ 175 c/c	10dia @ 100 c/c	8dia @ 175 c/c	10dia @ 125 c/c	8dia @ 175 c/c
5	1800	<=1200	200	200	12dia @ 150 c/c	8dia @ 140 c/c	12dia @ 150 c/c	8dia @ 140 c/c	12dia @ 150 c/c	8dia @ 140 c/c
6	2000	<=2000	200	200	12dia @ 120 c/c	8dia @ 140 c/c	12dia @ 120 c/c	8dia @ 140 c/c	12dia @ 120 c/c	8dia @ 140 c/c
7	2500	<=1250	300	250	12dia @ 100 c/c	10dia @ 140 c/c	12dia @ 100 c/c	10dia @ 140 c/c	12dia @ 100 c/c	10dia @ 175 c/c
8	3000	<=1500	350	300	16dia @ 150 c/c	10dia @ 125 c/c	16dia @ 150 c/c	10dia @ 125 c/c	16dia @ 150 c/c	10dia @ 140 c/c
9	3500	<=1750	400	350	16dia @ 140 c/c	10dia @ 110 c/c	16dia @ 125 c/c	10dia @ 110 c/c	16dia @ 125 c/c	10dia @ 125 c/c
10	4000	<=2000	450	400	16dia @ 120 c/c	12dia @ 140 c/c	16dia @ 100 c/c	12dia @ 140 c/c	16dia @ 100 c/c	12dia @ 150 c/c
11	5000	<=2500	450	400	16dia @ 120 c/c	12dia @ 140 c/c	16dia @ 100 c/c	12dia @ 140 c/c	16dia @ 100 c/c	12dia @ 150 c/c
12	5500	<=2750	450	450	16dia @ 120 c/c	12dia @ 140 c/c	16dia @ 100 c/c	12dia @ 140 c/c	16dia @ 100 c/c	12dia @ 150 c/c
13	6000	<=3000	500	450	16dia @ 120 c/c	12dia @ 140 c/c	16dia @ 100 c/c	12dia @ 140 c/c	16dia @ 100 c/c	12dia @ 150 c/c



