Andhra Pradesh Urban Finance and Infrastructure Development Corporation

Atal Mission for Rejuvenation and Urban Transformation

Detailed Project Report for Sewage Treatment Including Septage Treatment for Adoni Municipality – 5 MLD STP

VOLUME-I (REPORT & ESTIMATION)

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ABBREVIATION

AMRUT	:	Atal Mission for Rejuvenation and Urban Transformation
APUFIDC	:	Andhra Pradesh urban Financial & Infrastructure) Development Corporation
ASP	:	Activated Sludge Process
BOD	:	Biochemical Oxygen Demand
BR	:	Bio Reactor
COD	:	Chemical Oxygen Demand
CPCB	:	Central Pollution Control Board
CPHEEO	:	Central Public Health and Environmental Engineering Organization
CSBT	:	Camus Soil Bio technology
CT	:	Collection Tank
DB	:	Decibel
DG	:	Diesel Generator
DPR	:	Detailed Project Report
EA	:	Extended Aeration
EPC	:	Engineering Procurement Company
F/M	:	Food to Microorganism Ratio
GOI	:	Government of India
HR	:	Hour
Km	:	Kilo Meter
kW	:	Kilo Watt
LCB	:	Local Competitive Bidding
LPCD	:	Liters Per Capita Per Day
LT	:	Long Term
MBBR	:	Moving Bed Bio-film Reactor
MF	:	Membrane Filtration
MLD	:	Million Liters Per Day
MoU	:	Memorandum of Understanding
MoUD	:	Ministry of Urban Development
MPN	:	Most Probable Number
NBP	:	Non Biophysical Components
O &M	:	Operation and Maintenance
PDMC	:	Project Development and Management consultants
PLC	:	Programmable Logic Controller

PPM	:	Parts Per Million
PST	:	Primary Settler
RAS	:	Return Activated Sludge
RO	:	Reverse Osmosis
SAS	:	Surplus activated sludge
SBR	:	Sequencing Batch Reactor
SBT	:	Soil Biotechnology
SCADA	:	Supervisory Control And Data Acquisition
SLB	:	Service Level Bench Marking
SOR	:	Schedule of Rates
SPCB	:	State Pollution Control Board
SRT	:	Solid Retention Time
SS	:	Suspended Solids
ST	:	Short Term
STP	:	Sewage Treatment Plant
TSS	:	Total Suspended Solids
UF	:	Ultra filtration
ULB	:	Urban Local Body
UT	:	Urban Transportation
WAS	:	Waste Activated Sludge
WSP	:	Waste Stabilization Pond
SS Tank	:	Summer Storage Tank

DEFINITIONS

Suggest presenting a list of abbreviations and acronyms used

Effluent: the wastewater that flows out of a treatment system (in this case septic tank) or supernatant liquid discharged from the septic tank.

Pit Latrine: Latrine with a pit for collection and decomposition of excreta and from which liquid infiltrates into the surrounding soil.

Pour-flush Latrine: Latrine that depends for its operation of small quantities of water, poured from a container by hand, to flush away feces from the point of defecation.

Septic Tank: An underground tank that treats wastewater by a combination of solids settling and anaerobic digestion. The effluents may be discharged into soak pits or small-bore sewers, and the solids have to be pumped out periodically.

Sludge: Sludge is the settled solid matter in semi-solid condition – it is usually a mixture of solids and water deposited on the bottom of septic tanks, ponds, etc. The term sewage sludge is generally used to describe residuals from centralized wastewater treatment, while the term septage is used to describe the residuals from septic tanks.

Faecal sludge: Faecal sludge is the solid or settled contents of pit latrines and septic tanks. Faecal sludge differs from sludge produced in municipal wastewater treatment plants. Faecal sludge characteristics can differ widely from household to household, from city to city, and from country to country. The physical, chemical and biological qualities of faecal sludge are influenced by the duration of storage, temperature, intrusion of groundwater or surface water in septic tanks or pits, performance of septic tanks, and tank emptying technology and pattern.

Septage: Faecal sludge produced in septic tanks.

Sullage: Domestic dirty water not containing excreta. Sullage is also called grey water.

Scum: Scum is the extraneous or impure matter like oil, hair, grease and other light material that floats at the surface of the liquid, while the digested sludge is stored at the bottom of the septic tank.

CHAPTER:1 INTRODUCTION

1.1 INTRODUCTION

The Ministry of Urban Development, Government of India has launched Atal Mission for Rejuvenation and Urban Transformation (AMRUT) project with an objective to provide basic services (e.g. water supply, sewerage, urban transport) to households and build amenities in cities that will directly improve the quality of life, especially the poor. The Mission guidelines of AMRUT is to

- Ensure that every household has access to a tap with assured supply of water and a sewerage connection;
- Increase the amenity value of cities by developing greenery and well maintained open spaces (e.g. parks); and
- Reduce pollution by switching to public transport or by constructing facilities for non-motorized transport (ex. walking and cycling).

Indicators and standards have been prescribed by the Ministry of Urban Development (MoUD) in the form of Service Level Benchmarks (SLBs). The existing Service Level Benchmarks and the improvements anticipated by the implementation of Amrut Schemes in the project cities have already been addressed in the SAAP (State Annual Action Plan) report prepared and submitted by GoAP to GoI (SAAP 2016-17 report submitted by GoAP has been approved by GoI in August 2016). This study is a step taken in the direction of SAAP / SLIP implementation program for ‘Adoni Municipality having a population of about 1.66 Lakhs (as per 2011 census).

The basic objective of this assignment is to provide direct assistance to ULBs / APUFIDC / Urban Development Department of the State to ensure; effective coordination and implementation of the program are taken up under urban development initiatives.

1.1.1 NECESSITY OF THE PROJECT

The year 2011 population of Adoni Municipality is about 1.66 Lakhs and for Base year 2018 population is about 1.79 Lakhs. Clear water demand for the base year 2018 is about 30.80 MLD. At present, there are two WTPs of 18.00 MLD and 8.62 MLD for Adoni Municipality. About 17.5 MLD of wholesome water is being supplied to the public through well placed water supply installations. The total amount of 2018 sewage generated in the city from all sources is estimated to be about 22.04 MLD.

Based on the city topography, Adoni is divided into 4 Sewerage Zones. There is no sewerage and sewage treatment plant in the town. Sewage generated from these areas is being discharged to nearest natural drains without any treatment thus polluting the natural water bodies and the ground water table.

In order to prevent this, a sewage treatment plant of 5 MLD capacity is proposed for Zone-III to treat the sewage flows generated from the zone as per the prevailing standards.

As there is no sewerage existing in the town, the required flow of natural Avvadhoddi Vanka drain will be diverted through overflow weir. This project will help in addressing the Environmental degradations and improving the quality of life of the people and surrounding to a large extent.

This DPR is prepared to meet the intended objective of SAAP 2016-20; obtain necessary approvals from SLTC / SHPC and implement the project in the city as per Amrut Mission Guidelines.

1.1.2 OBJECTIVES OF THE PROJECT

The objective of this project is to prepare a DPR for construction of 5 MLD STP and Overflow Weir arrangement to get the sewage at the inlet of Pumping station so that the wastewater generated in zone III are treated and disposed off to the natural water bodies without creating Environmental issues.

1.1.3 SCOPE OF WORK

The scope of work includes

- Carrying out Flow measurement survey for the proposed STP capacities along the natural drains to meet the intended objective of the city.
- Prepare necessary designs, drawings, BOQ including cost estimates for obtaining necessary approvals from the concerned authorities.
- Preparation of tender documents for the project components including tender evaluation, negotiation and implementation of the project in the role of PDMC (Project Development and Management Consultants).

1.1.4 INPUT DATA AVAILABLE

Reconnaissance and Field Investigations are carried out to collect the information on the existing details of the wastewater disposal from various government authorities for

the present project. It is required to carry out the Topographical survey and geotechnical investigations in the project area to find salient soil classification properties and soil structural properties. As the scope and objective of study and project report confined to only sewage treatment plant and interceptor drain (as per SAAP approval from year 2016-20) no detailed filed investigations and surveys are carried out in present study. Required filed investigations and surveys needs to be carried out by the EPC contractor before execution. With design horizon of 2048 this DPR has been prepared.

1.2 BACKGROUND OF CITY

Adoni is city and a Municipality in Adoni district of the Indian state of Andhra Pradesh. It is located at the border of Adoni district and Kadapa district. The Adoni fort is central to the town's history. In the 15th century and early to mid 16th century, Adoni was a fort town of the Vijayanagara Empire. It was held by the kinsmen of Aliya Rama Raya, a powerful aristocrat of the Vijayanagara. From approximately 1558, at the decline of the Vijayanagara Empire, control of Adoni came to Ali Adil Shah I (1558–1579), the fifth Sultan of the Bijapur Sultanate.

Under the influence of British colonialism in the 20th century, Southern Indian was divided into several administrative districts; Adoni fell into the district of Bellary. In 1867, the Adoni and the Bellary Municipal Councils were created. Between 1876 and 1878, a severe El Nino famine affected Adoni and the surrounding areas lost nearly one third of the population. In 1953, after the linguistic reorganisation of the states, Adoni gained its present seat as part of Andhra Pradesh. The city spreads over an area of 32.71 km2. Adoni is well connected by rail and roads.

1.3 GENERAL INFORMATION ABOUT THE CITY

1.3.1 CITY PROFILE

The Adoni Municipality spreads over an area of 32.71 sq.kms. It is a Municipality and headquarters of Adoni Mandal under the administration of Adoni Revenue Division. It is the 16th most populous city in the state of Andhra Pradesh. Adoni is located about 84kms from Kurnool. There are total 41 wards in the city. The location of the city is provided as Figure 1-2.

1.3.2 LINKAGES AND ACCESSIBILITY

Adoni is located about 84kms from Kurnool. Adoni is well connected by road and rail . Adoni has a railway station and Adoni railway station and train routes were built during

British rule in 1870. It is now a part of the South Central Railway on the Solapur-Guntakal line which is part of Chennai-Mumbai line. Adoni is connected to major cities of the Andhra Pradesh by road. These cities include Hyderabad, Bengaluru, Kurnool, Anantapur, Vijayawada, Bellary, Tirupathi, and Mysore. Bus services are provided by Andhra Pradesh State Road Transport Corporation (APSRTC), Karnataka State Road Transport Corporation (KSRTC) and some private entities. Within the city, auto rickshaws and rented cars are a common means of transportation. The nearest airport is Rajiv Gandhi International airport, Hyderabad which is located 293 km from Adoni.

1.3.3 TOPOGRAPHY

Adoni is situated in between 15º 37' North Latitude 77º 16' East Longitude. It is spread over an area of 32.71 sqkm having a population of 166537 as per 2011. Census It has an average elevation of 435 metres (1427 feet) above sea level. Highest contour is +50 m and lowest contour is +7 m. The ground falls from west to east.

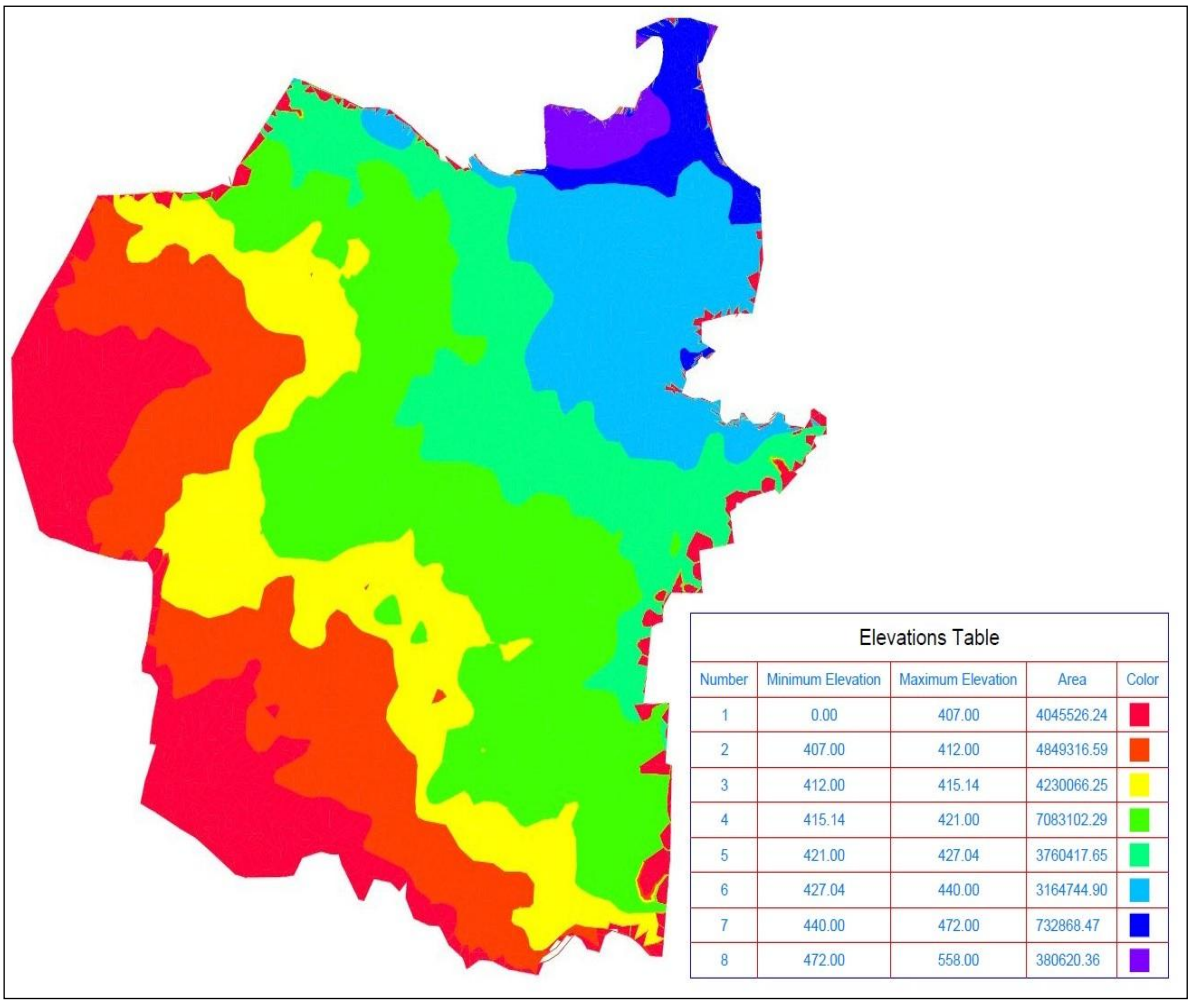

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Figure 1-1: Topography of Adoni Municipal Corporation

1.3.4 CLIMATE

The climate in Adoni is referred to as a local steppe climate. There is little rainfall throughout the year. Particularly the summers are very hot. The average temperature of the region is around 26.7 °C.The temperatures are highest on average in April, at around 28.6 °C. The lowest average temperatures in the year occur in January, when it is around 25.5 °C. The average annual rainfall is 659 mm. The most of the precipitation falls in the month of September with an average of 147 mm The least amount of rainfall occurs in January.

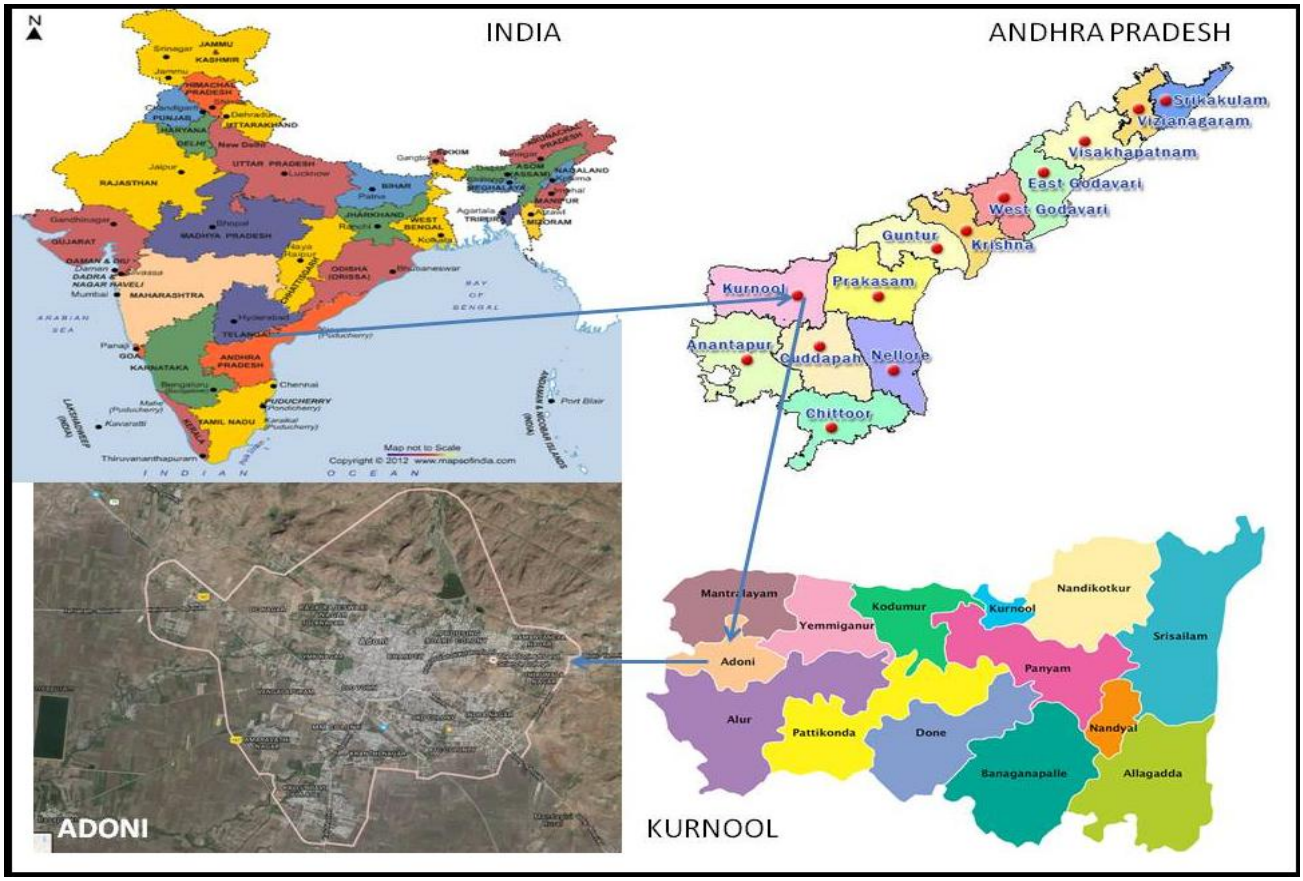


Figure 1-2: Map showing Location of Adoni

1.4 POPULATION

The Adoni Municipal Corporation encompasses 41 municipal wards. The population of Adoni Municipal Corporation is 166537 as per 2011 census. The population census data is as follows for previous years.

The population figures are given in **Table 1-1** below.

Table 1-1: Population Census Data for Adoni Municipality

Sl.No	Year	Population Census
1	1961	69951
2	1971	85311
3	1981	108905
4	1991	136180
5	2001	156464
6	2011	166537

The schematic diagram of the decadal growth is provided in Figure 1-3.

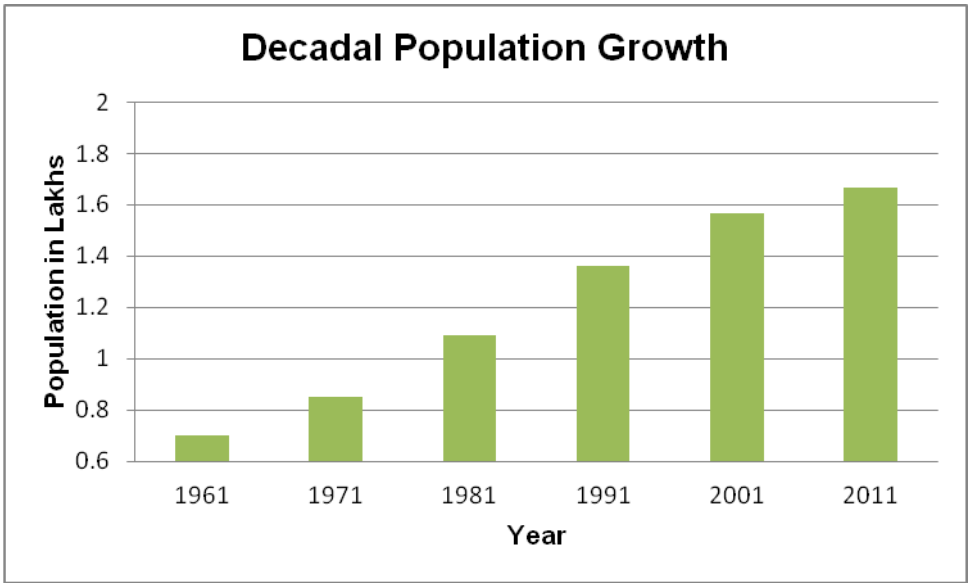


Figure 1-3: Decadal population growth

The salient features of Adoni Municipal Corporation are given in table 1-2.

Table 1-2: General Information

Sl No	Item	Details
1	Year of Constitution as Municipality	1964
2	Area	37.12 sqkm
3	Length of roads (in Kms)	96 km
4	Population – 2011 census	1.66 Lakhs
5	No of Wards	41
6	Average Rainfall in a year	659mm
7	Maximum Temperature	28.6^{o}C
8	Minimum Temperature	25.5 ^{o}C

Sl No	Item	Details
9	Nearest Railway station	Adoni
10	Nearest Airport	Rajiv Gandhi International Airport, Hydrabad

1.5 ROAD NETWORK

The corporation consists of various types of road networks as mentioned below:

C.C. type roads - 72 kms (75%)

B.T. type roads - 24 kms (25%)

Total Road network - 96 kms

The graphical representation of various categories of roads is provided in Figure 1-4

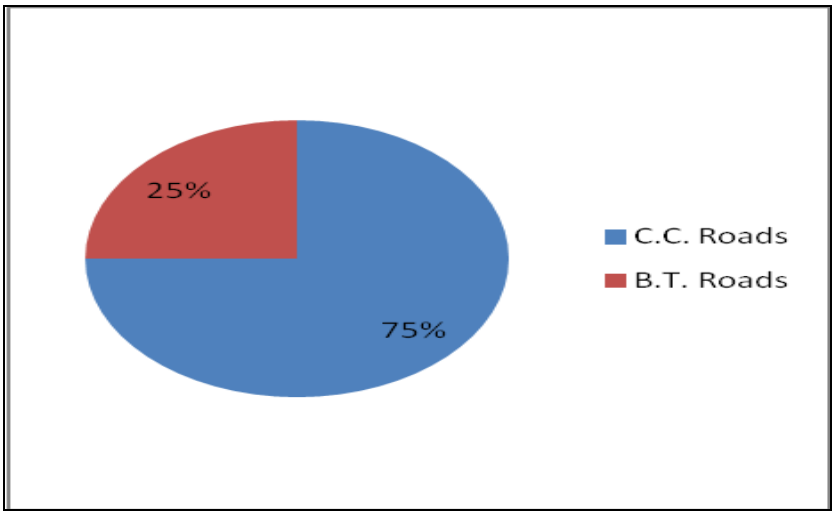


Figure 1-4: Summary of existing Road details

CHAPTER:2 EXISTING SYSTEM

2.1 INTRODUCTION

The main source of water for Adoni Town is Tungabhadra Project (TBP) Low Level Canal (LLC) which passes the city at about 8km from the town and runs for 6 months in a year. One summer storage (SS) tank with a capacity of 1217ML (Ramjala- natural tank whos catchment is about 7SqKM in which Gangalamanchi is the main drainage area for this tank) and another SS Tank of 3110ML at Basapuram are being utilized for the remaining 6 months during canal closure periods.

Raw water from SS Tank flows by gravity to Basapuram WTP. The treated water is pumped into 8 ESR in different zones of the city. The raw water to Ramajala WTP is pumped from Intake located on LLC canal at Basapuram along with tapping arrangement directly leading to Ramjala water body. The treated water from Ramjala WTP is supplied to 3 ESR (to the nearby areas of Ramjala) by combination of gravity/ pumping.

2.2 WATER SUPPLY SYSTEM

The Adoni City has two water treatment plants, 18.00 MLD and 8.62 MLD. Raw water from canals or natural pond is fed to these WTPs located in the city. The 18.00 MLD WTP is located at Basapuram and the 8.62 MLD WTP is located at Ramjala. There is also tapping arrangement for taking raw water directly from the pumping main (leading from the LLC Intake at Basapuram) to the WTP (for Ramjala WTP), inside the campus.

Raw water pumping system provided in **Table 2-1**.

Table 2-1: Summary of Raw water pumping system

Sl No	Pump station name	Design Capacity (MLD)
1	RWPS-1 (600mm dia pipeline) – 23.5 hrs of pumping from Basapuram intake at LLC to Ramjala water body	17.65
2	RWPS-2 (300mm dia pipeline) – 23.5 hrs of pumping from Basapuram intake at LLC to Ramjala water body	5.80
3	RWPS-3 – 23.5 hrs of pumping from Basapuram intake at LLC to SS tank at Basapuram	47.25
	Total	**70.70**

The city has a water supply distribution system covering some part of the area. The existing length of the distribution system is about 42 km which amounts to about 26% coverage.

In order to achieve the above objective, GoAP in its SAAP 2016-20 program, has approved a water supply project to Adoni Municipal Corporation for an estimated project cost of 16 crores.

The project proposals are in accordance with the guidelines issued by GoI, GoAP and CPHEEO manual on Water Supply and Treatment & Practical Hand Book on Public Health Engineering and various other relevant codes of BIS as applicable.

2.3 SEWERAGE

Main objective of any town in wastewater system involves proper collection of sewage from the individual households, conveyance to the STP locations by gravity / pumping and treating the sewage as per the standards. The treatment shall include removal of contaminants from wastewater, by physical, chemical and biological processes and produce environmentally safe treated effluent in accordance with CPHEEO / APPCB / CPCB norms before disposing it into the natural water bodies.

2.4 EXISTING SEWERGE SYSTEM

At Present, there is no existing Sewage Network in Adoni town including Sewage treatment plant. Open drain system is available for discharge of both sullage and storm water. Figure 2-1 shows open drains in Adoni.

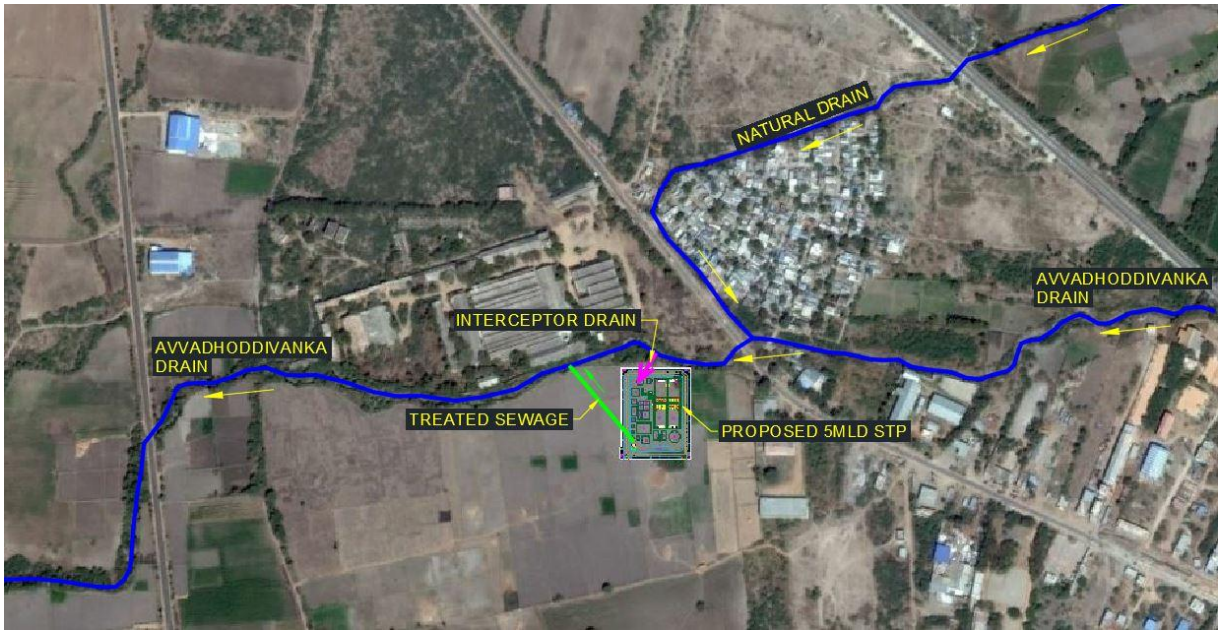


Figure 2-1: Existing open drain in Adoni

There is no sewage treatment plant in the town. The generated sewage is getting discharged to the nearby open areas and to water bodies untreated. There is no systematic and organized method to collect and treat the waste from septic tanks. These sceptic tanks are emptied by the individual house owners on their own using private players.

2.5 CURRENT SITUATION OF SEPTAGE MANAGEMENT

The existing Septage management in Adoni is similar to that of the management of septic tanks found in other small and medium cities in other parts of India. Majority of the Septage sludge is disposed off into the land fill sites outside the city limits by private players where as the supernatant of septic tanks flows all along the road side drains before joining to the natural water bodies.

In Adoni town, there is no organized method to collect and treat waste from septic tanks. The periodicity of cleaning of these septic tanks is approximately once in 1-3 years. The overflows of these septic tanks are let out into the open drains system which ultimately joins the natural nala / open fields.

Schematic representation of the existing Septage management in Adoni is provided in Figure 2-3.

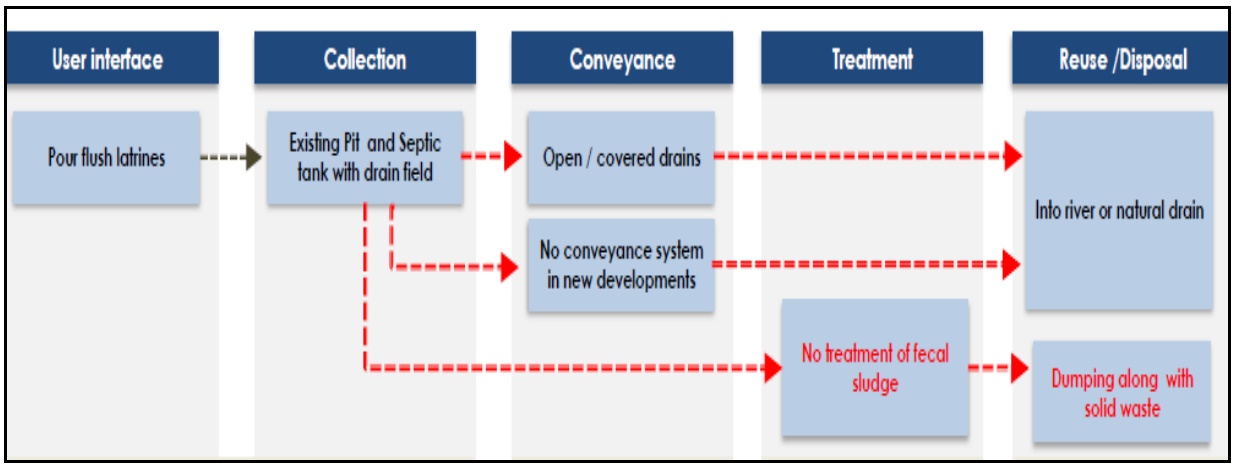


Figure 2-2: Septage management in Adoni

2.6 ANALYSIS OF EXISTING SYSTEM

Existing system of open drainage is found in the town. These few open drains are constructed and maintained by the Municipality. These drains are constructed without any systematic method of disposal and these drains discharges here and there in the town leading to eutrophication of water bodies. There is no systematic and organized method to collect and treat waste from septic tank. The Septage from septic tanks in the

town are being conveyed through gulfars and disposed on to the nearby fields. The duration of cleaning of septic tanks will be around annually. The overflows of septic tanks are disposed into the nearby drains or open fields. Hence efforts have to be made to treat this waste water suitably and dispose off in an environmental friendly manner.

2.7 SERVICE LEVEL BENCH MARK – SEWAGE SYSTEM – EXISTING

The existing sewage system benchmark as per MOUD is provided in table below.

Table 2-2: Existing Service Level bench mark for Adoni municipality

Sl. No	Indicator	MoUD Standard	Existing Value
1	Coverage of Toilets	100%	88%
2	Coverage of Sewerage Network	100%	0%
3	Adequacy of Sewage Treatment Capacity	100%	0%
4	Quality of Sewage treated	100%	0%
5	Extent of Reuse and Recycling of Sewage	20%	0%
6	Extent of cost recovery in waste water management	100%	NA
7	Efficiency in re-dressal of customer complaints	80%	NA
8	Efficiency in Collection of Sewage Water Charges	90%	NA

CHAPTER:3 FIELD INVESTIGATION AND SURVEYS

3.1 GENERAL INFORMATION

Field investigations and other survey works are required to assess the requisite details including the terrain and soil conditions in the area, which can impact the design and cost aspects of the project. Though detailed primary surveys are required to be carried to ascertain the required characteristics; for Sewer zoning; secondary data has been used for the overall planning of the Waste water system because of time and cost constraints.

3.2 TOPOGRAPHICAL SURVEY

For analysing the sewer zones of Adoni, the contours generated in-house using Google earth software has been used for overall planning.

As the scope of study is confined to sewage treatment plant and interceptor drains, as per SAAP 2016-20, which is intended to be tendered on EPC basis, no detailed field investigations and surveys have been carried out. The required field investigations and surveys need to be carried out by the EPC contractor before the execution. However for the present study, necessary Reconnaissance and field Investigations have been carried out to collect the information on the existing sewer collection network and existing treatment plant details for further planning.

3.3 FLOW MEASUREMENT STUDIES

The intended objective of the study is to prepare a DPR for construction of sewage treatment plant for treating the sewage generated from sewerage zones of the town. To meet the intended objective, analysis was carried out to identify suitable location where in the possibility of all the waste water flows of zones (as there is no proper sewer collection system) meet at minimum number of locations so that the same can be diverted / routed to the proposed STP locations by gravity.

Sewage generated from Zone III finally joins to the confluence point of Avvadhoddi Vanka Drain and a natural drain combining to form a single drain. It is very necessary to know the quantum of sewage generation at present conditions for future STP proposals. Hence, flow measurement study has been carried out at a culvert near Kachra Basti, Rayanagar. Flow was measured with a time interval of 2 hours.

After the requisite studies and site visits, location near to the proposed STP was identified as suitable to divert the flows into the proposed STP. The location was finalised as it was fulfilling the following parameters.

- Most of the sewage flows generated from sewerage zone III is disposed off into the drain which ultimately passes towards the proposed STP location.
- A location has been identified for 5 MLD STP near Siriguppa Check post and its possession is in process.

