KERALA WATER AUTHORITY

SEWERAGE CIRCLE KOCHI

DETAILED ENGINEERING REPORT

COMPREHENSIVE SEWERAGE SCHEME FOR KATTAPANA MUNICIPALITY

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EXECUTIVE SUMMARY

Environment protection has become the most important aspect in the present era of sustainable development. With uncontrolled urbanization, contamination of drinking water sources by sewage and septage has become a major threat to public health and safety. Direct discharge of sewage to the water courses from un sewered areas and discharges of septic tank effluents to the stream and canals have been contaminated the entire water course.

Government of Kerala (GoK) has launched the "Rebuild Kerala Initiative (RKI)" for infrastructure development of Kerala. Providing Sewerage network in major cities and towns is given utmost importance considering the increasing pollution of water bodies due to lack of proper disposal of sewage. Also Honorable National Green Tribunal (NGT) has given directions to implement sewerage system for various cities of Kerala to control pollution of major water bodies.

The local bodies, constitutionally entrusted with the responsibility of environmental protection, have only limited infrastructure and expertise to tackle the situation. Hence Kerala Water Authority, being a state wide establishment with qualified and experienced personnel in Public Health Engineering, has been considered by the government to take up the responsibility. As per the Kerala Water Supply and Sewerage Act, 1986 KWA has the function of rendering services in collection and disposal of waste water. To meet the growing demand for waste water management, KWA established a Sewerage Vertical Wing, led by the Chief Engineer, PPD & WASCON. PPD Wing's three circle offices in Thiruvananthapuram, Kochi, and Kozhikode have been designated as Sewage Circle offices in addition to Kochi sewerage circle office. These wings are responsible for the investigation, planning, design, and DER preparation of sewerage projects.

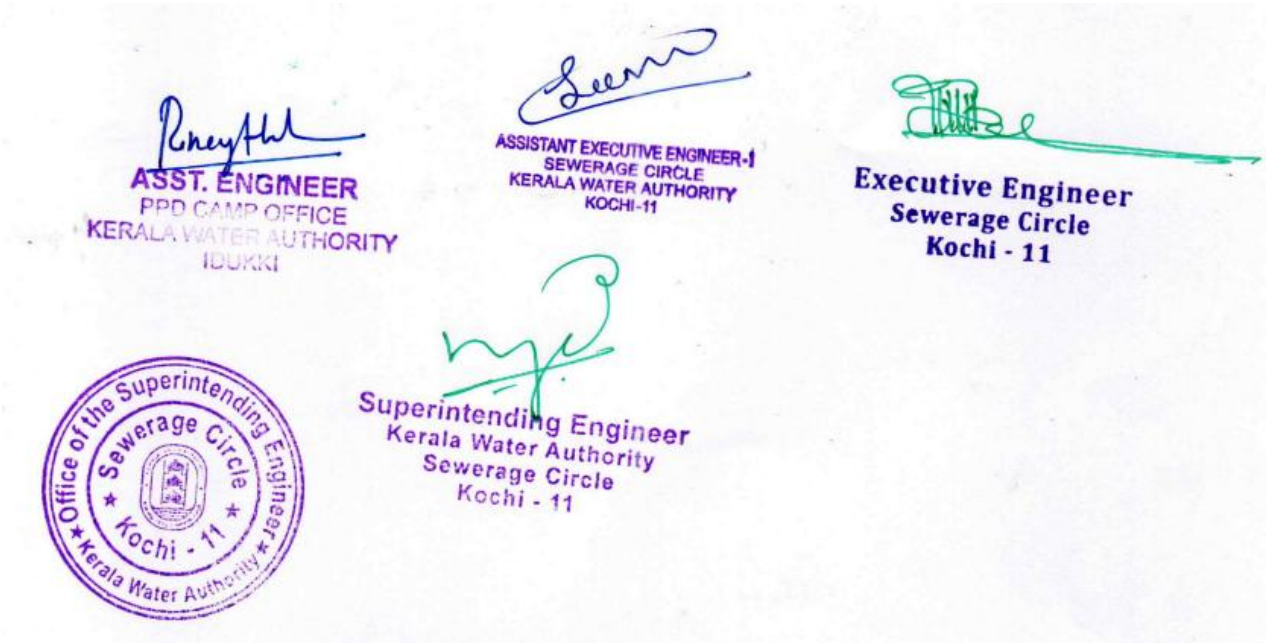
As per the direction of KWA, a comprehensive sewerage plan had been developed in the year 2020 for Idukki district. As a pilot project, two local urban bodies (ULBs) of Idukki district has been selected for implementation of sewerage scheme and Kattapana Municipality is one of the ULBs selected for the preparation of sewerage scheme by Sewerage Circle Kochi-11.

This Detailed Engineering Report envisions the establishment of comprehensive sewerage scheme for Kattapana Municipality of Idukki district in Kerala State. The project proposes a well-planned sewerage pipe line network for the core area of Municipality , pumping stations, and sewerage treatment plant with suitable technology so as to ensure the quality of effluent as per KSPCB standards and also to provide septage management facility to the area where laying of sewerage network is not feasible. Furthermore, septage treatment is proposed in core areas where the houses/building in the low lying areas which are not possible to connect to the sewage network system. The undulated terrain and scattered population is a

bottle neck in the sewerage scheme planning.

The scheme area is divided into two separate zones of sewage network and septage and is designed to meet the sewerage demand up to the year 2053, using 2023 as the base year and a design period of 30 years. The zoning is based on topography, population density, altitude and other factors. Sewerage network system is planned in the core area of municipality with a coverage of 5 sq.km and septage zone is proposed in balance areas where the population is scattered and terrain is highly undulated. Furthermore, septage treatment is proposed in the core city areas where there are no road network or in low lying areas. The ultimate sewage load for the Sewage scheme is 1.76 MLD including non-domestic demand and infiltration. The scheme covers 52.77 km2 area of kattapana Municipality with the design population of 58167. Co- Treatment is proposed along with the Sewage Treatment Plant covering entire septage zones of Municipality. This proposal includes 1.76 MLD STP with MBBR technology at Housing board plot near bypass road in Kattapana Municipality with a sewer network of 27.406 km, 1100 manholes, five collection wells and pumping stations and 24 lifting stations. Manholes at 30 m intervals and at all intersections are proposed to facilitate maintenance operations.

Total Estimated cost of the project including 10-year O&M cost is 113.50 corers.



PROJECT AT A GLANCE

KATTAPANA MUNICIPALITY- SEWERAGE PLAN AT A GLANCE		
Project Details	Detailed Engineering Report for the Sewerage scheme in Kattapana Municipality covering 5km sewerage network system in the city area and FSSM in balance area of Municipality with one STP of capacity 1.76MLD	
LSGI Covered under the scheme	Kattapana Municipality	
Total Scheme Area	52.77	Sq.km
Total Population (Year 2011)	42646	Nos
Total Population (Year 2023)	46601	Nos
Population Density	808	No./Sq.km
Design Period	30	years
Expected Population (Year 2053)	58167	Nos
Number of Zones	2	Nos. (Zone 1-Sewerage network, Zone 2-Septage)
Number of Collection Wells	5	Nos
Sewerage Network area	5.084	Sq.km
Population in Network area (Year 2011)	9491	Nos
Population Density in the Network area	1867	No./Sq.km
Total sewage Load to STP(including septage)	1.76	MLD
Total Length of Network Pipe	27406	m
Length of Pumping Main	5481	m
Total Cost of Project (w/o Land cost) including O&M cost of 10 year	113.50	Crores

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IDUKKI

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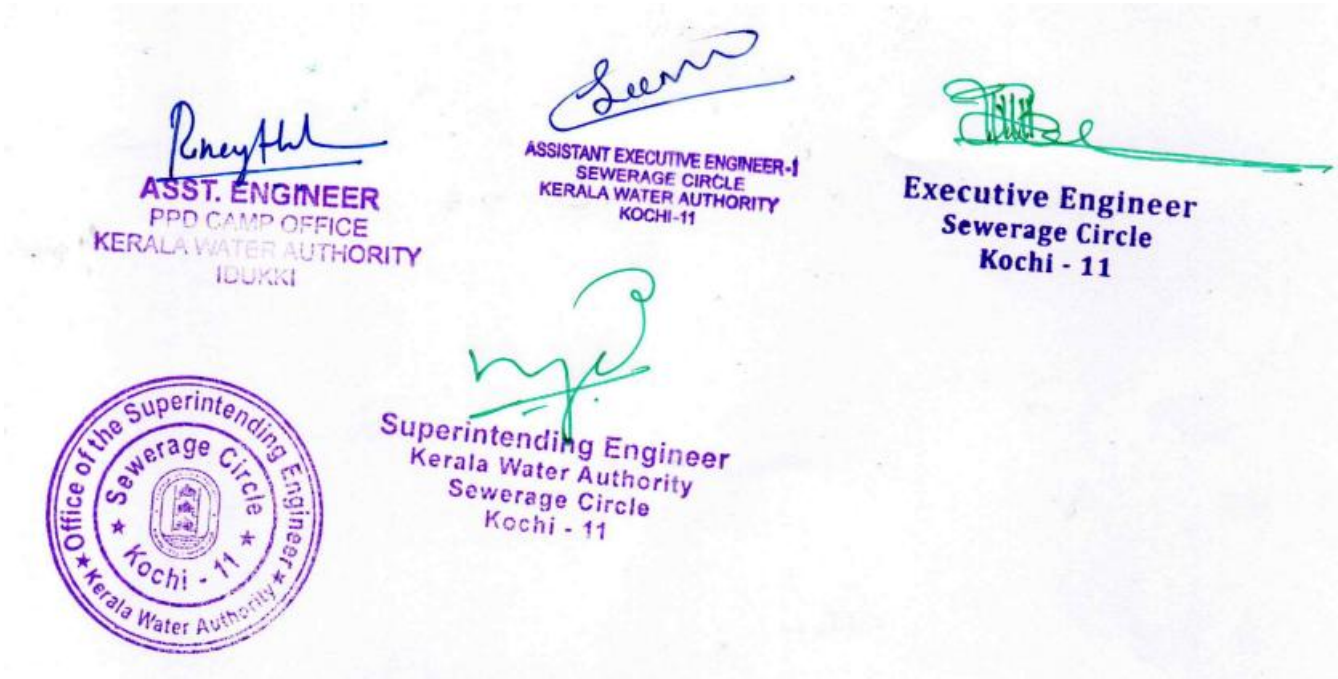
Office of the Superintending Engineer
Sewerage Circle
Kochi - 11
Kerala Water Authority

Superintending Engineer
Kerala Water Authority
Sewerage Circle
Kochi - 11

ABSTRACT OF ESTIMATED COST

Sl. No.	ITEM	AMOUNT
	CIVIL ITEMS	
1	Site Preparation-LS	₹ 4,500
2	OG Trap, Receiving Chamber, Screen, Grit Chamber	₹ 2,420,996
3	Equalisation Tank	₹ 5,816,692
4	Dilution tank for co treatment	₹ 1,274,343
5	Collection Tank for Co treatment -rectangular	₹ 554,758
6	Primary Clarifier	₹ 3,681,527
7	MBBR Tank-1	₹ 6,277,552
8	MBBR Tank-2	₹ 4,769,863
9	MBBR Tank-3	₹ 2,680,891
10	MBBR Tank-4	₹ 1,511,121
11	Clarifier with Tube/Plate Settler	₹ 1,745,782
12	Sludge Sump and Thickener	₹ 2,643,054
13	Chlorine Contact Tank and Treated Water Tank	₹ 2,255,778
14	Filter feed tank	₹ 868,490
15	Buffer zone with vegetation ,Green Belt and Landscaping	₹ 1,155,000
16	Facility for Recycling Purposes	₹ 150,000
17	Construction of administration cum laboratory building including Compound wall	₹ 17,500,000
18	Pump house building above wells & compound wall for well site	₹ 6,900,000
19	Equipment, Laboratory items, Furniture and Computer	₹ 133,929
20	Sewer network with pipelines, chambers and wells	₹ 464,165,336
	TOTAL OF CIVIL ITEMS	**₹ 526,509,610**
	MECHANICAL ITEMS	
1	Bar Screens	₹ 1,000,000
2	Pump sets and Aeration system	₹ 9,719,140
3	PSF & ACF	₹ 6,222,220
4	Centrifuge	₹ 400,000
5	Bypass arrangements, steel ladder and frame work	₹ 350,000
6	Piping and Valves	₹ 200,893
7	MBBR Carrier and other items	₹ 7,778,179
8	Tube settler media	₹ 66,964
9	Alum and Lime dosing systems	₹ 110,000
10	Odor control unit	₹ 60,000
11	Mechanical arrangement for oil & grease trap, clarifier	₹ 525,000
12	Electromagnetic flow meter	₹ 223,214
	TOTAL OF MECHANICAL ITEMS	**₹ 26,655,610**

ELECTRICAL ITEMS		
1	Diesel Generator	₹ 840,000
2	Electrical works, IoT based sensor and control units, transformer unit	₹ 4,600,000
3	Solar units	₹ 1,830,000
	TOTAL OF ELECTRICAL ITEMS	**₹ 7,270,000**
ABSTRACT OF COST		
Sl. No.	**ITEM**	**AMOUNT**
1	Civil Works	₹ 526,509,610
2	Mechanical Works	₹ 26,655,610
3	Electrical Works	₹ 7,270,000
4	Road restoration charges	₹ 173,186,813
5	Household Sewer connection charges @ 16500	₹ 33,000,000
	GST Component (18%)	₹ 137,991,966
	DPR preparation charge @ 2.5%	₹ 19,165,551
	Centage charges@10%	₹ 76,662,203
	Unforeseen	₹ 11,168,248
	GRAND TOTAL	**₹ 1,011,610,000**
	Total O&M cost for10 years	**₹ 123,390,000**
	TOTAL COST including 10 years O&M	**₹ 1,135,000,000**
	Rupees One hundred and thirteen crores fifty lakhs only	



CHAPTER - 1
INTRODUCTION

1.1 SANITATION – VISION, STATUS AND GOALS

To address the situation of inadequate sanitation facilities to the urban population, the Government of India has formally approved the National Urban Sanitation Policy in 2008 which envisions the creation of totally sanitized cities and towns. The policy articulates awareness generation and behavior change, open defecation free cities in which all urban dwellers have access to safe sanitation, integrated city wide sanitation planning and sanitary and safe disposal of urban wastes. The vision of the policy is that the municipality shall be totally sanitized, healthy and liveable and ensure and sustain good public health and environmental outcomes for all the citizens with a special focus on hygienic and affordable sanitation. The policy articulates the following goals

1. Awareness Generation and Behavioral Change

2. Open Defecation Free Cities

3. Integrated City Wide Sanitation

4. Sanitary and Safe Disposal

5. Proper Operation and Maintenance of all Sanitary Installations Wastewater disposal and treatment is a major problem in cities in Kerala.

The wastewater from toilets has been disposed through septic tanks and soaks pits and grey form of wastewater from kitchen and bathrooms is directly discharged into the sludge drains without any treatment. As per Census 2011, 45.45% of the urban households have “no drainage”. There are 14.32% of the households connected to centralized sewerage system. About 97.43% of the households in the urban areas of Kerala state have a toilet within their residential premises. Almost 56.69% of them are connected to septic tanks, 21.87% to pit latrines while households having connection to the centralized sewer system are about 14.32%.

Septage management is viewed as private provision with limited role of urban local bodies. Another set of reasons cited for urgency in taking up septage management is the occupational hazards for emptying the septic tanks. The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013 has expanded the definition of workers engaged in such sanitation works by including the practice of septic tank emptying and manual handling of such faecal sludge. The revised Manual Scavenging Act will require states to gear up the Municipal bodies in discharging their responsibilities effectively. In the

absence of efficient waste water treatment systems and solid waste management systems, untreated domestic and industrial wastes, and agriculture-runoff flow into the rivers polluting the rivers in Kerala.

There has been widespread bacteriological contamination of faecal origin in ground and surface water which relate to proximity of increasing numbers of leach pit latrines, leakages from septic tanks, washing, bathing and other domestic activities.

Hence the goals for setting a sewerage strategy for a district will involve multi-faceted approach to cover every habitation and other institutions and establishments. This will render adequate results in both short term and long-term development plans. If a plan has been chalked out which can provide a systematic and flexible implementation mode, stage by stage implementation and better control over the system can be achieved.

A district level plan document for sewerage prepared by KWA will create a backbone for the subsequent formation of detailed engineering reports for ULBs. National Green Tribunal (NGT) while considering various OAs related to pollution of river streches, pollution of coastal regions, pollution of ground water and restoration of water bodies in various States and UTs has ordered that all States and UTs shall ensure that various measures are taken to prevent the pollution of river stretches, water bodies and coastal areas on priority basis and within specified time limits. One of the directions is to ensure 100% treatment of sewage at least to the extent of in-situ remediation.

Following this, being the agency for ensuring sewerage services in the State, Kerala Water Authority (KWA) has created a separate Vertical within it exclusively for preparation of DPR sewerage works across the State. The newly formed Sewerage Vertical of KWA has prepared Preliminary Engineering Report for establishing a sewerage network/ septage management across the State. As per order no GO(Rt) No.352/2021/P&EA dated 16/8/2021 Administrative Sanction has been accorded for conducting DGPS leveling survey work for 28 Urban Local Bodies and DPR preparation of 4 corporations in Kerala and Kattapana Municipality is one among them. Sewerage Circle, Kochi is assigned with the task of preparation of DPR for sewerage scheme for Kattapana Municipality in Idukki District.

1.2 NEED FOR SEWAGE TREATMENT SYSTEM

The sewerage project in respect of which considerable public and social resources are being used, form a basic infrastructure for the country and an indisputable indicator of civilization and development. The works cover a number of substantial social needs and aim to improve the quality of life and to protect public health and the environment. Some of the benefits and advantages of the sewerage system are as follows:

(a) Upgrading the quality of life : The quality of life and the hygienic conditions in the areas where the system operates have already improved. The operation of the sewerage system has relieved these areas to a great extent from previous problems that were caused by the continuous maintain septic tanks and soak pits periodically. The sewerage system provides a healthier and more appropriate way to manage liquid wastes.

(b) Preserving the natural environment

Previously, all sewage waste was discharged in septic tanks and cesspits, resulting in the pollution of the ground water of the areas where such waste was discharged. Polluted water then ended in the sea and caused various risks and other environmental problems. With the operation of the sewerage system no more pollution of ground water is effected and the discharge of sewage waste has significantly been reduced. Moreover, the wastewater treatment plant produces by-products such as treated biosolids and methane. Treated sludge is used as a soil-improving substance mainly for tree cultivations whilst methane is being used for electricity generation, covering part of the power, required to operate the plant.

c) Saving and processing waters

Water is a substantial natural resource for our country and it should be managed in the best possible manner. The tertiary treated effluent at the wastewater treatment plant is reused for agricultural and other purposes.

(d) Economic development and tourism

The most significant advantage of the system is maintaining sustainable development, the protection of the environment and improvement of the quality of life in our town, with a further impact on the development of tourism and the economy in general.

(e) Standard of living

As a result of the above, the sewerage system contributes to further development and increase of the standard of living of the town of Kattapana inhabitants. Considering all the above advantages, there is no doubt that if we all cooperate, we and our children will enjoy a better quality of life in the years to come and that we will secure a better environment.

1.3 HUMAN DEVELOPMENT OUTCOMES FOR SEWERAGE INVESTMENTS

Lack of access to improved sanitation costs countries up to 7% of their GDP annually. At the national and global levels, the human cost manifests in huge economic losses. These losses are mainly driven by premature deaths, health care treatment, lost time and productivity seeking treatment, and finding access

to sanitation facilities in urban areas and thickly populated clusters of rural areas as well. In 2012, the World Health Organization (WHO) estimated that the global economic return on sanitation spending is US $5.5 for every one dollar invested, more than double the economic return on water spending (US$2.0). However, the UN 2012 Global Analysis and Assessment of Sanitation and Drinking Water indicates that only 10 out of 75 countries who participated in their survey reported to have more than 75% of the funds needed for sanitation. Investment in safe water supply and access to improved sanitation has multiple economic returns. For every 1 US Dollar invested, there is a projected USD 3 to 34 benefits gained. The benefits range from time savings and productivity gains to budget savings on health-care. Per capita gains for the developing world population could reach at least USD 15 per capita per year. It is well established that aspects of women safety, dignity and well-being are intrinsically linked to improved availability, access and use of sanitation and drinking water facilities.

1.4 ORGANIZATION OF DETAILED ENGINEERING REPORT

Improved Institutional governance and enhanced human resource capacities for planning and maintaining the sewerage is also coming under the goal. Capacity building for adoptability to modern technologies and applications for the service providers is also another goal.

Chapter 1 deals with a general introduction to the subject. Vision and goals of the sewerage for entire project area and its social implications are described.

Chapter 2 describes the salient features and various aspects of the selected project area.

Chapter 3 consists of various aspects of the sewerage strategy. Methodology adopted and Plan for the sewerage treatment and the technology are described.

Chapter 4 describes the design criteria for sewerage scheme planning as per the IS standards and CPHEEO manuel.

Chapter 5 deals with the proposed sewerage scheme of the project area includes details of network, pumping main, manhole, collection well, pump sets, lifting stations etc.

Chapter 6 deals with the Technology for the design of sewage treatment plant and various components of sewerage system design as per the IS standards and CPHEO manual.

Chapter 7 consists of design details of Sewerage treatment plant units including co treatment units and collection well

In Chapter 8, estimates for all components of the sewerage project are illustrated. Detailed estimate attached in Annexure 1.

Chapter 9 deals with various aspects of operation and maintenance of the sewage treatment plant in detail. Since it is decided to impart optimum cost and functional aspects of operation, applications of modern technologies for control of the process are also dealt with.

Chapter 10 consists of the action plan for the implementation of the project.

In the concluding Chapter 11, observations gathered from the pre-feasibility studies for the planning, design of the sewerage system and recommendations for the successfulness of project is presented.

CHAPTER - 2

KATTAPANA MUNICIPALITY AN OVERVIEW AND SALIENT FEATURES

2.1 CITY PROFILE

Kattappana is a municipal town in the Sahyadri (or Western Ghats) of Kerala state, India. It is the main urban centre in the high ranges of Idukki district, situated about 2,788.71–2,952.76 feet (850.00–900.00 m) above mean sea level, in the High Ranges, the high altitude region of Kerala has recently raised to the status of municipality. Kattappana is a CLASS III urban centre and it is the first municipality in high range of Idukki district with the real terraineous touch of Idukki as Thodupuzha municipality is situated in low range.

Previously, Kattappana was included in the Udumbanchola tehsil (taluk) of Idukki district and was later included in the newly formed Idukki tehsil (taluk). In 1962, it became a grama panchayath and the first council was held in 1964. It was officially declared as municipality by the state government on 1 November 2015.

However, it was the development of the Kottayam–Kattappana road and the Puliyanmala–Thodupuzha State highway that turned the town into a commercial centre. It is a major commercial town and flourished with the boost in production of agriculture and spices. It was the agriculture sector that played a pivotal role in economically uplifting the town.

2.2 TOPOGRAPHY

The area of Kattapana lies at 9o7557'N latitude and 77°11539'E longitude. Minimum elevation is 723 m; Maximum elevation is 1,299 m and Average elevation is 963 m. Physiographically the project area forms part of both the midland and highland units. Descending from the heights of the Western Ghats in the east, the land slopes towards the west forming three distinct – the highlands, the plains. Some of the lofty ridges and peaks extend towards the west by a succession of hills of diminishing altitude.

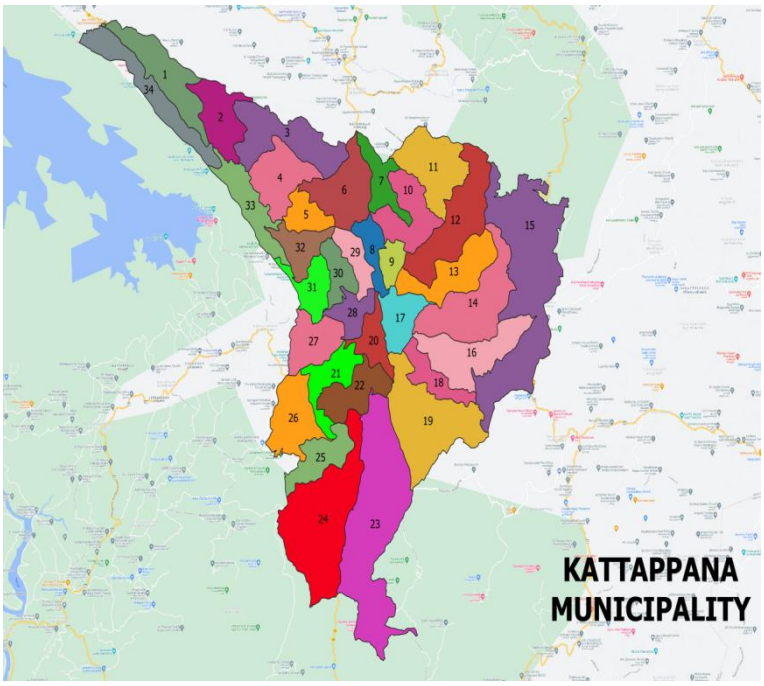


Fig.2.1 Project area -Kattapana Municipality

2.3 WATER RESOURCES

2.3.1 SURFACE SOURCE

Kattapanayar is the major river flowing through the district. The source of water supply to Kattapana Municipality is Kattapana River. Many portions of the Kattappana River have been encroached upon. The river is now a dump for waste generated in the town, and severely In Kattappana, the main sources of drinking water are ponds and borewells. In emergency situations, tanker Lorries distributes water. The households and hotels in the town depend on potable water supplied by private agencies, without any quality-check.

2.3.2 GROUNDWATER POTENTIAL

Idukki reservoir, one of the largest in Asia, has turned into a dumpyard for non-biodegradable wastes, with plastic and glass bottles, sanitary waste, and pesticide bottles flowing into the residential areas of Ayyappancoil, Kanchiyar, and Upputhara grama panchayats. When the water recedes, the waste gets deposited there. Local residents say they face this problem every year when the water inflow increases during monsoon. In summer and the garbage is either deposited on the banks or floats on the waterbody posing a threat to human life and fish.

The three panchayats are on the embankment area of the reservoir where water spreads to a large area by mid-monsoon. Once the water recedes, the area is spotted by heaps of non-bio degradable waste.The

pesticide bottles used in the cardamom hill areas of Elamala are the biggest threat. They arrive through the Periyar and float on the still water of the reservoir. Most of the aluminium bottles contain pesticides, which spread in the water. “There have been instances of large-scale fishkill in the reservoir. No studies have been conducted yet to find the reason. The urban waste from far away towns like Vandiperiyar and Kattappana to find their way to the reservoir. As the dam area is wide, waste gets deposited in the creeks and pockets of earth created by the reservoir. Anchuruly, where the Kattappana river joins the reservoir, too has its share of piled up waste that come from the Kattappana municipal area.

The Idukki Wildlife Sanctuary also faces the threat of garbage getting deposited on the banks. The scale is less when compared to the human-inhabited areas since the sanctuary is downstream of the dam. “However, the wildlife at the sanctuary is at risk since the reservoir is their main water source,” according to a Forest Department official.

2.4. CLIMATE AND RAINFALL

The climate of Kattappana falls under the Köppen climate classification. The place normally experiences a moderate climate. The humidity rises from the month of March to April and mid May. The average annual temperature here is 23 °C. The months of June, July, August and October receives significant amount of rainfall. November and December are the coldest months in the year.

2.5. DEMOGRAPHY

As of 2011 Census, Kattappana had a population of 42,646, with 21,159 males and 21,487 females. Kattappana has an area of 61.32 km2 (23.68 sq mi) with 10,419 families residing in it. In Kattappana, 10.3% was under 6 years of age. The Scheduled Castes (SC) were 6% of the total population and the Scheduled Tribes (ST) were 1.23%. Kattappana had an average literacy of 95.25% higher than the state average of 94%.

2.6 LITERACY

As per the Census 2011, the literacy rate of Kattappana is 95.3%. Thus Kattappana village has higher literacy rate compared to 83.2% of Idukki district. The male literacy rate is 96.41% and the female literacy rate is 94.11% in Kattappana village.. There are 13.55% Scheduled Caste (SC) and 1.57% Scheduled Tribe (ST) of total population in Kattappana village.

2.7 POPULATION GROWTH

As per the census in year 2011, total population is 42646 and in year 2001, population is 39608 which show 7.67% growth increase. But the study during the last decade (2001-2011)for Idukki district shows a growth decrease of 1,79%.

GROWTH RATE OF POPULATION IN IDUKKI DISTRICT	
Census Year	**Growth rate (in %)**
1901-11	108.88
1911-21	9.239
1921-31	72.59
1931-41	30.17
1941-51	35.67
1951-61	74.98
1961-71	31.75
1971-81	26.91
1981-91	10.95
1991-01	7.03
2001-11	-1.79

Source: Census handbook of Idukki

2.8 AGRICULTURE

Kattappana is the center for spices trade and the primary producer of cardamom and black pepper. The main occupation of people of Kattappana is agriculture. A specific type Njallani high yielding variety of cardamom, was developed in Kattappana. It is also the centre of production and marketing of coffee, cocoa and ginger. There are also several reputed tea plantations (Tata Tea, A V Thomas & Co, Malayalam Plantations, Kannan Devan etc.) in adjoining areas of the district.

Spices Board (erstwhile Cardamom Board under Government of India) has an office in Kattappana. A Spices Park is established at Puttadi near Kattappana. Cardamom Research Institute is situated at Pampadumpara.

2.9 A COMMERCIAL HUB OF HIGH RANGE REGION

Despite being the commercial hub of the High Ranges, most of Kattappana was shown in official records, as part of forest area, owned by the government. Granting title deeds to the land owners and farmers, had been a vote-catching slogan, raised by successive state governments. With the removal of legal hurdles, the Government has ordered issue of condition-free titles to the farmers in November 2010.There is a mini Industrial estate in Kattappana.

Large quantity of potable water is necessary for all the development works of the City. A survey was conducted under KWA to assess the requirement of major consumers and the project is prepared considering the above aspects. 80% of this water is assumed to be coming as waste water which has to be properly treated and disposed off. In addition to this, the seepage water and rain water are also considered while arriving at the quantity of sewage.

CHAPTER - 3

PLAN OF SEWERAGE TREATMENT SCHEME

3.1 GENERAL

In this Chapter, general aspects of sewage collection, treatment and disposal for the Kattapana Municipality is described. For core area of the Municipality, sewer network consisting of pipeline network is planned to be laid underground to collect sewage load from various nodes in the system across the project area. The sewage network system is consisting of manholes at the interval of 30 m in normal cases and at every bends in vertical and horizontal planes. Whenever there is a variation in diameter, manholes are provided. To reduce depth of cutting, lifting manholes are provided with sewage lifting pumps of smaller capacities. Solar power and diesel generator backup power is also provided to get uninterrupted working of the system. IoT enabled monitoring of the sewerage system is envisaged with a control station inside the Sewage Treatment Plant (STP). The locations in the project area without having sewer network are included in the septage management plan. Using septage transportation system, sludge from various points is collected and diluted using cotreatment facility at STP area and treated along with sewage. Sewage Treatment Plant is designed for primary treatment and subsequent bacteriological and chemical treatment process. Finally, sludge handling units are planned to be provided. The recycled water can be taken for agricultural and other commercial and industrial purposes and for recharging water bodies and to alleviate any pollution loads.

3.2 PRESENT SEWERAGE SYSTEM- OVERVIEW

Like all other Municipalities in Kerala, Kattapana Municipality is also not having a sewerage system. All the residential building, commercial buildings, institutional establishments are having their own septic tanks for collecting sewage from latrines and grey water is either collected in leach pits or directly disposed to drainage system and nearby canals. Most of septic tanks are unscientifically constructed and do not have the facility for treating the effluent resulting in contamination of surroundings and the ground water .Even though Hospitals and other institutions are having their own independent facilities, in most cases partly treated effluent is discharged to nearby drains or water bodies. Most of dwellings have their own wells as drinking water source and proximity to the septic tanks leads pollution in well water also. Coliform bacteria are detected in 70% of wells in Kerala and emphasizing the need for a well-planned sewerage system. Anchuruly, where the Kattappana river joins the reservoir, waste is piled up which come from the Kattappana municipal area.

Fig 3.1: Contaminated area in Anchuruly near kattapana

3.3 METHODOLOGY FOR PREPARATION OF SEWERAGE MASTER PLAN

The following tasks have been performed during the planning of the proposed Sewerage System:

- Data Collection and Field Visits
- Review of adequacy of existing sewerage system
- Field leveling survey using DGPS
- Social survey
- Population Projection and Sewage Flow Estimation
- Design of Sewage Collection System
- STP site identification, assessing area requirement

Discussions with Municipality authorities and scheme presentation in the council for land availability

- phasing of construction of STP
- Capital cost and O & M costs

3.4 FIELD INVESTIGATIONS

General Field investigations like topographic survey, geotechnical investigation, and sewage samples analysis has been conducted to ascertain the topography of the area, population density, the soil classifications and to ascertain its characteristics for designing the type of treatment, which forms the basis for proceeding further in designing the sewerage system.

3.4.1 TOPOGRAPHICAL SURVEY WITH DGPS

Topographical survey forms a very important component in formulating the sewerage project. A detailed topographical survey has been performed covering the area using DGPS and Total Station.

Fig 3.2: DGPS Survey conducted in Kattapana Municipality

Topographical survey of the project area was conducted using DGPS and Total station. Ground Levels have been taken along the roads at suitable intervals along straight portions and at all junctions of alignment. Important features and obligatory points like junctions such as culverts, major drains, and public utilities, cross roads, railway line have been captured. Using the topographical survey data and detailed base map showing the features like roads, land marks, public buildings, parks etc. has been developed.

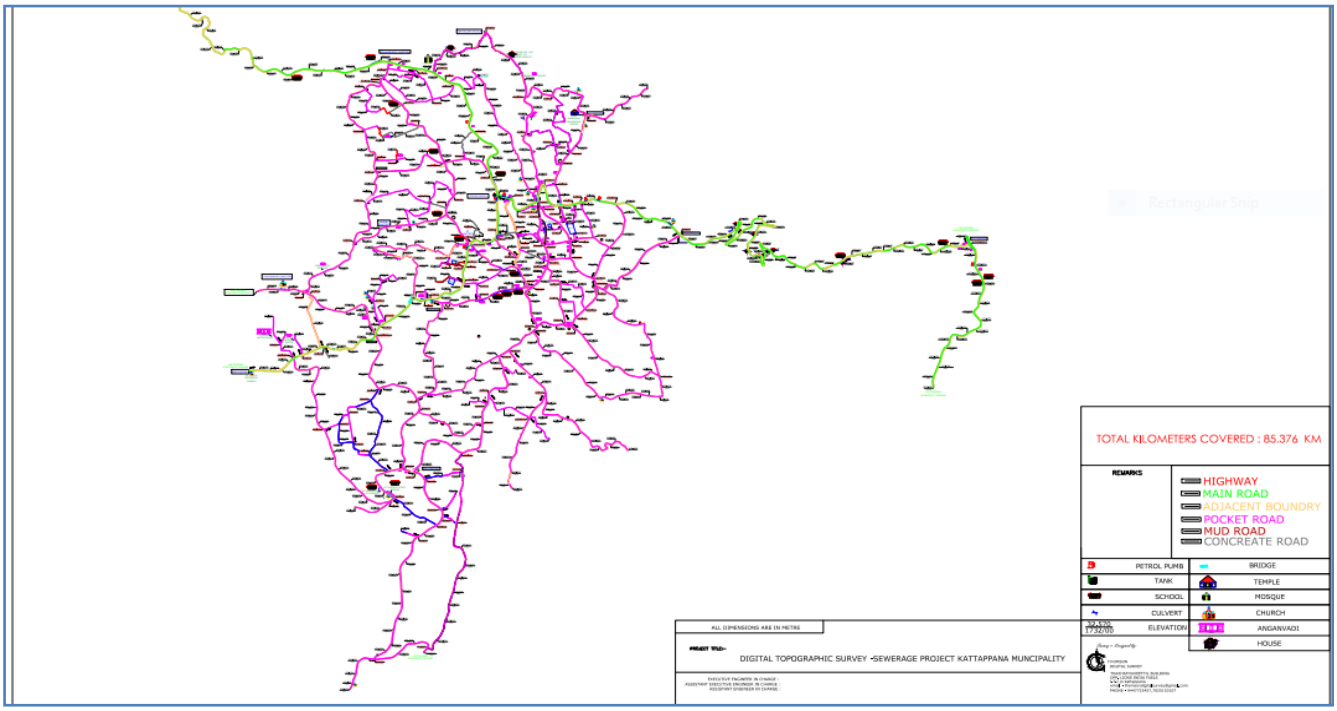


Fig 3.3: DGPS Survey levels

3.4.2 SOCIAL SURVEY

Social Survey was carried out for locating each buildings for arriving the sewer load in manholes. Identifying and arriving possible shock loads from institutions such as hospitals, flats, and other establishments are very important for avoiding overflows in manholes. Identifying the buildings which are not feasible to be connected to network, for arriving septage load /separate pumping arrangements is also carried out in social survey. Moreover the areas likely to be developed in future are to be identified for arriving sewer load to be incorporated in design. Major Non domestic institutions identified are listed below.

- Govt.Taluk hospital
- St.Johns hospital
- Co operative hospital
- Ortho hospital
- Bala hospital
- Ossanam English medium school
- St.Johns school of nursing & B Pharm.
- Infant jesus residential school
- St George HSS
- St Sebastian College
- Govt.Industrial training Institute(ITI)
- Govt.tribal HSS
- Kapuchian Ashramam
- SH Convent
- St.Martha Convent
- Womens hostel-st.Johns
- Theatre

3.5 COMPONENTS OF SEWAGE NETWORK

The components of the sewage collection and carriage network consist of the following elements:

Sl. No.	Type of element	Material	Function
1	Chambers	Reinforced concrete	Collection of sewage from individual units for transferring to manholes
2	Sewer pipelines	High Density Polyethylene (HDPE)	Transfer of sewage by gravity flow from one point to other
3	Manholes	Reinforced concrete	Sewage collection points and inspection areas for removing blocks and cleaning of lines
4	Lift manholes	Reinforced concrete	Sewage collection points and inspection areas for removing blocks and cleaning of lines and lifting of sewer load to the next manhole. Submersible pump sets are installed inside in such manholes.
5	Collection well	Reinforced concrete	Centralised collection point for sewer load from a subzone in the project area.
6	Pumping station	Reinforced concrete	Centralised collection point for sewer load from a subzone in the project area and pumping of sewage to the next well or STP

Table 3.1 Components of sewerage network

3.6 DESIGN OF SEWAGE NETWORK

For the design of sewage network, hydraulic analysis was performed for the initially planned network and refined for a set of constraints and inflow values. The pipelines are designed for gravity flow conditions except for lifting and collection points. Minimum outer diameter of the pipeline was taken as 180 mm for main lines along the roads and for carriage from chambers to manholes, with material as HDPE. The slope was taken as a minimum value of 1 in 170 in general and care has been taken to provide sufficient slopes to generate self-cleansing velocities during peak flow conditions when the pipe is near to full in load. All stipulations given by the relevant Indian Standard Codes of practice and CPHEEO Manual has been adopted in design.

3.6.1. CREATING PRIMARY MODEL FROM GEOGRAPHIC INFORMATION SYSTEMS (GIS)

Using GIS data available, the project area was examined thoroughly, and a primary model of sewer flow was generated. This model was later refined using reduced elevations obtained from Differential Global Positioning System (DGPS) Real Time Kinematic Survey (RTK) values at the control points established in the primary model. The GIS provides information of population density scatter, presence of water

bodies, road network and topographical features as a quick reference for planning an optimum site for the STP as well as the routing of sewer load.

3.7 SEPTAGE

Septage or septic tank waste refers to the partially treated matter stored in and pumped out of a septic tank. In other words, fecal sludge from septic tanks is known as Septage, but fecal sludge and Septage are interchangeably used in India. Septage is a by- product of pretreatment of household wastewater in a septic tank where it accumulates overtime. It is generally pumped out of a septic tank or onsite sanitation system using a vacuum tanker. Septage is the liquid and solid material that is pumped from a septic tank, cesspool, or other such onsite treatment facilities after it has accumulated over a period of time.

For the purpose of planning sewerage/septage management systems for this proposal the project area is broadly categorized into two: areas with higher population density and areas with lower population density. Networked sewerage system with STPs is proposed for the first category which is the city area of kattapana. Furthermore, septage treatment is proposed in densely populated areas where there is no road network and low lying area. Septage load from non network area of Kattapana Municipality is proposed to be transported to the proposed STP plant where Co treatment facility will be provided.

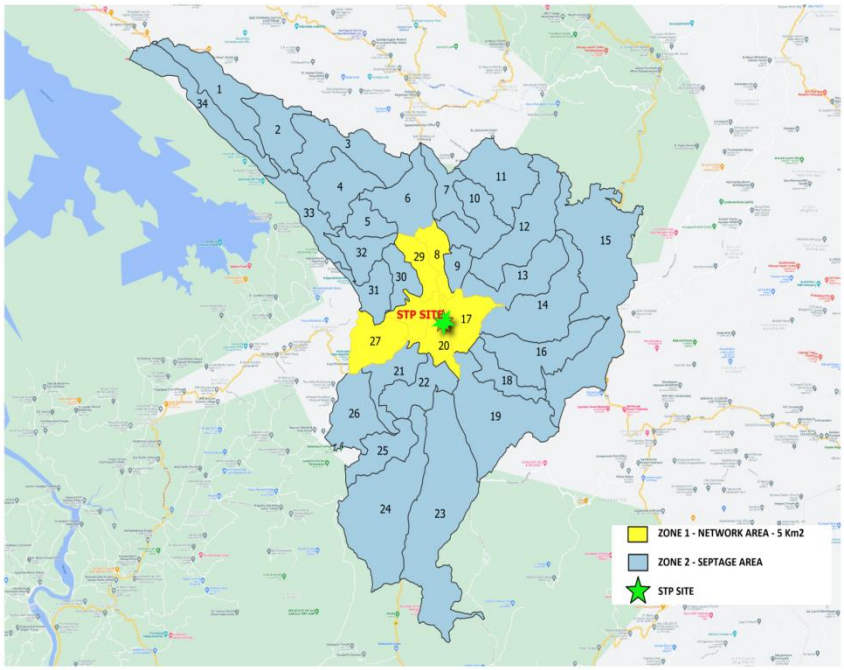


Fig 3.4: Zoning of Project scheme area and STP location

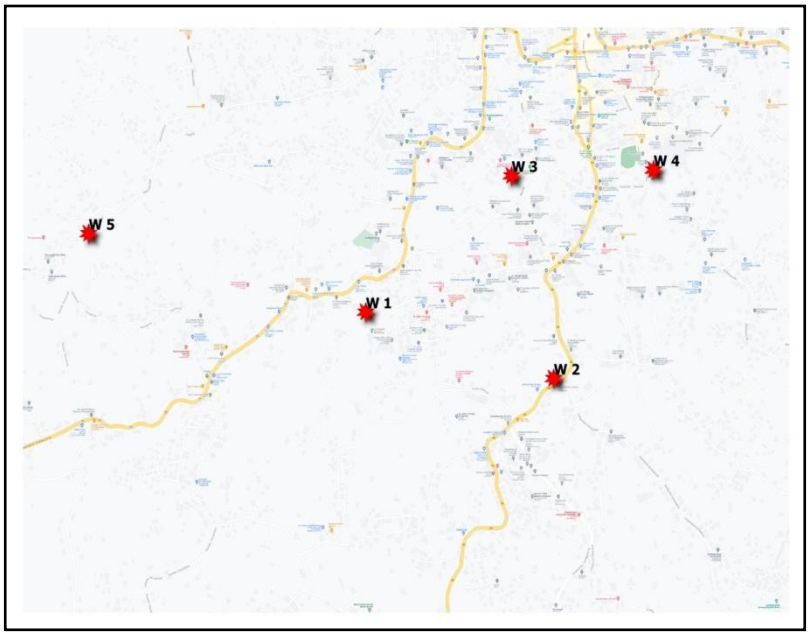


Fig 3.5: Collection well locations

3.8 PLAN FOR REUSE OF RECYCLED SEWAGE

In the planning and implementation of water reclamation and reuse, the reclaimed water application will usually govern the wastewater treatment needed to protect public health and the environment, and the degree of reliability required for the treatment processes and operation (Metcalf and Eddy). The major wastewaters re use categories are as follows:

a] agricultural irrigation, crop irrigation and commercial nurseries

b] landscape irrigation

c] industrial recycling and reuse

d] groundwater recharge, groundwater replenishment and saltwater intrusion control

e] recreational/environmental uses

f] non-potable urban uses

e] potable reuse

In the present project, the dewatered sludge can be used as manure for cultivating vegetables and other plant life.

3.9 INTEGRATION WITH OTHER PROJECTS

Planning and design of sewerage schemes can be combined with other water resources projects also. This is since most of these projects are inter-related and environment sensitive. Hence the location of an STP, collection wells and coverage of sewage networks in an area depends upon the water supply system existing in that area, proximity of irrigation canals, water bodies and flood routing structures if any. The integration of different projects related to the water resources and conservation schemes greatly influence the successful establishment and operation of the sewerage schemes in an area. The integrated planning of the projects associated with water resources will contribute effectively for a successful sewerage system.

CHAPTER - 4
DESIGN CRITERIA

4.1 SEWAGE COLLECTION & CONVEYANCE SYSTEM

The sewerage system or storm water carriage system can be separate system or combined system or partially separate system depending on domestic sewage and rain water are drained through two separate set of pipes or through single set of piping. However, the combined system is not quite suitable in tropical Indian conditions as;

i) Heavy and concentrated rainfall occurs during the monsoon period and thus there is a large variation in the quantity of sewage during different months of the year,
ii) Dry weather flow is generally a very small proportion of the total flow and hence sewers are likely to get silted up due to low velocity of flow in lean periods,
iii) Capital funds are limited,
iv) Treatment costs and pumping costs are significantly reduced in separate system due to reduction in quantity.
v) If the system is overdesigned, external flushing to attain the areas where the self-cleansing velocity is not attained which will increase the O&M cost. It affects system efficiency.

The pipes for collection can have;

vi) Zonal pattern in which entire city is divided into suitable zones and a separate interceptor is provided for each zone,
vii) Radial pattern in which sewers are laid radial outwards from the center of the city to dispose sewage at multiple points,
viii) Interceptor pattern in which sewers are intercepted by large size sewers laid along the natural watercourses or,
ix) Fan pattern in which the STP is located at a certain point and the entire sewage flow is directed towards this point.

4.2 ESTIMATION OF QUANTITY OF SEWAGE

Separate drainage system is proposed for rain water as such only dry weather flow will pass through sewers. The connection of roof, backyard and foundation drains to the sanitary sewers should be avoided and hence shall not be considered for estimation of sanitary sewage. The prevalent sewerage systems in India do receive rain water even if separate system for rain water exists but sewers are designed for 30 years and have spare capacity in early phases of implementation and considering that by end of 30 years

sewerage system will become water tight to rain water, it is appropriate to design system assuming no rain water penetration in sewers. The quantity of domestic sewage can be best estimated by quantity of water supply consumption minus evaporation plus sewage flow from personal water sources which are other than those of community water supply and this water reaching to sewers. Another important factor in Indian cities is generally less connectivity of sewage to the sewerage system as many people continue to use on site sanitation i.e. septic tanks and soak pits etc. particularly in colonies where sewerage system is laid after a long gap of construction of houses which is a general phenomenon in Indian cities. In actual practice about 70-80% of the water supplied is reaching to sewers. As such 80% of quantity of water supply can be taken as sewage generation.

4.2.1 INFILTRATION AND LEAKAGE.

Some quantity of ground water or subsoil water may infiltrate into sewers through defective joints, broken pipes etc. This is significant when water table is high and head of ground water is more than the head of sewage in sewers. Some quantity of sewage may leak out from defective joints and defective pipes when head of sewage is more in sewers than head of ground water outside. Infiltration and leakage mainly depends on quality of construction and water table levels. Infiltration can be considered 5000-50000 liters per day per hectare or 500-5000 liters per day per km length of sewers or 250-500 liters per day per manhole for sewers laid below ground water level.

4.2.2 ESTIMATION OF INDUSTRIAL SEWAGE

The quantity of industrial sewage will vary with type and size of industry, the manufacturing processes involved, degree of water reuse and onsite treatment methods that are used, if any. However, in general the quantity of industrial sewage may be taken 80 to 90 % of quantity of water supplied through public water supply system. Some industries develop their own source of water supply and may discharge their liquid waste into sewers. This should be estimated separately for large industries. It may, however, be stated that industrial sewage should be treated to the standards prescribed by the Pollution Control Boards before being discharged into sewers.

4.3 DESIGN PERIOD

Sewerage projects are normally designed to meet the requirements over a period of 30 years after their completion. However, the period of 30 years may be modified in respect of certain components of the project depending on their useful life or the facility for carrying out extensions when required and rate of interest, so that expenditure far ahead of its utilization is avoided. As such design period for various main components has been taken as indicated in Table below.

Sl. No	Design Component	Design Period	Remarks
1	Land Acquisition for STP, SPS, sewers etc.	30 Years	Land acquisition in future difficult
2	Sewer network (laterals, Trunk mains, Outfall etc.)	30 Years	Replacement difficult and costly
3	Pumping mains	30 Years	Cost may be economical
4	Pumping Stations- Civil Work	30 Years	Life of civil structure is 30 years
5	Pumping Machinery	15 Years	Life of pumping machinery is 15 years
6	Sewage Treatment Plants	30 Years	The construction shall be modular in phased manner as actual population less than design population and in Indian cities initially flows are much less due to connectivity problems
7	Effluent disposal and utilization	30 Years	Provision of design capacities in the initial stages itself is economical

Table 4.1: Design Period of Sewerage Components

4.4 VARIATION IN RATE OF FLOW

The rate of flow of sewage varies from season to season (seasonal or monthly variation), from day to day (daily variation) and from hour to hour (hourly variation). For design of sewers maximum or peak flow rates are adopted. The value of peak factor (ratio of maximum flow to average flow) depends on the contributing population and the values recommended in the Manual on Sewerage and Sewage Treatment prepared by CPHEEO are given in Table below.

S.N	Contributing Population	Peak Factor
1	Up to 20,000	3.00
2	20,000 – 50,000	2.50
3	50,000 – 7,50,000	2.25
4	Above 7,50,000	2.00

Table 4.2: Peak Factor

The variation between maximum and average rates of flow is large for domestic and lateral sewers because they receive the flow directly from the source. This variation gradually diminishes as the flow reaches the branch or sub main sewers and the main sewers.

Minimum rate of flow: The minimum rate of flow may vary from 0.5 to 0.33 of the average flow.

4.5 HYDRAULIC DESIGN OF SEWERS

The design for sewage collection system presumes flow to be steady and uniform. The unsteady and non-uniform sewage flow characteristics are accounted in the design by proper sizing of manhole. The sewage is mostly liquid containing about 0.1% of solid matter and hence follows same laws of flow as water. However the difference in design for water supply network and sewer network is, i) In order to avoid

clogging of sewers due to settlement of heavier particles of solids, sewers are to be laid at such gradient that self-cleansing velocity is achieved at all values of discharge and that the inner surface of the sewers should be capable of resisting the wear and tear due to abrasive action of solid particles and ii) sewage flows under gravity as open channel flow and as such sewers are laid at continuous downward gradient.

4.5.1 DEPTH OF FLOW

The sewers shall not run full as otherwise the pressure will rise above or fall below the atmospheric pressure and condition of open channel flow will cease to exist. Moreover, from consideration of ventilation, sewers should not be designed to run full. In case of circular sewers, the Manning's formula reveals that:

The velocity at 0.8 depth of flow is 1.14 times the velocity at full depth of flow.

The discharge at 0.8 depth of flow is 0.98 times the discharge at full depth of flow.

Accordingly, the maximum depth of flow in design shall be limited to 0.80 of the diameter at ultimate peak flow.

4.5.2 HYDRAULIC FORMULAE FOR DESIGN OF SEWERS

Manning's formula has been used for design of sewers in case of gravity flow. For pressure flow (Pumping Mains), the Hazen-William's formula has been used. Sewer Network design has been done with the help of Manning's Formulae i.e. Velocity V= [(1/n) x (R2/3 .S1/2)] (in m/s) For Circular Sections V = (1/n) (3.968 x 10-3D2/3S1/2) Q = (1/n) (3.118 x 10-6D8/3S1/2) Where, Q = discharge in lps; S = slope of hydraulic gradient; D =internal dia of pipe line in mm; R = hydraulic radius in m; n = Manning's Coefficient of roughness

4.5.3 PER CAPITA SEWAGE FLOW

The rate of water supply has been adopted 150 LPCD at consumer end throughout the whole design period as water supply schemes are designed with per capita supply of 150lpcd in Kerala. 80 percent of the water supply has been considered as sewage flow into the sewerage system

4.5.4 MINIMUM VELOCITY OF FLOW

A minimum velocity of 0.6 m/s for present peak flow and 0.8 m/s at design peak flow is recommended for sanitary sewers. Thus the sewers are designed on the assumption that although silting might occur at minimum flow, it would be flushed out during peak flows.

4.5.5 RECOMMENDED SLOPES FOR MINIMUM VELOCITY

For sewers running partially full, for a given flow and slope, velocity is little influenced by pipe diameter. As such for present peak flows up to 30 lps, the slopes given in Table below may be adopted which would ensure minimum velocity of 0.6 m/s in the early years.

S.N	Present Peak Flow in LPS	Slope per 1000
1	2	6.0
2	3	4.0
3	5	3.1
4	10	2.0
5	15	1.3
6	20	1.2
7	30	1.0

Table 4.3: Recommended slope

4.5.6 EROSION AND MAXIMUM VELOCITY OF FLOW

Erosion of sewers is caused by sand and other gritty material in the sewer and also by excessive velocity. Non-scouring or limiting velocities in sewers of different materials are given in CPHEEO manual. Accordingly maximum velocity for cement concrete pipes is 2.5- 3.00 m/s.

4.5.7 SEWER TRANSITIONS

Sewers shall be designed to ensure that the energy gradient is a continuous smooth line, thus transitions from larger to smaller diameters shall not be made. The crowns of sewers shall be kept continuous. In no case, the hydraulic flow line in the large sewers shall be higher than the incoming sewer. To avoid backing up, the crown of outgoing sewer shall not be higher than the crown of incoming sewer

4.5.8 MINIMUM PIPE DIAMETER

Minimum pipe diameter recommended in CPHEEO manual is 150 mm except that in hilly areas, where extreme slopes are prevalent, 100 mm can be used. Some states and ULBs have started adopting minimum diameter as 200 mm or even 250 mm. The logic is Maintenance of sewer system is generally not good and 150 mm dia sewer will block frequently and remain un-attended for some time, Quality of construction in smaller size RCC main such as 150 mm is not good, The sewerage system is not totally closed one and undesired waste such as solid waste and drains finds way in sewerage, making smaller size sewer lines more prone to frequent blocking, The cost of pipe line element is only about 15 percent of total project cost and increase in pipe size from minimum of 150 mm to minimum of 200 mm size will increase cost of project by 2 percent whereas flow capacity increases by more than 80 percent.

The minimum diameter may be adopted as 200 mm for cities having present / base year population of over 1 lakh. However, depending on growth potential in certain areas even 150 mm diameter can also be

considered. However, in towns having present / base year population of less than 1 lakh, the minimum diameter of 200mm shall be adopted.

The house sewer connection pipe to public sewer shall be (a) minimum 100 mm or higher based on the number of houses / flats connected and (b) subject to the receiving public sewer being of higher diameter. In this project 200 mm diameter has been suggested as minimum diameter in design of sewerage network.

4.6 MATERIAL OF CONSTRUCTION FOR GRAVITY SEWERS

Brickwork is used for large diameters as sewers can be constructed in any shape. However now it is not common. Concrete pipes are commonly used now as can be manufactured to any reasonable strength and laying is easy and jointing is leak proof. However these pipes are subject to corrosion where acid discharges are carried or where velocities are not sufficient to prevent septic conditions or where the soil is highly acidic or contains excessive sulphates. Only high alumina cement concrete should be used when it is exposed to corrosive sewage or industrial wastes. Salt glazed stoneware pipes are mostly manufactured in sizes 80-1000 mm but sizes greater than 380 mm are generally not used due to economic considerations. The length of these pipes is 60 cm75 cm and 90 cm. These pipes are good for corrosion resistance and erosion resistance. However due to less length, more joints, difficulty in jointing, requirement of special bedding and less compressive strength of pipes manufactured in India; use of these pipes is reducing in India.

S . N	EVALU ATION CRITERIA	RCC PIPES	DI PIPES	HDPE PIPES	DWC HDPE PIPES
1	Type of Joint	Available in both collar and S&S joints.	Tyton joint With rubber gasket	Butt fusion welding process	Simple push fit joints with Elastomeric sealing Ring for online system or with extra couplers.
2	Weight	Heavy	Lighter than R.C.C.	Light	Very Light in Comparison of Other Solid Wall Pipes
3	Corrosion resistance	To prevent corrosion sulphate resistant cement concrete to be used for pipe manufacture	Protective layers are Required to protect corrosion	Highly corrosion resistant	Highly corrosion resistant

4	Remarks on Cost	NP2 is Cheapest among all materials	Costlier than other pipes but cheaper than HDPE pipes	Smaller diameter pipes are cheaper and higher diameter Pipes are costlier	Uses minimal material for equal strength, therefore cost cheaper from other pipes
5	Infiltration	Infiltration is less	Infiltration is very less	Infiltration is very less	Infiltration is very less
6	Workability	due to heavy weight handling to be done with care	Good	Light weight for easy handling	They are user friendly, very fast and inexpensive in installation
7	Jointing	Jointing is easy in S&S pipes with Rubber ring joints	Jointing is easy in S&S pipes with Rubber ring joints	Jointing is expensive	Joining time is 2-5 minutes per joint
8	Maintenance	Almost nil if proper velocity is maintained	Minimum	Pipe ma y get damaged due to rodding	Maintenance is low because of non adherence of sewage elements
9	Previous Experien ce/Performance	It is durable pipe	. Performance is yet to be proven	Recent use started in India. It is durable.	They are maintenance free and therefore, once installed, will lie underground for years
10	Trenchless compatibility	Micro tunneling	Micro tunneling	HDD &Micro tunneling	Not suitable for Trenchless

Table 4.4: Pipe material Comparison

AC pipes cannot stand high superimposed loads, subject to corrosion from acids in sewage and high sulphate soils, require special bedding and weak against erosion where high velocities are encountered; as such use of AC pipe is not prevalent. Cast iron, DI and steel pipes are not used due to high cost. uPVC pipes are manufactured in sizes 75, 90,110, 140, 160,250,290 and 315 mm outer dia. uPVC pipes are smooth, light, easy to joint and have leak proof joint. Rates are also low. These days these pipes are used for making connection from house to sewer but not prevalent in street sewers.

GRP pipes are widely used in other countries where corrosion resistant pipes are required at reasonable rates. When using concrete or reinforced concrete, high density sulphur resistant cement should be used. These pipes are made of slag cement that contains fewer calcareous (CaOH2) particles than pipes made of Portland cement. These particles react with the sulphuric acid (created by bacterial dissipation of hydrogen sulphide) in sewers, causing the aforementioned crown corrosion. If this particular cement is

not used, lifetime of concrete sewers cannot be expected more than 30 years. A comparative study of characteristics of various pipe options for gravity sewers is presented in table above.

4.6.1 BENEFITS OF HDPE PIPES FOR SEWERS

When compared to other common wastewater piping system materials, such as PVC, ductile iron, or concrete, HDPE pipe offers significant benefits. Some of these include:

- Chemical Resistance. Hydrogen sulfide gas (H2S) corrosion is a serious threat to conventional sewer lines, like concrete and ductile iron, greatly reducing their service life. WL Plastics HDPE pipe is not attacked, corroded or degraded by H2S, ensuring a service life of 100 years.

- Anti-corrosive properties: HDPE piping systems are immune to the harmful effects of corrosion and tuberculation, common factors that reduces the operational life of concrete and ductile iron wastewater systems. HDPE also resists other corrosive or harmful agents, including scaling and organics such as fungi, bacteria, and other microbial contaminants.

- Leak-free:. HDPE pipe is joined together via heat fusion, creating a welded, leak- free joint unlike conventional bell and spigot joints. These leak-free joints prevent infiltration and exfiltration making it a truly sanitary piping system.

- Durability. HDPE pipe is resistant to fatigue from water hammer and surge events in sewer force mains. HDPE pipe is also abrasion resistant, ensuring that flowing water and slurries won't damage the pipe throughout its service life.

- Lightweight.: HDPE pipes are much lighter in weight compared with ductile iron or concrete alternatives, which makes transportation and installation significantly easier and safer.

- Cost-effectiveness. HDPE pipe is cost competitive with other sewer pipe options. HDPE pipe is faster, easier, and safer to install due to longer cut lengths and more linear footage per truck, which significantly reduce the overall project costs. With low maintenance costs and long service life, HDPE pipe is the ideal solution for wastewater systems.

However, HDPE pipes are slightly costlier compare to RCC pipe but as of now most of sewer pipes are laid through Trenchless technology method and because of this, plastic pipes like HDPE/ uPVC are most suitable and easy to use for trenchless as well as open cut trench method for pipe laying. The use of HDPE pipes are more economical and to be considered for smaller diameter pipes upto 110mm where they are available on coils thereby avoiding joints. Hence lesser number of joints thereby reducing leaks and the rates of pipes are reasonable. As a general pipe policy decision for the use of HDPE pipe shall be preferred up to 200mm & occasionally upto 350mm (source- KWA pipe policy, page 19). Therefore,

considering the above benefits of HDPE pipe over RCC pipes, HDPE pipes are recommended to use for maximum stretch of network. The pipe policy of KWA also favours adoption of HDPE pipes. However, RCC pipe (HDPE lined) has been recommended for higher diameter pipe (i.e. above 700 mm) as HDPE pipes for higher diameter pipes are not easily available and very costly for large diameter and generally not manufactured.

4.7 MANHOLES

A manhole is an opening constructed on the alignment of a sewer for facilitating a person to access the sewer for the purpose of inspection, testing, cleaning and removal of obstructions from the sewer line.

Manholes will be located at:

- Change of direction
- Change of slope
- Change of pipe diameter
- Change of material
- Ginning of each line at points of branches Manhole Sizes

Dia. of MH in mm for the given Dia. of sewer and Depth of MH				
Dia. of Outgoing Sewer in mm	**Depth of MH in Meters**			
	0-0.9	**0.91-1.65**	**1.66-2.3**	**2.31-6**
200	900	900	900	900
250	900	900	900	900
300	900	900	900	900
350	900	900	900	900
400		900	900	1200
450		900	1200	1200
500		1200	1200	1200
600		1200	1200	1200

Table 4.5: Recommended Size of manholes

4.7.1 TYPE OF MANHOLES

4.7.1.1 STRAIGHT – THROUGH MANHOLES

The simplest type of manhole is that built on a straight run of sewer with no side junctions. Where there is change in the size of sewer, the soffit or crown level of the two sewers should be the same, except where special conditions require otherwise.

4.7.1.2 JUNCTION MANHOLES

A manhole is provided at every junction of two or more sewers, and the curved portions of the inverts of tributary sewers have been formed within the manhole. The gradient of the smaller sewer may be steepened from the previous manhole sufficiently to reduce the difference of invert level at the point of junction to a convenient amount.

4.7.1.3 DROP MANHOLES:

As per CPHEEO manual, drop manhole is to be provided when a sewer connects with another sewer, where the difference in level between water lines (peak flow levels) of main line and the invert level of branch line is more than 600mm or a drop of more than 600mm is required to be given in the same line and it is uneconomical or impractical to arrange the connection within 600mm. The drop pipe may be either outside the manhole shaft and encased in concrete or supported on brackets inside the shaft. If the drop pipe is outside the shaft, a continuation of the sewer should be built through the shaft wall to form a rodding and inspection eye, which should be provided with a half blank flange. If the drop pipe inside the shaft, it should be in cast iron/ductile iron and it would be advantageous to provide adequate means for rodding and water cushion of 150mm depth should also be provided. The drop pipe should terminate at its lower end with a plan or duck-foot bend turned so as to discharge its flow at 45 degrees or less to the direction of the flow in the main sewer and the pipe, unless of cast iron, should be surrounded with 150mm concrete.

4.7.1.4 FLUSHING MANHOLES

Where it is not possible to obtain self-cleansing velocities due to flatness of the gradient especially at the starting point of branch sewers which receive very little flow, it is essential that some form of flushing device to be incorporated in the system. Flushing can be very conveniently accomplished using a fire hydrant or tanker and hose pipe. The upper reaches of lateral sewers, the discharges shall be partially full even at the ultimate design flow conditions, because of necessity of adopting the prescribed minimum size of sewer. In such situations, flushing arrangements have to be provided in the initial years.

4.7.2 MATERIAL OF CONSTRUCTION FOR MANHOLE

4.7.2.1 BRICK MASONRY MANHOLES

Bricks used for construction of manholes shall conform to the relevant Indian Standards. They shall be sound, hard and homogeneous in texture, well burnt in kiln without being vitrified, table moulded, deep red, cherry or copper coloured, of regular shape and size and shall have sharp and square and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing unground particles and/or which absorb water more than 1/6 th of their weight when soaked in water for twenty-four hours shall be rejected. Over burnt or under burnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 35 Kg/sq.cm unless otherwise noted in drawings. The class and quality requirements of bricks shall be as laid down in IS: 1077. The size of the brick shall be 23.0 x 11.5 x 7.5 or unless otherwise specified. Mortar for brick masonry shall be prepared as per IS: 2250. Manholes shall be constructed in brick masonry with cement mortar (1:4), 20 mm thick inside plaster with plasticized water proofing material consisting of 12 mm thick backing coat in CM 1:3 and 8 mm thick finishing coat in CM 1:1 and 15 mm thick outside plaster in CM 1:3. Whenever a pipe enters or leaves a manhole, bricks on edge must be cut to a proper form and laid around the upper end of the pipe so as to form an arch. All around the pipes, there shall be a joint of cement mortar (1:2) 13 mm thick between it and the bricks. The manhole base has been kept as 150mmfor manholes upto1mdepth, and 200mmfor manholes from 1 to 2 m depth and 300 mm for greater depths. In all cases, the thickness shall be counter checked for uplift conditions based on maximum ground water elevations at the site on the soil side by considering empty manhole conditions. The thickness of walls shall be typically one brick up to l.5 m deep manholes, one and a half brick for depths greater than 1.5 m. The actual thickness in any case shall be verified on the basis of engineering design in difficult soil conditions

4.7.2.2 RCC MANHOLES

The idea of RCC manholes is essentially to quicken the work of construction in the roads by adopting precast sections assembled at site. Thus, the issues related to their construction are more of design itself and quality control in casting. In general, plain and reinforced concrete work for manholes shall be carried out in accordance with the specification given in CPHEEO manual otherwise specified in this specification. Wherever good quality of brick and workmanship of the construction cannot be ensured, it is advisable to go in for RCC manholes. The provisions of IS: 456 and IS3370 Part I, II and IV shall inter alia apply to the design. The entire structure shall at all times be designed to the condition where the ground water is at ground level itself and the inside is empty and there is no superimposed load on the

manhole and not considering the skin friction of the manhole side wall with the soil. Now the newly available precast RCC chambers shall be conveniently used for the manholes upto 6.0m or more depth. This will make the construction very easy and faster.

4.7.2.3 HDPE MANHOLES

Polyethylene manholes remain leak-free because there is no chemical attack. The toughness of polyethylene eliminates the chance of cracking during installation. There is no infiltration of external ground water, reducing the amount of treatment required. There is no exfiltration of sewage to the environment. HDPE manholes are available with ladders installed. Ladder design has been inspected and meets all OSHA dimensional requirements

CHAPTER - 5
PROPOSED SEWERAGE SYSTEM

5.1 POPULATION PROJECTION

Population of the city normally depends on factors such as birth and death rates, migration, industrial development, general environmental conditions etc. Usually the population forecast of a city is made on the basis of methods of population forecast as provided for in section 1.5 of the CPHEEO manual for sewerage and sewerage treatment. The latest available census records are that of 2011.

As far as Kerala is concerned it is quite different from other states on education, health, life expectancy etc. The demographic pattern of the state therefore is quite different and need to take into account all the developmental parameters so as to avoid undue over designs. The anticipation of future growth in any community in terms of population or commercial and industrial expansion forms the basis for preparation of plan for providing the amenities including installation of sewers in the area to be served. The anticipated population, its density and its waste production is generally estimated for a specified planning period. The recommended planning period is 30 years.