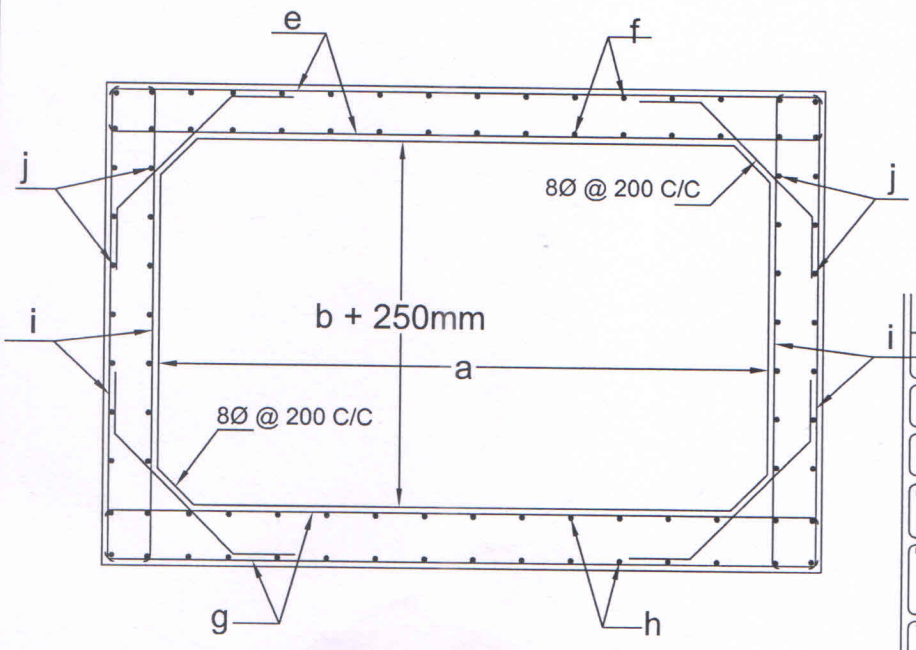
DETAILS OF BOX CULVERT

NOTES

1. ALL DIMENSIONS ARE IN mm AND LEVELS ARE IN m.
2. CEMENT PROPOSED SHALL BE OF OPC 43/53 GRADE.
3. GRADE OF STEEL SHALL BE Fe415 HYSD BAR CONFORMING TO IS: 1786, LATEST EDITION.
4. CLEAR COVER TO ANY REINFORCEMENT SHALL BE 40mm.
5. 300 mm WIDE NOTCHES WITH GRATING TO BE PROVIDED @ 3.0M. c/c WHERE G.L. IS BELOW TOP LEVEL OF WALL.
6. GENTLE SLOPE OF GROUND TO BE PROVIDED TOWARDS DRAINS WHERE G.L. IS ABOVE THE TOP LEVEL OF WALL.
7. WEEP HOLE AND GRADED STONE AGGREGATE FILTER MATERIAL SHOULD BE PROIDED AS PER MORTH SPECIFICATION CLAUSE NO. 2706 & 2504.
8. AVERAGE HEIGHT OF THE WALLS(H) ARE PROVIDED AS PER THE AVERAGE N.G.L. & IT MAY BE CHANGED AS PER SITE CONDITION.
9. EXPANSION JOINTS OF 20MM SHALL BE PROVIDED AT 20M INTERVALS.
10. MIN. LAP/DEVELOPMENT LENGTHS RECOMMENDED FOR REINFORCEMENT.

BAR DIA	Development Length (Ld)
8Ø	400
10Ø	500
12Ø	600
16Ø	800
20Ø	1000
25Ø	1250

11. SFRC EXTRA HEAVY DUTY MANHOLE COVERS SHALL BE PROVIDED WHERE EVER LENGTH OF THE CULVERT IS > 6M.
12. REFER DRAWING NO.TNUIFSL/SWD/SAT/011 FOR DETAILS OF MANHOLE.



BAR BENDING SCHEDULE OF BOX CULVERT

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW
ENGINEERS FOR ALL ABOUT TRUST

OFFICE OF ORIGIN: CHENNAI
65, UNIQUE STERLING APPT, 3RD CROSS STREET, STERLING RD, NUNGAMBAKKAM, TEL:28276710/28223360/-50

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.PATNA

DATE: DEC-2014

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD
HEAD OFFICE: 12th FLOOR, REGENT CHAMBERS, NARIMAN POINT, MUMBAI - 400021

DRAWN: Anwar

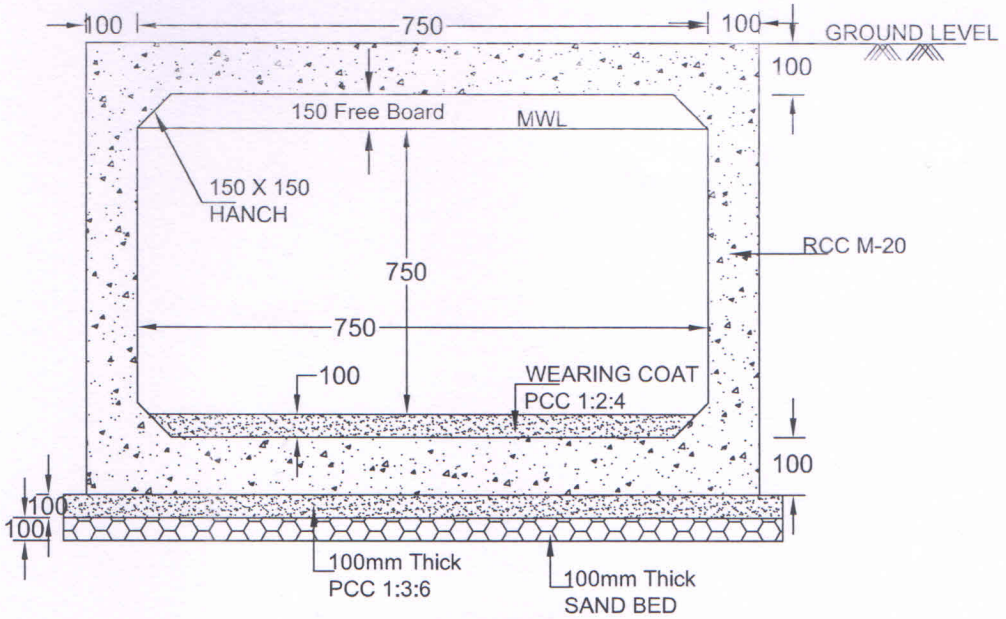
PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE NETWORK IN MUZAFFARPUR TOWN, BIHAR