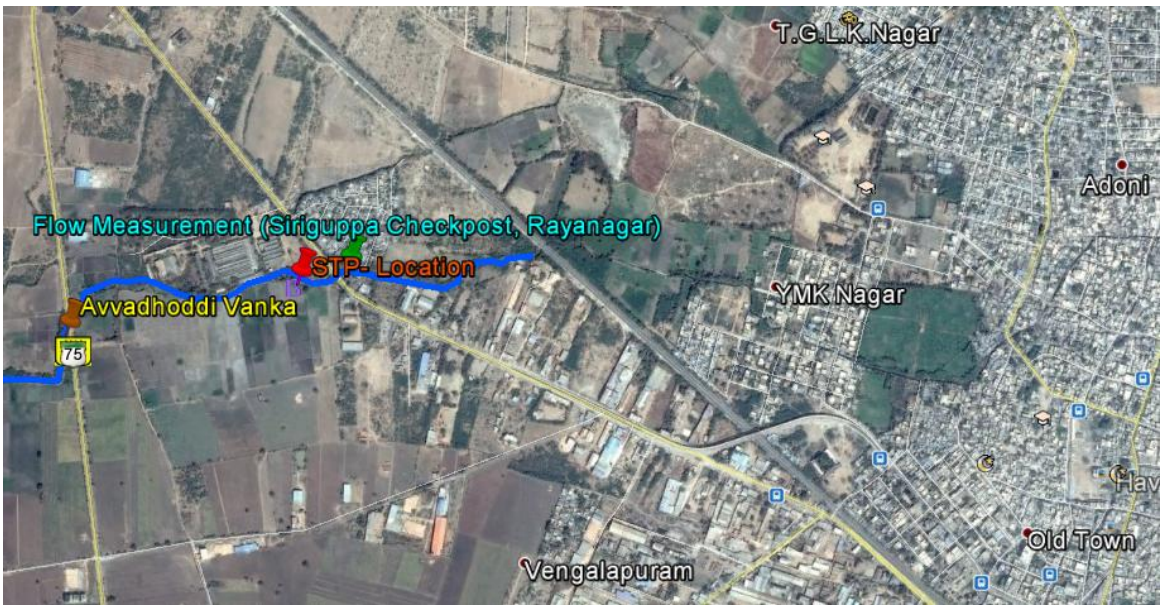


Figure 3-1: Flow measurement location and existing natural drains near the proposed 5 MLD STP

Flow measurement was carried out for the drain near the proposed STP location to assess the existing flows in the drains so that scientific analysis of the required STP capacities can be worked out. The flow measurement was further, cross checked with desk top studies using zone maps and zone populations as per population projections carried out for the city. Based on the fund availability for the city under SAAP 2016-20, the capacities of the STP's have been finalised for the required flows only. However, for meeting the future requirements of the city, augmentation of these STPs may have to be carried out at appropriate stages based on the requirements. The proposed STPs are intended to be designed on modular basis to aid for future expansions if any.

Based on the topography levels we presume that the sewage flows generated from Zone III flows into the downstream of Avvadhoddi Vanka Drain near the proposed location of STP. In order to divert and treat the sewage, a small concrete weir type structure is

proposed in the Avvadhoddi Vanka Drain which will be intercepted and diverted to the inlet of the receiving chamber of pumping station.

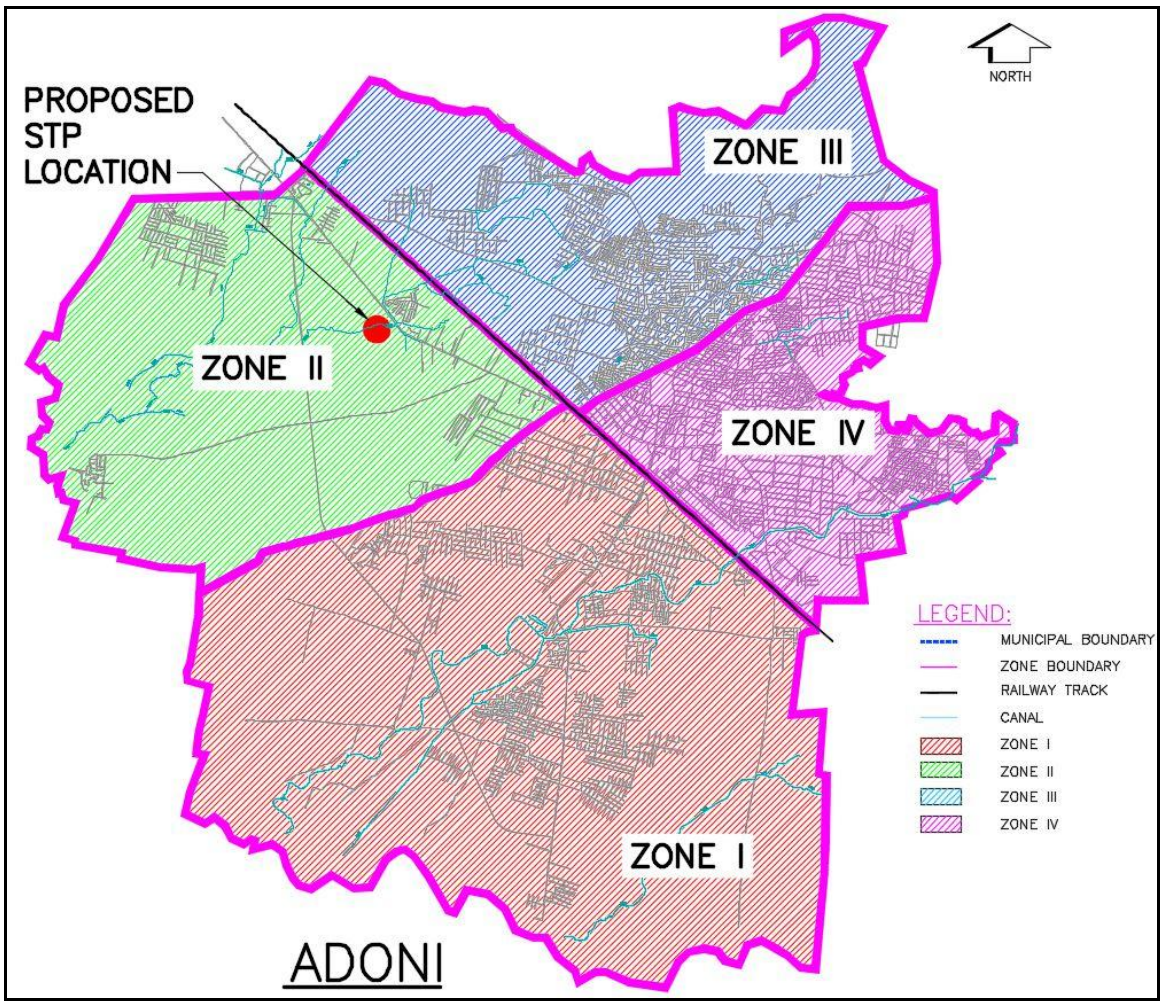


Figure 3-2: Catchment Zone and location of proposed STP location

The flow measurement was further, cross checked with desk top studies using zone maps and zone populations as per population projections carried out for the city. Based on the fund availability for the city under SAAP 2016-20, the capacities of the STP's have been finalised for the required flows only. However, for meeting the future requirements of the city, augmentation of these STPs may have to be carried out at appropriate stages based on the requirements. The proposed STPs are intended to be designed on modular basis to aid for future expansions if any.

3.3.1 FLOW MEASUREMENT METHOD

The amount of sewage flowing in channel during a given time is a function of velocity and cross-sectional area of the flowing water.

$$Q = AV$$

where Q is stream discharge (volume/time),

A is cross-sectional area, and V is flow velocity

Equipments used:

- Measuring Tape
- Stop-watch
- Rod, yard or meter stick to measure depth
- At least three highly visible buoyant objects such as a drifting branches or logs, pine cone, coffee stir sticks, half-filled bottles, or oranges (objects buoyant enough not to be effected by the wind)
- Stakes for anchoring tape measure to stream banks
- Waders

Float method: For measuring the surface velocity. The basic idea was to measure the time that takes for the object to float a specified distance downstream.

V = travel distance/ travel time = L/t

The following steps were involved in the flow measurement process

Step 1: A straight reach with minimum turbulence was selected.

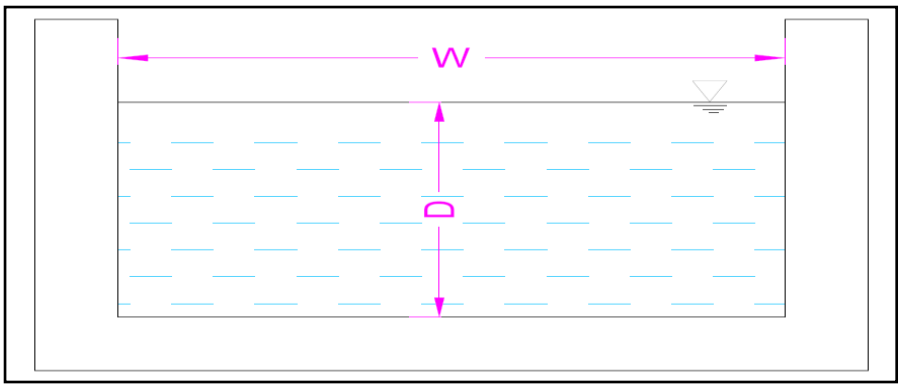
Step 2: The start and end point of the reach were marked (and the distance measured)

Step 3: An object was dropped in the upstream start point; start point of the reach.

Step 4: Stop watch was started at the point the object crossed the upstream marker and was stopped the moment the object crossed the downstream marker.

Step 5: The procedure was repeated for at least 3 times and the average of these was taken for further calculations.

Step 6: The stream width and depth were measured across many cross section and average sections were taken. The depths were also measured across the stream's width at the start and stops markers and average the two.



Q = Cross section area (A) * mean velocity (V)

A marked rod was used to measure the depth at regular intervals across the stream. Ten such depth measurements were made and the average cross-sectional areas (A) were arrived. Using the average area and average velocity, discharge Q was calculated. Many such measurements were made at various time slots in a day to arrive at the average daily flow. The summary of the flow measurements are provided in table 3-1.

3.4 GEO-TECHNICAL INVESTIGATION

As the entire STP cost is intended to be considered on MLD basis (as the EPC contractor will carry out the detailed engineering works for STP), Detailed Geotechnical Investigations have not been carried. However, it is intended to carry out exploratory bore well investigation survey to assess the soil characteristics and provide the same as supplementary information in the proposed STP tender documents for bidder's information.

Flow measurement study results are given in table 3-1 below carried out at sewage culvert near Kachra Basti, Rayanagar in Adoni town

Table 3-1: Flow measurement details at sewage culvert near Kachra Basti, Rayanagar , Adoni Town

Sl.No	Location	Latitude	Longitude	Time	Length (m)	Time (s)	Velocity (m/s)	Cross Sectional details			Discharge	
								Width (m)	Depth (m)	Area (sq.m)	m^3/s	MLD
1	Sewage Culvert near Kachra Basti, Rayanagar	$15^0$37'47.6"	$77^0$15'18.4"	9:00 AM	4.75	13.58	0.350	1.35	0.25	0.34	0.118	10.200
				11:00 AM		14.65	0.324	1.35	0.25	0.33	0.109	9.379
				1:00 PM		16.57	0.287	1.35	0.25	0.33	0.095	8.192
				3:00 PM		13.34	0.356	1.35	0.25	0.34	0.120	10.383
				5:00 PM		13.14	0.361	1.35	0.25	0.34	0.123	10.625
				7:00 PM		12.99	0.366	1.35	0.26	0.34	0.126	10.876
											Avg MLD	**9.942**

CHAPTER:4 POPULATION PROJECTIONS & WATER DEMAND

4.1 PAST CENSUS DATA

Past census data is collected and based on the census data (2011) the population of Adoni Municipality is 166537 nos The decadal population details from 1971-2011 is provided in the table 4-1 below.

Table 4-1: Decadal Increase in Population

S.No.	Decadal Year	Population	Increment	% of increment
1	1961	69951	-	-
2	1971	85311	15,360	22
3	1981	108905	23,594	28
4	1991	136180	27,275	25
5	2001	156464	20,284	15
6	2011	166537	10,073	6

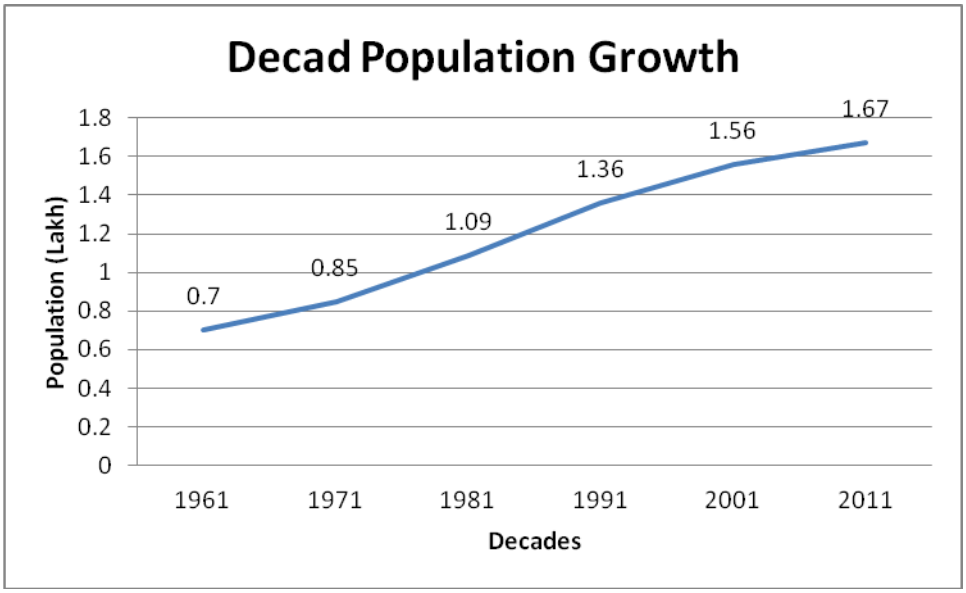


Figure 4-1: Decadal Increase in population change graph

4.2 DESIGN HORIZON

As per the census data, the population of Adoni Municipality in 2011 was 166537. Sewerage and water supply systems are normally designed to meet requirements over a period of 30 years after its completion. By considering time lag between design and completion of the project, the base year is considered as 2018, Prospective Year as 2033 & Ultimate Year as 2048.

4.3 POPULATION PROJECTIONS & WATER DEMAND

Based on the past census data, Population projections with various methods were carried out as under

- Arithmetic Progression method
- Incremental Increase method
- Geometric progression method
- Graphical method (polynomial)
- Graphical method(Exponential)
- Power Method

Summary of the populations projections carried out by various methods are provided in table 4-2 below.

Table 4-2: Summary of population projections

Projection Method	2011	2018	2023	2033	2048
Arithmetic Increase	166537	180060	189718	209035	238011
Geometric Increase	166537	185986	201253	235650	298576
Incremental Increase	166537	179273	187973	204383	226519
Polynomial Method	166537	181534	189427	204152	223583
Exponential Method	166537	205977	225633	270752	355896
Linear Graphical Method	166537	186722	197060	217736	248750

From the above table and graph, Incremental increase method was found to be best suited for the Adoni Municipality. As, in incremental increase method, the decade per growth rate is not assumed to be constant as in the arithmetic or geometric progression methods; but is Progressively increasing or decreasing, depending upon whether the average of the incremental increases in the past data is positive or negative.

As the master plan is not available with the ULB, population projection has not been made in consonance with the Developmental Master Plan. As the projected incremental increase method is in line with the projections made in SAAP 2015-16 DPR, the same has been adopted.

The total population of the city for various design horizons, after adding both erstwhile city corporation area and that of the newly added areas is summarized in table 4-3.

Table 4-3: Population Projection for Adoni Town

Sr. No.	Particulars	Value
1	Population as per Census in the Year 2011	166537
2	Projected Population in the Year 2018	179500
3	Projected Population in the Year 2023	188000
4	Projected Population in the Year 2033	204500
5	Projected Population in the Year 2048	227000

Further, CE (PH) during October 2016 has approved the Population projection for Adoni town by incremental increase method.

4.4 WARD WISE POPUALTION PROJECTIONS

Adoni has total of 41 wards. These 41 wards have been divided into 3 different categories based on their population densities (as per 2011 census data) as per the table 4-4 and the ward wise population projections carried out are provided in table 4-5

Table 4-4: Population Density Pattern

Population Density (persons / Ha)	Type of population pattern
<100	Scarcely populated (city outskirts)
100-250	Medium populated (developing area)
Above 250	Densely populated (core city area)

Table 4-5: Ward wise population projections

Ward No.	Ward Area (Ha)	Population 2011	Density 2011	Type of Wards	Population 2018	Density 2018	Population 2033	Density 2033	Population 2048	Density 2048
1	56.80	4411	78	Scarce	4764	84	5717	101	6918	122
2	16.16	3299	205	Medium	3580	222	4153	257	4486	278
3	6.04	3166	525	Dense	3372	559	3541	587	3648	605
4	129.25	3056	24	Scarce	3301	26	3962	31	4795	38
5	15.29	3926	257	Dense	4260	279	4942	324	5338	350
6	29.97	4512	151	Medium	4896	164	5680	190	6135	205
7	15.58	3837	247	Medium	4164	268	4831	311	5218	335
8	9.77	5504	564	Dense	5862	601	6156	631	6341	650
9	6.26	4899	782	Dense	5218	833	5479	875	5644	901
10	7.54	3996	530	Dense	4256	565	4469	593	4604	611
11	3.42	4004	1171	Dense	4265	1247	4479	1310	4614	1349
12	3.24	3435	1062	Dense	3659	1131	3842	1188	3958	1224
13	4.61	3897	845	Dense	4151	900	4359	945	4490	974
14	4.18	4154	994	Dense	4425	1059	4647	1112	4787	1146

Ward No.	Ward Area (Ha)	Population 2011	Density 2011	Type of Wards	Population 2018	Density 2018	Population 2033	Density 2033	Population 2048	Density 2048
15	5.91	4041	685	Dense	4304	729	4520	766	4656	789
16	11.63	4666	402	Dense	5063	436	5874	506	6344	546
17	59.35	4408	75	Scarce	4761	81	5714	97	6914	117
18	40.86	4422	109	Medium	4776	117	5732	141	6936	170
19	23.51	3798	162	Medium	4121	176	4781	204	5164	220
20	15.82	4466	283	Dense	4846	307	5622	356	6072	384
21	33.74	3624	108	Medium	3914	117	4697	140	5684	169
22	647.88	3861	6	Scarce	4170	7	5004	8	6055	10
23	77.47	3587	47	Scarce	3874	51	4649	61	5626	73
24	45.93	4351	95	Scarce	4700	103	5640	123	6825	149
25	51.54	3760	73	Scarce	4061	79	4874	95	5898	115
26	9.51	3939	415	Dense	4274	450	4958	522	5355	563
27	12.79	3871	303	Dense	4201	329	4874	382	5264	412
28	4.27	4559	1068	Dense	4856	1137	5099	1194	5252	1230
29	11.05	4856	440	Dense	5269	478	6113	554	6603	598
30	5.04	3468	689	Dense	3694	734	3879	771	3996	794
31	4.59	3910	853	Dense	4165	908	4374	954	4506	983
32	15.93	4310	271	Dense	4677	294	5426	341	5861	368
33	9.02	3690	410	Dense	4004	444	4645	515	5017	557
34	14.14	4570	324	Dense	4959	351	5753	407	6214	440
35	431.43	5517	13	Scarce	5959	14	7151	17	8653	21
36	36.42	3530	97	Scarce	3813	105	4576	126	5537	153
37	669.05	4176	7	Scarce	4511	7	5414	9	6551	10
38	195.80	3217	17	Scarce	3475	18	4170	22	5046	26
39	21.38	4660	219	Medium	5057	237	5867	275	6337	297
40	23.47	4111	176	Medium	4461	191	5175	221	5589	239
41	18.10	3073	170	Medium	3362	186	3662	203	4069	225
Total	**2803.72**	**166537**			**179500**		**204500**		**227000**	

CHAPTER:5 SYSTEM PLANNING CRITERIA

5.1 INTRODUCTION

Provision of safe, adequate water is a basic necessity for the healthy living of a community. In this section, norms that have been followed for estimation of water demand, design criteria and our approach for AMRUT project will be dealt with. Water demand has been estimated based on the projected population, agreed unit demand norms along with water requirements for Industrial use, irrigation use etc, if any. On the basis of the total water demand estimated, waste water generation have to be assessed. As Andhra Pradesh State does not have its own norms for Water and Wastewater projects, CPHEEO manual / NBC / IS codes were referred to, and accordingly, the design criteria note was prepared and submitted by TCE to CE-PH, Guntur for their review and approval. All the parameters were discussed with PH authorities during October 2016 and based on the discussion; CE-PH had approved the design criteria and the same has been reciprocated here.

5.2 WATER DEMAND

Water demand will be estimated based on the unit demand norms along with the projected population as per ULB boundary limits. Unit demand norms approved are provided in table 5-1 below;

Table 5-1: Unit Water demand norms

Category	LPCD	Remarks
Residential	135	CPHEEO Manual
Commercial and institutional needs	15– 450*	CPHEEO Manual
Floating population	45	CPHEEO Manual
Percentage of Wastewater	80%	CPHEEO Manual

5.3 CHARACTERISTICS OF SEWAGE

For the design of STP, it is assumed that, the raw domestic sewage generated from the residential, commercial and other activities shall have the following characteristics.

Table 5-2: Characteristics of Raw Sewage

S.No.	Parameters of Raw Sewage	Values	Unit
1.	BOD_5	250 - 300	Mg/l
2.	COD	500 - 600	Mg/l
3.	Suspended Solids	300 - 350	Mg/l
4.	pH	6.5 – 8.5	
5.	Total alkalinity as $CaCO_3$	300 - 400	Mg/l
6.	Chlorides	250 - 300	Mg/l

S.No.	Parameters of Raw Sewage	Values	Unit
7.	Sulphate	100 - 150	Mg/l
8.	Total Kjeldahl nitrogen	45 -50	Mg/l
9.	Ammonical Nitrogen	35 - 40	Mg/l
10.	Total Phosphorus	5 – 7	Mg/l
11.	Temperature	15 – 35	^{0}C

(Ref: Normal Municipal Domestic Sewage parameters in India)

5.4 SEWAGE TREATMENT PLANT

Sewage Treatment Plant will be designed to remove the contaminants from sewage as per the norms specified by CPHEEO Manual / APPCB and produce treated sewage for recycling.

5.5 WEIR WORKS

In Adoni town there is no sewerage system existing. The sewage generated are being discharged into the natural open drains. Avvadhoddi Vanka drain flows through the upstream of Zone III and reaches to the Zone II and confluences with another natural drain just before the location of the STP. The sewage generated from Zone III will be disposed off into the downstream confluence point of these nalla and forms a single drain. In order to divert and treat the sewage, a small concrete weir type structure is proposed in the existing natural drains of Avvadhoddi Vanka drain which will be intercepted and diverted to the inlet of the receiving chamber of pumping station.

The receiving chamber, two Inlet channels with isolation Gates (1 working + 1 Standby), trash screens in each channel to arrest the Large size of debris and grit, one working mechanical coarse screens and one manual Coarse screen and stilling chamber for Grit removal are provided before the collection well of pumping station in order to remove the floating matter and grit particles from the sewage which will be diverted. Further the sewage will be pumped from the collection well of pumping station to the inlet of STP. The weir work will be utilised till the completion of sewer network in the town. The plan and section of the weir arrangements are shown in the below Figure 5-1.

The overview of Inlet works is provided in Figure 5-2. The sizing units of Inlet works are as follows. The layout and hydraulic flow diagram of proposed Inlet works are provided in **Drawing No: TCE.10282A-CV-3009-SL-31704.**

Table 5-3: Inlet Works Sizing units

S.No	Name of the Unit	Unit Sizes
1	Weir	15 m (length) x 2.40m (base width) x 1.50m (top width) x 0.50m (depth)
2	Receiving Chamber	3.20 m (L) x 1.40 m (W) x 1 m (LD)
3	Manual Trash Screen (1 Working+1 Standby)	50mm opening
4	Mechanical Coarse Screen (1 Working +1 Manual Standby)	20mm opening
5	Mechanical Coarse Screen Channel	5m (L) x 0.60 m (W)x 0.60m (LD)
6	Manual Coarse Screen Channel	5m (L) x 0.60 m (W)x 0.60m (LD)
7	Grit Setting Channel - Manual	5m (L) x 2.00 m (W)x 1.60m (LD)
6	Terminal Pumping Station	5m Dia x 2.50 m (LD)

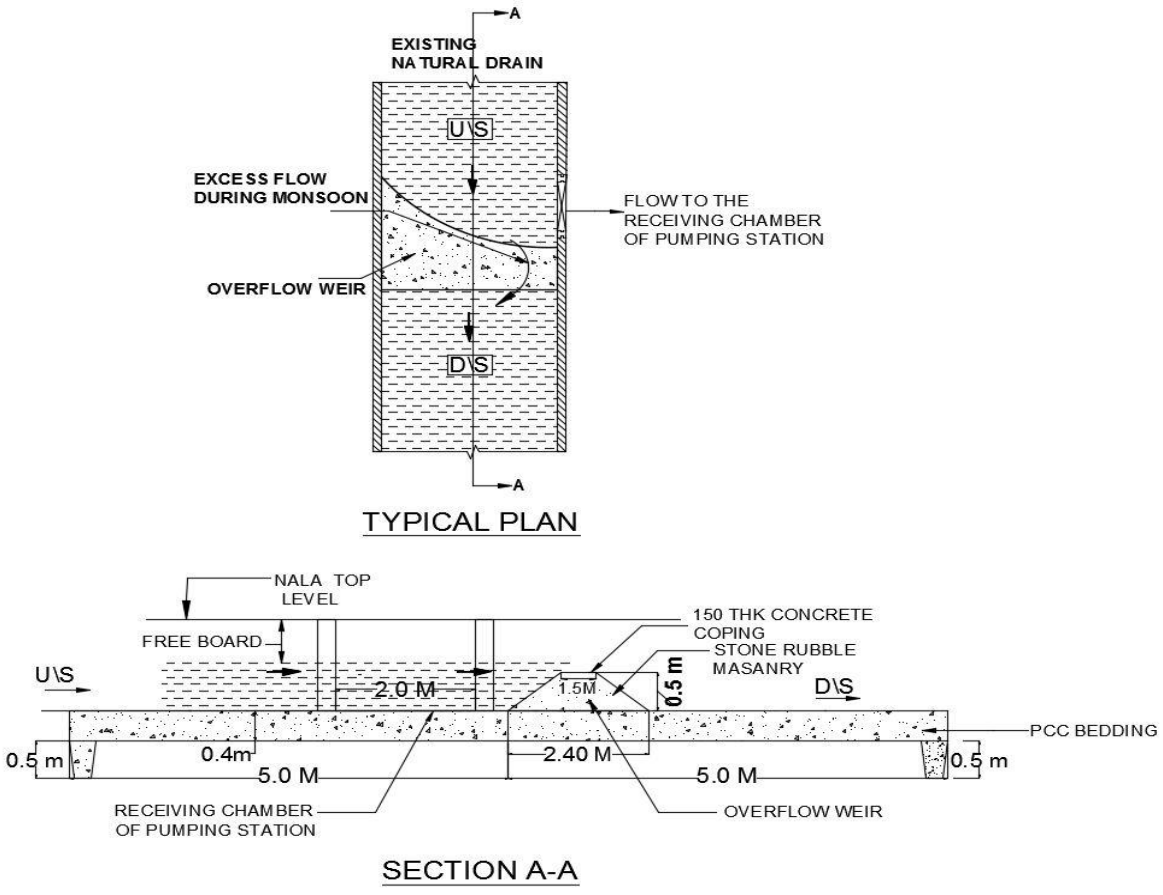


Figure 5-1: Plan and Sectional view of Weir

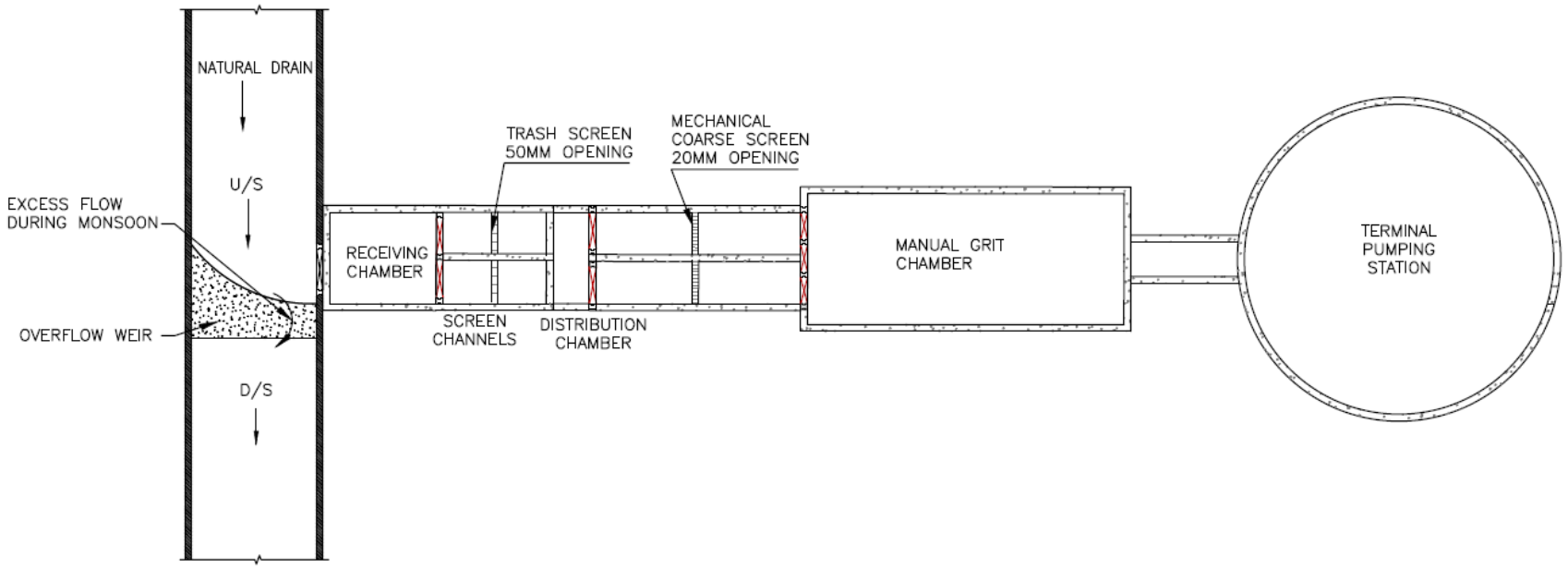


Figure 5-2: Overview of Inlet Works

5.6 GUIDELINES TO BE FOLLOWED FOR STP DESIGN

A. Open Technology

As per Government of India (GoI) Guidelines (REF NO Z-16025/2010-CPHEEO Dated 16-04-2013), it is encouraged to invite tenders with open technologies, where the bidders can provide any proven technology which is satisfactorily performing at least since one year. The treated sewage shall have the desired effluent criteria as specified below.

B. Standards for Treated Sewage Quality

I. Central Pollution Control Board (CPCB Guidelines)

The directions under section 18(1) (b) of the Water (Prevention and Control of Pollution) ACT, 1974 regarding treatment and utilization of sewage issued by CPCB for compliance are as follows.

- State Pollution Control Board shall make mandatory for local / urban bodies to set up a sewerage system for sewerage collection, underground conveyance, treatment and its disposal to cover the entire local / urban area to bridge the widening treatment gap along with enforcement of consent management in line with standards for sewage treatment.
- SPCB / PCC shall issue directions to all municipalities and other concerned authorities in the state / UT responsible for treatment plant and disposal of sewage to the following effect.

I. The existing STPs which are being operated before issuance of these directions shall meet the standards within two years from the date of issuance of these directions.

II. All the local bodies shall seek consent under Water (prevention and control of pollution) Act, 1974 from the SPCB / Committee within a period of 60 days.

III. Secondary treated sewage should be mandatorily sold for non potable purpose such as industrial process, railways & bus cleaning, flushing of toilets, horticulture and irrigation, through dual pumping. No potable Water to be allowed for such activities. They will also digest methane for captive power generation to further improve viability of STPs.

IV. Dual piping system should be enforced in new housing constructions for use of treated sewage for flushing proposes.

V. Each municipal authority and the concerned authority shall submit a time bound action plan for setting up sewerage system covering proper connection, treatment and disposal of sewage generated in the local / urban area and such plan shall be submitted by the municipal authority to the state Board within a period of 90-120 Days.

VI. In case of disposal of effluents on land or river or any water body including coastal water / creek or a drain, the treated effluents shall meet the suggested standards annexed to these directions.

VII. The new sewage treatment plants coming in existence after the issuance of these directions shall be designed to treat and achieve standards as per the suggested standards.

Suggested treated Effluent standards from the STP as per CPCB are provided in table 5-4.

Table 5-4: Effluent Discharged Standards for Sewage Treatment Plant

S. No.	Parameters	Parameters Limit (Standards for new STPs Design after notification date)
1	pH	5.5-9.0
2	BOD (mg / l)	Not more than 10
3	COD (mg / l)	Not more than 50
4	TSS (mg / l)	Not more than 20
5	NH4-N (mg / l)	Not more than 5
6	N-total (mg / l)	Not more than 10
7	Faecal Coliform (MPN / 100ml)	Less than 100

(Source: Annexure – I, http://cpcb.nic.in/AndhraP_swg_18(1)(b)_2015.pdf)

Note- These Standards will be applicable for discharge in water resources as well as for land disposal. The standards for Faecal Coliform may not be applied for use of treated sewage in industrial purpose.

II. Central Public Health and Environmental Engineering Organization (CPHEEO)

Ministry of Urban Development, Government of India, has released guidelines of sewage outlet criteria, through The Central Public Health and Environmental

Engineering Organization (CPHEEO) manual. According to the new CPHEEO manual - 2013, the recommended guidelines for treated sewage if it is discharged into surface water used as a source of drinking water, are provided in the table 5-4.

Table 5-5: Recommended Guidelines for Treated Sewage if Discharged into Surface Water after Tertiary Treatment

S. No.	Parameters	Recommended Values
1	BOD (mg / l)	Not more than 10
2	SS (mg / l)	Not more than 10
3	Total Nitrogen (mg / l)	Not more than 10
4	Dissolved Phosphorous (mg / l)	Not more than 2
5	Faecal Coliform (MPN / 100ml)	Less than 230

The standards for disposal of treated sewage into public sewers system, inland waterways and landscape irrigation are provided in table 5-5.

Table 5-6 : Standards for disposing sewage into Inland Surface Water, Public Sewers & for Landscape Irrigation

Sl. No.	Parameter	Standards		
		Inland Surface Water	Public Sewers	Land for Irrigation
		(a)	*(b)*	*(c)*
1	Colour and odour	See footnote	-	See Footnote
2	Suspended solids mg/1, Max	100	600	200
3	Particle size of suspended solids	Shall pass 850 micron IS Sieve		
4	PH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
5	Temperature	Shall not exceed 5oC above the receiving water temperature	-	-
6	Oil and grease mg/1 Max	10	20	10
7	Total residual chlorine mg/1 Max	1.0	-	-
8	Ammonical nitrogen as (N) mg/1	50	50	-
9	Total Kjeldahl nitrogen (as N) mg/1 Max	100	-	-
10	Free ammonia (as NH_3) mg/1, Max	5.0	-	-
11	Biochemical oxygen demand (5 days at 20oC), mg/1 Max	30	350	100
12	Chemical oxygen demand mg/1, Max	250	-	-

Sl. No.	Parameter	Standards		
		Inland Surface Water	Public Sewers	Land for Irrigation
		(a)	*(b)*	*(c)*
13	Arsenic (as As) mg/1	0.2	0.2	0.2
14	Mercury (as Hg) mg/1 Max	0.01	0.01	-
15	Lead (as PB) mg/1 Max	0.1	0.1	-
16	Cadmium (as Cd) mg/1, Max	2.0	1.0	-
17	Hexavalent chromium (as Cr+6) mg/1, Max	0.1	2.0	-
18	Total chromium (as Cr) mg/1, Max	2.0	2.0	-
19	Copper (as Cu) mg/1, Max	3.0	3.0	-
20	Zinc (as Zn) mg/1, Max	5.0	15	-
21	Selenium (as Se) mg/1, Max	0.05	0.05	-
22	Nickel (as Ni) mg/1, Max	3.0	3.0	-
23	Cyanide (as CN) mg/1, Max	0.2	2.0	0.2
24	Fluoride (as F) mg/1, Max	2.0	15	-
25	Dissolved phosphates (as P) mg/1, Max	5.0	-	-
26	Sulphide (as S) mg/1, Max	2.0	-	-
27	Phenolic compounds (as C_6H_5OH) mg/1, Max	1.0	5.0	-
28	Radioactive materials (a) Alpha emitters micro-curie mg/1, Max (b) Beta emitters micro-curie, mg/1, Max	 10-7 10-6	 10-7 10-6	 10-8 10-7
29	Bio-assay test after 96 hours in 100% effluent	90% survival of fish	90% survival of fish	90% survival of fish
30	Manganese (as Mn)	2 mg/1	2 mg/1	2 mg/1
31	Iron (as Fe)	3 mg/1	3 mg/1	3 mg/1
32	Vanadium (as V)	0.2 mg/1	0.2 mg/1	-
33	Nitrate nitrogen	10 mg/1	-	-

- These standards shall be applicable for industries, operations or processes other than those industries, operators or process for which standards have been specified in Schedule I.
- All efforts should be made to remove color and unpleasant odor as for as practicable.