Decadal growth of 7.67% is adopted for population projection, as the district average for the decade from 2001 to 2011 is 7.67%

YEAR	POPULATION	INCREASE IN POPULATION	% INCREASE IN POPULATION
2001	39608		
2011	42646	3038	7.67%

- Decimal increase 7.67%
- Current Year 2021
- Execution Period - 2 Year
- Design Year 2053
- Design Period 30 Years

Accordingly, the population forecast of the municipality using the Geometrical increase method is shown in the table below:

POPULATION FORCAST						
Sl.No	**WARD NO.**	**WARD NAME**	**POPULATION-YEAR 2011**	**POPULATION-YEAR 2023**	**POPULATION-YEAR 2038**	**POPULATION-YEAR 2053**
1	Ward No - 1	vazhavara	1170	1278	1428	1596
2	Ward No - 2	Nirmala city	1140	1246	1392	1555
3	Ward No - 3	Society	1166	1274	1423	1590
4	Ward No - 4	Konginipadavu	1129	1234	1378	1540
5	Ward No - 5	Vellayamkudi	1188	1298	1450	1620
6	Ward No - 6	Vettikuzha kavala	1376	1504	1680	1877
7	Ward No - 7	Nathukallu	1170	1278	1428	1596
8	Ward No - 8	Kallukunnu	1310	1431	1599	1787
9	Ward No - 9	pezhumkavala	1358	1484	1658	1852
10	Ward No - 10	Valiyapara	1303	1424	1591	1777
11	Ward No - 11	Kochuthovala north	1299	1419	1586	1772
12	Ward No - 12	Kochuthovala	1133	1238	1383	1545
13	Ward No - 13	Aanakuthi	1148	1254	1402	1566
14	Ward No - 14	Parakadavu	1240	1355	1514	1691
15	Ward No - 15	puliyanmala	1376	1504	1680	1877
16	Ward No - 16	Ambalapara	1376	1504	1680	1877
17	Ward No - 17	Kattapana	1184	1294	1445	1615
18	Ward No - 18	Kunthalampara north	1277	1395	1559	1742
19	Ward No - 19	Kunthalampara south	1299	1419	1586	1772
20	Ward No - 20	Pallikavala	1365	1492	1666	1862
21	Ward No - 21	Erupathekkar	1173	1282	1432	1600
22	Ward No - 22	Ambalakavala	1321	1443	1613	1802
23	Ward No - 23	Mettukuzhi	1373	1500	1676	1873
24	Ward No - 24	Vallakadavu	1172	1281	1431	1599
25	Ward No - 25	Kadamakuzhi	1161	1269	1417	1584
26	Ward No - 26	Nariyampara	1360	1486	1660	1855
27	Ward No - 27	Thovarayar	1205	1317	1471	1644
28	Ward No - 28	ITI kunnu	1373	1500	1676	1873
29	Ward No - 29	Valiyakandam	1354	1480	1653	1847
30	Ward No - 30	Govt.college	1299	1419	1586	1772
31	Ward No - 31	suvarnagiri	1177	1286	1437	1605
32	Ward No - 32	kalyanathandu	1232	1346	1504	1680
33	Ward No - 33	Mulakaramedu	1177	1286	1437	1605
34	Ward No - 34	Kownthi	1262	1379	1541	1721
	TOTAL		**42646**	**46601**	**52064**	**58167**

Table 5.1: Population Forecast

Based on topography, population etc municipality is divided into two zones . Population for the zone 1 (sewerage network area) has been worked out and provided as per the projection the designed population is as follows.

SEWERAGE NETWORK AREA POPULATION					
WARD NO.	WARD NAME	POPULATION-YEAR 2011	PROJECTED POPULATION-YEAR 2053	% COVERAGE	NETWORK AREA POPULATION
Ward No - 8	Kallukunnu	1310	1787	40%	715
Ward No - 9	pezhumkavala	1358	1852	5%	93
Ward No - 13	Aanakuthi	1148	1566	50%	783
Ward No - 17	Kattapana	1184	1615	100%	1615
Ward No - 18	Kunthalampara north	1277	1742	5%	87
Ward No - 19	Kunthalampara south	1299	1772	5%	89
Ward No - 20	Pallikavala	1365	1862	100%	1862
Ward No - 21	Erupathekkar	1173	1600	10%	160
Ward No - 26	Nariyampara	1360	1855	10%	185
Ward No - 27	Thovarayar	1205	1644	90%	1479
Ward No - 28	ITI kunnu	1373	1873	90%	1685
Ward No - 29	Valiyakandam	1354	1847	40%	739
	Total				**9491**

Table 5.2: Population Projection for network area

A septage zone (zone 2) is also proposed to areas where population density is less. In addition, in the high density populated areas but where there is no road network and low lying areas where connection to network is not possible, septage treatment is proposed. The Projected Population Capacity of Septage area is considered for the sewerage scheme is 48676.

5.2 SEWAGE LOAD

Sewerage load has been calculated based on the network area design population and water demand of 150 lpcd . Since some water is lost due to evaporation and seepage, only 80% of the average water supply is taken as sewage flow. Non domestic and floating water demand has been considered as 15% and infiltration as 10%. The Sewage load calculation in the network area is shown in the below table:

NETWORK AREA - SEWAGE LOAD CALCULATION	
Network area population	9491
Water demand in year 2053 @150 lpcd	1.42
Non domestic and floating water demand 15%	0.21
Total Water demand in year 2053	1.64
Seweage Load @80%	1.31
Add Infiltration 10%	0.13
Total Network area Sewage Load	**1.44**

Table 5.3: Sewage Load Calculation for Network area

The sewage load in the septage area is calculated based on design population of septage area and the sludge deposit coefficient of 95 liters/head/year .The Septage load calculated for the proposal of co treatment with STP is 0.32 MLD.

Hence the total Sewage load treating in the STP with co treatment unit of septage is 1.76 MLD

5.3 COLLECTION SYSTEM

The collection system has been designed for ultimate year peak flow. The cumulative flows and the cumulative contributory population are discussed zone wise in the succeeding sections. The design diameter and slope have been finalized based on the minimum flow velocity of 0.60 m/s (present peak flow) with maximum velocity of 3.00 m/sec. The system has been designed using EPASWWM software. Design calculations are shown in Annexure attached. The sewerage system network has been so planned to limit lifting and pumping stations. The Maximum depth of the sewer lines are kept at 5.5 m from the existing ground level and in very minimal areas (3%) areas, it varies from 6-8m.

5.3.1 SEWERAGE NETWORK AND MANHOLES

The project network area is divided into 5 different subzones based on the natural flow directions, ridges etc. for routing. The main roads are identified and ground levels have been taken from the DGPS survey conducted in year 2021. The junction points and control points were cross-checked with field survey data with DGPS equipment. Social survey was done to ascertain the living conditions and amenities provided in the households. Reconnaissance survey was also carried out to assess the nature of buildings such as offices, institutions such as schools, colleges, hospitals, lodges, etc.

5.3.2 HYDRAULIC SIMULATION OF SEWAGE NETWORK

Hydraulic simulation of sewage network was performed after collection of all basic input data like sewage inflow at all points, expected routing plan for easy carriage of sewer load towards a common collection point and location of STP. A suitable peak factor to accommodate sewage flow variations are provided in the hydraulic analysis. The sewer flow is expected to be carried out in gravity conditions through a network of pipelines, manholes and lifting stations. The maximum depth of cutting is limited below 5.50 m and hence sewage lifting stations are provided making use of the manholes itself. For all pipelines minimum slopes to generate gravity flow is given as per the recommendations of CPHEEO Manual of Sewage Treatment Systems. For hydraulic simulation of the sewage network comprising of pipelines, manholes and lifting stations, US Environmental Protection Agencies' Storm Water Management Model (SWMM) is adopted considering its versatility in hydraulic modelling using dynamic flow routing conditions. US EPA's Storm Water Management Model (SWMM) is used throughout the world for planning, analysis, and design related to storm water runoff, combined and sanitary sewers, and other drainage systems.

The software EPASWMM was used to design the network owing to the fineness in the results. The EPA Storm Water Management Model (SWMM) is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component of SWMM operates on a collection of sub catchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of SWMM transports this runoff through a system of pipes, channels, storage/treatment devices, pumps, and regulators. SWMM tracks the quantity and quality of runoff generated within each sub catchment, and the flow rate, flow depth, and quality of water in each pipe and channel during a simulation period comprised of multiple time steps. As the sewerage network system is designed by considering it as open channel flow, this software is the most apt for the design of sewer network. Moreover, we can visualize the output in a three dimensional platform and hence it can be refined to least error.

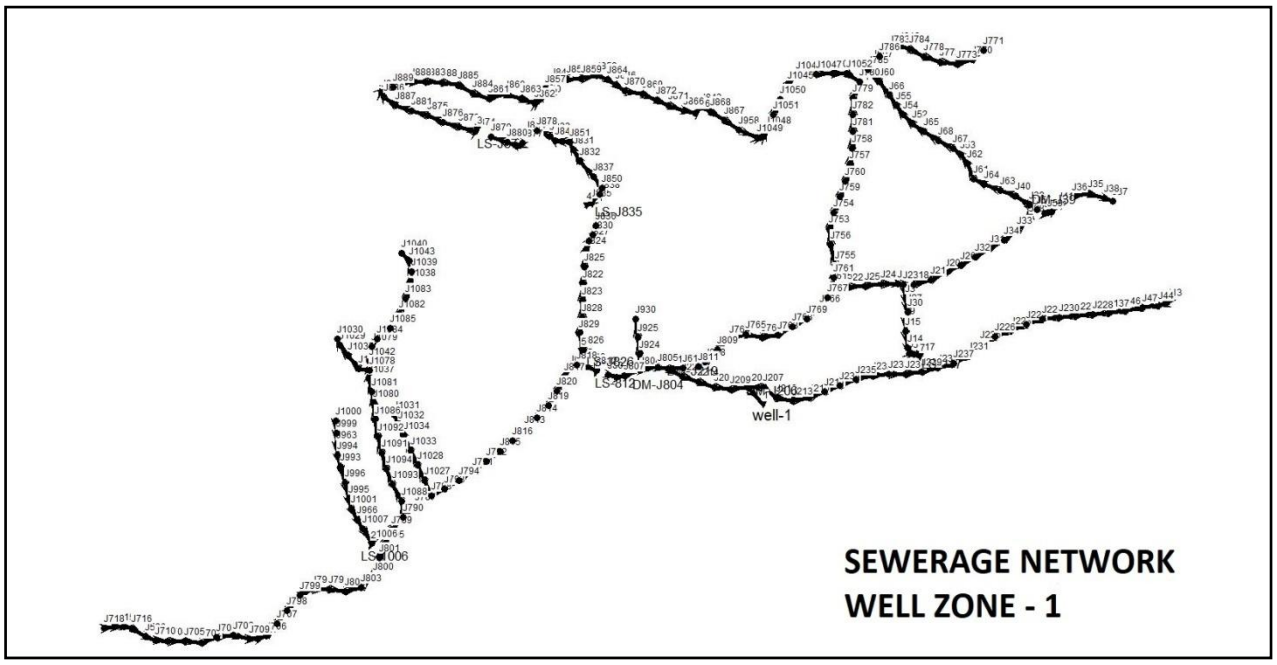
The manholes are first plotted in the scaled, geo referenced, auto cad base map. Using this auto cad base map prepared, a windows metafile format used as back drop in the EPASWMM window. The nodes representing manholes and links representing the conduits are plotted for developing the model in the EPASWMM software, consequently entered the parameters regarding the nodes and links. Based on the population scattered in the area especially taking into consideration, the point load from various non domestic buildings like hospitals, schools/colleges, lodges/hostels etc. located in the selected zone, the sewage load is assessed in each manhole and fed as dry weather flow in the model. The peak factor considered is 3. Flow routing is done correcting the invert levels of manholes by trial and error to the

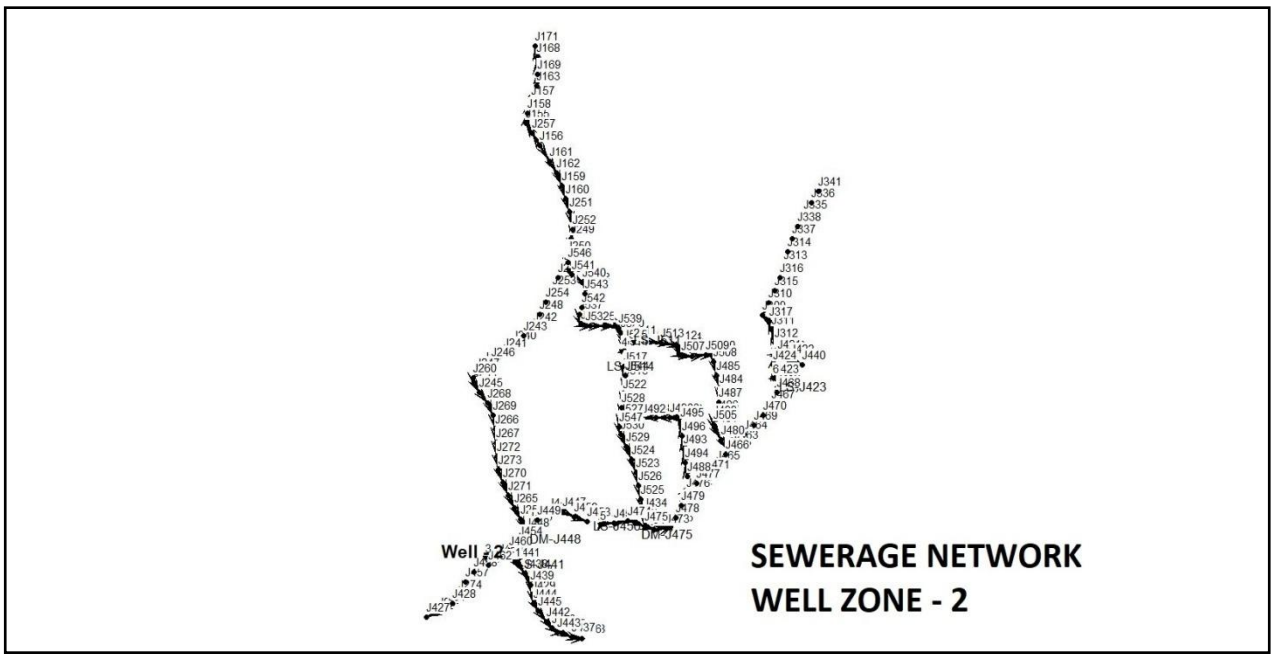
proposed outfalls. By several trials it was refined to successfully run with least error.

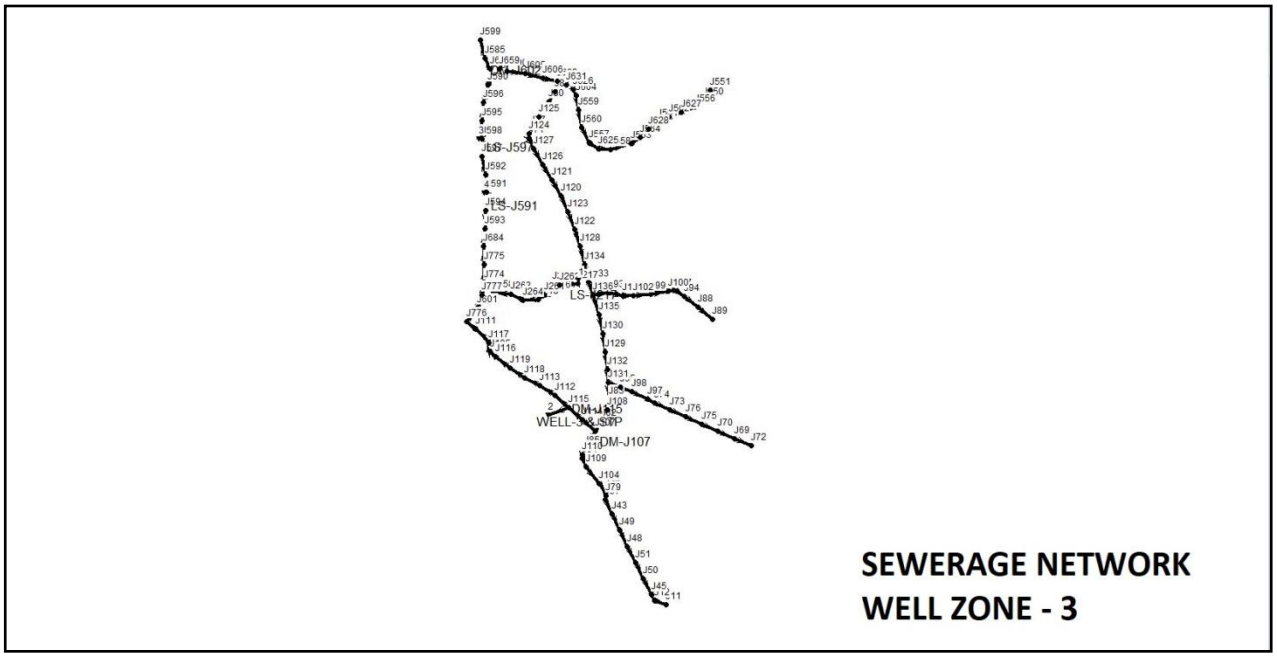
The detailed outputs of EPASWMM for five well zones are attached in Annexure-2.

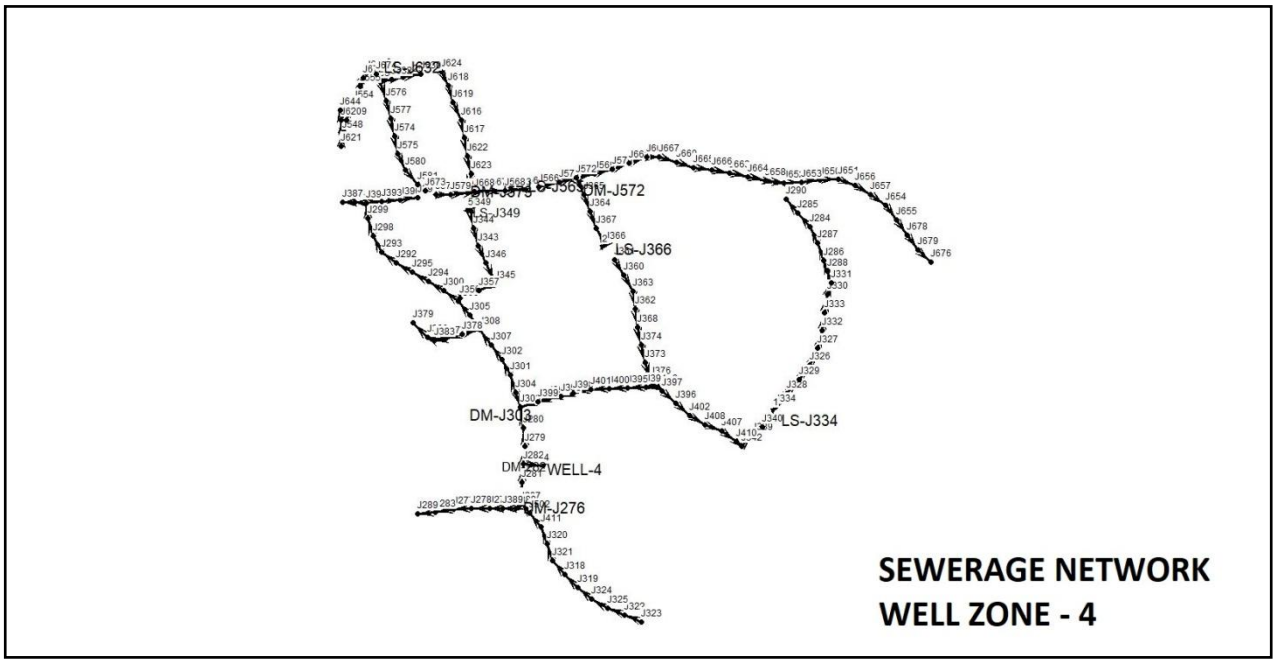
225mm HDPE-PE100, PN8 pipes for 27000m and 280mm HDPE-PE100, PN8 pipes for 406m are selected for the network for smooth functioning with little maintenance. The inverted level of manholes has been selected by providing the required slope for the movement of sewage with gravity.

The EPASWMM models of five well zones are as follows.




SEWERAGE NETWORK
WELL ZONE - 2


SEWERAGE NETWORK
WELL ZONE - 3



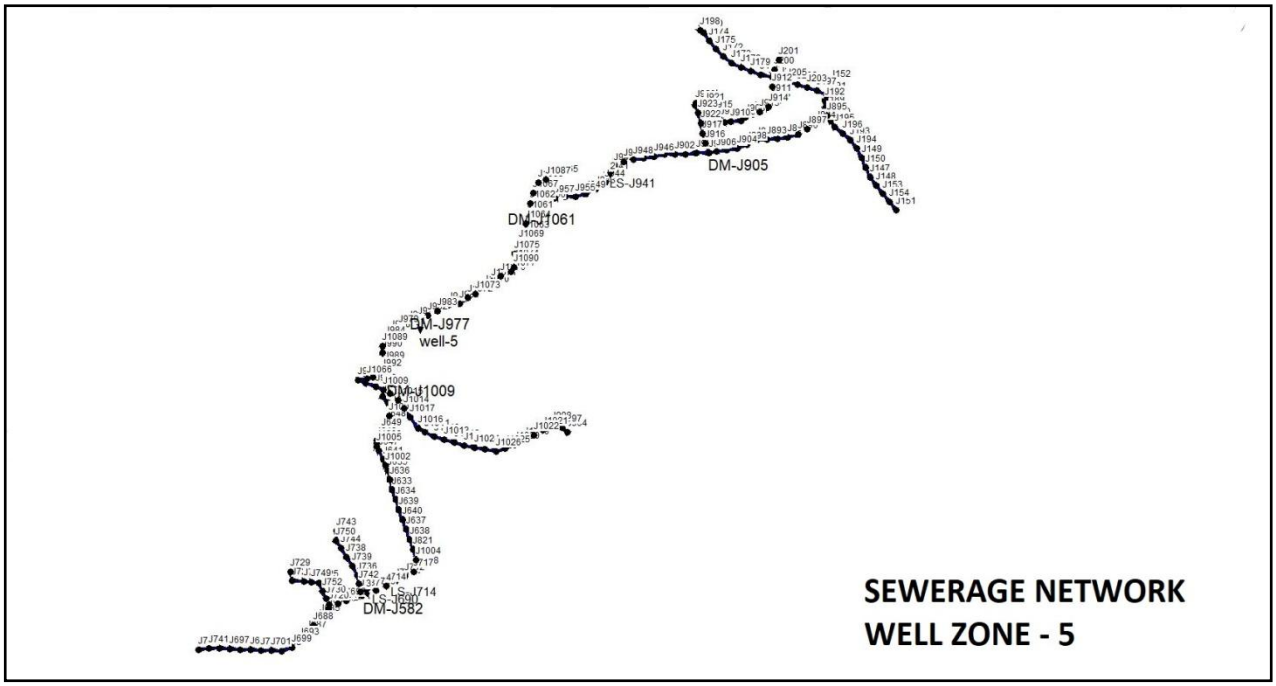


Figure 5.1 : Network Design output in EPASWMM

5.3.3 DETAILS OF SEWER NETWORK

Abstract of sewer network is furnished below:

NETWORK PIPE -SUMMARY							
Diameter mm (OD)	Type of Pipe	WELL ZONE 1-Length	WELL ZONE 2-Length	WELL ZONE 3-Length	WELL ZONE 4-Length	WELL ZONE 5-Length	TOTAL-Length(m)
225 mm	HDPE-PE100,PN8	6980.97	4398.4	4757.66	5506.86	5356.11	27400.00
280 mm	HDPE-PE100,PN8	160.00			98.38	148.00	406.38
TOTAL		7140.97	4398.4	4757.66	5605.24	5504.11	27406.38

Table 5.4: Network Length & Pipe details

5.3.4 MANHOLES

Total number of manholes comes to 1100.

MANHOLE TYPE -SUMMARY						
Diameter	WELL ZONE 1	WELL ZONE 2	WELL ZONE 3	WELL ZONE 4	WELL ZONE 5	TOTAL
900mm	204	130	137	135	144	750
1200mm	17	11	17	20	14	79
1500mm	72	50	39	57	53	271
TOTAL	293	191	193	212	211	1100

Table 5.5: Details of Manholes Type

MANHOLE DEPTH -SUMMARY						
Depth	WELL ZONE 1	WELL ZONE 2	WELL ZONE 3	WELL ZONE 4	WELL ZONE 5	TOTAL
upto1.5m	177	108	122	121	116	644
1.5-3m	54	38	38	39	47	216
3-4.5m	39	24	25	25	28	141
4.5-6m	23	21	8	27	20	99
TOTAL	293	191	193	212	211	1100

Table 5.6: Details of Manhole Depth

5.4 PUMPING STATION AND RISING MAIN

Pumping or force mains deliver wastewater discharged from a pumping station to its destination, which may be a treatment plant or the final disposal point.

5.4.1 LIFTING STATION /PUMPING STATION

Pump stations are normally required in a sewage collection system to lift the sewage against a gradient or to limit the depth of cutting of the pertinent sewer line. A simplified form of the pump station, called a

Lift Station, is also employed for the same purpose. The primary difference between a pump station and a lift station is that the Pump Station shall handle greater flows with arrangements for removal of floating material and grit prior to pumping through a force main. Lift Stations will have only an enlarged manhole as a wet well with pumps installed and a small control room adjacent to it, for lifting the sewage to ground level. Lift stations are generally used to restrict the depth of cutting and discharging normally to the manhole in a downstream trunk sewer. No screens and grit wells are provided in lift stations. Pumping and lifting stations shall use submersible pumps, such stations have a single well, circular or rectangular, in which pumps are installed. Superstructure requirement is minimum. The pump stations have been designed considering easy removal and reinstallation of the pumps without disturbing the connecting delivery pipe work.

Hydraulic Criteria: According to the existing ground level contour from the topographic survey, the number of pumping stations has been finalized. Lift stations are generally proposed where depth of cutting exceeds 5.5 m except at certain stretches (3%) goes upto 8m. The location of pumping stations is at lower points of the network, but away from public and flood areas. Overflow is not allowed.

5.4.2 DETAILS OF COLLECTION WELL/PUMPING STATIONS

In the project there are 5 Nos. of collection wells proposed. Out of this five collection wells, well 3 is located in the premises of STP site at Housing Board plot (Sy.No. no.39/4,6-9) near Bypass road. Well 1 is located near SH Convent, (Sy.No.305) Pallikavala-vallakadavu road and Well 2 is located opposite of St.Martha Convent, (Sy.No.43) By pass road. Well 4 is located opposite of Govt. Vetenary hospital, (Sy.No.48) Kunthalampara road and Well 5 is located after thovarayar post office in, Thovarayar road.

COLLECTION WELL/PUMPING STATIONS					
COLLECTION WELL/PUMPING STATIONS	LOCATION	LAND REQUIRED	PEAK FLOW IN LPS	DIAMETER OF WELL (M)	TOTAL DEPTH IN METERS
well-1	near SH Convent(Near block office ,bypass road)	6 Cents	18.71	6.2	6.65
well-2	near St.Martha Convent(pallikavala vallakadavu road)	6 Cents	6.8	4.6	5.15
well-3	STP plot –Housing board land	100 Cents including STP	7.12	4.6	5.75
well-4	Near sub treasury	6 Cents	7.73	6	6.76
well-5	Near samskarika nilayam(Thovarayar post office)	6 Cents	9.67	7	9.53

Table 5.7: Details of Collection well

Figure 5.2: Proposed STP site –Housing board plot

Figure 5.3: Proposed Well sites W1 &W2

5.4.3 DETAILS OF LIFTING STATIONS

WELL ZONE	NO	LS(nodes)	SWD in m	PEAK FLOW IN LPS	Diameter (OD) pipe in mm	Material
WELL-1	LS1	J1006-J801	1	0.576	90	HDPE-PE100 PN 10
	LS2	J826-J610	1	3.648	90	HDPE-PE100 PN 10
	LS3	J812-J806	1	8.4	90	HDPE-PE100 PN 10
	LS4	J835-J836	1	3.168	90	HDPE-PE100 PN 10
	LS5	J874-J879	1	2.304	90	HDPE-PE100 PN 10
	LS6	J17-J239	1	3.168	110	HDPE-PE100 PN 10
WELL-2	LS7	J441-J460	1	0.72	90	HDPE-PE100 PN 10
	LS8	J450-J453	1	5.4	90	HDPE-PE100 PN 10
	LS9	J514-J517	1	1.824	90	HDPE-PE100 PN 10
	LS10	J511-J515	1	0.864	90	HDPE-PE100 PN 10
	LS11	J423-J419	1	1.056	90	HDPE-PE100 PN 10
WELL-3	LS12	J598-J597	1	1.488	90	HDPE-PE100 PN 10
	LS13	J591-J594	1	1.68	90	HDPE-PE100 PN 10
	LS14	J217-J133	1	0.624	90	HDPE-PE100 PN 10
	LS15	J286-J285	1	0.768	90	HDPE-PE100 PN 10
	LS16	J289-J296	1	1.488	90	HDPE-PE100 PN 10

WELL-4	LS17	J349-J573	1	0.384	90	HDPE-PE100 PN 10
	LS18	J565-J566	1	2.16	90	HDPE-PE100 PN 10
	LS19	J366-J361	1	4.086	90	HDPE-PE100 PN 10
	LS20	J334-J340	1	0.768	90	HDPE-PE100 PN 10
	LS21	J207-J206	1	0.144	90	HDPE-PE100 PN 10
WELL-5	LS22	J690-J713	1	1.806	90	HDPE-PE100 PN 10
	LS23	J714-J711	1	1.899	90	HDPE-PE100 PN 10
	LS24	J941-J944	1	4.758	90	HDPE-PE100 PN 10

Table 5.8: Details of Lifting station

5.5 PUMPING MAINS

The pumping main carries sewage from collection well to STP under pressure. From each collection well, separate pumping main is designed to carry sewage to the treatment plant.

The schematic diagram of Pumping main is shown below:

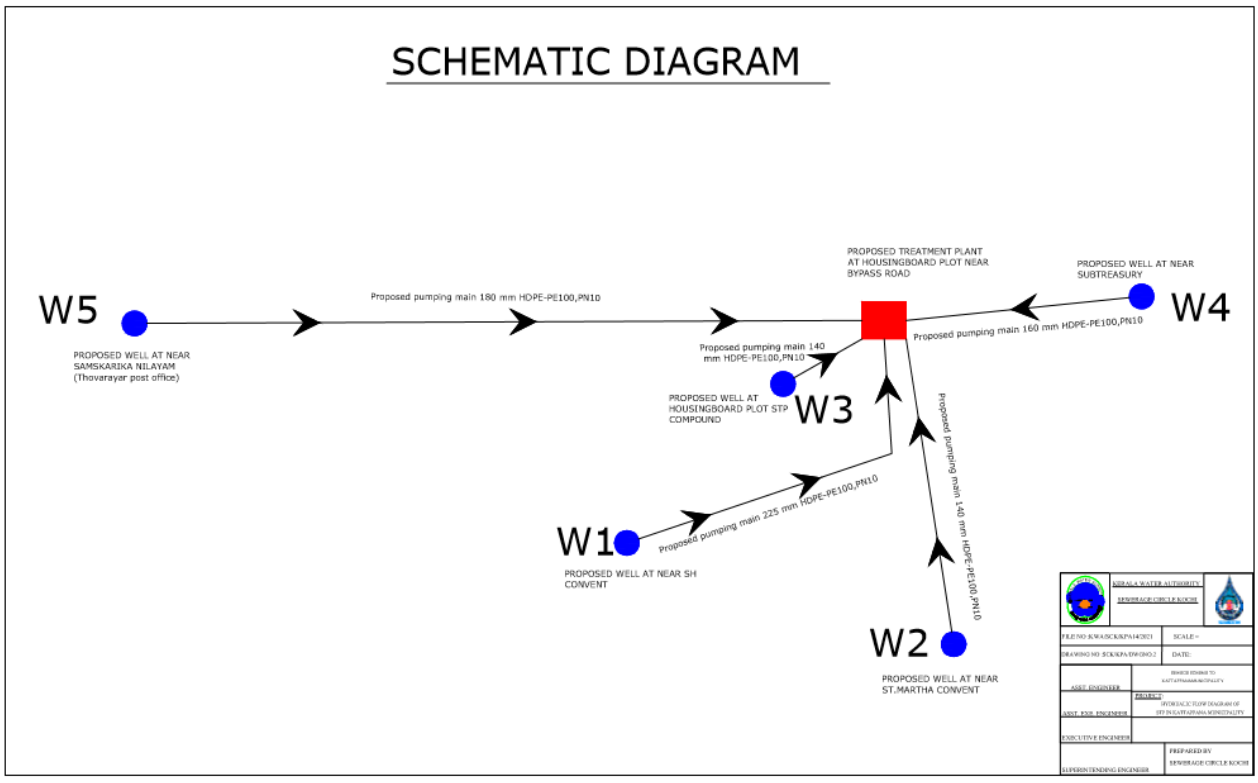
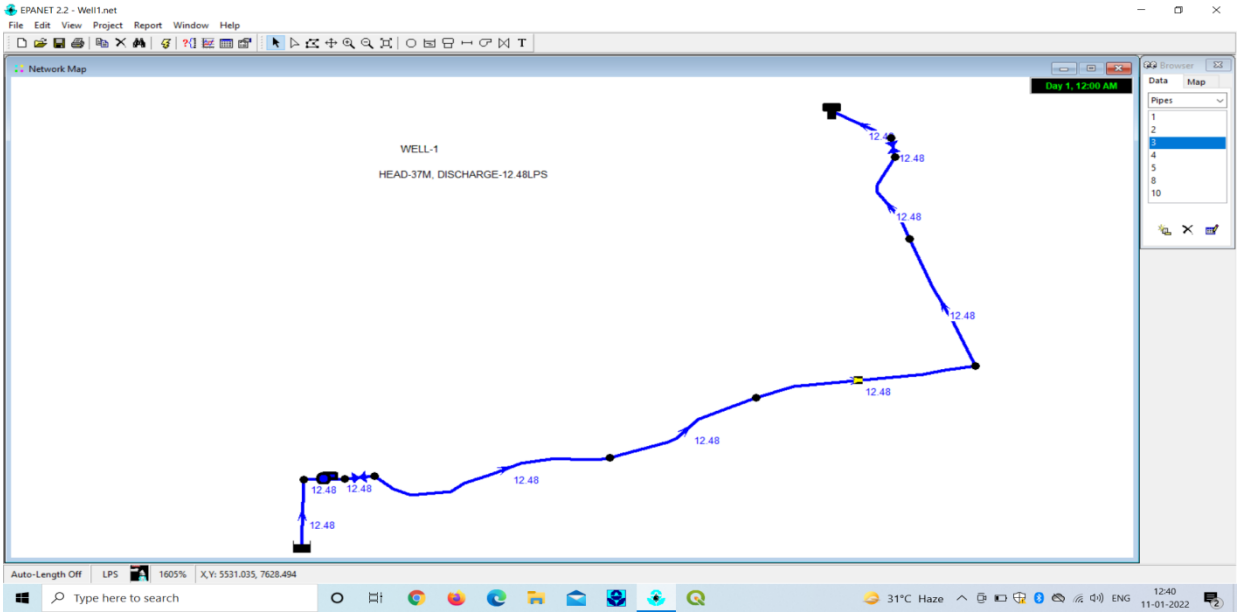
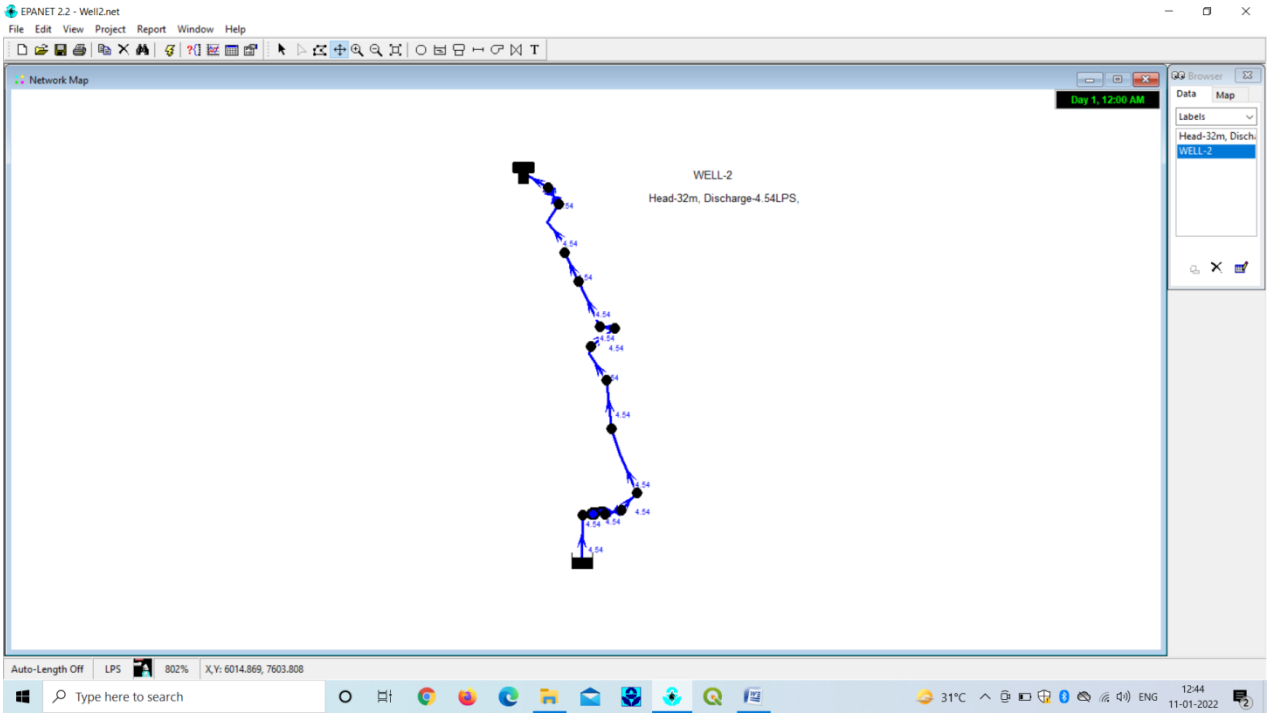
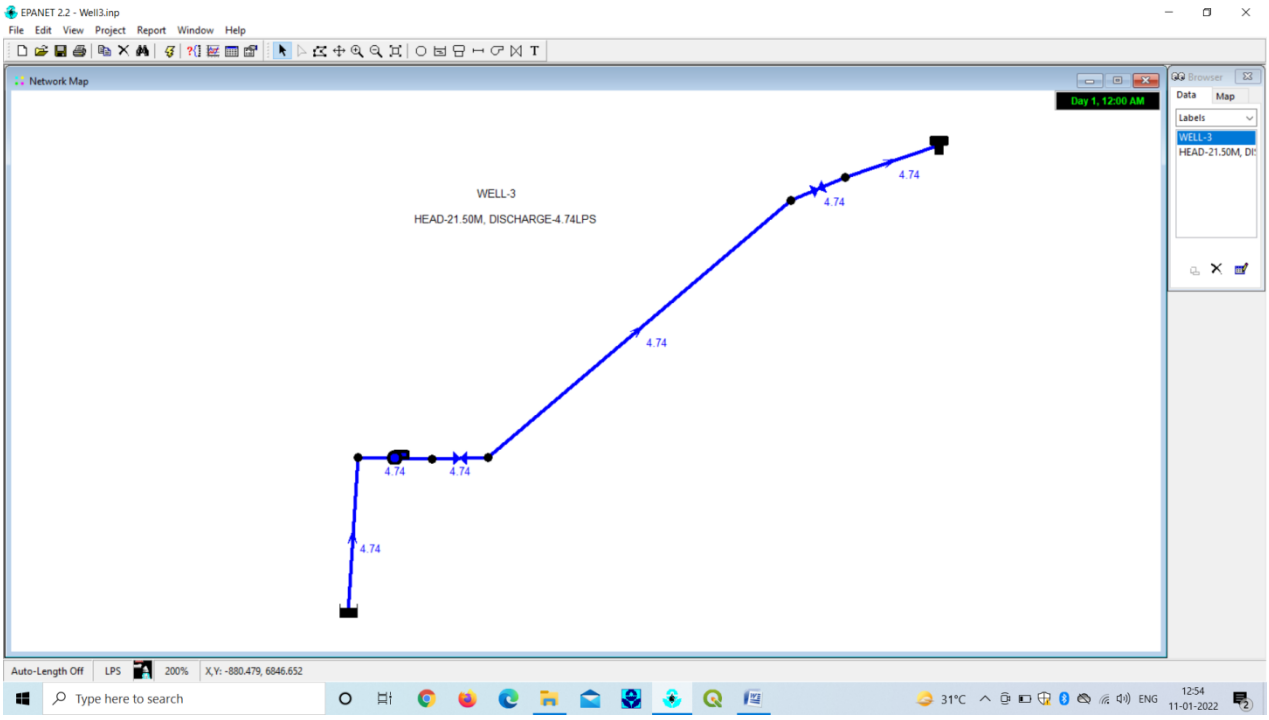


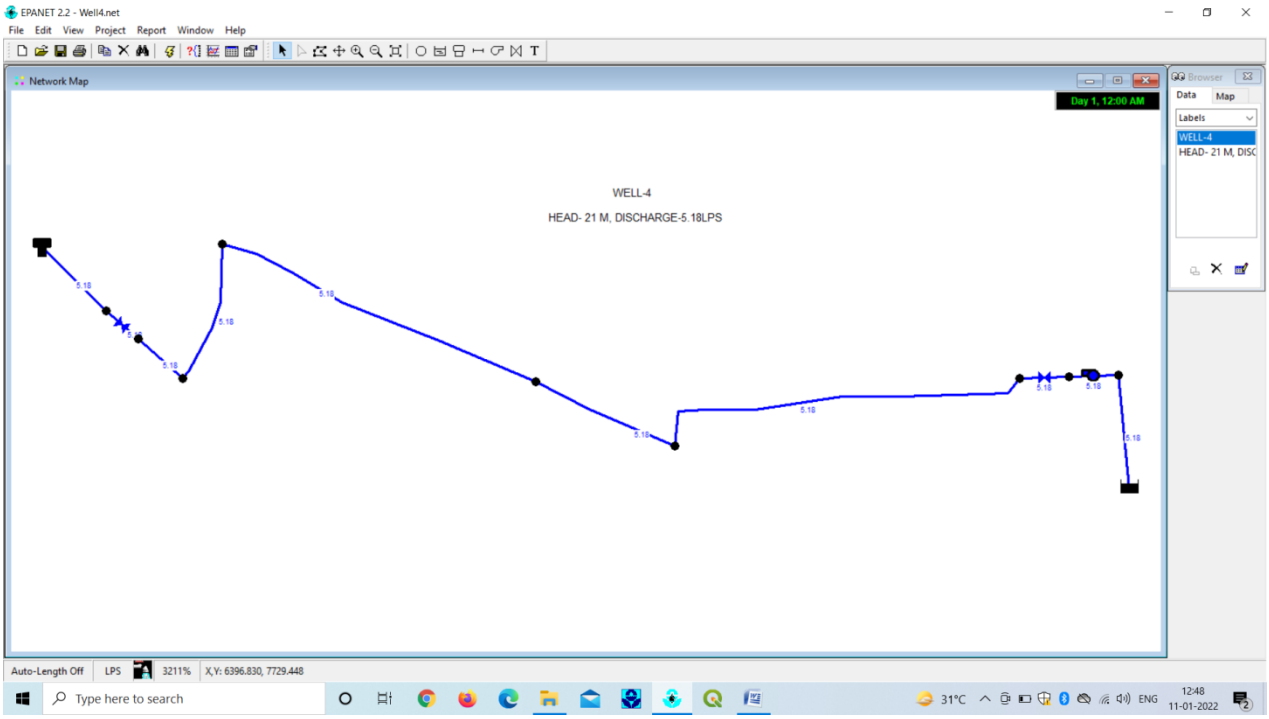
Figure 5.4 : Schematic diagram of Pumping Main

The EPANET model of five pumping main is as shown below.






EPANET 2.2 - Well3.inp
File Edit View Project Report Window Help
Network Map
Day 1, 12:00 AM
WELL-3
HEAD-21.50M, DISCHARGE-4.74LPS
4.74
Data
Map
Labels
WELL-3
Auto-Length Off
LPS
200%
X,Y: -880.479, 6846.652
Type here to search
31°C
ENG
12:54
11-01-2022


EPANET 2.2 - Well4.net
File Edit View Project Report Window Help
Network Map
Day 1, 12:00 AM
WELL-4
HEAD- 21 M, DISCHARGE-5.18LPS
5.18
Data
Map
Labels
WELL-4
Auto-Length Off
LPS
3211%
X,Y: 6396.830, 7729.448
Type here to search
31°C
ENG
12:48
11-01-2022

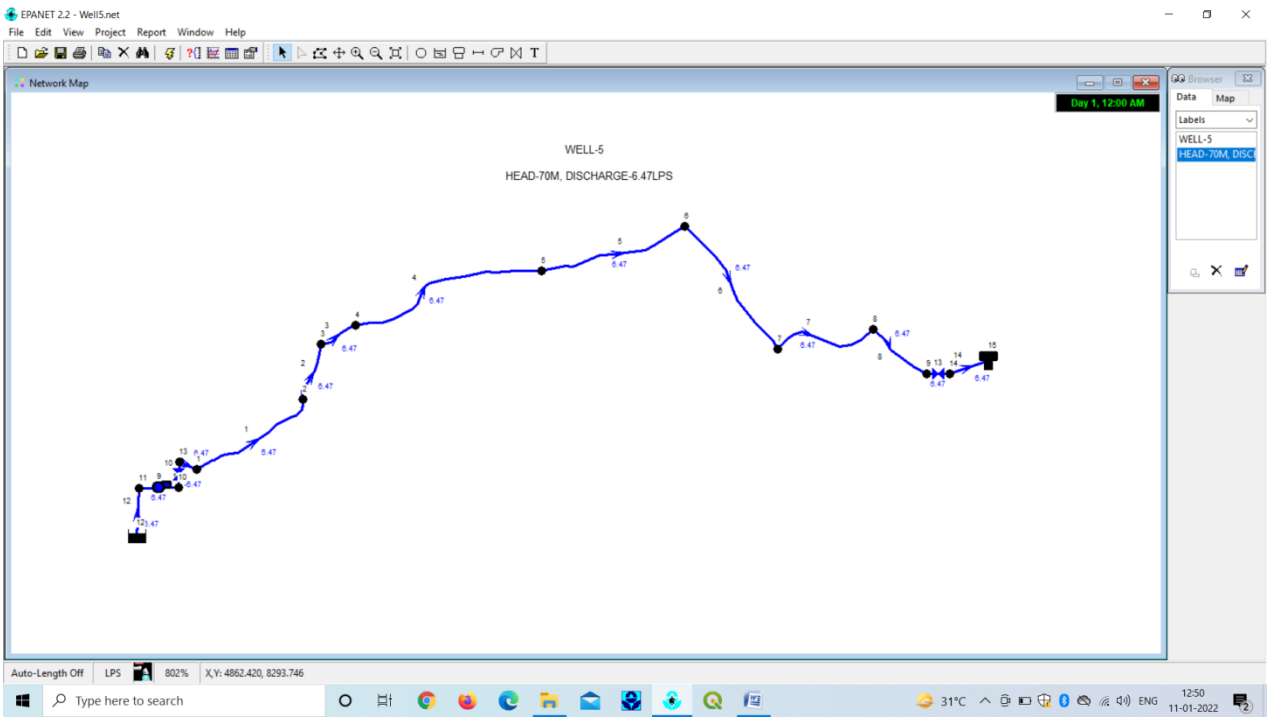


Figure 5.5 : Design of Pumping mains (5 Nos.) in EPANET

PUMPING MAIN DETAILS				
DESCRIPTION	**LENGTH (M)**	**DIAMETER(OD)mm**	**MATERIAL**	
WELL 1 to STP	1154	225	HDPE-PE100,PN10	
WELL 2 to STP	1104	140	HDPE-PE100,PN10	
WELL 3 to STP	50	140	HDPE-PE100,PN10	
WELL 4 to STP	763	160	HDPE-PE100,PN10	
WELL 5 to STP	2410	180	HDPE-PE100,PN10	

Table 5.9: Pumping main details

5.6 PUMP AND OPERATION CONTROL

Fluid level activated switches will be provided to start and to stop the pumps depending upon the quantity of sewage available in the pump house. This will ensure that the pumps will not run dry. A sluice valve will be provided on the suction side and a sluice valve and a non return valve will be provided on the delivery side. Flow meter (digital type) will be provided to measure the quantity of sewage flowing out of the pumping station. It will be an integrating type indicating instantaneous flow and the cumulative flow.

5.6.1 DETAILS OF PUMP SETS

DETAILS OF PUMP SET				
Sl.No	**Name**	**No. of Pump Set (Incl.One Standby)**	**HP**	**Type of Pump**
1	LS-1,7,9-17,20-23	2	0.5	Submersible
2	LS -2,4,5,18,19	2	1	Submersible
3	LS-8,24	2	1.5	Submersible
4	LS-3,6	2	2	Submersible
3	WELL 1 to STP	2	15	Submersible
4	WELL 2 to STP	2	5	Submersible
5	WELL 3 to STP	2	5	Submersible
6	WELL 4 to STP	2	5	Submersible
7	WELL 5 to STP	2	15	Submersible

Table 5.10: Pump set details

5.7 ARRANGEMENTS FOR POWER SUPPLY

KSEB will supply power at 11/22KV HT supply or 440 V LT supply for the operation of pumps in the pumping stations and for operation of equipment in the STP. In respect of HT supply, suitable transformers would be provided to step down the voltages to 440V. In case the Horse Power of pump set is less than 75HP, 440V LT supply will be availed. Each pumping station shall have Motor control centre for start-stop and other controls for protection and safety of motors and other auxiliary equipment. Capacitors of suitable capacity would be provided to improve the power factor, so that power consumption can be brought down.

CHAPTER - 6

TECHNOLOGY OPTION FOR STP

6.1 SEWAGE TREATMENT

Sewage treatment is a type of wastewater treatment which aims to remove contaminants from sewage to produce an effluent that is suitable for discharge to the surrounding environment or an intended reuse application, thereby preventing water pollution from raw sewage discharges. Sewage contains wastewater from households and businesses and possibly pre-treated industrial wastewater. There is a high number of sewage treatment processes to choose from. These can range from decentralized systems (including on-site treatment systems) to large centralized systems involving a network of pipes and pump stations which convey the sewage to a treatment plant.

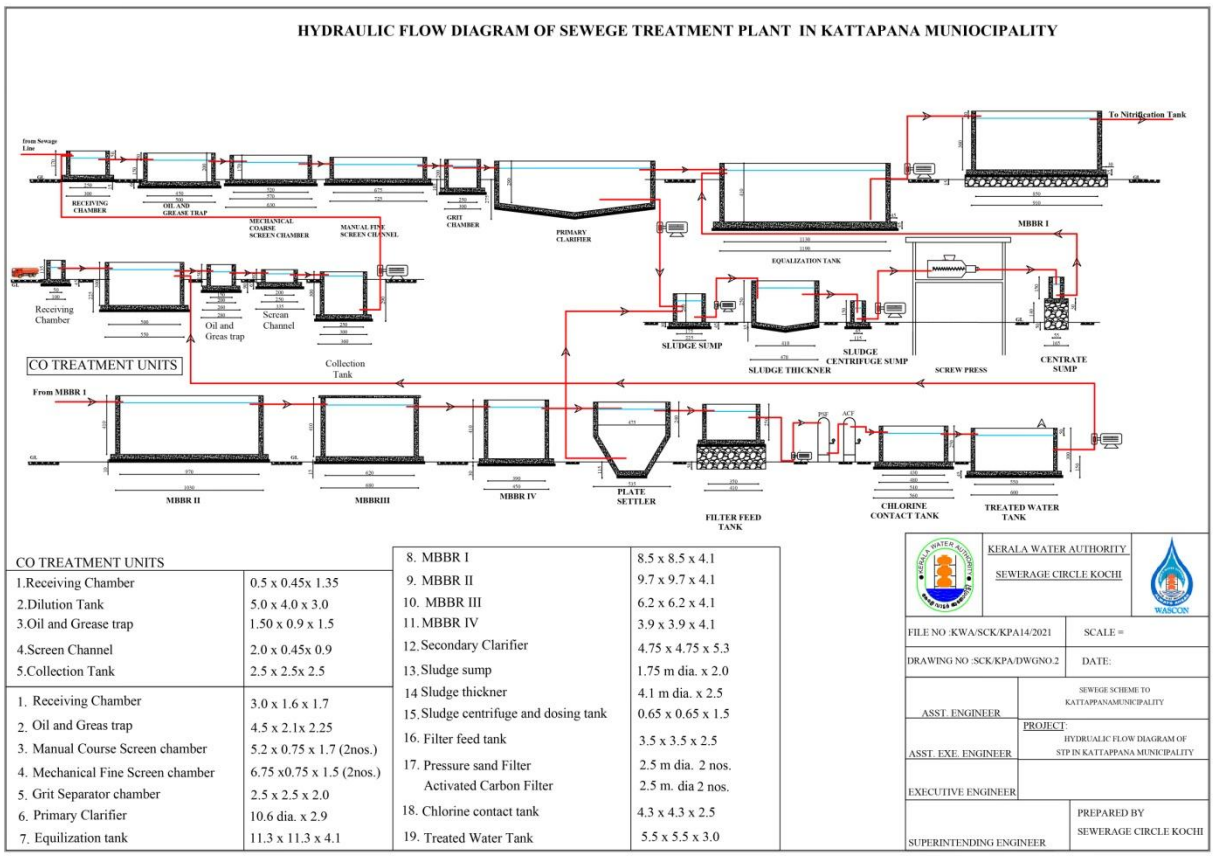
Sewage is a type of wastewater that is produced by a community of people. It is typically transported through a sewer system. Sewage consists of wastewater discharged from residences and from commercial, institutional and public facilities that exist in the locality. Sub-types of sewage are greywater (from sinks, bathtubs, showers, dishwashers, and clothes washers) and blackwater (the water used to flush toilets, combined with the human waste that it flushes away). Sewage also contains soaps and detergents. Food waste may be present from dishwashing. Sewage may contain micro-pollutants and pollutants from industrial wastewater.

The main parameters in sewage that are measured to assess the sewage strength or quality as well as treatment options include: solids, indicators of organic matter, nitrogen, phosphorus, and indicators of fecal contamination. The following four types of pathogens from fecal matter are found in sewage: bacteria, viruses, protozoa, helminths and their eggs. In order to quantify the organic matter, indirect methods are commonly used: mainly the Biochemical Oxygen Demand (BOD) and the Chemical Oxygen Demand (COD). Typical values for physical–chemical characteristics of raw sewage in developing countries have been published as follows: 180 g/person/d for total solids (1100 mg/L concentration), 50 g/person/d for BOD (300 mg/L), 100 g/person/d for COD (600 mg/L), 8 g/person/d for total nitrogen (45 mg/L), 4.5 g/person/d for ammonia-N (25 mg/L) and 1.0 g/person/d for total phosphorus (7 mg/L).

Sewage can be treated close to where the sewage is created, which may be called a "decentralized" system or even an "on-site" system (on-site sewage facility, septic tanks, etc.). Alternatively, sewage can be collected and transported by a network of pipes and pump stations to a municipal treatment plant. This is called a "centralized" system. The procedure for removing contaminants from the wastewater basically from the household sewage is called sewage treatment. It has to undergo the chemical, physical and biological procedure to remove these contaminants and give out an environmentally safe treated effluent.

Choosing the most suitable treatment process is complicated and requires expert inputs, often in the form of feasibility studies. This is because the main important factors to be considered when evaluating and selecting sewage treatment processes are numerous: process applicability, applicable flow, acceptable flow variation, influent characteristics, inhibiting or refractory compounds, climatic aspects, process kinetics and reactor hydraulics, performance, treatment residuals, sludge processing, environmental constraints, chemical product requirements, energy requirements, requirements of other resources, personnel requirements, operating and maintenance requirements, ancillary processes, reliability, complexity, compatibility, area availability. With regards to environmental impacts the following aspects are included in the selection process: Odors, vector attraction, sludge transportation, sanitary risks, air contamination, soil and subsoil contamination, surface water pollution or groundwater contamination, devaluation of nearby areas, inconvenience to the nearby population.

The different stages of the treatment process involved for the treatment of sewage is shown in the flow diagram.



CO TREATMENT UNITS	
1.Receiving Chamber	0.5 x 0.45x 1.35
2.Dilution Tank	5.0 x 4.0 x 3.0
3.Oil and Grease trap	1.50 x 0.9 x 1.5
4.Screen Channel	2.0 x 0.45x 0.9
5.Collection Tank	2.5 x 2.5x 2.5

1. Receiving Chamber	3.0 x 1.6 x 1.7
2. Oil and Greas trap	4.5 x 2.1x 2.25
3. Manual Course Screen chamber	5.2 x 0.75 x 1.7 (2nos.)
4. Mechanical Fine Screen chamber	6.75 x0.75 x 1.5 (2nos.)
5. Grit Separator chamber	2.5 x 2.5 x 2.0
6. Primary Clarifier	10.6 dia. x 2.9
7. Equilization tank	11.3 x 11.3 x 4.1

8. MBBR I	8.5 x 8.5 x 4.1
9. MBBR II	9.7 x 9.7 x 4.1
10. MBBR III	6.2 x 6.2 x 4.1
11. MBBR IV	3.9 x 3.9 x 4.1
12. Secondary Clarifier	4.75 x 4.75 x 5.3
13. Sludge sump	1.75 m dia. x 2.0
14 Sludge thickner	4.1 m dia. x 2.5
15. Sludge centrifuge and dosing tank	0.65 x 0.65 x 1.5
16. Filter feed tank	3.5 x 3.5 x 2.5
17. Pressure sand Filter Activated Carbon Filter	2.5 m dia. 2 nos. 2.5 m. dia 2 nos.
18. Chlorine contact tank	4.3 x 4.3 x 2.5
19. Treated Water Tank	5.5 x 5.5 x 3.0

Figure-6.1 Hydraulic Flow Diagram

6.2 TREATMENT UNITS

6.2.1 PRE-TREATMENT

Pre-treatment removes all materials that can be easily collected from the raw sewage before they damage or clog the pumps and sewage lines of treatment. Objects commonly removed during pretreatment include trash, tree limbs, and other large objects. The influent in sewage water passes through a bar screen to remove all large objects like cans, rags, sticks, plastic packets, etc. carried in the sewage stream. This is most commonly done with an automated mechanically raked bar screen in modern plants serving large populations, while in smaller or less modern plants, a manually cleaned screen may be used. The raking action of a mechanical bar screen is typically paced according to the accumulation on the bar screens and/or flow rate. The solids are collected and later disposed of in a landfill, or incinerated.

6.2.1.1 GRIT REMOVAL

Grit consists of sand, gravel, cinders, and other heavy materials. Pretreatment may include a sand or grit channel or chamber, where the velocity of the incoming sewage is adjusted to allow the settlement of sand and grit. Grit removal is necessary to

- Reduce formation of heavy deposits in aeration tanks, aerobic digesters, pipelines, channels, and conduits
- Reduce the frequency of digester cleaning caused by excessive accumulations of grit and
- Protect moving mechanical equipment from abrasion and accompanying abnormal wear.

The removal of grit is essential for equipment with closely machined metal surfaces such as comminutors, fine screens, centrifuges, heat exchangers, and high pressure diaphragm pumps. Grit chambers come in 3 types: horizontal grit chambers, aerated grit chambers, and vortex grit chambers. Sand and other particles of specific gravity > 2.65 are settled in the Grit Chamber. Grit removal systems have been designed to remove clean inorganic particles that are greater than 0.210 millimetres, most grit passes through the grit removal flows under normal conditions. During periods of high flow deposited grit is re suspended and the quantity of grit reaching the treatment plant increases substantially. It is, therefore, important that the grit removal system not only operate efficiently during normal flow conditions but also under sustained peak flows when the greatest volume of grit reaches the plant.

6.2.1.2 PARSHALL FLUME

The Parshall flume is an open channel flow metering device that was developed to measure the flow. It is used to measure volumetric flow rate in municipal sewer lines, and influent/effluent flows in wastewater treatment plants. In Parshall flume flow should be measured at a point that is 2/3 the length of the converging wall measured back from the throat. It is important to note that this distance is not simply 2/3 of the distance back from the throat, but it is 2/3 of the length of the side wall. The advantages of the Parshall flume are

- It passes sediment and small trash easily
- It requires only a small head loss, and
- It allows accurate flow measurements even when partially submerged.

A disadvantage of the Parshall flume is that it is not accurate at low flow rates.

6.2.2 EQUALIZATION TANK

Flow equalization is used to minimize the variability of water and wastewater flow rates and composition. The main function of the equalization tank is to act as a buffer: to collect the raw incoming sewage that comes at widely fluctuating rates and pass it on to the rest of the sewage treatment plant at a steady flow rate. The tank is rectangular in shape to provide placement of air diffusers for full floor coverage. Each unit operation in a treatment train is designed for specific wastewater characteristics. Improved efficiency and control are possible when all unit operations are carried out at uniform flow conditions. The equalization tanks are provided (i) to balance fluctuating flows or concentrations, (ii) to assist self-neutralization, or (iii) to even out the effect of a periodic "slug" discharge from a batch process. In STP design equalization tank is provided to enable the source to operate at a predetermined rate. Waste water generated does not flow at a constant rate. Even in dry weather, the flow rate varies from hour to hour. Flow equalization is a process of controlling flow velocity and flow composition. It is necessary in many municipal treatment processes to dampen severe variation in inflow and water quality. Providing consistent flow and loading to a biological process is important to maintain optimal treatment. The principal factors considered in the design of equalization tanks are

- Location and configuration,
- Volume
- Tanks geometry,
- Mixing and air requirements,
- Appurtenances (accessories, trappings) and
- Pumping facilities

Considering the variation in hourly flow pattern adopted as shown in appendix, volume of equalization tank is arrived at around 456 m3. Thus in order to maintain uniform flow rate the retention time is considered as 6.2 hrs. Due to the additional retention time, aeration and mixing is required to prevent the raw wastewater from becoming septic and to maintain solids in suspension. Homogeneous mixture in Equalization Tank is done via the actions of coarse bubble diffusers , oxygen transfer efficiency of a coarse bubble diffuser is 10%-20% and are capable of delivering 6 - 12 m3 / hour air , typical diameter of coarse bubble diffuser is 150 mm and other role is to make water homogeneous in nature.

6.2.3 SECONDARY TREATMENT

Secondary treatment removes the soluble organic matter that escapes primary treatment. It also removes more of the suspended solids. Removal is usually accomplished by biological processes in which microbes consume the organic impurities as food, converting them into carbon dioxide, water, and energy. MBBR has been proposed as a secondary treatment option due to the following reasons.

1. MBBR has been in existence sufficiently for a long time, also in India and is a proven technology.
2. Minimum footprint
3. Better stabilized sludge
4. Better Effluent Quality
5. Less sophisticated
6. Spare parts available
7. Lower life cycle cost
8. Nil odour nuisance and other environmental hazards

The MBBR process is an attached growth biological wastewater treatment process. That is, the microorganisms that carry out the treatment are attached to a solid medium, as in trickling filters or RBC systems. The microorganisms that carry out the treatment are kept suspended in the mixed liquor in the aeration tank.

6.2.3.1 MOVING BED BIO REACTOR (MBBR) TECHNOLOGY

MBBR technology employs thousands of polyethylene biofilm carriers operating in mixed motion within an aerated wastewater treatment basin. Each individual bio- carrier increases productivity through providing protected surface area to support the growth of heterotrophic and autotrophic bacteria within its cells. It is this high-density population of bacteria that achieves high-rate biodegradation within the system, while also offering process reliability and ease of operation.

This technology provides cost-effective treatment with minimal maintenance since MBBR processes self-maintain an optimum level of productive biofilm.

Additionally, the biofilm attached to the mobile bio carriers within the system automatically responds to load fluctuations.

6.2.3.2 PROCESS BENEFITS

- Compact Design: A fraction of the size of conventional systems
- Expandable: Capacity can be easily upgraded by simply increasing the fill fraction of biofilm carriers
- Single Pass Process: No return activated sludge stream required
- Load Responsive: Actively sloughed biofilm automatically responds to load fluctuations
- Minimal Maintenance

No F/M ratios or MLSS levels to maintain MBBR processes are an excellent solution for common wastewater applications including

- BOD Reduction
- Nitrification
- Total Nitrogen Removal

Moving Bed Biofilm Reactor systems deliver a flexible, cost-effective, and easy- to-operate means to address current wastewater requirements and the expandability to meet future loads or more stringent discharge requirements within a compact design.

6.2.3.3 FEATURES OF MBBR

In Fluidized aerobic process a non-clogging biofilm reactor with special grade plastic media having density close to that of water is used. This plastic media has more surface area and biofilm grows on these media which move along with the water in the reactor. This movement within the reactor is generated by providing aeration with the help of diffusers placed at the bottom of the aerobic reactor. The thin biofilm on the elements enables the bacteria to act upon the biodegradable matter in sewage and reduce BOD /

COD content in the presence of oxygen present in air. Area requirement for this process is 1/10 of space required for conventional sewage treatment plants. Power requirements are low as recycling of sludge is not done in this method as required in ASP. This can take shock loads and can withstand variation. Expected COD/BOD removal is more than 95%.

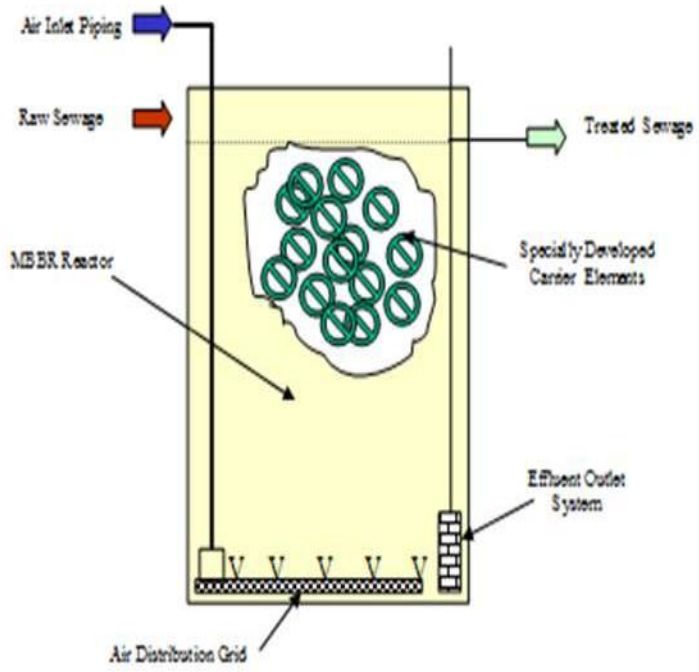


Fig 6.2: Essential Components of MBBR

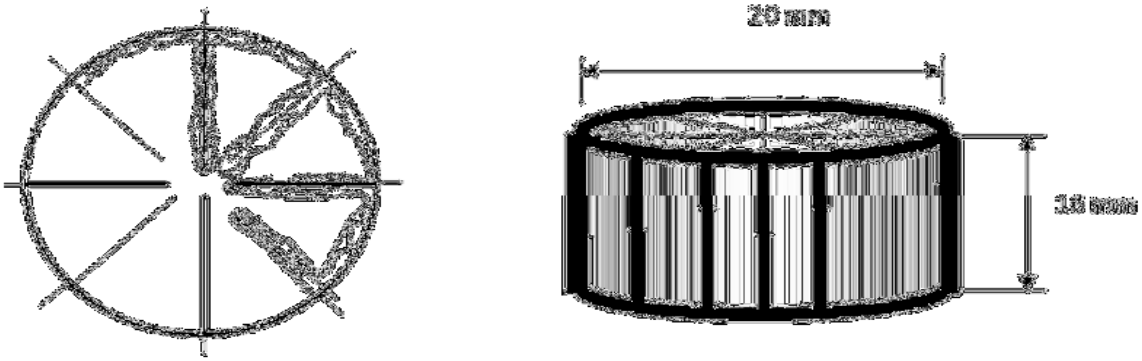


Fig 6.3: MBBR Media

6.2.3.4 MBBR WASTEWATER TREATMENT PROCESS ALTERNATIVES

The MBBR wastewater treatment process is quite flexible and can be used in several different ways. The figure shows the flow diagram of the options adopted for the proposed treatment plant, with single stage BOD removal, nitrification, post anoxic denitrification with raw sewage feeding for carbon source and thereafter removing low grade BOD in the subsequent reactor.

6.2.3.5 POST ANOXIC DENITRIFICATION ALTERNATIVE

In order to carry out the denitrification of the waste water flow (removal of the Nitrogen from the waste water), it is necessary to first nitrify the waste water, conversion of ammonia nitrogen typically present in the influent wastewater to nitrate. Nitrification will only take place at a reasonable rate in the MBBR reactor if the BOD level is quite low, thus an MBBR denitrification process will need a reactor for BOD removal, one for nitrification and one for denitrification. Nitrification reactor will always follow the BOD removal reactor because of the need for low BOD level in the nitrification reactor. Denitrification reactor is provided after the nitrification reactor as the post anoxic denitrification.