CHECKED: S.Avvaru

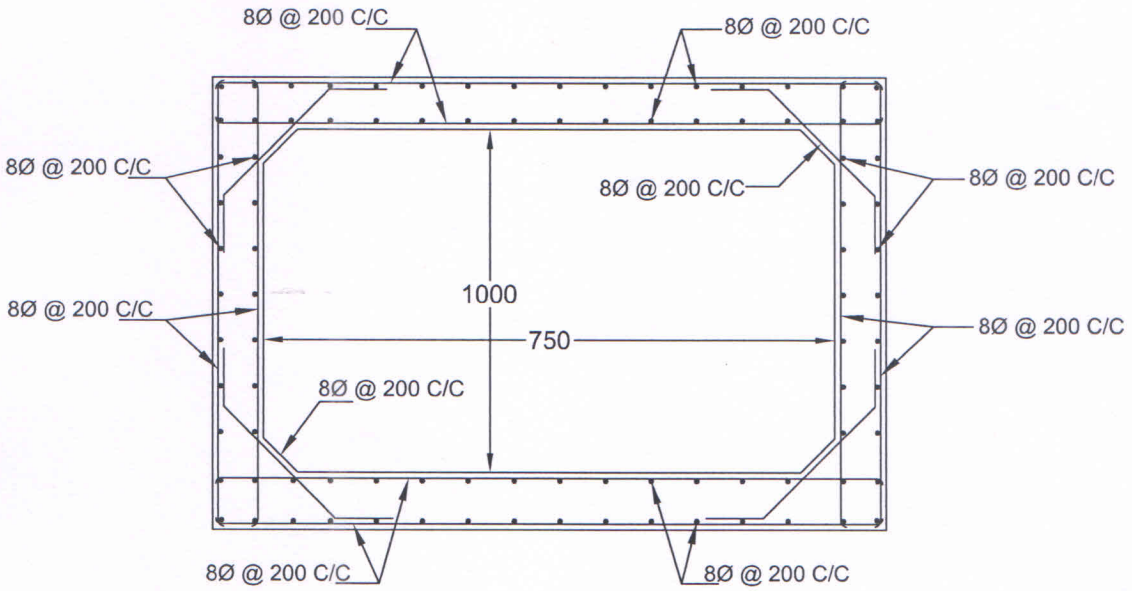
TITLE: CROSS SECTION DETAILS OF RCC COVERED DRAINS AND BOX CULVERT

APPROVED: T.A.Mohan

DRG. NO. DCPL-BUIDCO\MZF\SWD\10 | REV. R0 | SCALE -- | SHEET A3



DETAILS OF COVERED DRAIN



BAR BENDING SCHEDULE OF COVERED DRAIN

NOTES

1. ALL DIMENSIONS ARE IN mm AND LEVELS ARE IN m.
2. CEMENT PROPOSED SHALL BE OF OPC 43/53 GRADE.
3. GRADE OF STEEL SHALL BE Fe415 HYSD BAR CONFORMING TO IS: 1786, LATEST EDITION.
4. CLEAR COVER TO ANY REINFORCEMENT SHALL BE 40mm.
5. 300 mm WIDE NOTCHES WITH GRATING TO BE PROVIDED @ 3.0M. c/c WHERE G.L. IS BELOW TOP LEVEL OF WALL.
6. GENTLE SLOPE OF GROUND TO BE PROVIDED TOWARDS DRAINS WHERE G.L. IS ABOVE THE TOP LEVEL OF WALL.
7. WEEP HOLE AND GRADED STONE AGGREGATE FILTER MATERIAL SHOULD BE PROIDED AS PER MORTH SPECIFICATION CLAUSE NO. 2706 & 2504.
8. AVERAGE HEIGHT OF THE WALLS(H) ARE PROVIDED AS PER THE AVERAGE N.G.L. & IT MAY BE CHANGED AS PER SITE CONDITION.
9. EXPANSION JOINTS OF 20MM SHALL BE PROVIDED AT 20M INTERVALS.
10. MIN. LAP/DEVELOPMENT LENGTHS RECOMMENDED FOR REINFORCEMENT.

