TATA CONSULTING ENGINEERS LIMITED

LODHA DWELLERS PRIVATE LIMITED



PLANNING AND DETAIL ENGINEERING OF INFRASTRUCTURE FOR DEVELOPMENT OF 590 ACRES OF LAND UNDER DEVELOPMENT AT PALAVA NEAR DOMBIVALI

PRELIMINARY PLANNING NOTE

WASTE WATER MANAGEMENT

MAR 2013

REVISION STATUS SHEET

Issue	Date	Title	Prepared By (TCE)	Checked By (TCE)	Approval By (LODHA Dwellers)
R0	22-02-2013	Preliminary Planning Note – Waste Water Management	AC, SK	AG	
R1	05-02-2013	Preliminary Planning Note – Waste Water Management	AC	SK	
R2	22-03-13	Preliminary Planning Note – Waste Water Management	AC	SK	
R3	05-04-13	Preliminary Planning Note – Waste Water Management	AC	SK	
R3	08-04-13	Preliminary Planning Note – Waste Water Management	AC	SK	

Revision Notes:-

R0- Waste-water Process & Modules (For Client Approval)

R1- Waste-water conveyance (Collection and recycle system added)

R2- As per comments received during 12th March meeting:

- *STP cost break-up (civil and equipment) added.*
- *Power cost break-up (STP & Recycle network) added.*
- *Area requirement of STP revised.*
- *Phasing of cost added.*

R3 - As per comments received on R2 report:

- *Excavation & manholes cost added to gravity sewerage*
- *Trunk sewer spacing provided*
- *De-centralised STP cost (MBBR replaced by MBR)*

R4 - As per discussion with SBR Vendor & comments received on R3 report on 5.04.2013:

- *Revision STP Cost break –up for MBR (Civil & MEP percent)*
- *De-centralised STP cost revised.*

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ABBREVIATIONS

CPHEEO	-	Central Public Health and Environmental Engineering Organization
kms	-	Kilometers
kW	-	Kilo Watt
kgpcd	-	Kilogram per Capita per Day
MLD	-	Million Litres per day
MW	-	Mega Watt
sqft	-	Square Feet
sqm	-	square metres
STP	-	Sewage Treatment Plant
T	-	Tonnes
TCE	-	Tata Consulting Engineers

PRELIMINARY PLANNING NOTE – WASTE-WATER CONVEYANCE FOR DEVELOPMENT OF 590 ACRES LAND OF PALAVA

1 INTRODUCTION

Lodha Dwellers Private Limited (Lodha) has appointed Tata Consulting Engineers Limited (TCE) to provide consulting engineering services for the "Planning and Detail Engineering of Infrastructure for development of 590 acres of land development".

1.1 Project Background

Lodha has identified almost 2200 acres for planned development of the "Palava city", about 8 kms south of Dombivli. Half of this land (near about 1100 acres) is marked as the first parcel of development out of which Lodha plans to take up 590 acres on priority. This land is to be developed by 2030 years in phases.

Following recent developments, the FSI of the area has increased to 1.7. New Master Plan for the 590 acres township has been prepared in January 2013.

A workshop in this regard was called by Lodha on 4th to 6th Feb 2013. Infrastructure goals, utility management philosophies, security and smart city intent for 590 acres (Palava) township were discussed. Preliminary inputs required for planning have been formulated on basis of this workshop. The Preliminary Planning Notes are prepared in this regard.

2 WASTE-WATER CONVEYANCE

2.1 Development Phasing

The waste-water generation expected to be generated in Palava is calculated as per raw data provided in data file (2013-02-14 Palava 590 Delivery and Occupancy Estimate v2) provided by Lodha. The phasing identified is as follows:

Table 2-1 Phasing

Phases	Year	Occupancy	Residential Population
Phase 1	2018	20%	47,443
Phase 2	2023	60%	138,375
Phase 3	2029	100%	230,953

2.2 Waste-water Generation in Palava

The total waste-water expected to be generated in Palava is calculated as per CPHEEO Manual. The zone-wise quantification of waste for the various phases is provided in **Table 2-2**. Detailed basis and estimates for water and waste-water generation are provided in **Appendix 1**. The zone boundaries are considered as per **Appendix 2**.