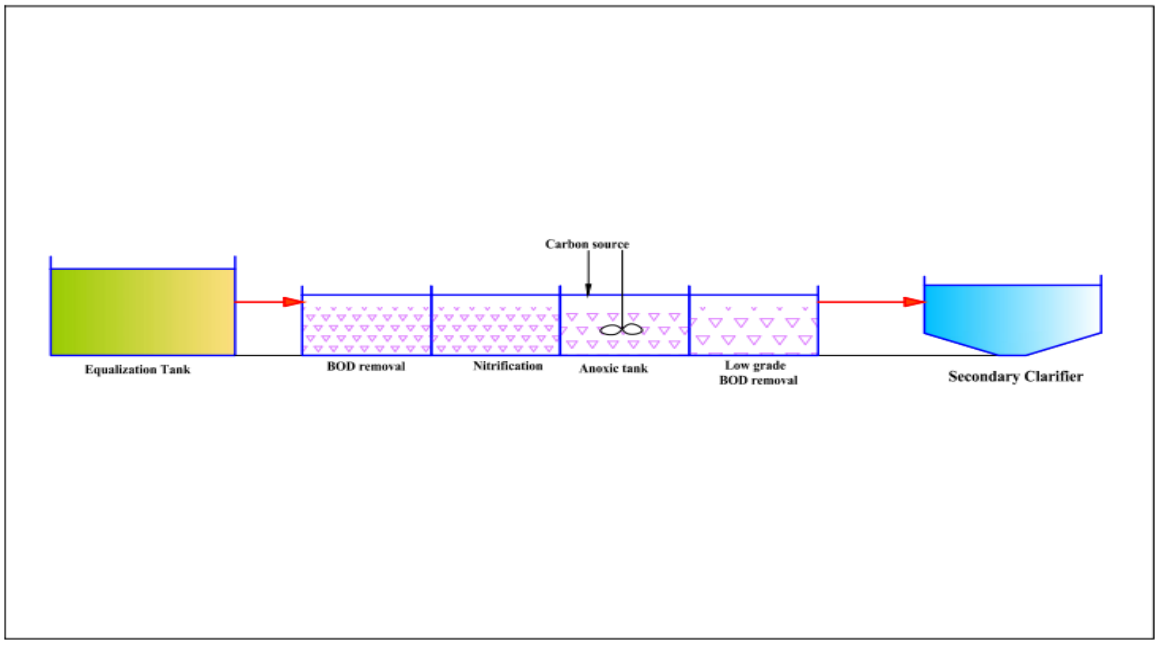


Figure 6.4 Nitrification and Denitrification Reactors

6.2.3.6 NITRIFICATION TANK

Ammonia in wastewater could originate from a variety of sources, including Proteins (meat and blood), urea, amino acid products, casein, corrosion inhibitors, process chemicals and raw materials or cleaning chemicals containing quaternary ammonium compounds. Nitrification is a bio-chemical reaction that occurs inside bacteria. Two species of bacteria are involved in the process – Nitrosomonas and Nitrobacter.

These bacteria are collectively known as nitrifiers and are autotrophic, i.e. they get their carbon source from inorganic carbon (carbonates, bicarbonates) or carbon dioxide.

A healthy and stable population of nitrifiers (Nitrosomonas and Nitrobacter) will not exist without the following conditions:

- OXYGEN: Nitrifiers are obligate aerobes, i.e. they require free molecular oxygen and are killed off by anaerobic conditions. Maximum nitrification occurs at a D.O. (Dissolved Oxygen) level of 3.0 mg/l. Significant nitrification occurs at a D.O. level of 2.0 to 2.9 mg/l. Nitrification ceases at D.O. levels of <0.5 mg/l. Approximately 4.6 kg of oxygen are required for every kg of ammonium ions oxidized to nitrate (This compares with a requirement of 1 kg of oxygen to oxidize 1 kg of carbonaceous B.O.D.). An absence of oxygen for <4 hours does not adversely affect nitrifiers when oxygen is restored. To ensure effective nitrification, always maintain a D.O. level of 1.5 mg/l.

- TEMPERATURE: Nitrification is temperature sensitive. The optimum temperature for nitrification is generally considered to be 30°C.

TEMPERATURE	EFFECT UPON NITRIFICATION
>45°C	Nitrification ceases
28-32°C	Optimal temperature range
16°C	Approx. 50% of nitrification rate at 30°C
10°C	Significant reduction in nitrification rate – 20% of rate at 30°C
<5°C	Nitrification ceases

- ALKALINITY AND pH: Alkalinity is lost in an activated sludge process during nitrification. Nitrifiers use alkalinity as a carbon source, i.e., they use an inorganic form of carbon. Hydrogen ions (H+) are produced when ammonium ions are oxidized to nitrite:

$$NH_4^{++} + 1.5O_2 \longrightarrow 2H^+ + NO_2^- + 2H_2O.$$

Nitrous acid (HNO2) is also produced during the oxidation of ammonium ions. This destroys alkalinity:

$$H^+ + NO_2^- \longrightarrow HNO_2^-$$

7.14 mg of alkalinity as CaCO3 are destroyed for every mg of ammonium ions oxidized. If the pH drops below 6.7, there is a significant decrease in nitrification. Therefore, it is important to maintain an adequate alkalinity in the aeration tank to provide pH stability and also to provide inorganic carbon for nitrifiers. After complete nitrification, a residual alkalinity of 50 mg/l in the aeration tank is desirable. If this alkalinity is not present, then alkalinity should be added to the aeration tank. The optimal pH range for nitrification is 7.2 to 8.0. A substantial reduction in nitrification activity occurs at pH levels below 6.7.

- **HIGH MEAN CELL RESIDENCE TIME (SLUDGE AREA) OR LOW F:M:**

The necessary MCRT or F: M values are temperature dependent. Nitrifier activity and reproduction are decreased during cold temperatures. Therefore, in winter, an increase in the quantity of nitrifiers (MLVSS) or an increase in MCRT is often required to maintain effective nitrification. Reducing the wasting rate (WAS rate) will increase the MCRT.

INHIBITION/TOXICITY:

Inhibition is temporary short-term or long-term loss of enzymatic activity. Toxicity is permanent loss of enzymatic activity or irreversible damage to cellular structure. Small increases in inhibitory wastes can cause a dramatic reduction in nitrification. Nitrifiers grow slowly and only account for a small portion of the bacterial assemblage in an aeration system. Nitrifiers are excellent indicators of toxic shock in an effluent treatment plant. Significant loss of nitrification will occur before loss in efficiency of carbonaceous BOD removal. Nitrifying bacteria are also inhibited by relatively low concentrations of free ammonia (10 mg/l for Nitrosomonas; 0.1 mg/l for Nitrobacter) and free nitrous acid (1.0 mg/l for both Nitrosomonas and Nitrobacter). Free ammonia (NH3) is produced from ammonium ions under a high pH in the aeration tank. Free nitrous acid (NHO2) is produced from nitrite ions under a low pH in the aeration tank. This type of inhibition is known as substrate inhibition. Substrate inhibition usually occurs

at a concentration of 400-500 mg/l ammonium ions or when ammonium ions are converted to nitrite ions at a faster rate than nitrite ions are converted to nitrate ions.

BOD: Soluble and simplistic forms of cBOD can inhibit the activity of nitrifying bacteria. They are able to enter the cells of nitrifying bacteria and inactivate their enzyme systems. This form of cBOD must be degraded significantly or completely by organotrophs in order for nitrifying bacteria to oxidize ammonium and nitrite ions. Nitrifiers are dependent on organotrophs to reduce cBOD to relatively low concentrations (<40-50 mg/l). Excess BOD can cause a significant oxygen demand, which may cause a drop in D.O. that adversely affects nitrifying bacteria. Fluctuations in BOD loading may lead to intermittent nitrification.

6.2.3.7 DENITRIFICATION PROCESS IN THE REACTOR

Denitrification is the process that converts nitrate to nitrogen gas, thus removing bioavailable nitrogen and returning it to the atmosphere. Unlike nitrification, denitrification is an anaerobic process, occurring mostly in soils and sediments and anoxic zones in lakes and oceans. In a biological water treatment, denitrification is generally the next step following nitrification. Here nitrate (NO3) and nitrite (NO2) are transformed into nitrogen (N2). The gaseous nitrogen escapes out of the water into the air. Air exists for 78% out of nitrogen (N2) and for 21% out of O2 (oxygen), so N2 is absolutely not polluting the atmosphere. A large number of aerobic bacteria is able to perform denitrification. When there is no oxygen in the water, these bacteria use nitrate and nitrite as a source of oxygen.

The denitrification reaction requires a carbon source. Hence raw sewage is proposed to dose from the equalization tank to the denitrification tank and BOD in the primary effluent waste water is used as the carbon source for the denitrification. Thereafter a reactor is also proposed for dealing low grade BOD in the effluent.

6.2.3.8 SECONDARY CLARIFIER

Secondary clarifiers are to separate biological floc from the treated liquid waste stream. Plate settlers are also being proposed in the clarifier to get more clarified water. Clarifiers are settling tanks built with mechanical means for continuous removal of solids being deposited by sedimentation. A clarifier is generally used to remove solid particulates or suspended solids from liquid for clarification. Necessary coagulants are being added before feeding the clarifier.

6.2.4 CLARIFIED WATER COLLECTION TANK

After treatment, the effluent is stored in this tank from where it is taken for further treatment.

6.2.5 SLUDGE COLLECTION SUMP

The dead bacteria that die after consuming BOD and COD are retained in the form of sludge from the bottom of the tank.

6.2.6 DEWATERING UNIT

A dewatering unit is required to further dry the sludge. The centrate at the outlet of the dewatering unit is then re circulated to the system.

6.2.7 TERTIARY TREATMENT

Tertiary treatment refers to secondary treatment followed by a filtration step, such as media filtration, so that the turbidity and TOC concentrations are generally lower, and if coagulation with metal salts is used, then the phosphate concentration will also be reduced.

6.2.7.1 PRESSURE SAND FILTER (PSF)

The treated water which is collected in the filter feed tank shall be pumped into the Pressure Sand Filter using the Filter Feed Pumps. They are the most popular method for removal of turbidity from water. The Pressure Sand Filter consists of a multiple layer of sand with a variety in size and specific gravity. These Filters are designed to remove turbidity and suspended particles present in the feed water with minimum pressure drop. Raw water flows downwards through the filter bed and as the suspended matter, which is treated by addition of a coagulant like alum or poly electrolyte, is retained on the sand surface and between the sand grains immediately below the surface. There is steady rise in the loss of head over a period of time and the flow reduces once the pressure drop across the filter is excessive. The filter is then taken out of service and cleaning of the filter media is affected by flow reversal also called as backwash. To assist in cleaning the bed, the backwash operation is sometimes preceded by air scouring by way of agitation through the under drain system. The air scouring agitates the sand with a scrubbing action, which loosens the intercepted particles.

Fig 6.5 Pressure Sand Filter

6.2.7.2 ACTIVATED CARBON FILTER (ACF)

Filtered wastewater from Pressure sand filter is then passed through the Activated Carbon Filter. They are generally employed in the process of removing organic compounds and/or extracting free chlorine from water, thereby making the water suitable for discharge.

Activated carbon is commonly used for removing organic constituents and residual disinfectants in water supplies. This not only improves taste and minimizes health hazards; it protects other water treatment units such as reverse osmosis membranes and ion exchange resins from possible damage due to oxidation or organic fouling. Activated carbon is a favoured water treatment technique because of its multifunctional nature and the fact that it adds nothing detrimental to the treated water. Most activated carbons are made from raw materials such as nutshells, wood, coal and petroleum.

Carbon filtering is a method of filtering that uses a bed of activated carbon to remove contaminants and impurities, using chemical adsorption. Each particle/granule of carbon provides a large surface area/pore structure, allowing contaminants the maximum possible exposure to the active sites within the filter media.

Fig 6.6 Activated Carbon Filter

6.2.7.3 CHLORINE CONTACT TANK

Chlorination is by far the most common method of wastewater disinfection and is used worldwide for the disinfection of pathogens before discharge into receiving streams, rivers or oceans. Chlorine is known to be effective in destroying a variety of bacteria, viruses and protozoa, including Salmonella, Shigella and

Vibrio cholera. Disinfection is achieved at this facility through chlorination using chlorine gas. The purpose of the Chlorine Contact Tanks is to allow sufficient time for the chlorine to disinfect the water.

6.2.8 TREATED WATER TANK

Treated water is being collected in treated water tank before being disposed of to water body.

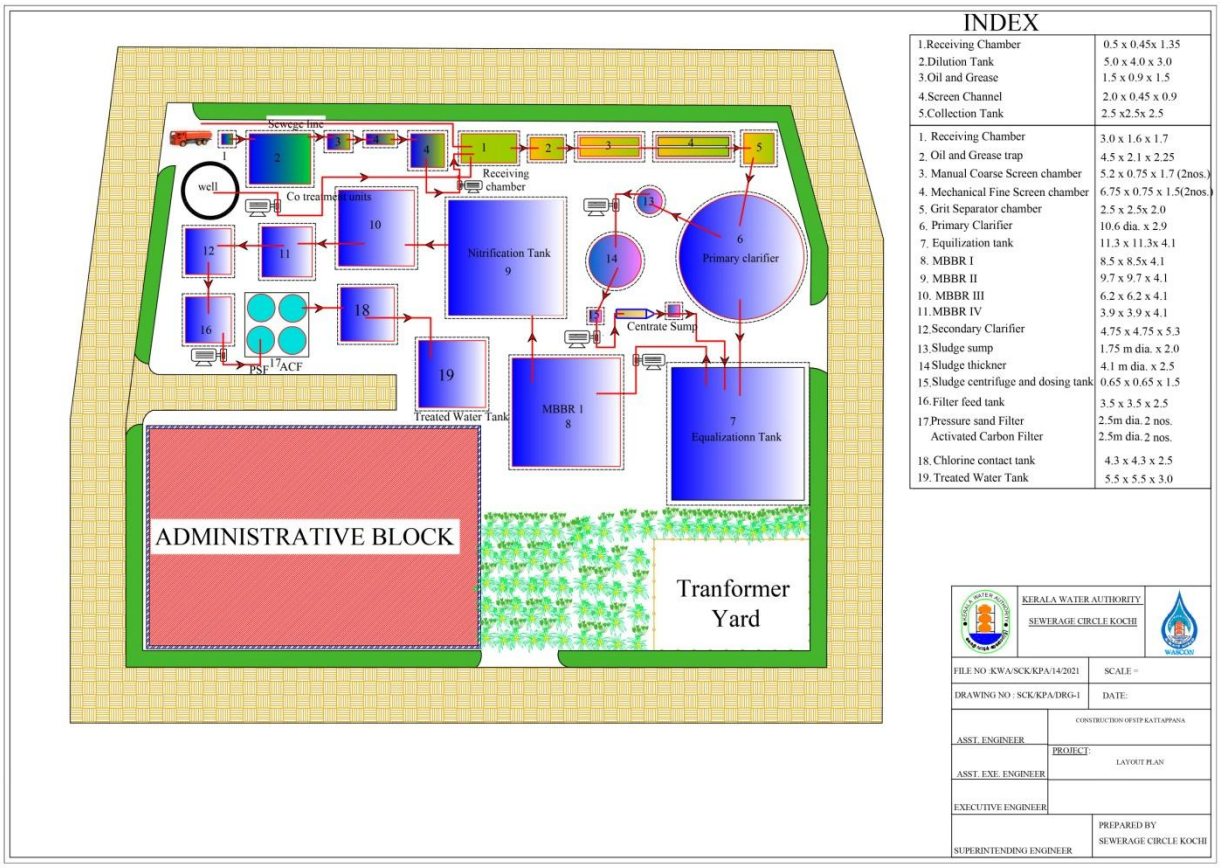


Figure 6.7 Layout of STP

6.3 SLUDGE MANAGEMENT

The solid particles separated from wastewater are in the form of slurry and known as sludge. The volume of sludge is more as it contains more water. Hence to reduce the volume of sludge, dewatering process is done with the help of centrifuges, sludge thickening units and sludge press. After this process, it is converted in the form of cake. The sludge from sewage is rich with nitrogen, phosphorous, Sulphur and other minerals which are essential for the growth of plants. Hence it can be used as manure. Further researches are going on this field to make this cake as a construction material but are in its infant stage.

CHAPTER - 7

DESIGN OF TREATMENT PLANT UNITS

7.1 DESIGN OF CO-TREATMENT UNITS FOR SEPTAGE

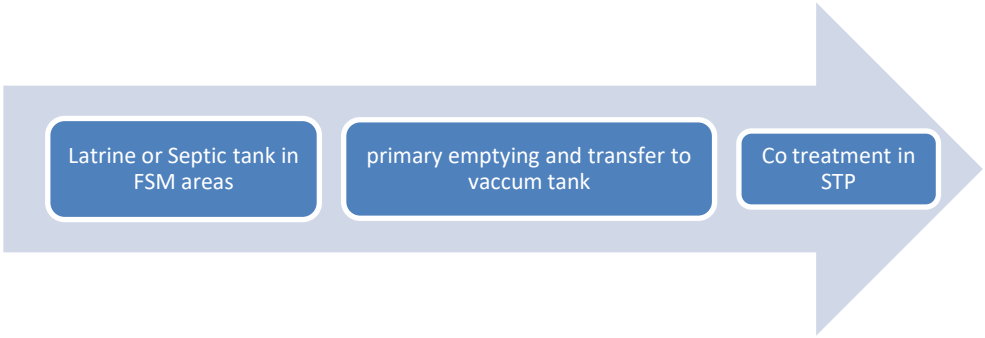


Fig.7.1 Containment, Emptying, Transportation, Treatment, End Use / Disposal

For the areas considered as septage zones, the households, institutions, commercial entities etc., shall undertake de-sludging of the septic tanks and pit once in every three years or when get filled up whichever is earlier as per the NBC code and CPHEEO guidelines. The most satisfactory method of sludge removal is by vacuum tankers. Though de-sludging frequencies vary, it is generally recommended to de-sludge tanks once every two to three years, or when the tank becomes one third full. Periodical de-sludging also helps to reduce the pollution levels in the liquid effluent, which normally enters waterways untreated. However, a small amount of sludge should be left in the tank to ensure that a minimum level of the necessary microorganisms responsible for anaerobic digestion remain in the tank. The gas generated due to anaerobic digestion might escape when tank is open for de-sludging. Hence, it is highly advisable to avoid using fire (or any incendiary material) in these cases. Regular de-sludging activities require well-organized community and public/private service providers. Because of the delicate nature of septic systems housing microbial processes, care should also be taken not to scrub the septic clean or use chemicals such as detergents etc. to avoid the complete destruction

DESIGN OF CO-TREATMENT UNIT FOR SEPTAGE WITH MOVING BED BIOFILM-REACTOR (MBBR)						
Design population	**48675**					
Sludge deposit coefficient	**95**	litres/person/year				
Sludge deposit	12.67	KLD				
Average septage flow	**12.67**	KLD				
Working hours	**24**					
Design flow	12.67	KLD	12670	LPD	12.7	m^3/day
Assumed peak factor	**1.5**		13	KLD	0.53	m^3/hour

Peak design flow	19.01	KLD	19005	LPD	19	m^3/day
					0.79	m^3/hour
Number of trips/day	**8**				0.00022	cum/sec
Quantity of septage obtained in single trip with peak factor	2.38	m^3				
Raw Septage Characteristics						
COD	**25000**	mg/l				
BOD	**5000**	mg/l				
TSS	**7000**	mg/l				
Treated Sewage Characteristics (after filtration)						
COD	**50**	mg/l				
BOD	**10**	mg/l				
TSS	**20**	mg/l				
Receiving Chamber						
Average quantity of flow	0.53	m^3/hour				
Peak flow	0.79	m^3/hour				
	0.00022	m^3/sec				
Average Retention Time for peak flow	**600**	sec	offset to wall	**0.3**	m	
Volume of the inlet chember	0.1320	m^3	free board	**0.85**	m	
Assumed depth of flow	**0.85**	m	total height	**1.35**	m	
Area required for inlet chamber	0.16	m^2	wall thickness	**0.25**	m	
Length of the tank	**0.5**	m	slab thickness	**0.3**	m	
Breadth of the tank	0.31	fix	**0.45**	m	area in m^2	**2.48**
Design of Dilution Chamber from Mass-balance Principle						
Target outflow BOD (actual incoming BOD to STP)	**265**	mg/l				
Target outflow TSS (actual incoming TSS to STP)	**400**	mg/l				
Volume of recycled water used for dilution	**45000**	litres				
Quantity of septage obtained as above	2.38	m^3	ratio of dilution		18.94	
BOD of diluted septage	260.22	mg/l	**ok**			
TSS of diluted septage	370.01	mg/l	**ok**			
Total volume of dilution tank	47.38	m^3				
Liquid depth adopted inside dilution tank	**2.50**	m	side of square tank		4.35	m
Length of dilution tank adopted	**5.00**	m				
Breadth of dilution tank adopted	**4.00**	m	volume	50.00	m^3	ok
Average outflow from dilution tank	10.53	m^3/hour				
Average sewage flow entering the STP	73.14	m^3/hour	% of diluted sepatge to sewage			14.39

with diluted septage						
Oil and Grease Trap						
Average quantity of flow	10.53	m^3/hour				
Peak flow	15.79	m^3/hour				
	0.00439	m^3/sec				
Average Retention Time for peak flow	**300**	sec	offset to wall	**0.15**	m	
Volume of the inlet chamber	1.32	m^3	free board	**0.5**	m	
Assumed depth of flow	**1**	m	total height	**1.5**	m	
Area required for inlet chamber	1.32	m^2	wall thickness	**0.25**	m	
Length of the tank	**1.5**	m	slab thickness	**0.3**	m	
Breadth of the tank	0.88	fix	**0.9**	m	area in m^2	**3.91**
Breadth of baffle wall inside	0.9	m				
Manual Coarse Screen Channel						
Peak design flow	0.00439	m^3/sec				
Number of screen	**1**					
Peak flow rate per screen	0.0044	m^3/sec				
Velocity at peak flow	**0.75**	m/sec	assumed			
Velocity through clean bar screen	**0.85**	m/sec				
Length of channel U/S	**1**	m	wall thickness	**0.25**	m	
Width of channel provided	**0.45**	m	offset to wall	**0.25**	m	
Depth of flow	0.0130	m	slab thickness	**0.30**	m	
Area required for screen	0.0058	sqm				
Headloss through bar screen	0.01	m	*assuming head loss coefficient = 0.7*			
Assumed depth of flow after inserting bar screen	**0.1**	m	0.02	(control value)		
Width of channel required	0.06	m	fix	**0.45**	m	
Clear bar spacing	**20**	mm	*(20 to 50 mm)*			
Bar thickness	**10**	mm	*(5 to 15 mm)*			
Number of bars	**15**					
Clear bar spacing obtained	21	mm	OK			
Inside width of screen (openings)	0.3	m			area in m^2	**2.9**
Full height of channel	**0.6**	m	fb	**0.3**		
Angle of inclination	**45**	degree	0.79	rad		

Actual velocity at peak flow	0.59	*(between 0.60 m/sec and 0.90 m/sec)*				
Length of channel required D/S	0.60	m	fix	**1**	m	
Sewage pump- for pumping to equalisation tank of STP						
Number of pumps	**1**	SB	**1**			
Type of pump set	submersible centrifugal sewage transfer- non clog					
Average flow	10.53	m^3/hour				
Peak design flow	15.79	m^3/hour				
Working hours	**23**					
Flow capacity of each pump	16.48	m^3/hour				
Peak factor	**1.20**					
Discharge	5.49	LPS	0.0055	m^3/sec		
Head required	**18**	m				
Efficiency	**50%**					
Power required	2.64	HP	fix	**3**	HP	
Energy	45.24	kwh				
Recycled water pump- for pumping to dilution tank						
Number of pumps	**1**	SB	**1**			
Type of pump set	submersible centrifugal sewage transfer- non clog					
Average flow	10.00	m^3/hour				
Peak design flow	15.00	m^3/hour				
Working hours	**23**					
Flow capacity of each pump	15.65	m^3/hour				
Peak factor	**1.20**					
Discharge	5.22	LPS	0.0052	m^3/sec		
Head required	**20**	m				
Efficiency	**50%**					
Power required	2.78	HP	fix	**3.5**	HP	
Energy	47.74	kwh				

Recycled water pump- for pumping to dilution tank						
Number of pumps	**1**	SB	**1**			
Type of pump set	Submersible centrifugal sewage transfer-non clog					
Average flow	10.00	m^3/hour				
Peak design flow	15.00	m^3/hour				
Working hours	**23**					
Flow capacity of each pump	15.65	m^3/hour				
Peak factor	**1.20**					
Discharge	5.22	LPS	0.0052	m^3/sec		
Head required	**20**	m				
Efficiency	**50%**					
Power required	2.78	HP	fix	**3.5**	HP	
Energy	47.74	kwh				

7.2 DESIGN OF STP UNITS WITH MBBR TECHNOLOGY

DESIGN OF STP WITH MOVING BED BIOFILM-REACTOR (MBBR)						
Average flow from network	**1.44**	MLD				
Working hours	**23**					
Flow from septage dilution tank	10.53	m^3/hour	0.25	MLD		
Design flow	**1.76**	MLD	1755281	LPD	1755	m^3/day
			1755	KLD	73.14	m^3/hour
Assumed peak factor	**2.25**					
Peak design flow	3.949	MLD	3949382	LPD	3949	m^3/day
					164.56	m^3/hour
Raw Sewage Characteristics						
Average sewage flow entering the STP	73.14	m^3/hour				
Peak flow entering the STP	164.56	m^3/hour				
COD	**500**	mg/l				
Primary ST/ET effluent BOD	**250**	mg/l				
Thickener overflow return as fraction of plant flow	**0.15**					
Thickener overflow return	0.263	MLD				
Thickener overflow return BOD	**350**	mg/l				
Centrate from sludge dewatering as fraction of plant flow	**0.006**					
Centrate from sludge dewatering return	0.01053	MLD				
Centrate from sludge dewatering return BOD	**280**	mg/l				

Influent BOD to aeration tank	263.1	mg/l				
TSS	**400**	mg/l				
Total Nitrogen (As N)	**40**	mg/l				
Total Phosphorous (As P)	**7**	mg/l				
Faecal Coliform	**3E+07**	mpn/100 ml				
E Coliform	**4E+07**	mpn/100 ml				
Chlorides as Cl	**125**	mg/l				
pH	**6**					
Treated Sewage Characteristics (after filtration)						
COD	**50**	mg/l				
BOD	**10**	mg/l				
TSS	**20**	mg/l				
Total Nitrogen (As N)	**10**	mg/l				
Total Phosphorous (As P)	**1**	mg/l				
E Coliform	**100**	mpn/100 ml				
pH	**7**					
Receiving Chamber						
Average quantity of flow	**73.14**	m3/hour				
Peak flow	**164.56**	m3/hour				
	0.05	m3/sec				
Average Retention Time for peak flow	**120.00**	sec	offset to wall	0.3	m	
Volume of the inlet chember	**5.49**	m3	free board	0.5	m	
Assumed depth of flow	**1.20**	m	total height	1.7	m	
Area required for inlet chamber	**4.57**	m2	wall thickness	0.25	m	
Length of the tank	**3.00**	m	slab thickness	0.3	m	
Breadth of the tank	**1.52**	fix	1.6	m	area in m2	11.07
Receiving Chamber						
Average quantity of flow	**73.14**	m3/hour				
Peak flow	**164.56**	m3/hour				
	0.05	m3/sec				
Average Retention Time for peak flow	**120.00**	sec	offset to wall	0.3	m	
Volume of the inlet chamber	**5.49**	m3	free board	0.5	m	
Assumed depth of flow	**1.20**	m	total height	1.7	m	
Area required for inlet chamber	**4.57**	m2	wall thickness	0.25	m	
Length of the tank	**3.00**	m	slab thickness	0.3	m	
Breadth of the tank	**1.52**	fix	1.6	m	area in m2	11.07
Provide Receiving Chamber of capacity 3.00 m x 1.60m x 1.20 m SWD						

Oil and Grease Trap						
Average quantity of flow	73.14	m^3/hour				
Peak flow	164.56	m^3/hour				
	0.0457	m^3/sec				
Average Retention Time for peak flow	**300**	sec	offset to wall	**0.15**	m	
Volume of the inlet chamber	13.71	m^3	free board	**0.75**	m	
Assumed depth of flow	**1.5**	m	total height	**2.25**	m	
Area required for inlet chamber	9.14	m^2	wall thickness	**0.25**	m	
Length of the tank	**4.5**	m	slab thickness	**0.3**	m	
Breadth of the tank	2.03	fix	**2.1**	m	area in m^2	**15.37**
Breadth of baffle wall inside	2.1	m				
Provide Oil and Grease trap of capacity 4.50 m x 2.10m x 1.50 m SWD						
Manual Coarse Screen Channel						
Peak design flow	0.0457	m^3/sec				
Number of screen	**1**					
Peak flow rate per screen	0.0457	m^3/sec				
Velocity at peak flow	**1**	m/sec	assumed			
Velocity through clean bar screen	**1.10**	m/sec				
Length of channel U/S	**1**	m	wall thickness	**0.25**	m	
Width of channel provided	**0.75**	m	offset to wall	**0.25**	m	
Depth of flow	0.06	m	slab thickness	**0.30**	m	
Area required for screen	0.05	sqm				
Headloss through bar screen	0.02	m	*assuming head loss coefficient = 0.7*			
Assumed depth of flow after inserting bar screen	**0.1**	m	0.08	(control value)		
Width of channel required	0.46	m	fix	**0.75**	m	
Clear bar spacing	**20**	mm	*(20 to 50 mm)*			
Bar thickness	**12**	mm	*(5 to 15 mm)*			
Number of bars	**23**					
Clear bar spacing obtained	22	mm	OK			
Inside width of screen (openings)	0.474	m			area in m^2	**9.1**
Full height of channel	**1.2**	m	fb	**0.5**		
Angle of inclination	**45**	degree	0.79	rad		

Actual velocity at peak flow	1.26	*(between 0.60 m/sec and 0.90 m/sec)*				
Length of channel required D/S	1.20	m	fix	**4.2**	m	
Mechanical Fine Screen Channel						
Peak design flow	0.046	m^3/sec				
Number of screen	**1**					
Peak flow rate per screen	0.046	m^3/sec				
Velocity at peak flow	**0.8**	m/sec	assumed			
Velocity through clean bar screen	**0.85**	m/sec				
Length of channel U/S	**1**	m	wall thickness	**0.25**	m	
Width of channel provided	**0.75**	m	offset to wall	**0.25**	m	
Depth of flow	0.08	m	slab thickness	**0.30**	m	
Area required for screen	0.06	sqm				
Headloss through bar screen	0.01	m	*assuming head loss coefficient = 0.7*			
Assumed depth of flow after inserting bar screen	**0.37**	m	0.08	(control value)		
Width of channel required	0.15	m	fix	**0.75**	m	
Clear bar spacing	**6**	mm	*(up to 6 mm)*			
Bar thickness	**10**	mm	*(5 to 15 mm)*			
Number of bars	**47**					
Clear bar spacing obtained	6.1	mm				
Inside width of screen (openings)	0.28	m				
Full height of channel	**1**	m	fb	**0.5**		
Angle of inclination	**70**	degree	1.22	rad		
Actual velocity at peak flow	1.99	*(between 0.60 m/sec and 1.20 m/sec)*				
Length of channel required D/S	2.74	m	fix	**2.75**	m	**2.8125**
Daily screening quantity						
Daily sewage quantity	1755.28	m^3/day				
Rate of screening quantity	**0.015**	m^3/1000 m^3				
Daily screening quantity	0.0263	m^3/day				
Grit Separator						
Number of grit units	**1**	SB	**0**			
Peak flow	0.0457	m^3/sec				
Flow in one unit	0.0457	m^3/sec				
Grit particle size	**0.15**	mm				

HRT	**60**	sec	*(45 to 90 sec, typical 60)*			
Volume of grit chamber	2.74	m^3				
SOR	**900**	$m^3/m^2/day$	*(empirical, from observations)*			
	0.010	$m^3/m^2/sec$				
Area required	4.39	m^2	wall thickness	**0.25**	m	
SWD	**1.50**	m	slab thickness	**0.30**	m	
Side of square channel	2.09	m	offset to wall	**0.3**	m	
Fix length	**2.5**	m	freeboard	**0.5**	m	
Fix width	**2.5**	m	area given	6.25	m^2	OK
Shape factor	**0.85**		volume given	9.3750	m^3	OK
Specific gravity of liquid	**2.65**					
Kinematic viscosity	**1E-06**	m^2/sec				
V_p in m/sec	0.020	*let Nr < 1, apply Stoke's law to get terminal velocity vp*				
N_r	3	*Apply Newton's equation*				
Assumed velocity in m/sec	**0.0146**					
Nr	2				area in m^2	**12.96**
drag coefficient Cd	15.47					
vp in m/sec	0.014					
Critical displacement velocity, Vc	0.0145	m/sec		R_t	1.67	
Horizontal velocity of flow, Vh	0.0122	m/sec	OK	R_v	1.19	
Provide Grit Separator of capacity 2.50 m x 2.50m x 1.50 m SWD						
Primary Clarifier						
Number of units	**1**					
Average flow to primary clarifier	1.8	MLD	1755280.696	LPD	1755.281	m^3/day
			1755.280696	KLD	73.14	m^3/hour
Assumed peak factor	**2.25**					
Peak design flow	3.949	MLD	3949381.565	LPD	3949.382	m^3/day
			3949.381565	KLD	164.56	m^3/hour
Detention period at peak	**1**	hours	*(1.5 to 2.5 hours only for average flow*			
Removal efficiency of TSS expected	**65%**		*to avoid septic conditions)*			

Overflow rate corresponding to efficiency	**57**	m/day	*(from typical graph of experiments)*			
Overflow area at average flow	30.79	m^2	required dia in m			6.26
Overflow area at peak flow	69.29	m^2	required dia in m			9.39
Volume of settling zone of tank at peak flow	164.56	m^3				
Height of settling zone	2.38	m	fix $H_{settling}$	**2.40**	m	
Diameter of tank	10.58	m	*(settling zone dia+inlet zone+outlet zone)*			
Fix diameter of primary sedimentation tank	**10.60**	m	volume	88.24754	m^3	
Depth of tank required	2.90	m				
Actual detention time for average flow	2.25	hours	OK			
Weir overflow rate at peak flow	118.66	m^3/m.day	OK			
					area in m^2	**88.2475**
Provide primary clarifier of 10.60 m dia and SWD 2.40 m						
Equalization Tank						
Average design flow	73.14	m^3/hour				
Volume of tank required	**456.00**	m^3	*from detailed analysis*			
HRT	6.23	hours				
SWD	**3.6**	m				
Area required for equalization tank	126.67	m^2	free board	**0.50**	m	
Number of tanks proposed	**1**		offset to wall	**0.45**	m	
Area required for each tank	126.67	m^2	wall thickness	**0.3**	m	
Side if square tank	11.25	m	fix length	**11.3**	m	
Thickness of foundation slab	**0.45**	m	fix breadth	**11.3**	m	
Actual capacity provided	459.684	m^3	rectangular	OK	area in m^2	**163.84**
Provide Equalization tank of capacity 11.3 m x 11.30 m x 3.60 m SWD						
Sewage pump- for pumping to MBBR tank						
Number of pumps	**1**	SB	**1**			
Type of pump set	submersible centrifugal sewage transfer-non clog					
Average flow	1755.28	m^3/day				
Peak design flow	3949.38	m^3/day				
Working hours	**23**					

Flow capacity of each pump	76.32	m^3/hour				
Peak factor	**1.20**					
Discharge	25.44	LPS	0.0254	m^3/sec		
Head required	**12**	m				
Efficiency	**50%**					
Power required	8.14	HP	fix	**9**	HP	
Energy	139.67	kwh				
Moving Bed Bio-Reactor (MBBR)-Single Stage						
Average design flow	1755.28	m^3/day				
Number of streams	**1**					
BOD of incoming sewage	263.13	mg/l				
TSS of incoming sewage	400	mg/l				
BOD expected after treatment	10	mg/l				
BOD to be removed	253.13	mg/l				
BOD removal % expected	96.20					
Number of tanks proposed	**1**					
BOD loading rate/volume	**4**	kg/m^3/day	*4-7 kg/m^3/day as per M&E*			
Actual BOD loading rate	461.87	kg/day				
Quantity of BOD to be removed per day	444.32	kg/day				
Volume of reactor required	115.47	m^3				
Surface area loading rate (SALR) for BOD removal	**7.50**	g/m^2/day				
Required carrier surface area	61582.62	m^2				
Specific surface area of carrier	**600.00**	m^2/m^3				
Required carrier volume	102.64	m^3				
Volume of media required	**40%**					
	46.19	m^3	depth of base	**0.3**	m	
Volume of tank required-BOD loading rate/volume method	161.65	m^3	slab thickness	**0.35**	m	
Volume of tank required- SALR method	256.59	m^3	offset to wall	**0.45**	m	
Volume of each tank	256.59	m^3	total height	**4.10**	m	
SWD	**3.6**	m	wall thickness	**0.30**	m	
Area of each tank	71.28	m^2	length	**8.5**	m	
Side of square tank	8.44	m	breadth	**8.5**	m	
Actual capacity provided-rectangular	260.10	m^3	OK			
Fix capacity	**260.10**	m^3				
Actual volume of media obtained	104.04	m^3				
Actual carrier surface area	62424.00	m^2				

Volume of liquid in the tank	218.48	m^3				
Hydraulic Retension Time at design average flow	2.99	hours	179.2	minutes		
Hydraulic Retension Time at peak flow	1.33	hours	79.7	minutes		
SARR for the given SALR	6.94	$g/m^2/day$			area in m^2	**100.00**
Estimated BOD removal rate	433.07	kg/day				
Actual BOD removal rate %	93.76	BOD of effluent		16.41	mg/l	ok
Provide MBBR Tank 1 of capacity 8.50 m x 8.50 m x 3.60 m SWD						
Moving Bed Bio-Reactor (MBBR)-Single Stage Nitrification						
Average design flow	1755.28	m^3/day				
Number of streams	**1**					
BOD of incoming sewage	**20.00**	mg/l				
NH_4-N of incoming sewage	**40.00**	mg/l				
Alkalinity as $CaCO_3$	**140.00**	mg/l				
Target effluent NH_3-N	**3.30**	mg/l	% removal	91.75		
DL level to be maintained in tank	**2.00**	mg/l				
Design minimum waste water temperature	**20.00**	^oC				
$SARR_{max}$	0.61		SARR temp coefft. θ		1.058	
Minimum NH_3-N at $SARR_{max}$	0.50		$SARR_T$	0.81	$g/m^2/day$	
Design value of SALR	0.88	$g/m^2/day$				
NH_3-N loading rate	70.21	kg/day				
Required carrier surface area	79662.60	m^2/day				
Specific surface area of carrier	**600.00**	m^2/m^3				
Required carrier volume	132.77	m^3/day	depth of base	**0.65**	m	
Volume of media required	**40%**		slab thickness	**0.35**	m	
Volume of tank required- SALR method	331.93	m^3	offset to wall	**0.45**	m	
Volume of each tank	331.93	m^3	total height	**4.10**	m	
SWD	**3.6**	m	wall thickness	**0.30**	m	
Area of each tank	92.20	m^2	length	**9.7**	m	
Side of square tank	9.60	m	breadth	**9.7**	m	
Actual capacity provided- rectangular	338.72	m^2	OK			
Fix capacity	**338.72**	m^3				
Actual volume of media obtained	135.49	m^3				
Actual carrier surface area	81292.80	m^2			area in m^2	**125.44**

Volume of liquid in the tank	284.52	m^3				
Hydraulic Retension Time at design average flow	3.89	hours	233.42	minutes		
Hydraulic Retension Time at peak flow	1.73	hours	103.74	minutes		
BOD SALR	0.43	$g/m^2/day$	*should be < 0.5 to achieve good nitrification*			
Using the equivalent weight of $CaCO_3$ as 50, the equivalent weight of $NaHCO_3$ as 84, the alkalinity use for nitrification as 7.14 g $CaCO_3$/g NH_3-N and the target effluent alkalinity as 80 mg/L as $CaCO_3$, give the calculated alkalinity requirement as 118.5 mg/L as $CaCO_3$.						
Influent alkalinity	**140.00**	mg/l				
Target effluent alkalinity	**80.00**	mg/l				
Alkalinity used for Nitrification	**7.14**	g $CaCO_3$/g NH_3-N				
Alkalinity to be added	202.04	mg/l				
Rate of alkalinity addition needed as $CaCO_3$	354.63	kg/day				
Equiv wt. of $CaCO_3$	50.00	g/equivalent				
Equiv wt. of $NaHCO_3$	84.00	g/equivalent				
Daily $NaHCO_3$ requirement	595.78	kg/day $NaHCO_3$				
|Provide MBBR Tank 2 of capacity 9.70 m x 9.70 m x 3.60 m SWD						
Moving Bed Bio Reactor (MBBR)-post-anoxic denitrification						
Carbon:Nitrogen ratio (C/N)	6.58					
Average design flow	1755	m^3/day				
Number of post-anoxic tanks	**1.00**					
Target effluent NO_3-N concentration	**4.00**	mg/l				
SALR for post-anoxic stage	**2.00**	g NO_3 N /m^2/day				
Estimate of SARR/SALR ratio	0.886	mg/l				
Target % N removal	91.75					
Specific surface area of carrier	**600.00**	m^2/m^3				
NO_3-N daily loading rate	64.42	kg/day				
Required carrier surface area	32209.401	m^2				
Required carrier volume	53.68	m^3				
Volume of media required	**40%**		depth of base	**0.65**	m	
Volume of tank required- SALR method	134.21	m^3	slab thickness	**0.35**	m	
Volume of each tank	134.2	m^3	offset to wall	**0.45**	m	
SWD	**3.6**	m	total height	**4.10**	m	
Area of each tank	37.28	m^2	wall thickness	**0.30**	m	

Diameter of circular tank	6.89	m	length	**6.2**	m	
Side of square tank	6.11	m	breadth	**6.2**	m	
Actual capacity provided-rectangular	138.38	m^2	OK			
Fix capacity	**138.38**	m^3	OK			
Actual volume of media obtained	55.35	m^3				
Actual carrier surface area	33211.20	m^2				
Volume of liquid in the tank	116.24	m^3			area in m^2	**59.29**
Hydraulic Retension Time at design average flow	1.59	hours	95.36	hours		
Hydraulic Retension Time at peak flow	0.71	hours	42.38	hours		
SARR	1.77	$g/m^2/day$				
Estimated NO_3-N removal rate	58.86	kg/day				
NO_3-N of effluent	3.17	mg/l				
Alkalinity produced by denitrification	**3.57**	g $CaCO_3$/g NO_3-N removed				
Actual alkalinity to be added	82.33	mg/l				
Rate of alkalinity addition needed as $CaCO_3$	144.51	kg/day				
Equiv wt. of $CaCO_3$	50.00	g/equivalent				
Equiv wt. of $NaHCO_3$	84.00	g/equivalent				
Daily $NaHCO_3$ requirement	242.78	kg/day $NaHCO_3$				
4.6 lb COD/lb NO_3-N removed and 1.5 lb COD/lb Methanol. The required methanol dosage is then calculated as: 4.6/1.5 = 3.1 lb methanol /lb NO_3-N removed. The methanol requirement in lb/day is then equal to 3.1 times the previously calculated NO_3-N removal rate						
Methanol requirement in kg/day	199.70	kg/day				
Considering toxicity, economy and safety considerations it is better to adopt retrun activated sludge feed into anoxic tank for carbon source. Alkaline fermentation can be adopted for better results.						
|Provide MBBR Tank 3 of capacity6.20 m x 6.20 m x 3.60 m SWD						
Moving Bed Bio-Reactor (MBBR) chamber after de-nitrification						
Average design flow	1755.28	m^3/day				
Number of streams	**1**					
BOD of incoming sewage	**87.71**	mg/l				
TSS of incoming sewage	**50**	mg/l				
BOD expected after treatment	**7**	mg/l				
BOD to be removed	80.71	mg/l				
BOD removal % expected	92.02					
Number of tanks proposed	**1**					
BOD loading rate/volume	**4**	kg/m^3/day	*4-7 kg/m^3/day as per M&E*			
Actual BOD loading rate	153.96	kg/day				

Quantity of BOD to be removed per day	141.67	kg/day				
Volume of reactor required	38.49	m^3				
Surface area loading rate (SALR) for BOD removal	**15.00**	$g/m^2/day$				
Required carrier surface area	10263.77	m^2				
Specific surface area of carrier	**500.00**	m^2/m^3				
Required carrier volume	20.53	m^3				
Volume of media required	**40%**					
	15.40	m^3	depth of base	**0.9**	m	
Volume of tank required-BOD loading rate/volume method	53.88	m^3	slab thickness	**0.35**	m	
Volume of tank required- SALR method	51.32	m^3	offset to wall	**0.45**	m	
Volume of each tank	53.88	m^3	total height	**4.10**	m	
SWD	**3.6**	m	wall thickness	**0.30**	m	
Area of each tank	14.97	m^2	length	**3.9**	m	
Side of square tank	3.87	m	breadth	**3.9**	m	
Actual capacity provided-rectangular	54.76	m^3	OK			
Fix capacity	**54.76**	m^3				
Actual volume of media obtained	21.90	m^3				
Actual carrier surface area	10952.00	m^2				
Volume of liquid in the tank	46.00	m^3				
Hydraulic Retension Time at design average flow	0.63	hours	37.7	minutes		
Hydraulic Retension Time at peak flow	0.28	hours	16.8	minutes		
SARR for the given SALR	13.13	$g/m^2/day$			area in m^2	**29.16**
Estimated BOD removal rate	143.75	kg/day				
Actual BOD removal rate %	93.37	BOD of effluent		5.82	mg/l	ok
|Provide MBBR Tank 4 of capacity 3.90 m x 3.90 m x 3.60 m SWD						
Blower air requirement						
BOD loading	615.83	kg/day				
NH_3-N loading rate	70.21	kg/day				
Oxygen uptake ratio-BOD	**1.50**	kg of O_2/kg of BOD				
Oxygen uptake ratio-NH_3-N	**4.57**	kg of O_2/kg of NH_3-N				
Oxygen required for BOD loading	923.74	kg/day				
Oxygen required for NH_3-N loading	320.87	kg/day				
Percentage of O_2 in air	**21.00**					

Weight of air required-BOD loading	4398.76	kg/day				
Weight of air required-NH_3-N loading	1527.93	kg/day				
Density of air	**1.225**	kg/m^3				
Volume of air-BOD loading	3590.82	m^3/day				
Volume of air-NH_3-N loading	1247.29	m^3/day				
Air transfer efficiency of diffuser	**0.075**					
Quantity of air required-BOD loading	47877.64	m^3/day				
Quantity of air required-NH_3-N loading	16630.53	m^3/day				
Factor of saftey	**1.20**					
Volume of air required-BOD loading	2393.88	m^3/hour				
Volume of air required-NH_3-N loading	831.53	m^3/hour				
Volume of equalisation tank	456.00	m^3				
Normal inflow	0.020	m^3/sec				
Air requirement for equalisation tank	**1.25**	m^3/m^3/hour				
Air requirement for sludge tank	**3.00**	m^3/m^3/hour				
Volume of ET	419.00	m^3				
Volume of air required for ET	523.75	m^3/hour				
Volume of air required for ST	10.45	m^3				
Total air required	3759.60	m^3/hour				
Capacity of blower	3760.00	m^3/hour				
Number of blowers working	**3.00**	SB	**1**			
Air required per blower	1253.33	m^3/hour				
Pressure given	**0.60**	kg/cm^2	5.89	m		
Volumetric efficiency	**50%**					
Power required for blower motor	55.03	HP	41.05	kw		
Fix power of blower motor	**56.00**	HP				
Energy	3007.87	kwh				
Alum solution tank						
number of units	**1**					
dosage of alum	**25**	ppm				
requirement for 8 hours	14.630	kg				
volume of solution at 10% strength/unit	0.13	m^3				
length of tank	**0.6**	m				
breadth of tank	**0.6**	m				
liquid depth	0.36	m				
total depth	**1**	m				

solution flow rate	0.0163	m^3/hour				
Provide Alum solution tank of capacity 0.60 m x 0.60 m x 1.00 m						
Lime solution tank						
number of units	**1**					
dosage of lime	**15**	ppm				
requirement for 8 hours	8.78	kg				
volume of solution at 10% strength/unit	0.08	m3				
length of tank	**0.6**	m				
breadth of tank	**0.6**	m				
liquid depth	0.22	m				
total depth	**1**	m				
solution flow rate	0.01000	m^3/hour				
Provide Lime solution tank of capacity 0.60 m x 0.60 m x 1.00 m						
Secondary Clarifier with Plate/Tube Settler						
Average output required from tube settler in MLD	1.755	73.14	m^3/hour	20.32	LPS	
Number of batteries	**1**					
Average design flow as input in MLD/unit	1.76	73.14	m^3/hour	20.32	LPS	
Width of plates in mm	**900**	space between plates		**20**	mm	23.10
Length of plates adopted in m	**0.75**					
Angle of inclination of tubes adopted in deg.	**60**	1.05	rad			
Relative length of settler (dimensionless) Lr = L/d	37.5		wall thickness	**0.3**	m	
Relative length is changed by L' = 0.058 x [Vo x d/v]			column size	**0.35**	m	
Where Vo is velocity of flow along tube settler			offset to wall	**0.6**	m	
v is kinematic viscosity of water			depth of raft	**0.75**	m	
Effective relative length of tube, L = Lr- [0.058 x Vo x d/v]			slab thickness	**0.35**	m	
Kinematic viscosity of water in m/day	0.087264		r-beam depth	**0.45**	m	
Effective relative length of tube/plate , L	37.5	(-)	0.013	Vo		
	31.85					
desirable value of relative length =	*around 20 but below 40*					
for one unit:			freeboard	**0.5**	m	
Vertical water height in chamber in m	**2.4**		t-beam width	**0.35**	m	
Height of chamber in hopper portion in m	**2.4**		t-beam depth	**0.45**	m	
Side of large square in m	**4.75**		r-beam width	**0.35**	m	
Side of small square in m	**2**		inlet pipe dia	**0.2**	m	

h_3 in m (height of the truncated cone)	1.75					
Angle of inclination of hopper side to vertical	0.520	29.82	degree	60.18	*deg. with hor.*	
Larger inclined length L_i of slanting slab in m	4.78	area in m^2	11.35			
Smaller inclined length l_i of slanting slab in m	2.01	area in m^2	2.01			
Contact area in m^2	37.34					
SOR in m^3/m^2/day for upflow clarifier	**47.01**	<	**50**			
Trial volume in m^3 of one unit	82.71	volume of hopper in m^3			28.56	
Detention time in hours	1.13	in square	0.74	in hopper	0.39	hours
Fix volume	**45.00**	m^3				
Performance parameter of tube settler S = Vs/Vo x [sinθ + L x cosθ]						
For laminar flow regime, critical performance parameter value for complete removal of particle,						
Critical value of performance parameter, Sc =	1.333	circular				
	1.375	square				
	1	parallel plates				
Particle size in mm	**0.025**					
Settling velocity of particle in m/sec, V_s (laminar)	0.0006	m/sec	48.08	m/d		
Reynolds number, Nr	0.014					
Trial value of flow along plate settler V_o in m/day	**424.78**					
Shape of cross section of tubes	**plates**	(square, circular, or plates)				
Critical of performance parameter obtained, Sc	[(Vs/Vo) x (sinθ+Lcosθ)					
	1.90					
Plate entrance area/one unit	3.96	m^2				
Number of modules of plates	**2**					
Number of plates required/module	110.00					
Fix number of plates required/module	**110**					
Length/module of tray holding plates	**2800**	mm				
Thickness of plate	**1.5**	mm				

Number of plates configured in one module	114.82	OK				
Height of plate module for 1m length of tubes inclined:	0.87					
Hence height of tube module	0.65	m				
Fix length of plate module	**0.75**	m				
Fix height of plate module	**0.65**	m				
Fix number of plates required per module	**110**					
Angle of inclination	60	degree to horizontal				
Contact area	148.5	m^2			area in m^2	**42.90**
SOR in m^3/m^2/day for plate settler	**11.33**	<	**40**			
Total plate entrance area	3.96	m^2				
Actual velocity of flow in m/day	424.78	***now correct velocity***				
Provide Secondary Clarifier with Plate/Tube Settler of 4.75 m x 4.75m x 4.80 m						
Sludge Sump						
Average flow	1755.28	m^3/day				
TSS	400	mg/l				
BOD	350.84	mg/l				
Assumed TSS Sludge	**30%**					
Assumed BOD Sludge	**35%**					
Sludge generated-TSS	210.6	kg/day				
Sludge generated-BOD	215.5	kg/day				
Total sludge	426.17	kg/day				
% sludge with 1.02 specific gravity	**10%**					
Sludge volume per day	41.78	m^3/day				
	1.74	m^3/hour				
Assumed HRT	**2**	hours	freeboard	**1.2**	m	
Volume of tank	3.48	m^3	slab thickness	**0.3**	m	
Assumed SWD	**1.5**	m	offset to wall	**0.3**	m	
Area of the tank	2.32	m^2	wall thickness	**0.25**	m	
Diameter of circular tank	1.72	m	fix	**1.75**	m	
Actual capacity provided	3.61	m^3			area in m^2	**2.85**
Provide Sludge sump of capacity 1.75 m dia x 1.50 SWD						
Pump for Sludge transfer to Thickner						
Number of pumps	**1.00**	W	**1**	SB		
Specific gravity of liquid	**1.03**					

Tipe of pump set	submersible centrifugal sewage transfer-non clog					
Working hours	**5.00**	hours				
Discharge required	8.36	m^3/hour	0.002321	m^3/sec		
Required head	**15.00**	m				
Velocity in sludge transfer pipe adopted	**0.70**	m/sec				
Pipe diameter required	64.98	mm	fix	**90**	mm	
Efficiency	**50%**					
Power required	0.93	HP	fix	**1.00**	HP	
Energy	3.46	kwh				
Sludge Thickener						
Number of units	**1**					
Total sludge	426.17	kg/day				
Solids Loading Rate	**40**	kg/m^2/day				
Thickening area required	10.65	m^2				
Surface Loading Rate	**12**	m^3/m^2/day				
Thickening area required	3.48	m^2	freeboard	**0.5**	m	
Maximum area	10.65	m^2	slab thickness	**0.35**	m	
Area of distribution chamber	**20%**		offset to wall	**0.35**	m	
Total area required	12.79	m^2	wall thickness	**0.3**	m	
Diameter of circular tank	4.03	m	fix	**4.1**	m	
Thickening area available	13.20	m^2				
SWD	**2**	m				
Actual volume provided	26.41	m^3				
Thickened sludge consistency	**3%**	of total sludge volume				
Thickened sludge volume	12.79	m^3/day			area in m^2	**5.40**
Provide Sludge thickener of 4.10 m dia x 2.00m SWD						
Pump for Sludge transfer to Centrifuge						
Type of pump set	Screw pump					
Number of pumps	1.00	W	1	SB		
Volume of thickened sludge to be pumped	12.79	m^3/day				
Working hours of centrifuge	**5.00**	hours				
Discharge required	2.56	m^3/hour	7.1E-04	m^3/sec		
Head required	**15.00**	m				
Efficiency	**50%**					

Power required	0.284	fix	**0.30**	HP		
Energy	1.060	kwh				
Sludge Centrifuge and Dosing Tanks						
Number of centrifuges	**1**	SB	**1**			
Capacity of centrifuge	**0.25**	m^3/hour				
Poly electrolyte dozing for centrifuge & thickener	**10%**					
Sludge volume	426.17	kg/day				
Dose	**2**	kg/1000 kg				
Quantity of Poly Electrolyte	0.85	kg/day				
Concentration	**0.1**					
Volume of tanks @ 24 hour	0.85	m^3				
	852.35	litres				
Volume	35.51	litres/hour				
Volume required for 8 hours	0.28	m^3				
Liquid depth of tank	**1**	m				
Area required	0.28	m^2				
side of square tank	0.53	m	fix	**0.6**	area in m^2	0.72
Provide Sludge Centrifuge and Dosing tank of 0.60m x 0.60 m x 1.00m (1+stand by)						
Chlorine contact tank						
HRT	**30**	minutes	offset to wall	**0.3**	m	
Average flow	73.14	m^3/hour	wall thickness	**0.25**	m	
Volume of tank	36.57	m^3	slab thickness	**0.3**	m	
Assumed liquid depth	**2**	m	freeboard	**0.5**	m	
Area of the tank	18.28	m^2			area in m^2	**29.16**
side of square tank	4.28	m	fix	**4.3**	m	
Provide Chlorine contact tank of 4.30 x 4.30 m x 2.00m (SWD)						
Filter feed tank						
HRT	**20**	minutes	offset to wall	**0.3**	m	
Average flow	73.14	m^3/hour	wall thickness	**0.25**	m	
Volume of tank	24.38	m^3	slab thickness	**0.3**	m	
Assumed liquid depth	**2**	m	freeboard	**0.5**	m	
Area of the tank	12.19	m^2				
side of square tank	3.49	m	fix length	**3.5**	m	
			fix breadth	**3.5**	m	
Volume provided	24.50	OK			area in m^2	**21.16**

Provide Cfilter feed tank of 3.50m x 3.50 m x 2.00 m (SWD)						
Pressure Sand Filter						
Average flow	1755.28	m^3/day				
Filter operating hours	**20**	hours				
Operating flow	87.76	m^3/hour				
Filter Loading Rate	12	m^3/m^2/hour				
Area of the filter required	7.31	m^2				
Number of filters	**2**					
Area of each filter	3.66	sqm				
Diameter of filter required	2.16	m	fix	**2.5**	m	
Height of the filter	**2.5**	m	offset to wall	**0.5**	m	
Operating pressure	**3.5**	Bar				
Filter media	Sand				area in m^2	**20.48**
Provide Pressure and Filter of 2.50 m dia x 2.50m height (2Nos)						
Activated Carbon Filter						
Average flow	1755.28	m^3/day				
Filter operating hours	**20**	hours				
Operating flow	87.76	m^3/hour				
Filter Loading Rate	10	m^3/m^2/hour				
Area of the filter required	8.78	m^2				
Number of filters	**2**					
Area of each filter	4.39	sqm				
Diameter of filter required	2.36	m	fix	**2.5**	m	
Height of the filter	**2.5**	m	offset to wall	**0.5**	m	
Operating pressure	**3.5**	Bar				
Filter media	Activated Carbon				area in m^2	**24.50**
Provide Activated Carbon Filter of 2.50 m dia x 2.50m height(2 Nos.)						
Pump for clarified water to PSF and ACF						
Type of pump set	CF					
Number of pumps	**1.00**	W	**1**	SB	**1**	
Discharge of clarified water required	73.14	m^3/hour				
Working hours of pumps	**20.00**	hours				
Discharge required	87.76	m^3/hour	2.4E-02	m^3/sec		
Head required	**35.00**	m				
Efficiency	**50%**					
Power required	22.75	fix	**23.00**	HP		
Energy	339.48	kwh				

Treated Water Tank						
HRT	**60**	minutes	offset to wall	**0.3**	m	
Average flow	73.14	m^3/hour	wall thickness	**0.25**	m	
Volume of the tank	73.1	m^3	slab thickness	**0.3**	m	
Assumed liquid depth	**2.5**	m	freeboard	**0.5**	m	
Area of the tank	29.25	m^2				
Number of tanks	**1**		fix length	**5.5**	m	
Area of one tank	29.25	m^2	fix breadth	**5.5**	m	
Side of square tank	5.41	m				
Volume provided	75.63	m^3	OK		area in m^2	**43.56**
Administrative bldg, lab, chemical store etc(30*25)	750.00					
Transformer yard (12*12)	144.00					
Total area of units	1693.21	m^2				
Movement space factor	**1.6**					
Total area rquired	2709.14	m^2	**0.67**	**Acre**		
Provide Treated Water Tank of capacity 5.50 m x 5.50 m x 2.50m SWD						

7.3 DESIGN OF COLLECTION WELLS

DESIGN OF COLLECTION WELL No.1				
Average inflow into well from network	**6.24**	LPS		
Peak inflow into well from network	**18.72**	LPS	PF	3.00
Average flow into well from other well	**0**	LPS		
Peak flow into well from other well	**0**	LPS		
Total average inflow into well from network+other well	6.24	LPS		
Total peak inflow into well from network+other well	18.72	LPS		
Peak hours	**4**			
Number of pumps operated in peak hours	**2**			
Rated outflow during peak hours/pump in parallel	6.24	LPS		
Total rated outflow in peak hours	12.48	LPS		
Inflow converted into storage during peak hours	6.24	LPS		
Volume of sewage to be stored	89.86	m^3		

in well				
Diameter of collection well-inner	**6.2**	m		
Depth of collection well for storage	**3**	m		
Volume of sewage actually stored in well	90.57	m^3	ok	
Wall thickness of collection well	**0.45**	m		
Base slab thickness	**0.45**	m		
Offset to base slab	**0.45**	m		
Outer dia of collection well	7.1	m		
Freeboard of collection well	0.5	m		
Distance of travel in pumping to next station	**50**	m		
Velocity of travel adopted	**0.7**	m/sec		
Diameter of pumping line required	150.67	mm	fix OD	**225**
		pressure rating		**PN 10**
Total head for the pump set	**37**	m		
Discharge for the pump set	12.48	LPS	efficiency	**0.5**
Power required for pump set/number	12.31	HP	fix HP	**15**
DESIGN OF COLLECTION WELL No.2				
Average inflow into well from network	**2.27**	LPS		
Peak inflow into well from network	**6.81**	LPS	PF	3.00
Average flow into well from other well	**0**	LPS		
Peak flow into well from other well	**0**	LPS		
Total average inflow into well from network+other well	2.27	LPS		
Total peak inflow into well from network+other well	6.81	LPS		
Peak hours	**4**			
Number of pumps operated in peak hours	**2**			
Rated outflow during peak hours/pump in parallel	2.27	LPS		
Total rated outflow in peak hours	4.54	LPS		
Inflow converted into storage during peak hours	2.27	LPS		
Volume of sewage to be stored in well	32.69	m^3		
Diameter of collection well-	**4.6**	m		

inner				
Depth of collection well for storage	**2**	m		
Volume of sewage actually stored in well	33.24	m^3	ok	
Wall thickness of collection well	**0.45**	m		
Base slab thickness	**0.45**	m		
Offset to base slab	**0.45**	m		
Outer dia of collection well	5.5	m		
Freeboard of collection well	0.5	m		
Distance of travel in pumping to next station	**900**	m		
Velocity of travel adopted	**0.7**	m/sec		
Diameter of pumping line required	90.87	mm	fix OD	**140**
		pressure rating		**PN 10**
Total head for the pump set	**32**	m		
Discharge for the pump set	4.54	LPS	efficiency	**0.5**
Power required for pump set/number	3.87	HP	fix HP	**5**
DESIGN OF COLLECTION WELL No.3				
Average inflow into well from network	**2.37**	LPS		
Peak inflow into well from network	**7.11**	LPS	PF	3.00
Average flow into well from other well	**0**	LPS		
Peak flow into well from other well	**0**	LPS		
Total average inflow into well from network+other well	2.37	LPS		
Total peak inflow into well from network+other well	7.11	LPS		
Peak hours	**4**			
Number of pumps operated in peak hours	**2**			
Rated outflow during peak hours/pump in parallel	2.37	LPS		
Total rated outflow in peak hours	4.74	LPS		
Inflow converted into storage during peak hours	2.37	LPS		
Volume of sewage to be stored in well	34.13	m^3		
Diameter of collection well-inner	**4.6**	m		

Depth of collection well for storage	**2.2**	m		
Volume of sewage actually stored in well	36.56	m^3	ok	
Wall thickness of collection well	**0.45**	m		
Base slab thickness	**0.45**	m		
Offset to base slab	**0.45**	m		
Outer dia of collection well	5.5	m		
Freeboard of collection well	0.5	m		
Distance of travel in pumping to next station	**900**	m		
Velocity of travel adopted	**0.7**	m/sec		
Diameter of pumping line required	92.85	mm	fix OD	**140**
		pressure rating		**PN 10**
Total head for the pump set	**21.5**	m		
Discharge for the pump set	4.74	LPS	efficiency	**0.5**
Power required for pump set/number	2.72	HP	fix HP	**5**
DESIGN OF COLLECTION WELL No.4				
Average inflow into well from network	**2.58**	LPS		
Peak inflow into well from network	**7.74**	LPS	PF	3.00
Average flow into well from other well	**0**	LPS		
Peak flow into well from other well	**0**	LPS		
Total average inflow into well from network+other well	2.58	LPS		
Total peak inflow into well from network+other well	7.74	LPS		
Peak hours	**4**			
Number of pumps operated in peak hours	**2**			
Rated outflow during peak hours/pump in parallel	2.58	LPS		
Total rated outflow in peak hours	5.16	LPS		
Inflow converted into storage during peak hours	2.58	LPS		
Volume of sewage to be stored in well	37.15	m^3		
Diameter of collection well-inner	**6**	m		
Depth of collection well for storage	**1.4**	m		

Volume of sewage actually stored in well	39.58	m^3	ok	
Wall thickness of collection well	**0.45**	m		
Base slab thickness	**0.45**	m		
Offset to base slab	**0.45**	m		
Outer dia of collection well	6.9	m		
Freeboard of collection well	0.5	m		
Distance of travel in pumping to next station	**900**	m		
Velocity of travel adopted	**0.7**	m/sec		
Diameter of pumping line required	96.88	mm	fix OD	**160**
		pressure rating		**PN 10**
Total head for the pump set	**21**	m		
Discharge for the pump set	5.18	LPS	efficiency	**0.5**
Power required for pump set/number	2.90	HP	fix HP	**5**
DESIGN OF COLLECTION WELL No.5				
Average inflow into well from network	**3.22**	LPS		
Peak inflow into well from network	**9.66**	LPS	PF	3.00
Average flow into well from other well	**0**	LPS		
Peak flow into well from other well	**0**	LPS		
Total average inflow into well from network+other well	3.22	LPS		
Total peak inflow into well from network+other well	9.66	LPS		
Peak hours	**4**			
Number of pumps operated in peak hours	**2**			
Rated outflow during peak hours/pump in parallel	3.22	LPS		
Total rated outflow in peak hours	6.44	LPS		
Inflow converted into storage during peak hours	3.22	LPS		
Volume of sewage to be stored in well	46.37	m^3		
Diameter of collection well-inner	**7**	m		
Depth of collection well for storage	**1.25**	m		
Volume of sewage actually stored in well	48.11	m^3	ok	

Wall thickness of collection well	**0.45**	m		
Base slab thickness	**0.45**	m		
Offset to base slab	**0.45**	m		
Outer dia of collection well	7.9	m		
Freeboard of collection well	0.5	m		
Distance of travel in pumping to next station	**900**	m		
Velocity of travel adopted	**0.7**	m/sec		
Diameter of pumping line required	108.23	mm	fix OD	**180**
		pressure rating		**PN 10**
Total head for the pump set	**70**	m		
Discharge for the pump set	6.44	LPS	efficiency	**0.5**
Power required for pump set/number	12.02	HP	fix HP	**15**

7.4 PRELIMINARY STRUCTURAL DESIGN OF COMPONENTS

For the various units of the STP, structural analysis and design have been performed in accordance with the stipulations of all relevant Indian Standard Codes of practice. For the reinforced concrete elements, special attention has been given to arrive at the preliminary dimensions to satisfy norms and conditions for the water retaining structures. For the metallic structures like pressure filter units, similar approach has been adopted. Since the units are constantly in contact with aggressive environment like sewage, non-corrosive coating for reinforcing steel and water proofing application for the inner side of reinforced concrete structures are recommended. These provisions are already given in the detailed estimates. During the execution stage, a detailed structural analysis of the components can be performed. However, the dimensions are expected to fall within the limits of the values obtained from the preliminary analysis. In the case of foundations, simple raft and beam-slab type raft is adopted for safety considerations. Since the soil nature is observed to be satisfactory to withstand medium loading conditions, deep foundations are not suggested. Soil analysis reports available for the locality have been examined to arrive at a decision. However, during the execution stage, detailed soil investigations can be performed. Cover for the reinforced concrete elements are to be given in accordance with the exposure conditions given in the IS 456 Code of practice. Even though, most of the components are designed as reinforced concrete, innovative materials with high strength to weight ratio like Fibre Reinforce Polymers (FRPs) can also be tried after performing detailed structural analysis. Manholes and pipelines are to be checked for external traffic loads pertaining to the characteristics of each road and soil conditions. Since the accurate data of this will be obtained during the execution stage of the project, the detailed structural analysis of the

pipelines and manholes will be required to be performed later and the changes are to be incorporated accordingly. The detailed structural design has to be carried out after conducting soil investigation test.