BAR DIA	Development Length (Ld)
8Φ	400
10Φ	500
12Φ	600
16Φ	800
20Φ	1000
25Φ	1250

11. SFRC EXTRA HEAVY DUTY MANHOLE COVERS SHALL BE PROVIDED AT EVERY 10M INTERVAL.
12. REFER DRAWING NO.TNUIFSL/SWD/SAT/011 FOR DETAILS OF MANHOLE.

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW

OFFICE OF ORIGIN: CHENNAI
60, UNIQUE STERLING APPT., 3RD CROSS STREET, STERLING RD.NUNGAMBAKKAM TEL:28278151/28272551-53

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD. PATNA

DATE: DEC-2014

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD
HEAD OFFICE: 12th FLOOR, REGENT CHAMBERS, NARIMAN POINT, MUMBAI - 400021

DRAWN: Anwar

PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE NETWORK IN MUZAFFARPUR TOWN, BIHAR

CHECKED: S.Avvaru

TITLE: CROSS SECTION DETAILS OF COVERED DRAINS

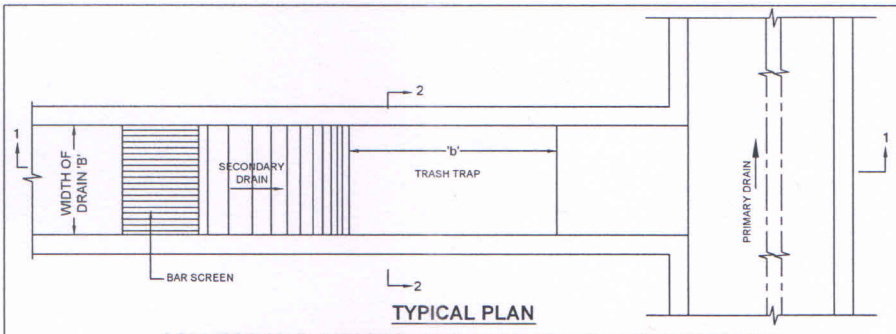
APPROVED: T.A.Mohan

DRG. NO. DCPL-BUIDCO\MZF\SWD\11

REV. R0

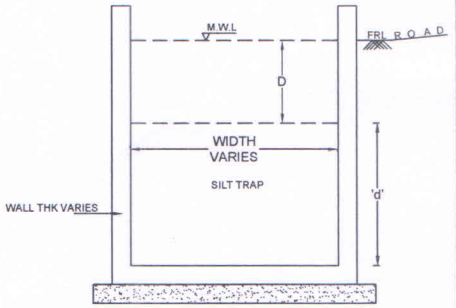
SCALE: -

SHEET: A4

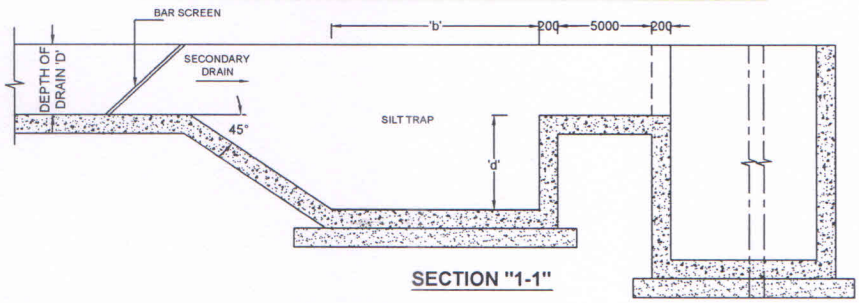


TYPICAL PLAN

CONNECTION B / W SECONDARY DRAINS AND PRIMARY DRAINS



SECTION "2-2"