Source: Schedule VI of Environment (Protection) Third Amendment Rules, from Manual on sewerage and sewage treatment, Ministry of Urban development, CPHEEO, New Delhi, 1993.

CHAPTER:6 SEWAGE TREATMENT TECHNOLOGIES

6.1 SEWAGE TREATMENT

Sewage Treatment generally involves three stages, called Primary, Secondary and Tertiary treatment.

- Primary treatment consists of temporarily holding the sewage in a quiescent basin where heavy solids can settle to the bottom while oil, grease and lighter solids float to the surface. The settled and floating materials are removed and the remaining liquid may be discharged or subjected to secondary treatment.
- Secondary treatment removes dissolved and suspended biological matter. Secondary treatment is typically performed by indigenous, water-borne micro-organisms in a managed habitat. Secondary treatment may require a separation process to remove the micro-organisms from the treated water prior to discharge or tertiary treatment (if required).
- Tertiary treatment (if required) - Treated water sometimes requires additional treatment to remove specific pollutant(s) left after primary and secondary treatment, depending on final disposal/ reuse. It can be treated chemically or physically (for example membrane filtration, chemical precipitation, etc) prior to discharge into sensitive or fragile ecosystems such as stream, river, bay, lagoon or wetland, or it can be used for the irrigation of a golf course, green way or park. If it is sufficiently clean, it can also be used for groundwater recharge or agricultural purposes. Figure x provides a schematic diagram of a typical STP and Figure-6-1 provides information on the processes followed in the STP.

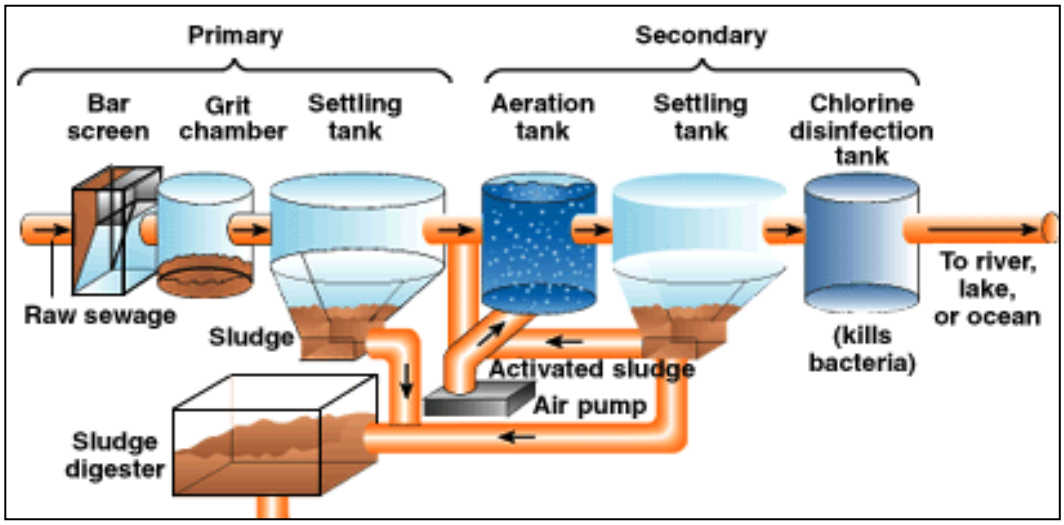


Figure 6-1: Schematic Flow Diagram of typical Sewage Treatment Plant

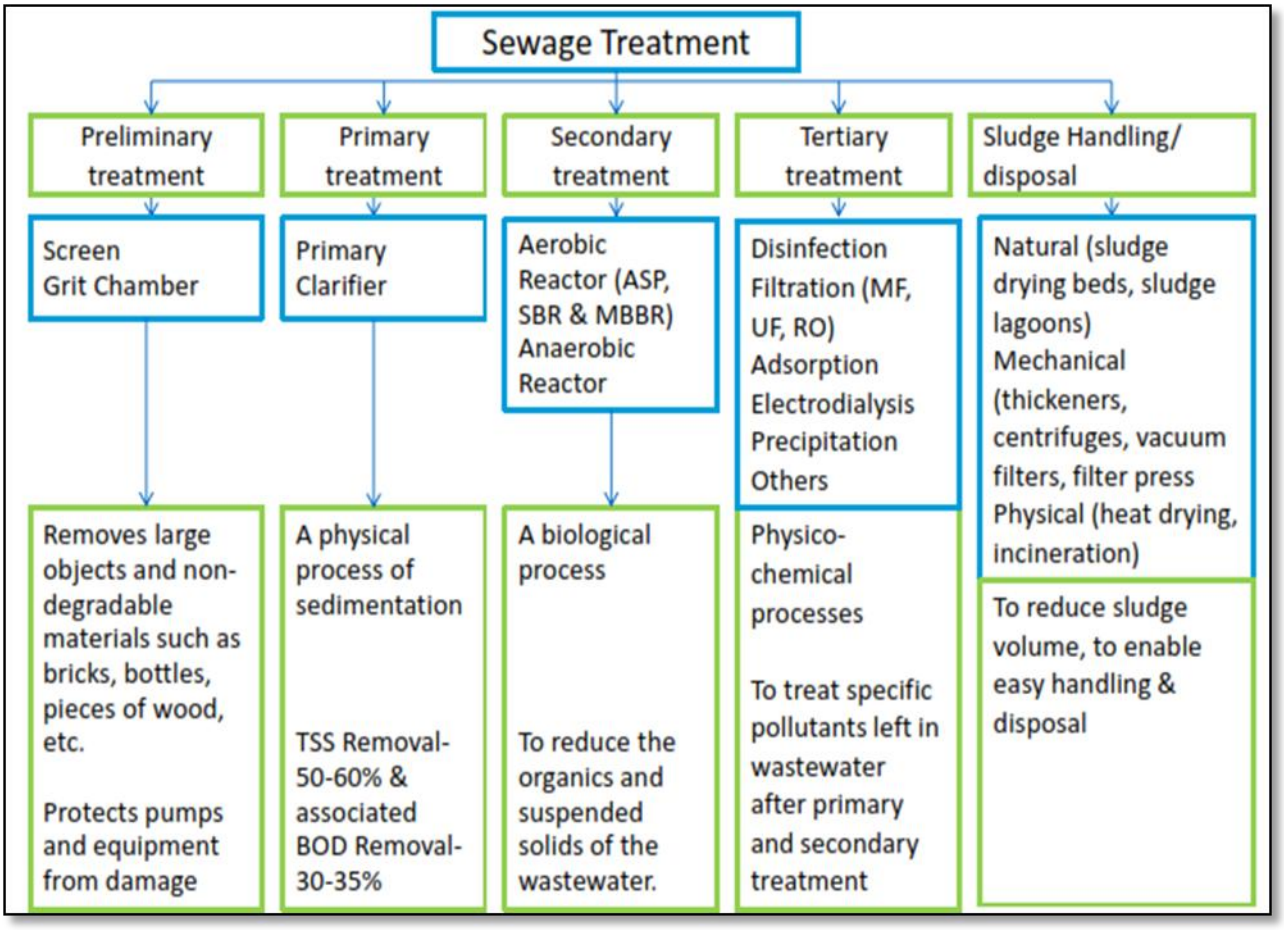


Figure 6-2: Processes followed in Sewage Treatment Plant

6.2 REVIEW OF VARIOUS TECHNOLOGIES FOR SEWAGE TREATMENT

The likely technologies to treat sewage are:

1. Extended Aeration
2. Moving Bed Bio-film Reactor (MBBR)
3. Sequencing Batch Reactor (SBR)
4. Membrane Bio Reactor
5. Soil Bio Technology

6.2.1 EXTENDED AERATION

The extended aeration process is similar to the conventional plug – flow process except that it operates in the endogenous respiration phase of the growth curve, which requires a low organic loading and long aeration time. Because of the long SRTs (20 to 30 d) and HRT (12 - 24 hr), aeration equipment design is controlled by mixing needs and oxygen demand. The process is simpler since primary settling tank and anaerobic digester are

not required. Generally, secondary clarifiers are designed at lower hydraulic loading rates than conventional activated sludge clarifiers for better settlement of sludge.

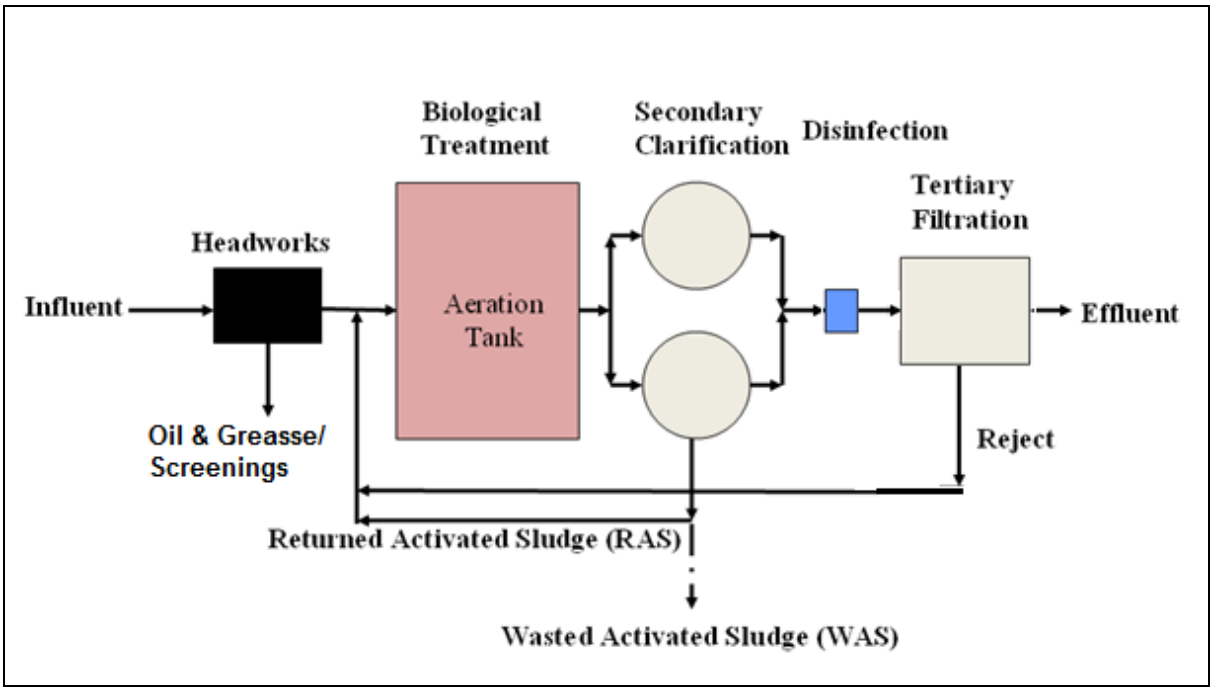


Figure 6-3: Schematic for Extended Aeration Process

Advantages of EA:

(a) Good quality effluent is possible
(b) Relatively less complicated design and operation
(c) Capable of treating shock loads
(d) Well stabilized sludge.

Disadvantages of EA:

(a) Aeration requires high energy
(b) Relatively large aeration tanks

6.2.2 Moving Bed Bio-film Reactor (MBBR)

The MBBR is an aerobic attached growth process which uses cylindrical shaped polyethylene carrier elements for biological growth. The moving media increases the contact time between the microorganisms and the organics. Since the media has high porosity it provides large surface area for microorganisms to attach and grow. It has excellent characteristics for BOD/ COD removal and nitrification/de-nitrification for all

types of sewage. It is compact and requires comparatively lesser space than the conventional system.

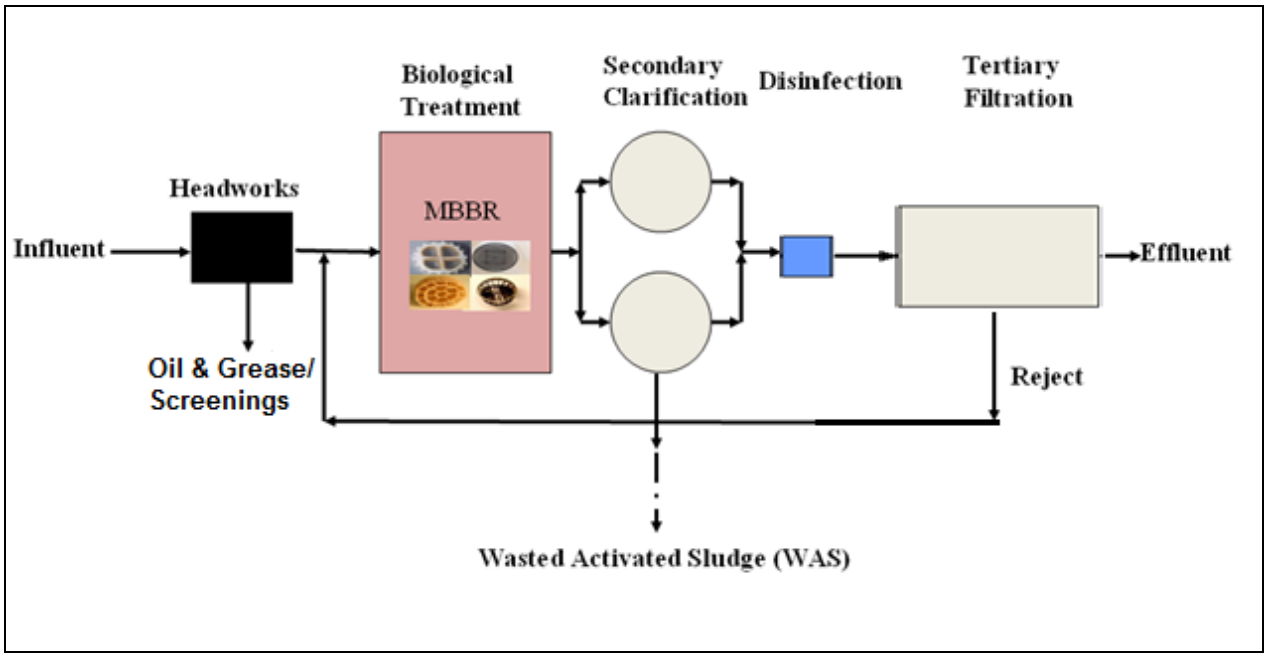


Figure 6-4: Schematic for MBBR

Advantages of MBBR:

(a) Provides long SRTs
(b) Good quality effluent is produced with low SS and COD
(c) Compact

Disadvantages of MBBR:

(a) Separate secondary settling tank required with sludge removal facility
(b) The process is sensitive

6.2.3 Sequential Batch Reactor

The SBR is a fill and draw type of reactor system involving a single complete – mix reactor in which all steps of the activated sludge process occur. For Wastewater Treatment with continuous flow, at least 2 basins are used so that one basin is in the fill mode while the other goes through react, solids settling and effluent withdrawal modes. A SBR goes through a number of cycles per day; a typical cycle may consist of 1.5 hr fill and aeration, 0.75 hr settling and 0.75 hr for withdrawal of supernatant. MLSS remains in the reactor during all cycles, thereby eliminating the need for separate secondary

sedimentation tanks. Decanting of supernatant is accomplished by decanter mechanism. The HRT for SBRs generally range from 16 to 22 hrs. Based on the influent flow rate and tank volume used. Aeration may be accomplished by jet aerators or coarse bubble diffusers. Separate mixing provides operating flexibility and is useful during the fill period for anoxic operation. Sludge wasting occurs normally during aeration period. The complete operation is PLC controlled.

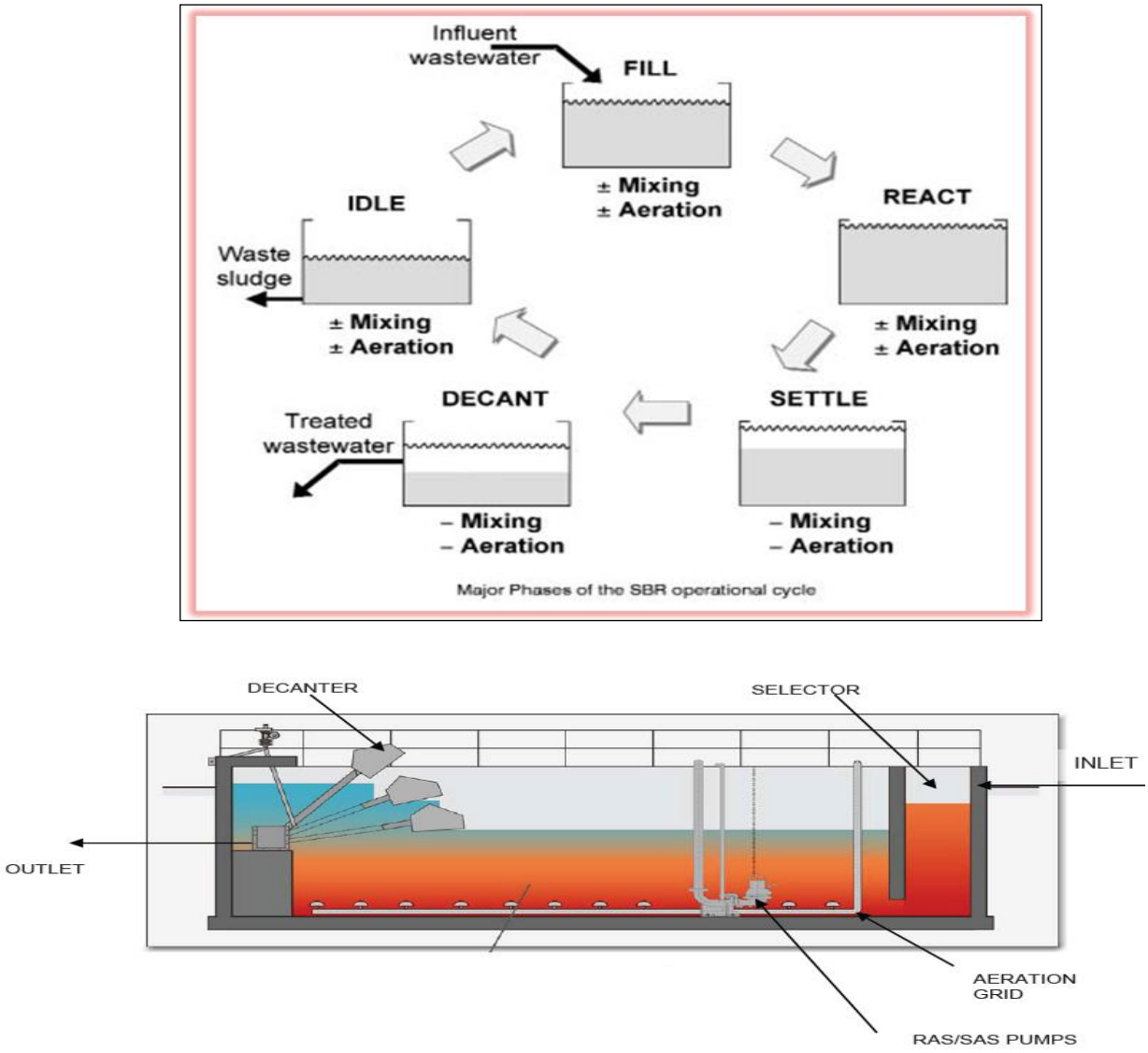


Figure 6-5: Schematic for Sequential Batch Reactor

Advantages of SBR:

(a) Process is simplified, separate final clarifiers not required and intermittent return activated sludge pumping is provided.

(b) Compact facility.

(c) Operation is flexible; nutrient removal can be accomplished by operational changes
(d) Can be operated as a selector process to minimize sludge bulking potential.

Disadvantages of SBR:

(a) High Peak flows can disrupt operation unless accounted for in design.
(b) Higher maintenance skills required.

6.2.4 Membrane Bio Reactor

MBR technology is the combination of a high rate, activated sludge biological process with Ultra filtration (UF) membranes for solids separation. The MBR technology has 2 alternatives:

(a) Submerged MBR in Aeration basin.
(b) MBR in separate tanks.

MBR is a two step process that includes:

(a) The bioreactor, where aerobic bacteria acts on the organic matter with the presence of dissolved oxygen.
(b) The membrane filtration module based on Ultra Filtration (UF), which separates the biomass and bacteria from water.

In MBR system through the use of a permeate pump, vacuum is applied to a header connected to the membranes. The vacuum draws the treated water through the membranes. Airflow is introduced to the bottom of the membrane module, producing turbulence that scours the external surface of the membranes. The scouring action transfers the rejected solids away from the membrane surface.

Wasted Sludge shall be collected in sludge sump and shall be pumped to portable type filter press for dewatering and then wasted directly from the system at solid concentration of 18 to 20 percent solids or can be used as manure for gardening.

In addition to membrane modules equipment's such as permeate pumps, Back pulse pumps, air blowers, PLC system and Chemical cleaning system and storage etc., are usually provided. There is no need of secondary clarifiers or polishing filters.

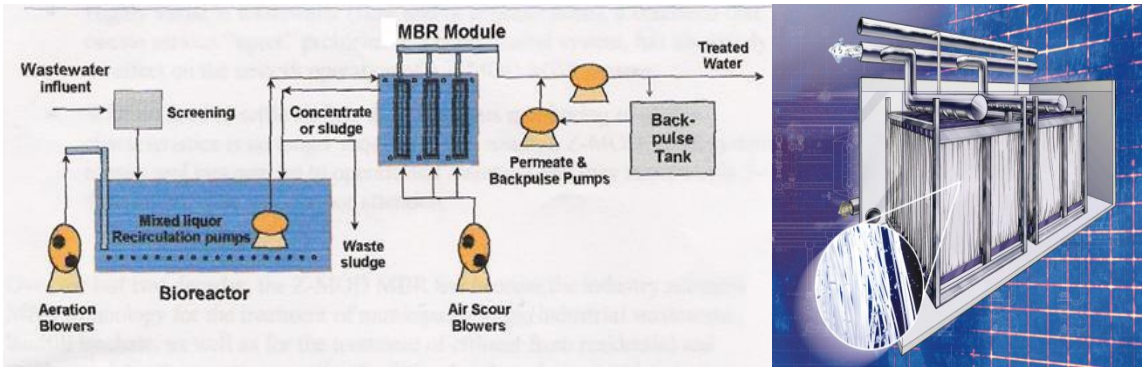


Figure 6-6: Schematic for Membrane Bio-Reactor

Advantages of MBR:

(a) Higher mixed liquor suspended solids concentrations in MBRs (8000 – 15,000 mg/L) as compared to the conventional process which allows only 1500 – 3000 mg/L MLSS.

(b) Optimum control of the microbial population and flexibility in operation with excellent effluent quality (COD removal: ≥ 95 %, BOD removal: ≥98 % and TSS removal: ≥ 99 %).

(c) MBR operates at low F/M ratio and long SRT. This means less sludge production and better sludge quality. Better sludge quality ultimately reduces sludge bulking.

(d) Smaller foot print per unit of BOD loading or per unit feed flow rate. Ideal for expansion of existing facilities without an increase in the footprint. The foot print of MBR based plant is 25 to 40% lesser than that of conventional treatment plants.

(e) Capable of absorbing organic shock loads.

(f) MBR serves as barrier to certain chlorine resistant pathogens such as Cryptosporidium and Giardia.

(g) Minimum odour.

(h) Sludge yield is 20 – 40 % less as compared to conventional WWTP.

(i) Disinfection requirements are reduced.

(j) The effluent quality is suitable for recycle and reuse for flushing and gardening.

(k) Process control is easier with automation.

(l) Modular design for easy expansion.

Disadvantages of MBR:

(a) High capital cost due to expensive membrane units.

(b) O &M cost is high due to higher energy consumption, Chemical consumption and limited life of membranes.
(c) Extensive piping and valves are required.
(d) Need to control membrane fouling.
(e) Higher maintenance skill required for monitoring device and automation.

6.3 Selection of Appropriate Sewage Treatment Technologies

Various alternative processes as described earlier have been evaluated for the proposed capacity of 20 MLD. Based on the techno-economic analysis and the life cycle cost, the treatment processes recommendations have been made. The evaluation is based on following criteria's:

(a) Area requirement;
(b) Power requirement;
(c) Cost comparison.

Life cycle cost analysis is carried out for the technologies mentioned earlier. Operation & Maintenance cost is considered for 10 years in life cycle analysis. The comparison of Area, Power and Cost comparison for different process are provided in the table 6-1 and life cycle cost comparison statements for the same is provided in table 6-1.

Table 6-1: Pros and Cos for each of the Treatment Processes

Parameters	Impact	EA	SBR	MBBR	MBR	SBT
Capital cost	Initial Investment	Medium cost – including primary and secondary clarifier requirement	Lower cost than EA cost requirement, Primary & secondary clarifier is not required.	Higher cost than EA & SBR, cost including secondary clarifier as well as MBBR media	Potential highest cost including membrane cost	Lower Cost
Periodic equipment replacement cost	Proportional to impact on lifecycle cost	Replacement after 15 years	Replacement after 15 year	Media to be replaced after 5 - 7 year	Membrane to be replaced in 5 - 7 years	Replacement after10 years
Power cost	Proportional to impact on lifecycle cost	Higher cost than MBBR & SBR power cost	Medium power cost	Medium power cost	Highest power cost	Medium power cost
Skilled personnel cost	Proportional to impact on lifecycle cost	Simplest to operate	Cycle time control needs higher skill	Simple to operate	MBRs need higher skill	Simple to operate
Maintenance cost	Proportional to impact on lifecycle cost	Lower than SBR and MBBR	Medium cost More automation maintenance	Medium cost	More automation maintenance	Medium cost
Chemical cost	Proportional to impact on lifecycle cost	Gas chlorination for disinfection	Gas chlorination for disinfection	Gas chlorination for disinfection	Gas chlorination for disinfection	Gas chlorination for disinfection

Parameters	Impact	EA	SBR	MBBR	MBR	SBT
Complexity	Simpler is better, but not a critical factor	Relatively simple process	Cycle time control adds some operational complexity	Relatively simple process	MBR TMP / permeability monitoring, scour, backpulse and maintenance cleaning adds some complexity	simple process
Performance reliability	Relates to regulatory compliance and reuse applications	Proven reliable with proper operation and control - need additional units for reuse applications	Proven reliable with proper operation and control - need additional units for reuse applications	Proven reliable with proper operation and control - need additional units for reuse applications	Highly reliable effluent quality. Additional units for reuse applications not required excellent disinfection	Not proven more than 3 MLD capacity
Space requirements	Space available on ground within campus in open area	Greater than MBBR, SBR and MBR.	20 – 30 % less as compare to EA	15 – 20% less as compare to EA	30 – 40% less as compare to EA	Less compared to others
Tertiary Treatment	Recycle water quality	Required	Required	Required	Not Required	Required

Table 6-2: Cost Comparison for different processes for 5 MLD Capacity STP at Adoni

SL NO	PARAMETERS	EXTENDED AERATION	MOVING BED BIOREACTOR (MBBR)	SEQUENTIAL BATCH REACTOR (SBR)	MEMBRANE BIOREACTOR (MBR)
A	**INLET DESIGN PARAMETERS**				
1	Biological Oxygen Demand (BOD)	200 - 250	200 - 250	200 - 250	200 - 250
2	Chemical Oxygen Demand (COD)	350 - 400	350 - 400	350 - 400	350 - 400
3	Total Suspended Solids (TSS)	350 - 450	350 - 450	350 - 450	350 - 450
4	Total Kjeldahl Nitrogen (TKN)	40 - 50	40 - 50	40 - 50	40 - 50
B	**EXPECTED OUTLET PARAMETERS**				
1	Biological Oxygen Demand (BOD)	< 20	< 20	< 20 (Less than 10 can be achieved)	< 20 (Less than 5 can be achieved)
2	Chemical Oxygen Demand (COD)	< 100	< 100	< 100	< 100
3	Total Suspended Solids (TSS)	< 30	< 30	< 30 (Less than 10 can be achieved)	< 30 (Less than 5 can be achieved)
4	Total Nitrogen Removal Efficiency, %	70-80	70-80	70-80	70-80
C	**PROCESS OPERATING FEATURES**				
1	Process Type	Aerobic, Continuous.	Aerobic, Continuous.	Aerobic, Batch	Aerobic, Continuous.
2	Automatic Control of Operating Parameters	Generally minimum automation provided.	Generally minimum automation provided.	Monitoring of Process Parameters like Rate of Change of Dissolved Oxygen, Inflow and	Monitoring of Process Parameters like Rate of Change of Dissolved Oxygen, Inflow and Outflow

SL NO	PARAMETERS	EXTENDED AERATION	MOVING BED BIOREACTOR (MBBR)	SEQUENTIAL BATCH REACTOR (SBR)	MEMBRANE BIOREACTOR (MBR)
				Outflow is automatically done by PLC	is automatically done by PLC
3	Odour and Fly Problems	Nil since the process produces fully stabilized Sludge.	No fly problems. Possibility of Odour in case the Sludge is stored at Site for a long time as the Sludge is not fully stabilized.	Nil since the process produces fully stabilized Sludge.	Nil since the process produces fully stabilized Sludge.
4	Treatment Efficiency	95% to 98% treatment efficiency can be acheived.	95%. Requires Tertiary Treatment to achieve < 10 mg/l BOD.	95% of BOD removal can be achieved in single stage.	98% of BOD removal can be achieved in single stage.
5	Replacement of System components	No replacement of components is required. Mechanical and Electrical components are designed for life period of 15 years.	Possibility of MBBR media replacement is necessary every 4 to 5 years. Mechanical and Electrical components are designed for life period of 15 years.	No replacement of components is required. Mechanical and Electrical components are designed for life period of 15 years.	Membranes have a life of 5-7 years, after which all membranes need to be replaced. The system uses membranes which contribute to about 30% of the capital investments. Mechanical and Electrical components are designed for life period of 15 years.
6	Level of Automation	Fully Automatic.	Fully Automatic.	Fully Automatic.	Fully Automatic. Controlled

SL NO	PARAMETERS	EXTENDED AERATION	MOVING BED BIOREACTOR (MBBR)	SEQUENTIAL BATCH REACTOR (SBR)	MEMBRANE BIOREACTOR (MBR)
		Controlled by PLC and Computer with Manual Override.	Controlled by PLC and Computer with Manual Override.	Controlled by PLC and Computer with Manual Override.	by PLC and Computer with Manual Override.
7	Ease during Shutdown / Maintenance	Partial Plant to be taken under Shutdown while Maintenance.	Partial Plant to be taken under Shutdown while Maintenance.	Standby Basin can be taken Offline while other Basin shall cater to the treatment requirements.	Membrane modules can be isolated and the balance can cater the treatment flow.
8	Required Level of Operator Attention	Low	Medium	Medium	High.
9	Area Requirements	Greater than MBBR, SBR and MBR Process.	25-30 %less as compared to that of extended aeration.	35 - 40 %less as compared to that of extended aeration.	40-50 % less as compared to that of extended aeration.
10	Net Operating Cost	Medium	Low.	Low.	High.
	CAPITAL COST				
1	Area Requirement (Acres)	1.61	0.68	0.68	0.56
2	Land Cost @ Rs. 30.36 Lacs/Acre (Rs. Lacs)	49	21	21	17
3	Total Capital Cost for STP (5 MLD) with Civil, Electromechanical equipments (Rs. Lacs)	650	775	800	1,375
4	Total (Land+Capital) Cost (Rs. Lacs)	698.75	795.63	820.63	1,391.88

SL NO	PARAMETERS	EXTENDED AERATION	MOVING BED BIOREACTOR (MBBR)	SEQUENTIAL BATCH REACTOR (SBR)	MEMBRANE BIOREACTOR (MBR)
	O&M COST				
1	Power Cost	59	33	36	89
2	Chemical Cost per annum in lacs	4	4	4	13
3	Manpower Cost per annum in Lacs	19	19	19	19
4	Total Maintainence & Repair Cost per Annum in Lacs	14	27	19	93
	Total O&M Cost (Rs. Lacs per Annum)	**96.03**	**82.88**	**77.26**	**213.84**
	SUMMARY OF LIFE CYCLE COST				
	Total Life Cycle Cost Excluding Landcost (Rs.Lacs)	**1,959.93**	**1,901.20**	**1,849.61**	**4,284.92**
	Total Life Cycle Cost Including Landcost (Rs.Lacs)	**2,008.68**	**1,921.82**	**1,870.24**	**4,301.80**

6.4 Conclusion and Recommendation

- Capital Costs for STP for Extended Aeration, Sequential Batch Reactor, SBT and MBBR is almost same whereas for MBR it is more.
- Power for Extended Aeration is more compared to MBBR, SBT & SBR and for MBR it is highest.
- Operation & Maintenance is higher for MBR as compared to other four processes.
- Area requirement for MBR is less as compared to that required for other alternatives. Further Tertiary Treatment is not required for MBR.
- MBR technology is good and generates high quality of effluent (5-7m years) but the capital cost and O & M cost is very high. Membrane life is also short and membranes needs to be replaced after certain interval of time which has high periodic cost.
- Comparing the LCC cost of all the above mentioned treatment technologies, It is concluded that the SBR is most economical followed by Extended Aeration. However the SBR technology is a fully automation technology requires skilled manner and Extended Aeration does not require automation & skilled manpower. Equalization tank and Primary clarifiers are not required in SBR whereas it required in Extended Aeration. Minimal foot area is required in SBR when compared to Extended Aeration.
- In respect of tertiary treatment (if required), SBR technology followed by Rapid gravity sand filter (if required) is the best option for Sewage treatment plant and hence, for the proposed STP at Adoni, SBR technology has been recommended.

Additional advantages of SBR when compared to other technologies includes

- ✓ Equalization, primary clarification, biological treatment and secondary clarification can be achieved in a single reactor vessel.
- ✓ Operating flexibility and control
- ✓ Minimal footprint area
- ✓ Potential capital cost savings by eliminating clarifiers and other equipment.