SIZING OF STP UNITS						
Sl No	Components	L	B	H	No of units	Type of construction
1	Receiving Chamber STP	3	1.6	1.7	1	RCC
2	Receiving Chamber CTU	0.5	0.45	1.35	1	RCC
3	Oil and Grease trap STP	4.5	2.1	2.25	1	RCC
4	Oil and Grease trap CTU	1.5	0.9	1.5	1	RCC
5	Manual Coarse Screen Channel STP	5.2	0.75	1.7	2	RCC
6	Manual Coarse Screen Channel CTU	2	0.45	0.9	1	RCC
7	Manual Fine Screen Channel STP	6.75	0.75	1.5	2	RCC
8	Dilution tank for CTU	5	4	3	1	RCC
9	Collection tank for CTU	2.5	2.5	2.5	1	RCC
10	Grit Separator	2.5	2.5	2	1	RCC
11	Primary Clarifier	Dia	10.6	2.9	1	RCC
12	Equalization Tank	11.3	11.3	4.1	1	RCC
13	Moving Bed Bio Reactor 1	8.5	8.5	4.1	1	RCC
14	Moving Bed Bio Reactor 2	9.7	9.7	4.1	1	RCC
15	Moving Bed Bio Reactor 3	6.2	6.2	4.1	1	RCC
16	Moving Bed Bio Reactor 4	3.9	3.9	4.1	1	RCC
17	Secondary Clarifier with Plate Settler	4.75	4.75	5.3	1	RCC
18	Filter Feed Tank	3.5	3.5	2.5	1	RCC
19	Sludge Sump	Dia	1.75	2	1	RCC
20	Sludge Thickener	Dia	4.1	2.5	1	RCC
21	Chlorine Contact Tank	4.3	4.3	2.5	1	RCC
22	Treated Water Tank	5.5	5.5	3	1	RCC
23	Alum Solution Tank	0.6	0.6	1	2	FRP/HDPE
24	Lime Solution Tank	0.6	0.6	1	2	FRP/HDPE
25	Hypo Dosing Tank	0.6	0.6	1	2	FRP/HDPE
26	Administrative Building,Office cum laboratory, etc.	1000		sqm		RCC

	ELECTRO-MECHANICAL UNITS					
1	Sewage Transfer pump to MBBR	9	HP		2	Submersible Centrifugal
2	Manual Coarse Screen- STP	20	mm	Opening	1	SS 304
3	Manual Coarse Screen- CTU	20	mm	Opening	1	SS 304
4	Manual Fine Screen- STP	6	mm	Opening	1	SS 304
5	Air Grid and Diffused aeration system for ET, MBBR Tanks and Sludge Tank			As per Design		PVC
6	MBBR Carrier			As per Design		PVC/HDPE
7	Air Blowers	1253.3	m3/hour		3+1 SB	
8	Plate Settlers			As per Design		SS
9	Sludge transfer pump to thickener	1	HP		2	Submersible Centrifugal
10	Sludge transfer pump to centrifuge	0.3	HP		2	Screw type pump
11	Sludge Centrifuge	0.25	m3/hour		2	
12	Pump for clarified water to PSF and ACF	23	HP		2	Submersible Centrifugal
13	Pressure Sand Filter (Dual media)	Dia	2.5	m	2	MS with all specials
14	Activated Carbon Filter	Dia	2.5	m	2	MS with all specials
15	Jetting/Cleaning machine				1	High Pressure pump
16	Generator				1	Diesel type automatic switch over
17	Chlorinator					Electro type of similar
18	Iot based sensors					Discharge,BOD,Do ,TSS,pH sensors

Table 7.1: Size of STP units

CHAPTER - 8

PROJECT ESTIMATED COST

8.1 LAND DEVELOPMENT

The land required for construction of sewerage treatment plant is 100cents and the site proposed is Housing board plot with Sy.No.39/6-9 near Bypass road (Block-58). Municipal council resolution in this regard is obtained and is enclosed as Annexure 5. Total land required for the Collection wells are 30 cents (approximately six cents for each well) and the proposed lands are private lands intended to be acquired and handed over by Municipality .In which, the land location of well no.3 is within the proposed site of STP.

8.2 PHYSICAL INFRASTRUCTURE

8.2.1 SEWERAGE NETWORK SYSTEM

The total length of sewer network is 27406m in which 27000m of 225mm HDPE PE100 PN8 pipe and 406m of 285mm HDPE PE100 PN8 pipe are proposed in the project. The network includes 750 Nos. manholes of 900mm diameter, 79Nos. 1200mm diameter and 271 Nos. 1500mm diameter for a depth varying from 1.5 m to 6m.

Total length of Pumping main is 5481m of HDPE PE100 PN-10 pipes from 5 nos of wells to STP and 720 m of HDPE PE100 PN-10 pipes for lifting stations.

The total cost of this network system and pumping main comes to Rs.4537.72 lakhs as per DSR 2018 rates including GST. Detailed break up of estimate is appended.

8.2.2 COLLECTION WELL CUM PUMP HOUSES

There are 5 Nos. of collection wells and out of which I No. is to be constructed in the premises of proposed STP land in Housing board plot. The diameter of 5 wells are 6.2m, 4.6m (2nos.),6m and 7m and corresponding depths are 6.65m, 5.15m,5.75m,6.76m & 9.53m respectively. The total cost is Rs.103.93 lakhs. Detailed estimate attached.

8.2.3 ROAD RESTORATION CHARGES

The cost is estimated based on the standard rate for road restoration charges to be remitted to various departments. The total cost is estimated as Rs. 1731.87 lakhs.

8.2.4 SEWERAGE TREATMENT PLANT UNITS

The total cost for the sewerage treatment plant units with co- treatment units comes to Rs.365.05 Lakhs and detailed estimate is attached.

8.2.5 MECHANICAL ITEMS

The total cost for Mechanical Items comes to Rs.266.56 Lakhs including screens, pump sets, Aeration system, PSF, ACF, MBBR carrier etc. Detailed estimate attached.

8.2.6 ELECTRICAL & INSTRUMENTATION ITEMS

The total cost for Electrical and Instrumentation items comes to Rs.72.70 Lakhs including Generator; IoT based sensor and control units, provision for solar units etc.

8.3 TOTAL ESTIMATED COST

The total Estimated Cost comes to **Rs.101.161 Crores** including 10%, 2.5% and 18% for Centage, DPR preparation charge and GST respectively. A provision for O&M for 10 years to an amount of Rs.12.339 Crores has also been incorporated in the DPR.

ABSTRACT OF ESTIMATED COST		
Sl. No.	**ITEM**	**AMOUNT (INR)**
	CIVIL ITEMS	
1	Site Preparation-LS	₹ 4,500
2	OG Trap, Receiving Chamber, Screen, Grit Chamber	₹ 2,420,996
3	Equalisation Tank	₹ 5,816,692
4	Dilution tank for co treatment	₹ 1,274,343
5	Collection Tank for Co treatment -rectangular	₹ 554,758
6	Primary Clarifier	₹ 3,681,527
7	MBBR Tank-1	₹ 6,277,552
8	MBBR Tank-2	₹ 4,769,863
9	MBBR Tank-3	₹ 2,680,891
10	MBBR Tank-4	₹ 1,511,121
11	Clarifier with Tube/Plate Settler	₹ 1,745,782
12	Sludge Sump and Thickener	₹ 2,643,054
13	Chlorine Contact Tank and Treated Water Tank	₹ 2,255,778
14	Filter feed tank	₹ 868,490
15	Buffer zone with vegetation ,Green Belt and Landscaping	₹ 1,155,000
16	Facility for Recycling Purposes	₹ 150,000
17	Construction of administation cum laboratary building including Compound wall	₹ 17,500,000
18	Pump house building above wells & compound wall for well site	₹ 6,900,000
19	Equipment, Laboratory items, Furniture and Computer	₹ 133,929
20	Sewer network with pipelines, chambers and wells	₹ 464,165,336
	TOTAL OF CIVIL ITEMS	**₹ 526,509,610**
	MECHANICAL ITEMS	
1	Bar Screens	₹ 1,000,000
2	Pump sets and Aeration system	₹ 9,719,140
3	PSF & ACF	₹ 6,222,220
4	Centrifuge	₹ 400,000
5	Bypass arrangements, steel ladder and frame work	₹ 350,000

6	Piping and Valves	₹ 200,893
7	MBBR Carrier and other items	₹ 7,778,179
8	Tube settler media	₹ 66,964
9	Alum and Lime dosing systems	₹ 110,000
10	Odor control unit	₹ 60,000
11	Mechanical arrangement for oil & grease trap, clarifier	₹ 525,000
12	Electromagnetic flow meter	₹ 223,214
	TOTAL OF MECHANICAL ITEMS	**₹ 26,655,610**
ELECTRICAL ITEMS		
1	Diesel Generator	₹ 840,000
2	Electrical works, IoT based sensor and control units, transformer unit	₹ 4,600,000
3	Solar units	₹ 1,830,000
	TOTAL OF ELECTRICAL ITEMS	**₹ 7,270,000**
ABSTRACT OF COST		
Sl. No.	**ITEM**	**AMOUNT**
1	Civil Works	₹ 526,509,610
2	Mechanical Works	₹ 26,655,610
3	Electrical Works	₹ 7,270,000
4	Road restoration charges	₹ 173,186,813
5	Household Sewer connection charges @ 16500	₹ 33,000,000
	GST Component (18%)	₹ 137,991,966
	DPR preparation charge @ 2.5%	₹ 19,165,551
	Centage charges@10%	₹ 76,662,203
	Unforeseen	₹ 11,168,248
	GRAND TOTAL	**₹ 1,011,610,000**
	Total O&M cost for10 years	**₹ 123,390,000**
	TOTAL COST including 10 years O&M	**₹ 1,135,000,000**
	Rupees One hundred and thirteen crores fifty lakhs only	

8.4 CHARGES FOR SEWERAGE HOUSEHOLD CONNECTIONS

The sewerage connections to the household are to be provided in parallel with the construction of STP for the timely commissioning of the plant and an amount of Rs.16500/household has been incorporated in the total estimated cost which comes to Rs.3.30 Crores. In addition to this the concerned ULB shall to bring the septage load to the proposed plant for its full functioning.

CHAPTER 9

OPERATION AND MAINTENANCE

9.1 GENERAL

For the success of a sewerage treatment system, it is inherent to note that meticulous operation and maintenance planning is the key. In the following sections various aspects of effective operation and maintenance, cost analysis, application of modern technologies for monitoring and process control and maintenance of an eco-friendly system are illustrated. In engineering parlance, the term operation refers to the daily operation of the components of a sewerage system such as collection system, sewage pumping stations (SPS), pumping mains, sewage treatment plants (STP), machinery and equipment, etc., in an effective manner by various technical personnel, and is a routine function. The term maintenance refers to the art of keeping the structures, plants, machinery and equipment and other facilities in optimum working order and includes preventive maintenance or corrective maintenance of mechanical adjustments, repairs, and planned maintenance. However, replacements, correction of defects etc., are considered as actions excluded from preventive maintenance.

9.2 PLANNING FOR EFFECTIVE OPERATION AND MAINTENANCE

Three categories of variability that can affect the design, performance and reliability of a wastewater treatment plant are

a] variability of the influent wastewater flow rate and characteristics,

b] inherent variability in wastewater treatment processes and

c] variability caused by mechanical breakdown, design deficiencies and operational failures.

It may be noted that effective use of the equalization facility will balance most of the issues related with the variability of the influent flow rate and abnormal BOD levels at certain points of time. Many of the treatment units exhibit variability in performance despite the efficient planning and design. However, these problems can be eliminated at the design stage itself by adopting some conservative values. At the operational stage, some of the design deficiencies can be addressed by few additions in the system which will not affect the total operational cost. Occurrence of mechanical and electrical breakdown can be addressed by careful planning of maintenance activities. There is a provision for diesel generator back up and solar energy sources also can be relied upon. It is recommended to form an internal monitoring committee for periodical inspection and control of activities related to the function, efficiency and operation of the STP. Operation and maintenance for 10 years is to be performed by the firm who carries out the construction and commissioning of the STP.

9.3 TYPE OF MAINTENANCE

There are three types of maintenance of a sewerage system – preventive, routine and emergency. Preventive or routine maintenance should be carried out to prevent any breakdown of the system and to avoid emergency operations to deal with clogged sewer lines or overflowing manholes or backing up of sewage into a house or structural failure of the system. Preventive maintenance is more economical and provides for reliability in operations of the sewer facilities. Emergency repairs, which would be very rare if proper maintenance is carried out well, also, must be provided for. Proper inspection and preventive maintenance are necessary.

9.4 INSPECTION AND EXAMINATION OF SEWER

Sewer collection systems are intended to be a reliable method of conveying sewage from individual discharge to sewage treatment plants. Inspection and examination are the techniques used to gather information to develop operation and maintenance programmes to ensure that new and existing collection systems serve their intended purposes on a continuing basis. Inspection and testing are necessary to do the following:

• Identify existing or potential problem areas in the collection system,

• Evaluate the seriousness of detected problems,

• Locate the position of problems, and

• Provide clear, concise, and meaningful reports to supervisors regarding problems.

Two major purposes of inspection and examination are to prevent leaks from developing in the sewers and to identify existing leaks so they can be corrected. Due to age, deterioration of the material of the sewer by attack of hydrogen sulphide or other chemicals, settlement of foundations and leaking joints may result in the structural failure of the sewer. It takes a very long time from the onset of the first initial defect to the collapse of the sewer. A crack or a leaking joint will allow subsoil water and soil mixture to enter the sewer causing cavities around it leading to slow settlement of foundation and the eventual collapse of the sewer. Very often soil with water is carried away below the bedding along the length of the sewer. The type of failures often gives a clue to the cause. A shear failure due to faulty foundation or movement of earth is a clean vertical break in the pipe or barrel. Excessive loading, either internally or externally, causes horizontal breaks. Breaks caused by internal pressure leads to cracks in the sewer while external overload causes the top of the pipe to be crushed. Regular inspection of the sewer can pinpoint the sewer that needs to be attended to before there is a complete failure or collapse. For preventing the above serious instances of damages to the sewer system, the maintenance engineer should establish adequate inspection and examination programmes.

9.5 SEWER CLEANING

To operate and maintain a sewer collection system to function as intended, the maintenance engineer should try to strive towards the following objectives:

• Minimize the number of blockages per unit length of sewer, and

• Minimize the number of odour complaints.

For this purpose, sewer-cleaning using hydraulic or mechanical cleaning methods needs to be done on a scheduled basis to remove accumulated debris in the pipe such as sand, silt, grease, roots and rocks. If debris is allowed to accumulate, it reduces the capacity of the pipe and blockage can eventually occur resulting in overflows from the system onto streets, yards and into surface waters. Roots and corrosion also can cause physical damage to sewers.

9.6 PROTECTION OF SEWER SYSTEMS

A sewer may get damaged if other facilities such as water pipe or electric cable work are done beside or at the cross-section of a sewer. Especially, fluctuations due to ground excavation may have a serious impact. To avoid damages of sewer, the maintenance engineer should do the following:

1. Collect all related information about the construction activities which are planned around the sewer location,

2. Advise appropriate construction methods to minimize impact for sewer, and

3. If necessary, request the concerned agencies to adopt the protective measures for sewer prior to the work commencement.

9.7 INSPECTION OF MANHOLES AND APPURTENANCES

Because they are part of the collection system, manholes require the same inspection and attention as the rest of sewer network. When located in streets, these structures are subject to vibrations and pounding by vehicle traffic. Manholes may settle at a different rate than connected sewer, creating cracks in sewer pipe joints. The objectives of manhole inspection are therefore, to determine the proper elevations or grades around the lid, to confirm that the lid is not buried, and to examine structural integrity (look for cracks) of the manhole and its functional capacity. The condition of the pipelines coming into a manhole may be known merely by observing the content and volume of flows from a specific direction. Manhole inspection and examination are made by visually inspecting the condition of the cover and the internal parts. Manhole inspection should be carried out together with the inspection and examination of sewer. It is generally carried out together with the cleaning of the sewer. Before entering any manhole, adequate safety measures should be taken in accordance with stipulations. Safety measures during the work should

be formulated considering traffic safety, oxygen deficiency, poisoning due to toxic gas such as hydrogen sulphide and so on.

9.8 CLEANING OF MANHOLES

Manhole cleaning should be performed by the most appropriate work method that suits the actual conditions of the work location. In manholes at starting point, junction manholes and manholes at sharp curve of sewers, sand and silt get deposited and environmental problems such as foul odours occur. For this reason, periodic cleaning is necessary. Moreover, when large debris flows in, it should be removed immediately otherwise there is a possibility of an overflow accident, float-off and dispersion of cover. Manhole inspection should be generally carried out together with the cleaning of the sewer. The work on the silt and sand in the bottom part should be pursuant to cleaning of the sewer pipe, while the dirt on the sidewall should be cleaned by high-pressure jet washing vehicle.

9.9 SAFTEY PRACTICES

Sewer cleaning is an occupation that has an overall accident frequency rate that is relatively higher than any other industry. The employer has the responsibility of providing the worker with a safe place to work. Nevertheless, the worker has the overall responsibility and must ensure that it is a safe place to work. This can only be done by constantly thinking of safety and working safely. The worker has the responsibility of protecting not only himself, but also all other plant personnel or visitors by establishing safety procedures for the plant and then ensuring they are followed. He must train himself to analyse jobs, work areas and procedures from a safety standpoint and learn to recognize potentiality hazardous actions or conditions. When he recognizes a hazard, he must take immediate steps to eliminate it through corrective action. If correction is not possible, guard against the hazard by proper use of warning signs and devices / by establishing and maintaining safety procedures. As an individual, the supervisor can be held liable for injuries or property damage, which results from an accident caused by his negligence.

9.10 OPERATION AND MAINTENANCE OF LIFT STATIONS

In general, lift stations are invariably used in gravity sewer network where depth of cut of sewers poses a problem in high water prone areas. The procedure is to sink a wet well on the road shoulder or an acquired plot after the shoulder and divert the deeper sewer there. The submersible pump will lift the sewage and discharge it to the next online shallow sewer. This is a very useful practice in such locations. Equipment located in the wet well should be minimized, including suction and discharge valves, check valves, or other equipment that require routine, periodic maintenance.

9.11 OPERATION AND MAINTENANCE OF PUMPING STATIONS

Pumping machinery is subjected to wear & tear, erosion and corrosion due to its nature of functioning, and therefore it is vulnerable to failures. Generally, failures or interruptions are mostly attributed to pumping machinery rather than any other component. Therefore, correct operation and timely maintenance and upkeep of pumping stations and pumping machinery are of vital importance. Sudden failures can be avoided by timely inspection, follow up actions on observations of inspection and planned periodical maintenance. Downtime can be reduced by maintaining inventory of fast moving spare parts. Obviously due attention needs to be paid to all such aspects for efficient and reliable functioning of pumping machinery.

9.11.1 OPERATION OF PUMPS

The following points should be observed while operating the pumps.

A. Dry running of the pumps should be avoided.

B. Centrifugal pumps if installed with negative suction should be primed before starting.

C. Pumps should be operated only within the recommended range of the head-discharge characteristics of the pump.

- If pump is operated at a point away from duty point, the pump efficiency normally reduces.
- Operation near the shut-off point should be avoided, as it causes substantial recirculation within the pump, resulting in overheating of sewage in the casing and consequently, overheating of the pump.

D. As far as possible positive suction is to be provided to avoid priming during design itself.

E. Voltage during operation of the pump-motor set should be within ±10 % of the rated voltage. Similarly, current should be below the rated current shown on the name plate of the motor.

F. When parallel pumps are to be operated, the pumps should be started and stopped with a time lag between two pumps to restrict change of flow velocity to minimum and to restrict the dip in voltage in the incoming feeder and should be adequate to allow the pump head to stabilise.

G. When the pumps are to be operated in series, they should be started and stopped sequentially, but with minimum time lag. Any pump next in sequence should be started immediately after the delivery valve of the previous pump is even partly opened. Due care should be taken to keep open the air vent of the pump next in sequence, before starting that pump.

H. The stuffing box should allow a drip of leakage to ensure that no air passes into the pump and that the packing gets adequate wetness for cooling and lubrication. When the stuffing box is sealed with grease, adequate refill of the grease should be maintained.

I. The running of duty pumps and standby pumps should be scheduled so that no pump remains idle for a long period and all pumps are in ready-to-run condition. Similarly, the running schedules should be ensured so that all pumps do not wear equally needing simultaneous overhaul.

J. If any undue vibration or noise is noticed, the pump should be stopped immediately and the cause for vibration or noise should be checked and rectified.

K. Generally, the number of starts per hour shall not exceed four. Frequent starting and stopping should be avoided as each start causes overloading of motor, starter, contactor and contacts. Although overloading lasts only for a few seconds, it reduces the life of the equipment.

9.12 SMART MANAGEMENT AND ONLINE MONITORING USING INTERNET OF THINGS (IoT)

Advancement in the field of digital technology has enabled the wastewater treatment system operators and managers to control and enhance the performance of various components of the system. Internet of things (IoT) consists of a network of physical objects using various sensors as end points to enable monitoring from a remote station. For the sewerage treatment plant, a network of various sensors can capture the variations of values of parameters like temperature, dissolved oxygen, chemical composition, TDS etc. at different control points of the system. The continuous data obtained through IoT is used by a customised algorithm for synthesis to impart a decision-making procedure. A centralised information processing system (CIPS) can be formed for this task. In addition to this smart water flow meters can also be coupled to this digital environment. IoT in wastewater management can also be used to calculate residual chemicals after the treatment. This data can be further used to calculate the efficiency of the treatment process and ensure that water quality standards are met before it is discharged in a water body. By using real-time data gathered through different embedded sensors, performance characteristics of machines can be monitored that further increase the productivity of equipment and boost maintenance tasks.

9.13 ODOUR CONTROL METHODS

Odours are a complex combination of a wide variety of compounds; however, there are certain compounds and groups of compounds that contribute specifically to sewage odours, and significantly determine the selection of the control technology. These include the following:

• Hydrogen sulphide, and

• Ammonia.

Odour control is a complex and time-consuming challenge, often requiring a combination of methods for treating odorous gases and for removing or reducing the potential causes of the odours. If an odour problem is severe enough to affect the community, an emergency response and solution to the problem must be carried out quickly. The approach for selecting an odour control method or technology includes the following steps:

A. Identify the odour source and characteristics through sampling and analysis.

B. List and assign priorities to controlling a specific odour problem, recognizing considerations such as cost, plant location, future upgrading of various sewage processes, severity of the odour problem, and the nature of the affected area.

C. Select one or more odour control method or technology for implementation to meet the objectives of steps “a” and “b”, taking into consideration the advantages and disadvantages of each.

D. Monitor odour emissions from the treated air for process adjustments and for feedback to evaluate the solution’s effectiveness. Hydrogen sulphide (H2 S) is the most common odorous gas found in sewage collection and treatment systems and results from the reduction of sulphate by bacteria under anaerobic conditions. Its characteristic rotten-egg odour is well known. The gas is corrosive, toxic and soluble in sewage. Hydrogen sulphide is considered a broad-spectrum poison, meaning it can poison several different systems in the body.

9.13.1 PREVENTION OF ODOUR

Hydrogen sulphide production can be controlled by maintaining conditions that prevent the build-up of sulphides in the sewage. The presence of oxygen at concentrations of more than 1.0 mg/L in the sewage prevents sulphide build-up because sulphide produced by anaerobic bacteria is aerobically oxidized. Maintaining an aerobic environment inhibits the anaerobic degradation process, which contributes to the generation of hydrogen sulphide. A checklist is given below:

• Prevent corrosion in the collection well of the facility by blowing air through the facility

• Avoid storing screenings and grit generated in the grit chamber for a long time. Dispose of screenings and grit at appropriate intervals

• Retention time of sludge in the sludge treatment facilities should be appropriate (Do not retain sludge for a long time)

• Maintain sewage at neutral pH range because most of the sulphide is present at a pH value of less than 7. Following is a short checklist of operational considerations for controlling odours of primary treatment facilities: (May also apply in other facilities)

• Remove scum routinely, with increased frequency during warm weather.

• Remove sludge before it can bubble or float.

• Wash weirs and other points where floatable and slime collect. Some facilities use submerged pipes with holes rather than effluent troughs. The submerged pipes do not splash the primary effluent, thereby reducing the release of hydrogen sulphide.

• Wash down all spills and grease coatings.

• When draining a tank, immediately flush it completely. If sludge does not drain quickly, spray lime, calcium hypochlorite, or potassium permanganate on the sludge surface to reduce odours. Because even a clean tank can produce odours, flushing the tank with a chlorine solution or keeping the tank floor covered with a low concentration of chlorine solution will reduce odours.

• If the sewage is septic, add chemicals in the collection system or at the plant, as appropriate, to reduce sulphides. • If tanks are covered for odour control, keep plates and access hatches in place.

• Routinely check any odour scrubbers or deodorizers for plugging, adequate supply of chemicals, proper pressures for demisting, and/or effectiveness of carbon.

• The splashing of primary sewage into weir troughs and effluent channels can result in the release of hydrogen sulphide. If possible, try to minimize the splashing of primary sewage into the channel or weirs. If it cannot be accomplished operationally, then installing submerged sewer pipes may be necessary. This will require tank modifications to verify the plant hydraulics and provide proper control to avoid fluctuations in the tank levels.

• Minimize the stripping of hydrogen sulphide from the sewage when using channel air diffuser systems. Adoption of the following regular practices will not only increase removal efficiency but will provide better working conditions for the operator:

• Regularly remove accumulations from the inlet baffles and outlet weirs with a hose or a broom with stiff bristles. Only experience will determine the necessary frequency.

• Clean scum removal equipment regularly; otherwise, obnoxious odours and an unsightly appearance will result.

• Keep cover plates in place except when operations or maintenance require their removal. • Immediately flush and remove all sewage and sludge spills. Avoid hosing down motors and enclosed control devices.
• Establish a housekeeping schedule for the primary treatment area, including galleries, stairwells, control rooms, and related buildings, and assign responsibility for each item to a specific employee. • Repaint surfaces as necessary for surface protection and appearance.

9.13.2 CONTROL OF ODOUR BY CHEMICAL ADDITION

Chemical addition can control odours in STP by preventing anaerobic conditions or controlling the release of odorous substances.

Chemical	Effective against
Ozone Oxidisers	Atmospheric hydrogen sulphide only
Hydrogen peroxide	Hydrogen sulphide also act as oxygen sourse
Chlorine	Hydrogen sulphide and other reduced sulphur compounds
Sodium and Calcium hypochlorite	Hydrogen sulphide and other reduced sulphur compounds
Potassium permanganate	Hydrogen sulphide and other reduced sulphur compounds

Table 9.1 Control of odour by chemical addition

9.14 MAINTAINING AN ECO-FRIENDLY SYSTEM

The treated water contains plant nutrients also, it will be beneficial for the environment when discharged as soil infiltration. Care has also been taken to properly treat the sludge produced during the operation. It may also be noted that a septic tank complying with the Indian Standard Code of practice has been designed and given at the initial treatment stage to reduce any shock of load to the biological treatment units. It has also been decided to impart a green environment to the STP units with special methods of growing plants at the exterior of plant components and space between units. Maximum utilisation of space has been taken at the planning and design stage itself and using the natural treatment properties of the soil, such decentralized systems provide good opportunities to use the natural environment. They can help reduce the level of difficulty and cost to treat pollutants, such as nutrients, and keeping them from entering lakes, rivers, and streams. Some aspects of the green landscaping eco-friendly unit management are described below for the proposed STP:

Soil: The soil acts as a natural filter and provides final treatment by removing harmful bacteria, viruses, and nutrients.

Odour management: Special attention is also given to proper odour management by using green belt inspired landscaping and chemical application whenever needed at extreme cases.

Trees: barrier formed with fast growing trees are planned for protection against pollution, for defining boundaries and for assisting in the creation of beautiful landscaping. Some of the plants are Casuarina Equisetifolia, golden bamboo, Grevillea Robusta etc. Shrubs: the use of shrubs in the mass as a basic

constituent in the planning of landscape is important. Shrubs with properties of hardiness, vigorous growth and an emphasis on evergreen plants are selected.

Creeping plants for exterior of units: The plants like climbing hydrangea creeps to walls and grow to impart a green environment.

Air purifying plants: Polluted air contains particles, odours and harmful gases like nitrogen oxides, sulphur dioxide and ammonia. These pollutants settle on the leaves of trees and plants. The leaves and plant surface absorb these pollutants and through their stomata (pores) and filter these harmful substances from the air. Trees also trap heat and reduce greenhouse gases in the atmosphere. They also reduce the ground level ozone level and enrich the air around us with life giving oxygen. For combating a variety of respiratory troubles and other illnesses caused by air pollution, there can be no better way than planting some chosen varieties of plants that can cleanse the air and make our environment better. The bamboo palm is a popular purifying houseplant due to its tropical look and insect-repelling quality. The bamboo palm can remove substances like benzene, formaldehyde, chloroform, carbon monoxide, and xylene.

9.15 OCCUPATIONAL HEALTH HAZARDS AND SAFTEY MEASURES

The sanitation workers, engaged in operation and maintenance (O&M) of sewerage system or septic tanks, are exposed to different types of occupational hazards like injuries caused by physical actions, chemicals contacts, infections caused by pathogenic organisms, and dangers inherent with oxygen deficiency, hydrogen sulphide, and combustible gases. The employers are obligated to provide their employees with safety equipment or protective gears as well as cleaning devices and ensure observance of safety precautions appropriate for each hazardous condition to reduce the employees' risks to health and safety. Moreover, to guard against human error and carelessness, proper safety training and adequate effective supervision by safety personnel are most essential. The GOI enacted the "Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act, 1993," which declared the employment of scavengers or the construction of dry latrines to be an offence, considering the foregoing, another bill titled "The Prohibition of Employment as Manual Scavengers and their Rehabilitation Bill, 2013" was introduced in the Parliament in September 2013 and has since been passed. The Bill aims to eliminate manual scavenging and insanitary latrines and provides for proper rehabilitation of manual scavengers in alternative occupations so that they can lead a life of dignity. In addition to the Acts mentioned above, employees shall follow "Contract Labour Regulation and Abolition Act, 1970" for secure operational health and safety at their sites. O&M of sewerage facilities, which should not be discontinued at any moment, requires health and safety consciousness equal to or greater than one that is needed for construction projects. In India, "health and safety policy" is defined in construction project management by Bureau of Indian Standard (BIS). Therefore, the same health and safety policy for

construction projects may also be adopted for O&M of sewerage facilities. STPs are subject to safety audits, which confirm the status of safety and health organizational setup, education / training, provision / inspection of personal protection, and records of safety, to ensure occupational safety and health at the work sites. The plant engineer should rectify failures immediately, if any. The audit shall be implemented as per IS: 14489 "Code of Practice on Occupational Safety and Health Audit." Standard safety audit procedures of the inspectorate of factories shall be at a frequency of a month and compliance reported to that agency.

9.16 COST ANALYSIS - OPERATION & MAINTENANCE COSTS

OPERATION & MAINTENANCE COSTS					
Sl. No.	**Item**		**Unit**		**Expenditure**
1	Power Charges for STP @ Rs.5 for kwh @	107536		kwh/month	₹ 537,680
2	Power Charges for network @ Rs.5 for kwh @	17322		kwh/month	₹ 86,611
3	Operators rate/month	25000	18	Nos.	₹ 450,000
4	Unskilled Worker	8000	3	Nos.	₹ 24,000
5	Chemist	20000	1	Nos.	₹ 20,000
6	Fuel for generator/month				₹ 6,000
7	Gas Chlorine/month				₹ 3,500
8	Alum and Lime ,polyelectrolyte dosing/month				₹ 54,329
9	Spares and replacements/month				₹ 5,000
10	Network routine inspection, flushing, cleaning including for manholes/month@	0.3% of cost of network/year			₹ 38,680
	Total per month				₹ 1,225,800
	Total per month excluding power charges				₹ 601,510
	Annual Operation & Maintenance Charge				₹ 14,709,605
	Annual Operation & Maintenance Charge excluding power charges				₹ 7,218,114
	Treatment Cost per Day				₹ 40,300
	Unit Cost of Treatment per Kilo Litre				₹ 23
10 YEAR ANNUAL O&M COST CONSIDERING 8% ANNUAL INCREASE EVERY YEAR					
Excluding power charges					
1	1st year				₹ 7,218,114
2	2nd year				₹ 7,795,563

3	3rd year				₹ 8,419,208
4	4th year				₹ 9,092,745
5	5th year				₹ 9,820,164
6	6th year				₹ 10,605,778
7	7th year				₹ 11,454,240
8	8th year				₹ 12,370,579
9	9th year				₹ 13,360,225
10	10th year				₹ 14,429,043
	Total O&M cost for 10 years				₹ 104,565,660
	GST @ 18%				₹ 18,821,819
	Unforseen Items				₹ 2,521
	Total O&M cost for 10 years including GST				**₹ 123,390,000**

CHAPTER - 10
IMPLIMENTATION OF THE PROJECT

10.1 IMPLEMENTING AGENCY

Kerala Water Authority is the responsible agency in Government sector in the water supply sector and sewerage Sector for implementation of Major Projects under various funding agencies AMRUTH, NABARD, Rebuild Kerala, ADB assistance, and also STATE PLAN Works. Being high value projects Implementation of sewerage projects also requires an agency with expertise and having sufficient human resources.

10.2 STEPS TO BE TAKEN WHILE TENDERING.

Conditions should be incorporated in the NIT that detailed field survey and design of network shall be carried out for ascertaining the levels due to road developments if any and in order to accommodate the fact that sewer network design based on gravity flow and accurate levels with Total Station equipment along both sides of road and centre of road is required. Due to limitation of fund and time DGPS survey along one side of the road is only taken in the present proposal. Additional changes required for satisfactory completion of work additional sewer lines required with additional manholes, lifting stations required due to future developments in the scheme area shall also be included in the scope of work while implementing the project. Better and advanced technology for treatment to be considered for STP while implementing the project. Soil investigation of STP site, well sites not carried out as the lands proposed are private lands. Hence detailed soil investigation is to be carried out and type of foundation of the structures to be changed accordingly.

10.3 INTEGRATION WITH OTHER PROJECTS

Planning and design of sewerage schemes can be combined with other water projects. This is since most of these projects are inter-related and environment sensitive. Hence the location of an STP, collection wells and coverage of sewerage networks in an area depends upon the water supply system existing in that area, proximity of irrigation canals, water bodies and flood routing structures if any. Planning shall also be done for integrating with road development projects in the scheme area so as to execute all road reformation works after laying sewerage system.

10.4 SUPPORT ACTIVITIES

It has been observed that in many cases of the implementation of the sewerage projects, public protests are experienced by the implementing agencies and authorities. This is because of the unawareness of the local people about the treatment process, disposal of sludge and re-use of treated sewage etc. In this regard, it is essential to educate the consumers to make them aware of the waste management process

thereby encouraging them to come up with sewerage connections. The state government is promoting the waste management concept in all the possible ways. More support is needed from the Local Self Government Departments, Suchitwa Mission Kerala, Haritha Keralam Mission Kerala and all the other departments by organizing programmers for motivation public through seminars and awareness classes.

10.5 IMPLIMENTATION SCHEDULE

Sl. No.	Activity / Month	Year 2022												Year 2023											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	Appraisal of Report																								
2	Sanction of the Project																								
3	Tendering and Awarding work																								
4	STP -Civil Work																								
5	STP-Mechanical Works																								
6	STP-Electrical and Instrumentation works																								
7	Sewer Network and Allied works																								
8	Trial Commissioning																								

Table 10.1 : Implementation Schedule

Proposed implementation Schedule is provided above. The project is proposed to complete within a period of two years.

CHAPTER - 11

CONCLUSION AND RECOMMENDATION

11.1 CONCLUSION

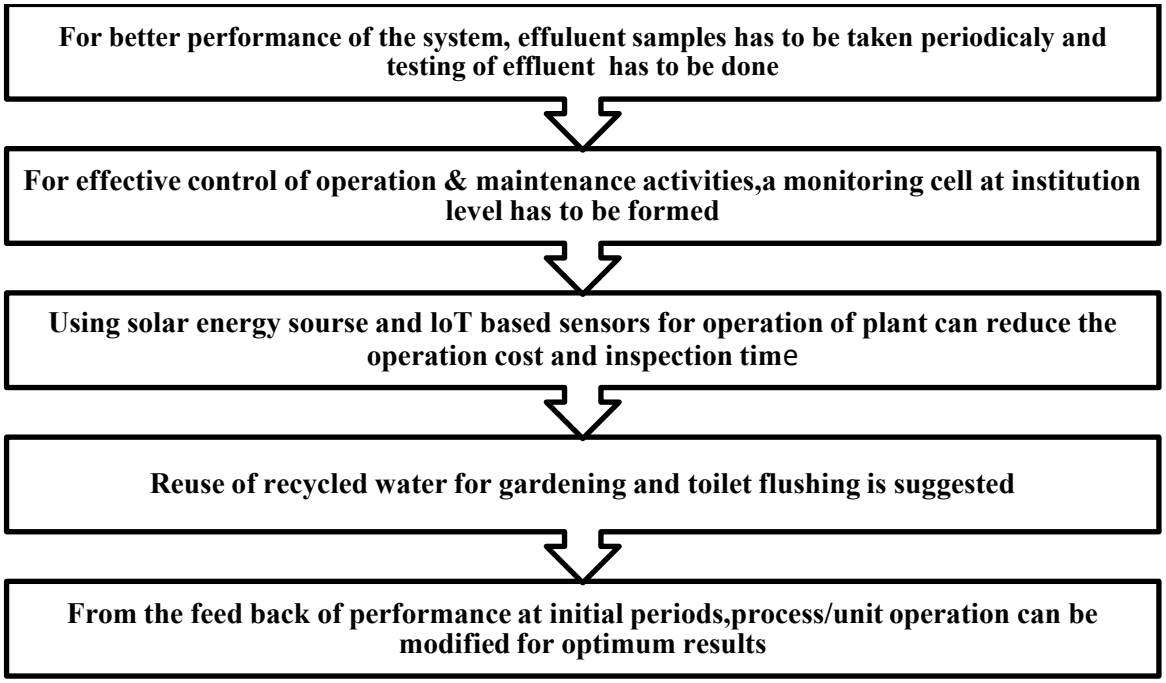
- The responsibility of providing sewerage systems rest with local bodies which can be facilitated by Kerala Water Authority. KWA has recently set up a Sewerage Vertical with four sewerage circles towards this. The idea and vision behind it are to visualize and materialize complete sewerage schemes for the State as it is vital for a safe environment. Moreover, there are directions from the Honourable National Green Tribunal (NGT) for ensuring the installation of Effluent Treatment Plants (ETPs), Common Effluent Treatment Plants (CETPs), Sewage Treatment Plants (STPs) and other pollution control measures. Hon. NGT has also directed to take necessary action to abate discharge of pollution into rivers (OA No. 673 of 2018).
- This proposal includes 1.76 MLD STP with MBBR technology at Housing board plot near Bypass road in Kattapana Municipality, a sewer network of 27.406 km, 1100 manholes, 5 pumping stations near to SH Convent, St.Martha Convent, Housing board plot, sub treasury, and thovarayar post office and 24 lifting stations. Manholes at 30 m intervals and at all intersections are proposed to facilitate maintenance operations. Septage load from balance area of Kattapana Municipality is proposed to be transported to the 1.76 MLD STP where Co-treatment facility will be provided.
- The cost estimate of the project is excluding land cost. The fund for land has to be provided by the local bodies /Government, according to the source of funding for the scheme.
- If sufficient funds and lands are made available, the projects can be taken up by KWA and can be completed in 2 years. For efficient control of operation and maintenance a monitoring cell at institutional level is to be formed.
- Soil investigation and sewage sample test has to be performed before implementing the project
- For better performance of the system testing of influent samples, effluent samples after treatment from each unit is to be tested at regular intervals and modifications if any shall be made at the initial stage itself so as to ensure efficiency of individual units and effluent standards as per design.
- Better and advanced technology for treatment to be considered for STP while implementing the project.
- Sludge generated in the STP must be properly disposed off by transforming it into fertilizer products or bricks for low impact construction activities. Recycled water generated from the STP is to be used as per the guidelines already given. Regarding the positive impacts, it is to be noted that water quality of the

rivers and streams will be greatly improved along with the general environment. The large quantity of recycled water will be useful for multiple purposes including agriculture.

- It may be noted that overall costs (capital and operating) and financial sustainability must be determined to arrive at the most optimum solution. Hence during the detailed engineering survey and investigations stage these factors are to be considered for better performance of the system.

11.2 RECOMMENDATIONS

The success of the system largely depends upon the commitment and attitude of the people benefitted from it and hence it is inherent that the Local Body will investigate every detail of the sewerage treatment plant and its supporting units to render a model of its kind in the State. Some of the points of action to be taken to enhance the performance of the system are outlined as follows:



ANNEXURE – 1

DEATILED ESTIMATE

DETAILED ESTIMATE OF SEWERAGE SCHEME IN KATTAPANA MUNICIPALITY										
CIVIL CONSTRUCTION-SEWERAGE TREATMENT PLANT (STP) ,CO-TREATMENT UNITS OF SEPTAGE										
OIL AND GREASE TRAP										
Item No.	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		For oil and grease trap-STP	1	5.3	2.9	1	15.37	m^3		
		For oil and grease trap-CTU	1	2.5	1.9	1	4.75	m^3		
		Total					20.12	m^3		
		Do for item ------All kinds of soil	0.35	20.12			7.042	@Rs	223.41	1573.22
		Do for item ------Ordinay rock	0.35	20.12			7.042	@Rs	433.01	3049.26
		Medium rock with blasting	0.15	20.12			3.018	@Rs	541.27	1633.54
		Medium rock with out blasting	0.15	20.12			3.018	@Rs	898.50	2711.68
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		For oil and grease trap-STP	1	5.3	2.9	0.15	2.31	m^3		
		For oil and grease trap-CTU	1	2.5	1.9	0.15	0.71	m^3		
		Total					3.02	m^3		
		Say		**3.02**	m^3		@	Rs	**7527.06**	**22731.72**
3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).								
		For oil and grease trap-STP								
		Bottom slab	1	5.30	2.90	0.3	4.61	m^3		
		Long wall	2	5.00	0.25	2.25	5.63	m^3		
		Short wall	2	2.10	0.25	2.25	2.36	m^3		
		For oil and grease trap-CTU								
		Bottom slab	1	2.30	1.70	0.3	1.17	m^3		
		Long wall	2	2.00	0.25	1.50	1.5	m^3		
		Short wall	2	1.40	0.25	1.50	1.05	m^3		
		Total					16.32	m3		
		Say		**16.32**	m^3		@	Rs	**10404.79**	**169806.18**

4	5.37.1	Providing and laying in position ready mixed M-25 grade concrete for reinforced cement concrete work, using cement content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ cum.Excess/less cement used as per design mix is payable/recoverable separately).								
		Top slab-STP	1	5	2.6	0.15	1.95	m^3		
		Top slab-CTU	1	2.2	1.6	0.15	0.53	m^3		
		Total					2.48	m^3		
		Deduction								
		Manhole	2	0.6	0.45	0.15	0.08	m^3		
		Total					0.08	m^3		
		Total after deduction					2.4	m^3		
		Say		**2.4**	m^3		@	Rs	**10319.09**	**24765.83**
5	5.22.6 +od 16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		16.32	m^3	120	kg/m^3	1958.40	kg
		Quantity as per item No.4	1		2.4	m^3	100	kg/m^3	240.00	kg
		Total							2198.40	kg
		Say		**2198.4**	kg		@	Rs	**104.91**	**230632.50**
6	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		16.32	m^3	340	kg/m^3	5548.80	kg
		Quantity as per item No.4	1		2.4	m^3	330	kg/m^3	792.00	kg
		Total							6340.80	kg
		Say		**126.816**	bags		@	Rs	**70.77**	**8974.13**
7	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab-STP	2	8.2		0.3	4.92	m^2		
		Bottom slab-CTU	2	4		0.3	2.40	m^2		
		Total					7.32	m^2		
		Say		**7.32**	m^2		@	Rs	**350.00**	**2562.03**
8	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside-STP	2	7.6		2.25	34.2	m^2		
		For walls inside-STP	2	6.6		2.25	29.7	m^2		
		For walls outside-CTU	2	3.4		1.5	10.2	m^2		
		For walls inside-CTU	2	2.4		1.5	7.2	m^2		
		Total					81.3	m^2		
		Say		**81.3**	m^2		@	Rs	**748.62**	**60863.04**
9	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for :Suspended floors, roofs, landings, balconies and access platform								
		Top slab-STP	2	7.6		0.15	2.28	m^2		
		Bottom portion-STP	1	4.5	2.1		9.45	m^2		
		Top slab-CTU	2	3.8		0.15	1.14	m^2		
		Bottom portion-CTU	1	2.2	1.6		3.52	m^2		
		Total					16.39	m^2		

		Say		**16.39**	m^2		@	Rs	**851.52**	**13956.33**
10	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.								
		Quantity as per item 1	1				20.12	m^3		
		Deductions								
		PCC	1				3.02	m^3		
		Bottom slab	1				16.32	m^3		
		Quantity after deductions	1				0.78	m^3		
		Say		**0.78**	m^3		@	Rs	**269.90**	**210.52**
11	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls-STP	2	6.6		2.25	29.7	m^2		
		Inside of walls-CTU	2	2.4		1.5	7.2	m^2		
		Total					36.9	m^2		
		Say		**36.9**	m^2		@	Rs	**595.28**	**21965.65**
12	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside-STP	1	4.5	2.1		9.45	m^2		
		Bottom slab inside-CTU	1	1.5	0.9		1.35	m^2		
		Total					10.8	m^2		
		Say		**10.8**	m^2		@	Rs	**458.77**	**4954.71**
13	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		For STP								
		Inside of walls	1	13.2		2.25	29.7	m^2		
		Base slab inside	1	4.5	2.1		9.45	m^2		
		Top slab bottom&top	2	4.5	2.1		18.9	m^2		
		For CTU								
		Inside of walls	1	2.4		1.5	3.6	m^2		
		Base slab inside	1	1.5	0.9		1.35	m^2		
		Top slab bottom& top	2	2	1.4		5.6	m^2		
		Total					68.6	m^2		
		Deduction								
		Manhole	2	0.6	0.45		0.54	m^2		
		Total					0.54	m^2		

		Total after deduction					68.06	m^2		
		Say		**68.06**	m^2		@	Rs	**418.79**	**28502.66**
14	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I. cover (light duty) the weight of the cover to be not less than 23 kg								
			2				1	No.		
		Say		**2**	No.		@	Rs	**1629.51**	**3259.01**
15	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
		For STP	6				6	No.		
		For CTU	3				3	No.		
		Say		**9**	No.		@	Rs	**568.88**	**5119.92**
16	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
		For STP	1	5	2.1	2.25	23.625	m3		
		For CTU	1	1.5	0.9	1.5	2.025			
		Say		**25.65**	Kilo litre		@	Rs	**218.95**	**5615.99**
		Total-Oil and Grease Trap								**612887.93**
RECEIVING CHAMBER										
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		For receiving chamber-STP	1	4.1	2.7	1	11.07	m^3		
		For receiving chamber-CTU	1	1.8	1.45	1	2.61	m^3		
		Total					13.68	m^3		
		Do for item ------All kinds of soil	0.5	13.68			6.84	@Rs	223.41	1528.09
		Do for item ------Ordinay rock	0.3	13.68			4.104	@Rs	433.01	1777.08
		Medium rock with blasting	0.1	13.68			1.368	@Rs	541.27	740.45
		Medium rock with out blasting	0.1	13.68			1.368	@Rs	898.50	1229.15
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		For receiving chamber-STP	1	4.1	2.7	0.15	1.66	m^3		
		For receiving chamber-CTU	1	1.8	1.45	0.15	0.39	m^3		
		Total					2.05	m^3		
		Say		**2.05**	m^3		@	Rs	**7527.06**	**15430.47**

3	5.37.1 +5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).									
		For receiving chamber-STP								
		Bottom slab	1	4.10	2.70	0.3	3.32	m^3		
		Long wall	2	3.50	0.25	1.70	2.98	m^3		
		Short wall	2	1.60	0.25	1.70	1.36	m^3		
		For receiving chamber-CTU								
		Bottom slab	1	1.60	1.25	0.3	0.6	m^3		
		Long wall	2	1.30	0.25	1.35	0.88	m^3		
		Short wall	2	0.45	0.25	1.35	0.3	m^3		
		Total					9.44	m^3		
		Say		**9.44**	m^3		@	Rs	**10404.79**	**98221.22**
4	5.37.1	Providing and laying in position ready mixed M-25 grade concrete for reinforced cement concrete work, using cement content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ cum.Excess/less cement used as per design mix is payable/recoverable separately).									
		Top slab-STP	1	3.5	2.1	0.15	1.1	m^3		
		Top slab-CTU	1	1.5	1.15	0.15	0.26	m^3		
		Total					1.36	m^3		
		Deduction								
		Manhole	2	0.6	0.45	0.15	0.08	m^3		
		Total					0.08	m^3		
		Total after deduction					1.28	m^3		
		Say		**1.28**	m^3		@	Rs	**10319.09**	**13208.44**
5	5.22.6 +OD 16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		9.44	m^3	120	kg/m^3	1132.80	kg
		Quantity as per item No.4	1		1.28	m^3	100	kg/m^3	128.00	kg
		Total							1260.80	kg
		Say		**1260.8**	kg		@	Rs	**104.91**	**132269.58**
6	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		9.44	m^3	340	kg/m^3	3209.60	kg
		Quantity as per item No.4	1		1.28	m^3	330	kg/m^3	422.40	kg
		Total							3632.00	kg
		Say		**72.64**	bags		@	Rs	**70.77**	**5140.37**
7	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab-STP	2	6.8		0.3	4.08	m^2		
		Bottom slab-CTU	2	2.85		0.3	1.71			
		Total					5.79	m^2		

		Say		**5.79**	m^2		@	Rs	**350.00**	**2026.52**
8	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside-STP	2	5.6		1.7	19.04	m^2		
		For walls inside-STP	2	4.6		1.7	15.64	m^2		
		For walls outside-CTU	2	2.25		1.35	6.075	m^2		
		For walls inside-CTU	2	1.25		1.35	3.375	m^2		
		Total					44.13	m^2		
		Say		**44.13**	m^2		@	Rs	**748.62**	**33036.73**
9	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for :Suspended floors, roofs, landings, balconies and access platform								
		For STP								
		Top slab	2	5.6		0.15	1.68	m^2		
		Bottom portion	1	3	1.6		4.8	m^2		
		For CTU								
		Top slab	2	2.25		0.15	0.675	m^2		
		Bottom portion	1	1.3	0.95		1.235	m^2		
		Total					8.39	m^2		
		Say		**8.39**	m^2		@	Rs	**851.52**	**7144.21**
10	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.								
		Quantity as per item 1	1				13.68	m^3		
		Deductions								
		PCC	1				2.05	m^3		
		Bottom slab	1				3.92	m^3		
		Top slab	1				1.28	m^3		
		Quantity after deductions	1				6.43	m^3		
		Say		6.43	m^3		@	Rs	**269.90**	**1735.44**
11	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls-STP	2	4.6		1.7	15.64	m^2		
		Inside of walls-CTU	2	1.25		1.35	3.375	m^2		
		Total					19.015	m^2		
		Say		19.015	m^2		@	Rs	**595.28**	**11319.16**
12	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								

		For STP								
		Bottom slab inside	1	3	1.6		4.8	m^2		
		Inside walls	1	8		2.25	18	m2		
		For CTU								
		Bottom slab inside	1	0.8	0.45		0.36	m^2		
		Inside walls	1	1.25		1.35	1.69	m2		
		Total					24.8475	m^2		
		Say		**24.8475**	m^2		@	Rs	**458.77**	**11399.28**
13	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		For STP								
		Inside of walls	2	4.6		1.7	15.64	m^2		
		Base slab inside	1	3	1.6		4.8	m^2		
		Top slab bottom	1	3	1.6		4.8	m^2		
		For CTU								
		Inside of walls	2	1.25		1.35	3.375	m^2		
		Base slab inside	1	0.8	0.45		0.36	m^2		
		Top slab bottom	1	1.3	0.95		1.235	m^2		
		Total					30.21	m^2		
		Deduction								
		Manhole	2	0.6	0.45		0.54	m^2		
		Total					0.54	m^2		
		Total after deduction					29.67	m^2		
		Say		**29.67**	m^2		@	Rs	**418.79**	**12425.42**
14	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I. cover (light duty) the weight of the cover to be not less than 23 kg								
			2				1	No.		
		Say		**2**	No.		@	Rs	**1629.51**	**3259.01**
15		Providing and fixing uPVC pipes & fittings includings jointing of pipes with one step uPVC solvent cement , testing of joints complete as per direction of Engineer in Charge. 110mm dia 6Kgf/cm²- for vent pipe								
			2	0.45			0.45	m		
		Total					0.45	m		
		Say		**0.45**	m		@	Rs	**1471.91**	**662.36**
16	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
		For STP	4				4	No.		
		For CTU	3				3	No.		
		Say		**7**	No.		@	Rs	**568.88**	**3982.16**
17	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
		For STP	1	3	1.6	1.7	8.16	m3		
		For CTU	1	0.8	0.45	1.35	0.486	m3		
		Say		**86.46**	Kilo litre		@	Rs	**218.95**	**18930.15**
		Total-Receiving Chamber								**375465.29**

GRIT SEPERATOR AND SCREEN CHANNEL										
Item No	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		For grit seperator	1	3.6	3.6	0.75	9.72	m^3		
		For fine screen channel-STP	1	7.25	2.25	0.50	8.16	m3		
		For coarse screen channel-STP	1	5.7	3.25	0.50	9.26	m^3		
		For screen channel-CTU	1	3	1.45	1.00	4.35	m^3		
		Total					31.49	m^3		
		Say		**31.49**	m^3		@	Rs	**223.41**	**7035.03**
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		For grit seperator	1	3.6	3.6	0.15	1.94	m^3		
		For fine screen channel-STP	1	7.25	2.95	0.15	3.21			
		For coarse screen channel-STP	1	5.7	2.95	0.15	2.52	m^3		
		For screen channel-CTU	1	3	1.45	0.15	0.65	m^3		
		Total					8.32	m^3		
		Say		**8.32**	m^3		@	Rs	**7527.06**	**62625.15**
3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately).								
		For grit seperator								
		Bottom slab	1	3.60	3.60	0.30	3.89	m^3		
		Walls	2	5.50	0.25	2.00	5.5	m^3		
		Top slab	1	3.00	3.00	0.15	1.35	m^3		
		Total					10.74	m^3		
		Deduction								
		Manhole	1	0.6	0.45	0.15	0.04	m^3		
		Total					0.04	m^3		
		Total after deduction					10.7	m^3		
		Say		**10.70**	m^3		@	Rs	**10404.79**	**111331.26**
		For coarse screen channel								
		Bottom slab	1	5.70	1.75	0.30	2.99	m^3		
		Wall	2	4.70	0.25	1.70	4	m^3		
			2	1.00	0.25	1.50	0.75	m3		
		For fine screen channel								
		Bottom slab-STP	1	6.55	1.75	0.30	3.44			
		Bottom slab-CTU	1	2.80	1.25	0.30	1.05			
		Wall -STP	2	6.25	0.25	1.50	4.69			
			2	1.00	0.25	1.50	0.75	m^3		
		Wall -CTU	2	2.50	0.25	0.90	1.13			

			2	0.95	0.25	0.90	0.43			
		Top slab-fine screen STP	2	6.55	2.25	0.30	8.84			
		Top slab-Course screen -STP	2	5.00	2.25	0.30	6.75			
		Top slab-CTU	1	2.80	1.25	0.30	1.05			
		Total					35.87	m^3		
		Say		**35.87**	m^3		@	Rs	**10404.79**	**373219.83**
4	5.22.6 +OD16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		46.57	m^3	120	kg/m^3	5588.40	kg
		Total							5588.40	kg
		Say		**5588.4**	kg		@	Rs	**104.91**	**586274.85**
5	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		46.57	m^3	340	kg/m^3	15833.80	kg
		Total							15833.80	kg
		Say		**316.676**	bags		@	Rs	**70.77**	**22409.58**
6	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab-grit seperator	2	7.2		0.30	4.32	m^2		
		STP Bottom slab-coarse screen channel	2	14.5		0.30	8.70	m^2		
		STP Bottom slab-fine screen channel	2	17.6		0.30	10.56			
		CTU Bottom slab-screen channel	1	8.1		0.30	2.43	m^2		
		Total					26.01	m^2		
		Say		**26.01**	m^2		@	Rs	**350.00**	**9103.60**
7	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside-grit seperator	2	6.00		2.00	24.00	m^2		
		For walls inside-grit seperator	2	5.00		2.00	20.00	m^2		
		For STP								
		For walls inside-coarse channel	2	5.65		1.70	19.21			
		For walls outside-coarse channel	2	6.20		1.70	21.08			
		For walls outside-fine channel	2	7.25		1.50	21.75	m^2		
		For walls inside- fine channel	2	6.50		1.50	19.50	m^2		
		For CTU-Wall outside-channel	2	2.45		0.90	4.41			
		For CTU-Wall inside-channel	2	3.45		0.90	6.21			
		Total					136.16	m^2		
		Say		**136.16**	m^2		@	Rs	**748.62**	**101932.50**
8	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for :Suspended floors, roofs, landings, balconies and access platform								
		Top slab-grit seperator	2	6.0		0.15	1.80	m^2		
		Bottom portion-grit seperator	1	2.50	2.5		6.25	m^2		
		Top slab -course screen channels STP	1	11.40		0.15	1.71	m^2		
		Bottom portion-course screen channels STP	1	4.70	1.25		5.88	m^2		

		Top slab -fine screen channels STP	1	14.50		0.15	2.18	m^2		
		Bottom portion-fine screen channels STP	1	6.25	1.25		7.81	m^2		
		Top slab - screen channels CTU	1	3.45		0.15	0.52			
		Bottom portion-screen channels CTU	1	2.50	0.95		2.38			
		Total					28.52	m^2		
		Say		**28.52**	m^2		@	Rs	**851.52**	**24280.96**
9	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm									
		Inside of walls-grit seperator	2	5		2.00	20	m^2		
		Inside of walls-Course screen channels STP	2	5.95		1.70	20.23			
		Inside of walls-Fine screen channels STP	2	7.5		1.50	22.5	m^2		
		Total					62.73	m^2		
		Say		**62.73**	m^2		@	Rs	**685.64**	**43010.33**
10	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.									
		Bottom slab inside-grit box	1	2.5	2.5		6.25	m^2		
		Bottom slab inside-channels STP	1	5.2	1.45		7.54	m^2		
			1	6.75	1.45		9.79			
		Bottom slab inside-channels -CT	1	2	0.45		0.90			
		Total					24.48	m^2		
		Say		**24.48**	m^2		@	Rs	**458.77**	**11229.53**
11	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls-grit seperator	2	5.0		2.00	20	m^2		
		Base slab inside-grit seperator	1	2.5	2.5		6.25	m^2		
		Top slab bottom-grit box	1	2.5	2.5		6.25	m^2		
		For STP								
		Inside of walls-Course channels	2	11.9		1.70	40.46	m^2		
		Base slab inside-course channels	1	5.2	0.75		3.9	m^2		
		Top slab bottom-coursechannels	1	5.2	0.75		3.9	m^2		
		Inside of walls-Fine screen chann	2	15.0		1.5	45			
		Base slab inside-fine channels	1	6.8	0.75		5.0625			
		Top slab bottom- fine channels	1	6.8	0.75		5.0625	m^2		

		Inside of walls- channels CTU	1	4.9		0.90	4.41	m^2		
		Base slab inside-channels CTU	1	2.0	0.45		0.9	m^2		
		Top slab bottom-channels CTU	1	2.0	0.45		0.9	m^2		
		Total					142.10	m^2		
		Deduction								
		Manhole	3	0.6	0.45		0.81	m^2		
		Total					0.81	m^2		
		Total after deduction					141.29	m^2		
		Say		**141.29**	m^2		@	Rs	**418.79**	**59168.36**
12	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.								
		Quantity as per item 1	1				31.49	m3		
		Deductions								
		PCC	1				8.32	m3		
		Bottom slab	1				11.37	m3		
		Quantity after deductions	1				11.8	m3		
		Say		**11.8**	m^3		@	Rs	**269.90**	**3184.79**
13	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I. cover (light duty) the weight of the cover to be not less than 23 kg								
			3				3	No.		
		Say		**3**	No.		@	Rs	**1629.51**	**4888.52**
14		joints complete as per direction of Engineer in Charge. 110mm dia 6Kgf/cm²- for vent pipe								
			1	0.45			0.45	m		
		Total					0.45	m		
		Say		**0.45**	m		@	Rs	**1471.91**	**662.36**
15	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design									
		For STP	10				10	No.		
		For CTU	1				1	No.		
		Say		**11**	No.		@	Rs	**568.88**	**6257.68**
16	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
		For STP	1	2.5	2.5	2	12.5	m3		
			1	6.75	0.75	1.5	7.59375			
			1	5.2	0.75	1.7	6.63			
		For CTU	1	2	0.45	0.9	0.81			
		total					27.53375			
		Say		**27.53**	Kilo litre		@	Rs	**218.95**	**6028.43**
		Total-Grit Seperator and Screen Channel								**1432642.76**
EQUALISATION TANK										

Item No.	Item Code	Description	No	L	B	H	V	Unit	Rate	Amount
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		Shape of tank	**1**	(put 1 for rectangular and 2 for circular)						
		Equalisation tank	1	13.00	13	1.50	253.5	m^3		
		Total					253.5	m^3		
		Say		**253.5**	m^3		@	Rs	**223.41**	**56633.19**
		Do for item ------All kinds of soil	0.35	253.5			88.725	@Rs	223.41	19821.62
		Do for item ------Ordinay rock	0.35	253.5			88.725	@Rs	433.01	38418.90
		Medium rock with blasting	0.15	253.5			38.025	@Rs	541.27	20581.69
		Medium rock with out blasting	0.15	253.5			38.025	@Rs	898.50	34165.58
		Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m to 3m, as directed by Engineer-in-charge(iind depth)								
		Equalisation tank	1	13.00	13	1.50	253.5			
		Do for item ------All kinds of soil	0.25	253.5			63.375	@Rs	334.44	21194.84
		Do for item ------Ordinay rock	0.25	253.5			63.375	@Rs	632.14	40062.11
		Medium rock with blasting	0.25	253.5			63.375	@Rs	740.40	46922.85
		Medium rock with out blasting	0.25	253.5			63.375	@Rs	1097.64	69562.68
		Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 3 m to 4.5m, as directed by Engineer-in-charge(iind depth)								
		Equalisation tank	1	13.00	13	1.30	219.7			
		Do for item ------All kinds of soil	0.25	219.7			54.925	@Rs	445.47	24467.20
		Do for item ------Ordinay rock	0.25	219.7			54.925	@Rs	831.28	45657.86
		Medium rock with blasting	0.25	219.7			54.925	@Rs	939.53	51603.84
		Medium rock with out blasting	0.25	219.7			54.925	@Rs	1296.77	71225.02
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		Equalisation tank	1	13	13	0.15	25.35	m^3		
		Footing base pcc	16	1.3	1.3	0.15	4.06			
		Total					29.41	m^3		
		Say		**29.41**	m^3		@	Rs	**7527.06**	**221370.86**
3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately).								
		For equalisation tank								

		Inverted beam	4	12.5	0.35	0.65	11.375			
			4	11.4	0.35	0.65	10.374			
		Bottom slab cum raft	1	13.00	13.00	0.45	76.05	m^3		
							97.799			
				97.799	m3				10404.79	**1017578.08**
3a	5.37.2 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using Sulphate Resistant Cement (SRC) content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/3.Excess/less cement used as per design mix is payable/recoverable separately).								
		Long wall	2	11.90	0.30	4.10	29.27	m^3		
		Short wall	2	11.30	0.30	4.10	27.8	m^3		
		Walk way	4	11.85	0.45	0.10	2.13			
		deduction-Manhole	1	0.60	0.45	0.15	0.04			
		Total after deduction					59.16	m^3		
		Say		**59.16**	m^3		@	Rs	**12129.26**	**717567.17**
4	5.22.6 +od16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3 & 3a	1		156.96	m^3	120	kg/m^3	18835.08	kg
		Total							18835.08	kg
		Say		**18835.1**	kg		@	Rs	**104.91**	**1975974.12**
5	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		156.96	m^3	340	kg/m^3	53366.06	kg
		Total							53366.06	kg
		Say		**1067.32**	bags		@	Rs	**70.77**	**75528.98**
6	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab	2	25.6		0.45	23.04	m^2		
		Beam side	4	12.5		1.30	65.00			
			4	11.4		1.30	59.28			
		Total					147.32	m^2		
		Say		**147.32**	m^2		@	Rs	**350.00**	**51562.54**
7	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside	2	23.80		4.10	195.16	m^2		
		For walls inside	2	22.60		4.10	185.32	m^2		
		Total					380.48	m^2		
		Say		**380.48**	m^2		@	Rs	**748.62**	**284836.05**
8	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for :Suspended floors, roofs, landings, balconies and access platform								
		Walk way	4	12.30	0.5		24.60			
		Bottom portion	1	11.60	11.6		134.56			
		Total					159.16	m^2		
		Say		**159.16**	m^2		@	Rs	**851.52**	**135527.17**

9	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls	2	22.6		4.10	185.32	m^2		
		Total					185.32	m^2		
		Say		**185.32**	m^2		@	Rs	**595.28**	**110316.40**
		GST component						Rs		**0.00**
10	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside	1	11.3	11.3		127.69	m^2		
		Total					127.69	m^2		
		Say		**127.69**	m^2		@	Rs	**458.77**	**58580.28**
11	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Outside walls	2	22.8		4.1	186.96			
		Inside of walls	2	22.6		4.10	185.32	m^2		
		Base slab inside	1	11.3	11.3		127.69	m^2		
		Walkway	4	11.85	1		47.4			
		Total					547.37	m^2		
		Say		**547.37**	m^2		@	Rs	**418.79**	**229231.59**
12	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.								
		Quantity as per item 1	1				726.7	m3		
		Deductions								
		PCC	1				25.35	m3		
		Bottom slab	1				76.05	m3		
		Tank	1				580.60	m3		
		Quantity after deductions	1				44.7	m3		
		Say		**44.7**	m^3		@	Rs	**269.90**	**12064.16**
13	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I. cover (light duty) the weight of the cover to be not less than 23 kg								
			1				1	No.		
		Say		**1**	No.		@	Rs	**1629.51**	**1629.51**
14		Providing and fixing uPVC pipes & fittings includings jointing of pipes with one step uPVC solvent cement , testing of joints complete as per direction of Engineer in Charge. 110mm dia 6Kgf/cm²- for vent pipe								
			1	0.45			0.45	m		
		Total					0.45	m		

		Say		**0.45**	m		@	Rs	**1471.91**	**662.36**
15	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
			12				12	No.		
		Say		**12**	No.		@	Rs	**568.88**	**6826.56**
16	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
		For STP	1	11.3	11.3	4.1	523.529	m3		
		total					523.529			
		Say		**523.53**	Kilo litre		@	Rs	**218.95**	**114625.06**
17	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total-51.4m/1m c/c vertical 50mm dia	52			0.75	5.17	kg	201.63	
		Horizontal 0.25m c/c-32mm dia	3	51.4			3.17	kg	488.81	
		Say		**690.444**	kg		@	Rs	**194.18**	**134069.84**
18	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	52	0.75		0.05	1.95	m2		
		Horizontal pipe	3	51.4		0.03	4.93	m2		
		Say		**6.88**	m2		@	Rs	**154.62**	**1064.48**
19	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Quantity as per item code 13.7.1	1	547.37			0		**547.37**	
		Say		**547.37**	m2		@	Rs	**232.68**	**127359.49**
		Total Equalisation Tank								**5816692.08**
DILUTION TANK FOR CO TREATMENT -rectangular										
m	**Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		Shape of tank	**1**	(put 1 for rectangular and 2 for circular)						
		Dilution tank	1	6.00	5	1.50	45	m^3		
		Do for item ------All kinds of	0.35	45			15.75	@Rs	223.41	3518.63
		Do for item ------Ordinay rock	0.35	45			15.75	@Rs	433.01	6819.92
		Medium rock with blasting	0.15	45			6.75	@Rs	541.27	3653.55
		Medium rock with out blasting	0.15	45			6.75	@Rs	898.50	6064.90

1b		Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m to 3, as directed by Engineer-in-charge								
			1	6.00	5	1.20	36	m^3		
		Do for item ------All kinds of	0.25	36			9	@Rs	334.44	3009.92
		Do for item ------Ordinay rock	0.25	36			9	@Rs	632.14	5689.29
		Medium rock with blasting	0.25	36			9	@Rs	740.40	6663.60
		Medium rock with out blasting	0.25	36			9	@Rs	1097.64	9878.72
		Total					36	m^3		
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		Dilution tank	1	6.00	5	0.15	4.5	m^3		
		Total					4.5	m^3		
		Say		**4.5**	m^3		@	Rs	**7527.06**	**33871.77**
3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).								
		For Dilution tank								
		Inverted beam	2	5.5	0.35	0.65	2.50	m^3		
			2	4.5	0.35	0.65	2.05	m^3		
		Bottom slab cum raft	1	5.65	4.65	0.45	11.82	m^3		
		Long wall	2	5.50	0.25	3.00	8.25	m^3		
		Short wall	2	4.50	0.25	3.00	6.75	m^3		
		Total					31.37			
		Say		31.37	m3				10404.79	**326398.27**
3a	5.37.2 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using Sulphate Resistant Cement (SRC) content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/3.Excess/less cement used as per design mix is payable/recoverable separately).								
		Top Slab	1	5.80	4.80	0.15	4.18			
		Walk way	2	10.60	0.45	0.10	0.95			
		deduction-Manhole	1	0.60	0.45	0.15	0.04			
		Total after deduction					5.09	m^3		
		Say		**5.09**	m^3		@	Rs	**12129.26**	**61737.95**
4	5.22.6 +od16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3 & 3a	1		36.46	m^3	120	kg/m^3	4375.20	kg
		Total							4375.20	kg
		Say		**4375.2**	kg		@	Rs	**104.91**	**458998.95**
5	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								

		Quantity as per item No.3 & 3a	1		36.46	m^3	340	kg/m^3	12396.40	kg
		Total							12396.40	kg
		Say		**247.928**	bags		@	Rs	**70.77**	**17544.62**
6	5.9.1	columns, etc. for mass concrete								
		Bottom slab	2	10.30		0.45	9.27	m^2		
		Beam side	4	5.5		1.30	28.60			
			4	4.5		1.30	23.40			
		Total					61.27	m^2		
		Say		**61.27**	m^2		@	Rs	**350.00**	**21444.73**
7	5.9.2	attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside	2	10.00		3.00	60.00	m^2		
		For walls inside	2	9.00		3.00	54.00	m^2		
		Total					114.00	m^2		
		Say		**114.00**	m^2		@	Rs	**748.62**	**85343.01**
8	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for :Suspended floors, roofs, landings, balconies and access platform								
		Walk way	2	10.60	0.5		10.60			
		Top slab	1	21.20		0.15	3.18			
		Bottom portion	1	5.50	4.5		24.75			
		Total					38.53	m^2		
		Say		**38.53**	m^2		@	Rs	**851.52**	**32808.88**
9	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm									
		Inside of walls	2	9		3.00	54	m^2		
		Total					54	m^2		
		Say		**54**	m^2		@	Rs	**595.28**	**32144.86**
10	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.									
		Bottom slab inside	1	5.5	4.5		24.75	m^2		
		Total					24.75	m^2		
		Say		**24.75**	m^2		@	Rs	**458.77**	**11354.55**
11	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	2	9.0		3.00	54	m^2		
		Base slab inside	1	5	4		20	m^2		
		Walkway	2	10	1		20	m^2		
		Total					94	m^2		
		Say		**94**	m^2		@	Rs	**418.79**	**39366.00**