SECTION "1-1"

PRIMARY DRAIN

SNo.	DRAW SIZE		SILT TRAP SIZE	
	B	D	b	d
1	450	450	900	500
2	600	600	1200	600
3	1000	500/600	2000	600
4	1500	750	3000	750
5	2000	1000	4000	750
6	2500	1250	5000	900
7	3000	1500	5000	900
8	3500	1750	5000	900

NOTES :-

1. ALL DIMENSIONS ARE IN mm AND LEVELS IN METER.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED. DIMENSIONS ARE NOT TO BE SCALED.
3. DETAILS SHOWN ARE TENTATIVE AND WILL BE FINALISED DURING DETAILED ENGINEERING.

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW

OFFICE OF ORIGIN: CHENNAI

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.PATNA

DATE: DEC-2014

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD

HEAD OFFICE: 12th FLOOR, REGENT CHAMBERS, NARIMAN POINT, MUMBAI - 400021

DRAWN: Anwar

PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE NETWORK IN MUZAFFARPUR TOWN, BIHAR

CHECKED: S.Avvaru

TITLE: CROSS SECTION DETAILS OF SILT TRAP

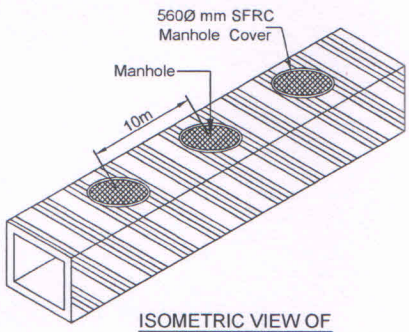
APPROVED: T.A.Mohan

DRG. NO. DCPL-BUIDCO\MZF\SWD\12

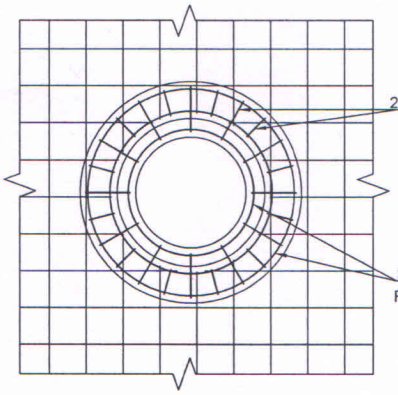
REV. R0

SCALE: --

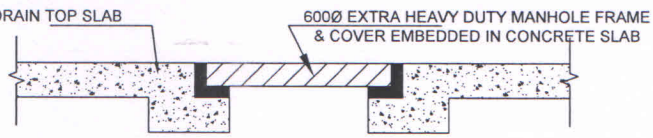
SHEET: A4



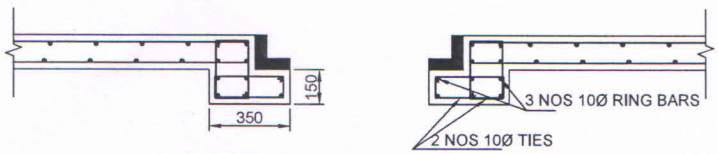
ISOMETRIC VIEW OF MANHOLE



MANHOLE REINFORCEMENT DETAILS IN PLAN



MANHOLE DETAILS



MANHOLE REINFORCEMENT DETAILS IN SECTION

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. C.I STEP AS PER I.S. 5455. FOOT REST SHALL BE PAINTED WITH COAL TAR.
3. SFRC MANHOLE FRAME & COVER OF HEAVY DUTY AS PER I.S.12592 (PART I & II).
4. CLEAR COVOR TO THE REINFORCEMENT SHALL BE 30MM
5. GRADE OF STEEL-FE 415, GRADE OF CONCRETE-M20
6. LAP LENGTH FOR REINFORCEMENT = 50 X Bar Dia

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW

OFFICE OF ORIGIN: CHENNAI

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD. PATNA

DATE: DEC-2014

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD

HEAD OFFICE: 12th FLOOR, RESIDENT CHAMBERS, NARIMAN POINT, MUMBAI - 400021.