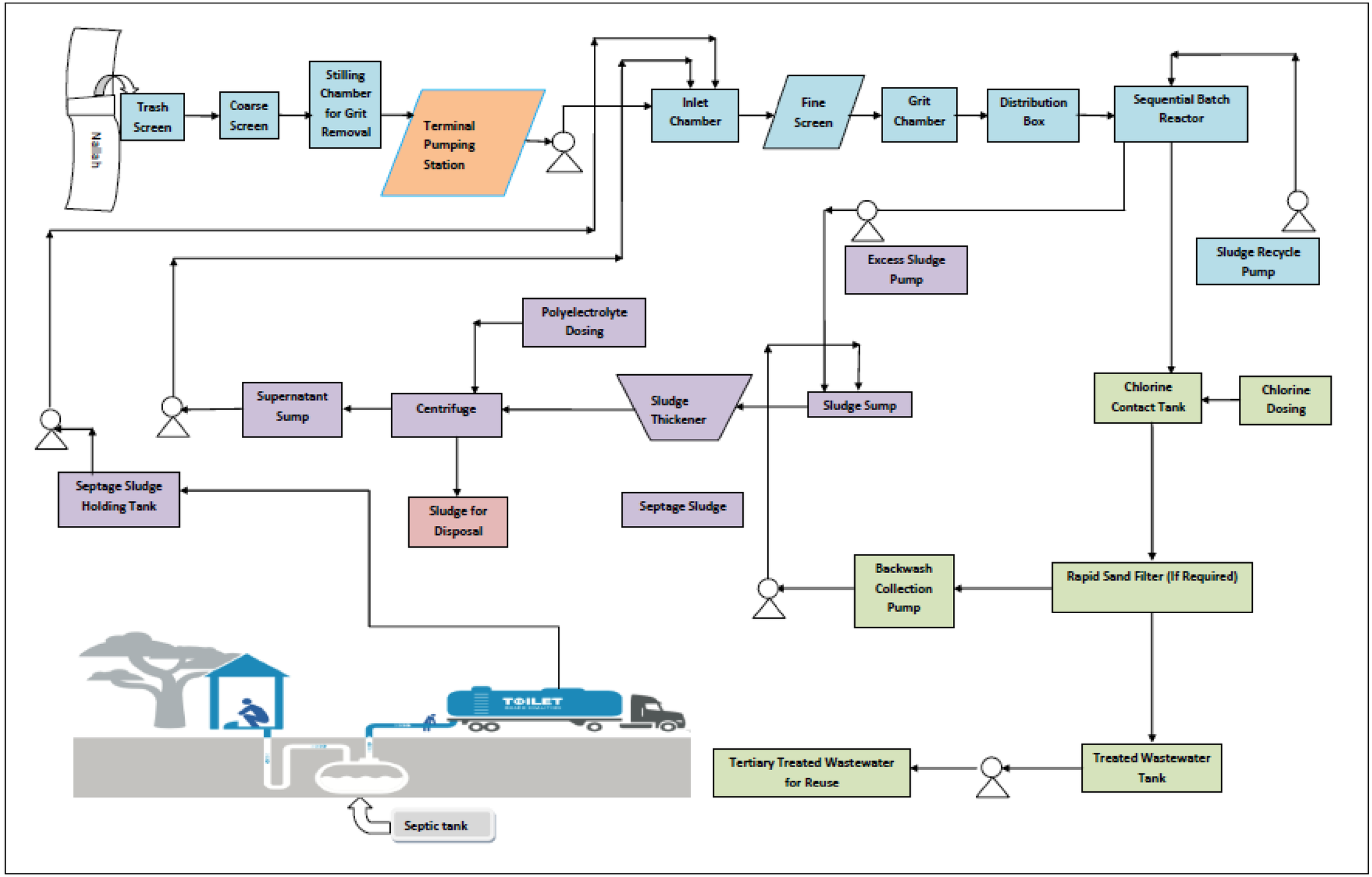


Figure 6-7: Process Flow Diagram for Sequential Batch Reactor Based STP

CHAPTER:7 SLUDGE/SEPTAGE MANAGEMENT

7.1 Septage

Septage or septic tank sludge refers to the partially treated sludge stored in a septic tank or (less commonly) in a pit latrine. Septage is the semi-liquid material removed from the septic tank, i.e a mixture of solids and water settled at the bottom of the septic tank.

Septic tanks are the primary source of septage generation. This functions as a settling tank and digestion unit. The solids in the wastewater settle to the bottom of the tank where they undergo anaerobic degradation along with the organic matter. It has an offensive odour and is high in organics and pathogenic microorganisms. Scum accumulates on the surface while the sludge settles at the bottom, comprising 20 to 50% of the total septic tank volume when pumped. A septic tank will usually retain 60 to 70% of the solids, oil and grease that passes through the system.

Septage is a highly variable organic waste that often contains large amounts of grease, grit, hair and debris and is characterized by an objectionable odour. These characteristics make septage difficult to handle and treat. The major reason for providing adequate treatment and disposal systems is to protect public health and the environment, as septage may harbour disease causing viruses, bacteria and parasites. Physical and chemical characteristics of septage are provided in table 7-1and an Illustrative characteristic of septage for Indian conditions is provided in table 7-2. The range of BOD, COD and SS in Indian conditions is provided in table 7-3 and that of the septage characteristics specified in US-EPA is specified in Table 7-4.

Table 7-1: Physical and chemical characteristics of septage

S.No	Constituent	Average (mg/L)	Range (mg/L)
1	Biochemical Oxygen Demand	6,480	440-78,600
2	Chemical Oxygen Demand	31,900	1,500-7,03,000
3	Total Solids	34,106	1,132-1,30,745
4	Total Volatile Solids	23,100	353-71,402
5	Total Suspended Solids	12,862	310-93,378
6	Volatile Suspended Solids	9,027	95-51,500
7	Total Kjeldahl Nitrogen	588	66-1,060
8	Ammonia Nitrogen	97	3-116
9	Total Phosphorous	210	20-760
10	Alkalinity	970	522-4,190
11	Grease	5600	208-23,368
12	pH- unitless		1.5-12.6

Table 7-2: Illustrative characteristics of septage for Indian Conditions

S. No	Source	Type "A" high strength	Type "B" low strength
		Public toilet or bucket latrine sludge	Septage
1.	Characterization	Highly concentrated, mostly fresh Faecal sludge; stored for days or weeks only	Faecal sludge of low concentration; usually stored for several years; more stabilized than Type "A"
2.	COD (mg/L)	20-50000	< 15000
3.	COD/BOD	5:1 to 10:1	5:1 to 10:1
4.	NH4-N (mg/L)	2-5000	< 1000
5.	TS (%)	≥ 3.5%	< 3%
6.	SS (mg/L)	≥ 30000	7000 (approx)
7.	Helminth Eggs (unit/ml)	20-60000	4000 (approx)

(Source: Table 9.15, page 9-45, CPHEEO Manual, 2012)

Table 7-3: Range values of BOD, COD and SS at inlet to septic tank in India

S.No.	Indicator	BOD, mg/L	COD, mg/L	SS, mg/L
1.	Mean	1290	2570	4140
2.	Standard Deviation	143	290	542
3.	Range	970 to 1550	1920 to 3050	2550 to 4860

(Source: Table 9.12, page 9-41, CPHEEO Manual, 2012)

Table 7-4: Septage Characteristics as per US EPA

S.No.	Parameter	EPA Mean	Suggested Design value
1.	TS	38000	40000
2.	TVS	25260	25000
3.	TSS	13000	15000
4.	VSS	8720	10000
5.	BOD5	5000	7000
6.	COD	42850	15000
7.	TKN	677	700
8.	NH3-N	157	150
9.	Total P	253	250
10.	Alkalinity		1000
11.	Grease	9090	8000
12.	pH	6.9	6.0

(Source: Table 9.13, page 9-43, CPHEEO Manual, 2012)

Table 7-5: Comparison of Septage and Municipal Wastewater

Parameter	Septage[b]	Wastewater[c]	Ratio of Septage to Wastewater
TS	40000	720	55:1
TVS	25000	360	69:1
TSS	15000	210	71:1
VSS	10000	160	62:1
BOD5	7000	190	37:1
COD	15000	430	35:1
TKN	700	40	17:1
NH3-N	150	25	6:1
Total P	250	7	36:1
Alkalinity	1000	90	11:1
Grease	8000	90	89:1
pH	6.0	-	-
Linear Alkyl Sulfonate	150	-	-

a Values expressed as mg/L, except for pH.

b Based on suggested design values in Appendix – Table No. 1 (USEPA Table 3-4)

c From Metcalf and Eddy, 4th Edition, "medium strength sewage".

Note: Appendix – Table No. 2 including footnotes is taken from the USEPA Handbook entitled "Septage Treatment and Disposal", 1984, EPA-625/6-84-009 and is designated in that document as "Table 3-8".

(Source: Table No. 2, Page No. A-5, http://10statesstandards.com/wastewaterstandards.pdf)

7.2 Septage Treatment & Disposal

Septage treatment and disposal facilities are either privately or publicly owned. Larger municipalities often have the technical and managerial capabilities necessary to exercise full control over septage handling, treatment, and disposal. Other municipalities are attracted to privately owned systems. Municipality, however, remain responsible for ensuring the safe handling and disposal of septage generated within its boundaries, for establishing local ordinances or regulations governing septage handling, and for meeting all state and federal permit requirements and regulations.

Alternatives for the treatment and disposal of septage fall into the following categories:

- Land application
- Treatment at wastewater treatment plants (WWTPs)
- Treatment at independent septage treatment plants

7.3 Elements of Septage Management

Septage generation rates vary widely from place to place depending on practices of septic tank use, number of users, water used for flushing, and the frequency of cleaning

the septage. Assuming an average septic tank volume of 3 m^3 and emptying of septage when one third of the septic tank is filled with settled solids, the volume of septage emptied would be 1 m^3. The accumulating sludge at the bottom of the septic tank has to be removed and treated once it has reached the designed depth or at the end of the designed de-sludging period whichever occurs earlier. Such a removal can be done possible by mechanical vaccumum type trucks. While sucking out the sludge, the liquid in the septic tank will also be sucked out. Such a mixture is referred to as septage. The removal of septage from a household septic tank should occur approximately once in two or three years.

7.4 Need of Septage Management

Facilities like septic tanks, dry latrines, community toilets, or other types accumulate faecal sludge. Septage needs to be removed periodically. If this septage is not properly managed, negative impacts would be created on the urban environment and on public health i,e contamination of ground and surface water resources.

7.5 Approach for Septage management

In order to improve the existing sewage system in the city, the consultants propose to adopt the following techniques of septage management which includes proper collection, transportation and treatment of the septage in an Environmental friendly manner including reinforcements of suitable law to curb the menace of improper septage management. Figure 7-6 provides the pictorial representation of the proposed septage management for Adoni Town.

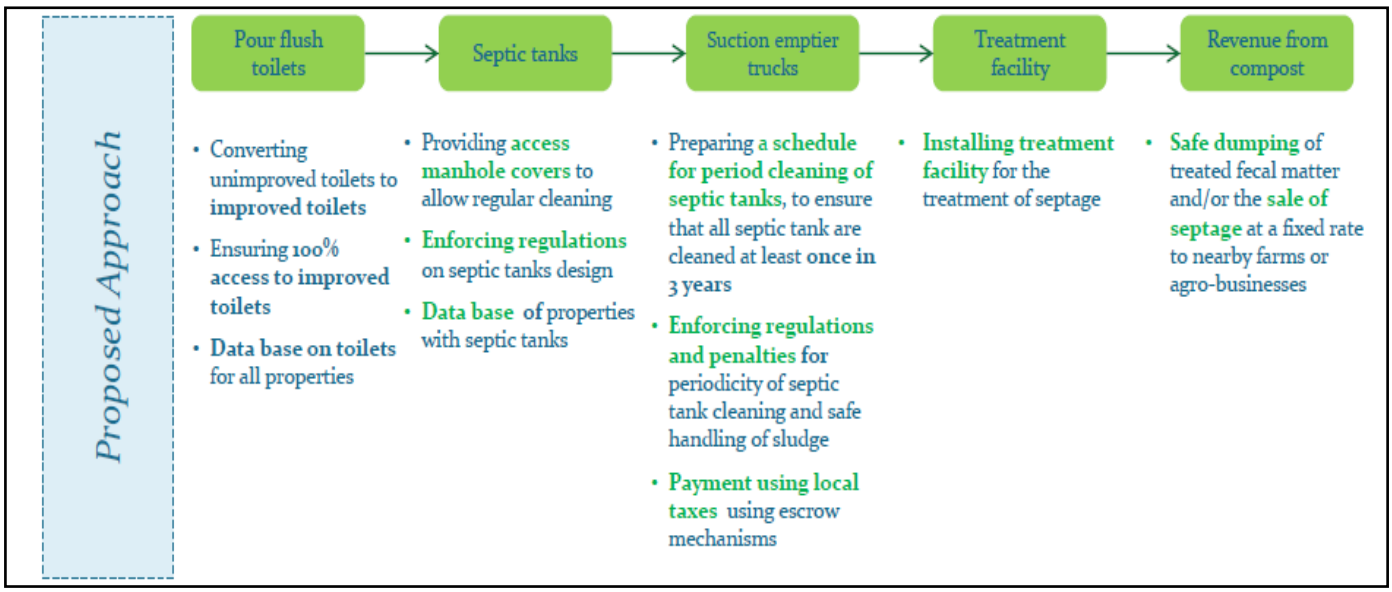


Figure 7-1: Proposed Septage Management for Adoni

7.6 Key activities involved in Septage Management

- Assessment of existing toilets and septic tanks through surveys and creation of database.
- Design and construction / refurbishment of septic tanks
- Desludging of septic tanks
- Scheduled septic tank emptying services
- Treatment of faecal sludge / septage

7.7 De-sludging of Septic Tanks

In Indian cities, most of the septic tanks are de-sludged manually. This is considered as an unpleasant and repulsive job. The Government of India has enacted the Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act, 1993 which emphasizes on

- Desludging /emptying of septic tanks need to be carried out using mechanical devices like suction emptier trucks / vacuum tankers.
- **Yearly desludging of septic tank is desirable**, but if it is not feasible or economical, then **septic tanks should be cleaned at least once in two-three years**, provided the tank is not overloaded due to use by more than the number of persons for which it is designed (As per CPHEEO Manual, Page 9- 22).
- Frequent desludging inhibits the anaerobic action in the tank. Normally the tanks are cleaned when the sum of the depth of the scum and the sludge is observed to exceed half the depth of the tank. (As per clause 5.1 note, page no. 16, IS: 2470 (Part-I), 1985.
- Periodical de-sludging also helps reduce the pollution levels in the liquid effluent, which normally enters waterways untreated.
- A small quantity of sludge (i.e 1-2 inch) should be left in tank to facilitate future decomposition.
- Regular de-sludging activities require well-organized community and public/private service providers.
- Septic tanks should not be scrub cleaned or washed with detergent.
- The sludge after removal should be transported in a controlled manner to avoid leakage or spillage.

7.8 Septic Tank Cleaning Machines and Septage Transportation

- Vehicle having a capacity of 2,000 litres shall clean 3 to 10 septic tanks per day.

- Small scale vacuum trucks called "Vacutug" are recommended for areas inaccessible to large vehicles
- Desludging trucks act as a “mobile sewer network” for onsite sanitation systems. They collect the septage at the household level and transport it to treatment or disposal sites.
- It is desirable to develop standard operating procedures for pumping and transportation of septage as part of a Manual of Practice for septage. These procedures will include following
  - Scheduling and routing for trucks
  - Customer service protocols
  - Locating tanks and cleanouts
  - Proper pumping equipment operation and worker safety
  - Site control, including post-pumping clean-up
  - Transportation requirements, including rules of the road
  - Disposal procedures at the treatment facility
  - Routine service of equipment – greasing and oiling, minor repairs
  - Recordkeeping for all tanks pumped and wastes discharged at the disposal facility.

7.9 Treatment of Septage at Sewage Treatment Plants

Co-treatment of septage along with domestic sewage at the sewage treatment plant (STP) is the most desirable option. The sewage treatment plants should have adequate capacity to accept the septage without hampering the functioning of the sewage treatment plant. The options in treating faecal sludge / septage are as follows

- **Option 1:** Treatment of septage at sewage treatment plants

- ✓ **Septage addition at the nearest sewer manhole:** Septage added to a sewer upstream of the sewage treatment plant so that substantial dilution of septage occurs before reaching the sewage treatment plant.
- ✓ **Septage addition at the STP:** Septage added immediately in the upstream of the screening and grit removal processes.
- ✓ Septage addition to sludge digesters/Sludge management units

➢ **Option 2:** Treatment of septage at independent Septage treatment plants

- ✓ **Space is not a constraint:** Lime treatment, Sludge drying beds, Anaerobic baffled reactor, stabilization pond, constructed wetland, co-composting with solid waste
- ✓ **Space is a constraint:** Mechanical Dewatering system

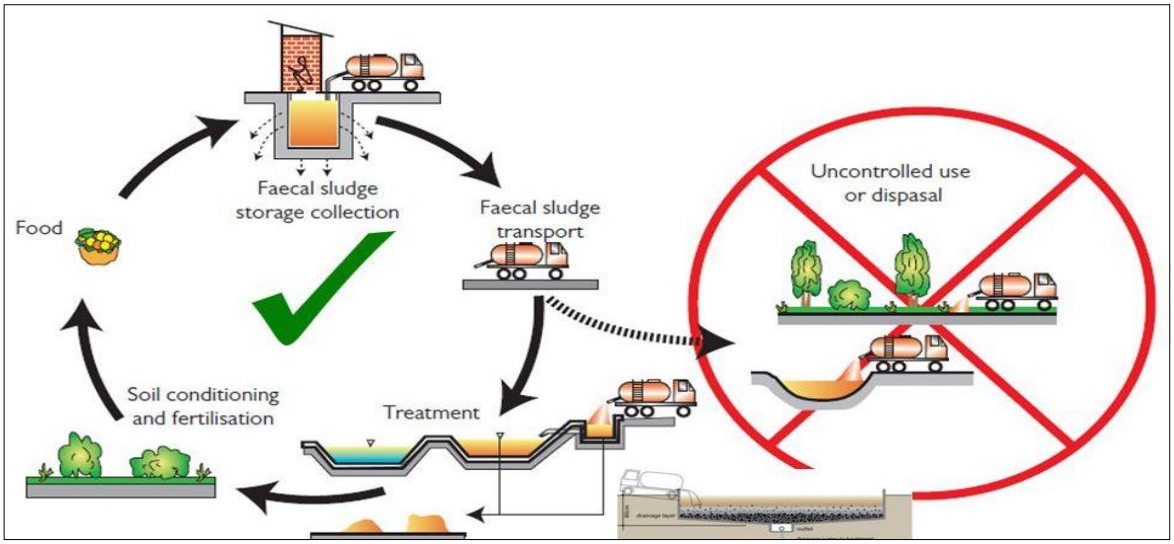


Figure 7-2: Typical Septage Management

7.10 Current and Recommended Septage Management Practices

The recommended Septage management system for Municipality is provided in table 7-7 below

Table 7-6: Recommended Septage Management

Sl. No	Current situation of Septage Management	Recommended Septage Management
1.	Cleaning is done on-call by the household, who do not see the need for regular cleaning. The cleaning services of the ULB are currently treated as a complaint redressal system for overflowing septic tanks rather than a regular cleaning and maintenance service.	Septic tanks shall be cleaned on a pre-determined schedule Regulations and penalties shall be set in place to ensure periodic cleaning Awareness generation activities to educate households about the need for regular cleaning
2.	Each municipality relay on private agencies to	Each town shall own 1-5 trucks to meet

Sl. No	Current situation of Septage Management	Recommended Septage Management
	clean the septic tanks through vacuum cleaners	service standard, which can be operated by a private player
3.	Household generally pay INR 500-1000 to get tanks cleaned, but only once in >8-10 years when the tanks overflow	Local taxes levied by the ULB as per municipal act will be used to recover the operating expenses for regular cleaning

7.11 Recycle System for Process Wastewater

Wastewater from the following process units will have to be collected and re-routed back into the mainstream, i.e., upstream of the SBR Basins for normal treatment.

7.12 Recycling and Reuse of treated effluent

There is no such proposal for recycling and reuse of treated water however the ULB can explore the possibilities for selling this water for needy industries or can be used for their own purposes. The following are the standards for the reuse of treated sewage quality provided in table 7-7.

Table 7-7: Recommended norms of treated sewage quality for specified activities at point of use

S.No	Parameter	Toilet Flushing	Fire Protection	Vehicle Exterior washing	Non-contact impoundments	Landscaping, Horticulture & Agriculture			
						Horticulture, Golf course	Crops		
							Non edible crops	Crops which are eaten	
								Raw	Cooked
1	Turbidity (NTU)	<2	<2	<2	<2	<2	<2	<2	<2
2	SS	nil	nil	nil	nil	nil	30	nil	30
3	TDS	2100							
4	pH	6.5 to 8.3							
5	Temperature ^{0} C	Ambient							
6	Oil & Grease	10	nil	nil	nil	10	10	nil	Nil
7	Minimum Residual Chlorine	1	1	1	0.5	1	nil	nil	nil
8	Total Kjeldahl Nitrogen as N	10	10	10	10	10	10	10	10
9	BOD	10	10	10	10	10	20	10	20
10	COD	AA	AA	AA	AA	AA	30	AA	30
11	Dissolved Phosphorous as P	1	1	1	1	2	5	2	5
12	Nitrate Nitrogen as N	10	10	10	5	10	10	10	10
13	Faecal Coliform in 100 ml	Nil	Nil	Nil	Nil	Nil	230	Nil	230
14	Helminthic Eggs/litre	AA	AA	AA	AA	AA	<1	<1	<1
15	Colour	Colourless	Colourless	Colourless	Colourless	Colourless	AA	Colourless	Colourless
16	Odour	Aseptic which means not septic and no foul odour							

All units in mg/L unless specified; AA-as arising when other parameters are satisfied

A tolerance of plus 5% is allowable when yearly average values are considered

CHAPTER:8 PROPOSED SYSTEM

8.1 INTRODUCTION

The present DPR is prepared for the Sewage components identified in SAAP 2016-20 for Adoni municipality.

For SAAP 2016-20 DPR requirements; TCE has undertaken the brief study of the complete system of Adoni municipality. Necessary observations on the collection system and STP have been provided. For the components identified under SAAP 2016-20 DPR, preliminary design has been carried out and accordingly this report has been prepared.

8.2 WATER DEMAND

The water demand for Adoni municipality for various design horizons has been assessed based on the approved unit demand norms along with the approved population projections from the competent authority. (Approved by CE- PH&ME – Guntur vide his letter No-2 dated 17-10-16).

The summary of the water demand calculations are provided in the table 8-1.

Table 8-1: Water Demand for Adoni municipality

Sl. No.	Component	2011	Base year 2018	Year 2033	Ultimate year 2048
1	Population	166537	179500	204500	227000
2	Prorata Supply 135 lpcd (with15% loss)	159	159	159	159
3	Clear Water (MLD)- Residential	26.45	28.51	32.48	36.05
4	Floating population (10%)	16654	17950	20450	22700
5	Floating Prorata Supply 45 lpcd (with 15% loss)	53	53	53	53
6	Clear Water (MLD)- Institutional	0.88	0.95	1.08	1.20
7	Fire Demand (MLD)	1.29	1.34	1.43	1.51
8	**Total Clear Water (MLD)**	**28.62**	**30.80**	**34.99**	**38.76**

8.3 SEWAGE FLOWS

The proposed sewage flows are worked out on the basis of the projected design population, per capita sewage generation of 108 litres per day. 10% of the total projected population is considered as institutional / commercial needs and the sewage generation of 36 liters per day is considered for institutional/Commercial needs. The infiltration allowance is considered as 10% of designed flows. The projected design

sewage flows for present, Intermediate and ultimate years are given in the table 8-2 below.

Table 8-2: Projected Sewage Flow for Adoni Town

Description	Base Year 2018	Intermediate Year 2033	Ultimate Year 2048
Population	179500	204500	227000
Sewage Flow (Litres per Capita per Day)	108	108	108
Sewage Generation (MLD)	19.39	22.09	24.52
Floating Population	17950	20450	22700
Sewage Flow for Floating (Litres per Capita per Day)	36	36	36
Sewage Generation (MLD)	0.65	0.74	0.82
Average Sewage Generation (MLD)	**20.04**	**22.83**	**25.34**
Infiltration 10%	2	2.28	2.53
Total Sewage generation MLD	**22.04**	**25.11**	**27.87**

As described in the existing system chapter, the town is divided into 4 sewerage zones. The zone wise coverage of Election wards is provided in table 8-3.

Table 8-3: Zone wise coverage of wards

Sr. No.	Zone No.	Wards Covered
1	Zone -I	21 to 25, 35 to 37
2	Zone –II	35 to 38
3	Zone –III	1 to 4, 6 to 10, 27, 29 to 34, 36, 38 to 41
4	Zone -IV	4 to 21, 25 to 29, 33, 34, 36

The probable sewage generation for present, intermediate and ultimate years for all the sewage catchment Zones in Adoni town are provided in the table 8-4 below.

The zone map of the town is shown in **Drawing No: TCE.10282A-CV-3009-SL-31702.**

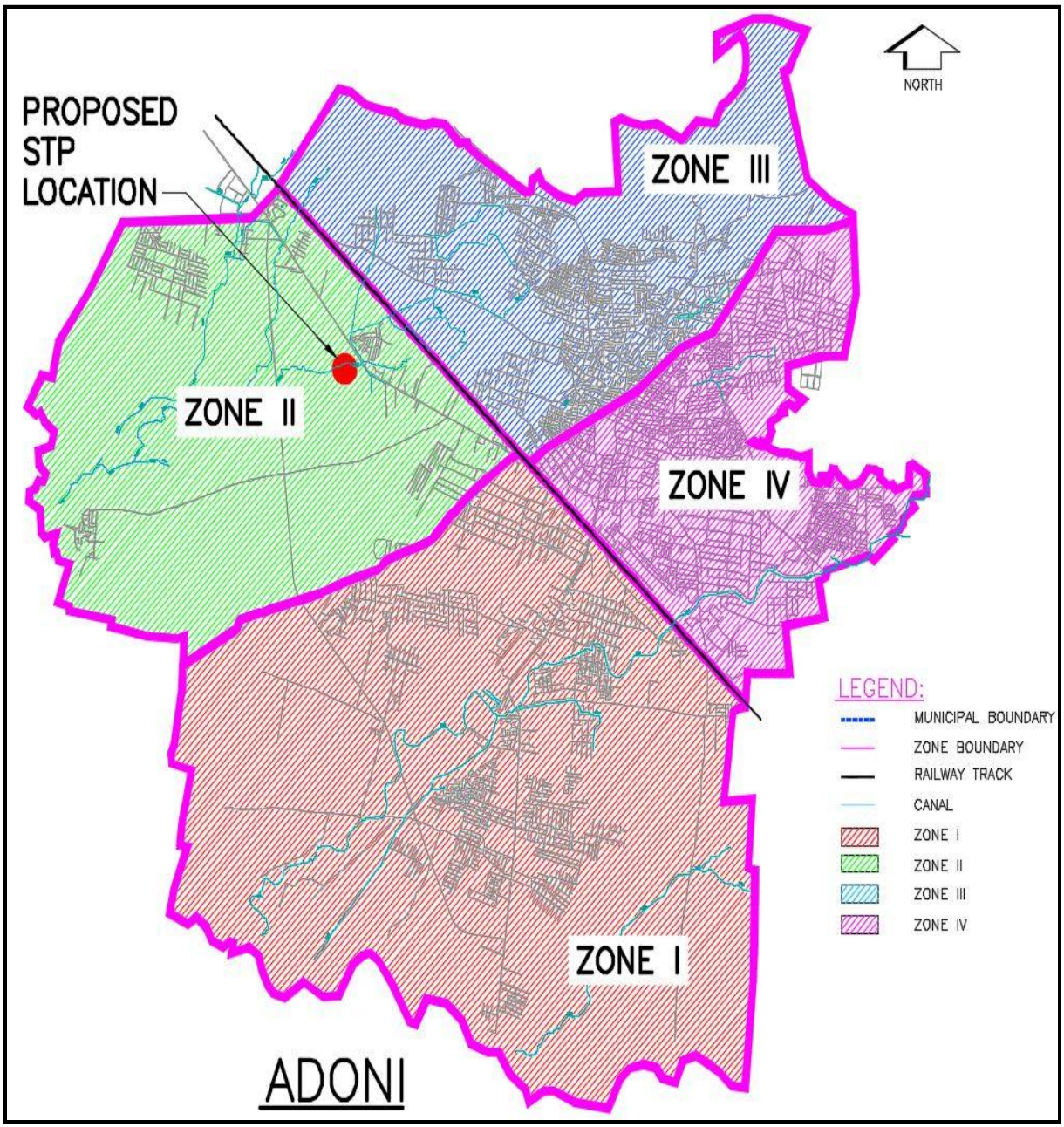


Figure 8-1: Zonal Map of Adoni City

Table 8-4: Zone wise projected sewage flow for Adoni town

Zone No.	Population			Demand @ 108 lpcd			Floating Population			Floating Demand @ 36 lpcd			Total Average Demand			Total Demand including infiltration losses			Proposed STP Capacity under Amrut (MLD)
	2018	2033	2048	2018	2033	2048	2018	2033	2048	2018	2033	2048	2018	2033	2048	2018	2033	2048	
Zone - I	19404	23285	28177	2.1	2.51	3.04	1941	2329	2818	0.07	0.08	0.1	2.17	2.59	3.14	2.39	2.85	3.45	
Zone - II	4930	5917	7159	0.53	0.64	0.77	493	592	716	0.02	0.02	0.03	0.55	0.66	0.8	0.61	0.73	0.88	
Zone - III	61180	69640	76723	6.61	7.52	8.29	6118	6964	7673	0.22	0.25	0.28	6.83	7.77	8.57	7.51	8.55	9.43	5
Zone - IV	93986	105658	114941	10.15	11.41	12.41	9399	10566	11495	0.34	0.38	0.41	10.49	11.79	12.82	11.54	12.97	14.1	
	179500	**204500**	**227000**	**19.39**	**22.08**	**24.51**	**17951**	**20451**	**22702**	**0.65**	**0.73**	**0.82**	**20.04**	**22.81**	**25.33**	**22.05**	**25.1**	**27.86**	

Table 8-5: Summary of Sewage generated in the zones

Zone No.	Total Sewage Generation (MLD)		
	2018	2033	2048
Zone – I	2.39	2.85	3.45
Zone – II	0.61	0.73	0.88
Zone – III	7.51	8.55	9.43
Zone – IV	11.54	12.97	14.1
	22.05	**25.1**	**27.86**

8.4 STP CAPACITIES - CALCULATION

As described earlier, the sewage generated from Zone-III and Zone II leads to the proposed 5 MLD. Necessary site visits and location suitability for the construction of the proposed STP has been carried out by TCE Engineers along with municipal Engineers and proposed lands are found to be suitable for the STP construction. The 5 MLD STP is proposed near Siriguppa Check Post, Rayanagar.

Based on the population projections and the sewage generations in the respective sewage zones, the capacities of the STPs have been calculated and is provided in the table 8-6 below.

Table 8-6: Summary of STP capacities required

Zone No.	Total Sewage Generation (MLD)		
	2018	2033	2048
Proposed STP for Zone-III (Near Siriguppa Check Post, Rayanagar)			
Zone-III	7.51	8.55	9.43
Total	**7.51**	**8.55**	**9.43**

From the above analysis, it can be concluded that a treatment plant of capacity 22.05 MLD will be required to treat the base year 2018 sewage flow for the entire town. However, at present 5 MLD for Zone-III capacity of STP is proposed under Amrut Scheme. During the horizon 2033 to 2048, to cater the Intermediate year flow of 20 MLD and for Ultimate year flow of about 2.86 MLD capacity of sewage treatment plants respectively will be required to treat future sewage flows generated from Adoni town.

Under AMRUT scheme, it is proposed 5 MLD capacity of STP which can treat present sewage generated from the town and the sewage is conveyed to STP through proposed interceptor drains.

Flow measurements, carried out on the drains near the proposed STP location (refer to the details provided in field surveys and investigations chapter) reveal that, the present waste water flow at Kachra Basti, Rayanagar is about 9.94 MLD. It can be concluded that at present, flow in the natural drain is available and therefore STP will get its design capacity flow during commissioning and operation.

Hence, based on the desktop analysis, field measurement and available funds, a capacity of 5 MLD capacity has been recommended.

This 5 MLD capacity is recommended for the following reasons

- With the 5 MLD proposed capacity, can be used to treat the part flows generated from the zone III & Zone II; until the above schemes are commissioned. Based on

the future increased flow of wastewater, new modules of required capacity can be added.

- The proposed capacity will meet the funds allocations for Adoni town under Amrut SAAP 2016-20 scheme.

8.5 Proposed STP for Zone I & II

The Adoni Municipality has identified a land of about 2 acre near Siriguppa Check Post, Rayanagar at 15^0 37'46.48"N, 77^0 15'14.34"E location for 5 MLD STP. The land is vacant and its transfer is in process. Treated effluent from STP will be discharged to the drains which will be finally utilised for irrigation purposes.

The location of the proposed STP is provided in figure 8-1.

Figure 8-2: Proposed STP location

Proposed STP location is shown in key plan of Drawing **No TCE.10282A-CV-3009-SL-31705**. Sewerage Zones for Adoni City is shown in **drawing No TCE.10282A-CV-3009-SL-31702.** Contour plan of Adoni City is shown in **drawing No TCE.10282A-CV-3009-SL-31701.**

8.6 INFLUENT AND EFFLUENT CHARACTERISTICS OF STP

Understanding of the nature of physical, chemical and biological characteristics of sewage is essential in planning, design and operation of treatment and disposal facilities. The raw sewage characteristics are referred from CPHEEO Manual, 2013. It is proposed that the sewage generated is to be treated to such standards that it can be used for Non potable applications. The typical characteristics of the raw sewage are provided in table 8-7.

Table 8-7: Characteristics of Raw Sewage

S.No.	Parameters of Raw Sewage	Values	Unit
1.	BOD_5	250 - 300	mg/l
2.	COD	500 - 600	mg/l
3.	Suspended Solids	300 - 350	mg/l
4.	pH	6.5 – 8.5	
5.	Total alkalinity as $CaCO_3$	300 - 400	mg/l
6.	Chlorides	250 - 300	mg/l
7.	Sulphate	100 - 150	mg/l
8.	Total Kjeldahl nitrogen	45 -50	mg/l
9.	Ammonical Nitrogen	35 - 40	mg/l
10.	Total Phosphorus	5 – 7	mg/l
11.	Temperature	15 – 35	0C

As per the new Guide lines of Central Pollution control board vide lr no A-14011/1/2015-MON/5245 Dated 09-10-2015, the characteristics of treated effluent standards of Sewage Treatment plant shall be as provided in the table 8-8.

Table 8-8: Standards for treated effluent of Sewage Treatment Plants

S. No	Parameters	Standards for New STPs (Design after notification date)*
1	pH	6.5-9
2	BOD, mg/l	Less Than 10
3	COD, mg/l	Less Than 50
4	TSS, mg/l	Less Than 10
5	NH_4-N, mg/l	Less Than 5
6	N-total, mg/l	Less Than 10
7	Fecal Coliform (MPN/100 ml)	Less Than 230
8	PO_4-P, mg/l	Less Than 2
Note: These standards will be applicable for discharge in water resources as well as for land disposal. The standards for Fecal coliform may not be applied for use of treated sewage In industrial purposes. Achievements of Standards for existing STPs within 5 years from date of notification.		

All other parameters shall be as per present APPCB/CPCB Norms for discharge in water resources as well as for land disposal.

8.7 PRELIMINARY DESIGN OF STP (SBR TREATMENT)

From the process selection studies carried out in the earlier chapters it was concluded that, SBR technology followed by Gravity sand filter was the recommended option for proposed Sewage treatment plant. This proposed STP is designed for an average flow of 5 MLD capacity. SBR based process description is provided below

8.7.1 PROCESS DESCRIPTION:

The Sequential batch reactor (SBR) followed by tertiary treatment including rapid gravity sand filters (if required) is intended to be adopted for treatment of sewage & shall be post chlorinated prior to usage. The hydraulics of the plant shall be designed in such a way that the flow from inlet chamber of STP to the disposal is by gravity.

The hydraulic gradient of the STP shall be such that no intermediate pumping is required. The following are the unit operations and processes required.