12	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.								
		Quantity as per item 1	1				90	m3		
		Deductions								
		PCC	1				4.5	m3		
		Bottom slab	1				11.82	m3		
		Tank	1	5.5	4.5	1	24.75	m3		
		Quantity after deductions	1				48.9	m3		
		Say		**48.9**	m^3		@	Rs	**269.90**	**13206.09**
13	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I. cover (light duty) the weight of the cover to be not less than 23 kg								
			1				1	No.		
		Say		**1**	No.		@	Rs	**1629.51**	**1629.51**
14		Providing and fixing uPVC pipes & fittings includings jointing of pipes with one step uPVC solvent cement , testing of joints complete as per direction of Engineer in Charge. 110mm dia 6Kgf/cm²- for vent pipe								
			1	0.45			0.45	m		
		Total					0.45	m		
		Say		**0.45**	m		@	Rs	**1471.91**	**662.36**
15	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
			9				9	No.		
		Say		**9**	No.		@	Rs	**568.88**	**5119.92**
16	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	5	4	3	60	m3		
		total					60			
		Say		**60.00**	Kilo litre		@	Rs	**218.95**	**13136.81**
17	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total-20m/1m c/c vertical 50mm dia	20			0.75	5.17	kg	77.55	
		Horizontal 0.25m c/c-32mm dia	3	20			3.17	kg	190.20	
		Say		**267.75**	kg		@	Rs	**194.18**	**51991.47**
18	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	20	0.75		0.05	0.75	m2		
		Horizontal pipe	3	20		0.03	1.92	m2		
		Say		**2.67**	m2		@	Rs	**154.62**	**412.84**
19	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								

		Quantity as per item code 13.7.1	1	94			0		**94.00**	
		Say		**94**	m2		@	Rs	**232.68**	**21871.48**
		Total Dilution Tank for Co Treatment								**1274342.61**
COLLECTION TANK FOR CO TREATMENT -rectangular										
m	**Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		Shape of tank	**1**	(put 1 for rectangular and 2 for circular)						
		Collection tank	1	3.50	3.5	1.50	18.38	m^3		
		Total					18.38	m^3		
		Say		**18.38**	m^3					
		Do for item ------All kinds of	0.35	18.38			6.433	@Rs	223.41	1437.17
		Do for item ------Ordinay rock	0.35	18.38			6.433	@Rs	433.01	2785.56
		Medium rock with blasting	0.15	18.38			2.757	@Rs	541.27	1492.27
		Medium rock with out blasting	0.15	18.38			2.757	@Rs	898.50	2477.17
		Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m to 3.0m, as directed by Engineer-in-charge								
		Collection tank	1	3.50	3.5	1.50	18.38	m^3		
		Say			18.38	m^3				
		Do for item ------All kinds of	0.25	18.38			4.595	@Rs	334.44	1536.73
		Do for item ------Ordinay rock	0.25	18.38			4.595	@Rs	632.14	2904.70
		Medium rock with blasting	0.25	18.38			4.595	@Rs	740.40	3402.14
		Medium rock with out blasting	0.25	18.38			4.595	@Rs	1097.64	5043.64
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		Collection tank	1	3.50	3.5	0.15	1.84	m^3		
		Total					1.84	m^3		
		Say		**1.84**	m^3		@	Rs	**7527.06**	**13849.79**
3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately).								
		Collection tank								
		Inverted beam	2	3	0.3	0.6	1.08	m^3		
			2	3	0.3	0.6	1.08	m^3		
		Bottom slab cum raft	1	3.15	3.15	0.45	4.47	m^3		
		Long wall	2	3.00	0.25	2.50	3.75	m^3		
		Short wall	2	2.50	0.25	2.50	3.13	m^3		
		Total					13.51			
		Say		13.51	m3				10404.79	**140568.72**

3a	5.37.2 + 5.34.1	work, using Sulphate Resistant Cement (SRC) content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/3.Excess/less cement used as per design mix is payable/recoverable separately).								
		Top Slab	1	3.00	3.00	0.15	1.35			
		Walk way	2	6.00	0.45	0.10	0.54			
		deduction-Manhole	1	0.60	0.45	0.15	0.04			
		Total after deduction					1.85	m^3		
		Say		**1.85**	m^3		@	Rs	**12129.26**	**22439.14**
4	5.22.6 +od16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3 & 3a	1		15.36	m^3	120	kg/m^3	1843.20	kg
		Total							1843.20	kg
		Say		**1843.2**	kg		@	Rs	**104.91**	**193368.73**
5	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3 & 3a	1		15.36	m^3	340	kg/m^3	5222.40	kg
		Total							5222.40	kg
		Say		**104.448**	bags		@	Rs	**70.77**	**7391.26**
6	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab	2	6.60		0.45	5.94	m^2		
		Beam side	4	3		1.20	14.40			
			4	2.5		1.20	12.00			
		Total					32.34	m^2		
		Say		**32.34**	m^2		@	Rs	**350.00**	**11319.12**
7	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside	2	6.00		2.50	30.00	m^2		
		For walls inside	2	5.00		2.50	25.00	m^2		
		Total					55.00	m^2		
		Say		**55.00**	m^2		@	Rs	**748.62**	**41174.26**
8	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for :Suspended floors, roofs, landings, balconies and access platform								
		Walk way	2	6.90	0.5		6.90			
		Top slab	1	12.00		0.15	1.80			
		Bottom portion	1	3.00	3		9.00			
		Total					17.70	m^2		
		Say		**17.70**	m^2		@	Rs	**851.52**	**15071.82**
9	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								

		Inside of walls	2	5		2.50	25	m^2		
		Total					25	m^2		
		Say		**25**	m^2		@	Rs	**595.28**	**14881.88**
10	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside	1	2.5	2.5		6.25	m^2		
		Total					6.25	m^2		
		Say		**6.25**	m^2		@	Rs	**458.77**	**2867.31**
11	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	2	5.0		2.50	25	m^2		
		Base slab inside	1	2.5	2.5		6.25	m^2		
		Walkway	2	6.9	1		13.8	m^2		
		Total					45.05	m^2		
		Say		**45.05**	m^2		@	Rs	**418.79**	**18866.37**
12	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.								
		Quantity as per item 1	1				36.76	m3		
		Deductions								
		PCC	1				1.84	m3		
		Bottom slab	1				6.63	m3		
		Tank	1	3	3	2.5	22.50	m3		
		Quantity after deductions	1				5.8	m3		
		Say		**5.8**	m^3		@	Rs	**269.90**	**1562.71**
13	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I. cover (light duty) the weight of the cover to be not less than 23 kg								
			1				1	No.		
		Say		**1**	No.		@	Rs	**1629.51**	**1629.51**
14		Providing and fixing uPVC pipes & fittings includings jointing of pipes with one step uPVC solvent cement , testing of joints complete as per direction of Engineer in Charge. 110mm dia 6Kgf/cm²- for vent pipe								
			1	0.45			0.45	m		
		Total					0.45	m		
		Say		**0.45**	m		@	Rs	**1471.91**	**662.36**
15	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
			3				3	No.		
		Say		**3**	No.		@	Rs	**568.88**	**1706.64**

16	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	2.5	2.5	2	12.5	m3		
		total					12.5			
		Say		**12.50**	Kilo litre		@	Rs	**218.95**	**2736.84**
17	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		vertical 50mm dia	14			0.75	5.17	kg	54.29	
		Horizontal 0.25m c/c-32mm dia	3	13.8			3.17	kg	131.24	
		Say		**185.52**	kg		@	Rs	**194.18**	**36024.70**
18	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	14	0.75		0.05	0.525	m2		
		Horizontal pipe	3	13.8		0.03	1.3248	m2		
		Say		**1.85**	m2		@	Rs	**154.62**	**286.02**
19	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		for wll inside & bottom slab	1	31.25			0		**31.25**	
		Say		**31.25**	m2		@	Rs	**232.68**	**7271.10**
		Total Collection Tank for Co Treatment								**554757.65**
PRIMARY CLARIFIER										
m	**Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		For clarifier	1	12.4	12.4	1.5	230.64	m^3		
		Say		**230.64**	m^3					
		Do for item ------All kinds of	0.35	230.64			80.724	@Rs	223.41	18034.15
		Do for item ------Ordinay rock	0.35	230.64			80.724	@Rs	433.01	34954.38
		Medium rock with blasting	0.15	230.64			34.596	@Rs	541.27	18725.68
		Medium rock with out blasting	0.15	230.64			34.596	@Rs	898.50	31084.62
		Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 mto 3.0m, as directed by Engineer-in-charge								
			1	12.4	12.4	1.5	230.64	m^3		
		Say		230.64	m^3					
		Do for item ------All kinds of	0.25	230.64			57.66	@Rs	334.44	19283.54
		Do for item ------Ordinay rock	0.25	230.64			57.66	@Rs	632.14	36449.41
		Medium rock with blasting	0.25	230.64			57.66	@Rs	740.40	42691.47
		Medium rock with out blasting	0.25	230.64			57.66	@Rs	1097.64	63289.69
		Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 3.0 mto 4.5m, as directed by Engineer-in-charge								
			1	12.4	12.4	0.85	130.7	m^3		
		Say		130.70	m^3					
		Do for item ------All kinds of	0.25	130.70			32.675	@Rs	445.47	14555.59

		Do for item ------Ordinay rock	0.25	130.70			32.675	@Rs	831.28	27161.96
		Medium rock with blasting	0.25	130.70			32.675	@Rs	939.53	30699.23
		Medium rock with out blasting	0.25	130.70			32.675	@Rs	1296.77	42371.91
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		For clarifier foundation	1	12.4	12.4	0.15	23.06	m^3		
		Total					23.06	m^3		
		Say		**23.06**	m^3		@	Rs	**7527.06**	**173574.02**
3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately). Up to plinth level.								
		Base slab-raft beam slab type Circular	1	106.54		0.45	47.94	m^3		
		Total					47.94	m^3		
		Say		**47.94**	m^3		@	Rs	**10404.79**	**498846.98**
4	5.37.2 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately). Above plinth level.								
		walls circular	1	10.27		3.4	34.91	m^3		
		Top slab with inverted beam	1	102.02		0.2	20.40			
		Walk way	1	36.58	0.45	0.10	1.65			
		Total					56.96	m^3		
		Say		**56.96**	m^3		@	Rs	**12142.28**	**691629.13**
5	5.22.6 +OD16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		47.94	m^3	120	kg/m^3	5753.28	kg
		Quantity as per item No.4	1		56.96	m^3	120	kg/m^3	6835.25	kg
		Total							12588.52	kg
		Say		**12588.5**	kg		@	Rs	**104.91**	**1320652.50**
6	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		47.94	m3	340	kg/m^3	16300.95	kg
		Quantity as per item No.4	1		56.96	m3	340	kg/m^3	19366.53	kg
		Total							35667.48	kg
		Say		**713.35**	bags		@	Rs	**70.77**	**50480.19**
7	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Circular	1	36.11		0.45	16.25	m^2		
		Base slab-inverted beams	6	12.20		0.65	47.58	m^2		
		Wall circular outer	1	35.17		3.4	119.57	m^2		
		Wall circular inner	1	33.28		3.4	113.17	m^2		

		Walkway	1	36.58		0.5	18.29	m2		
		Total					314.86	m^2		
		Say		**314.86**	m^2		@	Rs	**350.00**	**110201.04**
8	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm									
		Inside of walls	1	33.60		3.4	114.2332	m^2		
		Total					114.23	m^2		
		Say		**114.23**	m^2		@	Rs	**595.28**	**68000.19**
9	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.									
		Bottom slab inside	1	89.87			89.87	m^2		
		Total					89.87	m^2		
		Say		**89.87**	m^2		@	Rs	**528.47**	**47496.33**
10	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	1	33.60		3.4	114.23	m^2		
		Base slab inside	1	89.87			89.87	m^2		
		Outside of walls	1	35.17		2.4	84.40			
		Walkway	1	36.58		1	36.58			
		Total					325.09	m^2		
		Say		**325.09**	m^2		@	Rs	**418.79**	**136144.41**
11	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design									
			10				10	No.		
		Say		**10**	No.		@	Rs	**568.88**	**5688.80**
12	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	88.2026		2.9	255.7875	m3		
		total					255.7875			
		Say		**255.79**	Kilo litre		@	Rs	**218.95**	**56003.89**

13	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		vertical 50mm dia	37			0.75	5.17	kg	143.47	
		Horizontal 0.25m c/c-32mm dia	3	36.5			3.17	kg	347.12	
		Say		**490.583**	kg		@	Rs	**194.18**	**95260.90**
14	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	37	0.75		0.05	1.3875	m2		
		Horizontal pipe	3	36.5		0.03	3.504	m2		
		Say		**4.89**	m2		@	Rs	**154.62**	**756.33**
15	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Base slab & inside walls	1	204.11			0		**204.11**	
		Say		**204.108**	m2		@	Rs	**232.68**	**47490.86**
		Total-Primary Clarifier								**3681527.21**
MOVING BED BIOFILM REACTOR TANK-BOD REMOVAL										
Item No.	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
		Shape of tank	**1**	(put 1 for rectangular and 2 for circular)						
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		MBBR Tank-base	1	10.00	10	0.45	45	m^3		
		Total					45	m^3		
		Say		**45**	m^3		@	Rs	**223.41**	**10053.23**
2	7.1.1	Random rubble masonry in hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 up to plinth level with cement mortar 1:6								
		MBBR Tank-base	1	10.00	10	0.45	45	m^3		
		Total					45	m^3		
		Say		**45**	m^3		@	Rs	**7520.41**	**338418.40**
3	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		MBBR tank-base	1	10.00	10	0.15	15	m^3		
		Total					15	m^3		
		Say		**15**	m^3		@	Rs	**7527.06**	**112905.91**
4	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).								
		Base slab	1	10.00	10	0.45	45.00	m^3		
		Raft	1	11.90	11.9	0.35	49.56			
		Beam	4	11.90	0.35	0.65	10.83			
			4	11.40	0.35	0.65	10.37			

		Columns	16	0.35	0.35	1	1.96			
		Total					117.73	m^3		
		Say		**117.727**	m^3		@	Rs	**10404.79**	**1224919.54**
4a	5.37.2 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using Sulphate Resistant Cement (SRC) content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/3.Excess/less cement used as per design mix is payable/recoverable separately).									
		Tank walls	2	17.60	0.30	4.10	43.30	m^3		
		Walkway	4	11.45	0.45	0.10	2.06			
		Total					45.36	m^3		
		Say		**45.36**	m^3		@	Rs	**12129.26**	**550146.96**
5	5.22.6 +OD16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.4&4a	1		243.81	m^3	120	kg/m^3	29257.20	kg
		Total							29257.20	kg
		Say		**29257.2**	kg		@	Rs	**104.91**	**3069350.91**
6	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.4&4a	1		243.81	m^3	340	kg/m^3	82895.40	kg
		Total							82895.40	kg
		Say		**1657.91**	bags		@	Rs	**70.77**	**117321.86**
7	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab	2	18.20		0.35	12.74	m^2		
		Beam	8	11.65		1.3	121.16			
		Column	16	1.40		1	22.40			
		Total					156.30	m^2		
		Say		**156.30**	m^2		@	Rs	**350.00**	**54705.58**
8	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside	2	18.20		4.10	149.24	m^2		
		For walls inside	2	17.00		4.10	139.4	m^2		
		Walk way	4	11.45	0.5		22.9			
		Total					311.54	m^2		
		Say		**311.54**	m^2		@	Rs	**748.62**	**233225.99**
9	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm									

		Inside of walls	2	17.00		4.10	139.40	m^2		
		Total					139.40	m^2		
		Say		**139.40**	m^2		@	Rs	**595.28**	**82981.36**
10	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside	1	8.50	8.5		72.25	m^2		
		Total					72.25	m^2		
		Say		**72.25**	m^2		@	Rs	**458.77**	**33146.10**
11	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	2	17.00		4.10	139.40	m^2		
		Base slab inside	1	8.50	8.5		72.25	m^2		
		Outside wall	2	22.00		4.4	193.60			
		Walk way	4	11.45	1		45.80			
		Total					451.05	m^2		
		Say		**451.05**	m^2		@	Rs	**418.79**	**188894.00**
12	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
			12				12	No.		
		Say		**12**	No.		@	Rs	**568.88**	**6826.56**
13	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	10.4	10.4	3.6	389.376	m3		
		total					389.376			
		Say		**389.38**	Kilo litre		@	Rs	**218.95**	**85252.67**
14	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total-45.8m/1m c/c vertical 50mm dia	46			0.75	5.17	kg	178.37	
		Horizontal 0.25m c/c-32mm dia	3	45.8			3.17	kg	435.56	
		Say		**613.92**	kg		@	Rs	**194.18**	**119211.05**
15	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	46	0.75		0.05	1.725	m2		
		Horizontal pipe	3	45.8		0.03	4.40	m2		

		Say		**6.12**	m2			@	Rs	**154.62**	**946.56**
16	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work									
		Base slab & inside walls	1	211.65			0			**211.65**	
		Say		**211.65**	m2			@	Rs	**232.68**	**49245.73**
		Total-MBBR Tank-1									**6277552.41**
MOVING BED BIOFILM REACTOR TANK- NITRIFICATION											
Item No.	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**	
		Shape of tank	**1**	(put 1 for rectangular and 2 for circular)							
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge									
		MBBR Tank-base	1	11.20	11.2	1.00	125.44	m^3			
		Total					125.44	m^3			
		Say		**125.44**	m^3			@	Rs	**223.41**	**28023.94**
2	7.1.1	Random rubble masonry in hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 up to plinth level with cement mortar 1:6									
		MBBR Tank-base	1	11.20	11.2	0.90	112.9	m^3			
		Total					112.9	m^3			
		Say		**112.9**	m^3			@	Rs	**7520.41**	**849054.16**
3	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)									
		MBBR tank-base	1	11.2	11.2	0.15	18.82	m^3			
		Total					18.82	m^3			
		Say		**18.82**	m^3			@	Rs	**7527.06**	**141659.28**
4	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately).									
		Base slab	1	11.2	11.2	0.35	43.90	m^3			
		Total					43.90	m^3			
		Say		**43.90**	m^3			@	Rs	**10404.79**	**456811.91**
4a	5.37.2 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using Sulphate Resistant Cement (SRC) content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/3.Excess/less cement used as per design mix is payable/recoverable separately).									
		Tank walls	2	20.00	0.30	4.10	49.20	m^3			
		Walk way	4	**10.75**	0.45	0.1	1.94				
		Total					51.14	m^3			
		Say		**51.14**	m^3			@	Rs	**12129.26**	**620229.84**

5	5.22.6 +OD16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.4&4a	1		144.24	m^3	120	kg/m^3	17308.80	kg
		Total							17308.80	kg
		Say		**17308.8**	kg		@	Rs	**104.91**	**1815853.23**
6	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.4&4a	1		144.24	m^3	340	kg/m^3	49041.60	kg
		Total							49041.60	kg
		Say		**980.83**	bags		@	Rs	**70.77**	**69408.58**
7	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab	2	20.60		0.35	14.42	m^2		
		Total					14.42	m^2		
		Say		**14.42**	m^2		@	Rs	**350.00**	**5047.05**
8	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside	2	20.60		4.10	168.92	m^2		
		For walls inside	2	19.40		4.10	159.1	m^2		
		Walk way	4	11.45		1.00	45.8			
		Total					373.80	m^2		
		Say		**373.80**	m^2		@	Rs	**748.62**	**279835.25**
9	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls	2	19.40		4.10	159.08	m^2		
		Total					159.08	m^2		
		Say		**159.08**	m^2		@	Rs	**595.28**	**94696.38**
10	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside	1	9.70	9.7		94.09	m^2		
		Total					94.09	m^2		
		Say		**94.09**	m^2		@	Rs	**458.77**	**43165.62**
11	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	2	19.40		4.10	159.08	m^2		
		Base slab inside	1	9.70	9.7		94.09	m^2		
		Total					253.17	m^2		

		Say		**253.17**	m^2		@	Rs	**418.79**	**106024.37**
12	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
			12				12	No.		
		Say		**12**	No.		@	Rs	**568.88**	**6826.56**
13	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	9.7	9.7	3.6	338.724	m3		
		total					338.724			
		Say		**338.72**	Kilo litre		@	Rs	**218.95**	**74162.57**
14	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing,								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total-45.8m/1m c/c vertical 50mm dia	46			0.75	5.17	kg	178.37	
		Horizontal 0.25m c/c-32mm dia	3	45.8			3.17	kg	435.56	
		Say		**613.92**	kg		@	Rs	**194.18**	**119211.05**
15	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	46	0.75		0.05	1.725	m2		
		Horizontal pipe	3	45.8		0.03	4.40	m2		
		Say		**6.12**	m2		@	Rs	**154.62**	**946.56**
16	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Base slab & inside walls	1	253.17			1		**253.17**	
		Say		**253.17**	m2		@	Rs	**232.68**	**58906.41**
		Total-MBBR Tank-2								**4769862.76**
MOVING BED BIOFILM REACTOR TANK- DENITRIFICATION										
m	**Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
		Shape of tank	**1**	(put 1 for rectangular and 2 for circular)						
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		MBBR Tank-base	1	7.70	7.7	0.90	53.36	m^3		
		Total					53.36	m^3		
		Say		**53.36**	m^3		@	Rs	**223.41**	**11920.90**
2	7.1.1	Random rubble masonry in hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 up to plinth level with cement mortar 1:6								
		MBBR Tank-base	1	7.70	7.7	0.60	35.57	m^3		
		Total					35.57	m^3		
		Say		**35.57**	m^3		@	Rs	**7520.41**	**267500.94**
3	4.1.6	work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		MBBR tank-base	1	7.7	7.7	0.15	8.89	m^3		
		Total					8.89	m^3		

		Say		**8.89**	m^3		@	Rs	**7527.06**	**66915.57**
4	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately).								
		Base slab	1	7.7	7.7	0.35	20.75	m^3		
		Inverted beam	4	7.00	0.30	0.55	4.62			
		Total					25.37	m^3		
		Say		**25.37**	m^3		@	Rs	**10404.79**	**263985.14**
4a		Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately).								
		Tank walls	2	13.30	0.30	4.10	32.72	m^3		
		Top slab	1	7.00	7.00	0.15	7.35			
		Column	1	0.35	0.35	4.10	0.50			
		Walkway	4	7.25	0.45	0.10	1.31			
		Total					41.88	m3		
		Say		41.8753	m3		@	Rs	**12129.26**	**507915.90**
5	5.22.6 +OD16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.4&4a	1		67.25	m^3	120	kg/m^3	8069.61	kg
		Total							8069.61	kg
		Say		**8069.61**	kg		@	Rs	**104.91**	**846576.73**
6	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.2	1		67.25	m^3	340	kg/m^3	22863.90	kg
		Total							22863.90	kg
		Say		**457.28**	bags		@	Rs	**70.77**	**32359.27**
7	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab	2	13.60		0.35	9.52	m^2		
		Total					9.52	m^2		
		Say		**9.52**	m^2		@	Rs	**350.00**	**3332.04**
8	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside	2	13.60		4.10	111.52	m^2		
		For walls inside	2	12.40		4.10	101.7	m^2		
		top slab	1	6.20	6.2		38.4	m2		
		Beam	2	6.20	1.1		13.64			
		Walkway	4	7.25	1		29.00			
		Total					294.28	m^2		
		Say		**294.28**	m^2		@	Rs	**748.62**	**220304.76**

9	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls	2	12.40		4.10	101.68	m^2		
		Total					101.68	m^2		
		Say		**101.68**	m^2		@	Rs	**595.28**	**60527.58**
10	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside	1	6.20	6.2		38.44	m^2		
		Total					38.44	m^2		
		Say		**38.44**	m^2		@	Rs	**458.77**	**17635.10**
11	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	2	12.40		4.40	109.12	m^2		
		Base slab inside	1	6.20	6.2		38.44	m^2		
		Cover slab top	1	7.15	7.15		51.12	m^2		
		Cover slab bottom	1	6.20	6.2		38.44	m^2		
		Beam	2	6.20		1.4	17.36			
		Outside wall	4	6.80		4.1	111.52			
		Walkway	4	7.25		1	29			
		Total					395.0025	m^2		
		Say		**395.003**	m^2		@	Rs	**418.79**	**165422.02**
12	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
			12				12	No.		
		Say		**12**	No.		@	Rs	**568.88**	**6826.56**
13	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	6.2	6.2	3.6	138.384	m3		
		total					138.384			
		Say		**138.38**	Kilo litre		@	Rs	**218.95**	**30298.75**
14	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing,								

		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total-45.8m/1m c/c vertical 50mm dia	46			0.75	5.17	kg	178.37	
		Horizontal 0.25m c/c-32mm dia	3	45.8			3.17	kg	435.56	
		Say		**613.923**	kg		@	Rs	**194.18**	**119211.05**
15	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	46	0.75		0.05	1.725	m2		
		Horizontal pipe	3	45.8		0.03	4.40	m2		
		Say		**6.12**	m2		@	Rs	**154.62**	**946.56**
16	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per								
		Base slab & inside walls	1	254.48			0		**254.48**	
		Say		**254.483**	m2		@	Rs	**232.68**	**59211.80**
		Total-MBBR Tank-3								**2680890.67**
MOVING BED BIOFILM REACTOR TANK- BOD REMOVA AFTER DENITRIFICATION										
m	**Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
		Shape of tank	**1**	(put 1 for rectangular and 2 for circular)						
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		MBBR Tank-base	1	5.40	5.4	0.90	26.24	m^3		
		Total					26.24	m^3		
		Say		**26.24**	m^3		@	Rs	**223.41**	**5862.15**
2	7.1.1	Random rubble masonry in hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 up to plinth level with cement mortar 1:6								
		MBBR Tank-base	1	5.40	5.4	0.45	13.12	m^3		
		Total					13.12	m^3		
		Say		**13.12**	m^3		@	Rs	**7520.41**	**98667.76**
3	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		MBBR tank-base	1	5.4	5.4	0.15	4.37	m^3		
		Total					4.37	m^3		
		Say		**4.37**	m^3		@	Rs	**7527.06**	**32893.26**
4	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately).								
		Base slab	1	5.4	5.4	0.35	10.21	m^3		
		Total					10.21	m^3		
		Say		**10.21**	m^3		@	Rs	**10404.79**	**106191.29**
	5.37.2 +5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately).								

		Tank walls	2	8.40	0.30	4.10	20.66	m^3		
		Walkway	4	4.95	0.45	0.1	0.89			
		Total					21.56			
		Say		**21.56**	m^3		@	Rs	**12129.26**	**261446.25**
5	5.22.6 +OD16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.4a & 4	1		52.43	m^3	120	kg/m^3	6291.60	kg
		Total							6291.60	kg
		Say		**6291.6**	kg		@	Rs	**104.91**	**660047.04**
6	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.2	1		52.43	m^3	340	kg/m^3	17826.20	kg
		Total							17826.20	kg
		Say		**356.52**	bags		@	Rs	**70.77**	**25229.42**
7	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab	2	9.00		0.35	6.30	m^2		
		Total					6.30	m^2		
		Say		**6.30**	m^2		@	Rs	**350.00**	**2205.02**
8	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside	2	9.00		4.10	73.8	m^2		
		For walls inside	2	7.80		4.10	64.0	m^2		
		Walkway	4	4.35	0.5		8.7			
		Total					146.46	m^2		
		Say		**146.46**	m^2		@	Rs	**748.62**	**109643.32**
9	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls	2	7.80		4.10	63.96	m^2		
		Total					63.96	m^2		
		Say		**63.96**	m^2		@	Rs	**595.28**	**38073.80**
10	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside	1	3.90	3.9		15.21	m^2		
		Total					15.21	m^2		
		Say		**15.21**	m^2		@	Rs	**458.77**	**6977.88**

11	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	2	7.80		4.10	63.96	m^2		
		Outside of walls	2	9.00		4.40	79.2			
		Base slab inside	1	3.90	3.9		15.21	m^2		
		Walkway	4	4.95	1		19.80			
		Total					178.17	m^2		
		Say		**178.17**	m^2		@	Rs	**418.79**	**74615.33**
12	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with								
			12				12	No.		
		Say		**12**	No.		@	Rs	**568.88**	**6826.56**
13	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	3.9	3.9	3.6	54.756	m3		
		total					54.756			
		Say		**54.76**	Kilo litre		@	Rs	**218.95**	**11988.66**
14	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total 19.8m/1m c/c vertical 50mm dia	20			0.75	5.17	kg	77.55	
		Horizontal 0.25m c/c-32mm dia	3	19.8			3.17	kg	188.30	
		Say		**265.85**	kg		@	Rs	**194.18**	**51622.14**
15	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per								
		vertical pipe	20	0.75		0.05	0.75	m2		
		Horizontal pipe	3	19.8		0.03	1.9008	m2		
		Say		**2.65**	m2		@	Rs	**154.62**	**409.87**
16	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Base slab & inside walls	1	79.17			0		**79.17**	
		Say		**79.17**	m2		@	Rs	**232.68**	**18420.91**
		Total-MBBR Tank-4								**1511120.66**
SECONDARY CLARIFIER WITH PLATE SETTLER										
m	**Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		For clarifier	1	6.55	6.55	1.5	64.35	m^3		
		Say		**64.35**	m^3					
		Do for item ------All kinds of soil	0.35	64.35			22.5225	@Rs	223.41	5031.64
		Do for item ------Ordinay rock	0.35	64.35			22.5225	@Rs	433.01	9752.49
		Medium rock with blasting	0.15	230.64			34.596	@Rs	541.27	18725.68
		Medium rock with out blasting	0.15	230.64			34.596	@Rs	898.50	31084.62

2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		For clarifier foundation	1	6.55	6.55	0.15	6.44	m^3		
		Total					6.44	m^3		
		Say		**6.44**	m^3		@	Rs	**7527.06**	**48474.27**
3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately). Up to plinth level.								
		Base slab-raft beam slab type	1	6.55	6.55	0.35	15.02	m^3		
		Base slab-inverted beams	4	5.00	0.35	0.45	3.15	m^3		
		Total					18.17	m^3		
		Say		**18.17**	m^3		@	Rs	**10404.79**	**189012.12**
4	5.37.2 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately). Above plinth level.								
		Columns-long	4	0.35	0.35	5.2	2.55	m3		
		Columns-short	4	0.35	0.35	0.4	0.20	m3		
		Clarifier-square container	4	5.05	0.3	2.9	17.57			
		Clarifier-hopper container	4	3.68	0.3	2.77	12.20			
		Top beams	4	5.00	0.35	0.45	3.15			
		Walk way	4	5.80	0.45	0.10	1.04			
		Total					36.71	m^3		
		Deductions								
		Inlet pipe	1	0.031	0.3		0.01	m^3		
		Total					36.70	m^3		
		Say		**36.70**	m^3		@	Rs	**12142.28**	**445628.24**
5	5.22.6 +od16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		18.17	m^3	120	kg/m^3	2179.91	kg
		Quantity as per item No.4	1		36.70	m^3	120	kg/m^3	4404.06	kg
		Total							6583.97	kg
		Say		**6583.97**	kg		@	Rs	**104.91**	**690719.22**
6	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		18.17	m3	340	kg/m^3	6176.40	kg
		Quantity as per item No.4	1		36.70	m3	340	kg/m^3	12478.18	kg
		Total							18654.58	kg
		Say		**373.092**	bags		@	Rs	**70.77**	**26401.82**

7	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Base slab-raft beam slab type	4	6.55		0.35	9.17	m^2		
		Base slab-inverted beams	4	5.35		0.45	9.63	m^2		
		Base slab-inverted beams	4	4.65		0.45	8.37	m^2		
		Walkway	4	5.80		0.5	11.60			
		Total					38.77	m^2		
		Say		**38.77**	m^2		@	Rs	**350.00**	**13569.64**
8	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls-upper	4	4.75		2.9	55.1	m^2		
		Inside of walls-lower	4	3.38		2.77	37.34	m^2		
		Total					92.44	m^2		
		Say		**92.44**	m^2		@	Rs	**595.28**	**55027.64**
9	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside	1	2.00	2		4.00	m^2		
		Total					4.00	m^2		
		Say		**4.00**	m^2		@	Rs	**458.77**	**1835.08**
10	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls-upper	4	4.75		2.9	55.10	m^2		
		Inside of walls-lower	4	3.38		2.77	37.34	m^2		
		Base slab inside	1	2.00	2		4.00	m^2		
		Outside of walls-upper	4	5.35		2.9	62.06			
		Outside of walls-lower	4	3.98		2.78	44.26			
		Walkway	4	5.80		1	23.20			
		Total					225.96	m^2		
		Say		**225.96**	m^2		@	Rs	**418.79**	**94628.45**
12	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								

			16				16	No.		
		Say		**16**	No.		@	Rs	**568.88**	**9102.08**
13	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	4.75	4.75	4.8	108.3	m3		
		Total					108.3			
		Say		**108.30**	Kilo litre		@	Rs	**218.95**	**23711.95**
14	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total 23.2m/1m c/c vertical 50mm dia	23			0.75	5.17	kg	89.18	
		Horizontal 0.25m c/c-32mm dia	3	23.2			3.17	kg	220.63	
		Say		**309.815**	kg		@	Rs	**194.18**	**60159.52**
15	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	23	0.75		0.05	0.8625	m2		
		Horizontal pipe	3	23.2		0.03	2.23	m2		
		Say		**3.09**	m2		@	Rs	**154.62**	**477.73**
16	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Base slab & inside walls	1	96.44			0		**96.44**	
		Say		**96.44**	m2		@	Rs	**232.68**	**22439.37**
		Total-Secondary Clarifier with Plate Settler								**1745781.56**
SLUDGE SUMP-*circular*										
Item No.	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		For sludge sump	1	3	3	1	9	m^3		
		Total					9	m^3		
		Say		**9**	m^3		@	Rs	**223.41**	**2010.65**
		Random rubble masonry in hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 up to plinth level with cement mortar 1:6								
			1	**3**	3	0.45	112.9	m3		
		Total					112.9	m3		
		Say		**112.9**	m3		@	Rs	**7520.41**	**849054.16**
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		For sludge sump	1	2.85	2.85	0.15	1.22	m^3		
		Total					1.22	m^3		
		Say		**1.22**	m^3		@	Rs	**7527.06**	**9183.01**

3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).								
		Base slab	1	2.85	2.85	0.3	2.44	m^3		
		Tank walls	1	6.28	0.25	2.7	4.24	m^3		
		Walkway	1	8.48	0.45	0.1	0.38			
		Total					7.06	m^3		
		Say		**7.06**	m^3		@	Rs	**10404.79**	**73429.31**
4	5.22.6 +OD16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		7.06	m^3	120	kg/m^3	846.87	kg
		Total							846.87	kg
		Say		**846.871**	kg		@	Rs	**104.91**	**88844.62**
5	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		7.06	m^3	340	kg/m^3	2399.47	kg
		Total							2399.47	kg
		Say		**47.99**	bags		@	Rs	**70.77**	**3395.97**
6	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab	4	2.85		0.3	3.42	m^2		
		Total					3.42	m^2		
		Say		**3.42**	m^2		@	Rs	**350.00**	**1197.01**
7	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside	1	7.07		2.7	19.08	m^2		
		For walls inside	1	5.50		2.7	14.8	m^2		
		Walkway	1	8.48		0.5	4.2			
		Total					38.15	m^2		
		Say		**38.15**	m^2		@	Rs	**748.62**	**28560.71**
8	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls	1	5.50		2.7	14.84	m^2		
		Total					14.84	m^2		
		Say		**14.84**	m^2		@	Rs	**595.28**	**8831.80**

9	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside	1	2.41			2.41	m^2		
		Total					2.41	m^2		
		Say		**2.41**	m^2		@	Rs	**458.77**	**1103.47**
10	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	1	5.50		2.7	14.84	m^2		
		Base slab inside	1	2.41			2.41	m^2		
		Outside wall	1	7.07		2.95	20.84			
		Walkway	1	8.48		1	8.48			
		Total					46.56	m^2		
		Say		**46.56**	m^2		@	Rs	**418.79**	**19499.38**
11	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
			3				3	No.		
		Say		**3**	No.		@	Rs	**568.88**	**1706.64**
12	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	2.40		1.5	3.61	m3		
		total					3.61			
		Say		**3.61**	Kilo litre		@	Rs	**218.95**	**789.54**
13	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total 8.48m/1m c/c vertical 50mm dia	9			0.75	5.17	kg	34.90	
		Horizontal 0.25m c/c-32mm dia	3	8.48			3.17	kg	80.64	
		Say		**115.542**	kg		@	Rs	**194.18**	**22435.91**
14	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per								
		vertical pipe	9	0.75		0.05	0.3375	m2		
		Horizontal pipe	3	8.48		0.03	0.81	m2		
		Say		**1.15**	m2		@	Rs	**154.62**	**178.06**
15	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per								
		Base slab & inside walls	1	17.24			0		**17.24**	
		Say		**17.2418**	m2		@	Rs	**232.68**	**4011.74**

		Total-Sludge Sump								**1114231.98**
SLUDGE THICKENER-*circular*										
Item No.	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		For sludge thickener	1	5.45	5.45	1	29.7	m^3		
		Total					29.7	m^3	223.41	6635.13
		Random rubble masonry in hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 up to plinth level with cement mortar 1:6								
			1	**5.45**	5.45	0.45	112.9	m3		
		Total					112.9	m3		
		Say		**112.9**	m3			@ Rs	**7520.41**	**849054.16**
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		For sludge thickener	1	5.4	5.4	0.15	4.37	m^3		
		Total					4.37	m^3		
		Say		**4.37**	m^3			@ Rs	**7527.06**	**32893.26**
3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).								
		Base slab	1	5.4	5.4	0.35	10.21	m^3		
		Tank walls	1	13.82	0.3	2.5	10.36	m^3		
		Total					20.57	m^3		
		Say		**20.57**	m^3			@ Rs	**10404.79**	**214005.73**
4	5.22.6 +OD16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		20.57	m^3	120	kg/m^3	2468.16	kg
		Total							2468.16	kg
		Say		**2468.16**	kg			@ Rs	**104.91**	**258932.81**
5	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		20.57	m^3	340	kg/m^3	6993.12	kg
		Total							6993.12	kg
		Say		**139.86**	bags			@ Rs	**70.77**	**9897.36**
6	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab	4	5.40		0.35	7.56	m^2		
		Total					7.56	m^2		
		Say		**7.56**	m^2			@ Rs	**350.00**	**2646.03**
7	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside	1	14.76		2.5	36.90	m^2		

		For walls inside	1	12.87		2.5	32.2	m^2		
		Total					69.08	m^2		
		Say		**69.08**	m^2		@	Rs	**748.62**	**51714.87**
8	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm									
		Inside of walls	1	12.87		2.5	32.19	m^2		
		Total					32.19	m^2		
		Say		**32.19**	m^2		@	Rs	**595.28**	**19158.93**
9	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.									
		Bottom slab inside	1	13.20			13.20	m^2		
		Total					13.20	m^2		
		Say		**13.20**	m^2		@	Rs	**458.77**	**6056.94**
10	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	1	12.87		2.5	32.19	m^2		
		Outside of walls	1	14.76		2.8	41.32			
		Base slab inside	1	13.20			13.20	m^2		
		Total					86.71	m^2		
		Say		**86.71**	m^2		@	Rs	**418.79**	**36313.03**
11	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design									
			4				4	No.		
		Say		**4**	No.		@	Rs	**568.88**	**2275.52**
12	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	13.85		2	27.69	m3		
		total					27.69			
		Say		**27.69**	Kilo litre		@	Rs	**218.95**	**6063.69**
13	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing,								

		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total 8.48m/1m c/c vertical 50mm dia	9			0.75	5.17	kg	34.90	
		Horizontal 0.25m c/c-32mm dia	3	8.48			3.17	kg	80.64	
		Say		**115.542**	kg		@	Rs	**194.18**	**22435.91**
14	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	9	0.75		0.05	0.3375	m2		
		Horizontal pipe	3	8.48		0.03	0.81	m2		
		Say		**1.15**	m2		@	Rs	**154.62**	**178.06**
15	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Base slab & inside walls	1	45.39			0		**45.39**	
		Say		**45.3876**	m2		@	Rs	**232.68**	**10560.57**
		Total- Sludge Thickener								**1528822.00**
CHLORINE CONTACT TANK-*rectangular*										
m No	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		For chlorine contact tank	1	5.4	5.4	2.65	77.27	m^3		
		Total					77.27	m^3		
		Say		**77.27**	m^3		@	Rs	**223.41**	**17262.51**
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		For chlorine contact tank	1	5.4	5.4	0.15	4.37	m^3		
		Total					4.37	m^3		
		Say		**4.37**	m^3		@	Rs	**7527.06**	**32893.26**
3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).								
		Base slab	1	5.4	5.4	0.3	8.75	m^3		
		Tank walls	4	4.55	0.25	2.5	11.38	m^3		
		Walkway	4	5.00	0.45	0.1	0.90			
		Total					20.12	m^3		
		Say		**20.12**	m^3		@	Rs	**10404.79**	**209375.59**
4	5.22.6 +OD16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		20.12	m^3	120	kg/m^3	2414.76	kg
		Total							2414.76	kg
		Say		**2414.76**	kg		@	Rs	**104.91**	**253330.66**

5	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		20.12	m^3	340	kg/m^3	6841.82	kg
		Total							6841.82	kg
		Say		**136.84**	bags		@	Rs	**70.77**	**9683.23**
6	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab	4	5.40		0.3	6.48	m^2		
		Total					6.48	m^2		
		Say		**6.48**	m^2		@	Rs	**350.00**	**2268.02**
7	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside	4	4.80		2.5	48.00	m^2		
		For walls inside	4	4.30		2.5	43.0	m^2		
		Walkway	4	5.00		0.55	11.0	m2		
		Total					102.00	m^2		
		Say		**102.00**	m^2		@	Rs	**748.62**	**76359.54**
8	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls	4	4.30		2.5	43.00	m^2		
		Total					43.00	m^2		
		Say		**43.00**	m^2		@	Rs	**595.28**	**25596.83**
9	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside	1	4.30	4.3		18.49	m^2		
		Total					18.49	m^2		
		Say		**18.49**	m^2		@	Rs	**458.77**	**8482.65**
10	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	4	4.30		2.75	47.30	m^2		
		Outside of walls	4	5.00		2.5	50.00			
		Base slab inside	1	4.30	4.3		18.49	m^2		
		Walkway	4	5.00		1	20.00			
		Total					135.79	m^2		
		Say		**135.79**	m^2		@	Rs	**418.79**	**56867.12**

11	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
			4				4	No.		
		Say		**4**	No.		@	Rs	**568.88**	**2275.52**
12	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	4.30	4.3	2	36.98	m3		
		total					36.98			
		Say		**36.98**	Kilo litre		@	Rs	**218.95**	**8096.66**
13	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing,								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total 23.6 m/1m c/c vertical 50mm dia	24			0.75	5.17	kg	93.06	
		Horizontal 0.25m c/c-32mm dia	3	23.6			3.17	kg	224.44	
		Say		**317.496**	kg		@	Rs	**194.18**	**61651.11**
14	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	24	0.75		0.05	0.9	m2		
		Horizontal pipe	3	23.6		0.03	2.27	m2		
		Say		**3.17**	m2		@	Rs	**154.62**	**489.47**
15	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Base slab & inside walls	1	65.79			0		**65.79**	
		Say		**65.79**	m2		@	Rs	**232.68**	**15307.71**
		Total-Chlorine Contact Tank								**779939.88**
FILTER FEED TANK-*rectangular*										
m No.	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge								
		For filter feed tank	1	4.6	4.6	0.5	10.58	m^3		
		Total					10.58	m^3		
		Say		**10.58**	m^3		@	Rs	**223.41**	**2363.63**
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		For filter feed tank	1	4.6	4.6	0.15	3.17	m^3		
		Total					3.17	m^3		
		Say		**3.17**	m^3		@	Rs	**7527.06**	**23860.78**

3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).								
		Base slab	1	4.6	4.6	0.3	6.35	m^3		
		Raft	1	4.6	4.6	0.45	9.52			
		Column	4	0.35	0.35	2	0.98			
		Tank walls	2	7.50	0.25	2.5	9.38	m^3		
		Walkway	4	4.10	0.45	0.1	0.74			
		Total					26.96	m^3		
		Say		**26.96**	m^3		@	Rs	**10404.79**	**280544.36**
4	5.22.6 +OD16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		26.96	m^3	120	kg/m^3	3235.56	kg
		Total							3235.56	kg
		Say		**3235.56**	kg		@	Rs	**104.91**	**339440.17**
5	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		26.96	m^3	340	kg/m^3	9167.42	kg
		Total							9167.42	kg
		Say		**183.35**	bags		@	Rs	**70.77**	**12974.65**
6	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab	2	9.20		0.3	5.52	m^2		
		Raft	2	9.50		0.45	8.55			
		Column	4	1.40		2	11.2			
		Total					25.27	m^2		
		Say		**25.27**	m^2		@	Rs	**350.00**	**8844.59**
7	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For walls outside	2	8.00		2.5	40.00	m^2		
		For walls inside	2	7.00		2.5	35.0	m^2		
		Walkway	4	4.55		0.55	10.0			
		Total					85.01	m^2		
		Say		**85.01**	m^2		@	Rs	**748.62**	**63640.44**
8	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls	2	7.00		2.5	35.00	m^2		
		Total					35.00	m^2		

		Say		**35.00**	m^2		@	Rs	**595.28**	**20834.63**
9	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside	1	3.50	3.50		12.25	m^2		
		Total					12.25	m^2		
		Say		**12.25**	m^2		@	Rs	**458.77**	**5619.93**
10	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	2	7.00		2.5	35.00	m^2		
		Base slab inside	1	3.50	3.5		12.25	m^2		
		Outside wall	2	8.20		2.8	45.92			
		Total					93.17	m^2		
		Say		**93.17**	m^2		@	Rs	**418.79**	**39018.41**
11	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design									
			4				4	No.		
		Say		**4**	No.		@	Rs	**568.88**	**2275.52**
12	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	3.60	3.6	2	25.92	m3		
		total					25.92			
		Say		**25.92**	Kilo litre		@	Rs	**218.95**	**5675.10**
13	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total 20 m/1m c/c vertical 50mm dia	20			0.75	5.17	kg	77.55	
		Horizontal 0.25m c/c-32mm dia	3	20			3.17	kg	190.20	
		Say		**267.75**	kg		@	Rs	**194.18**	**51991.47**
14	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	20	0.75		0.05	0.75	m2		
		Horizontal pipe	3	20		0.03	1.92	m2		
		Say		**2.67**	m2		@	Rs	**154.62**	**412.84**
15	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per								
		Base slab & inside walls	1	47.25			0		**47.25**	

		Say		**47.25**	m2			@	Rs	**232.68**	**10993.91**
		Total- Filter Feed Tank									**868490.43**
TREATED WATER TANK-*rectangular*											
m	**Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**		**Rate**	**Amount**
1	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge									
		For treated water tank	1	6.6	6.6	0.75	32.67	m^3			
		Total					32.67	m^3			
		Say		**32.67**	m^3		@	Rs		**223.41**	**7298.64**
2	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)									
		For treated water tank	1	6.6	6.6	0.15	6.53	m^3			
		Total					6.53	m^3			
		Say		**6.53**	m^3		@	Rs		**7527.06**	**49151.71**
3	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).									
		Base slab	1	6.6	6.6	0.6	26.14	m^3			
		Tank walls	2	11.50	0.25	3	17.25	m^3			
		walkway	4	6.00	0.45	0.1	1.08				
		Total					44.47	m^3			
		Say		**44.47**	m^3		@	Rs		**10404.79**	**462659.40**
4	5.22.6 +od16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.									
		Quantity as per item No.3	1		44.47	m^3	120	kg/m^3		5335.92	kg
		Total								5335.92	kg
		Say		**5335.92**	kg		@	Rs		**104.91**	**559787.37**
5	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.									
		Quantity as per item No.3	1		44.47	m^3	340	kg/m^3		15118.44	kg
		Total								15118.44	kg
		Say		**302.37**	bags		@	Rs		**70.77**	**21397.13**
6	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete									
		Bottom slab	2	13.20		0.6	15.84	m^2			
		Total					15.84	m^2			
		Say		**15.84**	m^2		@	Rs		**350.00**	**5544.06**
7	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.									
		For walls outside	2	12.00		3.25	78.00	m^2			
		For walls inside	2	11.00		3	66.0	m^2			
		walkway	4	6.00		0.55	13.2				
		Total					157.20	m^2			
		Say		**157.20**	m^2		@	Rs		**748.62**	**117683.53**

8	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls	2	11.00		3	66.00	m^2		
		Total					66.00	m^2		
		Say		**66.00**	m^2		@	Rs	**595.28**	**39288.16**
9	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab inside	1	5.50	5.50		30.25	m^2		
		Total					30.25	m^2		
		Say		**30.25**	m^2		@	Rs	**458.77**	**13877.78**
10	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls	2	11.00		3	66.00	m^2		
		Outside walls	2	12.00		3.25	78.00			
		Base slab inside	1	5.50	5.5		30.25	m^2		
		Walkway	4	6.00		1	24.00			
		Total					198.25	m^2		
		Say		**198.25**	m^2		@	Rs	**418.79**	**83024.58**
11	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with								
			8				8	No.		
		Say		**8**	No.		@	Rs	**568.88**	**4551.04**
12	100.36	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	5.50	5.5	2.5	75.63	m3		
		total					75.63			
		Say		**75.63**	Kilo litre		@	Rs	**218.95**	**16557.86**
13	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total 27.60 m/1m c/c vertical 50mm dia	28			0.75	5.17	kg	108.57	

		Horizontal 0.25m c/c-32mm dia	3	27.6			3.17	kg	262.48	
		Say		**371.046**	kg		@	Rs	**194.18**	**72049.40**
14	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per								
		vertical pipe	28	0.75		0.05	1.05	m2		
		Horizontal pipe	3	27.6		0.03	2.65	m2		
		Say		**3.70**	m2		@	Rs	**154.62**	**572.04**
15	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per								
		Base slab & inside walls	1	96.25			0		**96.25**	
		Say		**96.25**	m2		@	Rs	**232.68**	**22395.00**
		Total- Treated water Tank								**1475837.70**
		TOTAL FOR STP UNITS								**₹ 36,500,846**

ECO-FRIENDLY UNITS										
m	**Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
a	Green Belt, Special Exterior Wall Garden and Landscaping, 3 layer buffer vegetation in the outer periphery with provision for landscape and internal roads.									
			1	Nos.			@	Rs	1155000.00	1155000.00
		Total- Eco-friendly units								1155000.00
b	Facility for Recycling Purposes									
			1	Nos.			@	Rs	150000	150000.00
		Total- Facility for recycling purposes								150000.00
c	Pump house building above wells									
		Wells	5	Nos.			@	Rs	1100000.00	5500000.00
		Compound wall for well site	4	Nos.			@	Rs	350000.00	1400000.00
d	Equipment, Laboratory items, Furniture and Computer system for CIPS of IoT									
			1	Nos.			@	Rs	133928.57	133928.57
e	Construction of adminidtaration cum laboratary building									
			1000	Sq.m			@	Rs	16000.00	16000000.00
		Compound wall	1				@	Rs	1500000.00	1500000.00
MECHANICAL ITEMS										
m No	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1		Raw Effluent Transfer pump - Supply, Installation, Commissioning, testing and trial run of submersible sewage handling type pump, with specified discharge and head and of reputed make.								
		Power of pump required	9	HP	Q	25.44	LPS	H	12.00	**m**
			2	**Nos.**			**@**	**Rs**	248806.08	497612.16
2		Bar Screen- Supply and installation, of manual bar screen, MS – epoxy frame to be fitted in bar screen chamber of specified width, with MS flat bars and 20 mm c/c gap between bars. The frame to be mounted on the chamber and provided with MS rake arm with racks for removal of collected solids and trough to be provided for transfer of the collected solids.Flow Rate and height should be as specified. Angle of Inclination: 45 Degree,Spacing: 20mm, Bar Size: 50x10 mm								
		Width of screen channel-STP	0.75	m	Q	0.05	m3/sec	H	1.20	m
		Width of screen channel-CTU	0.45	m	Q	0	m3/sec	H	0.60	m
			4	No.			@	Rs	25000.00	100000.00
		For lift stations	24	No.			@	Rs	25000.00	600000.00
		For Wells	10	No.			@	Rs	25000.00	250000.00
		Total								**950000.00**

3		Bar Screen-fine- Supply and installation, of manual bar screen, MS – epoxy frame to be fitted in bar screen chamber of specified width, with MS flat bars and 20 mm c/c gap between bars. The frame to be mounted on the chamber and provided with MS rake arm with racks for removal of collected solids and trough to be provided for transfer of the collected solids.Flow Rate and height should be as specified. Angle of Inclination: 45 Degree,Spacing: 6mm								
		Width of screen channel	0.75	m	Q	0.046	m^3/sec	H	1.00	m
			2	No.			@	Rs	25000.00	**50000.00**
4		MBBR media- Supplying and fixing of non-clogging freely moving biomass media of polypropylene construction Sp.Gravity 0.93 for MBBR reactor with required specific surface area, length 10-20 mm, dia 20-25 mm complete as per technical specification or as directed by Engineer in Charge								
		specific surface area of carrier			600.00	m^2/m^3				
			1		**316.78**	m^3	@	Rs	24553.57	**7778178.57**
5		Air Blower Supply,erection, testing and commissioning of twin lobe air blower for indoor application complete with acoustic canopy, air filter, motor of 1500 rpm , pulleys, pressure gauges, pressure relief valve, acoustic hood, suction silencer with suitable flanges, common motor and compressor base frame with motor belt tightening arrangement interconnecting line with flanges including all accessories complete as per technical specification or as Directed by Engineer in Charge.								
		Capacity of blower			3760.00	m^3/hour				
		Power of motor			56.00	HP				
			5				@	Rs	**840000.00**	**4200000.00**
6		Bubble Diffuser for MBBR- Fine Bubble Diffuser Supplying and fixing of retrievable type fine bubble diffusers of 90mm dia,1500mm length, Ethylene Propylene Diene Monomer (EPDM) make with SStee1"x1",SS lifting hook 8 mm, SS foundation bolt 6 mm, SS C clamp suitable for 1"O.D, hose, PP Rope, PP swivel nut, PP sleeve, Silicone Washer, SS hos clamp, RCC block complete as per technical specification compatible for specified air flow								
			4				@	Rs	31250.00	**125000.00**
7		Air Grid Pipe Supply and installation of air pipes (HDPE) assembly into valves and other accessories as required for the blowers to various tanks as a complete unit								
			4				@	Rs	44642.86	**178571.43**
8		Tube settler media- Media to be of UV stabilized PVC material, hexagonal chevron shaped, 750mm height and about 1.0mm thick and with tongue and groove tube fitting. The plan settling area should be between 10 – 12 m^2/m^3 /day minimum at 60^o slope. The media is to be provided along with lock nuts as required.								
		Total contact area	148.5		m^2					
			1				@	Rs	66964.29	**66964.29**
9		Electromagnetic Flow meter,pressure and quality sensors- Supply and erection of electromagnetic flow meter, pressure and quality sensors compatible to IoT and central control system with flow recorder, digital flow/quality/pressure indicator, flow/quality/pressure integrator with sensors, totaliser, transmittal and display arrangements and all accessories including housing arrangements, etc. complete to fix in the incoming pipeline to STP or at the Screen channel as directed by the Engineer in Charge								
			5				@	Rs	44642.86	**223214.29**
10		Filter feed pump - Supply, Installation, Commissioning, testing and trial run of submersible filtered water handling type pump, with specified discharge and head and of reputed make.								
		Power of pump required	23.00	HP	Q	24.38	LPS	H	35.00	m
			2	Nos.			@	Rs	404442.12	**808884.24**
11		Pressure Sand Filter- Supply, installation and erection, testing and comitioning of of Pressure Sand Filter - MS vessel construction. Filter to be of MS construction with multiport valve for operations. Suitable stand / support should be provided along with the filter. Filtration rate should not be greater than 12 m^3/hour/m^2 of the filtration area. Dirt loading capacity to be sufficient to initiate backwash once in 8 hours i.e. once / shift. Filter to have inlet and outlet piping, inlet and outlet for backwash and air vent. Sand filter to be fitted with pressure guage at inlet and outlet. Sand filter main header is to be fitted with flow meter – turbine type / rotameter type with range up to minimum of 125% of the rated flow through the pipe line. Media to consist of graded pebble, coarse and fine sand. Depth of media to be as per recommendations provided in CPHEEO manual and all relevant IS Codes of prectice. Cost includes supporting foundation.								
		Flow	87.76	m^3/hour	Diameter	2.5	m	H	2.50	m

			2					@	Rs	**1527777.50**	**3055555.00**
12		Carbon Filter- Supply, Installation and erection, testing and comitioning of Activated Carbon Filter - MS composite vessel construction. Filter to be of MS construction with multiport valve for operations. Suitable stand / support should be provided along with the filter. Filtration rate should not be greater than 10 m^3/hour/m^2 of the filtration area. Filter to have inlet and outlet piping, inlet and outlet for backwash and air vent. Carbon filter to be fitted with pressure guage at outlet. Media to consist of graded pebble, coarse, fine sand and activated carbon. Depth of media to be as per recommendations provided in CPHEEO manual. Activated carbon should be of high quality for removal of impurities and to be used for waste water purification. Cost includes for foundation also.								
		Flow	87.76	m^3/hour	Diameter	2.5	m	H	2.50	m
			2					@	Rs	**1583332.50**	**3166665.00**
		Total									
13		Alum and Lime Dosing System- Supply, installation, commitioning and testing of Alum dosing tank having capacity 50 litre in LLDPE/ FRP/PP material and alum dosing electronic metering type pump of 1-3 LPH range with 2.5 bar working pressure								
			2					@	Rs	**25000.00**	**50000.00**
		Total									
14		Hypo Dosing System - Supply, installation, commitioning and testing of Hypo dosing tank having capacity 50lit in LLDPE/ FRP/PP material and hypo dosing electronic metering type pump of 1-3lph range with 2 bar working pressure								
			2					@	Rs	30000.00	**60000.00**
		Total									
15		Odour control unit for co-treatment unit and STP								
			2					@	Rs	30000.00	**60000.00**
16		Sludge transfer to thickener pump - Supply, Installation, Commissioning, testing and trial run of submersible sewage handling type pump, with specified discharge and head and of reputed make.								
		Power of pump required	1.00	HP	Q	2.32	LPS	H	15.00	m
			2	Nos.				@	Rs	27645.12	**55290.24**
17		Sludge transfer to centrifuge pump of screw type - Supply, Installation, Commissioning, testing and trial run of submersible sewage handling type pump, with specified discharge and head and of reputed make.								
		Power of pump required	0.30	HP	Q	0.71	LPS	H	15.00	m
			2	Nos.				@	Rs	8293.54	**16587.07**
18		Filter backwash pumps - Supply, Installation, Commissioning, testing and trial run of filter backwash pump, with specified discharge and head and of reputed makewith all accessories.								
		Power of pump required	2.00	HP						
			2	Nos.				@	Rs	55290.24	**110580.48**
19		Filtrate cum dilution pump to equalisation tank								
		Power of pump required	1.00	HP						
			2	Nos.				@	Rs	27645.12	**55290.24**
20		Recycled water transfer pump for dilution tank								
		Power of pump required	3.5	HP						
			2	Nos.				@	Rs	96757.92	**193515.84**
21		Diluted septage transfer pump for STP								
		Power of pump required	3.00	HP						
			2	Nos.				@	Rs	82935.36	**165870.72**
22		Mechanical arrangement for oil and grease trap								
			1	Nos.				@	Rs	25000.00	**25000.00**
23		Mechanical arrangement for primary clarifier								
			1	Nos.				@	Rs	500000.00	**500000.00**

22		Sewage transfer pump - Supply, Installation, Commissioning, testing and trial run of submersible sewage handling type pump, with specified discharge and head and of reputed make.								
		For lifting stations								
		LF-1	0.5	HP	Q	0.58	LPS	H	3.51	m
		LF-2	1	HP	Q	3.65	LPS	H	6.39	m
		LF-3	2	HP	Q	8.40	LPS	H	7.07	m
		LF-4	1	HP	Q	3.17	LPS	H	7.69	m
		LF-5	1	HP	Q	2.30	LPS	H	8.34	m
		LF-6	2	HP	Q	3.17	LPS	H	14.10	m
		LF-7	0.5	HP	Q	0.72	LPS	H	4.69	m
		LF-8	1.5	HP	Q	5.40	LPS	H	7.79	m
		LF-9	0.5	HP	Q	1.82	LPS	H	8.04	m
		LF-10	0.5	HP	Q	0.86	LPS	H	6.49	m
		LF-11	0.5	HP	Q	1.06	LPS	H	9.32	m
		LF-12	0.5	HP	Q	1.49	LPS	H	6.34	m
		LF-13	0.5	HP	Q	1.68	LPS	H	7.69	m
		LF-14	0.5	HP	Q	0.62	LPS	H	3.04	m
		LF-15	0.5	HP	Q	0.77	LPS	H	9.98	m
		LF-16	0.5	HP	Q	1.49	LPS	H	2.43	m
		LF-17	0.5	HP	Q	0.38	LPS	H	9.04	m
		LF-18	1	HP	Q	2.16	LPS	H	8.18	m
		LF-19	1	HP	Q	4.09	LPS	H	7.26	m
		LF-20	0.5	HP	Q	0.77	LPS	H	7.85	m
		LF-21	0.5	HP	Q	0.14	LPS	H	11.06	m
		LF-22	0.5	HP	Q	1.81	LPS	H	7.89	m
		LF-23	0.5	HP	Q	1.90	LPS	H	7.38	m
		LF-24	1.5	HP	Q	4.76	LPS	H	8.12	m
			19.5	HP	2	nos	@	Rs	27645.12	**1078160.00**
		Pump sets in Well								
		Well 1 to STP	15	HP	Q	12.5	LPS	H	37.00	**m**
	OD19	Say	2	Nos.			@	Rs	346434.00	**692868.00**
		Well 2 to STP	5	HP	Q	4.54	LPS	H	32.00	**m**
	OD19	Say	2	Nos.			@	Rs	138817.20	**277634.40**
		Well 3 to STP	5	HP	Q	4.74	LPS	H	21.50	**m**
	OD19	Say	2	Nos.			@	Rs	138817.20	**277634.40**
		Well 4 to STP	5	HP	Q	5.18	LPS	H	21.00	**m**
	OD19	Say	2	Nos.			@	Rs	138817.20	**277634.40**
		Well 5 to STP	15	HP	Q	6.44	LPS	H	70.00	**m**
	OD19	Say	2	Nos.			@	Rs	354003.00	**708006.00**
23		Supply and installation of centrifuge								
			2	Nos.			@	Rs	200000.00	**400000.00**
24		Piping, initial channel arrangements, bypass arrangements, steel ladder, framework and fire fighting arrangements								
			1	Nos.			@	Rs	350000.00	**350000.00**
ELECTRICAL WORKS										
Item No	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**

1		Interconnecting piping system: • All process piping is to be in uPVC of approved ISI make, Class 2 minimum • All process valves to be in PP/PVC of Ball / Globe type• For valves in piping of ID > 150 mm, Butterfly valves are preferred • NRV should be provided at the common discharge header of all process pumps • Dosing lines to be in flexible Teflon / rigid PVC / HDPE. Detailed hydraulic analysis must be done for the system before supply and installation.								
			1	Nos.			@	Rs	200892.86	**200892.86**
2		ELECTRICAL & INSTRUMENTATION-Instrumentation items consisting of pressure guages, level switches, electro magnetic flow meter, normal flow meter , pressure gauges, IoT based sensors, electrical panels – Powder coated MCC Panel shall be Non compartmentalized free standing floor mounted, dust and vermin proof, with reinforcement of suitable size angle iron, channel, T -iron flats as required. Panel shall be suitable for 415V, 3-Phase,50 Hz incomer. Switchgear components to include, but not limited to, MCCB for incomer and for each switchgear, suitable OLR and contactor provisions to be given as per guidelines of the Electrical authority. Panel to be fabricated based on the Motor Load List as given in the technical specifications AC: MS powder coated panel with switchgear components as per motor load list, fixed, floor mounted and non compartmentalized pane.INTERCONNECTING CABLING – Outgoing feeders from AC panel to each prime mover will be based on CEIG guidelines. Cables to be suitably protected either through (a) PVC conduit or (b) armored cables as appropriate Cabling includes glanding and termination for each prime mover. Cables should not be run on the ground or directly on the walls. Cables to be mounted on suitable runners / cable trays / PVC conduits as appropriate. All interconnecting cabling and glanding , termination accessories as per specifications.								
			1	Nos.			@	Rs	625000.00	**625000.00**
3		Supply, installation and commissioning of diesel generator								
			7	Nos.			@	Rs	120000.00	**840000.00**
4		Supply and installation of accessories for electrical connection and control units for lifting stations and collection wells including foundations								
		Lifting stations	**24**	Nos.			@	Rs	100000.00	**2400000.00**
		Collection wells	**5**	Nos.			@	Rs	75000.00	**375000.00**
		Total								**2775000.00**
5		Supply, installation and commissioning of solar units for lifting stations and collection wells								
			5	Nos.			@	Rs	50000.00	250000.00
			29	Nos.			@	Rs	20000.00	**580000.00**
6		Supply, installation and commissioning of solar units for STP								
			1	Nos.			@	Rs	1000000.00	**1000000.00**
7		Transformer unit of 315 KVA (1+1)								
			2				@	Rs	600000.00	**1200000.00**

DETAILED ESTIMATE - SEWAGE SCHEME IN KATTAPANA MUNICIPALITY
CIVIL CONSTRUCTION - SEWER NETWORK WITH PIPES,PUMPING MAIN,MANHOLES ,LIFTING STATIONS AND INSPECTION CHAMBERS

1	16.83	Taking out existing CC interlocking paver blocks from footpath/ central verge, including removal of rubbish etc., disposal of unserviceable material to the dumping ground, for which payment shall be made separately and stacking of serviceable material within 50 metre lead as per direction of Engineer-in-Charge.								
		30% of road length	30%	27406	1		8221.8	m^2		
		Total					8221.8	m^2		
		Say		8221.8	m^2			@Rs	115.56	₹ 950,111.00
2	15.3	Demolishing R.C.C. work manually / by mechanical means including stacking of steel bars and disposal of unserviceable material with in 50 metres lead as per direction of Engineer -in-Charge.								
		30% of road length	30%	27406	1	0.15	1233.27	m^2		
		Total					1233.27	m^3		
		Say		1233.27	m^3			@Rs	3,114.30	₹ 3,840,773.00
3	15.43.2	Dismantling manually / by mechanical means including stacking of serviceable material and disposal of unserviceable material within 50 metres lead as per direction of Engineer -in-Charge:Bituminous road								
		40% of road length	40%	27406	1		10962.4	m^2		
		Say		10962.4	m^2			@Rs	376.75	₹ 4,130,084.00
4	100	Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth up to 1.5 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m								
		Descpn	No	Length(total	Width(avg	Depth avg				
		Network pipeline								
		Sub zone Well-1(conduits 292 Nos	1	7141	1	1.29	9211.89	m^3		
		Bedding	1	7141	1	0.1	714.1			
		Sub zone Well-2(conduits 190 Nos	1	4398.4	1	1.29	5673.94			
		Bedding	1	4398.4	1	0.1	439.84			
		Sub zone Well-3(conduits 192Nos	1	4757.66	1	1.25	5947.08			
		Bedding	1	4757.66	1	0.1	475.77			
		Sub zone Well-4(conduits 213 Nos	1	5605.24	1	1.35	7567.07			
		Bedding	1	5605.24	1	0.1	560.52			
		Sub zone Well-5(conduits 166 Nos	1	5504.11	1	1.31	7210.38			
		Bedding	1	5504.11	1	0.1	550.41			
		Pumping Main					0			
		Lifting stations	1	720	1.5	1.5	1620			
		well 1 to STP	1	1154	1	1.5	1731			
		well 2 to STP	1	1104	1	1.5	1656			
		well 3 to STP	1	50	1	1.5	75			
		well 4 to STP	1	1526	1	1.5	2289			
		well 5 to STP	1	2410	1	1.5	3615			
		Total					49337.00	m^3		
		Deductions								
		Man hole 900 mm dia	750	1.7	1	1.5	1912.50			