DRAWN: Anwar

PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE NETWORK IN MUZAFFARPUR TOWN, BIHAR

CHECKED: Kv Ramaraju

TITLE: REINFORCEMENT DETAILS OF MANHOLE FOR COVERED DRAINS

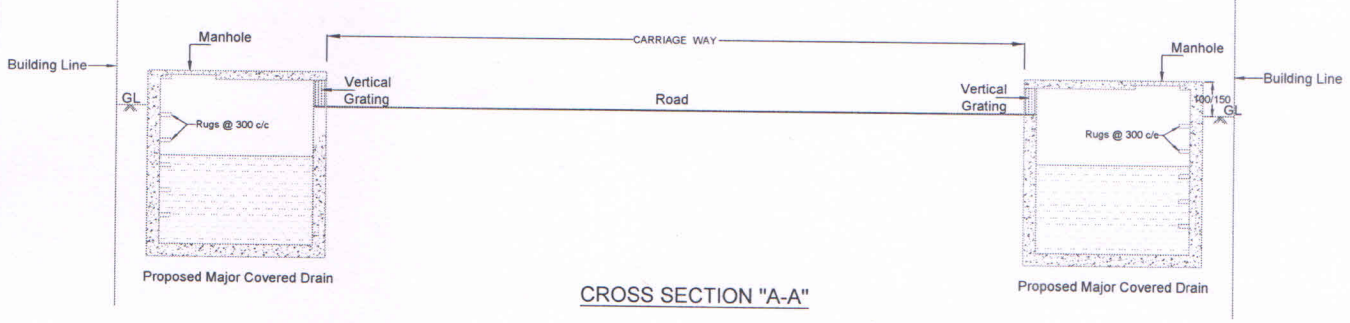
APPROVED: T.A.Mohan

DRG. NO. DCPL-BUIDCO\MZP\SWD\13

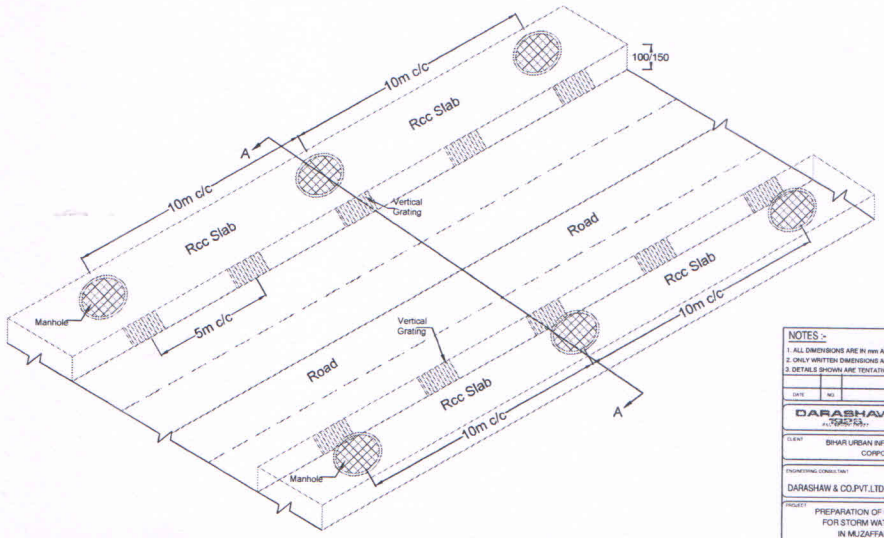
REV. R0

SCALE: -

SHEET: A4



CROSS SECTION "A-A"



DETAILS OF MAJOR COVERED DRAINS IN COMMERCIAL AREAS

NOTES :-

1. ALL DIMENSIONS ARE IN mm AND LEVELS IN METER.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED. DIMENSIONS ARE NOT TO BE SCALED.
3. DETAILS SHOWN ARE TENTATIVE AND WILL BE FINALISED DURING DETAILED ENGINEERING.