- Screening
- Grit removal
- Aeration and settling
- Recirculation of activated sludge (RAS)
- Transfer of surplus activated sludge (SAS)
- Post Chlorination
- Rapid gravity sand filter (if required)
- Sludge thickening
- Sludge dewatering using Centrifuges

8.7.2 PRIMARY TREATMENT

A. Inlet Chamber of STP

An inlet chamber shall be designed and constructed at a suitable location inside the plot. The levels in the inlet chamber shall be controlled through level controller to avoid overflow and the raw sewage pump should automatically trip at low level. The inlet chamber shall be provided with suitable arrangement of walkway with hand railing preferably connecting the inlet chamber, screen chamber and degritting system. Access facility to the walkways shall be provided. Sewage shall be received through the pumping main into the inlet chamber. The pumped sewage shall enter the inlet chamber such that the top sewage level in the inlet chamber shall coincide with the invert level of the pumping main.

B. Fine Screening Channels

Raw sewage received at inlet chamber shall be conveyed to a fine bar screen through channels designed for peak flows. The velocity in the channel shall not be less than 0.3 m/sec during minimum flow conditions and not more than 1.2 m/sec during peak flow conditions. There shall be two fine bar screen and each fine bar screen shall be

designed to deal with ultimate peak flow of the plant. The fine bar screens shall remove screenings from the sewage flow exceeding 6 mm in size.

C. De-gritting Unit

The screened sewage shall flow from the fine screens to degritting systems. Two degritting systems shall be provided each capable of handling ultimate peak flow. The degritting tanks shall be of RCC.

The systems shall be of square type with central scraping mechanism for removal of grit. A series of adjustable FRP baffles shall be provided at the inlet of the grit chambers for proper distribution of flow.

Grit shall be collected in one pocket at the periphery of the grit separation chamber by means of classifier mechanism; the grit shall be washed and discharged into hopper in the upstream of chamber which can be received in a trolley. A pump with suitable motor shall return organic matter at the inlet of the system. Corners of square grit chambers shall be sloped towards centre.

The degritted sewage shall be conveyed to the distribution chamber through a conveying channel. Suitable conditions for blending the Return Activated Sludge (RAS) with the degritted sewage and even distribution of flow between the anoxic zones/ tanks under all flow conditions shall be provided.

D. Parshall Flume

A Parshall flume, the most recognized and commonly used flume, is a fixed hydraulic structure developed to measure flow. It is currently used to measure volumetric flow rate in municipal sewer lines, and influent/effluent flows in wastewater treatment plants. The Parshall flume accelerates flow through a contraction of both the parallel sidewalls and a drop in the floor at the flume throat. Under free-flow conditions the depth of water at specified location upstream of the flume throat can be converted to a rate of flow.

8.7.3 SECONDARY TREATMENT

I. Sequencing Batch Reactor:

The Sequential batch reactor technology of activated sludge treatment shall be used.

The presence of solids in the influent to the aeration tanks shall be taken into account in the estimation of the surplus activated sludge. SBR basin(s) shall be designed for respective modular tank capacity. The aeration tank(s) shall be a reinforced concrete structure.

Each aeration module shall be preceded either by a separate anoxic tank or an anoxic zone. The anoxic zones / tanks shall be sized so that at a RAS flow rate equivalent to the average design flow of the incoming sewage, the nitrates present in the RAS shall be completely denitrified. SBR basin(s) to be designed for present average flow.

If an anoxic zone is used, it shall be separated from the aerated zone by a baffle. In order to prevent short-circuiting, the effluent from the anoxic zone shall be arranged in such a way that it is opposite to the influent, i.e., if the influent to the anoxic zone is at the top of the tank, the flow to the aeration zone shall be under the baffle. Back-mixing i.e., the intrusion of the mixed liquor from the aerated zone to the anoxic zone shall be prevented. The anoxic zones / tanks shall be equipped with mixers to maintain the activated sludge in suspension at all times. Slow mixers shall be used to avoid damaging the sludge flocs.

From the outlet weir of Anoxic tank(s), the mixed liquor shall flow into respective SBR basin(s). The portion of activated sludge from the Return activated sludge pumps shall be returned to the upstream of SBR basin(s). The return sludge arrangement shall ensure thorough mixing with the inflow into the Anoxic zone (s).

The diffused aeration system shall be so designed such that sufficient oxygen is provided for carbonaceous treatment, sludge stabilization, nitrification and maintaining the DO at the specified level. Allowance for diurnal variations in the load shall be made. Reduction in oxygen demand due to denitrification in the anoxic zones shall also be taken into account. An on-line DO monitoring system shall be provided for each SBR basin. Mounting shall be on a rigid base plate. During power failure and on application of standby power through DG set, the blower(s) are required to be run continuously. Necessary instrumentation and control system shall be provided for the same.

II. Chlorination Unit

Post chlorination facility shall be provided for disinfecting the treated sewage before transfer to the gravity sand filtration. The facilities shall comprise a mixing tank followed by chlorine contact tank. The overflow from the SBR basin(s) shall be received through a channel at the mixing tank and passed on to the chlorine contact

tank. The Chlorine contact tank shall be constructed of RCC, provided with baffles inside the tank. Chlorine contact tank shall be designed for a hydraulic retention time of 30 minutes at ultimate average flow.

Treated Sewage shall be dosed with chlorine gas at concentrations not less than 5 mg/l and not more than 10 mg/l at entry to the contact tank. Effluent from the chlorine contact tank shall not have more than 1 mg/l of residual chlorine at all flow conditions. The chlorinators shall be adequate to dose the required chlorine during the peak flow conditions.

HAZARDS ASSOCIATED WITH CHLORINE

Health Hazards

General—Chlorine gas is primarily a respiratory irritant. The characteristic penetrating odour of chlorine gas usually gives warning of its presence. At higher concentration it is visible as greenish yellow gas. The effect of chlorine may become more severe for upto 36 hours of exposure.

Acute Local—Short-duration exposures of skin to high concentrations of chlorine gas are not much irritating or corrosive. But this effect is perceptible only when prolonged exposure is tolerated by the use of respiratory protection. Splashes of liquid chlorine on the eyes, skin and clothing, may cause immediate irritation and chemical burns, and severe damage to body tissues.

Acute, Systemic—Chlorine gas is extremely irritating to the mucous membranes, the eyes and the respiratory tract. If the duration of exposure or the concentration of chlorine-is excessive, it will cause restlessness, throat irritation, sneezing and copious salivation. In extreme cases, lung tissues may be attacked resulting in pulmonary edema. Inhale lowest published toxic concentration TC_{L0} is 15 ppm and Inhale lowest published lethal concentration is 430 ppm. The physiological effects of various concentrations of chlorine gas are shown in Table 1.

Table 8-9: Effect of Chlorine at Various Concentrations (***clause* 4.1.3**)

Sl No.	Effects	Concentration of Chlorine Gas in Air, ppm
i	Least amount for detectable odour	3.5
ii	Threshold of irritation	4.0
iii	Noxiousness, impossible to breathe several minutes	5.0

Sl No.	Effects	Concentration of Chlorine Gas in Air, ppm
iv	Concentration causing immediate irritation of throat	15.0
v	Concentration causing cough	30.2
vi	Concentration dangerous in 30 minutes to 1 h	40-60
vii	Concentration dangerous for even short exposure	50.0

Chronic (Local and Systemic)—

- ✓ A concentration of 1 ppm of chlorine gas may produce slight symptoms after several hours exposure.
- ✓ Prolonged exposure to atmospheric chlorine concentration of 5 ppm results in disease of bronchi and a pre-deposition of tuberculosis while lung studies have shown that concentration of 0.8 to 1 ppm cause permanent, although moderate reduction in pulmonary function.
- ✓ Acne is not unusual in persons exposed for long periods of time to low concentrations of chlorine, and is commonly known as chlorance—Tooth enamel damage may also occur.

GENERAL PREVENTIVE MEASURES

The fundamental steps for safe working conditions in a plant or area where chlorine is produced, stored or processed are:

a. Designing of layout of area with due consideration for adequate natural or mechanical ventilation,
b. Use of properly selected material for construction of plant and equipment for handling of chlorine,
c. Preventive maintenance of all equipment in proper working condition, and
d. Availability and use of adequate and suitable personal protective equipment at all times.
e. Chlorine Leak Detector system

Chlorine is particularly irritating to persons afflicted with asthma, certain types of bronchitis, other chronic lung conditions, and irritations of the upper respiratory tract; such persons should not be employed where exposures to chlorine gas might occur. Pre-placement medical examination including a chest X-ray is recommended for all new entrants and follow-up medical examinations at suitable intervals for all workers handling chlorine.

Eye Protection

Eye protection devices should always be worn in a chemical plant. If there is danger of contact with liquid chlorine, it is essential to wear a gas mask with a full face piece.

Respiratory Protection

A suitable gas mask should be available to every employee involved with chlorine handling. Respiratory protective equipment should be carefully maintained and kept in clean, dry, light-proof cabinets properly protected by paraffined paper or polyethylene bags. Cleaning and inspection by competent person is generally necessary after each occasion on which the apparatus is used and should, in any case, take place at least once a month. Equipment used by more than one person should be sterilized after each use. A defective or inoperable mask is worse than none at all.

1.12 TERTIARY TREATMENT (IF REQUIRED)

A. Rapid Gravity Sand Filter

The rapid gravity sand filter comprises of bed of sand serving as a single medium granular matrix supported on gravel layer overlying an under drainage system. When the clarified water containing suspended and colloidal matter is applied to the top of filter bed, these solids are entrapped in the granular medium matrix. The accumulation of suspended particles in the pores and on the surface of filter medium leads to built up of head loss. When the head loss reaches at a pre-determined value, the filter is then backwashed with the help of air and water to remove the accumulated suspended matter from filter.

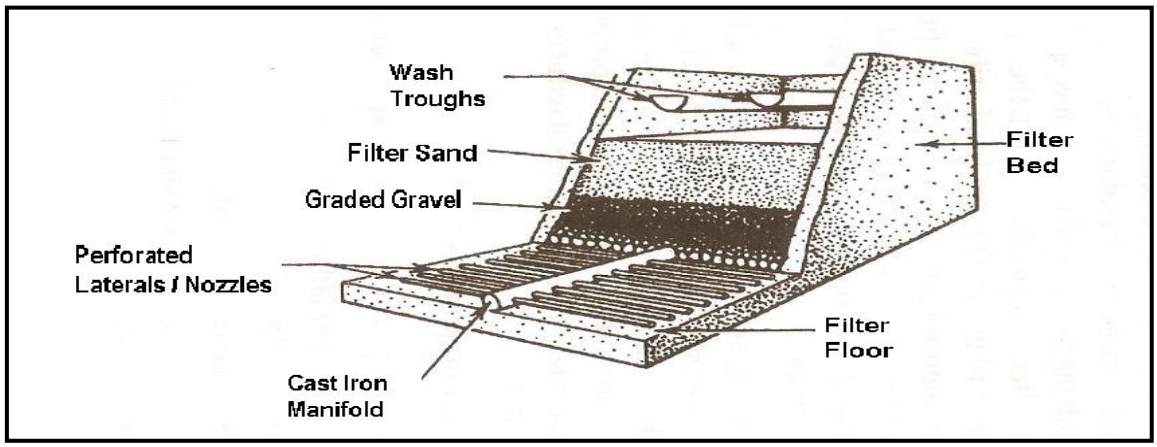


Figure 8-3 Rapid Gravity Sand Filter

After chlorination the treated effluent will be pumped to the Rapid gravity sand filter, Ferric chloride will be added to the online static mixer to enhance coagulation and flocculation. Inline Mixers shall be provided for mixing of chemicals with the secondary

treated water. The floc size will be increased with static mixers. The flocculated water will be transferred through the rapid gravity sand filter, where suspended matter will be accumulated on media and treated water will be stored in the treated water tank. The provision for chlorination shall be kept in the treated water tank. Treated water can be directly use for Non potable applications like flushing and floor washing gardening etc. Wash water will be transfer to the Equalization tank for further treatment.

Unit sizing of typical 5MLD capacity SBR technology treatment plant is given in table 6-3 below and layout is shown in **drawing no. TCE.10282A-CV-3009-SL-31705**

Table 8-10: STP Treatment Unit Sizes

S.No	Description	Sizing of Unit (in m)	Qty
1	Stilling Chamber	1.6 X 1.4 X 2	1
2	Mechanical Fine Screen	5 X 0.6 X 0.6	1
3	Manual Fine Screen	5 X 0.6 X 0.6	1
4	Grit Chamber	4.5 X 4.5 X 0.90	2
6	Distribution box	3.0 X 3.0 X 2.0	1
7	Selector Zone	18.2 X 5.3 X 5.5	2
8	SBR Basins	18.2 X 18.2 X 5.5	2
9	Sludge Sump	4 X 5.5 X 2.0	1
10	Thickened Sludge Sump	4 X 3.0 X 1.5	1
11	Sludge Dewatering Building	7.5 X 5.0X 5.0 (GF) 7.5 X 5 X 4.5 (FF)	1
12	Sludge Thickener	7.2 Dia X 3.50	1
13	Chlorine Contact Tank	14 X 6 X 2.5	1
14	Chlorine Building	6.0 X 5.0 X 3.5	1
15	Air Blower Building	12.0 X 5.0 X 5.5	1
16	Workshop	5.0 X 4.0 X 3.0	1
17	Admin Building & Toilet block	5.0 X 5.0 X 3.5 (GF) 5.0 X 5.0 X 3.5 (FF)	1
18	DG Room	8.0 X 5.0 X 4.5	1
19	MCC Room	9.0 X 5.0 X 3.5	1
20	Transformer Yard	9.0 X 5.0	1
21	Guard Room	2.4 X 2.4 X 3.0	1
22	Septage Holding Tank	4.5 x 4.5 x 2	1

8.8 EFFLUENT DISPOSAL

The options of reuse of treated sewage so far have not been explored. Meanwhile the treated effluent from the STP will be discharged into the existing drains, which will be finally utilised for irrigation purpose.

The project provides the reuse of treated sewage which can be utilised for water reclamation and non potable uses such as: Washing cars, flushing toilets, cooling water for power plants, concrete mixing, artificial lakes, irrigation for golf courses and public parks, and for hydraulic fracturing.

8.9 UTILITIES IN PROPOSED STP

Utilities for the treatment plant facilities will consist of the following components

i. Water Supply arrangement

At Sewage treatment plant potable water is required for various uses including

a. Domestic supply for the staff
b. Laboratory for testing
c. Preparation of chemicals
d. Washing purpose
e. Cooling system

The source of water will be Municipal supply.

ii. Green Belt

Provision of green belt on the periphery of the STP to shield the view of the facility from outside is proposed. Suitable trees shall be planted at various locations in such a way that they do not interfere with the work operations. Lawns and flower beds shall be provided at free available spaces.

iii. Roads

Roads will be provided around the structures. The roads will be 5m wide and surface with asphalt. Places where vehicular movement is not expected 2m wide brick pavement is provided. Storm water drainage will be provided along the roads which will finally terminate at the nearby natural nalas / drain.

iv. Storm Water Drainage

Storm water drainage will be provided along the roads and hard standing areas to prevent flooding and to divert storm water to the outfall effluent channel. A rainfall intensity of 50 mm/hour has been used for the design of the storm water system. The hydraulic design will be carried out using Manning's formula for open channel flow.

Channels are designed for a minimum self -cleansing velocity of 0.6 m/s and a maximum velocity of 3.0 m/s. The rectangular channels will have a minimum size of 0.3 m wide x 0.4 m deep and a maximum size of 1.0m wide x 1.0m deep. The minimum freeboard will be 0.2 m.

v. Compound walls/Fencing

Common burnt brick wall with barbed wire fencing above is proposed along the periphery of the STP. Gates will be provided at the main entrance and picket gates are proposed at selected other places along the boundary.

vi. Site Security

A security office with facilities to record the entry and exit of the Contractor's and employer's staff and visitors shall be provided at the entrance. Security posts are proposed at the corners of the plot boundary.

8.10 TERMINAL SEWAGE PUMPING STATION

As described in the earlier sections, the sewage generated from Zone-III flows into drain near Siriguppa Check Post, Rayanagar. A small weir like structure is intended to be constructed across the drains to intercept and divert the sewage to the proposed STP. At the proposed STP locations, a terminal Sewage Pumping station shall be constructed for lifting the sewage. The typical diagram of the proposed Sewage Pumping station is provided as **TCE.10282A-CV-3009-SL-31704.**

For sewage pumping stations, the civil works have been designed for the sewer capacities. However the mechanical and electrical equipment will be designed for the actual flows in view of the ease of changing equipment in short time. The equipment life is considered to be 15 years compared to structures which have about 50 years of useful life. Generally, the maximum flow i.e. peak inflow at design horizon dictates the size of wet well of the pumping station. Fully submersible pumps have been considered in the design where motor is housed in the submerged unit.

i. Screening and Grit Removal

Wastewater from open drain Nallah contains large solids and grit that can interfere with treatment processes or cause undue mechanical wear and increased maintenance on sewage treatment equipment. To minimize potential problems, these materials require separate handling. Preliminary treatment removes these constituents from the influent wastewater. Preliminary treatment

consists of trash screening followed by mechanical coarse screening & Manual grit removal channel.

ii. Terminal Pumping Station

At the proposed STP location, a terminal Sewage Pumping station shall be constructed for lifting the water. **The layout and HFD (Hydraulic Flow Diagram) of the inlet works are provided in the drawing no. TCE.10282A-CV-3009-SL-31704.**

For sewage pumping stations, the civil works have been designed for the sewer capacities. However the mechanical and electrical equipment will be designed for the actual flows in view of the ease of changing equipment in short time. The equipment life is considered to be only 15 years compared to structures which have about 60 years of useful life. Generally, the maximum flow i.e. peak inflow at design horizon dictates the size of wet well of the pumping station. Fully submersible pumps have been considered in the design where motor is housed in the submerged unit.

8.10.1 Design criteria

The size of the sump will be based on retention period of max 30 minutes of Average flow and minimum 5 minutes of peak flow. Pipes and valves will be sized such that the velocity shall not exceed 2.0 m/s.

8.10.2 Layout and installation

The sewage will be diverted through weir in the natural drain. The wet well is 5 m in diameter at 5 MLD STP. Submersible non - clog pump motor set with chain - pulley block and pump motor set sliding on guide rails has been selected. The arrangement is such that when pump reaches bottom base, its delivery nozzle sits automatically on delivery pipe. In order to remove the submersible pumps a cutout of 3m x 2m has been provided on the pump floor slab. For proper space utilization of pump house the delivery pipes, common header along with their valves and dismantling joints are placed in a separate chamber beside the pump house. For maintenance purpose CI rungs will be provided inside the valve chamber. In order to avoid solid deposition in the bottom floor of the wet well suitable benching will be provided and will be directed towards the submersible pumps. Superstructure of about 6m x6m has been considered in order to accommodate Electrical control panels, ventilation fans and manually operated overhead travelling hoist.

The capacity is kept 1.5 times in order to lift and lower the single heaviest component in the pump house. The hoist shall be provided with all needed slings and other associated equipment to handle the plant installed.

Head room in the pump room of pumping station is kept adequate to ensure handling of pump and motor in service bay without constraint. The headroom will also be adequate to ensure natural ventilation and heat dissipation to a tolerable limit in event of non-functioning of ventilation system. Rolling shutter has been considered for partial vehicle movement inside pumping station for loading and unloading of pumps.

8.10.3 Pump duty

There will be three working and two stands by pumps. The capacity of the working pumps will be 209 m3/hr (2Working DWF) + 105 m3/hr (1 Working ½ DWF) and standby pumps will be 209 m3/hr (1 Standby DWF) + 105 m3/hr (1 Standby ½ DWF) with a head of 18m for 5 MLD STP.

8.10.4 Valves and pipe work

Pump valves, pipe work, and their supports shall be designed to withstand the maximum stresses imposed by any operating condition, including the shock resulting from pump starting when the advancing inrush of sewage strikes the closed non-return valve.

The design maximum velocity through the valves and pump branch pipe work shall not exceed 2m/s.

The design pressure rating of valves and pipe work shall be 1.5 times the pump shut valve pressure or 10 bar, whichever is greater.

Each pump shall be provided with a delivery non-return valve, a delivery isolating valve, and an automatic air inlet/release valve. The air valve shall be fitted to the delivery pipe work near to the discharge bend and upstream of the non-return valve.

Pump delivery isolating valves shall be manually operated, resilient-seated butterfly valves/gate valves. Manual operation shall be by hand wheel through integral reduction gearing.

Non-return valves shall be of the swing-check type, designed for rapid closing as soon as forward flow stops.

Each pump air inlet/release valve shall be designed and sized to ensure:

a) On pump stopping, the pump column pipe drains into the pump well so that negative pressures, which could be damaging when the pump is restarted cannot occur.

b) On pump starting, air is expelled from the column pipe fast enough to prevent air being forced past the pump non-return valve and into the delivery manifold, and the air cushion in the column pipe prevents damage to pipe work or non-return valve from the advancing water column.

A delivery main isolating valve shall be provided as shown on the drawings.

The valve shall be gate type with resilient seating, and manually operated by a hand wheel through integral reduction gearing.

The valve shall be the same pressure rating as the delivery manifold.

Pump delivery pipe work shall be ductile iron, with flanged connections. Pressure ratings shall match those for valves as given above.

Dismantling joints shall be incorporated wherever needed to facilitate the removal of pipes valves.

8.11 Septage Quantity Generation

Septage generation rates vary widely from place to place depending on practices of septic tank use, number of users, water used for flushing and the frequency of cleaning the septage. The size of a septic tank in individual houses in India ranges from 1 to 4 cum, whereas the size of a septic tank in office or apartment buildings may vary from 10 to 100 cum.

The average daily quantity of septage to be treated depends on volume of digested sludge in septic tank and sludge withdrawal frequency. Volume of digested sludge is normally considered as 0.00021 m^3 per capita per day. The references have been taken from **IS: 2470 (Part I) – 1985, Clause** 3.4.3.3. Table 8-13 provides information on the quantum of septage generation calculated for Adoni Town used for septage treatment in the proposed STP's

Table 8-11:Sewage Treatment Plant Design Consideration with Septage

1	**Sewage Treatment Plant Design Consideration**		
	Description	**Value**	**Units**
	Number of House Holds	40611	Nos.
	Number of Existing Septic Tanks	30459	Nos.

	Number of Septic Tanks to be installed (Assuming Septic Tanks will be in Place within next 1-2 years)	10152	Nos.
	Total Population of at Base Year 2018	179500	Nos.
A	**Total BOD load to STP : From House Holds having Septic Tanks**		
	Part -1 : Overflow of Septic Tanks		
	Sewage Quantity as Septic Tank Effluent considering 45 liters per capita of total wastewater generated		
	Overflow of Septic Tanks	6058	M3/day
	Biological Oxygen Demand (BOD) values averaging considered as Septic Tank Effluent as Per MoUD.	140 - 200	mg/L
	BOD Considered as maximum Value	170	mg/L
	Total BOD Load per day to STP	1030	Kg/day
	Part -2 : Grey Water		
	Grey water generated considering 90 liters per capita of total wastewater generated	9693	M3/day
	Biological Oxygen Demand (BOD) values averaging considered as Septic Tank Effluent as Per Technical Documents available (Data on Grey water parameters not available in CPHEEO Manual)	50 – 150	mg/L
	BOD Considered as maximum Value	100	mg/L
	Total BOD Load per day to STP	969	Kg/day
	Total BOD load to STP : Septic Tank Effluent +Grey Water	1999	Kg/day
	Total flow : Septic Tank Effluent + Grey water	15752	M3/day
	Expected Average BOD after mixing Septic Tank Effluent + Grey Water	126.92	mg/L
B	**Total BOD load to STP : From House Holds without Septic Tanks**		
	Part -3 : Direct Sewer Line + Grey Water		
	Sewage Quantity	4846	M3/day
	Biological Oxygen Demand (BOD) value	250 - 300	mg/L
	BOD Considered as Average Value	275	mg/L
	Total BOD Load per day to STP	1333	Kg/day
C	**Expected Average BOD Load of Part 1, 2 & 3**		
	Total of Part 1, 2 & 3		
	Total Sewage Quantity Generated	20598	M3/day
	Total BOD Load per day	3332	Kg/day

	Expected Average BOD*	**161.8**	**mg/L**
	*** Maximum BOD value will be <200 mg/L due to partial degradation of the BOD in the Septic Tank.**		
	Total Sewage Quantity to STP	5000	M3/day
	Total BOD Load per day as per STP Capacity	809	Kg/day
D	**Septage Treatment :**		
	Description	**Value**	**Units**
	Population (for year 2018- from Zone)	179500	Nos.
	Volume of Septage	0.00021	Cum/capita/ d
		37.70	Cum/d
		13759	Cum/year
	Septic Tank Cleaning Frequency Assumed	1	Year
		365	Days
	Septage volume	13759	Cum/year
		37.70	Cum/day
	Biological Oxygen Demand (BOD) of Septage as Per MoUD.	7000	mg/L
	Total BOD Load per day to STP due to Septage	263.87	Kg/day
2	**Scenario 1 : If Independent Septage Treatment Facility will be Proposed :**		
2.1	**STP Design Value:** Expected Average BOD coming to STP is approximately 161.8 ppm, If we design the STP as per current Scenario of maximum BOD of 200, STP will be 30-40% under design when entire sewerage Network will be in Place.		
	STP shall be design assuming Entire Sewerage network will be in place within next 3-5 years. Then following will be the Scenario.		
	Description	**Value**	**Units**
	Sewage Quantity	5000	M3
	Inlet BOD for Design	250 - 300	mg/L
	BOD Considered as Average Value	275	mg/L
	Total BOD Load	1375	Kg/day

<table>
<tr><td>2.2</td><td colspan="3">Requirements of additional Treatment Units to Treat Septage Independently: Anaerobic sludge digestion in sludge Digester Tank, Biogas Generation & Storage/biogas flaring facilities should be provided.</td></tr>
<tr><td></td><td>Description</td><td>Value</td><td>Units</td></tr>
<tr><td></td><td>Biological Oxygen Demand (BOD) - Average Value considered as Septage as Per MoUD.</td><td>7000</td><td>mg/L</td></tr>
<tr><td></td><td>Septage Volume</td><td>37.70</td><td>M3/day</td></tr>
<tr><td></td><td>*All other parameters are considered as per mentioned in Chapter 7</td><td></td><td></td></tr>
<tr><td></td><td colspan="3">Septage has a much higher concentration of pollution constituents than septic tank effluent. Biochemical Oxygen Demand (BOD) and total suspended solids (TSS) are two common parameters indicating the strength of wastewater.</td></tr>
<tr><td>3</td><td colspan="3">Scenario 2 : If the Treatment of Septage at Sewage Treatment Plants will be Proposed :</td></tr>
<tr><td>3.1</td><td>STP Design Value :</td><td></td><td></td></tr>
<tr><td></td><td>Description</td><td>Value</td><td>Units</td></tr>
<tr><td></td><td rowspan="2">Septage volume</td><td>13759</td><td>Cum/year</td></tr>
<tr><td></td><td>37.70</td><td>Cum/day</td></tr>
<tr><td></td><td>Biological Oxygen Demand (BOD) of Septage as Per MoUD.</td><td>7000</td><td>mg/L</td></tr>
<tr><td></td><td>Total BOD Load per day to STP due to Septage</td><td>263.87</td><td>Kg/day</td></tr>
<tr><td></td><td>Expected Average BOD after mixing Septic Tank Effluent + Grey Water + Direct from Household without Septic Tank</td><td>161.76</td><td>mg/L</td></tr>
<tr><td></td><td>Total BOD Load per day to STP as Septic Tank Effluent + Grey Water</td><td>808.81</td><td>Kg/day</td></tr>
<tr><td></td><td>Expected BOD after Septage Mixing with Sewage at Inlet of STP</td><td>1073</td><td>Kg/day</td></tr>
<tr><td></td><td>Total Flow to at the inlet of STP</td><td>5000</td><td>M3/day</td></tr>
<tr><td></td><td>Expected BOD after Septage Mixing with Sewage at Inlet of STP</td><td>214.54</td><td>mg/L</td></tr>
<tr><td></td><td colspan="3">Maximum BOD value will be <250 mg/L due to partial degradation of the BOD in the Septic Tank. Hence, Sewage treatment plant has adequate design capacity to accommodate the Septage without hampering the functioning of the sewage treatment plant. The operational efficiency will remain same due to the flexibility and automation.
Assuming flow of 5 MLD of sewage of 140 - 210 mg/L BOD is conveyed to the treatment plant and additional Septage of 37.70 m3 of 7000 mg/L, the proportioned inlet BOD has diluted to 214.54 mg/L which is less than the design considered BOD. However the BOD shall be within the range of design parameter of 250 mg/L to 300 mg/L.</td></tr>
<tr><td></td><td colspan="3">When the entire Sewerage network for Zones will be in place within 3-5 years, then BOD value will be in the range of 250 – 300 mg/L , which is as per the Standard Parameters of CPHEEO.</td></tr>
</table>

	However, when the sewerage network will be in place, Septic Tanks needs to be Bypassed & demolished. If the septic tanks will not bypassed then the De-sludging of Septic Tanks, transporting the Septage would be resulting into the recurring cost.		
	Biological Oxygen Demand (BOD) considered for Design.	250 - 300	mg/L
	above table, provides a method to estimate the allowable rates of Septage addition, assuming that a holding tank is provided and that Septage is added to the sewage flow uniformly.		
	The Septage addition to the STP should be at a constant rate (uniform) as per the estimated Quantity as per above table with a provision of holding tank.		
3.2	Requirements of additional Treatment Units to Treat Septage in the STP: There is no requirement of Anaerobic sludge digestion in sludge Digester Tank, Biogas Generation & Storage/biogas flaring facilities.		
4	**Comparison of Septage Treatment**		
S.N.	**Description**	**Independent Septage Treatment Facility**	**Treatment of Septage at Sewage Treatment Plants**
a	Additional Units Required		
1	Septage Holding Tank	Tank Volume required at least 1 Day retention	Tank Volume required at Minimum retention
2	Sludge Digester	Required	Not Required
3	Bio Gas Holder	Required	Not Required
4	Bio gas Flaring Unit	Required	Not Required
5	Digested Sludge Holding Tank	Required	Not Required
b	Additional Land Requirement	Required	Not Required
c	Capital Cost	High	Very Low
d	Operational Cost (in terms of Skilled manpower to handle Bio Gas System)	High	Very Low
e	Proven Technology (Established and mature technology)	Not Proven	Proven & Mature
f	Technology - Capacity Scale and Set-up.	Not Proven	Optimized for any scale and can be easily set-up.

Conclusion: As presented in the overall scenario above, Co-treatment of Septage along with Septic Tank Effluent at a sewage treatment plant (STP) seems to be the most desirable option. It is recommended to consider the Co-treatment of Septage along with domestic sewage at a sewage treatment plant (STP).

8.12 Septage Transportation to STP

Present Septage quantity of entire town of Adoni is around 37.70 m3/day. Hence 4 nos. of vacuum cleaner tanks each capacity of 5 m3 tanks with approximately 2 no. of trips would be required for septage transportation to STP site.

Hence, the consultants have designed the septage management for the existing septic tanks in the town.

8.13 Sludge Treatment

The excess sludge generated from the STP shall be collected and dewatered using the mechanical dewatering sludge thickeners. The consistency of Waste Activated Sludge (WAS) from the clarifier shall be considered to be 0.5 - 1 %. Overflow from the gravity thickener & Centrate from the sludge treatment will be collected in Return Liquor Collection tank and recycled back to inlet chamber.

Septage collected from septic tanks will be transported to STP location by Septic tank cleaners. Septage Holding Tank with 1 day holding capacity will be provided. Septage will be blended with mechanical agitation. Homogenized Sludge will be then uniformly feed to inlet of STP. Waste activated sludge, which is typically pumped from SBR Basins will be passed to sludge thickeners. Total sludge from sludge thickeners will further passed to centrifuge system for solids separation from water. To enhance the dewatering process / treatment of excess sludge, Poly electrolyte (5Kg/tonne dry solids) will be dosed to the thickened sludge. The dewatered sludge generated from centrifuge will have the solid concentration of 18 - 20%. The dewatered sludge cake shall be collected and further treated for pathogen reduction, so that it can be disposed without any environmental hazard or finally used as manure.

8.14 BENEFITS OF THE PROJECT

Benefits of proposed project are listed below

- ✓ Zone of the town (Zone-III) will be served with sewage treatment system.
- ✓ Service levels will be improved to an extent with respect to sewage treatment system.

8.15 SUMMARY OF PROPOSED WORKS

Summary of proposed works are as follows

- ✓ Construction of overflow weir for the diversion of sewage to the STP - 15 m (length) x 2.40m (base width) x 1.50m (top width) x 0.50m (depth)Construction of Inlet works such as receiving chamber, trash screens, mechanical coarse screens, stilling chamber for removal of grit and collection well for pumping of sewage.
- ✓ Construction of 5 MLD Sewage Treatment Plant including septage management

8.16 SERVICE LEVEL BENCH MARK – SEWERAGE SYSTEM - PROPOSED

Service level with respect to treatment aspect increases from void to 30% for present conditions.

CHAPTER:9 ELECTRICAL WORKS

9.1 Scope of Works

This section provides brief description of the electrical power supply requirement and other electrical works for the proposed 5MLD STP and its associated pumping station at Adoni, which include the following equipment and systems;

a) Power Supply Arrangements.
b) 11/0.433 kV Distribution Transformer
c) Low Tension (LT) system – 415 V Low Voltage Distribution Board (LVDB)
d) 415V APFC Panel with Capacitor Bank.
e) Distribution Boards for Lighting and Receptacle (L+ PDB), Ventilation distribution board (VDB).
f) HT & LT Power and Control Cables and Cable carrier system
g) LT Motors
h) Illumination system
i) Earthing & Lightning Protection.
j) DG set

9.2 Design Concept

9.2.1 The design concept of electrical system as a whole shall be based on providing safe, reliable & stable power and efficient performance of electrical system.

9.2.2 The design standards described herein are generally in compliance with the latest Indian Standards and code of practices already established in the country.

9.2.3 All electrical installations shall conform to the latest Central Electricity Authority Regulations 2010.

9.2.4 The design ambient temperature for all electrical equipment shall be 50°C.

9.3 Power Supply Arrangement :

9.3.1 Primary Power Source

9.3.1.1 The power supply to the proposed system shall be provided from the nearest APSPDCL distribution substation-33/11 kV APSPDCL Industrial estate substation,

(15^0 38'18.68"N, 77^0 14'46.60"E), by dedicated feeder/s at 11 kV voltage level. APSPDCL shall provide the feeder with either overhead ACSR conductors or underground laid HT cable as suitable with two (2) pole structure.

9.3.1.2 Tariff Metering equipment (suitable for 11KV supply point) including combined CT/PT metering unit as per APSPDCL standards & specifications shall be provided by APSPDCL.

9.3.1.3 The Contractor's scope shall include 11KV two (2) pole structure (along with necessary earthing, fence and gate) with 11kV GOD (including operating handle and lock), Lightning Arrestors and Drop Out (DO) Fuses (wherever applicable for transformer(s) being fed directly from Two/ Four pole structure) for the 11kV power supply obtained through 11kV transmission line/ cable.

9.3.1.4 As per Statutory requirements if transformer capacity exceeds 800kVA, then 11kV breaker panel shall be provided.

9.3.1.5 11kV/ 0.433kV Oil type, ONAN, Dyn11, Distribution Transformers with OCTC, RTCC, Marshalling box etc. shall be provided with 100% standby unit.