Table 2-2 Waste-water Generation from Palava

Waste water (MLD)	Phase 1 2018 (20%)	Phase 2 2023 (60%)	Phase 3 2029 (100%)
Zone 1	7.76	8.34	11.49
Zone 2	1.53	4.85	4.85
Zone 3	0	4.25	4.25
Zone 4	0.01	2.46	4.63
Zone 5	0	0	9.26
Zone 6	0	0	3.66
EWS	3.2	3.8	6.4

2.3 STP Modular Sizing

2.3.1 For centralised STP ultimate capacity is selected as 47 MLD.
Module sizing is selected based on starting thresholds, phasing and repeatability:

Table 2-3 Centralised STP

Phases	% Occupancy	Common STP (MLD)	EWS STP (MLD)
Phase 1	20	5+5	3.5
Phase 2	60	10	
Phase 3	100	20	3.5

2.3.2 For de-centralised STP at each zone total capacity will be 48 MLD

Table 2-3 De-centralised STP

Waste water (MLD)	Phase 1 2018 STP (MLD)	Phase 2 2023 STP (MLD)	Phase 3 2029 STP (MLD)
Zone 1	4 + 4	0	4
Zone 2	2.5	2.5	0
Zone 3	0	2.5 + 2.5	0
Zone 4	0	2.5	2.5
Zone 5	0	0	5 + 5
Zone 6	0	0	4
EWS	3.5	0	3.5
TOTAL	**4 + 4 + 2.5 + 3.5 = 14**	**2.5+2.5+2.5+2.5 = 10**	**4+2.5+5+5+4+3.5 = 24**

2.4 Process Comparison

2.4.1 For centralised STP, process comparison of SBR & MBBR are provided for module size of 10 MLD.

Table 2-4 SBR & MBBR comparison for 10 MLD STP

Sr. No.	Description	Moving Bed Bio Reactor (MBBR)	Sequence Batch Reactor (SBR)
A	CAPITAL COST		
i	Area Requirement (ha) *including tertiary treatment*	0.9	0.8
ii	Civil (Rs. Cr) including Taxes	8.4	9
iii	MEP (equipment) cost (Rs. Cr) including Taxes	5.6	6
B	O&M COST		
i	Power Consumption (kWh/d)	4800	4320
ii	Power Cost per annum (Rs. Cr)	1.40	1.26
iii	Chemical Cost per annum (Rs. Cr)	0.15	0.15
iv	Manpower Cost per annum (Rs. Cr)	0.13	0.13
v	Repair Cost including spares (Rs. Cr)	0.30	0.30
vi	Total O&M Cost (Rs. Cr per yr)	1.99	1.84
	15 yrs Life Cycle Cost (Rs. Cr)	**43.9**	**42.7**

2.4.2 For Centralized STP, phase-wise cost requirement based on SBR Technology option is given in following table.

Table 2-5 Phase-wise Cost requirement for STP

Sr. No.	Phase Wise Cost for Centralised STP (Rs. Cr)	Phase 1 (2018)	Phase 2 (2023)	Phase 3 (2029)
1	Capital Cost (civil)	15.27	4.8	21.57
2	MEP Cost	8.68	7.2	14.38
3	Replacement cost (every 15 yrs)			8.68
4	Additional O & M cost per Year	1.85	1.75	3.6

Note: In Phase-1, Civil Works required for Phase -2 STP will be completed. Only Electro-mechanical works will be undertaken in Phase-2.

2.4.3 For de-centralised STP, process comparison of MBR & MBBR is provided for a module size of 5 MLD.

Table 2-6 MBR & MBBR comparison for 5 MLD STP

Sr. No.	Description	Moving Bed Bio Reactor (MBBR)	MBR
A	CAPITAL COST		
i	Area Requirement (Ha) including tertiary treatment	0.45	0.25
ii	Civil (Rs. Cr) including Taxes	5.1	3.5
iii	MEP capital cost including taxes (Rs Cr)	3.4	6.5
B	O&M COST		
i	Power Consumption (kWh/d)	2400	3000
ii	Power Cost per annum (Rs Cr)	0.70	0.87
iii	Chemical Cost per annum (Rs Cr)	0.15	0.21
iv	Manpower Cost per annum (Rs Cr)	0.13	0.10

Sr. No.	Description	Moving Bed Bio Reactor (MBBR)	MBR
v	Repair Cost including spares (Rs Cr)	0.15	0.24
vi	Total O&M Cost (Rs Cr)	1.14	1.43
vii	Replacement cost (Rs. Cr)	3.4 (every 15 years)	5.8 (every 5 years)

2.4.4 Phase wise cost for de-centralised STP (MBR) is provided. Membrane cost replacement is considered only once in ten years (Phase 3). This interval is to be guaranteed by vendor.