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW

OFFICE OF ORIGIN: CHENNAI

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD. PATNA

DATE: DEC 2014

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD

HEAD OFFICE: 13th FLOOR, REGENT CHAMBERS, NARIMAN POINT, MUMBAI - 400021

DRAWN: Sk. Anwar

PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE NETWORK IN MUZAFFARPUR TOWN, BIHAR

CHECKED: Ks.Ramaraju

TITLE: DETAILS OF MAJOR COVERED DRAINS IN COMMERCIAL AREAS

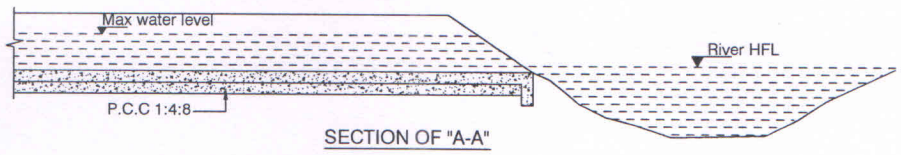
APPROVED: T.A.Mohan

DRG. NO. DCPL-BUIDCO\MZF\SWD\14

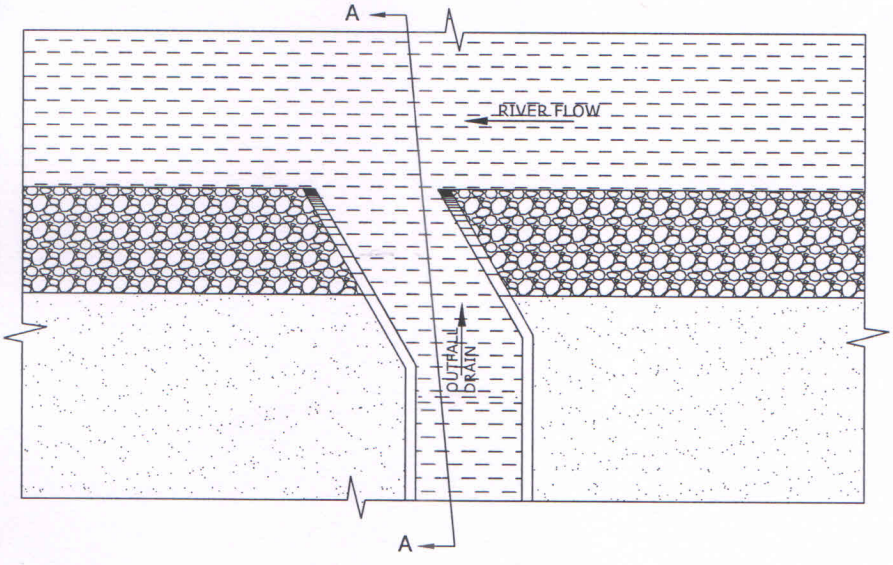
REV. R0

SCALE

SIZE A3



SECTION OF "A-A"



PLAN

NOTES :-

1. ALL DIMENSIONS ARE IN mm AND LEVELS IN METER.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED. DIMENSIONS ARE NOT TO BE SCALED.
3. DETAILS SHOWN ARE TENTATIVE AND WILL BE FINALISED DURING DETAILED ENGINEERING.

DATE	NO.	REVISION	DRAWN	CHECKED	APPROVED

DARASHAW

OFFICE OF ORIGIN: CHENNAI

CLIENT: BIHAR URBAN INFRASTRUCTURE DEVELOPMENT CORPORATION LTD. PATNA

DATE: DEC-2014

ENGINEERING CONSULTANT: DARASHAW & CO.PVT.LTD

HEAD OFFICE: 12th FLOOR, REGENT CHAMBERS, NARIMAN POINT, MUMBAI - 400021

DRAWN: Anwar

PROJECT: PREPARATION OF DETAILED PROJECT REPORT FOR STORM WATER DRAINAGE NETWORK IN MUZAFFARPUR TOWN, BIHAR

CHECKED: S.Awaru

TITLE: DETAILS OF OUTFALL ARRAIGNMENTS

APPROVED: T.A.Mohan

DRG. NO. DCPL-BUIDCO\MZF\SWD\15

REV. R0

SCALE: --

SHEET: A4

LOCATION OF BORE HOLE & TRAIL PIT