		Man hole 1200 mm dia	79	2	1	1.5	237.00			
		Man hole 1500 mm dia	271	2.3	1	1.5	934.95			
		Total deduction					3084.45	m^3		
		Total less deduction					46252.55	m^3		
				46252.55	m^3					
	100.1.1	Do for item 4------All kinds of soil	30%	46252.55			13875.765	@Rs	579.85	₹ 8,045,862.0
	100.1.5	Do for item 4------ Ordinay rock	30%	46252.55			13875.765	@Rs	842.10	₹ 11,684,782.0
	100.2.3	Medium rock with blasting	5%	46252.55			2312.6275	@Rs	1,043.15	₹ 2,412,417.0
	100.2.7	Medium rock with out blasting	15%	46252.55			6937.8825	@Rs	1,400.37	₹ 9,715,603.0
	100.1.9	Hardrock with blasting	5%	46252.55			2312.6275	@Rs	1,192.60	₹ 2,758,040.0
	100.1.13	Hard rock with out blasting	15%	46252.55			6937.8825	@Rs	1,624.48	₹ 11,270,451.0
5	100	Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth exceeding 1.5m but not exceeding 3 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m: 1.50m to 3.0m All kinds of soil(Ref. Item No. 2.11 of DSR)								
		Descpn	No	Length(total	Width(avg)	Depth avg		m^3		
		Sub zone Well-1(conduits 111 Nos	1	2542.8	1	1	2542.8			
		Sub zone Well-2(conduits 79Nos	1	1956.01	1	0.98	1916.8898			
		Sub zone Well-3(conduits 69 Nos	1	1844.16	1	0.76	1401.5616			
		Sub zone Well-4(conduits 96 Nos	1	2624.62	1	1.09	2860.8358			
		Sub zone Well-5(conduits 86 Nos	1	2242.76	1	1.09	2444.6084			
		Pumping Main								
		Lifting stations	1	720	1.5	1.5	1620			
		Total					12786.70	m^3		
		Deductions								
		Man hole 900 mm dia	28	1.7	1	0.23	10.95			
		Man hole 1200 mm dia	159	2	1	0.798	253.76			
		Man hole 1500 mm dia	234	2.3	1	1.406	756.71			
		Total deduction					1021.42	m^3		
		Total less deduction					11765.27	m^3		
		Say		11765.27	m^3					
	100.1.2	Do for item 4------All kinds of soil	5%	11765.2744			588.26	@Rs	690.88	₹ 406,420.00
	100.1.6	Do for item 4------ Ordinay rock	30%	11765.2744			3529.58	@Rs	1,041.24	₹ 3,675,142.00
	100.2.4	Medium rock with blasting	10%	11765.2744			1176.53	@Rs	1,242.28	₹ 1,461,577.00
	100.2.8	Medium rock with out blasting	30%	11765.2744			3529.58	@Rs	1,599.50	₹ 5,645,567.00
	100.1.10	Hardrock with blasting	10%	11765.2744			1176.53	@Rs	1,391.74	₹ 1,637,420.00

	100.1.14	Hard rock with out blasting	15%	11765.2744			1764.79	@Rs	266.78	₹ 470,811.00
6	100.1.3	Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth exceeding 3m in depth but not exceeding 4.5 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m : 3.0m to 4.50m All kinds of soil.(Ref. Item No. 2.12 of DSR)								
		Descpn	No	Length(total	Width(avg)	Depth avg		m^3		
		Sub zone Well-1(conduits 50 Nos	1	1091.3	1	0.94	1025.822			
		Sub zone Well-2(conduits 41Nos	1	1014.38	1	0.94	953.5172			
		Sub zone Well-3(conduits 23 Nos	1	651.3	1	0.98	638.274			
		Sub zone Well-4(conduits 47 Nos	1	1335.64	1	1.02	1362.3528			
		Sub zone Well-5(conduits 41 Nos	1	1096.37	1	1	1096.37			
		Pumping Main								
		Lifting stations	1	660	1.5	1.5	1485			
		Total					5076.34	m^3		
		Deductions								
		Man hole 1500 mm dia	240	2.3	1	1.04	574.08			
		Total less deduction					4502.26	m^3		
	100.1.3	Do for item 4------All kinds of soil								
	100.1.7	Do for item 4------ Ordinay rock	10.0%	4502.26			450.23	@Rs	1,240.37	558451.79
	100.2.5	Medium rock with blasting	10%	4502.26			450.23	@Rs	1,441.41	648966.02
	100.2.9	Medium rock with out blasting	20%	4502.26			900.45	@Rs	1,798.63	1619576.38
	100.1.11	Hardrock with blasting	10%	4502.26			450.23	@Rs	1,590.87	716257.4
	100.1.15	Hard rock with out blasting	50%	4502.26			2251.13	@Rs	2,022.75	4553473.21
7	100	Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth exceeding 4.5m in depth but not exceeding 6 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m : 4.5m to 6.0m.All kinds of soil.(Ref. Item No. 2.12 of DSR)								
		Descpn	No	Length (total)	Width(avg)	Depth avg		m^3		
		Sub zone Well-1(conduits 19 Nos	1	415.82	1	0.95	395.029			
		Sub zone Well-2(conduits 25 Nos	1	624.53	1	0.9	562.077			
		Sub zone Well-3(conduits 5 Nos	1	135.4	1	0.7	94.78			
		Sub zone Well-4(conduits 23 Nos	1	646.82	1	0.94	608.0108			
		Sub zone Well-5(conduits 14 Nos	1	370.59	1	0.68	252.0012			
		Pumping Main								
		Lifting stations	1	600	1.5	1.5	1350			
			1	480	1.5	2.1	1512			
		Total					4773.90	m^3		

		Deductions								
		Man hole 1500 mm dia	99	2.3	1	1.04	236.81			
		Total less deduction					4537.09	m^3		
		Say		4537.09	m^3					
	100.1.4	Do for item 4------All kinds of soil								
	100.1.8	Do for item 4------ Ordinay rock	5.0%	4537.09			226.85	@Rs	1,439.50	326550.58
	100.2.6	Medium rock with blasting	5%	4537.09			226.85	@Rs	1,640.54	372156.5
	100.2.10	Medium rock with out blasting	25%	4537.09			1134.27	@Rs	1,997.77	2266010.58
	100.1.12	Hardrock with blasting	10%	4537.09			453.71	@Rs	1,790.00	812140.9
	100.1.16	Hard rock with out blasting	55%	4537.09			2495.4	@Rs	2,221.88	5544479.35
8	100.8.1	Fencing one side of trenches, 1.50 m height with two rows of 10 cm plastic caution tape in vertical casuarina pole (girth 15cm to 24cm) fixed at 2 m intervals (Data Prepared based on PWD SDB - Item No.1009)								
			2	10962.504			21925.008	m		
							21925.008	m		
		Say		21925.008	m			@Rs	32.76	₹ 718,263.00
9	100.8.2	Fencing 1.50m high with two rows of casuarina poles (girth 15cm to 24cm) tied with coir yarn on vertical casuarina pole (girth 15cm to 24cm) fixed at 1.5m intervals. NEW DATA (Prepared based on PWD SDB - Item No.1009								
			2	16443.756			32887.512	m		
		Total					32887.512	m		
		Say		32887.512	m			@Rs	110.68	₹ 3,639,990.00
10	2.16.1	Close timbering in trenches including strutting, shoring and packing cavities (wherever required) complete (Measurements to be taken of the face area timbered).Depth not exceeding 1.5m								
		(50 % of total Length)	2	13703.5		1.5	41110.5	m^2		
		Total					41110.5	m^2		
		Say		41110.5	m^2			@Rs	159.65	₹ 6,563,291.00
11	2.16.2	Close timbering in trenches including strutting, shoring and packing cavities (wherever required) complete (Measurements to be taken of the face area timbered).Depth exceeding 1.5 m but not exceeding 3 m								
		(10 % of Length for second depth)	2	1121		1.02	2286.84	m^2		Ht taken weighted avg
		Total					2286.84	m^2		
		Say		2286.84	m^2			@Rs	173.45	₹ 396,652.00
12	2.16.3	Close timbering in trenches including strutting, shoring and packing cavities (wherever required) complete (Measurements to be taken of the face area timbered).Depth exceeding 3 m but not exceeding 4.5 m								
		(5 % of Length for third & forth depth)	2	259.45		0.98	508.52	m^2		
			2	109.65		0.87	190.79			
		Total					699.31	m^2		
		Say		699.31	m^2			@Rs	204.65	₹ 143,114.00
	100.98.1 38 KWA	Supply of PE Pipe, PE100, PN8, 180 mm dia, conforming to IS 4984/2016								
		For connection from chamber to manholes	2200	13			28600	m		
		Total					28600	m		
		Say		**28600**	m		@	Rs	964.95	**₹ 27,597,570**

	100.98.141 KWA	Supply of PE Pipe, PE100, PN8, 225 mm dia, conforming to IS 4984/2016								
		For sewer network								
			1	27000			27000	m		
		Deduction for man holes	750	0.9			675			
			79	1.2			94.8			
			271	1.5			406.5			
		Total deduction					1176.3			
		Total less deduction					25823.7	m		
		Say		**25823.7**	m		@	Rs	1,892.11	**₹ 48,861,281**
	100.98.143 KWA	Supply of PE Pipe, PE100, PN8, 280 mm dia, conforming to IS 4984/2016.								
		For sewer network								
			1	406			406	m		
		Total					406	m		
		Say		**406**	m		@	Rs	2,924.43	**₹ 1,187,319**
	100.98.154 KWA	Supply of PE Pipe, PE100, PN10, 90 mm dia, conforming to IS 4984/2016.								
		For sewer network pumping line-lifting stations	2	690			1380	m		
		Total					1380	m		
		Say		**1380**	m		@	Rs	378.10	**₹ 521,778**
	100.98.155 KWA	Supply of PE Pipe, PE100, PN10, 110 mm dia, conforming to IS 4984/2016.								
		For sewer network pumping line-lifting stations	2	30			60	m		
		Total					60	m		
		Say		**60**	m		@	Rs	555.65	**₹ 33,339**
	100.98.157 KWA	Supply of PE Pipe, PE100, PN10, 140 mm dia, conforming to IS 4984/2016.								
		For well-2 to STP	1	1104			1104			
		For well-3 toSTP	1	50			50	m		
		Total					1154	m		
		Say		**1154**	m		@	Rs	897.58	**₹ 1,035,807**
	100.98.158 KWA	Supply of PE Pipe, PE100, PN10, 160 mm dia, conforming to IS 4984/2016.								
		For well-4 to STP	1	763			763			
		Total					763	m		
		Say		**763**	m		@	Rs	1,177.03	**₹ 898,074**
	100.98.159 KWA	Supply of PE Pipe, PE100, PN10, 180 mm dia, conforming to IS 4984/2016.								
		For well-5 to STP	1	2410			2410			
		Total					2410	m		
		Say		**2410**	m		@	Rs	1,487.69	**₹ 3,585,333**
	100.98.161 KWA	Supply of PE Pipe, PE100, PN10,225mm dia, conforming to IS 4984/2016.								
		For well-1 to STP	1	1154			1154			
		Total					1154	m		
		Say		**1154**	m		@	Rs	2,326.05	**₹ 2,684,262**

	100.10.6 KWA	Laying HDPE pipes (IS : 4984)on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi automatic electrofusion machines, testing the pipe line thus fabricated to suit the hydrulic working pressure and after testing , aligning the pipeline, lowering the pipe in position into the trenches already made, testing the line to suitable pressure with potable water before back filling and leveling the trenches including all labour charge, hire for appliances etc. complete but excluding cost of pipe and fittings.								
		For sewer network - 180 mm OD HDPE pipes								
		connection chamber to manhole	1	28600			28600	m		
		Say		**28600**	m		@	Rs	**277.19**	**₹ 7,927,534**
	100.10.8 KWA	Laying HDPE pipes (IS : 4984)on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi automatic electrofusion machines, testing the pipe line thus fabricated to suit the hydrulic working pressure and after testing , aligning the pipeline, lowering the pipe in position into the trenches already made, testing the line to suitable pressure with potable water before back filling and leveling the trenches including all labour charge, hire for appliances etc. complete but excluding cost of pipe and fittings.								
		For sewer network - 225 mm OD HDPE pipes								
		Sewer network	1	25823.7			25823.7	m		
		Say		**25823.7**	m		@	Rs	**393.81**	**₹ 10,169,560**
	100.10.10 KWA	Laying HDPE pipes (IS : 4984)on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi automatic electrofusion machines, testing the pipe line thus fabricated to suit the hydrulic working pressure and after testing , aligning the pipeline, lowering the pipe in position into the trenches already made, testing the line to suitable pressure with potable water before back filling and leveling the trenches including all labour charge, hire for appliances etc. complete but excluding cost of pipe and fittings.								
13		For sewer network - 280 mm OD HDPE pipes								
		For sewer network	1	406			406	m		
		Say		**406**	m		@	Rs	**542.56**	**₹ 220,277**
	100.10.1 KWA	Laying HDPE pipes (IS : 4984)on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi automatic electrofusion machines, testing the pipe line thus fabricated to suit the hydrulic working pressure and after testing , aligning the pipeline, lowering the pipe in position into the trenches already made, testing the line to suitable pressure with potable water before back filling and leveling the trenches including all labour charge, hire for appliances etc. complete but excluding cost of pipe and fittings.(PE100 PN10)								
14		For sewer network pumping line-lifting stations-90mm OD HDPE								
			1	1380			1380	m		
		Total					1380	m		
		Say		**1380**	m		@	Rs	**97.37264**	**₹ 134,374**
	100.10.2 KWA	Laying HDPE pipes (IS : 4984)on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi automatic electrofusion machines, testing the pipe line thus fabricated to suit the hydrulic working pressure and after testing , aligning the pipeline, lowering the pipe in position into the trenches already made, testing the line to suitable pressure with potable water before back filling and leveling the trenches including all labour charge, hire for appliances etc. complete but excluding cost of pipe and fittings.(PE100 PN10)								
		For sewer network pumping line-lifting stations-110mm OD HDPE								
			1	60			60	m		
		Total					60	m		
		Say		**60**	m		@	Rs	**132.04749**	**₹ 7,923**
	100.10.4 KWA	Laying HDPE pipes (IS : 4984)on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi automatic electrofusion machines, testing the pipe line thus fabricated to suit the hydrulic working pressure and after testing , aligning the pipeline, lowering the pipe in position into the trenches already made, testing the line to suitable pressure with potable water before back filling and leveling the trenches including all labour charge, hire for appliances etc. complete but excluding cost of pipe and fittings.(PE100 PN10)								

		For well-2 to STP-140mm OD HDPE					1104			
		For well-3 toSTP					50			
		Total	1	1154			1154	m		
		Say		**1154**	m		@	Rs	**188.09337**	**₹ 217,060**
	100.10.5 KWA	Laying HDPE pipes (IS : 4984)on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi automatic electrofusion machines, testing the pipe line thus fabricated to suit the hydrulic working pressure and after testing , aligning the pipeline, lowering the pipe in position into the trenches already made, testing the line to suitable pressure with potable water before back filling and leveling the trenches including all labour charge, hire for appliances etc. complete but excluding cost of pipe and fittings.(PE100 PN10)								
		For well-4 to STP160mm OD HDPE								
			1	763			763	m		
		Say		**763**	m		@	Rs	**224.60811**	**₹ 171,376**
	100.10.6 KWA	Laying HDPE pipes (IS : 4984)on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi automatic electrofusion machines, testing the pipe line thus fabricated to suit the hydrulic working pressure and after testing , aligning the pipeline, lowering the pipe in position into the trenches already made, testing the line to suitable pressure with potable water before back filling and leveling the trenches including all labour charge, hire for appliances etc. complete but excluding cost of pipe and fittings.(P100 PN10)								
		For well-5 to STP-180mm OD HDPE								
			1	2410			2410	m		
		Say		**2410**	m		@	Rs	**277.19**	**₹ 668,019**
	100.10.8 KWA	Laying HDPE pipes (IS : 4984)on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi automatic electrofusion machines, testing the pipe line thus fabricated to suit the hydrulic working pressure and after testing , aligning the pipeline, lowering the pipe in position into the trenches already made, testing the line to suitable pressure with potable water before back filling and leveling the trenches including all labour charge, hire for appliances etc. complete but excluding cost of pipe and fittings.(PE100 PN10)								
		For well-1 to STP-225mm OD HDPE								
			1	1154			1154	m		
		Say		**1154**	m		@	Rs	**393.81**	**₹ 454,454**
15	100.31.2.1+OD KWA	Supply ,"Conveying and fixing C.I. sluice valves (with cap) by providing complete with bolts, nuts, rubber insertions etc. excluding the cost of valve (the tail pieces if required will be paid separately) :								
	100.31.2.1+OD KWA	80 mm dia	46				46	No	**6652.74**	**₹ 306,026**
	100.31.2.2+OD KWA	110mm dia	2				2	No	**8999.70**	**₹ 17,999**
	100.31.2.3+OD KWA	125mm dia	4				4	No	**10606.76**	**₹ 42,427**
	100.31.2.4+OD KWA	150mm dia	4				4	No	**13340.08**	**₹ 53,360**
	100.31.2.5+OD KWA	200mm dia	2				2	No	**16805.29**	**₹ 33,611**
16	100.7.1	Bailing out water with 5 HP engine and pumpset including conveyance to the site, errection, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc. complete. NEW DATA (Prepared based on PHED SDB - Item No.1070								
		For 27km	3	54	10	0.746	6042.6	Kwh		
		Total					6042.6	Kwh		
		Say		6042.6	Kwh			@Rs	38.57	₹ 233,063.00
17	100.7.2	Bailing out water with engine and pumpset above 5 HP upto 10 HP including conveyance to the site, errection, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc. complete. NEW DATA (Prepared based on PHED SDB - Item No.1070								
		For 27km	2	27	10	0.746	4028.4	Kwh		

		Total					4028.4	Kwh		
		Say		4028.4	Kwh			@Rs	19.25	₹ 77,547.00
19	100.98.1008	Engaging Coolie - Bailing out water and controlling traffic								
		For 27km	1	27	10		270	day		
		Say		270	Day			@Rs	917.26	₹ 247,660.00
20	2.6.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil - MAN HOLES								
		Manholes 0.9 m dia								
			NO	L	B	Avg ht				
		Sub zone Well-1(Man holes	204	1.7	1.7	1.5	884.34	m^3		
		Sub zone Well-2(Man holes	130	1.7	1.7	1.5	563.55	m^3		
		Sub zone Well-3(Man holes	137	1.7	1.7	1.5	593.9	m^3		
		Sub zone Well-4(Man holes	135	1.7	1.7	1.5	585.23	m^3		
		Sub zone Well-5(Man holes	144	1.7	1.7	1.5	624.24	m^3		
		Manholes 1.20 m dia								
		Sub zone Well-1(Man holes	17	2	2	1.5	102	m^3		
		Sub zone Well-2(Man holes	11	2	2	1.5	66	m^3		
		Sub zone Well-3(Man holes	17	2	2	1.5	102	m^3		
		Sub zone Well-4(Man holes	20	2	2	1.5	120	m^3		
		Sub zone Well-5(Man holes	14	2	2	1.5	84	m^3		
		Manholes 1.50 m dia								
		Sub zone Well-1(Man holes	72	2.3	2.3	1.5	571.32	m^3		
		Sub zone Well-2(Man holes	50	2.3	2.3	1.5	396.75	m^3		
		Sub zone Well-3(Man holes	39	2.3	2.3	1.5	309.47	m^3		
		Sub zone Well-4(Man holes	57	2.3	2.3	1.5	452.3	m^3		
		Sub zone Well-5(Man holes	53	2.3	2.3	1.5	420.56	m^3		
		For lift manhole panel board foundation	24	1	0.45	0.6	6.48	m^3		
		For Sewer chambers	2200	1.3	1.3	1	3718	m^3		
		For Lifting station manholes-additional depth	24	1.77		1.00	42.39	m^3		
		Total					9642.53	m^3		
		Say		9642.53	m3					
	2.6.1	Do for item 4------All kinds of soil	30%	9642.53			2892.759	@Rs	223.41	₹ 646,271.0
	2.7.1	Do for item 4------ Ordinay rock	30%	9642.53			2892.759	@Rs	433.01	₹ 1,252,594.0
	OD	Medium rock with blasting	5%	9642.53			482.1265	@Rs	541.27	₹ 260,961.0

	OD	Medium rock with out blasting	15%	9642.53			1446.3795	@Rs	898.50	₹ 1,299,572.0
	2.7.2	Hardrock with blasting	5%	9642.53			482.1265	@Rs	749.05	₹ 361,137.0
	2.7.3	Hard rock with out blasting	15%	9642.53			1446.3795	@Rs	1,248.58	₹ 1,805,921.0
21	OD-25	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil - MAN HOLES 2nd depth								
		Manholes 0.9 m dia								
			NO	L	B	Avg ht				
		Sub zone Well-1(Man holes	27	1.7	1.7	0.22	17.17	m^3		
		Sub zone Well-2(Man holes	22	1.7	1.7	0.22	13.99			
		Sub zone Well-3(Man holes	15	1.7	1.7	0.22	9.54			
		Sub zone Well-4(Man holes	14	1.7	1.7	0.22	8.9			
		Sub zone Well-5(Man holes	28	1.7	1.7	0.26	21.04			
		Manholes 1.20 m dia								
		Sub zone Well-1(Man holes	17	2	2	0.81	55.08	m^3		
		Sub zone Well-2(Man holes	11	2	2	0.8	35.2			
		Sub zone Well-3(Man holes	17	2	2	0.74	50.32			
		Sub zone Well-4(Man holes	100	2	2	0.82	328			
		Sub zone Well-5(Man holes	14	2	2	0.82	45.92			
		Manholes 1.50 m dia								
		Sub zone Well-1(Man holes	72	2.3	2.3	1.47	559.89	m^3		
		Sub zone Well-2(Man holes	50	2.3	2.3	1.49	394.11			
		Sub zone Well-3(Man holes	39	2.3	2.3	1.45	299.15			
		Sub zone Well-4(Man holes	20	2.3	2.3	1.48	156.58			
		Sub zone Well-5(Man holes	53	2.3	2.3	1.49	417.75			
		Total					2412.64	m^3		
		Say		2412.64	m^3					₹ 0.00
	2.6.1+add lift	Do for item 4------All kinds of soil	5%	2412.64			120.632	@Rs	334.44	₹ 40,344.00
	2.7.1+add lift	Do for item 4------ Ordinay rock	30%	2412.64			723.792	@Rs	632.14	₹ 457,538.00
	OD	Medium rock with blasting	10%	2412.64			241.264	@Rs	740.40	₹ 178,632.00
	OD	Medium rock with out blasting	30%	2412.64			723.792	@Rs	1,097.64	₹ 794,463.00
	2.7.2+add lift	Hardrock with blasting	10%	2412.64			241.264	@Rs	948.18	₹ 228,762.00
	2.7.3+add lift	Hard rock with out blasting	15%	2412.64			361.896	@Rs	1,447.71	₹ 523,920.00
22	OD-26	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil - MAN HOLES 3 rd depth								
		Manholes 1.50 m dia								
		Sub zone Well-1(Man holes	62	2.3	2.3	0.98	321.42	m^3		

		Sub zone Well-2(Man holes	45	2.3	2.3	1.08	257.09			
		Sub zone Well-3(Man holes	33	2.3	2.3	1.02	178.06			
		Sub zone Well-4(Man holes	52	2.3	2.3	1.06	291.58			
		Sub zone Well-5(Man holes	48	2.3	2.3	1.1	279.31			
		Total					8026.14	m^3		
	2.6.1+2* addl lift	Do for item 4------All kinds of soil	0				0			
	2.7.1+2* addl lift	Do for item 4------ Ordinay rock	10.0%	8026.14			802.61	@Rs	831.28	667193.64
	OD	Medium rock with blasting	10%	8026.14			802.61	@Rs	939.53	754076.17
	OD	Medium rock with out blasting	20%	8026.14			1605.23	@Rs	1,296.77	2081614.11
	2.7.2+2* addl lift	Hardrock with blasting	10%	8026.14			802.61	@Rs	1,147.31	920842.48
	2.7.3+2* addl lift	Hard rock with out blasting	50%	8026.14			4013.07	@Rs	1,646.84	6608884.2
23	OD-27	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil - MAN HOLES 4th depth								
		Manholes 1.50 m dia								
		Sub zone Well-1(Man holes	23	2.3	2.3	1.18	143.57	m^3		
		Sub zone Well-2(Man holes	21	2.3	2.3	1.22	135.53			
		Sub zone Well-3(Man holes	8	2.3	2.3	0.7	29.62			
		Sub zone Well-4(Man holes	27	2.3	2.3	1.2	171.4			
		Sub zone Well-5(Man holes	20	2.3	2.3	0.88	93.1			
		Total					573.22	m^3		
	2.6.1+3* addl lift	Do for item 4------All kinds of soil	0				0			
	2.7.1+3* addl lift	Do for item 4------ Ordinay rock	10.0%	573.22			57.32	@Rs	1,030.41	59063.1
	OD	Medium rock with blasting	10%	573.22			57.32	@Rs	1,138.67	65268.56
	OD	Medium rock with out blasting	20%	573.22			114.64	@Rs	1,495.90	171489.98
	2.7.2+3* addl lift	Hardrock with blasting	10%	573.22			57.32	@Rs	1,346.45	77178.51
	2.7.3+3* addl lift	Hard rock with out blasting	50%	573.22			286.61	@Rs	1,845.98	529076.33
24	100.6.1	Providing steel sheet shoring to the sides of the trenches to depths of above 4.00 m but not exceeding 6.00m using 6 mm M.S. sheet 0.50 M wide stiffen on edges with 50 mm x 50mm x 6 mm M.S. angles driving down vertically on either side one after another in lines and levels with suitable pile driving equipments and accessories to a maximum depth of 0.50 M below the bottom of the proposed excavation 0.5 M above ground level suitably braced by horizontal walling pieces at 75 x 150 mm x 8 mm angles on either side at intervals not exceeding 1.50M and horizontal screw jack type struts at 1.50M intervals and maintaining the shoring till the pipes are laid and works are completed, dismantling, cleaning and restacking for reuse including all labour, hire charges and conveyance for equipments, tools and plants and sundries etc. complete.								
		Manhole 0.9m dia	750	6.8		1.5	7650	m^2		
		Manhole 1.2m dia	79	8		1.5	948			
		Manhole 1.5m dia	271	9.2		1.5	3739.8			

		Total					12337.8	m^2		
		Say		12337.8	m^2			@Rs	781.95	₹ 9,647,543.00
25	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		Manhole 0.9m dia	750	1.7	1.7	0.15	325.125	m^3		
		Manhole 1.2m dia	79	2	2	0.15	47.4			
		Manhole 1.5m dia	271	2.3	2.3	0.15	215.04			
		For lift manhole panel board foundation	24	1	0.45	0.15	1.62			
		For Sewer chambers	2200	1.3	1.3	0.15	557.7			
		bedding for pipe laying	1	27406.26	1	0.1	2740.626			
		Total					3887.5095	m^3		
		Say		3887.5095	m^3			@Rs	7,527.06	₹ 29,261,517.00
26	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).								
		0.90m dia manholes -mat	750	1.5	1.5	0.35	590.63	m^3		
		1.20m dia manholes -mat	79	1.8	1.8	0.4	102.38			
		1.50m dia manholes -mat	271	2.1	2.1	0.45	537.8			
		0.90m dia manholes - cover slab(circular 3.14/4*1.5*1.5*0.3)	750	1.77		0.2	264.94			
		1.20m dia manholes - cover slab(circular 3.14/4*1.8*1.8*0.3)	79	2.54		0.2	40.19			
		1.50m dia manholes - cover slab(circular 3.14/4*2.1*2.1*0.3)	271	3.46		0.2	187.63			
		sewer chamber -mat	2200	1	1	0.2	440.00			
		sewer chamber -cover slab	2200	1	1	0.1	220.00			
		Sewer chamber walls	2200	2.4	0.2	0.5	528.00			
		Deduct Manhome cover 600mm dia	1100	0.28		0.15	46.63			
		Total					2864.94	m^3		
		Say		2864.94	m^3			@Rs	10,404.79	₹ 29,809,063.00
28	4.1.3	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level: 1:2:4 (cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size)								
		Manhole pipe channel and slanted portion								
		0.90m dia manholes(3.14/4*0.9*0.9*0.2)	750	0.64		0.2	95.38			
		1.20m dia manholes(3.14/4*1.2*1.2*.25)	79	1.13		0.25	22.33			
		1.50m dia manholes (3.14/4*1.5*1.5*0.3)	271	1.77		0.3	143.60			
		Deductions								
		0.90m dia hole -pipe portion((3.14/4*0.15*0.15)*1/3*0.9)	750	0.0176625		0.3	-3.97			

		Channel portion-0.9*(0.9+0.15)/2*0.05	750	0.9	0.525	0.05	-17.72			
		1.200m dia hole -pipe portion((3.14/4*0.15*0.15)*1/3*1.2)	79	0.0176625		0.4	-0.56			
		Channel portion 1.2*(1.20+0.15)/2*0.1	79	1.2	0.675	0.1	-6.40			
		1.500m dia hole -pipe portion((3.14/4*0.15*0.15)*1/3*1.5)	271	0.0176625		0.5	-2.39			
		Channel portion 1.5*(1.50+0.15)/2*0.15	271	1.2	0.825	0.15	-40.24			
		Total					190.01	m^3		
		Say		190.012309	m^3			@Rs	8,340.93	₹ 1,584,879.00
29	5.7	Reinforced cement concrete work in well - steining excluding the cost of centering, shuttering, finishing and reinforcement, with 1:1.5:3 (1 cement : 1.5 coarse sand (Zone - III) : 3 graded stone aggregate 20 mm nominal size)								
		0.90m dia manhole - side wall - steining total(3.14/4*(1.3*1.3-0.9*0.9) * total ht of manholes	1	0.6908		901.85	623.00	m^3		(zone1-248.7,zone2-154.26,zone3-160.82,zone4-165.09,zone5-172.98
		1.2m dia manhole - side wall- steining total(3.14/4*(1.6*1.60-1.2*1.20) * total ht of manholes	1	0.8792		155.81	136.99			Zone1-33.39,zone2-21.48,zone3-33.57,zone4-39.79,zone5-27.58
		1.50m dia manhole - side wall- steining total(3.14/4*(1.9*1.9-1.5*1.5) * total ht of manholes	1	1.0676		1109.68	1184.69			zone1-283.49,zone2-225.99, zone3-138.51,zone4-246.75,zone5-
		Total					1944.68	m^3		
		Deduction- Man hole pipe portions								
		150mm dia pipes(3*3.14/4*0.15*0.15*0.2) (45Nos) (intersection joints)	135	0.0176625		0.2	-0.48			
		150mm dia pipes (2*3.14/4*0.15*0.15*0.2) (942 Nos)	1884	0.0176625		0.2	-6.66			
							-7.13			
							1951.81			
		Say		1951.81	m^3			@Rs	8,932.67	₹ 17,434,898.00
	5.22.6+od 16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity of Concrete	1		5006.76	m^3	110	kg/m^3	550743.7558	kg
		Total							550743.7558	kg
		Say		**550743.756**	kg		@	Rs	**104.91**	**57778114.36**
	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity of Concrete	1		5006.76	m^3	340	kg/m^3	1702298.882	kg
		Total							1702298.882	kg
		Say		**34045.9776**	bags		@	Rs	**70.77**	**2409263.61**
27	5.9.1	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete								

		0.90m dia manholes -mat	750	6		0.35	1575	m^2		
		1.20m dia manholes -mat	79	7.2		0.4	227.52			
		1.50m dia manholes -mat	271	8.4		0.45	1024.38			
		Sewer chamber -mat	2200	4		0.2	1760			
		Total					4586.9	m^2		
		Say		4586.9	m^2			@Rs	350.00	₹ 1,605,415.00
28	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		0.90m dia 750 manholes - walls	1	6.91		901.85	6229.98	m^2		
		1.20m 79 dia manholes - walls	1	8.79		136.99	1204.40			
		1.50m dia 271 manholes - walls	1	10.68		1184.69	12647.80			
		Sewer chamber -outside	2200	4.00		0.50	4400.00			
		Sewer chamber -inside	2200	3.60		0.50	3960.00			
		Total					28442.18	m^2		
		Say		**28442.1767**	m^2		@	Rs	**748.62**	**21292465.8**
	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		0.90m dia 750 manholes - walls	1	2.83		901.85	2548.63	m^2		
		1.20m 79 dia manholes - walls	1	3.77		155.81	587.09	m^2		
		1.50m dia 271 manholes - walls	1	4.71		1109.68	5226.59			
		Sewer chamber -inside	2200	3.60		0.50	3960.00			
		Total					12322.31	m^2		
		Say		**12322.313**	m^2		@	Rs	**595.28**	**7335167.08**
	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		0.90m dia manholes -mat	750	2.826			2119.5	m^2		
		1.20m dia manholes -mat	79	3.768			297.672	m2		
		1.50m dia manholes -mat	271	4.71			1276.41			
		Sewer chamber -mat	2200	0.36			792	m^2		
		Total					4485.582	m^2		

		Say		**4485.582**	m^2		@	Rs	**458.77**	**2057848.19**
	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		0.90m dia 750 manholes - walls	1	2.83		901.85	2548.63			
		1.20m 79 dia manholes - walls	1	3.77		155.81	587.09	m^2		
		1.50m dia 271 manholes - walls	1	4.71		1109.68	5226.59	m^2		
		Sewer chamber -inside	2200	3.60		0.50	3960.00	m^2		
		0.90m dia manholes -mat	750	2.826			2119.5			
		1.20m dia manholes -mat	79	3.768			297.672	m^2		
		1.50m dia manholes -mat	271	4.71			1276.41	m^2		
		Sewer chamber -mat	2200	0.36			792	m^2		
		Total					16807.89	m^2		
		Say		**16807.89**	m^2		@	Rs	**418.79**	**7038932.45**
	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I. cover (light duty) the weight of the cover to be not less than 23 kg								
		0.90m dia manholes	750				750	No		
		1.20m dia manholes -	79				79	No		
		1.50m dia manholes	271				271	No		
		Sewer chamber	2200				2200	No		
		Total					3300.00	No		
		Say		**3300.00**	No		@	Rs	**1629.51**	**5377368.66**
34	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design.								
		0.90m dia manholes	1	1804			1803.7	No		
		1.20m dia manholes -	1	312			311.62			
		1.50m dia manholes	1	2219			2219.36			
		Total					4334.68	No		
		Say		4335	No			@Rs	568.88	₹ 2,466,095.00
38	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.								
		qty same as excavation	1	20654.53			20654.53	m^3		
		deductions								
		pcc		1146.88			1146.88			
		base slab		4485.58			4485.58			
		Manhole	1	1.33		901.85	1196.44			
			1	2.27		155.81	353.48			
			1	3.80		1109.68	4216.12			
		Total deductions					11398.50			
		Total less deduction					9256.03	m^3		
		Say		9256.02865	m^3			@Rs	269.90	₹ 2,498,202.00
39	OD	Taking connection for manholes and chambers								
			1	6650			6650	Nos.		
		Total					6650	Nos.		
		Say		**6650**	Nos.		@	Rs	**756.4**	**₹ 5,030,060**
40	100.41.40	Supply, stacking, spreading and consolidating of Red earth in the trench of pipe line for cushion including carriage, loading ,unloading & stacking up to any lead.								

		Total volume	1	27000.00	0.80	0.40	8640.00	m^3		
		Deduction								
			1	27000.00	0.04		1025.84			
				1616.30	0.04		61.41			
		Total deduction					1087.25			
		Total less deduction					7552.75			
		Say		7552.75	m^3			@Rs	370.74	₹ 2,800,107.00
41	50.2.25.1	Filling with contractor's own earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m as per direction of site Engineer-in-charge								
		Total volume(80 % of ewe qty of medium to hard rock)					32504	m^3		
		Total					32504	m^3		
		Say		32504	m^3	Cl	35.59	@Rs	548.85	₹ 24,189,012.00
		TOTAL FOR NETWORK							**453,772,218.50**	
		Road restoration charges								
1		Shoulder cutting								
			2200	1.1	1.1		2662			
								@Rs	1,366.76	₹ 3,638,315.12
2		Concrete road								
		Pipe	1	8221.8	1.5		12332.7			
		Mamhole	330	2	1.5		990			
							13322.7			
		Say		13322.7	m^2			@Rs	4,887.00	₹ 65,108,035.00
3		Tar road surface restoration charges								
			1	10962.4	1.5		16443.6			
		Mamhole	440	2	1.5		1320			
							17763.6			
		Say		17763.6	m^3			@Rs	3,086.87	₹ 54,833,924.00
4		BM & BC road surface restoration charges								
			1	8221.8	1.5		12332.7			
			440	2	1.5		1320			
							13652.7			
		Say		13652.7				@	3,633.46	₹ 49,606,539.00
		TOTAL FOR ROAD RESTORATION							**173,186,813.12**	

DETAILED ESTIMATE

SEWERAGE SCHEME IN KATTAPANA MUNICIPALITY

CIVIL CONSTRUCTION -COLLECTION WELLS

COLLECTION WELL -2

Item No.	Item Code	Description	No	L	B	H	V	Unit	Rate	Amount
1	100	Earthwork open well excavation (above water) for wells of dia. above 3.5m and upto 6.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift up to 1.5 m including neat banking.NEW DATA (Prepared based on PHED SDB - Item No.1089 & 1092								
		Collection well 2	1	6.2	6.2	1.5	57.66			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		71.5	m^3					
	100.3.5.1	Do for item 4------All kinds of soil	30%	71.5			21.45	@Rs	490.76	**₹ 10,527.0**
	100.3.6.1	Do for item 4------Ordinay rock	30%	71.5			21.45	@Rs	1,241.08	**₹ 26,621.0**
	OD MR-B1		5%	71.5			3.58	@Rs	1,537.37	**₹ 5,496.0**
	OD MR-NB1		15%	71.5			10.73	@Rs	2,063.83	**₹ 22,135.0**
	OD HR-B1		5%	71.5			3.58	@Rs	2,021.27	**₹ 7,226.0**
	OD HR-NB1		15%	71.5			10.73	@Rs	2,992.67	**₹ 32,096.0**
2	100	Earthwork open well excavation (above water) for wells of dia. above 3.5m and upto 6.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 1.5m to 3.0 m including neat banking.								
		Collection well 2	1	6.2	6.2	1.5	57.66			
		Inlet chamber	1	4.1	2.25	0.65	6.00			
		Say		63.66	m^3					
	100.3.5.2	Do for item 4------All kinds of soil	30%	63.66			19.10	@Rs	539.87	**₹ 10,310.0**
	100.3.6.2	Do for item 4------Ordinay rock	30%	63.66			19.10	@Rs	1,365.20	**₹ 26,073.0**
	OD MR-B2		5%	63.66			3.18	@Rs	1,691.11	**₹ 5,383.0**
	OD MR-NB2		15%	63.66			9.55	@Rs	2,270.24	**₹ 21,679.0**
	OD HR-B2		5%	63.66			3.18	@Rs	2,223.42	**₹ 7,077.0**
	OD HR-NB2		15%	63.66			9.55	@Rs	3,291.96	**₹ 31,435.0**
3	100	Earthwork open well excavation (above water) for wells of dia. above 3.5m and upto 6.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 3.0m to 4.5 m including neat banking.								
		Collection well 2	1	6.2	6.2	1.5	57.66			
		Say		57.66	m^3					
	100.3.5.3	Do for item 4------All kinds of soil	30%	57.66			17.30	@Rs	588.91	**₹ 10,187.0**
	100.3.6.3	Do for item 4------Ordinay rock	30%	57.66			17.30	@Rs	1,489.32	**₹ 25,762.0**
	OD MR-B3		5%	57.66			2.88	@Rs	1,844.89	**₹ 5,319.0**
	OD MR-NB3		15%	57.66			8.65	@Rs	2,476.65	**₹ 21,421.0**
	OD HR-B3		5%	57.66			2.88	@Rs	2,425.58	**₹ 6,993.0**

	OD HR-NB3		15%	57.66			8.65	@Rs	3,591.27	**₹ 31,061.0**
4	100	Earthwork open well excavation (above water) for wells of dia. above 3.5m and upto 6.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 4.5m to 6.0 m including neat banking.								
		Collection well 2	1	6.2	6.2	0.15	5.77			
		Say		5.77	m^3					
	100.3.5.4	Do for item 4------All kinds of soil	30%	5.77			1.73	@Rs	638.02	**₹ 1,104.0**
	100.3.6.4	Do for item 4------Ordinay rock	30%	5.77			1.73	@Rs	1,613.37	**₹ 2,793.0**
	OD MR-B4		5%	5.77			0.29	@Rs	1,998.55	**₹ 577.0**
	OD MR-NB4		15%	5.77			0.87	@Rs	2,682.94	**₹ 2,322.0**
	OD HR-B4		5%	5.77			0.29	@Rs	2,627.62	**₹ 758.0**
	OD HR-NB4		15%	5.77			0.87	@Rs	3,890.39	**₹ 3,367.0**
6	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		Collection well 2	1	6.2	6.2	0.2	7.69			
		Inlet chamber	1	4.1	2.15	0.2	1.76			
		Total					9.45	m^3		
		Say		**9.45**	m^3		@	Rs	**7527.0608**	**71130.72**
7	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 $kg/^3$.Excess/less cement used as per design mix is payable/recoverable separately).								
		Collection well 2								
		Bottom slab(3.14/4*(4.6+0.6+.3)^2* 0.3	1	23.75		0.3	7.12	m^3		
		wall(3.14/4*(5.2^2-4.6^2))*H	1	4.62	0.30	4.15	5.75	m^3		
		Inlet chamber bottom slab	1	3.95	1.85	0.2	1.46	m^3		
		Inlet chamber wall	2	3.70	3.15	0.2	4.66	m^3		
		Inlet chamber wall	2	1.25	3.15	0.2	1.58	m^3		
		Total					20.57	m^3		
		Say		**20.57**	m^3		@	Rs	**10404.79**	**214026.54**

8	5.37.1	Providing and laying in position ready mixed M-25 grade concrete for reinforced cement concrete work, using cement content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ cum.Excess/less cement used as per design mix is payable/recoverable separately).								
		wall(3.14/4*(5.2^2-4.6^2))*H	1	4.62	0.30	1.00	1.38	m^3		
		Top slab incl.cantilever beam(3.14/4*(4.6+0.6+2)^2*0.2	1	40.69		0.2	8.14	m^3		
		Main beam	2	4.60		0.3	2.76	m3		
		Inlet chamber top slab	1	2.80	1.85	0.2	0.56	m3		
		Total					12.84	m^3		
		Deduction								
		Manhole	4	0.6	0.45	0.2	0.22	m^3		
		Total					0.22	m^3		
		Total after deduction					12.62	m^3		
		Say		**12.62**	m^3		@	Rs	**10319.094**	**130226.96**
9	5.22.6+OD 16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		20.57	m^3	120.00	kg/m^3	2468.4	
		Quantity as per item No.4	1		12.62	m^3	100.00	kg/m^3	1262	
		Total							3730.4	
		Say		**3730.4**	kg		@	Rs	**104.90925**	**391353.47**
10	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		20.57	m^3	340.00	kg/m^3	6993.8	
		Quantity as per item No.4	1		12.62	m^3	330.00	kg/m^3	4164.6	
		Total							11158.4	
		Say		**223.168**	bags		@	Rs	**70.77**	**15792.48**
11	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab(3.14*D*H)	1	17.584		0.3	5.28	m^2		
		Total					5.28	m^2		
		Say		**5.28**	m^2		@	Rs	**350.00369**	**1846.34**
12	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For well walls outside(3.14*D*H)	1	16.328		5.15	84.09	m^2		
		Forwell walls inside(3.14*d*	1	14.444		5.15	74.39	m^2		
		Inlet chamber wall	4	4.9		3.15	61.74	m^2		

		Total					220.22	m^2		
		Say		**220.2158**	m^2		@	Rs	**748.62294**	**164858.6**
13	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for :Suspended floors, roofs, landings, balconies and access platform								
		Top slab (3.14*D)	1	3.14		7.2	22.61	m^2		
		Beam side	4	4.6		0.3	5.52	m2		
		inlet chamber top slab	1	2.8		1.85	5.18	m2		
		Total					33.31	m^2		
		Say		**33.308**	m^2		@	Rs	**851.51525**	**28362.27**
14	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.								
		Quantity as per item (all kind of soil)	1				59.58	m^3		
		Say		**59.58**	m^3		@	Rs	**269.89771**	**16079.7**
15	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls(3.14*d*h)	1	14.444		4.15	59.94	m^2		
		Total					59.94	m^2		
		Say		**59.9426**	m^2		@	Rs	**595.27518**	**35682.34**
16	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab(3.14*d)	1	14.444			14.44	m^2		
		Total					14.44	m^2		
		Say		**14.444**	m^2		@	Rs	**458.7695**	**6626.47**
		GST component								
17	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								

		Inside of walls(3.14*d*h)	1	14.444		4.15	59.94	m^2		
		Bottom slab(3.14*d)	1	14.444			14.44	m^2		
		Top slab (3.14*D)	1	3.14		7.2	22.61	m^2		
		Inlet chamber walls(total length)	1	10.75		3.65	39.24	m2		
		Total					136.23	m^2		
		Deduction								
		Manhole	4	0.6	0.45		1.08	m^2		
		Total					1.08	m^2		
		Total after deduction					135.15	m^2		
		Say		**135.1521**	m^2		@	Rs	**418.78727**	**56599.98**
18	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I. cover (light duty) the weight of the cover to be not less than 23 kg								
			4				1.00	No.		
		Say		**4**	No.		@	Rs	**1629.5057**	**6518.02**
19	13.59	Coal tarring two coats on new work using 0.16 litre and 0.12 litre coal tar per sqm in the first coat and second coat respectively.								
		For walls outside(3.14*D*H)	1	16.328		5.15	84.09			
		Say		**84.0892**	m2		@	Rs	**61.777845**	**5194.85**
20	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Quantity as per item code 13.7.1	1	135.1521			0.00		**135.1521**	
		Say		**135.1521**	m2		@	Rs	**232.67532**	**31446.56**
21	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design									
		well	16				16.00	No.		
		Inlet chamber	9				9.00	No.		
		Say		**25**	No.		@	Rs	**568.87984**	**14222**
22	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total-23m/1m c/c vertical 50mm dia	22			0.75	5.17	kg	85.305	
		Horizontal 0.25m c/c-32mm dia	3	22.608			3.17	kg	215.00208	
		Say		**300.30708**	kg		@	Rs	**194.17916**	**58313.38**
23	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								

		vertical pipe	22	0.75		0.05	0.83	m2		
		Horizontal pipe	3	22.608		0.032	2.17	m2		
		Say		**3.00**	m2		@	Rs	**154.62153**	**463.15**
24	100.36.1	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	16.6106		4.15	68.93	m3		
		Say		**68.93**	Kilo litre		@	Rs	**218.94691**	**15092.88**
		Total-collection well 2								**₹ 1,581,558.70**
COLLECTION WELL -3										
Item No.	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	100.00	Earthwork open well excavation (above water) for wells of dia. above 3.5m and upto 6.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift up to 1.5 m including neat banking.NEW DATA (Prepared based on PHED SDB - Item No.1089 & 1092								
		Collection well 3	1	6.2	6.2	1.5	57.66			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		71.5	m^3					
	100.3.5.1	Do for item 4------All kinds of soil	30%	71.5			21.45	@Rs	490.76	**₹ 10,527.0**
	100.3.6.1	Do for item 4------Ordinay	30%	71.5			21.45	@Rs	1,241.08	**₹ 26,621.0**
	OD MR-B1		5%	71.5			3.58	@Rs	1,537.37	**₹ 5,496.0**
	OD MR-NB1		15%	71.5			10.73	@Rs	2,063.83	**₹ 22,135.0**
	OD HR-B1		5%	71.5			3.58	@Rs	2,021.27	**₹ 7,226.0**
	OD HR-NB1		15%	71.5			10.73	@Rs	2,992.67	**₹ 32,096.0**
2	100	Earthwork open well excavation (above water) for wells of dia. above 3.5m and upto 6.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 1.5m to 3.0 m including neat banking.								
		Collection well 2	1	6.2	6.2	1.5	57.66			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		71.5	m^3					
	100.3.5.2	Do for item 4------All kinds of soil	30%	71.5			21.45	@Rs	539.87	**₹ 11,580.0**
	100.3.6.2	Do for item 4------Ordinay rock	30%	71.5			21.45	@Rs	1,365.20	**₹ 29,284.0**
	OD MR-B2		5%	71.5			3.58	@Rs	1,691.11	**₹ 6,046.0**
	OD MR-NB2		15%	71.5			10.73	@Rs	2,270.24	**₹ 24,348.0**
	OD HR-B2		5%	71.5			3.58	@Rs	2,223.42	**₹ 7,949.0**
	OD HR-NB2		15%	71.5			10.73	@Rs	3,291.96	**₹ 35,306.0**
3	100	Earthwork open well excavation (above water) for wells of dia. above 3.5m and upto 6.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 3.0m to 4.5 m including neat banking.								
		Collection well 2	1	6.2	6.2	1.5	57.66			
		Say		57.66	m^3					**0**
	100.3.5.3	Do for item 4------All kinds of soil	30%	57.66			17.30	@Rs	588.91	**₹ 10,187.0**

	100.3.6.3	Do for item 4------Ordinay rock	30%	57.66			17.30	@Rs	1,489.32	**₹ 25,762.0**
	OD MR-B3		5%	57.66			2.88	@Rs	1,844.89	**₹ 5,319.0**
	OD MR-NB3		15%	57.66			8.65	@Rs	2,476.65	**₹ 21,421.0**
	OD HR-B3		5%	57.66			2.88	@Rs	2,425.58	**₹ 6,993.0**
	OD HR-NB3		15%	57.66			8.65	@Rs	3,591.27	**₹ 31,061.0**
4	100	Earthwork open well excavation (above water) for wells of dia. above 3.5m and upto 6.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 4.5m to 6.0 m including neat banking.								
		Collection well 2	1	6.2	6.2	0.75	28.83			
		Say		28.83	m^3					**0**
	100.3.5.4	Do for item 4------All kinds of soil	30%	28.83			8.65	@Rs	638.02	**₹ 5,518.0**
	100.3.6.4	Do for item 4------Ordinay rock	30%	28.83			8.65	@Rs	1,613.37	**₹ 13,954.0**
	OD MR-B4		5%	28.83			1.44	@Rs	1,998.55	**₹ 2,881.0**
	OD MR-NB4		15%	28.83			4.32	@Rs	2,682.94	**₹ 11,602.0**
	OD HR-B4		5%	28.83			1.44	@Rs	2,627.62	**₹ 3,788.0**
	OD HR-NB4		15%	28.83			4.32	@Rs	3,890.39	**₹ 16,824.0**
5	100	Earthwork open well excavation (above water) for wells of dia. above 3.5m and upto 6.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 6 m to 7.5m including neat banking.								
		Collection well 2	1							
		Say		0	m^3					**0**
	100.3.5.5	Do for item 4------All kinds of soil	30%	0			0.00	@Rs	687.06	**₹ 0.0**
	100.3.6.5	Do for item 4------Ordinay rock	30%	0			0.00	@Rs	1,737.49	**₹ 0.0**
	OD MR-B5		5%	0			0.00	@Rs	2,152.30	**₹ 0.0**
	OD MR-NB5		15%	0			0.00	@Rs	2,889.35	**₹ 0.0**
	OD HR-B5		5%	0			0.00	@Rs	2,829.76	**₹ 0.0**
	OD HR-NB5		15%	0			0.00	@Rs	4,189.70	**₹ 0.0**
6	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		Collection well 2	1	6.2	6.2	0.2	7.69			
		Inlet chamber	1	4.1	2.15	0.2	1.76			
		Total					9.45	m^3		
		Say		**9.45**	m^3		@	Rs	**7527.0608**	**71130.72**
7	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).									

		Collection well 2								
		Bottom slab(3.14/4*(4.6+0.6+	1	23.75		0.3	7.12	m^3		
		wall(3.14/4*(5.2^2-4.6^2))*H	1	4.62	0.30	4.75	6.58	m^3		
		Inlet chamber bottom slab	1	3.95	1.85	0.2	1.46	m^3		
		Inlet chamber wall	2	3.70	3.55	0.2	5.25	m^3		
		Inlet chamber wall	2	1.25	3.55	0.2	1.78	m^3		
		Total					22.19	m^3		
		Say		**22.19**	m^3		@	Rs	**10404.79**	**230882.3**
8	5.37.1	Providing and laying in position ready mixed M-25 grade concrete for reinforced cement concrete work, using cement content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ cum.Excess/less cement used as per design mix is payable/recoverable separately).								
		wall(3.14/4*(5.2^2-4.6^2))*H	1	4.62	0.30	1.00	1.38	m^3		
		Top slab incl.cantilever beam(3.14/4*(4.6+0.6+2)^2*0.2	1	40.69		0.2	8.14	m^3		
		Main beam	2	4.60		0.3	2.76	m3		
		Inlet chamber top slab	1	2.80	1.85	0.2	0.56	m3		
		Total					12.84	m^3		
		Deduction								
		Manhole	4	0.6	0.45	0.2	0.22	m^3		
		Total					0.22	m^3		
		Total after deduction					12.62	m^3		
		Say		**12.62**	m^3		@	Rs	**10319.094**	**130226.96**
9	5.22.6+OD 16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		22.19	m^3	120.00	kg/m^3	2662.8	
		Quantity as per item No.4	1		12.62	m^3	100.00	kg/m^3	1262	
		Total							3924.8	
		Say		**3924.8**	kg		@	Rs	**104.90925**	**411747.82**
10	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		22.19	m^3	340.00	kg/m^3	7544.6	
		Quantity as per item No.4	1		12.62	m^3	330.00	kg/m^3	4164.6	
		Total							11709.2	
		Say		**234.184**	bags		@	Rs	**70.77**	**16572.03**
11	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		Bottom slab(3.14*D*H)	1	17.584		0.3	5.28	m^2		
		Total					5.28	m^2		
		Say		**5.28**	m^2		@	Rs	**350.00369**	**1846.34**

12	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For well walls outside(3.14*D*H)	1	16.328		5.75	93.89	m^2		
		Forwell walls inside(3.14*d*	1	14.444		4.75	68.61	m^2		
		Inlet chamber wall	4	4.9		3.55	69.58	m^2		
		Total					232.08	m^2		
		Say		**232.075**	m^2		@	Rs	**748.62294**	**173736.67**
13	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for :Suspended floors, roofs, landings, balconies and access platform								
		Top slab (3.14*D)	1	3.14		7.2	22.61	m^2		
		Beam side	4	4.6		0.3	5.52	m2		
		inlet chamber top slab	1	2.8		1.85	5.18	m2		
		Total					33.31	m^2		
		Say		**33.308**	m^2		@	Rs	**851.51525**	**28362.27**
14	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.								
		Quantity as per item (all kind of soil)	1				68.85	m^3		
		Say		**68.85**	m^3		@	Rs	**269.89771**	**18581.65**
15	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls(3.14*d*h)	1	14.444		4.75	68.61	m^2		
		Total					68.61	m^2		
		Say		**68.609**	m^2		@	Rs	**595.27518**	**40841.23**
16	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab(3.14*d)	1	14.444			14.44	m^2		

		Total					14.44	m^2		
		Say		**14.444**	m^2		@	Rs	**458.7695**	**6626.47**
17	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls(3.14*d*h)	1	14.444		4.75	68.61	m^2		
		Bottom slab(3.14*d)	1	14.444			14.44	m^2		
		Top slab (3.14*D)	1	3.14		7.2	22.61	m^2		
		Inlet chamber walls(total leng	1	10.75		3.55	38.16	m2		
		Total					143.82	m^2		
		Deduction								
		Manhole	4	0.6	0.45		1.08	m^2		
		Total					1.08	m^2		
		Total after deduction					142.74	m^2		
		Say		**142.7435**	m^2		@	Rs	**418.78727**	**59779.16**
18	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I. cover (light duty) the weight of the cover to be not less than 23 kg								
			4				1.00	No.		
		Say		**4**	No.		@	Rs	**1629.5057**	**6518.02**
19	13.59	Coal tarring two coats on new work using 0.16 litre and 0.12 litre coal tar per sqm in the first coat and second coat respectively.								
		For walls outside(3.14*D*H)	1	16.328		5.75	93.89			
		Say		**93.886**	m2		@	Rs	**61.777845**	**5800.07**
20	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Quantity as per item code 13.7.1	1	142.7435			0.00		**142.7435**	
		Say		**142.7435**	m2		@	Rs	**232.67532**	**33212.89**
21	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
		well	17				17.00	No.		
		Inlet chamber	10				10.00	No.		
		Say		**27**	No.		@	Rs	**568.87984**	**15359.76**
22	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total-23m/1m c/c vertical 50mm dia	22			0.75	5.17	kg	85.305	
		Horizontal 0.25m c/c-32mm dia	3	22.608			3.17	kg	215.00208	

		Say		**300.30708**	kg		@	Rs	**194.17916**	**58313.38**
23	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	22	0.75		0.05	0.83	m2		
		Horizontal pipe	3	22.608		0.032	2.17	m2		
		Say		**3.00**	m2		@	Rs	**154.62153**	**463.15**
24	100.36.1	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	16.6106		4.75	78.90	m3		
		Say		**789.00**	Kilo litre		@	Rs	**218.94691**	**172749.88**
		Total-collection well 3								**₹ 1,856,674.80**
COLLECTION WELL -1										
Item No.	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	100.00	Earthwork open well excavation (above water) for wells of dia. above 6.0m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift up to 1.5 m including neat banking.NEW DATA (Prepared based on PHED SDB - Item No.1089 & 1092								
		Collection well 1	1	7.8	7.8	1.5	91.26			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		105.1	m^3					
	100.3.7.1	Do for item 4------All kinds of soil	30%	105.1			31.53	@Rs	471.51	**₹ 14,867.0**
	100.3.8.1	Do for item 4------Ordinay rock	30%	105.1			31.53	@Rs	1,207.11	**₹ 38,060.0**
	OD MR-B6		5%	105.1			5.26	@Rs	1,495.29	**₹ 7,858.0**
	OD MR-NB6		15%	105.1			15.77	@Rs	2,007.35	**₹ 31,646.0**
	OD HR-B6		5%	105.1			5.26	@Rs	1,965.96	**₹ 10,331.0**
	OD HR-NB6		15%	105.1			15.77	@Rs	2,910.76	**₹ 45,888.0**
2	100	Earthwork open well excavation (above water) for wells of dia. above 6.0m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 1.5m to 3.0 m including neat banking.								
		Collection well 2	1	7.8	7.8	1.5	91.26			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		105.1	m^3					
	100.3.7.2	Do for item 4------All kinds of soil	30%	105.1			31.53	@Rs	518.64	**₹ 16,353.0**
	100.3.8.2	Do for item 4------Ordinay rock	30%	105.1			31.53	@Rs	1,327.83	**₹ 41,866.0**
	OD MR-B7		5%	105.1			5.26	@Rs	1,644.85	**₹ 8,644.0**
	OD MR-NB7		15%	105.1			15.77	@Rs	2,208.11	**₹ 34,811.0**
	OD HR-B7		5%	105.1			5.26	@Rs	2,162.58	**₹ 11,364.0**
	OD HR-NB7		15%	105.1			15.77	@Rs	3,201.86	**₹ 50,477.0**

3	100	Earthwork open well excavation (above water) for wells of dia. above 6.0m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 3.0m to 4.5 m including neat banking.								
		Collection well 1	1	7.8	7.8	1.5	91.26			
		Inlet chamber	1	4.1	2.25	0.15	1.38			
		Say		91.26	m^3					**0**
	100.3.7.3	Do for item 4------All kinds of soil	30%	91.26			27.38	@Rs	565.84	**₹ 15,492.0**
	100.3.8.3	Do for item 4------Ordinay rock	30%	91.26			27.38	@Rs	1,448.56	**₹ 39,659.0**
	OD MR-B8		5%	91.26			4.56	@Rs	1,794.39	**₹ 8,188.0**
	OD MR-NB8		15%	91.26			13.69	@Rs	2,408.87	**₹ 32,975.0**
	OD HR-B8		5%	91.26			4.56	@Rs	2,359.21	**₹ 10,765.0**
	OD HR-NB8		15%	91.26			13.69	@Rs	3,492.97	**₹ 47,815.0**
4	100	Earthwork open well excavation (above water) for wells of dia. above 6m and upto9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 4.5m to 6.0 m including neat banking.								
		Collection well 1	1	7.8	7.8	1.5	91.26			
		Say		91.26	m^3					**0**
	100.3.7.4	Do for item 4------All kinds of soil	30%	91.26			27.38	@Rs	612.98	**₹ 16,782.0**
	100.3.8.4	Do for item 4------Ordinay rock	30%	91.26			27.38	@Rs	1,569.21	**₹ 42,962.0**
	OD MR-B9		5%	91.26			4.56	@Rs	1,943.84	**₹ 8,870.0**
	OD MR-NB9		15%	91.26			13.69	@Rs	2,609.52	**₹ 35,722.0**
	OD HR-B9		5%	91.26			4.56	@Rs	2,555.71	**₹ 11,662.0**
	OD HR-NB9		15%	91.26			13.69	@Rs	3,783.92	**₹ 51,798.0**
5	100	Earthwork open well excavation (above water) for wells of dia. above 6m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 6 m to 7.5m including neat banking.								
		Collection well 1	1	7.8	7.8	0.15	9.13			
		Say		9.13	m^3					**0**
	100.3.7.5	Do for item 4------All kinds of soil	30%	9.13			2.74	@Rs	660.10	**₹ 1,808.0**
	100.3.8.5	Do for item 4------Ordinay rock	30%	9.13			2.74	@Rs	1,689.94	**₹ 4,629.0**
	OD MR-B10		5%	9.13			0.46	@Rs	2,093.40	**₹ 956.0**
	OD MR-NB10		15%	9.13			1.37	@Rs	2,810.28	**₹ 3,849.0**
	OD HR-B10		5%	9.13			0.46	@Rs	2,752.32	**₹ 1,256.0**
	OD HR-NB10		15%	9.13			1.37	@Rs	4,075.02	**₹ 5,581.0**
6	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		Collection well 2	1	7.8	7.8	0.2	12.17			
		Inlet chamber	1	4.1	2.15	0.2	1.76			
		Total					13.93	m^3		
		Say		**13.93**	m^3		@	Rs	**7527.0608**	**104851.96**

7	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).								
		Collection well 1								
		slab(3.14/4*(6.2+0.6+.3)^2* 0.3	1	50.24		0.3	15.07	m^3		
		wall(3.14/4*(6.8^2-6.2^2))*H	1	6.12	0.30	5.65	10.38	m^3		
		Inlet chamber bottom slab	1	3.95	1.85	0.2	1.46	m^3		
		Inlet chamber wall	2	3.70	3.65	0.2	5.40	m^3		
		Inlet chamber wall	2	1.25	3.65	0.2	1.83	m^3		
		Total					34.14	m^3		
		Say		**34.14**	m^3		@	Rs	**10404.79**	**355219.54**
8	5.37.1	Providing and laying in position ready mixed M-25 grade concrete for reinforced cement concrete work, using cement content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ cum.Excess/less cement used as per design mix is payable/recoverable separately).								
		WELL wall(3.14/4*(6.8^2-6.2^2))*H	1	6.12	0.30	1.00	1.84	m^3		
		Top slab incl.cantilever beam(3.14/4*(6.2+0.6+2)^2* 0.2	1	60.79		0.2	12.16	m^3		
		Main beam	2	6.20		0.3	3.72	m3		
		Inlet chamber top slab	1	2.80	1.85	0.2	0.56	m3		
		Total					18.28	m^3		
		Deduction								
		Manhole	4	0.6	0.45	0.2	0.22	m^3		
		Total					0.22	m^3		
		Total after deduction					18.06	m^3		
		Say		**18.06**	m^3		@	Rs	**10319.094**	**186362.83**
9	5.22.6+OD 16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		34.14	m^3	120.00	kg/m^3	4096.8	kg
		Quantity as per item No.4	1		18.06	m^3	100.00	kg/m^3	1806	kg
		Total							5902.8	kg
		Say		**5902.8**	kg		@	Rs	**104.90925**	**619258.32**

10	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		34.14	m^3	340.00	kg/m^3	11607.6	kg
		Quantity as per item No.4	1		18.06	m^3	330.00	kg/m^3	5959.8	kg
		Total							17567.4	kg
		Say		**351.348**	bags		@	Rs	**70.77**	**24863.14**
11	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		well Bottom slab(3.14*D*H)	1	21.352		0.3	6.41	m^2		
		Total					6.41	m^2		
		Say		**6.41**	m^2		@	Rs	**350.00369**	**2241.98**
12	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For well walls outside(3.14*D*H)	1	21.352		6.65	141.99	m^2		
		Forwell walls inside(3.14*d*	1	19.468		5.65	109.99	m^2		
		Inlet chamber wall	4	4.9		3.65	71.54	m^2		
		Total					323.53	m^2		
		Say		**323.525**	m^2		@	Rs	**748.62294**	**242198.24**
13	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for :Suspended floors, roofs, landings, balconies and access platform								
		Top slab (3.14*D)	1	3.14		8.8	27.63	m^2		
		Beam side	4	6.2		0.45	11.16	m2		
		inlet chamber top slab	1	2.8		1.85	5.18	m2		
		Total					43.97	m^2		
		Say		**43.972**	m^2		@	Rs	**851.51525**	**37442.83**
14	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.								
		Quantity as per item (all kind of soil)	1				120.56	m^3		
		Say		**120.56**	m^3		@	Rs	**269.89771**	**32537.52**
15	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls(3.14*d*h)	1	19.468		4.75	92.47	m^2		
		Total					92.47	m^2		
		Say		**92.473**	m^2		@	Rs	**595.27518**	**55046.88**

16	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab(3.14*d)	1	19.468			19.47	m^2		
		Total					19.47	m^2		
		Say		**19.468**	m^2		@	Rs	**458.7695**	**8931.32**
17	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls(3.14*d*h)	1	19.468		6.65	129.46	m^2		
		Bottom slab(3.14*d)	1	19.468			19.47	m^2		
		Top slab (3.14*D)	1	3.14		8.8	27.63	m^2		
		Inlet chamber walls(total length)	1	10.75		3.65	39.24	m2		
		Total					215.80	m^2		
		Deduction								
		Manhole	4	0.6	0.45		1.08	m^2		
		Total					1.08	m^2		
		Total after deduction					214.72	m^2		
		Say		**214.7197**	m^2		@	Rs	**418.78727**	**89921.88**
18	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I.								
			4				1.00	No.		
		Say		**4**	No.		@	Rs	**1629.5057**	**6518.02**
19	13.59	Coal tarring two coats on new work using 0.16 litre and 0.12 litre coal tar per sqm in the first coat and second coat respectively.								
		For walls outside(3.14*D*H)	1	21.352		5.75	122.77			
		Say		**122.774**	m2		@	Rs	**61.777845**	**7584.71**
20	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Quantity as per item code 13.7.1	1	214.7197			0.00		**214.7197**	
		Say		**214.7197**	m2		@	Rs	**232.67532**	**49959.97**

21	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design								
		well	20				20.00	No.		
		Inlet chamber	11				11.00	No.		
		Say		**31**	No.		@	Rs	**568.87984**	**17635.27**
22	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total-23m/1m c/c vertical 50mm dia	28			0.75	5.17	kg	108.57	
		Horizontal 0.25m c/c-32mm dia	3	28			3.17	kg	266.28	
		Say		**374.85**	kg		@	Rs	**194.17916**	**72788.06**
23	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	28	0.75		0.05	1.05	m2		
		Horizontal pipe	3	28		0.032	2.69	m2		
		Say		**3.74**	m2		@	Rs	**154.62153**	**577.98**
24	100.36.1	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	30.1754		5.65	170.49	m3		
		Say		**1704.91**	Kilo litre		@	Rs	**218.94691**	**373284.8**
		Total-collection well 1								**₹ 2,940,159.25**

COLLECTION WELL -4

m	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	100.00	Earthwork open well excavation (above water) for wells of dia. above 6.0m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift up to 1.5 m including neat banking.NEW DATA (Prepared based on PHED SDB - Item No.1089 & 1092								
		Collection well 4	1	7.6	7.6	1.5	86.64			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		100.48	m^3					
	100.3.7.1	Do for item 4------All kinds of soil	30%	100.48			30.14	@Rs	471.51	**₹ 14,213.0**
	100.3.8.1	Do for item 4------Ordinay rock	30%	100.48			30.14	@Rs	1,207.11	**₹ 36,387.0**
	OD MR-B6		5%	100.48			5.02	@Rs	1,495.29	**₹ 7,512.0**
	OD MR-NB6		15%	100.48			15.07	@Rs	2,007.35	**₹ 30,255.0**
	OD HR-B6		5%	100.48			5.02	@Rs	1,965.96	**₹ 9,877.0**
	OD HR-NB6		15%	100.48			15.07	@Rs	2,910.76	**₹ 43,871.0**

2	100	Earthwork open well excavation (above water) for wells of dia. above 6.0m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 1.5m to 3.0 m including neat banking.								
		Collection well 4	1	7.6	7.6	1.5	86.64			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		100.48	m^3					
	100.3.7.2	Do for item 4------All kinds of soil	30%	100.48			30.14	@Rs	518.64	**₹ 15,634.0**
	100.3.8.2	Do for item 4------Ordinay rock	30%	100.48			30.14	@Rs	1,327.83	**₹ 40,026.0**
	OD MR-B7		5%	100.48			5.02	@Rs	1,644.85	**₹ 8,264.0**
	OD MR-NB7		15%	100.48			15.07	@Rs	2,208.11	**₹ 33,281.0**
	OD HR-B7		5%	100.48			5.02	@Rs	2,162.58	**₹ 10,865.0**
	OD HR-NB7		15%	100.48			15.07	@Rs	3,201.86	**₹ 48,258.0**
3	100	Earthwork open well excavation (above water) for wells of dia. above 6.0m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 3.0m to 4.5 m including neat banking.								
		Collection well 4	1	7.6	7.6	1.5	86.64			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		100.48	m^3					**0**
	100.3.7.3	Do for item 4------All kinds of soil	30%	100.48			30.14	@Rs	565.84	**₹ 17,057.0**
	100.3.8.3	Do for item 4------Ordinay rock	30%	100.48			30.14	@Rs	1,448.56	**₹ 43,665.0**
	OD MR-B8		5%	100.48			5.02	@Rs	1,794.39	**₹ 9,015.0**
	OD MR-NB8		15%	100.48			15.07	@Rs	2,408.87	**₹ 36,306.0**
	OD HR-B8		5%	100.48			5.02	@Rs	2,359.21	**₹ 11,853.0**
	OD HR-NB8		15%	100.48			15.07	@Rs	3,492.97	**₹ 52,646.0**
4	100	Earthwork open well excavation (above water) for wells of dia. above 6m and upto9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 4.5m to 6.0 m including neat banking.								
		Collection well 1	1	7.8	7.8	1.5	91.26			
		Inlet chamber	1	4.1	2.25	0.25	2.31			
		Say		93.57	m^3					**0**
	100.3.7.4	Do for item 4------All kinds of soil	30%	93.57			28.07	@Rs	612.98	**₹ 17,207.0**
	100.3.8.4	Do for item 4------Ordinay rock	30%	93.57			28.07	@Rs	1,569.21	**₹ 44,049.0**
	OD MR-B9		5%	93.57			4.68	@Rs	1,943.84	**₹ 9,094.0**
	OD MR-NB9		15%	93.57			14.04	@Rs	2,609.52	**₹ 36,626.0**
	OD HR-B9		5%	93.57			4.68	@Rs	2,555.71	**₹ 11,957.0**
	OD HR-NB9		15%	93.57			14.04	@Rs	3,783.92	**₹ 53,109.0**
5	100	Earthwork open well excavation (above water) for wells of dia. above 6m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 6 m to 7.5m including neat banking.								
		Collection well 4	1	7.6	7.6	0.15	8.66			
		Say		8.66	m^3					**0**
	100.3.7.5	Do for item 4------All kinds of soil	30%	8.66			2.60	@Rs	660.10	**₹ 1,715.0**

	100.3.8.5	Do for item 4------Ordinay rock	30%	8.66			2.60	@Rs	1,689.94	**₹ 4,390.0**
	OD MR-B10		5%	8.66			0.43	@Rs	2,093.40	**₹ 906.0**
	OD MR-NB10		15%	8.66			1.30	@Rs	2,810.28	**₹ 3,651.0**
	OD HR-B10		5%	8.66			0.43	@Rs	2,752.32	**₹ 1,192.0**
	OD HR-NB10		15%	8.66			1.30	@Rs	4,075.02	**₹ 5,293.0**
6	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		Collection well 4	1	7.6	7.6	0.2	11.55			
		Inlet chamber	1	4.1	2.15	0.2	1.76			
		Total					13.31	m^3		
		Say		**13.31**	m^3		@	Rs	**7527.0608**	**100185.18**
7	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).								
		Collection well 1								
		Bottom slab(3.14/4*(6+0.6+.3	1	37.37		0.3	11.21	m^3		
		wall(3.14/4*(6.6^2-6^2))*H	1	5.93	0.30	6.76	12.04	m^3		
		Inlet chamber bottom slab	1	3.95	1.85	0.2	1.46	m^3		
		Inlet chamber wall	2	3.70	5.36	0.2	7.93	m^3		
		Inlet chamber wall	2	1.25	5.36	0.2	2.68	m^3		
		Total					35.32	m^3		
		Say		**35.32**	m^3		@	Rs	**10404.79**	**367497.19**
8	5.37.1	Providing and laying in position ready mixed M-25 grade concrete for reinforced cement concrete work, using cement content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ cum.Excess/less cement used as per design mix is payable/recoverable separately).								
		WELL wall(3.14/4*(6.6^2-6^	1	5.93	0.30	1.00	1.78	m^3		
		Top slab incl.cantilever beam(3.14/4*(6+0.6+2)^2*0.2	1	58.06		0.2	11.61	m^3		
		Main beam	2	6.00		0.3	3.60	m3		
		Inlet chamber top slab	1	2.80	1.85	0.2	0.56	m3		
		Total					17.55	m^3		
		Deduction								

		Manhole	4	0.6	0.45	0.2	0.22	m^3		
		Total					0.22	m^3		
		Total after deduction					17.33	m^3		
		Say		**17.33**	m^3		@	Rs	**10319.094**	**178829.9**
9	5.22.6+OD 16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		35.32	m^3	120.00	kg/m^3	4238.4	kg
		Quantity as per item No.4	1		17.33	m^3	100.00	kg/m^3	1733	kg
		Total							5971.4	kg
		Say		**5971.4**	kg		@	Rs	**104.90925**	**626455.1**
10	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		35.32	m^3	340.00	kg/m^3	12008.8	kg
		Quantity as per item No.4	1		17.33	m^3	330.00	kg/m^3	5718.9	kg
		Total							17727.7	kg
		Say		**354.554**	bags		@	Rs	**70.77**	**25090.01**
11	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		well Bottom slab(3.14*D*H)	1	20.724		0.3	6.22	m^2		
		Total					6.22	m^2		
		Say		**6.22**	m^2		@	Rs	**350.00369**	**2176.04**
12	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		For well walls outside(3.14*D*H)	1	20.724		6.76	140.09	m^2		
		Forwell walls inside(3.14*d*	1	18.84		6.76	127.36	m^2		
		Inlet chamber wall	4	4.9		5.36	105.06	m^2		
		Total					372.51	m^2		
		Say		**372.50864**	m^2		@	Rs	**748.62294**	**278868.51**
13	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for :Suspended floors, roofs, landings, balconies and access platform								
		Top slab (3.14*D)	1	3.14		8.6	27.00	m^2		
		Beam side	4	6		0.45	10.80	m2		
		inlet chamber top slab	1	2.8		1.85	5.18	m2		
		Total					42.98	m^2		
		Say		**42.984**	m^2		@	Rs	**851.51525**	**36601.53**
14	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.								
		Quantity as per item (all kind of soil)	1				121.10	m^3		
		Say		**121.10**	m^3		@	Rs	**269.89771**	**32684.88**

15	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls(3.14*d*h)	1	18.84		6.76	127.36	m^2		
		Total					127.36	m^2		
		Say		**127.3584**	m^2		@	Rs	**595.27518**	**75813.29**
16	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab(3.14*d)	1	18.84			18.84	m^2		
		Total					18.84	m^2		
		Say		**18.84**	m^2		@	Rs	**458.7695**	**8643.22**
17	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls(3.14*d*h)	1	18.84		6.76	127.36	m^2		
		Bottom slab(3.14*d)	1	18.84			18.84	m^2		
		Top slab (3.14*D)	1	3.14		8.6	27.00	m^2		
		Inlet chamber walls(total leng	1	10.75		5.36	57.62	m2		
		Total					230.82	m^2		
		Deduction								
		Manhole	4	0.6	0.45		1.08	m^2		
		Total					1.08	m^2		
		Total after deduction					229.74	m^2		
		Say		**229.7424**	m^2		@	Rs	**418.78727**	**96213.19**
18	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I. cover (light duty) the weight of the cover to be not less than 23 kg								
			4				1.00	No.		
		Say		**4**	No.		@	Rs	**1629.5057**	**6518.02**
19	13.59	Coal tarring two coats on new work using 0.16 litre and 0.12 litre coal tar per sqm in the first coat and second coat respectively.								