Table 2-7 Phase-wise Cost requirement for STP

Cost Component	Phase-1	Phase-2	Phase-3
Civil capital cost (Rs. Cr)	9.8	7.0	16.8
MEP Capital cost (Rs. Cr)	18.2	13.0	31.2
Replacement cost every 15 years (Rs. Cr)	-	-	18.2
O&M Cost (Rs. Cr)	4.04	2.98	6.69

2.5 Waste-water Conveyance Philosophy

2.5.1 Waste-water Schematics

The alternatives being considered for the waste-water are as discussed with Lodha and Byron S. in the teleconference dated 20 February 2013. The schematics for Scheme 1 & Scheme 2 are provided in Appendix 3A & 3B respectively.

(i) Scheme 1 (Centralised STP):

- *Components: Sewage Collection Network + Centralized STP + Recycle Network*

(ii) Scheme 2 (De-centralised STP):

- *Components: Zonal Sewage Collection Network + De-centralized STP + Recycle Network*

2.5.2 CAPEX AND OPEX

Cost comparison is provided in **Table 2-8**. Details of cost estimates are provided in **Appendix 4**. Following is the basis for the costing:

- SBR costs are provided for the centralised Scheme-1 and MBR costs are provided for the de-centralised Scheme 2.

- Two transmission mains are considered for optimisation of the centralized TSE recycled pumping system. Peak flow (4 Hrs flow) is used for pumping head estimates.
- Pumping equipment cost is estimated at 15000/KW. Pipeline costs are based on MJP 2012. Civil cost of reservoirs is considered as 8 Rs/litre for centralised and 12 Rs/litre for building level tanks.

Table 2-8 Comparison for Centralised & De-Centralised Alternatives

Sr. No.	Description	Scheme 1 Centralised STP	Scheme 2 De-Centralised STP
A	CAPITAL COST	(Rs. Cr)	(Rs. Cr)
i	Gravity sewerage	10.38 (15 kms) Trunk Sewer: 600mm to 1200mm Trench corridor 1.5 m to 2 m	6.62 (13 kms) Terminal Sewer: Maximum 450mm Trench corridor: 1m
ii	STP civil	41.64	33.6
iii	MEP cost	30.26	62.4
iv	Recycled TSE reservoir/ tank	25	37.51
v	Recycled TSE pumping equipment	6.44	8.20
vi	Recycled TSE network cost	8.20	4.48
A	**Total capital cost (Rs. Cr)**	**121.92**	**152.81**
B	O&M COST		
i	Pumping power cost (Rs. Cr per year)	2.51	3.19
ii)	STP Power cost (Rs. Cr/ yr)	5.93	8.41
Iii	STP O&M with chemical and manpower (Rs. Cr per year)	2.75	5.36
B	**Total O&M Cost (Rs. Cr per yr)**	**11.19**	**16.96**
(i)	Replacement cost every 15 years (Recycled TSE Network)	6.44	8.20
(ii)	Replacement cost every 15 years (STP)	30.26	52.8
C	Total replacement cost in 15 years (Rs. Cr)	**36.7**	**61.00**

2.5.3 Risk Assessment

The risk assessment and mitigation for alternative schemes are provided in **Table 2-9**

Table 2-9 Risk Assessment & Mitigation for Centralised & De-Centralised

Sr. No.	Risk	Scheme 1 Centralised STP	Scheme 2 De-centralised STP
i	Power failure	(i) Backup-power required at STP. (ii) TSE recycle system to be designed for 4 hrs supply.	(i) Backup-power required at STP. (ii) TSE recycle system to be designed for 4 hrs supply.
Ii	Flushing velocities will not be obtained in generation from initial occupancies.	Daily flushing of the network will be required for initial phases.	Flushing velocities will be obtained sooner. Daily flushing may be required for a brief period.
iii	Networks may be oversized in case of delay or omission in development of any particular zone at later date.	Trunk sewers and recycled pipeline will need to be constructed upfront. Network required to be developed as per bare minimum phase requirement to minimise risk. Also initial network may use STP package at EWS to prevent full trunk development upto riverfront.	This risk is not applicable in the de-centralised scheme.
iv	2016 occupancy generates only about 1.5 MLD	Package unit for EWS may be used for 2016.	Package unit for Zone 2 may be used for 2016.
v	STP process gets superseded by other technologies. Access to MEP replacement and O&M reduces.	Long term O&M contract for STP and performance guarantee.	De-centralised package units may later be replaced by new technologies in event that the additional civil costs are not prohibitive.
vi	Pump failure at common TSE reservoir/ sump	Stand-by pump arrangement	Stand-by pump arrangement
vii	Pressure in network excessive	PRVs shall be provided	PRVs shall be provided