9.3.1.6 For schematic distribution please refer Single Line Drawing (SLD) number **TCE.10282A- 4001-AU-40007 (Sheet 1 of 2 and Sheet 2 of 2).**

9.4 General Design Criteria

9.4.1 11kV HT System

a)	Nominal Voltage	:	11 kV
b)	Frequency	:	50 Hz ± 5 %
c)	No. of Phases	:	3
d)	Connection	:	3 Wire
e)	Maximum fault level	:	500 MVA (As per IS:2026)

9.4.2 LT System

a)	Nominal Voltage	:	415 V ± 10 %

b)	Frequency	:	50 Hz ± 5 %
c)	Connection	:	4 wire
d)	No load transformer voltage	:	433 V
e)	System earthing	:	Solidly earthed
f)	Maximum fault level	:	Based on the transformer rating

9.4.3 AC Control , Lighting and Space Heating

a)	Nominal Voltage	:	240 V ± 10 %
b)	Phase	:	Single
c)	Frequency	:	50 Hz ± 5 %
d)	Connection	:	2 wire (Ph + N)

9.5 Distribution Transformer

9.5.1 11/ 0.433kV Distribution Transformers (DT) shall be oil filled and suitable for outdoor installation. With reference to Transformer sizing Two (2) nos. of DT's sets- 400 kVA are proposed with 100% stand-by arrangement. The DT's shall have Off– Load (Circuit) Tap Changers (OCTC). The transformers shall be Delta/ Star connected with effectively earthed Star point on the secondary side. The primary and secondary terminals will be brought to the bushings for ease of termination of conductors and cables/ bus duct respectively.

9.5.2 Protection against internal incipient fault will be by Buchholz relays. Over temperature indicator and winding temperature shall be provided for the prevention of over-temperature of oil and windings.

9.5.3 Two (2) nos. of transformers shall be provided in substation such that under normal condition, each transformer will be loaded up to 50% and in case of failure of any one transformer, the healthy transformer shall have capacity to take entire load so as to have 100 % redundancy. The Transformer shall also be sized for motor starting of the largest rated motor with maximum possible base load with voltage drop/dip within the tolerable limits of 15% during starting and 5% during running.

9.6 System Protection

9.6.1 The following protection systems shall be used:

a) 11 kV Incoming Supply

(i) Drop Out fuse

b) 415 V Incomer Feeders/ Bus couplers

(i) Overload, Earth fault and short circuit protection through microprocessor based releases;

c) 415 V Incomer Feeders/ Bus couplers

(i) Overload, Earth fault and short circuit protection through microprocessor based releases;

d) LV Motors

(i) Motors of rating less than 15 kW

- Thermal Overload (OL) Relay

- Single phasing Preventer.

(ii) Motors of rating above 15 kW and below 110kW

-Thermal Overload (OL) Relay

-Motor Control Unit (MCU)

Motor Control Unit (MCU) shall provide the following protection :

- Earth fault (EF)
- Phase currents out of balance
- Single phasing Preventer.

(iii) Motors of rating above 110 kW

-Numerical protection relay shall be considered.

Numerical relay shall provide the following protection

- Short circuit
- Earth fault (E/F)
- Thermal overload

- Unbalance current
- Locked rotor
- Number of start within a specified time interval
- Under current function
- Single phasing Preventer

(iv) Submerged Motors shall be provided with the following additional protection:

- Moisture sensor
- Dry run protection

9.7 Switchgear / Instruments

9.7.1 415V Incomer Feeders and Bus Coupler

a) Above 630A, Four Pole (FP) Air Circuit Breaker (ACB) with Microprocessor based O/L, S/C and E/F (in built) release shall be provided

b) Ammeter with Ammeter Selector Switch (144 X 144mm,240 scale,tacet band)

c) Voltmeter with Voltmeter selector switch;

d) Control Fuse/ MCB based on Fault level at the Bus;

e) 96 x 96mm microprocessor based Multifunction Meter

f) R, Y, B indicating Lamps

g) CT, PT with required ratios & appropriate burden & class.

9.7.2 415V Outgoing Feeders

a) For MCCB Feeders (Other than Motor feeders)

(i) ON, OFF & TRIP Indications

(ii) O/L, S/C (in built) release and separate E/F release

b) For MCCB Feeders (Motor feeders)

(i) ON, OFF & TRIP Indications

(ii) Emergency Trip Indication

(iii) O/L, S/C (in built) release

9.7.3 Local Push Button Station for Motor

(i) ON Push Button/ Emergency Trip Push Button (ETPB).

9.7.4 415 V LT Switchgear Panels:

9.7.4.1 415V LV switchgear shall consist of Low Voltage Distribution Board (LVDB); Lighting & Power Distribution Board (L+PDB), Ventilation fan Distribution Board (VDB).

9.7.4.2 The LVDB is a Single front, floor mounted, CRCA enclosed, Compartmentalised panel conforming to IP 4X as per IS/IEC 60529 and enclosure Form 4B as per IS 8623 requirements. All control gear and switchgear and their assemblies shall conform to IS/IEC 60947. The LVDB shall have Al bus bars mounted on SMC insulators.

9.7.4.3 The panel shall confine to the following standard

- IEC 61439 - Type test
- IS 61641 - Internal Arc test
- IEC 60364 - Protection against Electric Shock

9.7.4.4 All switchgear shall be easily extendible on either side.

9.7.4.5 Earth bus-bar shall be extended outside the switchboard at both the ends.

9.7.4.6 Switchgear panel with form 4B construction are recommended due to safety during maintenance. It will reduce the chances of touching the live parts during maintenance.

9.7.4.7 Switchgear panel for all motor feeders/ starter shall be as per published type II co-ordination chart of respective manufacturer for the name plate rating

9.7.4.8 L+PDB shall be wall mounted DB for supplying power for all the proposed lighting requirements and auxiliary power requirements at STP. The panel shall have Four Pole (FP) MCB incomer with Residual Current Circuit Breaker (RCCB) and single phase and three phase outgoing MCBs with copper bus-bars.

9.7.4.9 Panel height shall not be more than 2300 mm (Including 100mm base ISMC). The depth of panel shall not exceed 1000 mm & any operating

handle of switchgear shall not be more than 1800 mm and not lower than 300 mm from base of the panel.

9.7.4.10 VDB shall be wall mounted DB for supplying power to the proposed ventilation system. The panel shall consist of TPN system (Three Pole & Neutral) with three pole MCB incomer and outgoings as required.

9.8 APFC Panel

9.8.1 The Automatic Power Factor Correction (APFC) Panel shall provide automatically controlled multistage power factor correction to maintain a system Power Factor (PF) of 0.99. The panel shall be floor mounting, CRCA enclosed, Compartmentalised panel conforming to IP 4X as per IS/IEC 60529 and enclosure Form 4B as per IS 8623 requirements. All control gear and switchgear and their assemblies shall conform to IS/IEC 60947. The APFC panel shall have Al bus bars mounted on SMC insulators. The capacitor shall be heavy duty All Poly-Propylene (APP) type.

9.8.2 Two (2) Nos. 160 Kvar APFC panels providing no less than four (4) stages controller per panel shall be provided. One (1) APFC panel shall be connected to each bus section of the distribution board. The PF on each half of the board (each bus) shall be monitored and corresponding PFC capacitors switched in and out automatically in discrete stages in order to maintain a set point PF value.

9.8.3 CT changeover scheme shall be provided so that the load is compensated as per its requirement even in case of failure of one of the transformer or fault in its one of the transformer secondary or primary feeder.

9.8.4 Additional APFC panel with Thyristor based switching panel with 7% detuned filter shall be considered on both incomers for no load compensation.

9.9 Cables & Cable Carrier

9.9.1 LV multi-core cables for use on 415 V and 240 V power supply system shall be XLPE insulated multi-stranded aluminium conductors for sizes 6 sq mm and above and / PVC insulated Copper Conductors for sizes below 6 sq mm.

9.9.2 Control cables will be PVC insulated multi-stranded copper conductor armoured cables.

9.9.3 All the HV cables shall be Earthed grade (as per system requirement), multistranded Al conductor, XLPE insulated, inner/ outer extruded PVC sheath ST2, galvanized steel flat strip armoured cables.

9.9.4 The LT cables shall be 1.1 kV grade, multi-stranded Copper/ Al conductor, XLPE insulated, colour coded, inner and outer extruded PVC sheathed, galvanized steel round wire/ flat strip armoured cables.

9.9.5 The construction, performance and testing of cables shall comply with IS 7098 - 2011 Part II for HT XLPE armoured cables, IS 7098 -1988 Part I for LT XLPE cables and IS1554 - 1988 -Part-I for PVC cables.

9.9.6 Power and control cables will be laid buried underground or on Hot dip galvanised prefabricated ladder/ perforated type cable trays as per good engineering practices. At small stretches the cables may be laid fastened on the wall/ ceiling with aluminium saddle –spacer. Cable trays shall be supported on steel structures at every one (1) meter interval.

9.9.7 All the Vertical cable trays shall be provided with covers. All cable trays & covers (only for vertical drops) shall be MS sheet fabricated and then hot dip galvanised with thickness of minimum 70 Micron as per IS 4759:1996. Thickness for Cable tray shall be minimum 2 mm & for covers shall be min. 1.6 mm.

9.9.8 The cable trays having width 300 mm and above shall be ladder type and those below 300 mm shall be perforated type.

9.9.9 Cable installation works shall be carried out in accordance with IS 1255, latest version.

9.9.10 Table of Separation Distances (mm) between different Categories of Cable

Table 9-1: Cable Details

Sl. No.	Cable Category	HV Power	LV Power	C&I Protection	Telecoms
1	HV Power	N/A	300	500	500
2	LV Power	300	N/A	300	300
3	C&I Protection	500	300	N/A	100
4	Telecomm	500	300	100	N/A

9.9.11 LV power cables shall be sized considering the following De-rations as per respective manufacturer due to:

a) Maximum ambient design temperature: 50°C.

b) Maximum short circuit current and its duration (fault clearing time)

c) Depth of laying (for underground cables)

d) The number of and distance between cables

e) The number of layers

f) Soil thermal resistivity

g) Voltage drop during motor starting limited to 15% of the rated voltage

h) Voltage drop during steady state loading limited to 5% of the rated voltage

9.10 Motors & Starters

9.10.1 All motors will be highly energy efficient (IE2) type and shall conform to IS: 9283.

9.10.2 Motors will be capable of giving rated output without reduction in the expected life span when operated continuously under either of the following supply conditions as specified in Data Sheet.

Supply Condition

(a)	Variation in supply voltage	
	From rated voltage	+10%
(b)	Variation in supply frequency	
	From rated frequency	+5%
(c)	Combined voltage and	
	Frequency variation	+10%

9.10.3 The minimum permissible voltage shall be 85% of the rated voltage during motor starting.

9.10.4 Motors shall be capable of starting and accelerating the load with the applicable method of starting, without winding temperatures reaching injurious levels, when the supply voltage is in the range of 85% of the rated motor voltage to maximum permissible voltage.

9.10.5 The locked rotor current of the motor shall not exceed 600% of full load current (subject to tolerances as per the applicable standard) unless otherwise specified.

9.10.6 Motors shall be capable of developing the rated full load torque even if the supply voltage drops to 70% of the rated voltage. The pull out torque of the motor shall be at least 205% of full load torque.

9.10.7 Motors when started with the driven equipment coupled shall be capable of withstanding at least two successive starts from cold conditions & one start

from hot condition without injurious heating of windings. The motors shall also be suitable for three equally spread starts per hour under the above referred supply conditions.

9.10.8 All Motors shall have class F insulation with the temperature rise limited to class B. All VFD operated motor shall be provided with thermister.

9.10.9 Motors rated above 30 kW shall have space heaters suitable for 240V, single phase, 50 Hz, AC supply. Space heaters shall have adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation during idle period. The space heaters shall be placed in easily accessible positions in the lowest part of the motor frame. Separate terminal box shall be provided for space heaters.

9.10.10 Terminal boxes shall have a degree of protection of at least IP 55 for outdoor applicable. This shall be minimum IP 68 in case of submerged motors.

9.10.11 Motor starter selection shall be done as follows:

a) Direct On Line (DOL) Starter – For motors rated up to 5.5 kW

b) Star- Delta Starter - For motors rated above 5.5 kW to 15 kW

c) Auto Transformer Starter (ATS) - For motors rated above 15 kW to 75 kW

d) Soft Starter – For all low voltage motors above 75 kW rating.

e) VFD – As per Process requirements.

9.10.12 All the motor except submerged motor shall be 3-phase squirrel cage induction type totally enclosed fan cooled (TEFC) or as otherwise required by the duty.

9.10.13 Submerged Motor (wherever applicable) shall atleast have following specific constructional features:

(a) Motor shall be capable of flowing Water immersion up to 20mwc (on continuous basis) for S1 duty. Motor shall be min. IP68. Sealed type motor shall be preferred. Motor's Rotor shall be of dual caged copper bar brazed type to ensure;

(i) Long Corrosion-free Service life (in presence of high moisture inevitable in submerged motors)

(ii) Ease of Onsite Repairing

(iii) Beneficial Fly Wheel type Inertial effect which reduces detrimental effects of water hammer

(iv) Better Motor Efficiency & Cooler Operating Temperature.

(v) The Motor Rating should be higher of the two criteria i.e.,10% over Maximum pump shaft input at any point of the curve &/ or 20% over pump shaft input @ duty point

(b) Motor Cooling :

(i) To restrict the Dead Water Level (in case of Vertical/ Horizontal Installation) in the Sump to minimum, Medium & Large sized pumps (≥55kW) should have a Cooling Jacket – i.e. motor cooling is accomplished by circulation of pumped water between the motor casing & the jacket shell.

(ii) This jacket shell is fed by normal water from the pump casing & discharges its heated water back into the sump (in case of Wet Installation) or Pump casing (in case of Dry Installation) by integrally cast ducts. There should not be any pipes, hoses, etc for this circulation.

(iii) Alternatively, Close Circuit cooling technology (using Glycol, etc) may also be offered.

(c) Motor Protection:

(i) Thermal Overload Protectors (Min. 3 PTC thermistors in series) should be embedded in each phase of the stator winding to detect overheating & trip the motor from the control panel in the event of the temperature exceeding the safe operating limit (above insulation class B temperature). Bimetallic thermal switch (PTC relay) to trip the motor against increase in temperature shall be provided.

(ii) To detect primary Mechanical Seal's Leakage a Moisture sensor shall be provided in intermediate Chamber (& not in the Motor casing or elsewhere) – this shall detect water mixing in oil by mode of increased leakage current from the moisture sensor.

(iii) The motor shall be provided with dry run protection.

(d) Motors Cables:

(i) The cables shall be suitable for submersible pump application and visually identifiable from other cables. It should have Power as well as Control Cables of Dual Sheathed EPR/ XLPE insulated, flexible GI wire Armoured, with longitudinally water tight flexible Copper conductor of required size. Cable shall be with copper conductor.

(ii) The cables shall include earthing conductors.

(iii) The cables shall be brought directly out of the submerged motor without joints, and shall be of sufficient length, minimum 50 m to be terminated in respective MCC/panel/IP 68 junction box (in the scope of electrical contractor) outside adjacent to the wet well & above the HFL.

(iv) The Cross Section of the cable shall be sized to ensure a Voltage Drop of not more than 2% at actual running conditions.

(v) The power cable together with the cable (or pipe/hoses) shall be clamped in scallops in the rising main flanges with clips of Monel 400 (or equivalent) type material. Alternative catenary type cable supports may be proposed.

(e) Stuffing Box / Oil Chamber:

(i) The pressurized entry of water into the motor (from the pump's volute casing) should be prevented by two separate mechanical seals mounted in a Tandem mode within an oil chamber.

(ii) The Primary (Inboard) seal should be of Silicon Carbide or Tungsten Carbide faces to withstand erosive wear due to any silt particles. The Secondary (Outboard) seal should be of Carbon Cast Chrome Molybdenum Steel or Silicon Carbide or Tungsten Carbide - i.e., Thermally Unstable materials like Alumina/ Aluminium Oxide shall not be allowed.

(f) The submerged motor windings shall be of wet type. The thrust bearing should be of wet type water lubricated and designed to take all untoward load at most unfavourable running conditions. Front and Rear bearing housing and thrust bearing housing should preferably fixed by separate replaceable

bolts/studs and (not threaded connections) to the starter to facilitate easy dismantling.

(g) Fool proof sealing arrangement by sand guard shall be preferred in the submerged Motor inlet body to prevent open well water impurities like sand, silt from entering the motor bearing Stator and submerged Motor should be impregnated with a superior varnish class-B thermal insulation properties by vacuum pressure or epoxy paints on stator cold rolled stamping used and rotor shall be painted with Polyurethane paint & baked properly under controlled temperature condition and not by manual or gravity flow to remove air pocket so that these are thoroughly filled up by varnish.

(h) Fool proof arrangement should be made for stopping the rotating or shifting of stampings inside the stator body of the submerged motor due to operation of pump sets. Earth leakage current should not be more than 50 mA at rated voltage.

(i) The cables shall be brought directly out of the submerged motor without joints, and shall be of sufficient length, minimum 50 m to be terminated in respective MCC/panel/IP 68 junction box (in the scope of electrical contractor) outside adjacent to the wet well & above the HFL.

(j) The motor should not get overloaded in the range of + 10% & (-) 25% of the specified pump head. The meaning of overload will be interpreted as per IS 8034.

9.11 Illumination

9.11.1 All the rooms, internal roads, outdoor areas etc will be illuminated by appropriate luminaries with suitable type and wattage lamps. Indoor lighting illumination levels will be as per IS 3646 and where as outdoor lighting illumination level will be as per IS 1944.

9.11.2 Normal Lighting within STP shall be carried out as follows;

S. No.	Area Description	Type of Fitting
1	Loading – unloading Bay	1 X 40W TLED Fitting
2	Pump House	16W/20W LED batten tube light

3	Office/ Control Room	1 X 40W TLED Fitting
4	Store room	1 X 40W TLED Fitting
5	Toilets	1 X40W TLED Fitting
6	Electrical Room	1 X 40W TLED Fitting
7	Roads	36 W LED Fitting
8	Transformer Yard	70 W LED Flood Light

9.11.3 As mentioned above L+PDB shall supply power to all the lighting inside and outside the STP like street light, gate light or building periphery lights. Adequate spare feeders will be included for future use.

9.11.4 Battery operated 2 X 10 W fluorescent Emergency Light fitting shall be considered at critical locations like Entry & Exit points.

9.11.5 The lighting load will be distributed across the three phases as equally as practicable.

9.11.6 The Illumination levels to be achieved shall be as follows:

Area	**Illumination Level (Lux)**
Electrical Switchgear room	250 Lux
Machinery service area	200 Lux
Offices	300 Lux
Control rooms	300 Lux
General stores	150 Lux
Building entrance	100 Lux
Outdoor transformer yards General - On equipment	 10 Lux 30 Lux
Roads	15 Lux

9.11.7 Following factors shall be considered while arriving at the utilisation factor to determine the number of fixtures for each area/buildings in the plant.

Maintenance Factor

a) Air conditioned clean interiors
like control rooms/houses : 0.8

b) Industrial areas with normal interiors : 0.7

c) Industrial areas with dusty interiors : 0.6

Reflection factor for wall/ceiling/floor

a) White and very light colours : 0.7

b) Light colours : 0.5

c) Middle tints : 0.3

d) Dark colours : 0.1

9.11.8 Colour temperature of the lamp shall be based on following consideration:

a) Indoor Area : 6500K Minimum

b) Outdoor Area : 5400K Preferably, but minimum 4000K

9.11.9 The uniformity of 50% shall be maintained for indoor area and while that of 25 to 40% for outdoor area.

9.12 UPS

9.12.1 The PLC shall be supplied through UPS.

9.12.2 UPS system shall be suitable for 415V 3 phase 4 wire as input and output Single phase, 230V, 50Hz, 2 wire, IGBT based UPS with Static Bypass to stand-by supply, inbuilt input isolation transformer and SMF battery banks of suitable capacity.

9.12.3 The backup time for UPS shall be 30min at Full-Load (As per the instrumentation requirement).

9.13 Earthing System

9.13.1 The safety earthing system will be generally designed on the basis of following codes and standards:

a) IS 3043 - 2006: Code of practice for Safety Earthing

b) IEEE 80 – 2013: IEEE Guide for Safety in Sub-station Earthing.

c) Central Electricity Authority (CEA) Regulations – 2010

9.13.2 Presently the fault currents considered are as tabulated below-

Sr. No.	System	Fault Level & duration

1	11 kV	26 kA for 1 Sec
2	415 V	Based on the rating of Transformer

9.13.3 Following factors will be considered for sizing the earthing conductor.

a) Design Ambient Temperature 50°C

b) Allowable temperature rise 500°C

c) For steel welded joints

Fault clearing time 1.0 seconds.

9.13.4 With reference to IS 3043 - 2006, overall earthing resistance shall be designed to achieve less than 1 Ohm. All the earthing stations will be interconnected by GI strip conductors below ground to form a grid to reduce the effective resistance.

9.13.5 The soil resistivity measurement of the STP area shall be carried out by Contractor after finalization of contract however for the present consideration 100 ohm meter has been considered.

9.13.6 Conductor material shall be used as per mentioned in below table.

Sr. No.	Application	Material and Size
1	Main Earth Grid below ground level	GI flat strip capable of withstanding fault level for 1 Sec
2	Conductor above ground level along the cable trench	GI flat strip capable of withstanding fault level for 1 Sec
3	Conductor connecting electrical equipment body to the Main Earth Grid or earth pit	GI flat strip capable of withstanding fault level for 1 Sec
4	Conductor connecting electrical equipment neutral to earth pit	Cu flat strip capable of withstanding fault level for 1 Sec
5	Lightning protection air termination and down conductor	GI flat strip of 25 X 6mm

9.13.7 For equipment earthing, two earthing leads shall be provided if the rated voltage of the equipment is equal to or above 250V and one earthing lead shall be provided for equipment rated below 250V.

9.13.8 Earth stations shall comprise of Copper plate earthing, GI Pipe earthing electrode and GI & Copper Earth strip for connecting grid. All the copper

and GI earth electrodes shall be as per IS 3043. The description of each type of electrode is as mentioned below;

a) GI Pipe Earthing:

40mm Dia. 3000 mm long Heavy duty, GI pipe electrode as per IS 3043. Charcoal & Salt shall be provided for earth pits. Installation as per IS 3043.

b) Cu Plate Earthing:

Earthing station with 600 mm x 600 mm x 3.15 mm Cu plate & 3000mm long with watering pipe and meshed funnel as per IS 3043. Charcoal & Salt shall be provided for earth pits. Installation as per IS 3043.

9.13.9 Based on the point 3.12.7, the neutrals of star connected transformer windings, non-current carrying parts and enclosures of all electrical equipment such as LV switchboards, transformers, motors, LDBs, local control stations, cable trays, socket outlets, transformer yard fences etc will be connected to the earthing grid by two separate (one for each lead) or one earth conductors (one from one lead).

9.13.10 Following equipment shall have dedicated Cu Plate eathing as mentioned below ;

a) Transformer Neutral – 2 nos. per transformer

b) Lightning arrestors on two pole structure – 2 nos. per set

9.13.11 Following equipment shall have dedicated GI Pipe eathing as mentioned below ;

a) Transformer Body – 2 nos. per transformer

b) Lightning protection – 1 nos. per downcomer

c) Panel - 2 nos.

9.13.12 Additional GI Pipe earthing shall be considered to satisfy the requirement mentioned in the 3.12.4.

9.14 Lightning Protection:

9.14.1 The lightning protection system need will be established by calculating the risk factor value of each building, structure etc. as per procedure given in IS/IEC 62305, Part-2 - 2010.

9.14.2 For Building structure and any other tall structure, if found necessary, Air termination system comprising of horizontal roof conductors will be provided. Spacing between the roof conductors will be as recommended by IEC 62305 - 2010.

9.15 Point wiring:

9.15.1 Point wiring for lighting and fans shall consist of supply, installation and testing commissioning of lighting system / fan system including 0.75 kV grade, FRLS PVC insulated multistranded copper conductor wires of area 2.5 sq mm for phase and neutral with 1.5sq.mm Earthing wire laid in 25 mm dia , 1.6mm thick black enamelled MS conduit with all accessories (e.g. bends, reducers, couplers, switchboard consisting of switches for control, junction boxes, etc.) .

9.15.2 Point wiring for 6/16A receptacle shall consist of supply, installation and testing commissioning of receptacle system including 0.75 kV grade, FRLS PVC insulated multistranded copper conductor wires of area 4 sq mm laid in 25 mm dia , 1.6mm thick black enamelled MS conduit with all accessories (e.g. bends, reducers, couplers, switchboard consisting of switches for control, junction boxes, etc.) .

9.16 Diesel Generator:

9.16.1 The diesel generators shall be provided with Acoustic enclosure with automatic mains failure (AMF) shall be installed for backup power to 25 MLD STP. The diesel generator shall be selected to have withstand capacity to supply starting load of largest motor.

9.16.2 The diesel generator and its component shall conform to latest applicable standards.

CHAPTER:10 COST ESTIMATE

10.1 GENERAL

The present STP including the Septage Treatment and inlet works are designed for Adoni Municipality Corporation taking into the consideration of present requirements of the ULB. At present, the ULB has not enough water infrastructures to serve the needs of the population residing in the town. The objective of the present project is to provide a system to treat the waste water presently flowing in the natural water bodies to the extent possible and dispose the same in an environmental friendly manner.

The proposed Sewage system of the ULB is planned and designed taking into consideration of the demography, topography, present service levels, existing system, functionality and existing conditions.

10.2 RATE ANALYSIS

It is proposed to implement the project through open technology method and under EPC Contract. As no standard rates on MLD basis are available in the AP Standard schedule of rates; prevailing market rates for STP have been considered by collecting quotations from the vendors having similar experience in India and in the region.

For Inlet Works and pumping station, Rate analysis have been carried out for the items identified for the execution works as per the drawings prepared.

10.3 COST ESTIMATE OF SEWAGE TREATMENT PLANT INCLUDING SEPTAGE TREATMENT

Proposed Treatment plant market cost and house service connection's cost is tabulated below.

Table 10-1: Cost Estimation for proposed works - Adoni

Sl.No	Name of Work	Total Cost (In Cr.)
1.	Sewage Treatment Plant Including Septage Treatment	15.84
	Total	**15.84**

The abstract cost of the project is as provided below

Table 10-2: Abstract cost of the project

ADONI MUNICIPALITY				
ABSTRACT OF COST FOR PROPOSED WORKS - SEWAGE & SEPTAGE TREATMENT PLANT.				
S.N	**Description of Item**	**Unit**	**Rate**	**Amount (Rs)**
1	Investigation survey by total station, Hydraulic designs & drawings. Structural designs & drawings, detailed estimates/BOQs. Completion reports including executed drawings etc. complete as per directions of departmental authorities.	1 Job	LS	500,000.00
2	Construction of Interception and Diversion works with RCC M30 including drain sidewalls, Weir structure ,providing aprons with RCC diversion arrangements, Trash Screening Channels.	1 Job	-	1,892,810.00
3	Designing and Construction of Inlet works consisting of lead channel with isolation gates, mechanical coarse screens+ manual coarse screens, manual grit channel with overflow weir (with one working & one standby) all mechanical and manual screens.	1 No		2,401,602.00
4	Designing and Construction of Wet Well cum pumping station for a diameter of 5.0m and depth of 7.75 m with RCC M30 grade of concrete including aluminum windows, MS shutters and lighting arrangements	1 No	-	2,338,666.00
5	Supply, delivery, erection, commissioning and testing of non clog sewage submersible pumps with discharge 3 No's 209m3/hr and head 18m & 2 No's 105m3/hr and head 18m with a minimum efficiency of 75% including delivery pipes with DI K9 double flange pipes of 350mm & 200mm diameter including DI valves, specials and fittings etc.including Chain pulley block with a minimum capacity of 1 Tonnes complete.	1 Job		2,395,557.00
6	Supply, delivery, laying, jointing and testing of 350mm dia DI K9 including valves, specials etc. for a length of 25 m from pump station to STP by pumping system	1 Job		120,726.00
7	Supply, delivery and erection, commissioning, testing and panel board with suitable starters, ammeters, voltmeters, capacitors & copper bus bar as per electrical specifications. Including transformer of suitable capacity	1 Job		2,476,605.00
8	Construction of RCC M30 septage holding tank with 5m dia at 1 day retention time provided partly below ground level with	1 No		1,264,050.00

	agitator, screw pump, pumping main with DI-K9.			
9	Designing, constructing, hydraulic testing, commissioning and giving satisfactorily trials of **5 MLD** STP of Advanced modern technology which can be accommodated in limited identified land space consisting of Primary, Secondary and Tertiary Treatment Units as per the requirement of designed CPHEEO norms relevant IS codes etc. necessary piping work with required valves, gates, drains, path Ways, Administration Block cum Laboratory, Laboratory Equipments, Internal Roads, Pathways, Compound Wall, Tools and plants, Treated effluent arrangements complete as turnkey job with all involved Civil, electrical, electrical Including HT Substation including 4-pole structure, HT Panel, Transformers 1 No's, power control centre Internal HT Cabling etc, Instrumentation and mechanical works Inclusive of following Items, units as per detailed specifications for civil, electrical, Instrumentation and mechanical components complete to achieve latest CPCB/ APPCB / CPHEEO discharge standards BOD < 10ppm, TSS < 10ppm,Biological TN<10 ppm & PO4 < 2ppm to get recyclable quality of water for Industrial / agricultural purposes. The Coagulant Dosing System shall be provided as an optional / backup. All units shall be interconnected with administration building by suitable or RCC overhead walkways Including treatment of septage generated in the ULB supplied at the STP component as per the scope and confirming norms as mentioned above. The plant should be completely automated with OSSCADA etc complete. Including DG sets of required capacity	1 MLD	16,600,000	83,000,000.00
10	Earth filling with proper compaction for average depth of 1.0 m as per site requirement	Cum	355.26	1,298,412.00
11	Charges payable to Hiring of Vehicles one vehicle for construction period and one vehicle for maintenance period(for 36 months)	1 Job	25,000.00	900,000.00
a)	**Subtotal admissible items (A)**			**98,588,428.00**
b)	**O & M**			
12	O & M (For 10 Years excluding power charges)			41,461,247.00

	Subtotal (B)			**41,461,247.00**
c)	**Other provisions**			
13	Provision for other departments	LS		300,000.00
	Subtotal (C)			**300,000.00**
	IBM value (A+B+C)			**140,349,675.00**
d)	**In admissible items**			
14	Provision towards seigniorage charges			131,198.00
15	Provision towards VAT/GST			17,600,000.00
16	Provision towards NAC@ 0.10%			98,588.00
	Subtotal (D)			**17,829,786.00**
e)	Provision for Unforeseen items & price variation	LS		220,543.00
	Grand Total of admissible and in admissible items (a+b+c+d+e)			**158,400,000.00**
	Total	**Cr**		**15.84**

CHAPTER:11 IMPLEMENTATION SCHEDULE

11.1 GENERAL

This chapter provides the insights for the implementation schedule for the proposed project.

For projects greater than 10 Crores, the contract would be on EPC basis where in the requisite survey and investigation, design work needs to be carried out by the agency before execution and get it approved by PDMC / ULB. For projects less than 10 crores, the contract would be on Item based tenders, where in the executing agency would be carrying out the works as per the designs and drains supplied by PDMC.

As the proposed project is a high end activity, with substantial field and office inputs required for effective planning and execution of the proposed components, it is suggested to opt for EPC contract with minimum 10 years of O&M with specified performance criteria to ripe the benefit of the project.

The activities to be performed for implementation of work and estimated time duration for completion of proposed works are given in the form of a bar chart in Table-8.1

11.2 TOTAL COST OF THE PROJECT

The cost estimate is prepared for the financial year 2016-2017. The cost of various components of the project is worked out to be **9.87 Crores** (Admissible cost).

11.3 CONTRACT PACKAGING

The whole works has been planned to be implemented in two packages,

- **Package -1**: Tender for Construction of 5 MLD STP

Tender for Construction of 5 MLD capacity Sewage Treatment Plant and allied works mentioned near Siriguppa Check Post, Rayanagar for Zone III.

11.4 CONTRACT APPROACH

The procurement procedure adopted can be Local Competitive Bidding (LCB), Single Stage and Two-envelope system. In the first stage, the Bidders shall be technically

qualified based on qualification criteria set forth in the bid documents. The financial bids shall be opened for the technically qualified bidders only. The contract shall be awarded to the lowest quoted bidder. The successful bidder i.e. the contractor will be responsible for execution, quality, safety and timely completion of the works.

11.5 CONDITIONS OF CONTRACT

It is proposed that the Conditions of Contract for the contract package shall be based on the Andhra Pradesh Transparency in Tenders Act. It is also proposed and considered essential that Bidders be qualified on such a contract to ensure that realistic bids are received from Contractors who are suitably experienced, have sufficient financial resources to carry out the work and having suitable manpower, technical resources, plant and equipment etc for successful, timely completion of the project with necessary quality parameters.

11.6 IMPLEMENTATION SCHEDULE

The implementation schedule for the project is estimated to be 18 months after award of contract to the successful bidder. With this schedule, the project is expected to be completed by October 2018. The bid documents can be published in the month of March 2018 and evaluation of bids, award of contracts would be completed by April 2018. Next three year involves the construction activities and commissioning of works.

The Implementation Schedule for this project is given in Annexure-II. It is expected that the total project would be implemented by the October 2018 along with the Expenditure pattern during construction.

This is assumed that ULB has adequate experience and is well known of procedures to carry out these activities without much delay. However, there would be possibility of delay in getting approval of bidding documents or contract documents from agencies or any other unforeseen event which is considered.

It is assumed that ULB has adequate experience and is well known of procedures to carry out these activities without much delay. However, there would be possibility of delay in getting approval of bidding documents or contract documents from agencies or any other unforeseen event which is to be considered.

Table 11-1: Expenditure pattern for Construction Activities

Sl no	Project Component	Cost (Crores)	Percent Implementation of Base Cost for year-2016							Total
			Q1	Q-2	Q-3	Q-4	Q-5	Q-6	Q-7	
1	10 MLD STP + Septage Treatment + Feeder main works + Weir and Inlet works	9.86	0.86	0.86	0.86	0.86	1.47	1.97	2.47	9.86
3	Percentage Expenditure of base cost	%	**10**	**10**	**10**	**10**	**15**	**20**	**25**	**100**

The funding pattern for SAAP project implementation of these works is provide in **Table 11-2**

Table 11-2: Funding Pattern of Project Implementation

Funding Pattern as per Final DPR														
Sr. No.	Name of ULB	SAAP Approved cost	SLTC Approved cost				Funding pattern							
									Convergence			ULB share		
			Admissible cost	O&M cost	VAT Cess	Total (4+5+6)	GOI share	GoAP share	APPCB Assistance	GoAP special Assistance	Total (10+11)	As per AMRUT Guidelines	Additional Share (7-8-9-12-13)	Total ULB share (13+14)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Adoni	8.75	10.16	4.15	1.53	15.84	2.91	1.15	2.40	1.65	4.12	1.74	5.92	7.66

CHAPTER:12 OPERATION AND MAINTENANCE

12.1 GENERAL

The O&M cost consists of energy cost, staff cost, consumables, repairs & maintenance of assets of the project components executed under this contract. This O&M cost is prepared only for the components planned to be executed under SAAP 2016-20.

12.2 BASIS FOR OPERATIONAL AND MAINTENANCE COST

- Annual establishment charges for the project are broadly worked out based on likely operating staff required for the project (to be covered under this DPR i.e SAAP 2016-20).
- Annual maintenance costs are worked out on percentage basis of capital cost for different components of the project.
- Annual energy charges are worked out considering 23 hrs working for average flow at Rs.7.00 / kwh and the cost of chlorine is assumed as Rs.15,000 per tonne.
- The cost of other chemical and energy charges if any is worked as per the MLD basis.
- The cost of operation of the pumps is considered based on the KW rating of the pumps and its hours of operation.
- The cost of maintenance and repair works for civil works and pipe line works is considered as per the IWWA recommendations.
- The daily rates of the manpower intended to be deployed have been considered from the AP SoR-2016-17

The O &M calculation approach is given in table 12-1.