		For walls outside(3.14*D*H)	1	20.724		6.76	140.09			
		Say		**140.09424**	m2		@	Rs	**61.777845**	**8654.72**
20	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Quantity as per item code 13.7.1	1	229.7424			0.00		**229.7424**	
		Say		**229.7424**	m2		@	Rs	**232.67532**	**53455.39**
21	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design									
		well	21				21.00	No.		
		Inlet chamber	16				16.00	No.		
		Say		**37**	No.		@	Rs	**568.87984**	**21048.55**
22	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total-23m/1m c/c vertical 50mm dia	27			0.75	5.17	kg	104.6925	
		Horizontal 0.25m c/c-32mm dia	3	27			3.17	kg	256.77	
		Say		**361.4625**	kg		@	Rs	**194.17916**	**70188.48**
23	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	27	0.75		0.05	1.01	m2		
		Horizontal pipe	3	27		0.032	2.59	m2		
		Say		**3.60**	m2		@	Rs	**154.62153**	**557.33**
24	100.36.1	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	28.26		5.76	162.78	m3		
		Say		**1627.78**	Kilo litre		@	Rs	**218.94691**	**356396.53**
		Total-collection well 4								**₹ 3,004,051.10**

COLLECTION WELL -5

Item No.	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	100.00	Earthwork open well excavation (above water) for wells of dia. above 6.0m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift up to 1.5 m including neat banking.NEW DATA (Prepared based on PHED SDB - Item No.1089 & 1092								

		Collection well 5	1	8.6	8.6	1.5	110.94			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		124.78	m^3					
	100.3.7.1	Do for item 4------All kinds of soil	30%	124.78			37.43	@Rs	471.51	**₹ 17,651.0**
	100.3.8.1	Do for item 4------Ordinay rock	30%	124.78			37.43	@Rs	1,207.11	**₹ 45,187.0**
	OD MR-B6		5%	124.78			6.24	@Rs	1,495.29	**₹ 9,329.0**
	OD MR-B7		15%	124.78			18.72	@Rs	2,007.35	**₹ 37,572.0**
	OD MR-B8		5%	124.78			6.24	@Rs	1,965.96	**₹ 12,266.0**
	OD MR-B9		15%	124.78			18.72	@Rs	2,910.76	**₹ 54,481.0**
2	100	Earthwork open well excavation (above water) for wells of dia. above 6.0m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 1.5m to 3.0 m including neat banking.								
		Collection well 5	1	8.6	8.6	1.5	110.94			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		124.78	m^3					
	100.3.7.2	Do for item 4------All kinds of soil	30%	124.78			37.43	@Rs	518.64	**₹ 19,415.0**
	100.3.8.2	Do for item 4------Ordinay rock	30%	124.78			37.43	@Rs	1,327.83	**₹ 49,706.0**
	OD MR-B7		5%	124.78			6.24	@Rs	1,644.85	**₹ 10,262.0**
	OD MR-NB7		15%	124.78			18.72	@Rs	2,208.11	**₹ 41,329.0**
	OD HR-B7		5%	124.78			6.24	@Rs	2,162.58	**₹ 13,492.0**
	OD HR-NB7		15%	124.78			18.72	@Rs	3,201.86	**₹ 59,929.0**
3	100	Earthwork open well excavation (above water) for wells of dia. above 6.0m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 3.0m to 4.5 m including neat banking.								
		Collection well 5	1	8.6	8.6	1.5	110.94			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		124.78	m^3					**0**
	100.3.7.3	Do for item 4------All kinds of soil	30%	124.78			37.43	@Rs	565.84	**₹ 21,182.0**
	100.3.8.3	Do for item 4------Ordinay rock	30%	124.78			37.43	@Rs	1,448.56	**₹ 54,225.0**
	OD MR-B8		5%	124.78			6.24	@Rs	1,794.39	**₹ 11,195.0**
	OD MR-NB8		15%	124.78			18.72	@Rs	2,408.87	**₹ 45,087.0**
	OD HR-B8		5%	124.78			6.24	@Rs	2,359.21	**₹ 14,719.0**
	OD HR-NB8		15%	124.78			18.72	@Rs	3,492.97	**₹ 65,378.0**
4	100	Earthwork open well excavation (above water) for wells of dia. above 6m and upto9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 4.5m to 6.0 m including neat banking.								
		Collection well 5	1	8.6	8.6	1.5	110.94			
		Inlet chamber	1	4.1	2.25	1.5	13.84			
		Say		124.78	m^3					**0**
	100.3.7.4	Do for item 4------All kinds of soil	30%	124.78			37.43	@Rs	612.98	**₹ 22,946.0**
	100.3.8.4	Do for item 4------Ordinay rock	30%	124.78			37.43	@Rs	1,569.21	**₹ 58,742.0**

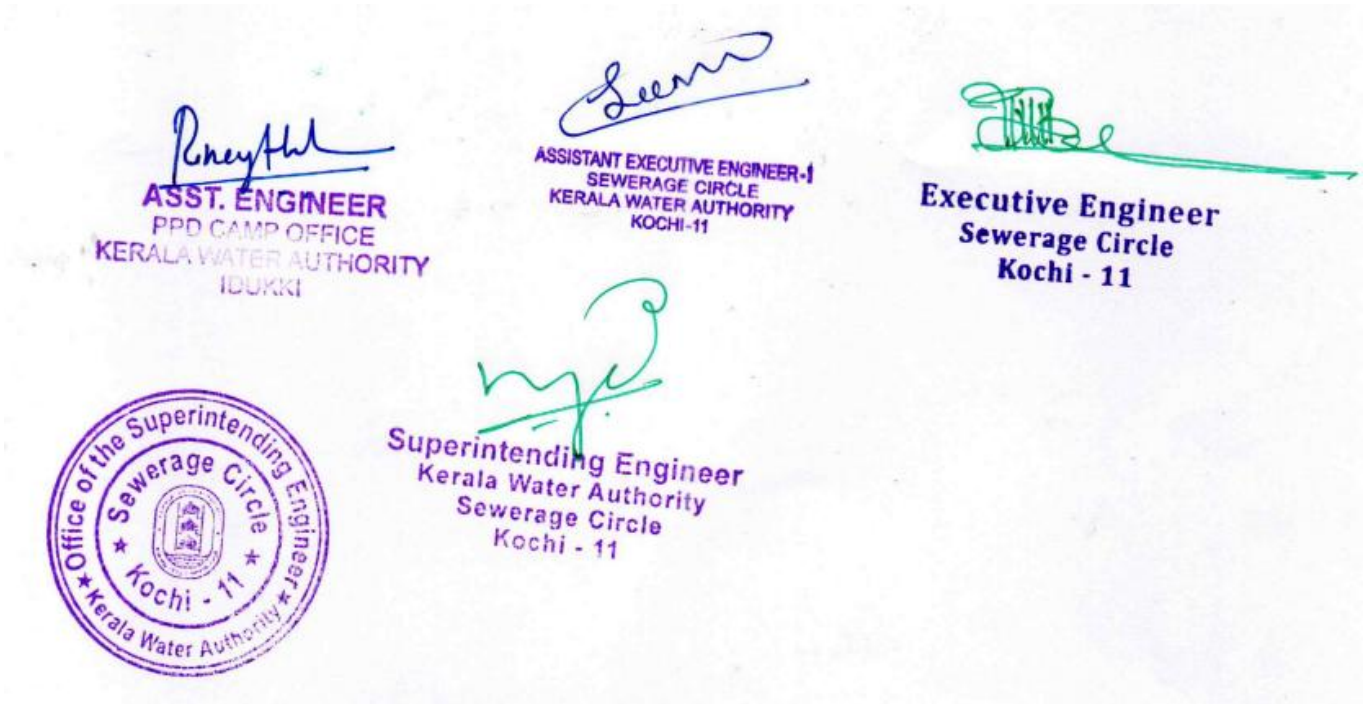
	OD MR-B9		5%	124.78			6.24	@Rs	1,943.84	**₹ 12,128.0**
	OD MR-NB9		15%	124.78			18.72	@Rs	2,609.52	**₹ 48,842.0**
	OD HR-B9		5%	124.78			6.24	@Rs	2,555.71	**₹ 15,945.0**
	OD HR-NB9		15%	124.78			18.72	@Rs	3,783.92	**₹ 70,824.0**
5	100	Earthwork open well excavation (above water) for wells of dia. above 6m and upto 9.0 m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift from 6 m to 7.5m including neat banking.								
		Collection well 5	1	8.6	8.6	0.15	11.09			
		Inlet chamber	1	4.1	2.25	1.28	11.81			
		Say		22.9	m^3					**0**
	100.3.7.5	Do for item 4------All kinds of soil	30%	22.9			6.87	@Rs	660.10	**₹ 4,535.0**
	100.3.8.5	Do for item 4------Ordinay rock	30%	22.9			6.87	@Rs	1,689.94	**₹ 11,610.0**
	OD MR-B10		5%	22.9			1.15	@Rs	2,093.40	**₹ 2,397.0**
	OD MR-NB10		15%	22.9			3.44	@Rs	2,810.28	**₹ 9,653.0**
	OD HR-B10		5%	22.9			1.15	@Rs	2,752.32	**₹ 3,151.0**
	OD HR-NB10		15%	22.9			3.44	@Rs	4,075.02	**₹ 13,998.0**
6	4.1.6	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)								
		Collection well 2	1	8.6	8.6	0.2	14.79			
		Inlet chamber	1	4.1	2.15	0.2	1.76			
		Total					16.55	m^3		
		Say		**16.55**	m^3		@	Rs	**7527.0608**	**124572.86**
7	5.37.1 + 5.34.1	Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using **Sulphate Resistant Cement (SRC)** content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/^{3}.Excess/less cement used as per design mix is payable/recoverable separately).									
		Collection well 1								
		Bottom slab(3.14/4*(7+0.6+.3)^2*0.3	1	48.99		0.3	14.70	m^3		
		wall(3.14/4*(7.6^2-7^2))*H	1	6.88	0.30	8.53	17.60	m^3		
		Inlet chamber bottom slab	1	3.95	1.85	0.2	1.46	m^3		
		Inlet chamber wall	2	3.70	7.28	0.2	10.77	m^3		
		Inlet chamber wall	2	1.25	7.28	0.2	3.64	m^3		
		Total					48.17	m^3		
		Say		**48.17**	m^3		@	Rs	**10404.79**	**501198.75**

8	5.37.1	Providing and laying in position ready mixed M-25 grade concrete for reinforced cement concrete work, using cement content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ cum.Excess/less cement used as per design mix is payable/recoverable separately).								
		WELL wall(3.14/4*(6.6^2-6^2))*H	1	17.08	0.30	1.00	5.12	m^3		
		Top slab incl.cantilever beam(3.14/4*(7+0.6+2)^2*0.2	1	72.35		0.2	14.47	m^3		
		Main beam	2	7.00		0.3	4.20	m3		
		Inlet chamber top slab	1	2.80	1.85	0.2	0.56	m3		
		Inlet chamber wall	2	3.70	1.00	0.2	1.48	m^3		
		Inlet chamber wall	2	1.25	1.00	0.2	0.50	m^3		
		Total					24.35	m^3		
		Deduction								
		Manhole	4	0.6	0.45	0.2	0.22	m^3		
		Total					0.22	m^3		
		Total less deduction					24.13	m^3		
		Say		**24.13**	m^3		@	Rs	**10319.094**	**248999.73**
9	5.22.6+OD 16	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.								
		Quantity as per item No.3	1		48.17	m^3	120.00	kg/m^3	5780.4	kg
		Quantity as per item No.4	1		24.13	m^3	100.00	kg/m^3	2413	kg
		Total							8193.4	kg
		Say		**8193.4**	kg		@	Rs	**104.90925**	**859563.45**
10	4.12	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.								
		Quantity as per item No.3	1		48.17	m^3	340.00	kg/m^3	16377.8	kg
		Quantity as per item No.4	1		24.13	m^3	330.00	kg/m^3	7962.9	kg
		Total							24340.7	kg
		Say		**486.814**	bags		@	Rs	**70.77**	**34449.39**
11	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		well Bottom slab(3.14*D*H)	1	23.864		0.3	7.16	m^2		
		Total					7.16	m^2		
		Say		**7.16**	m^2		@	Rs	**350.00369**	**2505.75**
12	5.9.2	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.								
		outside(3.14*D*H)	1	23.864		9.53	227.42	m^2		
		Forwell walls inside(3.14*d*	1	21.98		8.53	187.49	m^2		
		Inlet chamber wall	4	4.9		8.28	162.29	m^2		

		Total					577.20	m^2		
		Say		**577.20132**	m^2		@	Rs	**748.62294**	**432106.15**
13	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for :Suspended floors, roofs, landings, balconies and access platform								
		Top slab (3.14*D)	1	3.14		9.6	30.14	m^2		
		Beam side	4	7		0.5	14.00	m2		
		inlet chamber top slab	1	2.8		1.85	5.18	m2		
		Total					49.32	m^2		
		Say		**49.324**	m^2		@	Rs	**851.51525**	**42000.14**
14	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.								
		Quantity as per item (all kind of soil)	1				156.61	m^3		
		Say		**156.61**	m^3		@	Rs	**269.89771**	**42267.6**
15	22.23.1	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm								
		Inside of walls(3.14*d*h)	1	21.98		8.53	187.49	m^2		
		Total					187.49	m^2		
		Say		**187.4894**	m^2		@	Rs	**595.27518**	**111607.79**
16	22.23.2	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.								
		Bottom slab(3.14*d)	1	21.98			21.98	m^2		
		Total					21.98	m^2		
		Say		**21.98**	m^2		@	Rs	**458.7695**	**10083.75**
17	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Inside of walls(3.14*d*h)	1	21.98		9.53	209.47	m^2		
		Bottom slab(3.14*d)	1	21.98			21.98	m^2		

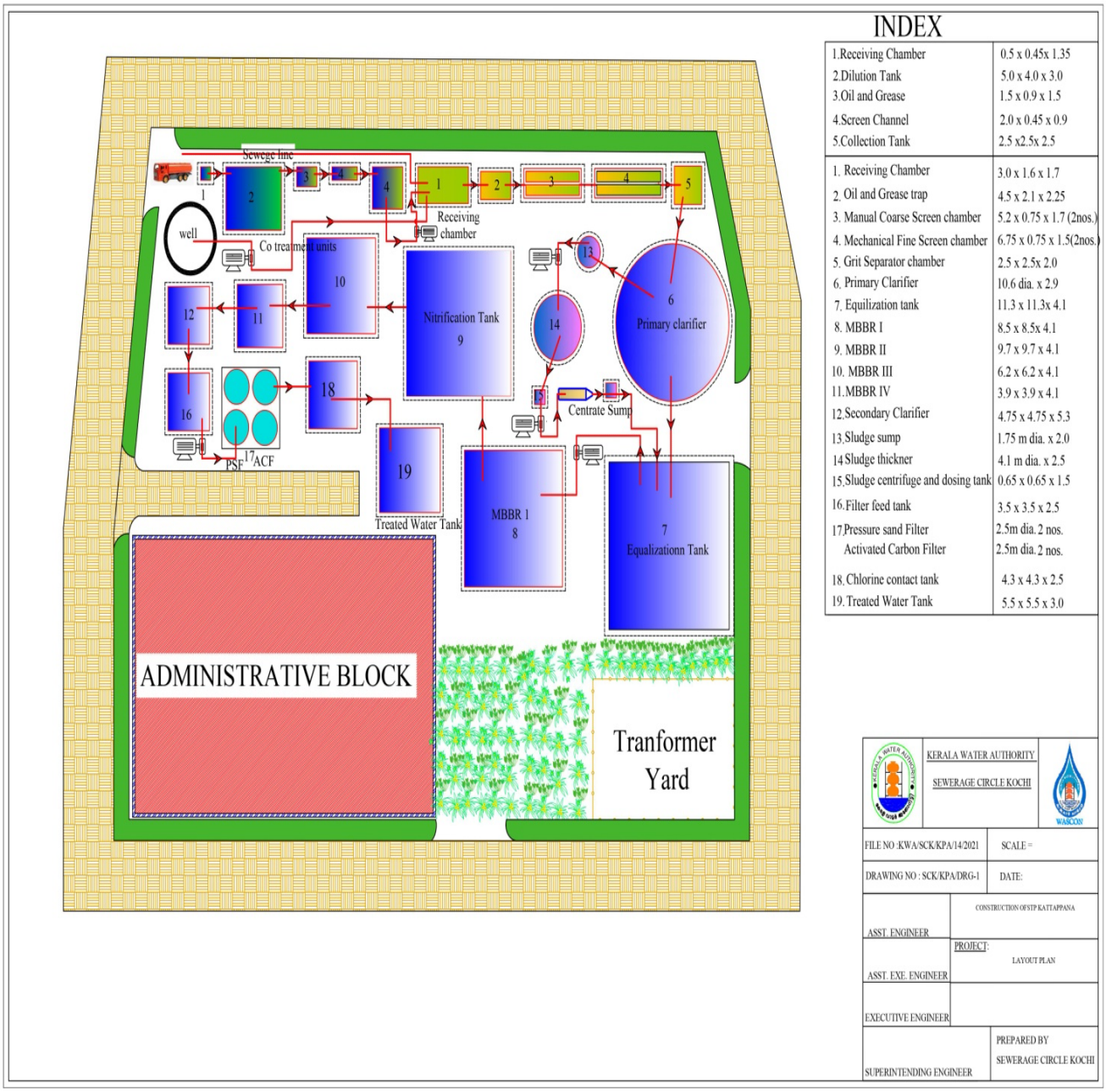
		Top slab (3.14*D)	1	3.14		9.6	30.14	m^2		
		Inlet chamber walls(total leng	1	10.75		8.28	89.01	m2		
		Total					350.60	m^2		
		Deduction								
		Manhole	4	0.6	0.45		1.08	m^2		
		Total					1.08	m^2		
		Total after deduction					349.52	m^2		
		Say		**349.5234**	m^2		@	Rs	**418.78727**	**146375.95**
18	19.18.1	Supplying and fixing C.I. cover without frame for manholes :455x610 mm rectangular C.I. cover (light duty) the weight of the cover to be not less than 23 kg								
			4				1.00	No.		
		Say		**4**	No.		@	Rs	**1629.5057**	**6518.02**
19	13.59	Coal tarring two coats on new work using 0.16 litre and 0.12 litre coal tar per sqm in the first coat and second coat respectively.								
		For walls outside(3.14*D*H)	1	23.864		8.53	203.56			
		Say		**203.55992**	m2		@	Rs	**61.777845**	**12575.49**
20	13.52.2	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On concrete work								
		Quantity as per item code 13.7.1	1	349.5234			0.00		**349.5234**	
		Say		**349.5234**	m2		@	Rs	**232.67532**	**81325.47**
21	19.16	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design									
		well	30				30.00	No.		
		Inlet chamber	26				26.00	No.		
		Say		**56**	No.		@	Rs	**568.87984**	**31857.27**
22	10.26.3	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.								
		50mm dia G.I. -5.17kg/m , 32mm dia GI-3.17kg/m								
		Outer total-23m/1m c/c vertical 50mm dia	30			0.75	5.17	kg	116.325	
		Horizontal 0.25m c/c-32mm dia	3	30			3.17	kg	285.3	
		Say		**401.625**	kg		@	Rs	**194.17916**	**77987.21**
23	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	30	0.75		0.05	1.13	m2		
		Horizontal pipe	3	30		0.032	2.88	m2		
		Say		**4.01**	m2		@	Rs	**154.62153**	**619.26**

24	100.36.1	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.								
			1	38.465		8.53	328.11	m3		
		Say		**3281.06**	Kilo litre		@	Rs	**218.94691**	**718378.93**
		Total-collection well 5								**₹ 432,168.96**
25	100.7.1	Bailing out water with 5 HP engine and pumpset including conveyance to the site, errection, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc. complete. NEW DATA (Prepared based on PHED SDB - Item No.1070								
		For 5 wells (5* 3 nos*20 days* 10 hrs* 5 HP)		**15000**						
				15000	**kwh**		@	**Rs**	**38.57**	**₹ 578,503.88**
		TOTAL FOR COLLECTION WELL								**10,393,116.69**



ANNEXURE - 2

LAYOUT OF STP UNITS



INDEX

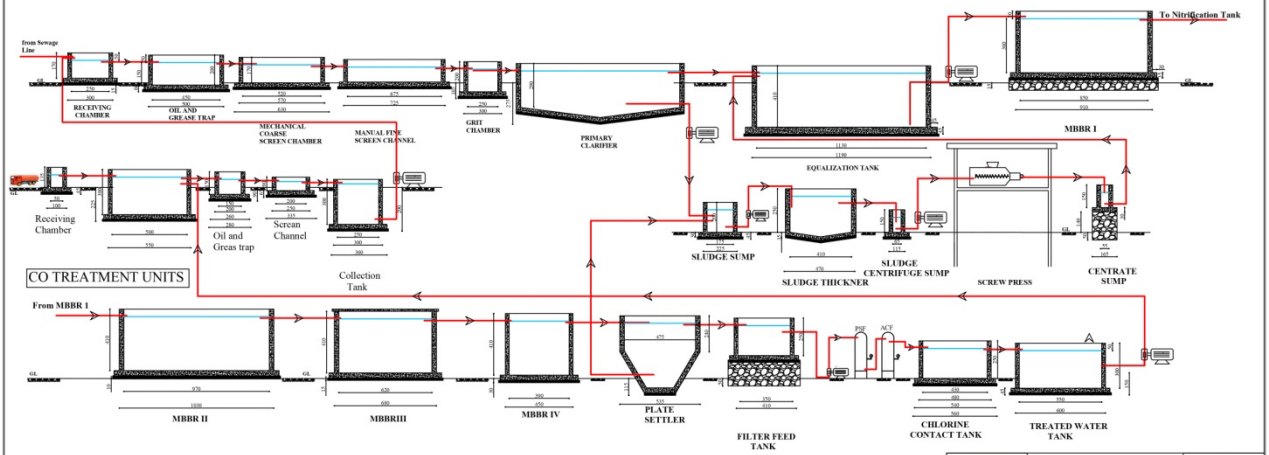
1.Receiving Chamber	0.5 x 0.45x 1.35
2.Dilution Tank	5.0 x 4.0 x 3.0
3.Oil and Grease	1.5 x 0.9 x 1.5
4.Screen Channel	2.0 x 0.45 x 0.9
5.Collection Tank	2.5 x2.5x 2.5
1. Receiving Chamber	3.0 x 1.6 x 1.7
2. Oil and Grease trap	4.5 x 2.1 x 2.25
3. Manual Coarse Screen chamber	5.2 x 0.75 x 1.7 (2nos.)
4. Mechanical Fine Screen chamber	6.75 x 0.75 x 1.5(2nos.)
5. Grit Separator chamber	2.5 x 2.5x 2.0
6. Primary Clarifier	10.6 dia. x 2.9
7. Equilization tank	11.3 x 11.3x 4.1
8. MBBR I	8.5 x 8.5x 4.1
9. MBBR II	9.7 x 9.7 x 4.1
10. MBBR III	6.2 x 6.2 x 4.1
11.MBBR IV	3.9 x 3.9 x 4.1
12.Secondary Clarifier	4.75 x 4.75 x 5.3
13.Sludge sump	1.75 m dia. x 2.0
14 Sludge thickner	4.1 m dia. x 2.5
15.Sludge centrifuge and dosing tank	0.65 x 0.65 x 1.5
16.Filter feed tank	3.5 x 3.5 x 2.5
17.Pressure sand Filter Activated Carbon Filter	2.5m dia. 2 nos. 2.5m dia. 2 nos.
18.Chlorine contact tank	4.3 x 4.3 x 2.5
19.Treated Water Tank	5.5 x 5.5 x 3.0

KERALA WATER AUTHORITY SEWERAGE CIRCLE KOCHI	
FILE NO :KWA/SCK/KPA/14/2021	SCALE =
DRAWING NO : SCK/KPA/DRG-1	DATE:
ASST. ENGINEER	CONSTRUCTION OFSTP KATTAPPANA
ASST. EXE. ENGINEER	PROJECT: LAYOUT PLAN
EXECUTIVE ENGINEER	
SUPERINTENDING ENGINEER	PREPARED BY SEWERAGE CIRCLE KOCHI

ANNEXURE – 3

PROCESS FLOW DIAGRAM

HYDRAULIC FLOW DIAGRAM OF SEWEGE TREATMENT PLANT IN KATTAPANA MUNIOCIPALITY



CO TREATMENT UNITS	
1.Receiving Chamber	0.5 x 0.45x 1.35
2.Dilution Tank	5.0 x 4.0 x 3.0
3.Oil and Grease trap	1.50 x 0.9 x 1.5
4.Screen Channel	2.0 x 0.45x 0.9
5.Collection Tank	2.5 x 2.5x 2.5
1. Receiving Chamber	3.0 x 1.6 x 1.7
2. Oil and Greas trap	4.5 x 2.1x 2.25
3. Manual Course Screen chamber	5.2 x 0.75 x 1.7 (2nos.)
4. Mechachical Fine Screen chamber	6.75 x0.75 x 1.5 (2nos.)
5. Grit Separator chamber	2.5 x 2.5 x 2.0
6. Primary Clarifier	10.6 dia. x 2.9
7. Equilization tank	11.3 x 11.3 x 4.1
8. MBBR I	8.5 x 8.5 x 4.1
9. MBBR II	9.7 x 9.7 x 4.1
10. MBBR III	6.2 x 6.2 x 4.1
11. MBBR IV	3.9 x 3.9 x 4.1
12. Secondary Clarifier	4.75 x 4.75 x 5.3
13. Sludge sump	1.75 m dia. x 2.0
14 Sludge thickner	4.1 m dia. x 2.5
15. Sludge centrifuge and dosing tank	0.65 x 0.65 x 1.5
16. Filter feed tank	3.5 x 3.5 x 2.5
17. Pressure sand Filter	2.5 m dia. 2 nos.
Activated Carbon Filter	2.5 m. dia 2 nos.
18. Chlorine contact tank	4.3 x 4.3 x 2.5
19. Treated Water Tank	5.5 x 5.5 x 3.0

KERALA WATER AUTHORITY	
SEWERAGE CIRCLE KOCHI	
FILE NO :KWA/SCK/KPA14/2021	SCALE =
DRAWING NO :SCK/KPA/DWGNO.2	DATE:
ASST. ENGINEER	SEWEGE SCHEME TO KATTAPPANAMUNICIPALITY
ASST. EXE. ENGINEER	PROJECT: HYDRUALIC FLOW DIAGRAM OF STP IN KATTAPPANA MUNICIPALITY
EXECUTIVE ENGINEER	
SUPERINTENDING ENGINEER	PREPARED BY SEWERAGE CIRCLE KOCHI

ANNEXURE – 4

DESIGN USING SWMM SOFTWARE – OUTPUTS

Kattapana Network-Well zone -1

[NODE]						[CONDUITS]			
Node ID	Ground Elevation	Invert Elevation	Depth of Cut	DWF (LPS)	Peak Flow (LPS)	Conduit ID	From Node	To Node	Length
J718	877.49	876.34	1.15	0.0113	0.0339	168	J718	J715	18.17
J715	878.18	876.23	1.95	0.0113	0.0339	169	J715	J589	18.25
J589	878.89	876.13	2.76	0.0113	0.0339	170	J589	J716	13.57
J716	879.29	876.05	3.24	0.0113	0.0339	171	J716	J586	28.22
J586	880.23	875.88	4.35	0.0113	0.0339	172	J586	J710	19.94
J710	880.24	875.76	4.48	0.0113	0.0339	173	J710	J704	21.62
J704	881.24	875.64	5.60	0.0113	0.0339	174	J704	J705	29.91
J705	881.9	875.46	6.44	0.0113	0.0339	175	J705	J702	29.88
J702	881.72	875.28	6.44	0.0113	0.0339	176	J702	J703	29.82
J703	881.71	875.11	6.60	0.0113	0.0339	177	J703	J708	29.45
J708	879.53	874.94	4.59	0.0113	0.0339	178	J708	J709	29.88
J709	876.98	874.76	2.22	0.0113	0.0339	179	J709	J587	15.25
J587	876.33	874.67	1.66	0.0113	0.0339	180	J587	J706	14.91
J706	875.97	874.58	1.39	0.0113	0.0339	181	J706	J707	29.44
J707	875.52	874.37	1.15	0.0113	0.0339	182	J707	J798	30
J798	875.57	874.19	1.38	0.0113	0.0339	183	J798	J799	35.59
J799	876.4	873.98	2.42	0.0113	0.0339	184	J799	J796	23.97
J796	875.87	873.84	2.03	0.0113	0.0339	185	J796	J797	29.79
J797	874.35	873.20	1.15	0.0113	0.0339	186	J797	J802	29.87
J802	872.07	870.92	1.15	0.0113	0.0339	187	J802	J803	29.21
J803	869.76	868.61	1.15	0.0113	0.0339	188	J803	J800	29.64
J800	867.91	866.76	1.15	0.0113	0.0339	189	J800	J801	33.78
J801	866.24	865.09	1.15	0.0113	0.0339	190	J801	J795	26.06
J795	865.91	864.76	1.15	0.0113	0.0339	191	J795	J789	29.83
J789	865.78	864.58	1.20	0.0113	0.0339	192	J789	J790	29.98
J790	865.69	864.41	1.28	0.0113	0.0339	193	J790	J787	29.91
J787	865.83	864.23	1.60	0.0113	0.0339	194	J787	J788	33.73
J788	865.55	864.03	1.52	0.0113	0.0339	195	J788	J793	26.2
J793	864.92	863.77	1.15	0.0113	0.0339	196	J793	J794	29.98
J794	863.94	862.79	1.15	0.0113	0.0339	197	J794	J791	29.97
J791	862.8	861.65	1.15	0.0113	0.0339	198	J791	J792	29.96
J792	861.19	860.04	1.15	0.0113	0.0339	199	J792	J815	29.95
J815	860	858.85	1.15	0.0113	0.0339	200	J815	J816	29.97
J816	858.69	857.54	1.15	0.0113	0.0339	201	J816	J813	29.96
J813	857.17	856.02	1.15	0.0113	0.0339	202	J813	J814	29.94
J814	855.37	854.22	1.15	0.0113	0.0339	203	J814	J819	29.8
J819	853.08	851.93	1.15	0.0113	0.0339	204	J819	J820	29.9
J820	851.77	850.62	1.15	0.0113	0.0339	205	J820	J817	29.99
J817	851.85	850.44	1.41	0.0113	0.0339	206	J817	J611	16.12
J611	852.08	850.35	1.73	0.0863	0.2589	207	J611	J818	13.46
J818	852.17	850.27	1.90	0.0113	0.0339	208	J818	J610	15.25

J610	852.1	850.18	1.92	0.0113	0.0339	209	J610	J812	22.13	
J812	853.91	850.05	3.86	0.0113	0.0339	210	J812	J806	22.33	LS
J806	855.62	854.47	1.15	0.0113	0.0339	211	J806	J609	15.2	
J609	856.99	854.38	2.61	0.0113	0.0339	212	J609	J807	14.5	
J807	858.17	854.30	3.87	0.0113	0.0339	213	J807	J804	29.62	
J804	859.61	854.12	5.49	0.0113	0.0339	214	J804	J608	15.34	
J608	860.13	854.03	6.10	0.0113	0.0339	215	J608	J805	16.89	
J805	860.56	853.93	6.63	0.0113	0.0339	216	J805	J219	18.56	
J219	860.8	853.82	6.98	0.0113	0.0339	680	J219	J220	29.54	
J220	859.57	853.65	5.92	0.0113	0.0339	681	J220	J214	29.85	
J214	856.58	853.47	3.11	0.0113	0.0339	682	J214	J208	29.76	
J208	852.85	851.70	1.15	0.0113	0.0339	683	J208	J209	29.39	
J209	851.02	849.87	1.15	0.0113	0.0339	684	J209	J206	30	DM
J1000	870.13	868.98	1.15	0.0113	0.0339	130	J1000	J999	22.59	
J999	870.2	868.85	1.35	0.0113	0.0339	131	J999	J963	19.41	
J963	869.52	868.37	1.15	0.0113	0.0339	132	J963	J994	19.99	
J994	868.83	867.68	1.15	0.0113	0.0339	133	J994	J993	20.55	
J993	867.96	866.81	1.15	0.0113	0.0339	134	J993	J996	29.99	
J996	867.04	865.89	1.15	0.0113	0.0339	135	J996	J995	29.97	
J995	866.47	865.32	1.15	0.0113	0.0339	136	J995	J1001	18.29	
J1001	866.44	865.21	1.23	0.0113	0.0339	137	J1001	J966	21.71	
J966	866.12	864.97	1.15	0.0113	0.0339	138	J966	J1007	20	
J1007	865.82	864.67	1.15	0.0113	0.0339	139	J1007	J1006	30	
J1006	865.38	864.23	1.15	0.0113	0.0339	492	J1006	J801	29.99	LS
J1040	896.21	895.06	1.15	0.0113	0.0339	504	J1040	J1043	18.62	
J1043	896.39	894.95	1.44	0.0113	0.0339	503	J1043	J1039	20.71	
J1039	896.59	894.83	1.76	0.0113	0.0339	502	J1039	J1038	18.83	
J1038	897.1	894.72	2.38	0.0113	0.0339	501	J1038	J1083	29.97	
J1083	896.77	894.54	2.23	0.0113	0.0339	500	J1083	J1082	29.93	
J1082	895.68	894.37	1.31	0.0113	0.0339	499	J1082	J1085	29.84	
J1085	893.07	891.92	1.15	0.0113	0.0339	498	J1085	J1084	29.85	
J1084	891.91	890.76	1.15	0.0113	0.0339	497	J1084	J1079	16.4	
J1079	891.69	890.54	1.15	0.0113	0.0339	496	J1079	J1042	26.22	
J1042	891.36	890.21	1.15	0.0113	0.0339	495	J1042	J1078	17.28	
J1078	891.18	890.03	1.15	0.0113	0.0339	494	J1078	J1037	14.82	
J1037	890.45	889.30	1.15	0.0113	0.0339	515	J1037	J1081	23.23	
J1081	888.01	886.86	1.15	0.0113	0.0339	491	J1081	J1080	21.67	
J1080	885.69	884.54	1.15	0.0113	0.0339	490	J1080	J1086	29.79	
J1086	882.27	881.12	1.15	0.0113	0.0339	489	J1086	J1092	29.88	
J1092	879.57	878.42	1.15	0.0113	0.0339	488	J1092	J1091	29.93	
J1091	878.02	876.87	1.15	0.0113	0.0339	487	J1091	J1094	29.97	
J1094	876.61	875.46	1.15	0.0113	0.0339	486	J1094	J1093	29.78	
J1093	874.46	873.31	1.15	0.0113	0.0339	485	J1093	J1088	34.22	
J1088	869.47	868.32	1.15	0.0113	0.0339	484	J1088	J790	28.25	
J1030	907.49	906.34	1.15	0.0113	0.0339	519	J1030	J1029	10.97	
J1029	905.25	904.10	1.15	0.0113	0.0339	518	J1029	J1035	25.06	
J1035	899.3	898.15	1.15	0.0113	0.0339	517	J1035	J1041	29.56	

J1041	894.22	893.07	1.15	0.0113	0.0339	516	J1041	J1078	19.64
J1031	882.12	880.97	1.15	0.0113	0.0339	483	J1031	J1032	19.68
J1032	880.28	879.13	1.15	0.0113	0.0339	482	J1032	J1034	19.91
J1034	878.41	877.26	1.15	0.0113	0.0339	481	J1034	J1033	29.87
J1033	875.61	874.46	1.15	0.0113	0.0339	480	J1033	J1028	29.87
J1028	872.81	871.66	1.15	0.0113	0.0339	479	J1028	J1027	29.87
J1027	870.01	868.86	1.15	0.0113	0.0339	478	J1027	J788	29.87
J1050	896.6	895.45	1.15	0.0113	0.0339	649	J1050	J1051	29.93
J1051	898.18	895.27	2.91	0.0113	0.0339	648	J1051	J1048	29.98
J1048	898.75	895.10	3.65	0.0113	0.0339	647	J1048	J935	8.85
J935	898.28	895.05	3.23	0.0113	0.0339	646	J935	J936	5.05
J936	898.04	895.02	3.02	0.0113	0.0339	645	J936	J844	4.35
J844	897.77	894.99	2.78	0.0113	0.0339	644	J844	J1049	6.09
J1049	897.37	894.95	2.42	0.0113	0.0339	643	J1049	J958	35.6
J958	897.84	894.75	3.09	0.0113	0.0339	642	J958	J867	29.89
J867	898.27	894.57	3.70	0.0113	0.0339	641	J867	J868	29.98
J868	897.82	894.39	3.43	0.0113	0.0339	640	J868	J843	18.42
J843	893.81	892.66	1.15	0.0113	0.0339	639	J843	J865	15.92
J865	893.46	892.31	1.15	0.0113	0.0339	638	J865	J866	20.65
J866	890.98	889.83	1.15	0.0113	0.0339	637	J866	J871	29.84
J871	889.6	888.45	1.15	0.0113	0.0339	636	J871	J872	22.53
J872	889.84	888.32	1.52	0.0113	0.0339	635	J872	J869	27.46
J869	890.15	888.16	1.99	0.0113	0.0339	634	J869	J870	31.44
J870	887.01	885.86	1.15	0.0113	0.0339	633	J870	J846	20.04
J846	885.11	883.96	1.15	0.0113	0.0339	632	J846	J864	18.14
J864	883.4	882.25	1.15	0.0113	0.0339	631	J864	J858	21.1
J858	881.37	880.22	1.15	0.0113	0.0339	630	J858	J859	27.22
J859	876.68	875.53	1.15	0.0113	0.0339	629	J859	J856	26.41
J856	873.65	872.50	1.15	0.0113	0.0339	628	J856	J845	27.03
J845	869.75	868.60	1.15	0.0113	0.0339	627	J845	J857	16.84
J857	868.25	867.10	1.15	0.0113	0.0339	626	J857	J840	18.72
J840	866.08	864.93	1.15	0.0113	0.0339	625	J840	J839	6.11
J839	864.13	862.98	1.15	0.0113	0.0339	624	J839	J842	3.16
J842	864.97	862.96	2.01	0.0113	0.0339	623	J842	J862	5.75
J862	864.14	862.93	1.21	0.0113	0.0339	622	J862	J863	25.64
J863	863.89	862.74	1.15	0.0113	0.0339	621	J863	J860	30
J860	863.57	862.42	1.15	0.0113	0.0339	620	J860	J861	29.28
J861	861.76	860.61	1.15	0.0113	0.0339	619	J861	J884	29.94
J884	861.35	860.20	1.15	0.0113	0.0339	618	J884	J885	29.89
J885	860.7	859.55	1.15	0.0113	0.0339	617	J885	J882	28.98
J882	858.22	857.07	1.15	0.0113	0.0339	616	J882	J883	29.91
J883	857.26	856.11	1.15	0.0113	0.0339	615	J883	J888	26.55
J888	856.6	855.45	1.15	0.0113	0.0339	614	J888	J889	33.35
J889	854.63	853.48	1.15	0.0113	0.0339	613	J889	J841	16.66
J841	852.1	850.95	1.15	0.0113	0.0339	612	J841	J847	4.37
J847	851.39	850.24	1.15	0.0113	0.0339	611	J847	J853	4.35
J853	850.83	849.68	1.15	0.0113	0.0339	610	J853	J886	8.09

J886	849.36	848.21	1.15	0.0113	0.0339	609	J886	J887	25.48	
J887	846.35	845.20	1.15	0.0113	0.0339	608	J887	J881	29.82	
J881	844.15	843.00	1.15	0.0113	0.0339	607	J881	J875	29.93	
J875	842.59	841.44	1.15	0.0113	0.0339	606	J875	J876	29.99	
J876	843.2	841.26	1.94	0.0113	0.0339	605	J876	J873	29.95	
J873	843.89	841.09	2.80	0.0113	0.0339	604	J873	J874	29.93	
J874	845.85	840.91	4.94	0.0113	0.0339	603	J874	J879	29.93	LS
J879	847.75	846.60	1.15	0.0113	0.0339	602	J879	J880	29.95	
J880	849.4	846.42	2.98	0.0113	0.0339	601	J880	J852	18.87	
J852	849.83	846.31	3.52	0.0113	0.0339	600	J852	J855	5.96	
J855	849.94	846.28	3.66	0.0113	0.0339	599	J855	J877	5.79	
J877	849.78	846.24	3.54	0.0113	0.0339	598	J877	J854	16.76	
J854	850.97	846.15	4.82	0.0113	0.0339	597	J854	J849	9.64	
J849	850.52	846.09	4.43	0.0113	0.0339	596	J849	J878	12.2	
J878	849.56	846.02	3.54	0.0113	0.0339	595	J878	J833	25.66	
J833	846.05	844.90	1.15	0.0113	0.0339	594	J833	J848	11.85	
J848	847.51	844.83	2.68	0.0113	0.0339	593	J848	J834	12.26	
J834	847.99	844.76	3.23	0.0113	0.0339	592	J834	J851	14.99	
J851	850.17	844.67	5.50	0.0113	0.0339	591	J851	J831	14.46	
J831	851.21	844.58	6.63	0.0113	0.0339	590	J831	J832	23.06	
J832	850.75	844.45	6.30	0.0113	0.0339	589	J832	J837	36.76	
J837	847.14	844.23	2.91	0.0113	0.0339	588	J837	J850	25.57	
J850	844.9	843.75	1.15	0.0113	0.0339	587	J850	J838	12.03	
J838	844.77	843.62	1.15	0.0113	0.0339	586	J838	J835	21.13	
J835	845.65	843.50	2.15	0.0113	0.0339	585	J835	J836	41.94	LS
J836	849.69	848.54	1.15	0.0113	0.0339	584	J836	J830	17.35	
J830	851.8	848.44	3.36	0.0113	0.0339	583	J830	J827	12.84	
J827	851.78	848.36	3.42	0.0113	0.0339	582	J827	J824	17.1	
J824	850.42	848.26	2.16	0.0113	0.0339	581	J824	J825	29.97	
J825	850.92	848.09	2.83	0.0113	0.0339	580	J825	J822	29.99	
J822	850.46	847.91	2.55	0.0113	0.0339	579	J822	J823	29.96	
J823	850.15	847.73	2.42	0.0113	0.0339	578	J823	J828	29.98	
J828	850.24	847.56	2.68	0.0113	0.0339	577	J828	J829	29.68	
J829	851.53	847.38	4.15	0.0113	0.0339	576	J829	J826	29.69	
J826	852.79	847.21	5.58	0.0113	0.0339	575	J826	J610	29.92	LS
J1045	892.52	891.37	1.15	0.0113	0.0339	651	J1045	J1044	22.33	
J1044	888.84	887.69	1.15	0.0113	0.0339	652	J1044	J1047	36.48	
J1047	882.63	881.48	1.15	0.0113	0.0339	653	J1047	J1046	29.68	
J1046	878.37	877.22	1.15	0.0113	0.0339	654	J1046	J1052	24.6	
J1052	875.07	873.92	1.15	0.0113	0.0339	655	J1052	J780	27.09	
J780	873.91	872.76	1.15	0.0113	0.0339	242	J780	J779	31.63	
J779	873.59	872.44	1.15	0.0113	0.0339	241	J779	J782	29.95	
J782	873.02	871.87	1.15	0.0113	0.0339	240	J782	J781	30	
J781	872.84	871.69	1.15	0.0113	0.0339	239	J781	J758	29.98	
J758	872.56	871.41	1.15	0.0113	0.0339	238	J758	J757	29.95	
J757	872.35	871.20	1.15	0.0113	0.0339	237	J757	J760	29.96	
J760	872.19	871.02	1.17	0.0113	0.0339	236	J760	J759	29.96	

J759	872.03	870.85	1.18	0.0113	0.0339	235	J759	J754	29.99	
J754	871.92	870.67	1.25	0.0113	0.0339	234	J754	J753	29.79	
J753	871.88	870.50	1.38	0.0113	0.0339	233	J753	J756	29.78	
J756	871.94	870.32	1.62	0.0113	0.0339	232	J756	J755	36.23	
J755	872.16	870.11	2.05	0.0113	0.0339	231	J755	J761	23.65	
J761	872.41	869.97	2.44	0.0113	0.0339	230	J761	J615	14.02	
J615	872.78	869.89	2.89	0.0113	0.0339	229	J615	J767	22.97	
J767	872.6	869.75	2.85	0.0113	0.0339	228	J767	J766	23.26	
J766	872.05	869.61	2.44	0.0113	0.0339	227	J766	J769	29.63	
J769	870.51	869.36	1.15	0.0113	0.0339	226	J769	J768	29.97	
J768	869.25	868.10	1.15	0.0113	0.0339	225	J768	J763	29.95	
J763	867.66	866.51	1.15	0.0113	0.0339	224	J763	J762	29.08	
J762	865.73	864.58	1.15	0.0113	0.0339	223	J762	J765	29.87	
J765	864.54	863.39	1.15	0.0113	0.0339	222	J765	J764	29.21	
J764	863.51	862.36	1.15	0.0113	0.0339	221	J764	J809	29.93	
J809	862.9	861.75	1.15	0.0113	0.0339	220	J809	J808	29.97	
J808	862.2	861.05	1.15	0.0113	0.0339	219	J808	J811	15.09	
J811	862.04	860.89	1.15	0.0113	0.0339	218	J811	J614	27.63	
J614	861.36	860.21	1.15	0.0113	0.0339	217	J614	J219	26.67	DM
J13	885.64	884.49	1.15	0.0113	0.0339	459	J13	J10	3.26	
J10	885.53	884.38	1.15	0.0113	0.0339	460	J10	J44	12.21	
J44	885.54	884.31	1.23	0.0113	0.0339	461	J44	J47	29.85	
J47	883.16	882.01	1.15	0.0113	0.0339	462	J47	J46	29.9	
J46	880.87	879.72	1.15	0.0113	0.0339	463	J46	J137	29.96	
J137	880.16	879.01	1.15	0.0113	0.0339	464	J137	J228	30	
J228	880.14	878.83	1.31	0.0113	0.0339	465	J228	J227	29.98	
J227	881.06	878.66	2.40	0.0113	0.0339	466	J227	J230	29.99	
J230	881.87	878.48	3.39	0.0113	0.0339	467	J230	J229	29.94	
J229	882.42	878.30	4.12	0.0113	0.0339	468	J229	J224	29.97	
J224	881.75	878.13	3.62	0.0113	0.0339	469	J224	J223	29.96	
J223	880.54	877.95	2.59	0.0113	0.0339	470	J223	J226	29.81	
J226	877.69	876.54	1.15	0.0113	0.0339	471	J226	J225	29.74	
J225	873.95	872.80	1.15	0.8863	2.6589	472	J225	J231	29.83	
J231	871.93	870.78	1.15	0.0113	0.0339	473	J231	J237	29.26	
J237	868.95	867.80	1.15	0.0113	0.0339	474	J237	J236	29.76	
J236	865.19	864.04	1.15	0.0113	0.0339	696	J236	J239	30.6	
J239	862.17	861.02	1.15	0.0113	0.0339	695	J239	J238	29.1	
J238	860.61	859.46	1.15	0.0113	0.0339	694	J238	J233	29.96	
J233	859.29	858.14	1.15	0.1363	0.4089	693	J233	J232	29.89	
J232	857.9	856.75	1.15	0.0113	0.0339	692	J232	J235	29.79	
J235	856.9	855.75	1.15	1.3723	4.1169	691	J235	J234	30	
J234	856.57	855.42	1.15	0.0113	0.0339	690	J234	J211	29.97	
J211	855.31	854.16	1.15	0.0113	0.0339	689	J211	J210	29.94	
J210	853.72	852.57	1.15	0.0113	0.0339	688	J210	J213	29.73	
J213	851.74	850.59	1.15	0.0113	0.0339	687	J213	J212	29.1	
J212	850.49	849.34	1.15	0.0113	0.0339	686	J212	J207	29.96	
J207	850.64	849.16	1.48	0.0113	0.0339	1	J207	J206	29.7	

J206	850.64	848.99	1.65	0.1053	0.3159	354	J206	OUTFALL 1	43.61	WELL
J771	883.83	882.68	1.15	0.0113	0.0339	254	J771	J770	25.55	
J770	883.1	881.95	1.15	0.0113	0.0339	253	J770	J773	29.53	
J773	882.49	881.34	1.15	0.0113	0.0339	252	J773	J772	29.91	
J772	881.95	880.80	1.15	0.0113	0.0339	251	J772	J778	29.9	
J778	880.45	879.30	1.15	0.0113	0.0339	250	J778	J784	29.98	
J784	879.27	878.12	1.15	0.0113	0.0339	249	J784	J612	18.64	
J612	878.06	876.91	1.15	0.0113	0.0339	248	J612	J783	19.25	
J783	877.42	876.27	1.15	0.0113	0.0339	247	J783	J786	21.55	
J786	876.23	875.08	1.15	0.0113	0.0339	246	J786	J607	18.57	
J607	874.97	873.82	1.15	0.0113	0.0339	245	J607	J785	13.08	
J785	874.43	873.28	1.15	0.0113	0.0339	244	J785	J613	3.3	
J613	874.16	873.01	1.15	0.0113	0.0339	656	J613	J60	29.95	
J60	874.76	872.83	1.93	0.0113	0.0339	436	J60	J66	29.99	
J66	875.51	872.66	2.85	0.0113	0.0339	435	J66	J55	21.89	
J55	876.17	872.53	3.64	0.0113	0.0339	434	J55	J54	20	
J54	876.07	872.41	3.66	0.0113	0.0339	433	J54	J52	23	
J52	876.02	872.28	3.74	0.0113	0.0339	432	J52	J65	25	
J65	875.37	872.13	3.24	0.0113	0.0339	431	J65	J68	29.95	
J68	873.72	871.95	1.77	0.0113	0.0339	430	J68	J67	29.3	
J67	873.15	871.78	1.37	0.0113	0.0339	429	J67	J53	17.8	
J53	873.22	871.68	1.54	0.0113	0.0339	428	J53	J62	20.67	
J62	871.83	870.68	1.15	0.0113	0.0339	427	J62	J61	29.74	
J61	875.01	870.51	4.51	0.0113	0.0339	426	J61	J64	21.58	
J64	869.48	868.33	1.15	0.0113	0.0339	425	J64	J63	29.54	
J63	864.25	863.10	1.15	0.0113	0.0339	424	J63	J40	29.55	
J40	859.06	857.91	1.15	0.0113	0.0339	423	J40	J39	29.97	DM
J22	869.16	868.01	1.15	0.0113	0.0339	409	J22	J25	29.32	
J25	863.04	861.89	1.15	0.0113	0.0339	410	J25	J24	29.49	
J24	857.84	856.69	1.15	0.0113	0.0339	411	J24	J19	29.4	
J19	853.06	851.91	1.15	0.0113	0.0339	412	J19	J23	9.84	
J37	872.88	871.73	1.15	0.3973	1.1919	446	J37	J38	16.23	
J38	873.02	871.63	1.39	0.0113	0.0339	445	J38	J35	29.75	
J35	870.59	869.44	1.15	0.0113	0.0339	444	J35	J36	29.59	
J36	866.85	865.70	1.15	0.0113	0.0339	443	J36	J41	29.54	
J41	862.16	861.01	1.15	0.0113	0.0339	442	J41	J56	15.89	
J56	859.37	858.22	1.15	0.0113	0.0339	441	J56	J59	7.19	
J59	858.93	857.78	1.15	0.0113	0.0339	440	J59	J42	6.18	
J42	858.74	857.59	1.15	0.0113	0.0339	439	J42	J58	14.86	
J58	858.54	857.39	1.15	0.0113	0.0339	438	J58	J39	15.5	
J39	858.69	857.30	1.39	0.0113	0.0339	422	J39	J28	23.2	
J28	857.34	856.19	1.15	0.0113	0.0339	421	J28	J33	29.94	
J33	855.78	854.63	1.15	0.0113	0.0339	420	J33	J34	29.87	
J34	854.87	853.72	1.15	0.0113	0.0339	419	J34	J31	29.99	
J31	854.56	853.41	1.15	0.0113	0.0339	418	J31	J32	29.99	
J32	853.98	852.83	1.15	0.0113	0.0339	417	J32	J26	29.95	

J26	853.5	852.35	1.15	0.0113	0.0339	416	J26	J20	29.97	
J20	853.09	851.94	1.15	0.0113	0.0339	415	J20	J21	29.96	
J21	852.8	851.65	1.15	0.0113	0.0339	414	J21	J18	29.87	
J18	852.62	851.47	1.15	0.0113	0.0339	413	J18	J23	19.99	
J23	852.09	850.94	1.15	0.0113	0.0339	697	J23	J3	25.23	
J3	851.79	850.64	1.15	0.0113	0.0339	698	J3	J27	16.43	
J27	851.68	850.53	1.15	0.0113	0.0339	699	J27	J30	8.79	
J30	851.46	850.31	1.15	0.0113	0.0339	700	J30	J9	15.49	
J9	851.19	850.04	1.15	0.0113	0.0339	701	J9	J15	19.26	
J15	851.24	849.93	1.31	0.0113	0.0339	702	J15	J14	29.96	
J14	852.61	849.75	2.86	0.0113	0.0339	703	J14	J6	9.47	
J6	853.48	849.69	3.79	0.0113	0.0339	704	J6	J8	9.06	
J8	855.44	849.64	5.80	0.0113	0.0339	707	J8	J7	8.53	
J7	855.33	849.59	5.74	0.0113	0.0339	706	J7	J17	4.14	
J17	855.91	849.57	6.34	0.0113	0.0339	710	J17	J239	26.94	LS
J930	877.38	876.23	1.15	0.0113	0.0339	477	J930	J925	33.56	
J925	871.49	870.34	1.15	0.0113	0.0339	476	J925	J924	29.37	
J924	865.57	864.42	1.15	0.0113	0.0339	475	J924	J804	29.47	DM
				6.2269	18.6807					

Kattapana Network-Well zone -2

[NODE]						[CONDUITS]			
Node ID	Ground Elevation	Invert Elevation	Depth of Cut	DWF (LPS)	Peak Flow (LPS)	Conduit ID	From Node	To Node	Length
J171	896.09	894.94	1.15	0.0113	0.0339	800	J171	J168	26.45
J168	898.82	894.78	4.04	0.0113	0.0339	799	J168	J169	35.74
J169	902.54	894.57	7.97	0.0113	0.0339	798	J169	J163	26.22
J163	902.33	894.42	7.91	0.0113	0.0339	797	J163	J157	33.73
J157	901.62	894.22	7.40	0.0113	0.0339	796	J157	J158	29.97
J158	900.89	894.05	6.84	0.0113	0.0339	795	J158	J155	21.51
J155	900.02	893.92	6.10	0.0113	0.0339	794	J155	J257	25.54
J257	899.19	893.77	5.42	0.0113	0.0339	793	J257	J156	31.62
J156	897.3	893.58	3.72	0.0113	0.0339	801	J156	J161	41.19
J161	896.01	893.34	2.67	0.0113	0.0339	802	J161	J162	29.97
J162	894.61	893.16	1.45	0.0113	0.0339	803	J162	J159	29.95
J159	893.47	892.32	1.15	0.0113	0.0339	804	J159	J160	30
J160	893.48	892.14	1.34	0.0113	0.0339	805	J160	J251	29.98
J251	894.39	891.97	2.42	0.0113	0.0339	806	J251	J252	39.08
J252	895.32	891.74	3.58	0.0113	0.0339	807	J252	J249	18.75
J249	895.53	891.63	3.90	0.0113	0.0339	808	J249	J250	38.15
J250	894.83	891.40	3.43	0.0113	0.0339	809	J250	J255	23.8
J255	894.34	891.26	3.08	0.0113	0.0339	810	J255	J256	29.86
J256	892.12	890.97	1.15	0.0113	0.0339	811	J256	J253	29.8
J253	888.8	887.65	1.15	0.0113	0.0339	812	J253	J254	29.96
J254	887.37	886.22	1.15	0.0113	0.0339	813	J254	J248	29.99

J248	886.8	885.65	1.15	0.0113	0.0339	814	J248	J242	29.85	
J242	887	885.47	1.53	0.0113	0.0339	815	J242	J243	30	
J243	886.47	885.30	1.17	0.0113	0.0339	816	J243	J240	29.98	
J240	887.11	885.12	1.99	0.0113	0.0339	817	J240	J241	25.97	
J241	888.28	884.97	3.31	0.0113	0.0339	818	J241	J246	33.87	
J246	889.37	884.77	4.60	0.0113	0.0339	819	J246	J16	19.98	
J16	890.14	884.65	5.49	0.0113	0.0339	820	J16	J247	21.75	
J247	889.86	884.52	5.34	0.0113	0.0339	821	J247	J260	13.11	
J260	889.67	884.45	5.22	0.0113	0.0339	822	J260	J244	9.95	
J244	889.13	884.39	4.74	0.0113	0.0339	823	J244	J245	24.64	
J245	886.84	884.24	2.60	0.0113	0.0339	824	J245	J268	29.95	
J268	885.36	884.07	1.29	0.0113	0.0339	825	J268	J269	29.64	
J269	883.76	882.61	1.15	0.0113	0.0339	826	J269	J266	29.9	
J266	881.55	880.40	1.15	0.0113	0.0339	827	J266	J267	29.98	
J267	880.69	879.54	1.15	0.0113	0.0339	828	J267	J272	29.99	
J272	880.06	878.91	1.15	0.0113	0.0339	829	J272	J273	29.91	
J273	878.73	877.58	1.15	0.0113	0.0339	830	J273	J270	29.79	
J270	875.91	874.76	1.15	0.0226	0.0678	831	J270	J271	29.92	
J271	873.89	872.74	1.15	0.0113	0.0339	832	J271	J265	29.91	
J265	871.62	870.47	1.15	0.0113	0.0339	833	J265	J259	29.83	
J259	868.5	867.35	1.15	0.0113	0.0339	834	J259	J448	29.61	DM
J341	881.17	880.02	1.15	0.0113	0.0339	1017	J341	J336	29.99	
J336	880.8	879.65	1.15	0.0113	0.0339	1018	J336	J335	30	
J335	881.03	879.47	1.56	0.0113	0.0339	1019	J335	J338	29.94	
J338	881.88	879.30	2.58	0.0113	0.0339	1020	J338	J337	29.98	
J337	882.5	879.12	3.38	0.0113	0.0339	1021	J337	J314	29.99	
J314	882.71	878.94	3.77	0.0113	0.0339	1022	J314	J313	29.98	
J313	882	878.77	3.23	0.0113	0.0339	1023	J313	J316	29.99	
J316	881.1	878.59	2.51	0.0113	0.0339	1024	J316	J315	29.94	
J315	879.91	878.42	1.49	0.0113	0.0339	1025	J315	J310	29.94	
J310	878.12	876.97	1.15	0.0113	0.0339	1026	J310	J309	29.95	
J309	876.44	875.29	1.15	0.0113	0.0339	906	J309	J317	18.51	
J317	875.28	874.13	1.15	0.0113	0.0339	905	J317	J311	19.21	
J311	873.98	872.83	1.15	0.0113	0.0339	904	J311	J312	29.93	
J312	872.32	871.17	1.15	0.0113	0.0339	903	J312	J416	29.82	
J416	870.89	869.74	1.15	0.0113	0.0339	900	J416	J421	8.92	
J421	871.55	869.69	1.86	0.0113	0.0339	899	J421	J417	7.06	
J417	872.91	869.65	3.26	0.0113	0.0339	898	J417	J424	20.91	
J424	873.74	869.52	4.22	0.0113	0.0339	897	J424	J423	29.81	
J423	875.22	869.35	5.87	0.0113	0.0339	896	J423	J419	20.56	LS
J419	877.17	876.02	1.15	0.0113	0.0339	895	J419	J468	10.38	
J468	878.04	875.96	2.08	0.0113	0.0339	894	J468	J418	11.64	
J418	878.59	875.89	2.70	0.0113	0.0339	893	J418	J467	17.18	
J467	878.41	875.79	2.62	0.0113	0.0339	892	J467	J470	29.91	
J470	876.45	875.30	1.15	0.0113	0.0339	891	J470	J469	29.83	
J469	873.62	872.47	1.15	0.0113	0.0339	890	J469	J464	29.89	
J464	871.15	870.00	1.15	0.0113	0.0339	889	J464	J463	29.96	