Sr. No.	Risk	Scheme 1 Centralised STP	Scheme 2 De-centralised STP
viii	Valve closure at Building OHT	Transient analysis for TSE pumped network will be required. Accordingly network may be strengthened or alternatively, TSE building level tank may be provided at each building to break pressure for the centralised network.	Transient analysis for TSE pumped network will be required. According strengthening will be provided.

2.6 Recommendation

2.6.1 The scheme 1 i.e. the centralized system is more economic. However, risks and initial O&M issues in the development of the centralised scheme will be greater. The difference in investment of the two schemes (based on the life cycle financial model) can be reduced if more economic quotations are received on the MBR STP.

2.6.2 Phasing of capital cost

The phasing of centralized capital expenditure is provided in **Table 2-10A**. The phasing of de-centralized capital expenditure is provided in **Table 2-10B**.

Table 2-10A:Phasing of Capital Expenditure (Centralised)

Capex (Rs Cr)	Phase 1	Phase 2	Phase 3
Collection Network	6.77	2.29	1.32
STP Civil	15.27	4.8	21.57
STP MEP	8.68	7.2	14.38
Replacement (STP)			8.68
Sub-Total	**30.72**	**14.29**	**45.95**
TSE Network	4.23	0.88	3.08
TSE pumping equipment	3.65	0	2.79
Replacement			3.65
TSE Reservoir	8	8	9
Sub- Total	**15.88**	**8.88**	**18.52**
Total	**46.6**	**23.17**	**64.47**

Table 2-10B: Phasing of Capital Expenditure (De-Centralised)

Capex (Rs Cr)	Phase 1	Phase 2	Phase 3
Collection Network	3.75	0.93	1.94
STP Civil	9.80	7.00	16.80
STP MEP	18.20	13.0	31.20
Replacement (STP)			18.20
Sub-Total	**31.75**	**20.93**	**65.34**
TSE Network	1.87	1.12	1.49
TSE pumping equipment	2.73	2.05	3.42
Replacement			2.73
TSE Reservoir	16.74	8.93	11.84
Sub-Total	**21.34**	**12.1**	**19.48**
Total	**53.09**	**33.03**	**84.82**

APPENDIX 4
DETAILS FOR COST ESTIMATES

Gravity network assigned for centralised Scheme 1			
Diameter	Length (m)	Rate	Cost (Lacs)
200mm	6666	581	39
250 mm	2222	806	18
375 mm	1075	1925	21
400mm	2222	2045	45
600mm	1258	2795	35
750 mm	473	4956	23
900 mm	1054	5204	55
1200 mm	487	8630	42
Total	**15460**		278

Gravity network assigned for de-centralised Scheme 2			
Diameter	Length (m)	Rate	Cost (Lacs)
200mm	5555	581	32
250 mm	5555	806	45
375 mm	703	1925	14
450mm	357	2280	8
525 mm	481	1075	5
600 mm	375	2795	10
750 mm	945	4956	47
Total	**13975**		161

Recycled network assigned for centralised Scheme 1			
Diameter (mm)	Length	Rate/m	Cost(lacs)
1000	2824.3	10000	282.43
900	2020.6	8625	174.27
100	32826	1107	363.38

Recycled network assigned for de-centralised Scheme 2			
Diameter (mm)	Length	Rate/m	Cost(lacs)
800	850	7109	60
500	3200	3410	109
80	32826	850	279

TSE Pumping Centralised – Scheme 1

Pump rating (KW)	Rate	Cost (Lacs)
2843	15000/KW	644

TSE Pumping De-Centralised – Scheme 2

Pump rating (KW)	Rate	Cost (Lacs)
3644	15000/KW	820