Table 12-1: O&M CALCULATION APPROACH

Sl no	Name of Work	% of M&R	% of annual depreciation	Remarks
1.	STP (Civil works)	1.00	1.50	All activities to maintain the unit in good condition
2.	STP (Electro mechanical works)	3.00	3.00	All activities to maintain the unit in good condition

The total annual O&M charges for STP are provided in table 12-2; annual maintenance and repair charges are provided in table 12-3 and table 12-4 provide the summary of the manpower required for the project maintenance as per CPHEEO manual. Detailed manpower worked out as per CPHEEO manual along with their proposed salary structure is provided in table 12-4

Table 12-2: O&M charges for 5 MLD STP – Annual

S.No.	PARTICULARS	Years	Total Amount
1	Repairs & Maintenance excluding Two years defect liability period	8	176.56
2	Chemicals and Consumables	10	29.20
3	Manpower Charges	10	189.27
	Total		**395.04**
4	Contingencies 5%		19.75
	TOTAL (in Lakhs)		**414.79**

Table 12-3: Annual Maintenance and Repair Charges (Lakhs)

Sl No	Description	Cost per Annum in Lacs
1	Civil Cost @1.5%	6.06
2	Mechanical & Electrical Cost @ 3%	16.01
	Total (lakhs) =	**22.07**

Table 12-4: Operation and Maintenance Staff for STP – (Annual Costing)

	Table 5.4: BASIS FOR Manpower Cost for STP					
Sl No	**Designation**	**Nos.**	**RATE(APSOR-2016-17)**	**Rate Rs. P.M.**	**Total Amount Rs**	**Total Amount Rs. Per Year**
1	Fitter (Mech) Ist class	1	475	14,250	14,250	171,000
2	Electrician Ist Class	1	515	15,450	15,450	185,400
3	Gardener	1	350	10,500	10,500	126,000
4	watchman	2	350	10,500	21,000	252,000
5	Lab Assistant	1	520	15,600	15,600	187,200
6	Sweeper	1	350	10,500	10,500	126,000
7	Operator	2	445	13,350	26,700	320,400
				TOTAL	**114,000**	**1,368,000**

For ESI & PF 10 %		**136,800**
TOTAL in Lacs Per Year		**15.05**

Sl No	Manpower Cost	Total Amount Rs. Per Year
1	1st Year	15.05
2	2nd Year with 5% Increase from last Year	15.80
3	3rd Year with 5% Increase from last Year	16.59
4	4th Year with 5% Increase from last Year	17.42
5	5th Year with 5% Increase from last Year	18.29
6	6th Year with 5% Increase from last Year	19.21
7	7th Year with 5% Increase from last Year	20.17
8	8th Year with 5% Increase from last Year	21.17
9	9th Year with 5% Increase from last Year	22.23
10	10th Year with 5% Increase from last Year	23.34
Total Manpower Cost for 10 Year		**189.27**

CHAPTER:13 ENVIRONMENTAL MANAGEMENT PLAN

13.1 Introduction

In this Chapter potential impacts on the environment from the proposed project on the ULB are identified based on the nature and extent of various activities associated during construction and after completion of the project. The proposed expansion activities will have impact of varying magnitude on environmental components both beneficial (positive) and adverse (negative) impacts. Both these (positive) and adverse (negative) impacts are considered for the impact prediction studies. The details of impact prediction and assessment are given in this chapter.

13.2 Legal and Regulatory Frame Works

The project is expected to bring significant environmental and health benefits, such as improvements in the sustainability of water sources and improvements in public health through better quality of treated water. Although no major environmental issues are anticipated, certain investments items to be funded under the project may require special mitigation measures to protect the environment and enhance health safety.

13.3 Local Regulatory Framework

As per the Environmental regulations in India, the S.0.1533 no Environmental clearance is required for Water supply projects. However, Pollution Control Board can be approached for funding for STP projects and the regulatory frame works of PCB norms shall be adhered to.

13.4 Impacts during Construction

13.4.1 Impacts during construction of Air Quality

The potential ambient air quality impacts arising from the proposed project would occur mainly during construction phase. During construction, the project would have two major impacts on ambient air quality due to an increase in gaseous emissions by heavy construction equipments and vehicles, and an increase in dust by construction activities. Earth excavation work, foundation work, superstructure work, material storage, transportation and handling of construction materials, and wind erosion are the major factors that would produce a temporary, localized increase in SPM and RPM levels. The increased movement of heavy vehicles carrying construction materials, operation of DG

sets as standby power back up system would generate gaseous emissions. However as DG sets are used as standby, the impacts are insignificant. The degree of dust generated would depend on the soil compaction and moisture content of the ground surface during construction. Dust and exhaust particulate emissions from heavy equipment operations would temporarily degrade air quality in the immediate construction zone. The increase in air particulates would be minimized by the performance of the work. The construction contractor will visually monitor dust levels on the site during construction. Dust suppression will be instituted, using water tankers mounted on tractors, sprinklers and other means as necessary, in the event that high levels of dust are observed, strong winds and dry conditions make dust generation likely, and complaints about dust are received.

13.4.2 Impacts during construction of Noise Quality

Construction activities normally result in temporary and short duration increases in noise levels. The main sources of noise during construction period include movement of vehicles for loading and unloading of construction materials, fabrication, handling of equipment and materials, operation of concrete mixing plants, generators etc. The areas affected are those close to the site.

Under the worst case scenario, considered for prediction of noise levels during construction phase, it has been assumed that all these equipments generate noise from a common point at an average noise level of 85 dB (A).

13.4.3 Impacts of Construction Wastes

The generation of waste material is inevitable during the construction phase of the development. Waste is generated at different stages of construction process. Waste during construction activity relates to excessive cement mix or concrete left after work is over, rejection caused due to change in design or wrong workmanship etc. Excavation of earth and rock generates muck. Other wastes include top soil, clay, sand, and gravel. These are normally re-used as filler at the same site after completion of excavation work. Other miscellaneous materials that arise as waste include glass, plastic material, general refuse, scrap metal, cardboard, plastics, and sewage wastes from the construction workers housing. Construction waste is bulky and heavy and is mostly unsuitable for

disposal by incineration or composting. Unutilized or unused solid wastes generated during construction will be disposed of to a designated landfill sites in the project area.

13.5 Impacts during Operation

13.5.1 Impacts during operation of Air Quality

None of the proposed structures of STP, Pumping Stations etc at the project site would be expected to have an impact on air quality during their normal operation.

13.5.2 Impacts during operation of Noise Quality

None of the proposed structures of STP, Pumping Stations at the project site would be expected to have an impact on Noise during their normal operation.

13.6 Mitigation Measures

13.6.1 Mitigation Measures of Air Quality

Since the project involves large-scale construction (Sewage Treatment Plant, laying of pipes, etc) of activity the negative impacts on the air quality would be significant during this phase. The impact on the air quality due to the operation of construction machineries in the site is found to be insignificant given the vast area of the proposed project site. However, the negative impacts created as a result of movement of construction vehicles needs critical attention. For mitigation of these impacts following measures are suggested:

- Vehicles transporting construction materials prone to fugitive dust emissions should be covered.
- Trucks carrying sand should be provided with tarpaulin sheets to cover the bed and sides of the trucks.
- Idling of delivery trucks or other equipment should not be permitted during loading and unloading
- All construction vehicles should comply with air emission standards and be maintained properly.
- Dust suppression measures in addition to the traffic management should be followed on the roads.

13.6.2 Mitigation Measures of Land Environment

The solid waste generated during the construction phase is usually Excavated earth material and Construction debris. Excavated earth material will be reused for backfilling between foundations; to fill up the low-lying areas and whereas, topsoil will be reused for Landscaping/Greenbelt development purpose.

13.6.3 Mitigation Measures of water quality

- Construction equipment requiring minimum water for cooling and operation for optimum effectiveness should be chosen.
- High pressure hose should be used for cleaning and dust suppression purposes.
- Appropriate sanitation facilities, septic tank and soak pits should be provided for the workers onsite and offsite to reduce impact on water resources
- Discharge of construction wastes to surface water bodies or ground water should not be allowed during construction.
- During construction period in rainy season, the water quality is likely to be affected due to the construction work and loosening of topsoil. This is likely to increase the suspended solids in the run – off during heavy precipitation. In order to reduce the impact on water quality, temporary sedimentation tanks shall be constructed for the settlement of suspended matter. However, it is envisaged that the monsoon period will be avoided for cutting and filling of earthwork.

13.7 Socio Economic Impacts of the Proposed Project

The project will generate employment opportunities to the local people. There will also be secondary growth that will create self-employment opportunities for the local villagers like small hotels, shops etc., which would lead to improvement in the quality of the life of the local population. The positive impact of the proposed activity is expected during the start-up of construction activities. Besides the local population would have employment opportunities in service activities, contracts and supply of construction materials. This will lead to economic up-liftment of the area.

13.8 Potential Environmental Impact Matrix

This methodology incorporates a list of project activities with a checklist of environmental components that might be affected. Matrix methods incorporate environmental conditions on one axis and proposed actions on the other.

The impact of each action on various environmental components are filled in a tabular format to estimate the impacts may be either qualitative, insignificant, high, adverse, beneficial or quantitative by assessing a numerical score, but in the end there should be a grand total to signify the magnitude of the impact. The activities discussed above are likely to affect the environment in varying degrees. Relevant components of environment, which are likely to experience some impacts due to the proposed project activities, have been identified.

Environmental parameters are broadly classified under three following groups considering the cause - effect relationship:

- Physical Environment
- Biological Environment
- Non Biophysical Components (NBP)

The parameters selected for impact identification are site activities and project specific. Different parameters considered under the said groups are as follows:

- Ambient Air Quality
- Noise
- Soil stability / erosion
- Vegetation
- Resource use
- Health
- Socio economic

The interaction between project activities and environmental parameters described above are shown in the impact matrix in the Table below, the matrix points out each activity and its impact on specific environmental parameters. This is a qualitative work and does not indicate quantitative impact. Some of the impacts are temporary and localized and some impacts are short term and long term in the matrix.

The predicted impacts of the proposed project have been discussed in Table below. The environmental management measures to reduce the adverse impacts are detailed in this Section.

Table 13-1: POTENTIAL ENVIRONMENTAL IMPACT MATRIX

Project Activities	Physical				Biological	Non Biophysical Components (NBP)	
	Air Quality	Noise	Soil stability / erosion	Water Quality	Vegetation	Health (Individual /Community, Occupational)	Socio-economic (Population, Community Infrastructure, Employment)
- Implementation Phase							
Pumping Stations	ST, -ve	ST, -ve	ST, -ve	Nil	ST, -ve	Nil	ST, +ve
Sewage Treatment Plants	ST, -ve	ST, -ve	ST, -ve	Nil	ST, -ve	Nil	ST, +ve

Project Activities	Physical				Biological	Non Biophysical Components (NBP)	
	Air Quality	Noise	Soil stability / erosion	Water Quality	Vegetation	Health (Individual /Community, Occupational)	Socio-economic (Population, Community Infrastructure, Employment)
Operation Phase							
Sewage Treatment Plant	Nil	Nil	Nil	LT, +ve	LT, +ve	LT, +ve	LT, +ve

Note: *ST – Short Term, LT – Long Term, +ve – Potential Positive Impact, -ve – Potential Negative Impact (require mitigation measures)*

Table 13-2: SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN

Parameters	Potential Adverse Environmental Impacts	Proposed Mitigation Measures	Residual Impacts	Implementation Issues	
				Responsibilities	Monitoring
Topography soils, geology and hydrogeology at new STP	Requirement for aggregate/earth	Abstract resources on site to avoid import of material. Balance cut and fill on site to maximize use of resources and avoid wastage.	Not Significant. Good use of resources on sites.	Contractor	Site supervision
	Soil Erosion and Slumping	Limit vegetation clearance to working areas. Landscape the STPs, Pumping Station Areas.	Not Significant. Small area potentially affected.	Contractor	Site Supervision
Hydrology and Drainage along the Transmission lines and at STP sites	Increased storm water runoff and entrainment of sediment, oil contaminated sediment, and litter.	Program construction for the dry season. Avoid aggregate stockpile on site. Compact earthworks, road base, etc. Re-vegetate bare soil in landscaping areas prior to start of rainy season.	Not significant. The area is relatively small. The works will be completed before the start of the rainy season.		Site Supervision
Water Quality at construction labor camp sites at STP,	Pollution by construction activities including accidental spillages	Prepare and implement an adequate site environmental management plan (SEMP).	Low level nuisance during construction, but no long term impacts.	Contractor to prepare SEMP	Compliance with site management plan.
People and Communities – Disruption	Disruption to local communities due to new activities during construction/operation.	Consultation with local communities.	Highly Significant, since major works is inside the city.	Contractor	Periodic reviews by senior management

Parameters	Potential Adverse Environmental Impacts	Proposed Mitigation Measures	Residual Impacts	Implementation Issues	
				Responsibilities	Monitoring
Environmental Quality – Air Quality at new STP construction site, laying of Transmission lines and STP	Dust during Construction	- Suppress dust using water bowsers - Avoid double handling of spoil - Compact and e-vegetate Earthworks - Minimize height of stockpiles and surround with hoardings. - Storage of cement in enclosed areas -'Just in Time' delivery to avoid large stockpiles.	Highly Significant, dust arises during construction activities. Possible nuisance surrounding communities.	Contractor	Daily monitoring of onsite activities.
	Emissions from construction plant and vehicles	Maintain all vehicles, Plant and Equipment. Switch Plant Off when not in use.	Not Significant. Small number of vehicles.	Contractor	Daily monitoring of onsite activities.
Noise in STP, and Pumping stations,	Noise impact on Local receivers during construction	Select working methods and program to reduce noise. Handle materials in a way which minimizes noise. Set audible warning systems to minimum legal setting.	Highly Significant, dust arises during construction activities. Possible nuisance surrounding communities.	Contractor	Daily monitoring of onsite activities
	Control of Noise during Operation Phase	Noise may arise from operation of Pumping Stations.	No Significant. Low impact on workers at the site.	Contractor	Monitoring noise levels especially during start up conditions and noisy activities.
	Noise and Vibration – Health and Safety of	Prepare a risk assessment and health and safety plan for the	Minimize hazards to workforce by	Contractor	Daily monitoring of

Parameters	Potential Adverse Environmental Impacts	Proposed Mitigation Measures	Residual Impacts	Implementation Issues	
				Responsibilities	Monitoring
	workforce during construction	construction phase. Provide appropriate PPE to all employees. Limit the time employees spend in the noisy environments.	foreseeing potential risks and reducing them.		onsite activities
Waste Management at construction site at STP	Disposal of construction wastes	Control of disposal of construction wastes through a SEMP	Low level nuisance during construction, but no long term impacts.	Contractor to prepare SEMP. Supervision by PDMC	Daily monitoring of onsite activities

13.9 CONCLUSION

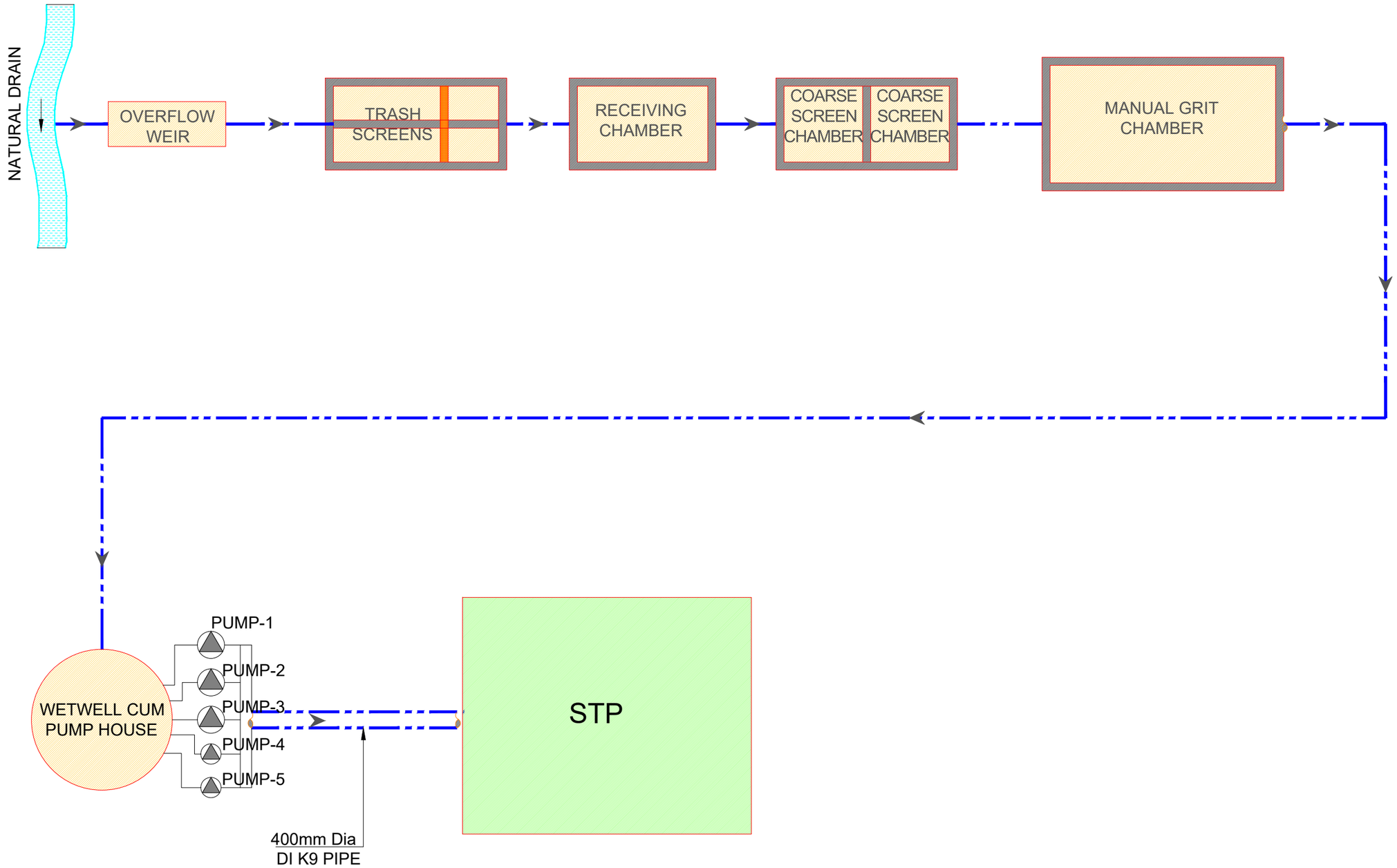
To summarize; from the proposed project in ULB, the following beneficial and adverse impacts can be attributed,

- The proposed project will have positive impacts on the socio-economic environment of the study area. The project will provide direct and indirect employment for Technical, Skilled, and unskilled personnel.
- Improvement of resources: Reuse of tertiary quality of treated sewage can be used in sustainable landscaping irrigation, to recharge ground water aquifers, to meet commercial and industrial water needs. Also it can be used for stream flow augmentation to benefit ecosystems and improve aesthetics.
- The project provides the reuse of treated sewage can be utilised for water reclamation and non potable uses such as: Washing cars, flushing toilets, cooling water for power plants, concrete mixing, artificial lakes, irrigation for golf courses and public parks, and for hydraulic fracturing. Where applicable, systems run a dual piping system to keep the recycled water separate from the potable water.
- Dust suppression measures in addition to the traffic management should be followed.
- The sewage generated from the city will be treated in sewage treatment plant.
- Regular monitoring of air, water and noise parameters shall be carried out and to keep a check on routine compliance of statutory requirements.

Certain positive and negative impact may be encountered during the implementation of the proposed project.

The proponent, APUFIDC strongly believe in the concept of sustainable development and understand the impacts as identified above from the proposed project and shall take all measures to mitigate such negative impacts and also lay emphasis on the implementation of the recommendations of the Environmental Management Plan in true spirits.

SCHEMATIC LAYOUT OF SEWAGE TREATMENT PROCESS



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CONTOUR PLAN FOR ADONI TOWN

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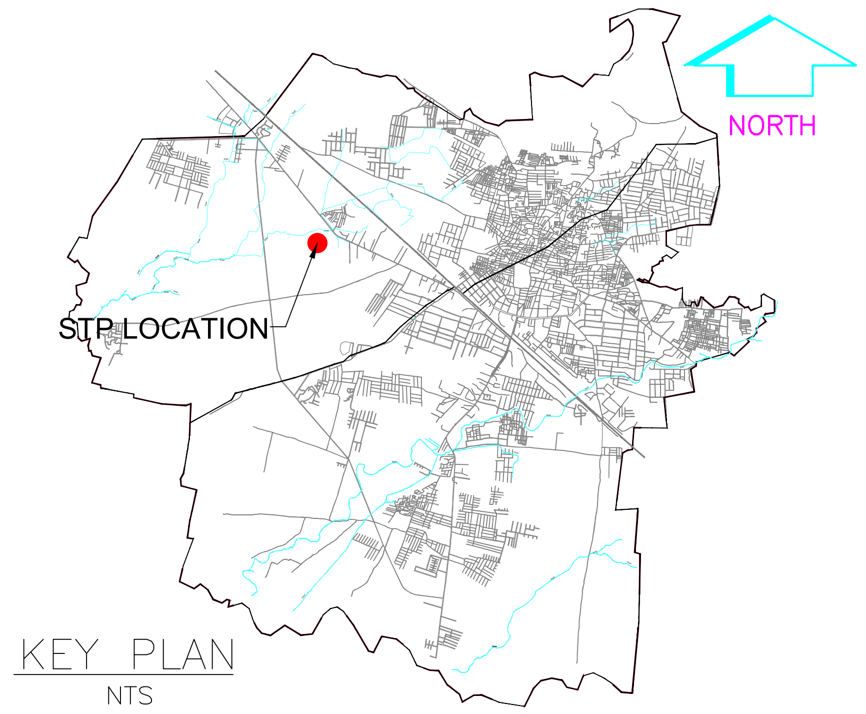
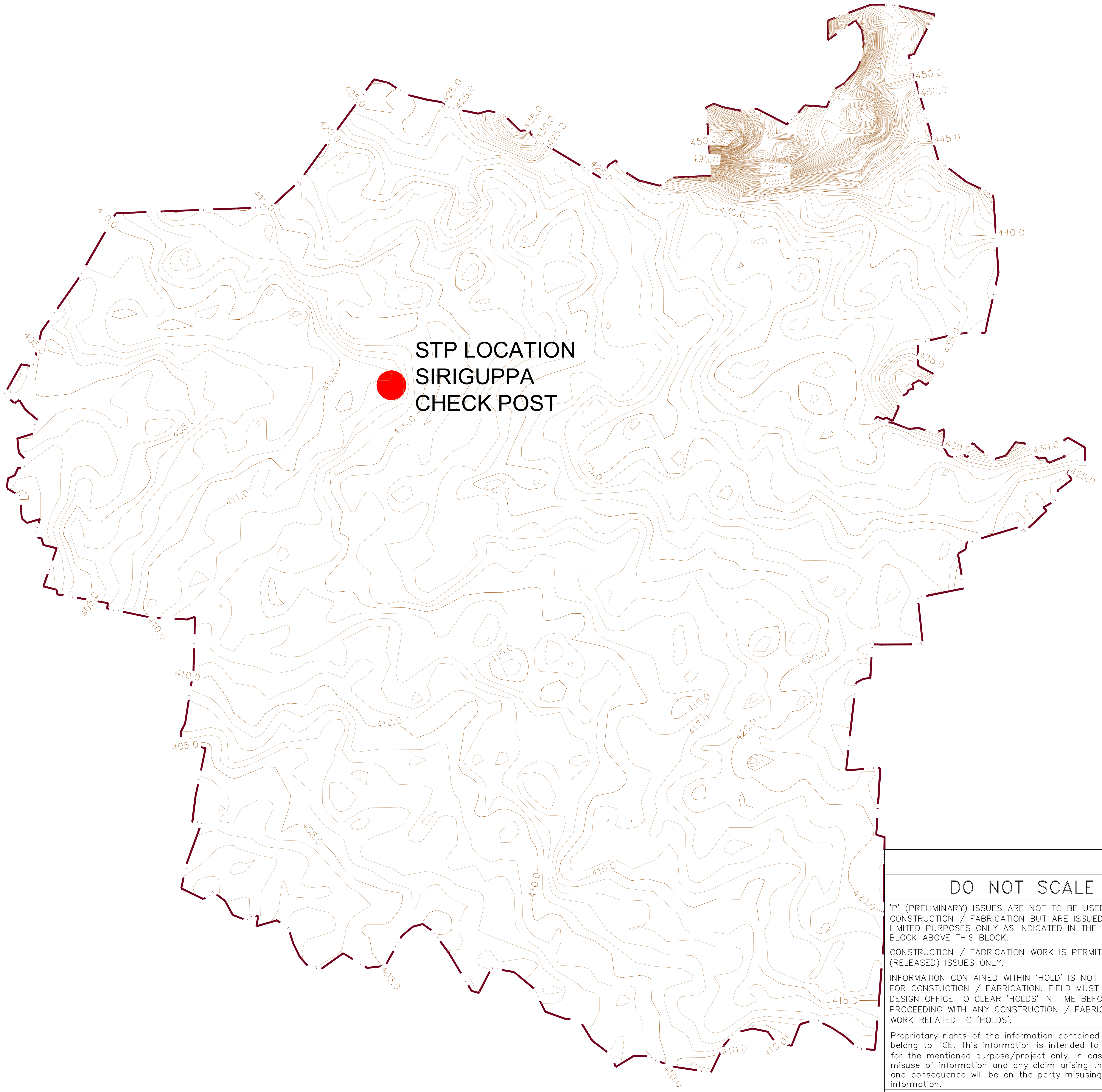
NORTH





LEGEND:

- PROJECT BOUNDARY
- CONTOURS
- STP LOCATION

ISSUE		DRN	DSN	CHD	CV	EL	IC	ME	PE/PM	APPD	DATE
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	INITIALS	AJS	RBY	UN							
	REVISIONS	DETAILS UPDATED									
P0	SIGN.										
	INITIALS	AJS	RBY								

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PDMC FOR ATAL MISSION FOR REJUVENATION AND URBAN TRANSFORMATION

CONTOUR PLAN FOR ADONI TOWN

TATA CONSULTING ENGINEERS LIMITED

MUMBAI

SCALE : 1:20000

DC & DISC: BLR, CV

DWG NO. TCE.10282A-CV-3009-SL-31701

ISSUE R1

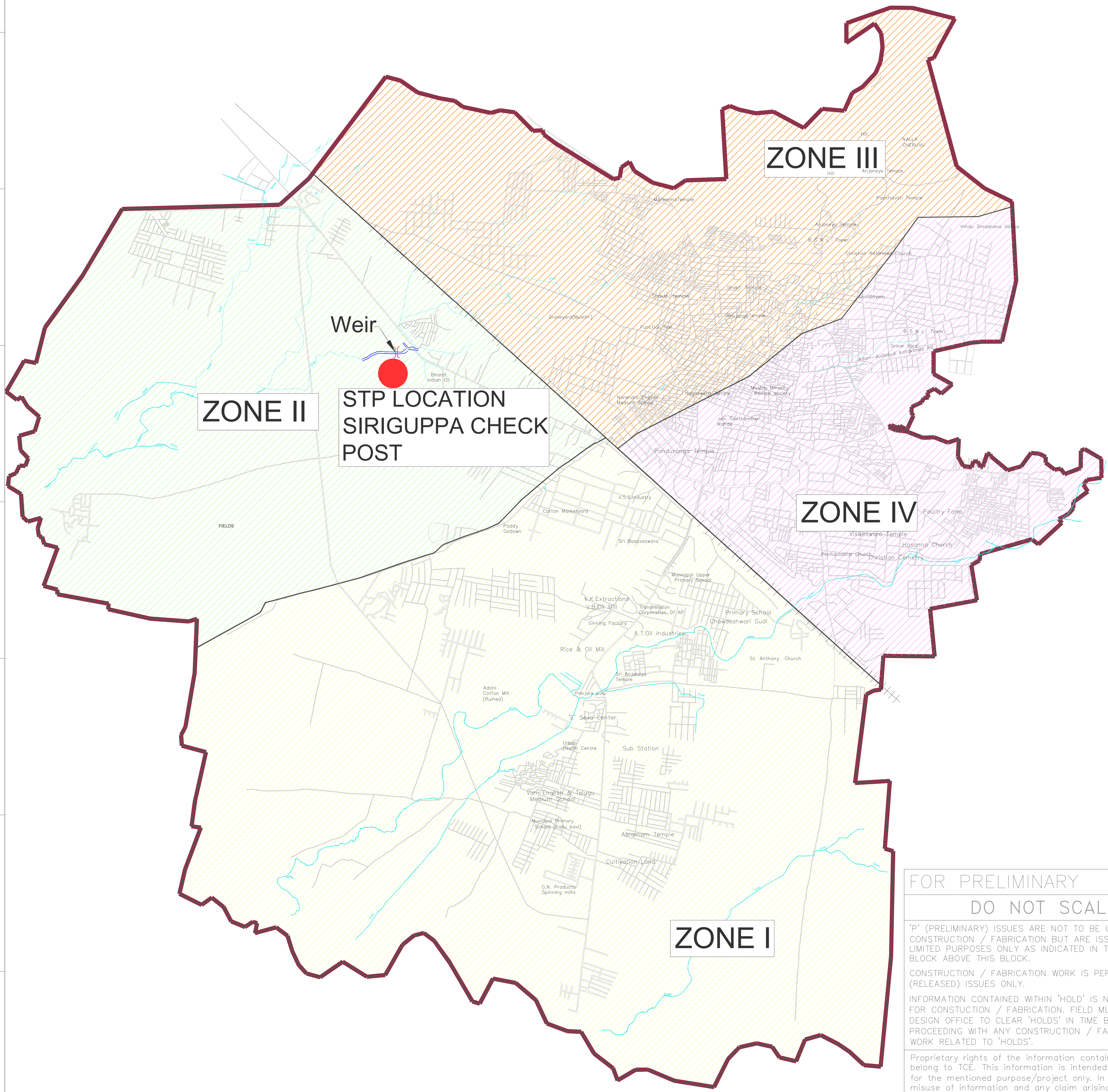
SIZE-A2

FILE NAME: F-092-Rev-R0.dwg

TCE FORM NO. 092 R0

TITLE: SEWAGE CATCHMENT ZONE BOUNDARY AND ROAD NETWORK MAP OF ADONI TOWN

DWG NO TCE.10282A-CV-3009-SL-31702



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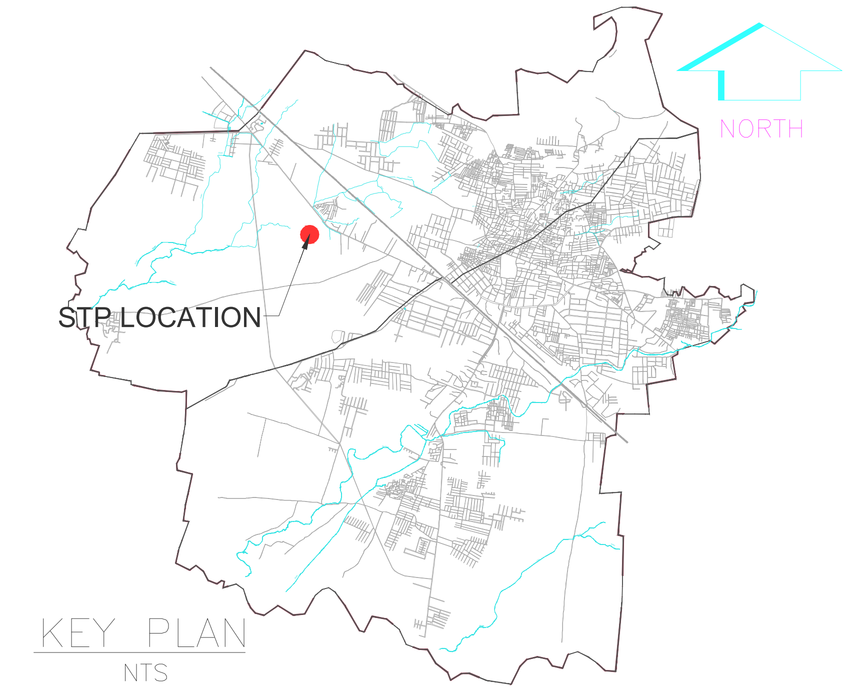

KEY PLAN
NTS

LEGEND:

- MUNICIPAL BOUNDARY
- ZONE BOUNDARY
- RAILWAY TRACK
- CANAL
- ZONE I
- ZONE II
- ZONE III
- ZONE IV
- STP LOCATION

NOTE

1. ALL UNITS ARE IN METERS, UNLESS INDICATED OTHERWISE.

ISSUE							
R1	SIGN.						07.07.2017
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SEWAGE CATCHMENT ZONE BOUNDARY AND ROAD NETWORK MAP OF ADONI TOWN

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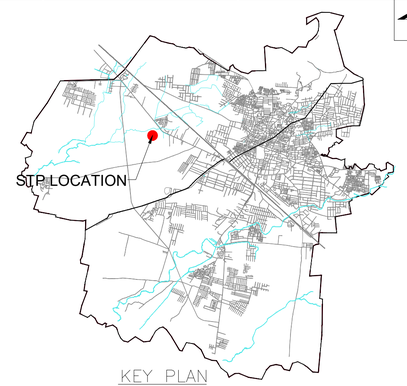
SIZE-A2

TITLE: WATERSHED BOUNDARY OF ADONI TOWN

DWG NO TCE.10282A-CV-3009-SL-31703

NORTH



KEY PLAN
NTS

STP LOCATION
SIRIGUPPA
CHECK POST

LEGEND :

- PROJECT BOUNDARY
- NALA
- WATER SHED BOUNDARY
- STP

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS IN METRES UNLESS NOTED.