J463	869.7	868.55	1.15	0.0113	0.0339	888	J463	J413	21.07	
J413	868.21	867.06	1.15	0.0113	0.0339	887	J413	J466	8.9	
J466	868.67	867.01	1.66	0.0113	0.0339	886	J466	J465	29.94	
J465	867.47	866.32	1.15	0.0113	0.0339	885	J465	J471	29.95	
J471	865.95	864.80	1.15	0.0113	0.0339	884	J471	J477	29.87	
J477	863.28	862.13	1.15	0.0113	0.0339	883	J477	J412	22.09	
J412	861.75	859.97	1.78	0.0113	0.0339	882	J412	J476	7.82	
J476	861.42	859.93	1.49	0.0113	0.0339	881	J476	J479	29.98	
J479	860.5	859.35	1.15	0.0113	0.0339	880	J479	J478	29.97	
J478	860.07	858.92	1.15	0.0113	0.0339	879	J478	J415	23.82	
J415	859.9	858.75	1.15	0.0113	0.0339	878	J415	J414	3.91	
J414	859.84	858.69	1.15	0.0113	0.0339	877	J414	J473	5.87	
J473	859.84	858.66	1.18	0.0113	0.0339	876	J473	J472	26.27	
J472	859.99	858.50	1.49	0.0113	0.0339	875	J472	J475	20.86	
J475	860.11	858.38	1.73	0.0113	0.0339	874	J475	J420	25.19	
J420	859.82	858.23	1.59	0.0113	0.0339	873	J420	J474	13.77	
J474	859.73	858.15	1.58	0.0113	0.0339	872	J474	J451	30	
J451	860.07	857.97	2.10	0.0113	0.0339	871	J451	J450	29.91	
J450	861.39	857.80	3.59	0.0113	0.0339	870	J450	J453	29.81	LS
J453	864.09	862.94	1.15	0.0113	0.0339	869	J453	J452	29.92	
J452	865.56	862.76	2.80	0.0113	0.0339	868	J452	J447	27.3	
J447	865.83	862.60	3.23	0.0113	0.0339	867	J447	J426	15.43	
J426	865.59	862.51	3.08	0.0113	0.0339	866	J426	J446	16.86	
J446	865.72	862.41	3.31	0.0113	0.0339	865	J446	J449	29.99	
J449	866.29	862.24	4.05	0.0113	0.0339	864	J449	J425	23.02	
J425	866.31	862.10	4.21	0.0113	0.0339	863	J425	J448	14.98	
J448	864	862.01	1.99	0.0113	0.0339	835	J448	J454	23.64	
J454	863.1	861.87	1.23	0.0113	0.0339	836	J454	J460	31.24	
J460	860.64	859.49	1.15	0.0113	0.0339	837	J460	J459	26.61	
J459	859.32	858.17	1.15	0.1113	0.3339	838	J459	J462	29.92	
J462	858.75	857.60	1.15	0.0113	0.0339	437	J462	OUTFALL	30.09	WELL
J440	871.34	870.19	1.15	0.0113	0.0339	902	J440	J422	28.37	
J422	871.06	869.91	1.15	0.0113	0.0339	901	J422	J416	22.56	
J487	884.95	883.80	1.15	0.0113	0.0339	1109	J487	J484	29.42	
J484	885.55	883.63	1.92	0.0113	0.0339	1108	J484	J485	29.85	
J485	882.66	881.51	1.15	0.0113	0.0339	1107	J485	J508	29.91	
J508	880.86	879.71	1.15	0.0113	0.0339	1106	J508	J500	15.42	
J500	879.38	878.23	1.15	0.0113	0.0339	1105	J500	J509	14.25	
J509	879.04	877.89	1.15	0.0113	0.0339	1104	J509	J506	29.9	
J506	876.96	875.81	1.15	0.0113	0.0339	1103	J506	J507	24.38	
J507	871.99	870.84	1.15	0.0113	0.0339	1102	J507	J497	4.23	
J497	871.58	870.43	1.15	0.0113	0.0339	1101	J497	J501	4.37	
J501	871.34	870.19	1.15	0.0113	0.0339	1100	J501	J498	9.59	
J498	871.1	869.95	1.15	0.0113	0.0339	1099	J498	J503	2.75	
J503	870.79	869.64	1.15	0.0113	0.0339	1098	J503	J504	2.95	
J504	870.36	869.21	1.15	0.0113	0.0339	1097	J504	J512	10.41	
J512	868.54	867.39	1.15	0.0113	0.0339	1096	J512	J513	29.75	

J513	864.67	863.52	1.15	0.0113	0.0339	1095	J513	J510	29.92	
J510	863.52	862.37	1.15	0.0113	0.0339	1094	J510	J511	29.92	
J511	865	862.19	2.81	0.0113	0.0339	1093	J511	J515	24.17	
J546	894.86	893.71	1.15	0.0113	0.0339	1046	J546	J535	15.54	
J535	892.01	890.86	1.15	0.0113	0.0339	1047	J535	J536	5.82	
J536	890.96	889.81	1.15	0.0113	0.0339	1048	J536	J541	8.14	
J541	889.61	888.46	1.15	0.0113	0.0339	1049	J541	J540	29.53	
J540	884.61	883.46	1.15	0.0113	0.0339	1050	J540	J538	13.1	
J538	881.93	880.78	1.15	0.0113	0.0339	1051	J538	J543	16.01	
J543	879.06	877.91	1.15	0.0113	0.0339	1052	J543	J542	29.71	
J542	874.95	873.80	1.15	0.0113	0.0339	1053	J542	J537	15.96	
J537	872.81	871.66	1.15	0.0113	0.0339	1054	J537	J519	13.75	
J519	871.71	870.56	1.15	0.0113	0.0339	1055	J519	J531	9.34	
J531	871.52	870.37	1.15	0.0113	0.0339	1056	J531	J532	9.68	
J532	871.27	870.12	1.15	0.0113	0.0339	1057	J532	J518	10.8	
J518	870.81	869.66	1.15	0.0113	0.0339	1058	J518	J521	29.89	
J521	868.34	867.19	1.15	0.0113	0.0339	1059	J521	J534	23.01	
J534	867.08	865.93	1.15	0.0113	0.0339	1060	J534	J533	6.17	
J533	866.88	865.73	1.15	0.0113	0.0339	1061	J533	J539	3.69	
J539	866.89	865.71	1.18	0.0113	0.0339	1062	J539	J520	10.69	
J520	866.96	865.65	1.31	0.0113	0.0339	1063	J520	J515	14.09	
J515	867.18	865.56	1.62	0.0113	0.0339	1064	J515	J545	12.17	
J545	867.61	865.49	2.12	0.0113	0.0339	1065	J545	J514	16.38	
J514	868.92	865.39	3.53	0.0113	0.0339	1066	J514	J517	32.79	LS
J517	871.93	870.78	1.15	0.0113	0.0339	1067	J517	J544	20.2	
J544	873.69	870.66	3.03	0.0113	0.0339	1068	J544	J516	10.42	
J516	873.85	870.60	3.25	0.0113	0.0339	1069	J516	J522	29.83	
J522	876.93	870.42	6.51	0.0113	0.0339	1070	J522	J528	29.97	
J528	878.13	870.25	7.88	0.0113	0.0339	1071	J528	J527	24.58	
J527	877.83	870.10	7.73	0.0113	0.0339	1072	J527	J547	19.11	
J547	877.96	869.99	7.97	0.0113	0.0339	1073	J547	J530	16.01	
J530	877.95	869.90	8.05	0.0113	0.0339	1074	J530	J529	29.98	
J529	876.99	869.72	7.27	0.0113	0.0339	1075	J529	J524	29.92	
J524	875.4	869.54	5.86	0.0113	0.0339	1076	J524	J523	29.92	
J523	873.31	869.37	3.94	0.0113	0.0339	1077	J523	J526	29.87	
J526	870.56	869.19	1.37	0.0113	0.0339	1078	J526	J525	29.8	
J525	867.46	866.31	1.15	0.0113	0.0339	1079	J525	J434	29.68	
J434	863.67	862.52	1.15	0.0113	0.0339	1080	J434	J475	29.65	DM
J491	875.57	874.42	1.15	0.0113	0.0339	1091	J491	J492	29.49	
J492	870.08	868.93	1.15	0.0113	0.0339	1090	J492	J489	29.56	
J489	865.01	863.86	1.15	0.0113	0.0339	1089	J489	J490	29.83	
J490	862.43	861.28	1.15	0.0113	0.0339	1088	J490	J483	14.64	
J483	862.28	861.13	1.15	0.0113	0.0339	1087	J483	J482	6.63	
J482	862.2	861.05	1.15	0.0113	0.0339	1086	J482	J495	8.43	
J495	862.04	860.89	1.15	0.0113	0.0339	1085	J495	J496	29.98	
J496	861.89	860.71	1.18	0.0113	0.0339	1084	J496	J493	30	
J493	861.78	860.54	1.24	0.0113	0.0339	1083	J493	J494	29.99	

J494	861.72	860.36	1.36	0.0113	0.0339	1082	J494	J488	30
J488	861.3	860.15	1.15	0.0113	0.0339	1081	J488	J412	29.97
J486	880.25	879.10	1.15	0.0113	0.0339	1111	J486	J499	12.03
J499	878.06	876.91	1.15	0.0113	0.0339	1112	J499	J505	9.45
J505	876.15	875.00	1.15	0.0113	0.0339	1113	J505	J481	8.03
J481	875.61	874.46	1.15	0.0113	0.0339	1114	J481	J480	29.78
J480	872.04	870.89	1.15	0.0113	0.0339	1115	J480	J413	29.75
J433	875.55	874.40	1.15	0.0113	0.0339	862	J433	J436	7.44
J436	875.59	874.36	1.23	0.0113	0.0339	861	J436	J437	14.04
J437	874.6	873.45	1.15	0.0113	0.0339	860	J437	J435	23.76
J435	872.72	871.57	1.15	0.0113	0.0339	859	J435	J443	10.69
J443	870.15	869.00	1.15	0.0113	0.0339	858	J443	J430	13.49
J430	869.1	867.95	1.15	0.0113	0.0339	857	J430	J442	20.09
J442	868.55	867.40	1.15	0.0113	0.0339	856	J442	J445	29.96
J445	867.25	866.10	1.15	0.0113	0.0339	855	J445	J444	18.87
J444	865.28	864.13	1.15	0.0113	0.0339	854	J444	J429	19.83
J429	862.67	861.52	1.15	0.0113	0.0339	853	J429	J439	20.78
J439	860.25	859.10	1.15	0.0113	0.0339	852	J439	J431	8.43
J431	859.23	858.08	1.15	0.0113	0.0339	851	J431	J432	5.46
J432	859.23	858.05	1.18	0.0113	0.0339	850	J432	J438	16.04
J438	858.78	857.63	1.15	0.0113	0.0339	849	J438	J441	29.98
J441	859.71	857.45	2.26	0.0113	0.0339	848	J441	J460	29.98 LS
J427	871.16	870.01	1.15	0.0113	0.0339	847	J427	J90	29.97
J90	870.08	868.93	1.15	0.0113	0.0339	846	J90	J91	25.14
J91	868.28	867.13	1.15	0.0113	0.0339	845	J91	J428	9.9
J428	867.38	866.23	1.15	0.0113	0.0339	844	J428	J274	24.66
J274	864.85	863.70	1.15	0.0113	0.0339	843	J274	J457	29.82
J457	861.64	860.49	1.15	0.0113	0.0339	842	J457	J458	29.78
J458	858.98	857.83	1.15	0.0113	0.0339	140	J458	J462	35.49
				2.2696	6.8088				

Kattapana Network-Well zone -3

[NODE]						[CONDUITS]			
Node ID	Ground Elevation	Invert Elevation	Depth of Cut	DWF (LPS)	Peak Flow (LPS)	Conduit ID	From Node	To Node	Length
J11	887.11	885.96	1.15	0.0113	0.0339	456	J11	J12	18.82
J12	885.14	883.99	1.15	0.0113	0.0339	455	J12	J45	12.05
J45	883.38	882.23	1.15	0.0113	0.0339	454	J45	J50	29.7
J50	879.15	878.00	1.15	0.0113	0.0339	453	J50	J51	29.73
J51	875.18	874.03	1.15	0.0113	0.0339	452	J51	J48	29.88
J48	872.81	871.66	1.15	0.0113	0.0339	451	J48	J49	29.96
J49	872.44	871.29	1.15	0.0113	0.0339	450	J49	J43	30
J43	872.43	871.11	1.32	0.0113	0.0339	449	J43	J57	26.32
J57	872.66	870.96	1.70	0.0113	0.0339	448	J57	J79	6.17
J79	872.64	870.92	1.72	0.0113	0.0339	778	J79	J78	7.3

J78	871.71	870.56	1.15	0.0113	0.0339	777	J78	J104	16.32	
J104	869.55	868.40	1.15	0.0113	0.0339	776	J104	J109	35.27	
J109	864.87	863.72	1.15	0.0113	0.0339	775	J109	J84	16.88	
J84	864.38	863.23	1.15	0.0113	0.0339	774	J84	J110	5.62	
J110	864.06	862.91	1.15	0.0113	0.0339	773	J110	J85	11.07	
J85	863.97	862.82	1.15	0.0113	0.0339	772	J85	J107	33.09	DM
J81	880.25	879.10	1.15	0.0113	0.0339	712	J81	J80	19.39	
J80	878.02	876.87	1.15	0.0113	0.0339	713	J80	J125	29.84	
J125	875.08	873.93	1.15	0.0113	0.0339	714	J125	J77	22.95	
J77	873.5	872.35	1.15	0.0113	0.0339	715	J77	J124	9.51	
J124	872.93	871.78	1.15	0.0113	0.0339	716	J124	J71	13.45	
J71	872.28	871.13	1.15	0.0113	0.0339	717	J71	J127	19.84	
J127	870.5	869.35	1.15	0.0113	0.0339	718	J127	J126	29.93	
J126	869	867.85	1.15	0.0113	0.0339	719	J126	J121	29.99	
J121	868.36	867.21	1.15	0.0113	0.0339	720	J121	J120	29.99	
J120	867.74	866.59	1.15	0.0113	0.0339	721	J120	J123	29.95	
J123	867.19	866.04	1.15	0.0113	0.0339	722	J123	J122	29.99	
J122	866.55	865.40	1.15	0.0113	0.0339	723	J122	J128	29.99	
J128	866.08	864.93	1.15	0.0113	0.0339	724	J128	J134	29.99	
J134	865.63	864.48	1.15	0.0113	0.0339	725	J134	J133	29.99	
J133	865.18	864.03	1.15	0.0113	0.0339	738	J133	J136	23.22	
J136	864.85	863.70	1.15	0.0113	0.0339	739	J136	J135	34.54	
J135	864.46	863.31	1.15	0.0213	0.0639	740	J135	J130	32.15	
J130	863.81	862.66	1.15	0.0113	0.0339	741	J130	J129	30	
J129	863.46	862.31	1.15	0.0113	0.0339	742	J129	J132	29.99	
J132	863.12	861.97	1.15	0.0113	0.0339	743	J132	J131	20.43	
J131	862.87	861.72	1.15	0.0113	0.0339	744	J131	J83	28.31	
J83	862.77	861.55	1.22	0.0113	0.0339	745	J83	J108	17.61	
J108	862.76	861.45	1.31	0.0113	0.0339	746	J108	J82	21.42	
J82	863.05	861.32	1.73	0.0113	0.0339	747	J82	J107	19.94	
J107	863.3	861.21	2.09	0.0113	0.0339	748	J107	J114	30	
J114	862.85	861.03	1.82	0.0113	0.0339	749	J114	J115	30	
J115	862.4	860.85	1.55	0.0113	0.0339	408	J115	OUTFALL	35.73	WELL3
J551	900.82	899.67	1.15	0.0133	0.0399	295	J551	J550	19.91	
J550	899.35	898.20	1.15	0.0113	0.0339	294	J550	J556	18.7	
J556	898.46	897.31	1.15	0.0113	0.0339	293	J556	J627	23.68	
J627	896.7	895.55	1.15	0.0113	0.0339	292	J627	J562	22.05	
J562	896.38	895.23	1.15	0.0113	0.0339	291	J562	J561	20.38	
J561	896.08	894.93	1.15	0.0113	0.0339	290	J561	J628	19.98	
J628	895.06	893.91	1.15	0.0113	0.0339	289	J628	J564	19.47	
J564	894.07	892.92	1.15	0.0113	0.0339	288	J564	J563	18.16	
J563	893.46	892.31	1.15	0.0113	0.0339	287	J563	J558	35.6	
J558	890.79	889.64	1.15	0.0113	0.0339	286	J558	J625	20.17	
J625	888.25	887.10	1.15	0.0113	0.0339	285	J625	J557	17.93	
J557	887.68	886.53	1.15	0.0113	0.0339	284	J557	J560	27.57	
J560	885.93	884.78	1.15	0.0113	0.0339	283	J560	J559	29.91	
J559	883.79	882.64	1.15	0.0113	0.0339	282	J559	J604	23.92	

J604	882.61	881.46	1.15	0.0113	0.0339	281	J604	J626	11.91	
J626	882.15	881.00	1.15	0.0113	0.0339	280	J626	J631	13.79	
J631	881.59	880.44	1.15	0.0113	0.0339	279	J631	J603	15.8	
J603	881.45	880.30	1.15	0.0113	0.0339	278	J603	J606	24.14	
J606	880.23	879.08	1.15	0.0173	0.0519	277	J606	J605	29.99	
J605	879.51	878.36	1.15	0.0113	0.0339	276	J605	J600	31.11	
J600	879.3	878.15	1.15	0.0113	0.0339	275	J600	J659	13.1	
J659	879.33	878.07	1.26	0.0113	0.0339	274	J659	J602	15.73	
J602	879.77	877.98	1.79	0.0113	0.0339	271	J602	J584	7.09	DM
J584	879.48	877.94	1.54	0.0113	0.0339	270	J584	J590	20.22	
J590	878.91	877.76	1.15	0.0113	0.0339	269	J590	J596	29.97	
J596	878.97	877.58	1.39	0.0113	0.0339	268	J596	J595	29.97	
J595	879.57	877.41	2.16	0.0113	0.0339	267	J595	J598	29.98	
J598	880.63	877.23	3.40	0.0113	0.0339	266	J598	J597	29.97	LS
J597	882.07	880.92	1.15	0.0113	0.0339	265	J597	J592	29.93	
J592	883.81	880.74	3.07	0.0123	0.0369	264	J592	J591	29.96	
J591	884.8	880.57	4.23	0.0113	0.0339	263	J591	J594	29.9	LS
J594	886.76	885.61	1.15	0.0113	0.0339	262	J594	J593	29.92	
J593	888.91	885.43	3.48	0.0113	0.0339	261	J593	J684	29.96	
J684	890.1	885.26	4.84	0.0113	0.0339	260	J684	J775	29.99	
J775	890.72	885.08	5.64	0.0113	0.0339	259	J775	J774	29.98	
J774	890.17	884.91	5.26	0.0253	0.0759	258	J774	J777	20.96	
J777	889.05	884.78	4.27	0.0113	0.0339	257	J777	J601	22.47	
J601	887.42	884.65	2.77	0.0113	0.0339	256	J601	J776	28.26	
J776	885.06	883.91	1.15	0.0113	0.0339	760	J776	J111	19.99	
J111	886.26	883.79	2.47	0.0113	0.0339	759	J111	J106	27.13	
J106	887.25	883.63	3.62	0.0113	0.0339	758	J106	J117	4.58	
J117	886.9	883.61	3.29	0.0113	0.0339	757	J117	J103	12.67	
J103	886.07	883.53	2.54	0.0113	0.0339	756	J103	J105	3.13	
J105	885.6	883.51	2.09	0.0113	0.0339	755	J105	J116	12.18	
J116	883.82	882.67	1.15	0.0113	0.0339	754	J116	J119	29.42	
J119	878.04	876.89	1.15	0.0113	0.0339	753	J119	J118	29.32	
J118	871.72	870.57	1.15	0.0113	0.0339	752	J118	J113	29.27	
J113	865.26	864.11	1.15	0.0113	0.0339	751	J113	J112	29.73	
J112	863.46	862.31	1.15	0.0113	0.0339	750	J112	J115	29.98	DM
J599	881	879.85	1.15	0.0113	0.0339	273	J599	J585	30.88	
J585	880.69	879.54	1.15	0.0173	0.0519	272	J585	J602	20.01	
J258	888.6	887.45	1.15	0.0173	0.0519	736	J258	J263	28.16	
J263	885.71	884.56	1.15	0.0113	0.0339	735	J263	J264	22.95	
J264	882.67	881.52	1.15	0.0113	0.0339	734	J264	J218	25.55	
J218	875	873.85	1.15	0.0113	0.0339	733	J218	J261	12.76	
J261	871.01	869.86	1.15	0.0113	0.0339	732	J261	J215	8.17	
J215	869.18	868.03	1.15	0.0113	0.0339	731	J215	J216	1.77	
J216	868.76	867.61	1.15	0.0113	0.0339	730	J216	J221	13.89	
J221	867.52	866.37	1.15	0.0113	0.0339	729	J221	J222	1.93	
J222	867.39	866.24	1.15	0.0113	0.0339	728	J222	J262	11.43	
J262	864.97	863.82	1.15	0.0113	0.0339	727	J262	J217	29.99	

J217	865.03	863.64	1.39	0.0113	0.0339	726	J217	J133	18.98	LS
J89	896.5	895.35	1.15	0.0113	0.0339	791	J89	J88	29.97	
J88	896.03	894.88	1.15	0.0113	0.0339	790	J88	J94	29.74	
J94	892.53	891.38	1.15	0.0113	0.0339	789	J94	J87	15.49	
J87	890.27	889.12	1.15	0.0113	0.0339	788	J87	J86	4.16	
J86	889.57	888.42	1.15	0.0113	0.0339	787	J86	J100	10.05	
J100	888.33	887.18	1.15	0.0113	0.0339	786	J100	J99	29.16	
J99	881.47	880.32	1.15	0.0113	0.0339	785	J99	J102	28.6	
J102	872.47	871.32	1.15	0.0113	0.0339	784	J102	J101	18.07	
J101	866.98	865.83	1.15	0.0113	0.0339	783	J101	J92	9.8	
J92	865.74	864.59	1.15	0.0113	0.0339	782	J92	J93	13.29	
J93	865.39	864.24	1.15	0.0113	0.0339	781	J93	J96	17.88	
J96	865.04	863.89	1.15	0.0113	0.0339	780	J96	J136	9.48	
J72	898.93	897.78	1.15	0.0573	0.1719	770	J72	J69	29.98	
J69	899.91	897.60	2.31	0.0113	0.0339	769	J69	J70	30.06	
J70	890.63	889.48	1.15	0.0113	0.0339	768	J70	J75	28.9	
J75	883.2	882.05	1.15	0.0113	0.0339	767	J75	J76	29.21	
J76	877.06	875.91	1.15	0.0113	0.0339	766	J76	J73	29.39	
J73	871.19	870.04	1.15	0.0113	0.0339	765	J73	J74	26.59	
J74	866.61	865.46	1.15	0.0113	0.0339	764	J74	J97	13.7	
J97	865.1	863.95	1.15	0.0113	0.0339	763	J97	J98	29.98	
J98	864.09	862.94	1.15	0.0113	0.0339	762	J98	J95	19.99	
J95	863.48	862.33	1.15	0.0113	0.0339	761	J95	J131	21.28	
J104	892.36	891.21	1.15	0.0113	0.0339	65	J104	J281	24.21	Vellayamkudi Jn-Idukki kava
J281	891.15	890.00	1.15	0.0113	0.0339	64	J281	J283	29.96	
J283	889.73	888.58	1.15	0.0113	0.0339	63	J283	J282	29.97	
J282	888.41	887.26	1.15	0.0113	0.0339	62	J282	J275	29.95	
J275	886.72	885.57	1.15	0.0113	0.0339	61	J275	J274	29.95	
J274	885.03	883.88	1.15	0.0113	0.0339	60	J274	J276	29.92	
J276	882.77	881.62	1.15	0.0113	0.0339	59	J276	J278	29.92	
J278	880.55	879.40	1.15	0.0113	0.0339	58	J278	J277	24.98	
J277	878.79	877.64	1.15	0.0113	0.0339	57	J277	J284	24.22	
J284	877.38	876.23	1.15	0.0113	0.0339	56	J284	J291	40.64	
J291	875.5	874.35	1.15	0.0113	0.0339	55	J291	J290	29.98	
J290	874.6	873.45	1.15	0.0113	0.0339	54	J290	J292	29.97	
J292	874.45	873.27	1.18	0.0113	0.0339	53	J292	J294	29.98	
J294	875.17	873.10	2.07	0.0113	0.0339	52	J294	J293	29.94	
J293	876.57	872.92	3.65	0.0113	0.0339	51	J293	J286	24.57	
J286	878.36	872.78	5.58	0.0113	0.0339	50	J286	J285	35.17	LS
J285	881.26	880.11	1.15	0.0113	0.0339	49	J285	J287	29.88	
J287	883.89	879.93	3.96	0.0113	0.0339	48	J287	J289	29.9	
J289	886.31	879.76	6.55	0.0113	0.0339	47	J289	J296	37.86	
J296	880.69	879.54	1.15	0.0113	0.0339	46	J296	J288	22.05	LS
J288	888.96	887.81	1.15	0.0113	0.0339	45	J288	J259	29.92	
J259	888.19	887.04	1.15	0.0113	0.0339	44	J259	J258	29.99	
J258	887.73	886.58	1.15	0.0113	0.0339	43	J258	J260	29.98	

J260	887.51	886.36	1.15	0.0113	0.0339	42	J260	J262	29.29	
J262	887.85	886.19	1.66	0.0113	0.0339	41	J262	J261	29.84	
J261	888.55	886.01	2.54	0.0113	0.0339	40	J261	J254	29.99	
J254	888.78	885.84	2.94	0.0113	0.0339	39	J254	J253	29.97	
J253	888.68	885.66	3.02	0.0113	0.0339	38	J253	J255	29.99	
J255	888.08	885.48	2.60	0.0113	0.0339	37	J255	J257	29.97	
J257	887.2	885.31	1.89	0.0113	0.0339	36	J257	J256	29.98	
J256	886.18	885.03	1.15	0.0113	0.0339	35	J256	J263	29.99	
J263	885.78	884.63	1.15	0.0113	0.0339	34	J263	J270	29.91	
J270	885.46	884.31	1.15	0.0113	0.0339	33	J270	J269	29.96	
J269	885.04	883.89	1.15	0.0113	0.0339	32	J269	J271	29.25	
J271	884.99	883.72	1.27	0.0113	0.0339	31	J271	J273	29.98	
J273	885.83	883.54	2.29	0.0113	0.0339	30	J273	J272	30	
J272	886.2	883.37	2.83	0.0113	0.0339	29	J272	J265	29.86	
J265	886.3	883.19	3.11	0.0113	0.0339	28	J265	J264	29.77	
J264	886.74	883.01	3.73	0.0113	0.0339	27	J264	J266	29.54	
J266	887.09	882.84	4.25	0.0113	0.0339	26	J266	J268	25.56	
J268	886.75	882.69	4.06	0.0113	0.0339	25	J268	J267	34.41	
J267	886.43	882.49	3.94	0.0113	0.0339	24	J267	J322	30	
J322	886.29	882.31	3.98	0.0113	0.0339	23	J322	J321	29.95	
J321	886.28	885.13	1.15	0.0113	0.0339	22	J321	J323	29.98	
J323	886.14	884.95	1.19	0.0113	0.0339	21	J323	J325	29.98	
J325	886.03	884.78	1.25	0.0113	0.0339	20	J325	J324	29.85	
J324	886.18	884.60	1.58	0.0113	0.0339	19	J324	J317	29.9	
J317	886.07	884.43	1.64	0.0113	0.0339	18	J317	J316	29.55	
J316	886.05	884.25	1.80	0.0113	0.0339	17	J316	J318	29.99	
J318	886.14	884.08	2.06	0.0113	0.0339	16	J318	J320	29.94	
J320	886.04	883.90	2.14	0.0113	0.0339	15	J320	J86	12.52	
J86	886.09	883.83	2.26	0.0113	0.0339	14	J86	J319	16.32	
J319	885.96	883.73	2.23	0.0113	0.0339	13	J319	J326	30	
J326	886.13	883.55	2.58	0.0113	0.0339	12	J326	J333	29.88	
J333	886.08	883.38	2.70	0.0113	0.0339	11	J333	J332	29.93	
J332	886.28	883.20	3.08	0.0113	0.0339	10	J332	J334	29.5	
J334	886.32	883.03	3.29	0.0113	0.0339	9	J334	J336	30	
J336	886.07	882.85	3.22	0.0113	0.0339	8	J336	J335	30	
J335	885.88	882.68	3.20	0.0113	0.0339	7	J335	J328	30	
J328	885.7	882.50	3.20	0.0113	0.0339	6	J328	J327	32.34	
J327	885.62	882.31	3.31	0.0113	0.0339	5	J327	J329	27.65	
J329	885.43	882.15	3.28	0.0113	0.0339	4	J329	J331	29.98	
J331	884.69	881.97	2.72	0.0113	0.0339	3	J331	J330	29.82	
J330	883.24	881.79	1.45	0.1123	0.3369	2	J330	J301	29.93	
J301	882.08	880.93	1.15	0.0113	0.0339	1	J301	J300	29.72	
J300	881.11	879.96	1.15	0.0113	0.0339	457	J300	J599	10	DM
				2.3729	7.1187					

Kattapana Network-Well zone -4

[NODE]						[CONDUITS]				
Node ID	Ground Elevation	Invert Elevation	Depth of Cut	DWF (LPS)	Peak Flow (LPS)	Conduit ID	From Node	To Node	Length	
J290	895.27	894.12	1.15	0.0113	0.0339	1043	J290	J285	29.73	
J285	891.82	890.67	1.15	0.0163	0.0489	1042	J285	J284	29.74	
J284	888.39	887.24	1.15	0.0113	0.0339	1041	J284	J287	29.74	
J287	885.61	884.46	1.15	0.0113	0.0339	1040	J287	J286	29.98	
J286	884.55	883.40	1.15	0.0113	0.0339	1039	J286	J288	19.57	
J288	884.08	882.93	1.15	0.0113	0.0339	1038	J288	J331	19.72	
J331	885.77	882.81	2.96	0.0113	0.0339	1037	J331	J330	19.86	
J330	880.5	879.35	1.15	0.0113	0.0339	1036	J330	J333	29.88	
J333	878.08	876.93	1.15	0.0113	0.0339	1035	J333	J332	29.99	
J332	878.34	876.75	1.59	0.0113	0.0339	1034	J332	J327	29.83	
J327	880.4	876.58	3.82	0.0113	0.0339	1033	J327	J326	29.8	
J326	881.94	876.40	5.54	0.0113	0.0339	1032	J326	J329	29.96	
J329	881.18	876.23	4.95	0.0113	0.0339	1031	J329	J328	30	
J328	880.99	876.05	4.94	0.0113	0.0339	1030	J328	J334	30	
J334	881.44	875.87	5.57	0.0113	0.0339	1029	J334	J340	29.99	LS
J340	882.22	881.07	1.15	0.0113	0.0339	1028	J340	J339	29.98	
J339	883.24	880.89	2.35	0.0113	0.0339	1027	J339	J342	24.69	
J342	883.86	880.75	3.11	0.0113	0.0339	1015	J342	J410	11.66	
J410	883.7	880.68	3.02	0.0113	0.0339	1014	J410	J407	29.61	
J407	881.76	880.51	1.25	0.0113	0.0339	1013	J407	J408	29.57	
J408	876.8	875.65	1.15	0.0113	0.0339	1012	J408	J402	29.47	
J402	873.71	872.56	1.15	0.0113	0.0339	1011	J402	J396	29.98	
J396	872.68	871.53	1.15	0.0113	0.0339	1010	J396	J397	29.99	
J397	872.84	871.35	1.49	0.0113	0.0339	1009	J397	J353	9.69	
J353	873.42	871.30	2.12	0.0113	0.0339	996	J353	J352	12.44	
J352	873.09	871.22	1.87	0.0113	0.0339	997	J352	J394	13.47	
J394	874.02	871.14	2.88	0.0113	0.0339	998	J394	J395	29.99	
J395	873.47	870.97	2.50	0.0113	0.0339	999	J395	J400	29.98	
J400	872.52	870.79	1.73	0.0113	0.0339	1000	J400	J401	29.93	
J401	870.59	869.44	1.15	0.0113	0.0339	1001	J401	J398	29.9	
J398	869.73	868.58	1.15	0.0163	0.0489	1002	J398	J355	20.77	
J355	869.93	868.46	1.47	0.0113	0.0339	1003	J355	J354	20.01	
J354	870.26	868.34	1.92	0.0113	0.0339	1004	J354	J399	19.21	
J399	870.71	868.23	2.48	0.0163	0.0489	1005	J399	J303	29.94	
J387	894.22	893.07	1.15	0.0113	0.0339	963	J387	J385	19.55	
J385	892.72	891.57	1.15	0.0113	0.0339	962	J385	J392	19.85	
J392	890.29	889.14	1.15	0.0113	0.0339	961	J392	J299	26.38	
J299	889.52	888.37	1.15	0.0113	0.0339	960	J299	J298	29.92	
J298	889	887.85	1.15	0.0113	0.0339	959	J298	J293	29.71	
J293	888.59	887.44	1.15	0.0113	0.0339	958	J293	J292	29.88	
J292	888.52	887.26	1.26	0.0113	0.0339	957	J292	J295	30	
J295	888.54	887.09	1.45	0.0113	0.0339	956	J295	J294	30	

J294	888.66	886.91	1.75	0.0113	0.0339	955	J294	J300	29.98	
J300	887.7	886.55	1.15	0.0113	0.0339	954	J300	J306	29.62	
J306	885.07	883.92	1.15	0.0113	0.0339	953	J306	J305	29.91	
J305	883.15	882.00	1.15	0.0113	0.0339	952	J305	J308	28.81	
J308	882.4	881.25	1.15	0.0113	0.0339	946	J308	J307	31.1	
J307	880.93	879.78	1.15	0.0113	0.0339	945	J307	J302	29.86	
J302	881.61	879.60	2.01	0.0113	0.0339	944	J302	J301	28.72	
J301	876.53	875.38	1.15	0.0113	0.0339	943	J301	J304	29.8	
J304	873.62	872.47	1.15	0.0113	0.0339	243	J304	J303	25.15	DM
J303	872.01	868.05	3.96	0.0113	0.0339	932	J303	J280	34.74	
J280	871.05	867.85	3.20	0.0113	0.0339	931	J280	J279	29.84	
J279	869.92	867.67	2.25	0.0113	0.0339	930	J279	J282	29.97	DM
J282	869.32	865.96	3.36	0.0113	0.0339	447	J282	OUTFALL	34.34	
J391	894.22	893.07	1.15	0.0113	0.0339	966	J391	J390	29.99	
J390	894.22	892.89	1.33	0.0113	0.0339	965	J390	J393	30	
J393	894.22	892.72	1.50	0.0113	0.0339	964	J393	J392	24.81	
J323	876.84	875.69	1.15	0.0113	0.0339	908	J323	J322	30	
J322	876.87	875.51	1.36	0.0113	0.0339	909	J322	J325	29.95	
J325	876.57	875.34	1.23	0.0113	0.0339	910	J325	J324	29.98	
J324	875.43	874.28	1.15	0.0113	0.0339	911	J324	J319	29.95	
J319	874.5	873.35	1.15	0.0113	0.0339	912	J319	J318	29.98	
J318	873.34	872.19	1.15	0.0113	0.0339	913	J318	J321	29.88	
J321	871.85	870.70	1.15	0.0113	0.0339	914	J321	J320	29.4	
J320	868.65	867.50	1.15	0.0113	0.0339	915	J320	J411	29.52	
J411	867.79	866.64	1.15	0.0113	0.0339	916	J411	J502	29.94	
J502	868.74	866.46	2.28	0.0113	0.0339	917	J502	J276	22.89	
J276	869.95	866.33	3.62	0.0113	0.0339	928	J276	J281	32.33	
J281	869.43	866.14	3.29	0.0113	0.0339	929	J281	J282	30	
J289	892.54	891.39	1.15	0.0113	0.0339	926	J289	J283	29.78	
J283	889.14	887.99	1.15	0.0113	0.0339	925	J283	J277	29.79	
J277	885.64	884.49	1.15	0.0113	0.0339	924	J277	J278	29.65	
J278	881.48	880.33	1.15	0.0113	0.0339	923	J278	J275	29.69	
J275	877.16	876.01	1.15	0.0113	0.0339	922	J275	J389	21.49	
J389	873.71	872.56	1.15	0.0113	0.0339	921	J389	J388	20.72	
J388	870.32	869.17	1.15	0.0113	0.0339	920	J388	J296	5.14	
J296	869.9	868.75	1.15	0.0113	0.0339	919	J296	J297	5.23	
J297	869.73	868.58	1.15	0.0113	0.0339	918	J297	J276	4.33	DM
J621	900.16	899.01	1.15	0.0163	0.0489	297	J621	J548	22.18	
J548	899.51	898.36	1.15	0.0113	0.0339	298	J548	J549	21.64	
J549	898.12	896.97	1.15	0.0113	0.0339	299	J549	J554	29.92	
J554	896.08	894.93	1.15	0.0113	0.0339	300	J554	J555	29.94	
J555	894.2	893.05	1.15	0.0113	0.0339	301	J555	J672	15.37	
J672	893.41	892.26	1.15	0.0113	0.0339	302	J672	J671	8.26	
J671	893.16	892.01	1.15	0.0113	0.0339	303	J671	J552	8.43	
J552	892.93	891.78	1.15	0.0113	0.0339	304	J552	J674	11.27	
J674	892.37	891.22	1.15	0.0113	0.0339	305	J674	J553	13.21	
J553	891.2	890.05	1.15	0.0113	0.0339	306	J553	J576	32.57	

J576	889.05	887.90	1.15	0.0113	0.0339	307	J576	J577	29.94	
J577	887.15	886.00	1.15	0.0113	0.0339	308	J577	J574	29.96	
J574	885.62	884.47	1.15	0.0113	0.0339	309	J574	J575	29.88	
J575	883.39	882.24	1.15	0.0113	0.0339	310	J575	J580	29.74	
J580	881.78	880.63	1.15	0.0163	0.0489	311	J580	J581	29.93	
J581	880.32	879.17	1.15	0.0113	0.0339	312	J581	J673	16.17	
J673	879.33	878.18	1.15	0.0113	0.0339	313	J673	J578	19.28	
J578	879.22	878.07	1.15	0.0113	0.0339	314	J578	J579	24.08	
J579	879.01	877.86	1.15	0.0113	0.0339	315	J579	J573	27.9	
J573	879.37	877.70	1.67	0.0113	0.0339	316	J573	J668	12.05	
J668	878.29	877.14	1.15	0.0113	0.0339	317	J668	J567	20	
J567	879.75	877.02	2.73	0.0113	0.0339	318	J567	J568	29.98	
J568	880.35	876.85	3.50	0.0113	0.0339	319	J568	J565	29.97	
J565	881.61	876.67	4.94	0.0243	0.0729	320	J565	J566	25.33	LS
J566	883.35	882.20	1.15	0.0113	0.0339	321	J566	J571	34.53	
J571	885.28	882.00	3.28	0.0113	0.0339	322	J571	J572	29.37	
J572	887.93	881.82	6.11	0.0113	0.0339	984	J572	J365	29.78	
J365	884.32	881.65	2.67	0.0113	0.0339	985	J365	J364	29.84	
J364	882.71	881.47	1.24	0.0113	0.0339	986	J364	J367	29.76	
J367	882.3	881.15	1.15	0.0163	0.0489	987	J367	J366	29.98	
J366	882.79	880.97	1.82	0.0113	0.0339	988	J366	J361	29.65	LS
J361	886.73	885.58	1.15	0.0113	0.0339	989	J361	J360	29.57	
J360	890.51	885.41	5.10	0.0113	0.0339	990	J360	J363	29.8	
J363	891.71	885.23	6.48	0.0113	0.0339	991	J363	J362	29.97	
J362	891.06	885.05	6.01	0.0113	0.0339	992	J362	J368	29.97	
J368	889.88	884.88	5.00	0.0113	0.0339	993	J368	J374	29.85	
J374	887	884.70	2.30	0.0113	0.0339	994	J374	J373	29.41	
J373	881.07	879.92	1.15	0.0113	0.0339	995	J373	J376	29.38	
J376	875.48	874.33	1.15	0.0113	0.0339	996	J376	J352	12.44	
J644	901.04	899.89	1.15	0.0113	0.0339	366	J644	J620	15.92	
J620	899.63	898.48	1.15	0.0113	0.0339	365	J620	J548	21.58	
J624	881.97	880.82	1.15	0.0113	0.0339	358	J624	J618	26.05	
J618	882.8	880.67	2.13	0.0113	0.0339	359	J618	J619	29.99	
J619	881.93	880.49	1.44	0.0113	0.0339	360	J619	J616	29.98	
J616	882.07	880.31	1.76	0.0113	0.0339	361	J616	J617	29.99	
J617	882.1	880.14	1.96	0.0113	0.0339	362	J617	J622	29.98	
J622	880.59	879.44	1.15	0.0113	0.0339	363	J622	J623	29.98	
J623	880.25	879.10	1.15	0.0113	0.0339	346	J623	J573	31.59	DM
J630	886.08	884.93	1.15	0.0113	0.0339	356	J630	J629	29.79	
J629	889.81	884.75	5.06	0.0113	0.0339	355	J629	J632	19.69	
J632	891.25	884.64	6.61	0.0113	0.0339	296	J632	J553	19.42	LS
J356	884.42	883.27	1.15	0.0113	0.0339	974	J356	J357	33.35	
J357	878.91	877.76	1.15	0.1423	0.4269	973	J357	J345	29.49	
J345	873.73	872.58	1.15	0.0113	0.0339	972	J345	J346	37.69	
J346	875.93	872.36	3.57	0.0113	0.0339	971	J346	J343	29.97	
J343	876.5	872.18	4.32	0.0113	0.0339	970	J343	J344	29.91	
J344	877.03	872.01	5.02	0.0113	0.0339	969	J344	J349	29.95	

J349	879.34	871.83	7.51	0.0113	0.0339	357	J349	J573	29.16	
J379	900.54	899.39	1.15	0.0113	0.0339	951	J379	J380	34.27	
J380	897.73	896.58	1.15	0.0113	0.0339	950	J380	J383	12.04	
J383	895.82	894.67	1.15	0.0113	0.0339	949	J383	J377	17.34	
J377	892.73	891.58	1.15	0.0113	0.0339	948	J377	J378	29.52	
J378	888.33	887.18	1.15	0.0113	0.0339	2	J378	J308	29.15	
J676	894.93	893.78	1.15	0.0113	0.0339	345	J676	J679	29.91	
J679	895.41	893.60	1.81	0.0113	0.0339	344	J679	J678	29.97	
J678	895.76	893.43	2.33	0.0113	0.0339	343	J678	J655	30	
J655	895.94	893.25	2.69	0.0113	0.0339	342	J655	J654	29.84	
J654	896.02	893.08	2.94	0.0113	0.0339	341	J654	J657	29.94	
J657	895.65	892.90	2.75	0.0113	0.0339	340	J657	J656	29.99	
J656	895.66	892.72	2.94	0.0113	0.0339	339	J656	J651	29.79	
J651	895.67	892.55	3.12	0.0113	0.0339	338	J651	J650	29.83	
J650	897.1	892.37	4.73	0.0113	0.0339	337	J650	J653	29.98	
J653	898.08	892.20	5.88	0.0113	0.0339	336	J653	J652	29.95	
J652	897.95	892.02	5.93	0.0113	0.0339	335	J652	J291	13.17	
J291	899.29	891.94	7.35	0.0113	0.0339	334	J291	J658	16.79	
J658	897.79	891.84	5.95	0.0113	0.0339	333	J658	J664	30	
J664	897.78	891.67	6.11	0.0113	0.0339	332	J664	J663	30	
J663	897.56	891.49	6.07	0.0113	0.0339	331	J663	J666	29.98	
J666	897.38	891.31	6.07	0.0113	0.0339	330	J666	J665	29.98	
J665	896.59	891.14	5.45	0.0113	0.0339	329	J665	J660	29.93	
J660	894.78	890.96	3.82	0.0113	0.0339	328	J660	J667	29.96	
J667	893.4	890.79	2.61	0.0113	0.0339	327	J667	J662	20.74	
J662	892.88	890.66	2.22	0.0113	0.0339	326	J662	J661	29.91	
J661	891.76	890.49	1.27	0.0113	0.0339	325	J661	J570	29.96	
J570	890.18	889.03	1.15	0.0163	0.0489	324	J570	J569	29.92	
J569	888.52	887.37	1.15	0.0113	0.0339	323	J569	J572	30.53	DM Busstand road
J193	976.93	975.78	1.15	0.0113	0.0339	259	J193	J200	19.66	KSEB Jn
J200	971.33	970.18	1.15	0.0113	0.0339	258	J200	J207	29.66	
J207	975.81	970.01	5.80	0.0113	0.0339	257	J207	J206	29.69	LS
J206	979.57	978.42	1.15	0.0113	0.0339	256	J206	J208	29.78	
J208	981.87	978.24	3.63	0.0113	0.0339	255	J208	J210	29.92	
J210	983.57	978.07	5.50	0.0113	0.0339	254	J210	J209	29.54	
J209	982.99	977.90	5.09	0.0113	0.0339	253	J209	J202	27.53	
J202	980.46	977.73	2.73	0.0113	0.0339	252	J202	J201	31.98	
J201	977.17	976.02	1.15	0.0113	0.0339	251	J201	J203	40.67	
J203	976.26	975.11	1.15	0.0113	0.0339	250	J203	J205	19.09	
J205	976.9	975.00	1.90	0.0113	0.0339	249	J205	J204	29.87	
J204	976.93	974.82	2.11	0.0113	0.0339	248	J204	J175	29.96	
J175	975.81	974.65	1.16	0.0113	0.0339	247	J175	J174	29.95	
J174	974.63	973.48	1.15	0.0113	0.0339	246	J174	J309	16.87	
J309	973.13	971.98	1.15	0.0113	0.0339	245	J309	J176	19.42	
J176	969.96	968.81	1.15	0.0113	0.0339	244	J176	J178	22.88	
J178	967.92	966.77	1.15	0.0113	0.0339	243	J178	J177	29.92	

J177	966.21	965.06	1.15	0.0113	0.0339	242	J177	J170	29.74	
J170	962.27	961.12	1.15	0.0113	0.0339	241	J170	J169	29.81	
J169	958.95	957.80	1.15	0.0113	0.0339	240	J169	J171	29.74	
J171	955.19	954.04	1.15	0.0113	0.0339	239	J171	J196	14.78	
J196	952	950.85	1.15	0.0113	0.0339	238	J196	J173	14.54	
J173	949.36	948.21	1.15	0.0113	0.0339	237	J173	J172	29.9	
J172	947.36	946.21	1.15	0.0113	0.0339	236	J172	J179	29.96	
J179	947.02	945.87	1.15	0.0113	0.0339	235	J179	J186	29.87	
J186	947.66	945.69	1.97	0.0113	0.0339	234	J186	J185	29.89	
J185	945.68	944.53	1.15	0.0113	0.0339	233	J185	J189	29.63	
J189	941	939.85	1.15	0.0113	0.0339	231	J189	J337	14.7	
J337	939.2	938.05	1.15	0.0113	0.0339	230	J337	J188	15.61	
J188	937.08	935.93	1.15	0.0113	0.0339	229	J188	J181	30	
J181	936.82	935.67	1.15	0.0113	0.0339	228	J181	J180	29.38	
J180	939.23	935.50	3.73	0.0113	0.0339	227	J180	J182	34.69	
J182	939.36	935.29	4.07	0.0113	0.0339	226	J182	J184	24.82	
J184	937.38	935.15	2.23	0.0113	0.0339	225	J184	J183	29.69	
J183	933.22	932.07	1.15	0.0113	0.0339	224	J183	J238	29.68	
J238	928.82	927.67	1.15	0.0113	0.0339	223	J238	J237	29.72	
J237	926.23	925.08	1.15	0.0113	0.0339	222	J237	J239	29.92	
J239	924.82	923.67	1.15	0.0113	0.0339	221	J239	J241	29.6	
J241	920.5	919.35	1.15	0.0113	0.0339	220	J241	J240	33.58	
J240	916.94	915.79	1.15	0.0113	0.0339	219	J240	J233	38.35	
J233	915.81	914.66	1.15	0.0113	0.0339	218	J233	J232	17.76	
J232	914.12	912.97	1.15	0.0113	0.0339	217	J232	J234	29.26	
J234	911.27	910.12	1.15	0.0113	0.0339	216	J234	J236	34.51	
J236	908.02	906.87	1.15	0.0113	0.0339	215	J236	J195	19.52	
J195	906.98	905.83	1.15	0.0113	0.0339	214	J195	J197	9.19	
J197	905.66	904.51	1.15	0.0113	0.0339	213	J197	J199	9.54	
J199	903.92	902.77	1.15	0.0113	0.0339	212	J199	J644	30	DM
				2.5746	7.7238					

Kattapana Network-Well zone -5

[NODE]						[CONDUITS]			
Node ID	Ground Elevation	Invert Elevation	Depth of Cut	DWF (LPS)	Peak Flow (LPS)	Conduit ID	From Node	To Node	Length
J151	873.71	872.56	1.15	0.2713	0.8139	368	J151	J154	29.98
J154	873.2	872.05	1.15	0.0113	0.0339	369	J154	J153	30
J153	872.9	871.75	1.15	0.0113	0.0339	370	J153	J148	29.99
J148	872.48	871.33	1.15	0.0113	0.0339	371	J148	J147	29.89
J147	871.28	870.13	1.15	0.0113	0.0339	372	J147	J150	29.94
J150	869.96	868.81	1.15	0.0113	0.0339	373	J150	J149	29.92
J149	868.48	867.33	1.15	0.0113	0.0339	374	J149	J194	29.91
J194	866.77	865.62	1.15	0.0113	0.0339	375	J194	J193	29.88

J193	864.48	863.33	1.15	0.0113	0.0339	376	J193	J196	29.76	
J196	860.7	859.55	1.15	0.0113	0.0339	377	J196	J195	29.67	
J195	856.98	855.83	1.15	0.0113	0.0339	378	J195	J190	19.49	
J190	854.98	853.83	1.15	0.0113	0.0339	379	J190	J895	17.87	
J895	853.91	852.76	1.15	0.0113	0.0339	401	J895	J894	39.31	
J894	853.39	852.24	1.15	0.0113	0.0339	400	J894	J897	29.99	
J897	853.11	851.96	1.15	0.0113	0.0339	399	J897	J896	29.98	
J896	852.96	851.78	1.18	0.0113	0.0339	398	J896	J891	29.76	
J891	853.36	851.61	1.75	0.0113	0.0339	397	J891	J890	29.91	
J890	855.56	851.43	4.13	0.0113	0.0339	396	J890	J893	29.91	
J893	855.72	851.26	4.46	0.0113	0.0339	395	J893	J892	29.98	
J892	855.45	851.08	4.37	0.4913	1.4739	394	J892	J898	29.85	
J898	858.06	850.90	7.16	0.0113	0.0339	393	J898	J904	29.98	
J904	857.86	850.73	7.13	0.0113	0.0339	392	J904	J903	29.64	
J903	855.47	850.55	4.92	0.0113	0.0339	391	J903	J906	29.96	
J906	854.18	850.38	3.80	0.0113	0.0339	390	J906	J905	22.06	
J905	853.94	850.25	3.69	0.0213	0.0639	37	J905	J900	35.28	
J900	853.87	850.04	3.83	0.0113	0.0339	38	J900	J899	32.42	
J899	853.94	849.85	4.09	0.0113	0.0339	39	J899	J902	29.85	
J902	851.81	849.67	2.14	0.0113	0.0339	40	J902	J901	29.74	
J901	848.43	847.28	1.15	0.0113	0.0339	41	J901	J946	29.87	
J946	845.73	844.58	1.15	0.0113	0.0339	42	J946	J945	29.65	
J945	841.2	840.05	1.15	0.0113	0.0339	43	J945	J948	29.65	
J948	836.65	835.50	1.15	0.0113	0.0339	44	J948	J947	29.85	
J947	835.29	834.14	1.15	0.0113	0.0339	45	J947	J942	29.93	
J942	834.9	833.75	1.15	0.0113	0.0339	46	J942	J919	14.47	
J919	835.18	833.66	1.52	0.0113	0.0339	47	J919	J941	15.2	
J941	837.42	833.58	3.84	0.0113	0.0339	48	J941	J944	23.52	LS
J944	840.2	839.05	1.15	0.0113	0.0339	49	J944	J943	34.53	
J943	842.29	838.85	3.44	0.0113	0.0339	50	J943	J949	29.79	
J949	840.95	838.67	2.28	0.0113	0.0339	51	J949	J955	29.84	
J955	839.88	838.50	1.38	0.0113	0.0339	52	J955	J954	29.87	
J954	837.94	836.79	1.15	0.0113	0.0339	53	J954	J957	29.86	
J957	837.18	836.03	1.15	0.0113	0.0339	54	J957	J956	29.83	
J956	836.02	834.87	1.15	0.0113	0.0339	55	J956	J951	21.37	
J951	836.9	834.74	2.16	0.0113	0.0339	56	J951	J918	18.64	
J918	837.56	834.63	2.93	0.0113	0.0339	57	J918	J1061	19.92	
J1061	837.8	834.52	3.28	0.0113	0.0339	63	J1061	J1064	28.76	
J1064	833.4	832.25	1.15	0.0113	0.0339	64	J1064	J1063	29.72	
J1063	828.86	827.71	1.15	0.0113	0.0339	65	J1063	J1069	29.54	
J1069	825.58	824.43	1.15	0.0113	0.0339	66	J1069	J1075	33.34	
J1075	824.06	822.91	1.15	0.0113	0.0339	67	J1075	J1074	23.09	
J1074	823.3	822.15	1.15	0.0113	0.0339	68	J1074	J1090	15.69	
J1090	822.56	821.41	1.15	0.0113	0.0339	69	J1090	J1077	15.28	
J1077	822.74	821.32	1.42	0.0113	0.0339	70	J1077	J1076	31.29	
J1076	823.34	821.14	2.20	0.0113	0.0339	71	J1076	J1071	29.7	
J1071	823.71	820.96	2.75	0.0113	0.0339	72	J1071	J1070	29.53	

J1070	826.99	820.79	6.20	0.0113	0.0339	73	J1070	J1073	29.82	
J1073	824.05	820.61	3.44	0.0113	0.0339	74	J1073	J1072	23.7	
J1072	822.65	820.47	2.18	0.0113	0.0339	75	J1072	J981	28	
J981	822.23	820.31	1.92	0.0113	0.0339	76	J981	J980	31.93	
J980	822.71	820.12	2.59	0.0113	0.0339	77	J980	J983	36.18	
J983	822.9	819.91	2.99	0.0113	0.0339	78	J983	J982	29.99	
J982	823.14	819.73	3.41	0.0113	0.0339	79	J982	J977	29.85	
J977	825.84	819.56	6.28	0.0113	0.0339	1	J977	OUTFALL	29.65	WELL
J1065	853.47	852.32	1.15	0.0113	0.0339	62	J1065	J1087	19.95	
J1087	852.09	850.94	1.15	0.0113	0.0339	61	J1087	J1068	23.04	
J1068	850.21	849.06	1.15	0.0113	0.0339	60	J1068	J1067	34.22	
J1067	846.61	845.46	1.15	0.0113	0.0339	59	J1067	J1062	29.59	
J1062	842.48	841.33	1.15	0.0113	0.0339	58	J1062	J1061	30.51	DM
J740	887.79	886.64	1.15	0.0113	0.0339	141	J740	J741	29.95	
J741	886.57	885.42	1.15	0.0113	0.0339	142	J741	J696	29.92	
J696	884.8	883.65	1.15	0.0113	0.0339	143	J696	J697	29.95	
J697	883.05	881.90	1.15	0.0113	0.0339	144	J697	J694	29.91	
J694	880.72	879.57	1.15	0.0113	0.0339	145	J694	J695	29.95	
J695	879.13	877.98	1.15	0.0113	0.0339	146	J695	J700	29.96	
J700	877.7	876.55	1.15	0.0113	0.0339	147	J700	J701	29.97	
J701	876.41	875.26	1.15	0.0113	0.0339	148	J701	J698	29.94	
J698	874.79	873.64	1.15	0.0113	0.0339	149	J698	J699	29.46	
J699	873.62	872.47	1.15	0.0113	0.0339	150	J699	J693	29.95	
J693	872.55	871.40	1.15	0.0113	0.0339	151	J693	J687	29.95	
J687	870.96	869.81	1.15	0.0113	0.0339	152	J687	J688	29.95	
J688	869.21	868.06	1.15	0.0113	0.0339	153	J688	J685	29.94	
J685	867.29	866.14	1.15	0.0113	0.0339	154	J685	J686	33.55	
J686	864.76	863.61	1.15	0.0113	0.0339	155	J686	J583	7.98	
J583	864.76	863.56	1.20	0.0113	0.0339	156	J583	J691	23.21	
J691	863.17	862.02	1.15	0.0113	0.0339	157	J691	J692	25.08	
J692	863.1	861.87	1.23	0.0113	0.0339	158	J692	J689	29.99	
J689	863.59	861.70	1.89	0.0113	0.0339	159	J689	J582	15.53	
J582	864.2	861.60	2.60	0.0113	0.0339	160	J582	J690	14.41	
J690	865.41	861.52	3.89	0.0113	0.0339	161	J690	J713	29.89	LS
J713	867.92	866.77	1.15	0.0113	0.0339	162	J713	J714	29.9	
J714	870.27	866.59	3.68	0.0113	0.0339	163	J714	J711	29.9	LS
J711	872.48	871.33	1.15	0.0113	0.0339	164	J711	J712	29.94	
J712	874.34	871.15	3.19	0.0113	0.0339	165	J712	J717	29.91	
J717	876.27	870.98	5.29	0.0113	0.0339	166	J717	J588	15.4	
J588	876.77	870.89	5.88	0.0113	0.0339	389	J588	J1004	29.94	
J1004	875.28	870.71	4.57	0.0113	0.0339	521	J1004	J821	29.95	
J821	873.61	870.54	3.07	0.0113	0.0339	522	J821	J638	29.95	
J638	871.97	870.36	1.61	0.0113	0.0339	523	J638	J637	30	
J637	871.53	870.18	1.35	0.0113	0.0339	524	J637	J640	30	
J640	871.08	869.93	1.15	0.0113	0.0339	525	J640	J639	30	
J639	870.64	869.49	1.15	0.0113	0.0339	526	J639	J634	30	
J634	870.2	869.05	1.15	0.0113	0.0339	527	J634	J633	29.98	

J633	869.71	868.56	1.15	0.0113	0.0339	528	J633	J636	29.95	
J636	868.03	866.88	1.15	0.0113	0.0339	529	J636	J635	25.38	
J635	866.6	865.45	1.15	0.0113	0.0339	530	J635	J1002	16.86	
J1002	863.75	862.60	1.15	0.0113	0.0339	531	J1002	J641	17.6	
J641	863.76	862.50	1.26	0.0113	0.0339	564	J641	J647	29.68	
J647	859.5	858.35	1.15	0.0113	0.0339	565	J647	J1005	12.74	
J1005	857.52	856.37	1.15	0.0113	0.0339	566	J1005	J1003	8.33	
J1003	855.8	854.65	1.15	0.0113	0.0339	567	J1003	J646	8.42	
J646	854.2	853.05	1.15	0.0113	0.0339	568	J646	J649	29.36	
J649	848.04	846.89	1.15	0.0113	0.0339	569	J649	J648	29.36	
J648	841.89	840.74	1.15	0.0113	0.0339	570	J648	J1008	19.79	
J1008	838.98	837.83	1.15	0.0113	0.0339	571	J1008	J643	21.95	
J643	835.77	834.62	1.15	0.0113	0.0339	572	J643	J642	22.92	
J642	836.95	834.49	2.46	0.0113	0.0339	573	J642	J645	22.63	
J645	838.11	834.35	3.76	0.0113	0.0339	574	J645	J1009	18.17	
J1009	840.05	834.25	5.80	0.0113	0.0339	107	J1009	J987	23.57	
J987	835.88	834.11	1.77	0.0113	0.0339	106	J987	J971	31.66	
J971	837.54	833.92	3.62	0.0113	0.0339	105	J971	J988	20.99	
J988	836.95	833.80	3.15	0.0113	0.0339	90	J988	J1066	23.73	
J1066	836.53	833.66	2.87	0.0113	0.0339	89	J1066	J991	18.39	
J991	836.42	833.55	2.87	0.0113	0.0339	88	J991	J992	29.4	
J992	837.02	833.38	3.64	0.0113	0.0339	87	J992	J989	23.62	
J989	837.62	833.24	4.38	0.0113	0.0339	86	J989	J990	33.01	
J990	838.05	833.04	5.01	0.0113	0.0339	85	J990	J1089	19.86	
J1089	837.91	832.93	4.98	0.0113	0.0339	84	J1089	J984	20.84	
J984	837.38	832.80	4.58	0.0113	0.0339	83	J984	J978	22.04	
J978	836.81	832.67	4.14	0.0113	0.0339	82	J978	J979	29.61	
J979	834.56	832.50	2.06	0.0113	0.0339	81	J979	J976	29.7	
J976	830.37	829.22	1.15	0.0113	0.0339	80	J976	J977	29.66	DM
J729	868.64	867.49	1.15	0.0113	0.0339	547	J729	J728	25.35	
J728	873.21	867.34	5.87	0.0113	0.0339	546	J728	J731	34.22	
J731	872.05	867.14	4.91	0.0113	0.0339	545	J731	J749	20.03	
J749	871.3	867.02	4.28	0.0113	0.0339	544	J749	J725	22.03	
J725	870.62	866.89	3.73	0.0113	0.0339	543	J725	J752	24.31	
J752	868.2	866.75	1.45	0.0113	0.0339	542	J752	J730	23.49	
J730	867.3	866.15	1.15	0.0113	0.0339	541	J730	J720	18.54	
J720	866.01	864.86	1.15	0.0113	0.0339	540	J720	J583	11.35	
J743	874.13	872.98	1.15	0.0113	0.0339	539	J743	J750	27.55	
J750	870.22	869.07	1.15	0.0113	0.0339	538	J750	J744	25.3	
J744	870.22	868.92	1.30	0.0113	0.0339	537	J744	J738	30	
J738	870.22	868.74	1.48	0.0113	0.0339	536	J738	J739	30	
J739	870.22	868.57	1.65	0.0113	0.0339	535	J739	J736	31.93	
J736	870.22	868.38	1.84	0.0113	0.0339	534	J736	J742	24.4	
J742	868.4	867.25	1.15	0.0113	0.0339	533	J742	J737	23.7	
J737	870.22	867.11	3.11	0.0113	0.0339	532	J737	J582	9.97	DM
J964	869.55	868.40	1.15	0.1013	0.3039	128	J964	J997	20.13	
J997	868.39	867.24	1.15	0.0113	0.0339	127	J997	J998	29.14	

J998	866	864.85	1.15	0.0113	0.0339	126	J998	J1021	30.55	
J1021	863.32	862.17	1.15	0.0113	0.0339	125	J1021	J1022	29.84	
J1022	860.24	859.09	1.15	0.0113	0.0339	124	J1022	J1019	29.83	
J1019	857.26	856.11	1.15	0.0113	0.0339	123	J1019	J1020	29.83	
J1020	854.14	852.99	1.15	0.0113	0.0339	122	J1020	J1025	29.82	
J1025	850.85	849.70	1.15	0.0113	0.0339	121	J1025	J1026	26.71	
J1026	847.52	846.37	1.15	0.0113	0.0339	120	J1026	J1023	32.67	
J1023	845.78	844.63	1.15	0.0113	0.0339	119	J1023	J1024	29.98	
J1024	845.26	844.11	1.15	0.0113	0.0339	118	J1024	J1018	29.95	
J1018	845.35	843.93	1.42	0.0113	0.0339	117	J1018	J1012	30	
J1012	845.17	843.76	1.41	0.0113	0.0339	116	J1012	J1013	30	
J1013	844.89	843.58	1.31	0.0113	0.0339	115	J1013	J1010	29.99	
J1010	844.99	843.40	1.59	0.0113	0.0339	114	J1010	J1011	29.97	
J1011	845.27	843.23	2.04	0.0113	0.0339	113	J1011	J1016	21.05	
J1016	845.72	843.10	2.62	0.0113	0.0339	112	J1016	J1017	38.83	
J1017	847.46	842.88	4.58	0.0113	0.0339	111	J1017	J1014	29.98	
J1014	847.47	842.70	4.77	0.0113	0.0339	110	J1014	J1015	29.7	
J1015	846.27	842.52	3.75	0.0113	0.0339	109	J1015	J970	29.62	
J970	843.77	842.35	1.42	0.0113	0.0339	108	J970	J1009	21.45	DM
J198	908.69	907.54	1.15	0.0113	0.0339	3	J198	J180	9.78	
J180	908.42	907.27	1.15	0.0113	0.0339	4	J180	J174	29.91	
J174	907	905.85	1.15	0.0113	0.0339	5	J174	J175	29.99	
J175	906.72	905.57	1.15	0.0113	0.0339	6	J175	J172	29.84	
J172	904.69	903.54	1.15	0.0113	0.0339	7	J172	J173	29.79	
J173	901.35	900.20	1.15	0.0113	0.0339	8	J173	J178	29.68	
J178	897.21	896.06	1.15	0.0113	0.0339	9	J178	J179	29.89	
J179	894.65	893.50	1.15	0.0113	0.0339	10	J179	J176	29.73	
J176	891.3	890.15	1.15	0.0113	0.0339	11	J176	J177	34.62	
J177	886.04	884.89	1.15	0.0113	0.0339	12	J177	J185	4.88	
J185	876.92	875.77	1.15	0.0113	0.0339	15	J185	J912	24.7	
J912	876.92	875.62	1.30	0.0113	0.0339	16	J912	J911	29.98	
J911	876.92	875.45	1.47	0.0113	0.0339	17	J911	J188	16.94	
J188	876.92	875.35	1.57	0.0113	0.0339	18	J188	J914	12.88	
J914	876.91	875.27	1.64	0.0113	0.0339	19	J914	J187	14.08	
J187	876.72	875.19	1.53	0.0113	0.0339	20	J187	J913	15.73	
J913	877.91	875.10	2.81	0.0113	0.0339	21	J913	J182	19.93	
J182	876.44	874.98	1.46	0.0113	0.0339	22	J182	J908	22.97	
J908	874.17	873.02	1.15	0.0113	0.0339	23	J908	J907	16.57	
J907	874.62	872.92	1.70	0.0113	0.0339	24	J907	J910	29.63	
J910	875.09	872.75	2.34	0.0113	0.0339	25	J910	J181	16.85	
J181	873.91	872.65	1.26	0.0113	0.0339	26	J181	J909	12.95	
J909	873.07	871.92	1.15	0.0113	0.0339	27	J909	J915	29.96	
J915	872.84	871.69	1.15	0.0113	0.0339	28	J915	J921	29.99	
J921	872.77	871.51	1.26	0.0113	0.0339	29	J921	J184	21.53	
J184	870.75	869.60	1.15	0.0113	0.0339	30	J184	J920	7.33	
J920	870.55	869.40	1.15	0.0113	0.0339	31	J920	J183	7.71	
J183	870.21	869.06	1.15	0.0113	0.0339	32	J183	J923	22	

J923	868.89	867.74	1.15	0.0113	0.0339	33	J923	J922	29.9	
J922	868.03	866.88	1.15	0.0113	0.0339	34	J922	J917	29.85	
J917	865.45	864.30	1.15	0.0113	0.0339	35	J917	J916	29.2	
J916	860.33	859.18	1.15	0.0113	0.0339	36	J916	J905	29.31	DM
J201	885.65	884.50	1.15	0.0113	0.0339	14	J201	J200	29.64	
J200	885.66	884.33	1.33	0.0113	0.0339	13	J200	J185	24.38	
J204	879.93	878.78	1.15	0.0113	0.0339	388	J204	J205	21.44	
J205	875.71	874.56	1.15	0.0113	0.0339	387	J205	J202	29.43	
J202	869.91	868.76	1.15	0.0113	0.0339	386	J202	J203	29.56	
J203	864.84	863.69	1.15	0.0113	0.0339	385	J203	J197	29.47	
J197	859.34	858.19	1.15	0.0113	0.0339	384	J197	J191	29.44	
J191	854.2	853.05	1.15	0.0113	0.0339	382	J191	J192	18.99	
J192	854.57	852.94	1.63	0.0113	0.0339	381	J192	J189	20.11	
J189	854.44	852.82	1.62	0.0113	0.0339	380	J189	J895	22.35	
J152	855.76	854.61	1.15	0.0113	0.0339	383	J152	J191	35.03	
				3.2243	9.6729					

ANNEXURE – 5

MUNICIPAL COUNCIL RESOLUTION

കട്ടപ്പന നഗരസഭാ കാര്യാലയം

ഐ.എസ്.ഒ 9001 : 2015 സർട്ടിഫൈഡ് സ്ഥാപനം
കട്ടപ്പന പി. ഒ, ഇടുക്കി ജില്ല. പിൻ– 685 508
ഫോൺ: 04868–272235.
ഇ–മെയിൽ: munsecktpna@gmail.com

കട്ടപ്പന നഗരസഭാ കൗൺസിലിന്റെ 17.11.2021 ലെ 2–ാം നമ്പർ സപ്ലി.തീരുമാനം

കട്ടപ്പന നഗരസഭ – സീവേജ് സിസ്റ്റം നടപ്പാക്കുന്നതിന്റെ ഭാഗമായി മുനിസിപ്പാലിറ്റിയിൽ സീവേജ് ട്രീറ്റ്മെന്റ് പ്ലാന്റ് സ്ഥാപിക്കുന്നതിന് ബഹു.സർക്കാരിൽ നിന്നും തുക അനുവദിക്കുന്ന മുറയ്ക്ക് സ്ഥലം ഏറ്റെടുക്കുന്നതിനുള്ള നടപടികൾ സ്വീകരിക്കുന്നതിന് അനുമതി നൽകി തീരുമാനിച്ചു.

ഒപ്പ്

ചെയർപേഴ്സൻ

(സെക്രട്ടറി)
ശരിപകർപ്പ്

Kattappana Municipality
Kattappana P.O, Idukki -685 508
Phone 04868-272235.
email: munsecktpna@gmail.com

Date: 08/11/2021

From

Secretary
Kattappana Municipality

To

The Superintending Engineer
Sewerage Circle
Kerala Water Authority
Kochi-11

Sir,

A meeting was conducted with officials of Kerala Water authority – Assistant Executive Engineer, Assistant Engineer and Honourable Chairperson, Secretary and Municipal Engineer of Kattappana Municipality in Municipal Office, Kattappana on 26th Oct. 2021 at 11.00 AM regarding the location confirmation for sewerage treatment plant in Kattappana Municipality. Due to the terraneous landscape and considering the population density, the locations for sewerage network are proposed within selected wards including town and central area with high population density. Also site visits have been done jointly on the same day. During discussion it is confirmed that were extremely willing to provide all necessary support for purchase and provision of Land required as soon as the sanctioning of Government Fund for Land Procurement.

MUNICIPAL OFFICE • KATTAPPANA

Dospatched on
Signature
Kattappana Municipality

Secretary
S.JAYAKUMAR M.A.,L.L.B
Municipal Secretary
Kattappana Municipality