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	REVISIONS	DETAILS UPDATED											
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WATERSHED BOUNDARY OF ADONI TOWN

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DC & DISC: BLR & CV

SIZE-A1

FILE NAME: F-091-Rev-R0.dwg

TCE FORM NO. 091 R0

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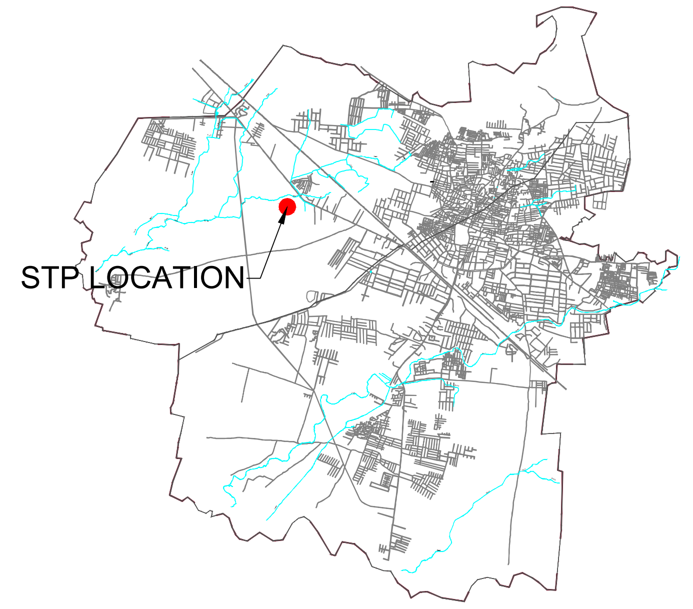
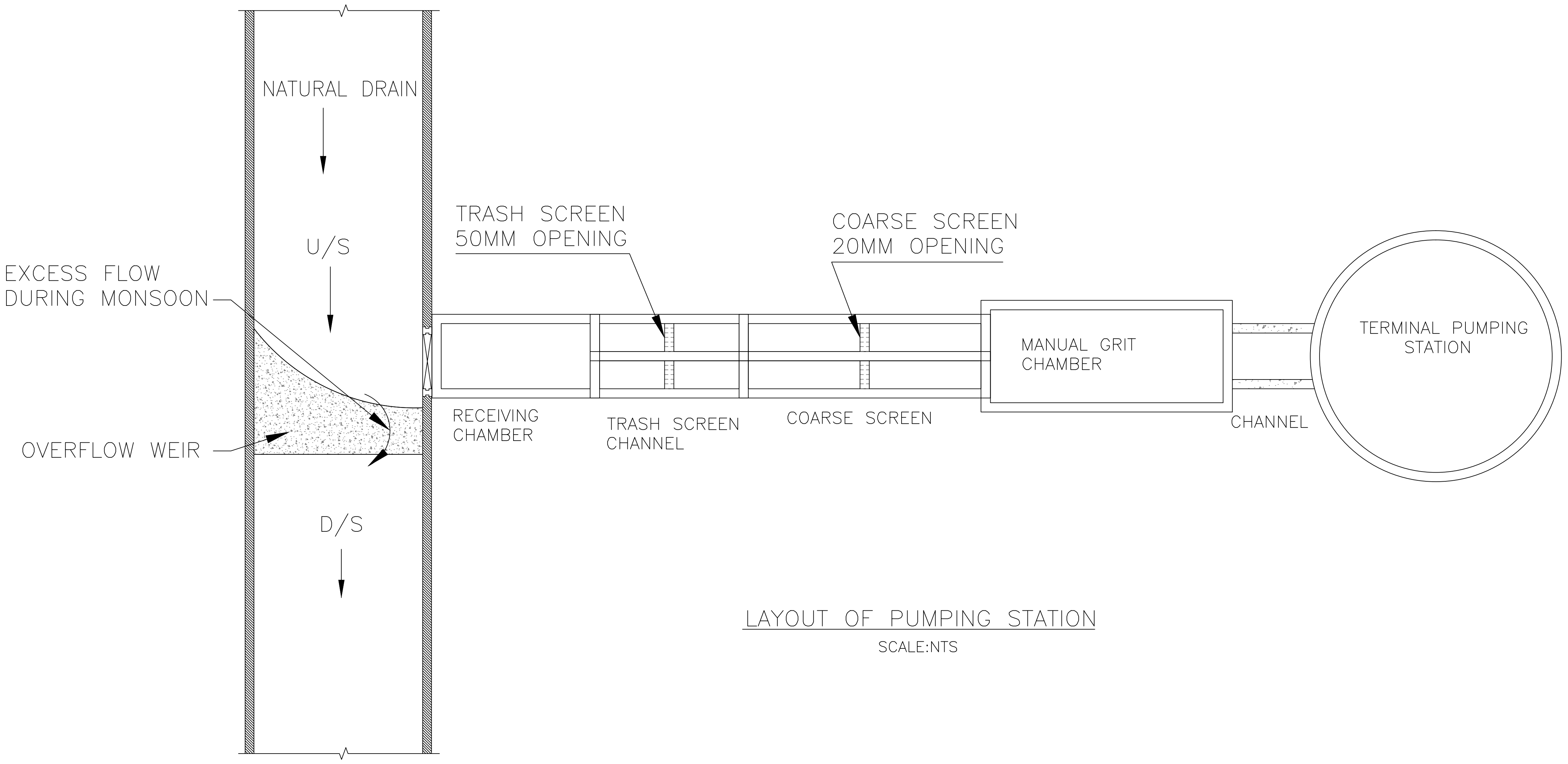
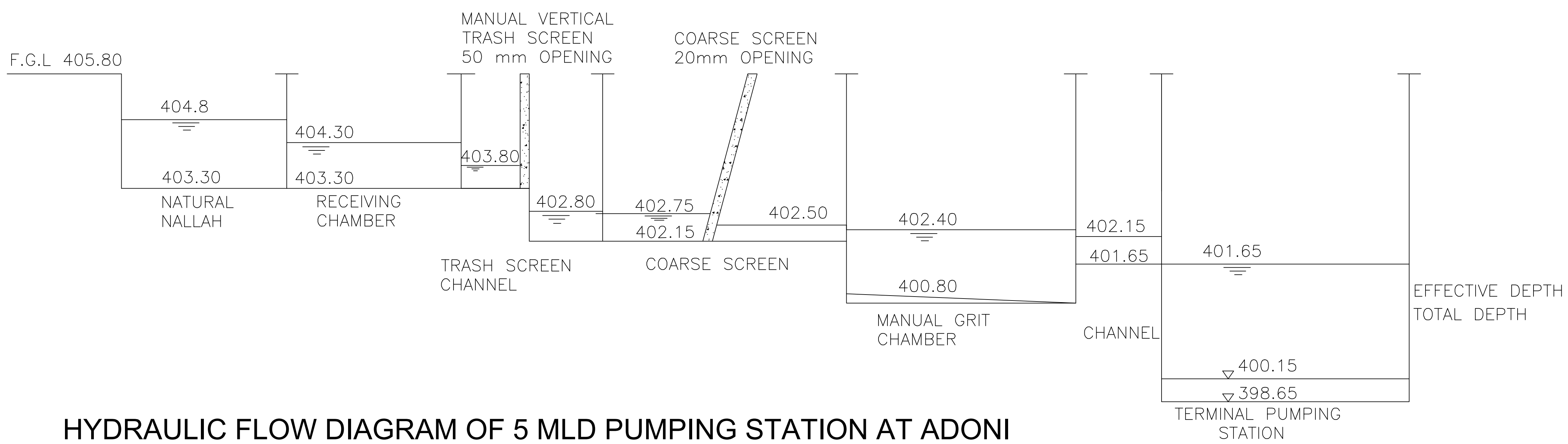
DWG NO TCE.10282A-CV-3009-SL-31704





LAYOUT OF PUMPING STATION

SCALE:NTS



HYDRAULIC FLOW DIAGRAM OF 5 MLD PUMPING STATION AT ADONI

SCALE:NTS

NOTE

1. ALL UNITS ARE IN METERS, UNLESS INDICATED OTHERWISE.

ENGINEERING REFERENCE DRAWINGS

--NIL--

CONSTRUCTION REFERENCE DRAWINGS

--NIL--

HOLD

--NIL--

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LAYOUT AND HYDRAULIC FLOW DIAGRAM OF INLET WORK & 5 MLD PUMPING STATION AT ADONI TOWN

TATA CONSULTING ENGINEERS LIMITED

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SCALE : NTS

DC & DISC : BLR, CV

DWG NO. TCE.10282A-CV-3009-SL-31704

ISSUE P0

SIZE-A2

FILE NAME: F-092-Rev-R0.dwg

TCE FORM NO. 092 R0

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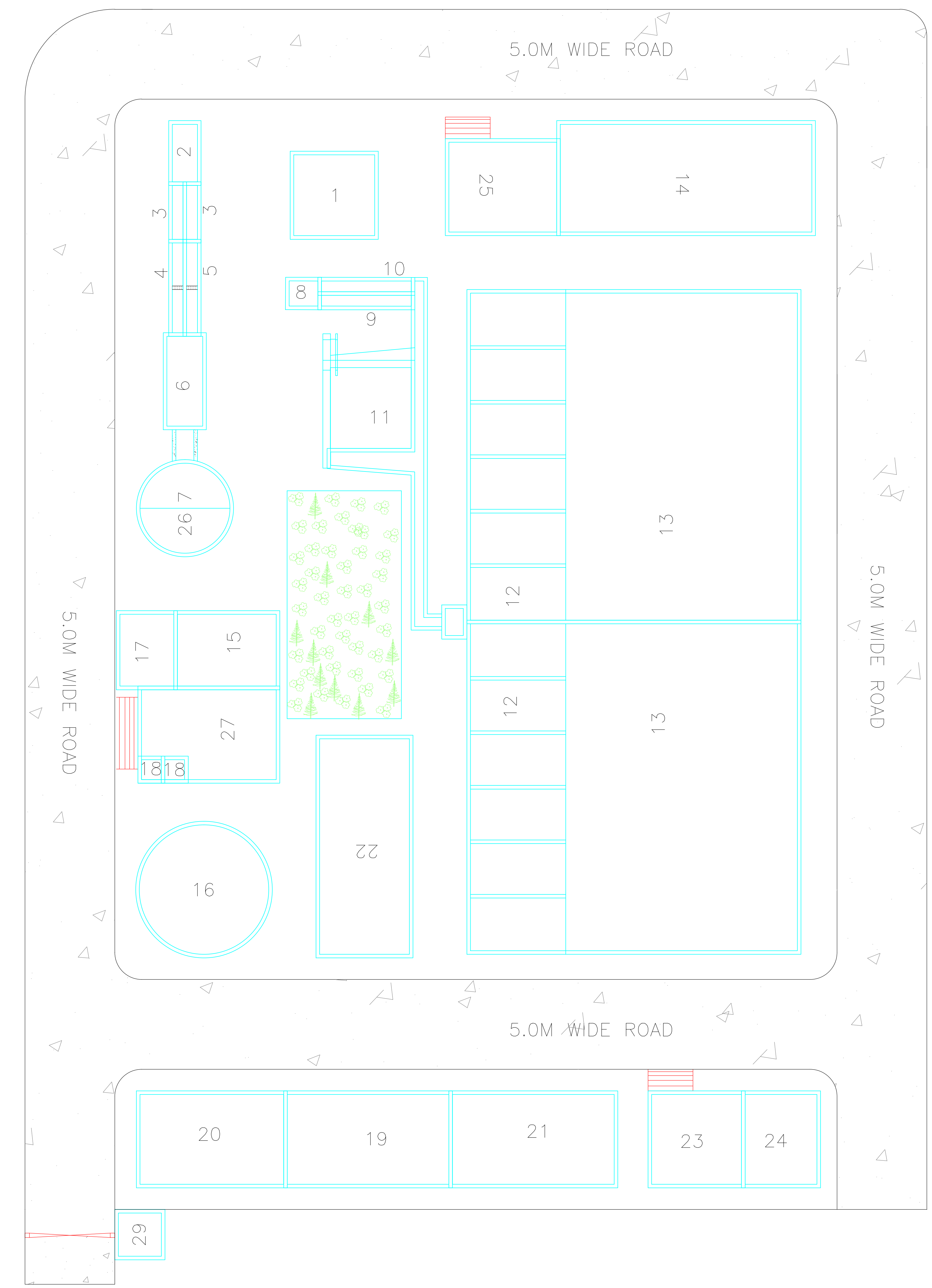
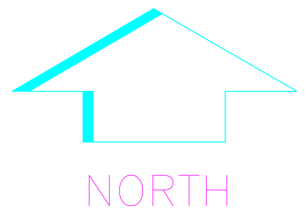
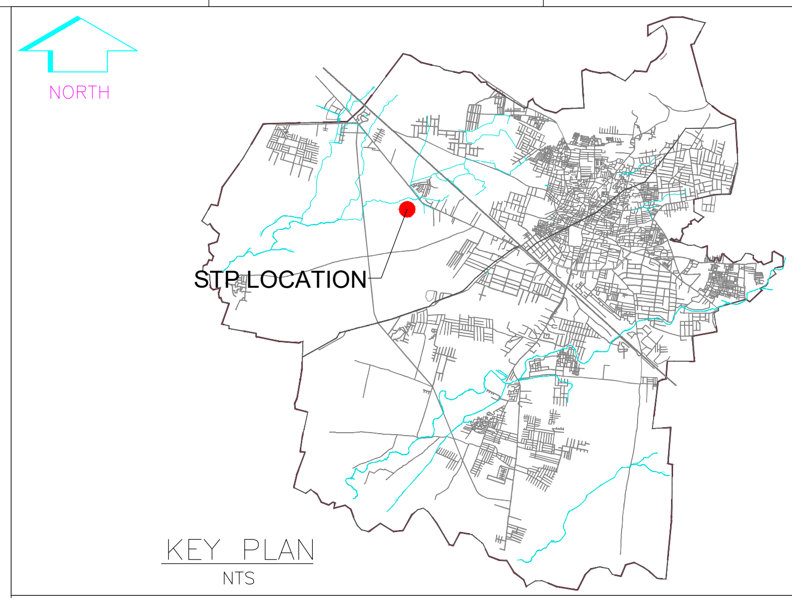
DWG NO: TCE.10282A-CV-3009-SL-31705

AREA 3417 Sq.M







KEY PLAN
NTS

LEGEND:

NOS.	DESCRIPTION	SIZE	QTY
1 –	SEPTAGE STORAGE TANK	4.50M X 4.0M X 2.0M	1
2	RECEIVING CHAMBER	3.2M X 1.4M X 1.0M	1
3	TRASH SCREEN CHANNEL	3.0M X 0.60M X 1.0M	2
4	COARSE SCREEN CHANNEL –MECHANICAL	5.0M X 0.60M X 0.60M	1
5	COARSE SCREEN CHANNEL –MANUAL	5.0M X 0.60M X 0.60M	1
6	GRIT CHAMBER –MANUAL	5.0M X 2.0M X 1.60M	1
7	RAW SEWEAGE SUMP	Ø5.0M X 2.50M	1
8	STILLING CHAMBER	1.6M X 1.4M X 2.0M	1
9	FINE SCREEN CHANNEL–MECHANICAL	5.0M X 0.60M X 0.60M	1
10	FINE SCREEN CHANNEL–MANUAL	5.0M X 0.60M X 0.60M	1
11	GRIT CHAMBER–MECHANICAL	4.5M X 4.5M X 0.90M	1
12	SELECTOR COMPARTMENTS	18.20M X 5.30M X 5.50M	6
13	SBR BASINS	18.20M X 18.20M X 5.50M	2
14	CHLORINE CONTACT TANK	14.0M X 6.0M X 2.5M	1
15	THICKENER FEED SUMP	4.0M X 5.50M X 2.0M	1
16	GRAVITY SLUDGE THICKENER	Ø7.2M X 3.30M	1
17	CENTRIFUGE FEED SUMP	4.0M X 3.0M X 1.5M	2
18	DWPE DOSING TANKS	1.10M X 1.10M X 1.0M	1
19	TRANSFORMER YARD	9.0M X 5.0M X 4.50M	1
20	DG ROOM	8.0M X 5.0M X 4.5M	1
21	MCC ROOM	9.0M X 5.0M X 3.5M	1
22	AIR BLOWER BUILDING	12.0M X 5.0M X 5.50M	1
23	ADMIN BUILDING & TOILET BLOCK	5.0M X 5.0M X 3.5M	1 FF
23	LABORATORY AND SCADA ROOM	5.0M X 5.0M X 3.5M	1 GF
24	WORKSHOP	5.0M X 4.0M X 3.5M	1
25	CHLORINE BUILDING	6.0M X 5.0M X 4.5	1
26	RAW SEWAGE PUMP HOUSE (ABOVE RAW SEWAGWE SUMP)	Ø5.0M X 5.50M	1
27	SLUDGE DEWATERING BUILDING	7.50M X 5.0M X 5.0	1 FF
27	SLUDGE DEWATERING BUILDING	7.50M X 5.0M X 4.5	1 GF
28	GUARD ROOM	2.4M X 2.4M X 3.0M	1

– CANAL
– 5M WIDE ROAD
– LANDSCAPING

NOTE

1. ALL UNITS ARE IN METERS, UNLESS INDICATED OTHERWISE.

ENGINEERING REFERENCE DRAWINGS

--NIL--

CONSTRUCTION REFERENCE DRAWINGS

--NIL--

HOLD

--NIL--

ISSUE		DRN	DSN	CHD	CV	EL	IC	ME			PE/PM	APPD	DATE
	SIGN. / INITIALS / REVISIONS												
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P0	SIGN. / INITIALS	AJS	NL										07.07.2017

CLEARED: CV, EL, IC, ME

FOR PRELIMINARY

DO NOT SCALE

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FILE NAME : TCE.10282A.SL.31705

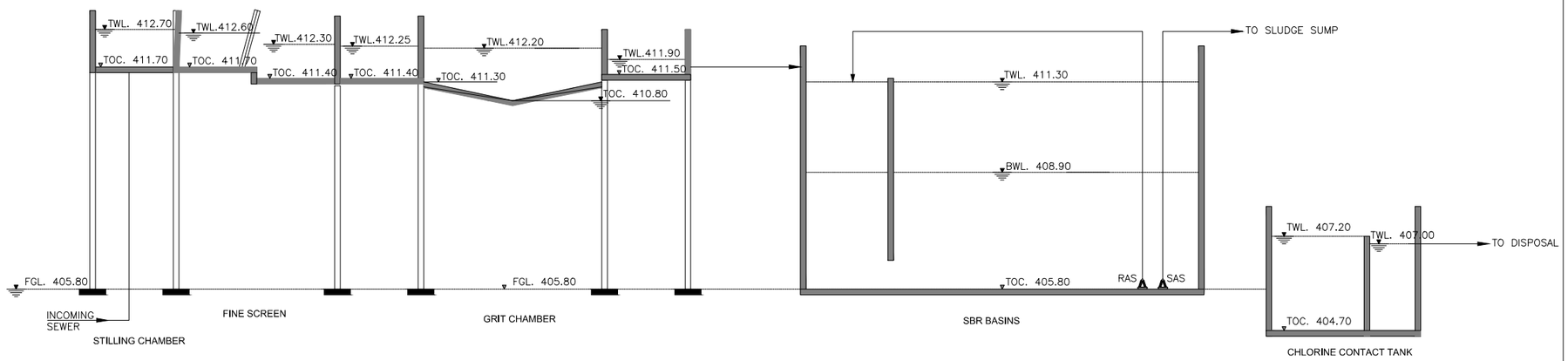
ANDHRA PRADESH URBAN FINANCE AND INFRASTRUCTURE DEVELOPMENT CORPORATION

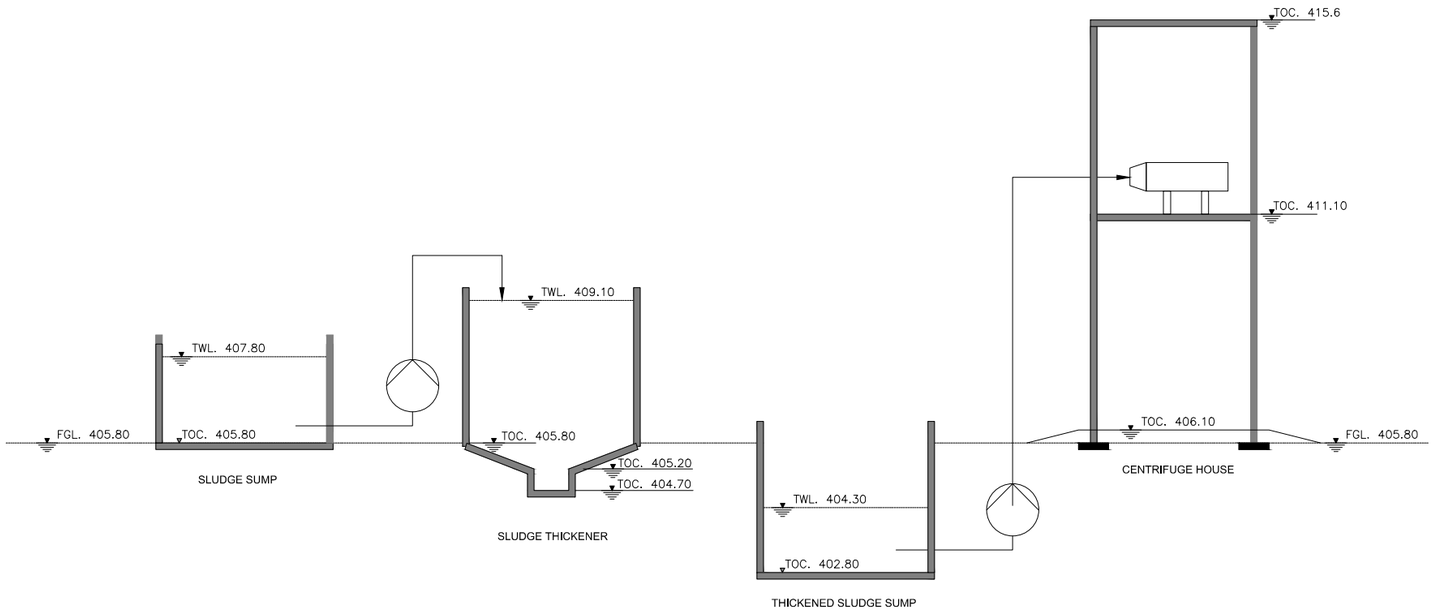
PDMC FOR ATAL MISSION FOR REJUVENATION AND URBAN TRANSFORMATION

LAYOUT FOR PROPOSED 5 MLD STP AT ADONI TOWN

TATA CONSULTING ENGINEERS LIMITED
MUMBAI

SCALE : 1:150
DC & DISC : BLR, CV
DWG NO. TCE.10282A-CV-3009-SL-31705
ISSUE P0
SIZE-A1





NOTE

1. ALL UNITS ARE IN METERS, UNLESS INDICATED OTHERWISE.

ENGINEERING REFERENCE DRAWINGS

--NIL--

CONSTRUCTION REFERENCE DRAWINGS

--NIL--

HOLD

--NIL--

	SIGN.												
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	REVISIONS												
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	INITIALS	AJS	SJG										
	REVISIONS												
ISSUE		DRN	DSN	CHD	CV	EL	IC	ME			PE/PM	APPD	DATE
					CLEARED								

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FOR PRELIMINARY

DO NOT SCALE

FILE NAME TCE.10282A.SL.31706

ANDHRA PRADESH URBAN FINANCE AND INFRASTRUCTURE DEVELOPMENT CORPORATION

PDMC FOR ATAL MISSION FOR REJUVENATION AND URBAN TRANSFORMATION

HYDRAULIC FLOW DIAGRAM OF 5 MLD STP AT ADONI TOWN

TATA CONSULTING ENGINEERS LIMITED

MUMBAI

SCALE : NTS

DC & DISC: BLR, CV

DWG NO. TCE.10282A-CV-3009-SL-31706

ISSUE P0

TITLE: SINGLE LINE DIAGRAM FOR 5.0 MLD SEWAGE TREATMENT PLANT (STP) AT ADONI (SHEET 01 OF 02)

DWG NO TCE.10282A-EL-4001-AU-40008-ADN

APSPDCL SCOPE

CONTRACTOR'S SCOPE

33/11KV APSPDCL S/S

11kV, OVERHEAD CABLE (OR) UNDER GROUND CABLE

11kV DP STRUCTURE

L.A

ISOLATOR 11kV

11kV, Al. CONDUCTOR, XLPE ARM. UNDER GROUND CABLE

HT METERING UNIT

TVM

COMBINED CT/PT UNIT

ACSR CONDUCTOR

11 KV DP

LA

GOD

D.O. FUSE

OUTDOOR OIL FILLED TRANSFORMER-1
11/0.433kV,*kVA TRANSFORMER
Dyn11, WITH WTI, OTI, OCTC
+5% TO -5%,TAPS IN STEPS OF 2.5%, Z=4.5%

OUTDOOR OIL FILLED TRANSFORMER-2
11/0.433kV,*kVA TRANSFORMER
Dyn11, WITH WTI, OTI, OCTC
+5% TO -5%,TAPS IN STEPS OF 2.5%, Z=4.5%

49W 49O 63

2Nos. 25X3 SQ.MM. Cu STRIP

1.1KV, XLPE AL. ARMOURED CABLE

415V LT PCC

CONNECTED LOAD- *** kW
RUNNING LOAD- *** kW

ON INCOMER B/C & OUTGOING ACB: ON OFF TRIP; SC TCH SP; TP CSH

ON OUTGOING MCCB: ON OFF TRIP

ON STARTER FEEDER: ON OFF TRIP; A/M L/R; ST ETPB

11kV/√3 / 110V/√3 / 110V/√3 CLASS 1 3P VA 50 50 PT

MFM SPARE

CT-1 */1A CL 1.0 15VA

START STOP R

FILTER CONTACTOR

*KVAR CAPACITOR BANK APP DOUBLE LAYER

*A,TP MCCB WITH TM TRIP UNIT Ice=Icu=100%

CT_2 */1A 15VA CL 1.0

SUMMATION CT

P2 P1 P1 P2

TO APFC PANEL-1

TO APFC PANEL-2

ACB *A,50kA FOR 1SEC,4P μP BASED (O/L+S/C+E/F) RELEASE EDO

EMI

415V, 3P,4W*A, 50kA 1 SEC 50HZ, AL BUS BAR(R=Y=B=100%,N=50%)

1 2 3 4 5 6 7 8 9 B/C 10 *A ACB 50kA 1 SEC, TPN TM BASED (O/L+S/C+E/F) 11 B/C 12 13 14 15 16 17 18

MCCB TPN

*/1A 15VA CL 1.0

I MFM A AS

*A MCCB *kA 1 SEC, TPN

I VS V

415V, 110V/√3 CLASS 1.0 VA 30

*R*C*X* Sq.mm CU, XLPE CABLE

DG

AMF PANEL

RAW SEWAGE PUMP HOUSE MCC

AIR BLOWER MCC

HEADWORKS MCC

SBR MCC

LDB MCC BUILDING

SPARE

CHLORINE MCC

ADMIN BLDG. MCC

SLUDGE MCC

STREET LIGHTING

SPARE (2 NOS.)

* KVAR APFC PANEL

GI STRIP EARTHING

TCE.10282A-EL-4001-AU-40009-ADN (SHEET 02 OF 02)

TCE.10282A-EL-4001-AU-40009-ADN (SHEET 02 OF 02)

LEGEND:

- THREE PHASE TRANSFORMER WITH OCTC
- AIR CIRCUIT BREAKER
- CURRENT TRANSFORMER
- POTENTIAL TRANSFORMER
- CABLE TERMINATION
- INDICATING LAMPS (R-RED, Y-YELLOW, B-BLUE)
- 415V, FIXED TYPE MOULDED CASE CIRCUIT BREAKER (MCCB)
- 415V, MINIATURE CIRCUIT BREAKER
- M MOTOR
- G EMERGENCY SOURCE
- M METERING UNIT
- ON BREAKER ON INDICATION (RED COLOUR)
- OFF BREAKER OFF INDICATION (GREEN COLOUR)
- TCH TRIP CIRCUIT HEALTHY INDICATION
- SC SPRING CHARGING MOTOR INDICATION
- DIRECT-ON-LINE STARTER WITH SINGLE PHASE PREVENTOR AND BIMETALLIC RELAY
- STAR DELTA STARTER WITH SINGLE PHASE PREVENTOR AND BIMETALLIC RELAY
- SS SOFT STARTER
- VFD VARIABLE FREQUENCY DRIVE

- A/M AUTO MANUAL SELECTOR SWITCH
- L/R LOCAL REMOTE SELECTOR SWITCH
- PBON ON PUSH BUTTON
- ETPB EMERGENCY PUSH BUTTON
- A ANALOG AMMETER
- V ANALOG VOLTMETER
- AS AMMETER SELECTOR SWITCH
- VS VOLTMETER SELECTOR SWITCH
- 49O OIL TEMPRETURE INDICATOR
- 49W WINDING TEMPRETURE INDICATOR
- 63 BUCHHOLZ RELAY
- Hz FREQUENCY METER
- PF PF METER
- T TRIPPED ON FAULT INDICATION (AMBER COLOUR)
- DCF DC SUPPLY FAIL INDICATION (BLUE COLOUR)
- SP SERVICE POSITION
- TP TEST POSITION

NOTES:

1. RATINGS & SIZES OF EQUIPMENTS (WHEREVER GIVEN) ARE MINIMUM REQUIREMENTS AND ARE FOR REFERENCE ONLY.BIDDER SHALL CALCULATE EQUIPMENT SIZES & RATINGS BASED ON DESIGN CRITERIA GIVEN IN TENDER.
2. ALL THE EQUIPMENTS WILL BE AS PER RELEVANT IS/IEC STANDARD AND TENDER SPECIFICATIONS.
3. ALL MCCBs SHALL BE CURRENT LIMITING TYPE.
4. THE INCOMING ACB FOR 415V LT PANEL SHALL BE 4P,FIXED TYPE WITH THERMAL MAGNETIC BASED INBUILT O/L, S/C & E/F RELEASES WHILE THE OUTGOING MCCB OF LT PANEL SHALL BE THERMAL MAGNETIC BASED INBUILT O/L, S/C RELEASES
5. VA BURDEN SHOWN ON DRAWING IS TENTATIVE & SHALL BE FINALIZED DEPENDING ON METERING/PROTECTION LOADS BY VENDOR.
6. FOR ALL MOTOR FEEDERS, MCCB/MPCB, CONTACTORS, OLR SHALL BE AS PER TYPE-2 CO-ORDINATION OF RESPECTIVE MANUFACTURER.
7. MOTOR PROTECTION RELAY SHALL BE PROVIDED FOR OVERLOAD, EARTH FAULT, PHASE CURRENT OUT OF BALANCE, SINGLE PHASING PREVENTER FOR ALL MOTOR FEEDERS.
8. MOTOR FEEDERS GREATER THAN OR EQUAL TO 30KW SHALL BE PROVIDED WITH 240 V SUPPLY WITH INTERLOCK FOR MOTOR SPACE HEATER.
9. ALL PANEL WIRING SHALL BE WITH 1100 VOLTS GRADE FRLS PVC INSULATED, 1.5 SQ.MM. MULTI STRANDED COPPER WIRE FOR CONTROL WIRING & 2.5 SQ.MM FOR CT SECONDARY WIRING.
10. MCCB TERMINALS SHALL BE SHROUDED AND SHALL BE DESIGNED TO RECEIVE CABLE LUGS FOR RELEVANT CABLE SIZES.
11. ALL INDICATING LAMPS SHALL BE MULTICHIP LED TYPE.
12. ALL PANELS SHALL BE EXTENDIBLE ON BOTH SIDES.
13. THE LT SWGR. SHALL BE FREE STANDING, INDOOR METAL ENCLOSED COMPARTMENTALISED, FLOOR MOUNTED OF UNIFORM HEIGHT OF 2300MM & WIDTH OF FEEDER COLUMN SHALL BE MIN 550MM AND CABLE ALLEY SHALL BE 300MM MIN. FOR LT PANEL.
14. INTERLOCK SHALL BE PROVIDED BETWEEN I/C-1 AND I/C-2, SUCH THAT I/C-2 CAN BE SWITCHED ON MANUALLY WHEN I/C-1 IS OFF.

REFERENCE DRAWINGS:

	SIGN.												
	INITIALS												
	REVISIONS												
	SIGN.												
	INITIALS												
	REVISIONS												
P0	SIGN.	LSD	DB										25-02-2017
	INITIALS												
ISSUE		DRN	DSN	CHD	CV	EL	IC	ME	CLEARED			PE/PM	APPD	DATE

FOR APPROVAL

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FILE NAME : TCE.10282A-EL-4001-AU-40007.dwg

ANDHRA PRADESH URBAN FINANCE AND INFRASTRUCTURE DEVELOPMENT CORPORATION
PDMC FOR ATAL MISSION FOR REJUVENATION AND URBAN TRANSFORMATION

SINGLE LINE DIAGRAM FOR 5.0 MLD SEWAGE TREATMENT PLANT (STP) AT ADONI (SHEET 01 OF 02)

TATA CONSULTING ENGINEERS LIMITED
BANGALORE

SCALE : NTS | DWG NO. TCE.10282A-EL-4001-AU-40008-ADN | ISSUE P0

DC & DISC: BLR & EL

SIZE-A1

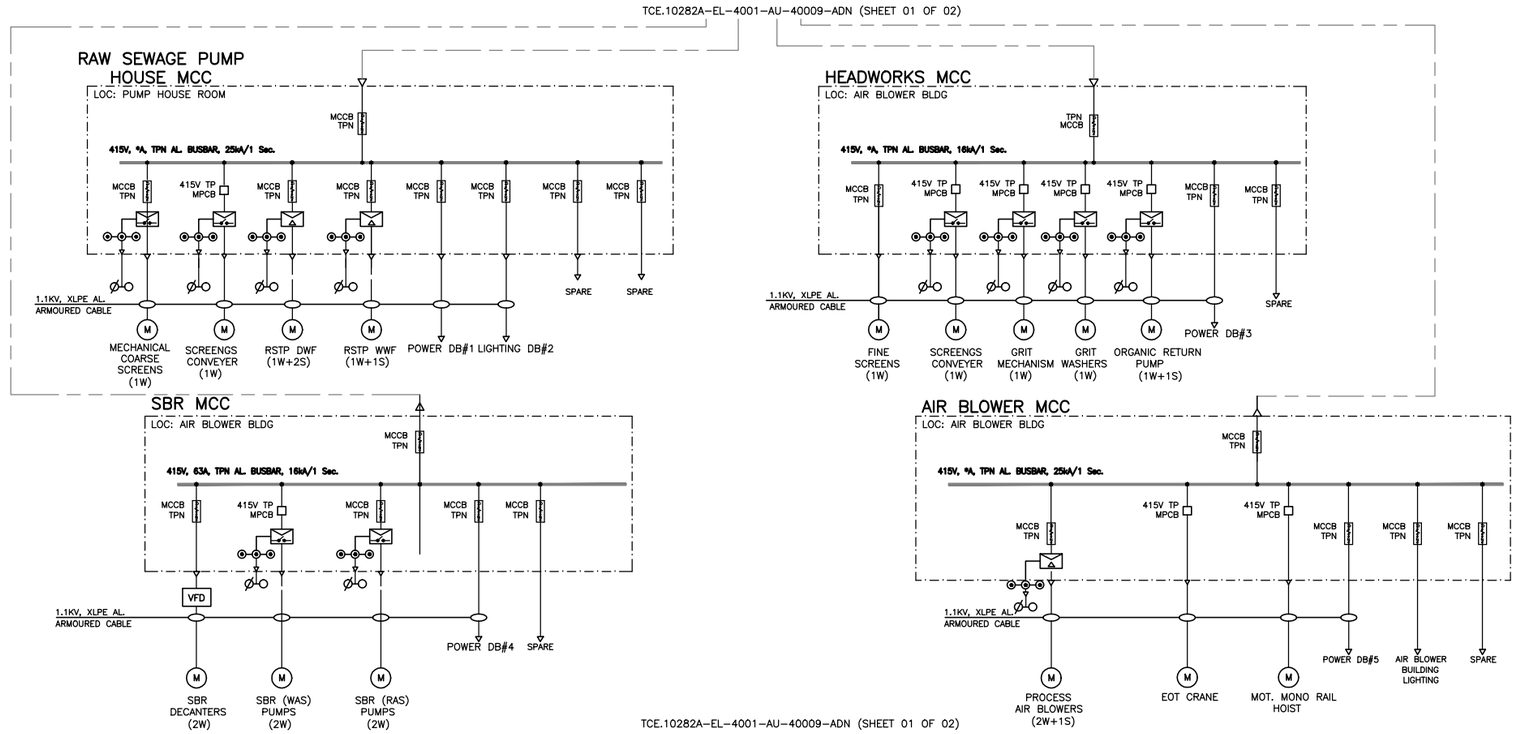
FILE NAME: F-091-Rev-R0.dwg

TCE FORM NO. 091 R0

TITLE:	DWG NO
SINGLE LINE DIAGRAM FOR 10.0 MLD SEWAGE TREATMENT PLANT (STP) AT ADONI (SHEET 02 OF 02)	TCE.10282A-EL-4001-AU-40008-ADN

NOTES:

1. FOR LEGEND, NOTES & REFERENCE DRAWINGS, REFER SINGLE LINE DIAGRAM FOR 10.0 MLD STP, DWG. NO. TCE.10282A-EL-4001-AU-40009-ADN (SHEET 1 OF 2)



REFERENCE DRAWINGS:

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	INITIALS											
ISSUE		DRN	DSN	CHD	CV	EL	IC	ME	CLEARED		PE/PM	APPD	DATE

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SINGLE LINE DIAGRAM FOR 10.0 MLD SEWAGE TREATMENT PLANT (STP) AT ADONI (SHEET 02 OF 02)

TATA CONSULTING ENGINEERS LIMITED
BANGALORE

SCALE	DWG NO.	ISSUE
: NTS	TCE.10282A-EL-4001-AU-40008-ADN	P0
DC & DISC: BLR & EL		SIZE-A1

FILE NAME: F-091-Rev-R0.dwg

TCE FORM NO. 091 R0