KERALA WATER AUTHORITY

SEWERAGE CIRCLE KOCHI-11

NETWORK DESIGN AND ALLIED COMPONENTS FOR THE UNUTILIZED CAPACITY OF STP AT ELAMKULAM

KERALA

2022

ACKNOWLEDGEMENT

We, the Sewerage Circle, Kochi team use this opportunity to express our gratitude to everyone who supported us throughout the preparation of this DPR.

First of all we thank Sri **M.Anilkumar,** Adorable Mayor, Kochi Corporation for his support rendered during the various meetings held in due course of time. We also thankful to Sri **Antony Painuthara,** Councillor, Division No.54 of Kochi Corporation for his positive approach towards the project and his valuable help.

We are thankful to **Sri. T.K.Jose IAS**, Additional Chief Secretary to Government of Kerala and Chairman, KWA for his aspiring guidance, invaluably constructive criticism and advices during the preparation of DPR.

We would like to express our special thanks of gratitude to our Managing Director **Sri Venkatesapathy.S IAS** who gave us overall support, guidance**,** suggestions by time to time interventions during the preparation of DPR.

We also express our gratitude towards **Sri G.Sreekumar**, Technical Member, KWA and **Smt.Preethimol.C.K**, Chief Engineer, Sewerage WASCON &PPD for their technical support and guidance throughout the DPR preparation period.

Lastly but leastly, we would like to thank all our colleague and everyone else who has directly or indirectly supported and helped us at all the time.

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1 Schematic Diagram of Project Area

2 Layout of Project Area

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1 Population Forecasting

2 List of Flats in the project area

3 Design using SWMM Software - Output

ESTIMATE

EXECUTIVE SUMMARY

Kerala Water Authority is a public sector undertaking under the Government of Kerala formulated to plan, execute, operate and maintain water supply and sewerage schemes in Kerala. Kochi city, waste water disposal is the main environmental issue that has created unsanitary conditions, odor and mosquito problems within the city, which causes nuisance to the residents and affects their health. Poor disposal of septage from septic tanks results this unsanitary conditions. The present Sewage Treatment Plant (STP) is insufficient in treating the sewage/septate generated in the entire city.

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) have given directions to implement sewerage system for various cities of Kerala to control pollution of major water bodies.

After that as per the direction of KWA, a comprehensive sewerage plan has been developed in the year 2020 for Ernakulam district. As a pilot project two local urban bodies (ULBs) of Ernakulam district has been selected for implementation of sewerage scheme and the same is under preparation by Sewerage Circle Kochi-11.

In Kochi Corporation there exists a sewerage treatment plant at Elamkulam commissioned during 1970's having a capacity of 4.5 mld which is now functioning not up to designed capacity. As per the directions in order dated 21/09/2020 in OA No 593/2017,673/2018,829/2019 and 148/2016 of the Hon'ble National Green Tribunal it was directed to expeditiously make use of the unutilized capacity of the existing STP's under Kerala Water Authority. In this context a meeting has been convened by Additional Chief Secretary , WRD and directed to take initiative for utilizing the unutilized capacity of the existing plant at Elamkulam also. The existing plant at Elamkulam having capacity 4.50MLD is age old and going to be discarded. An STP of capacity 5 mld is envisaged and its construction is progressing under AMRUT scheme. In order to make use of the full capacity of the proposed plant additional network and allied components are taken under this project. For this the nearby area (the area that not covered at present) which is in the Division No.54 of Kochi Corporation has been selected for this purpose.

The extent of area covered is 1.35 square kilo meters having a population of 10740(as per census 2011). As the trend of population growth of Kochi Corporation shows decreasing, the treatment facility for the present load can be used for the next 30 years also. Considering the per capita water usage as 150lpcd, UFW and non-domestic consumption, total water usage is calculated as 2.01 MLD. Taking 85% of water consumption as sewerage produced, the total sewerage load is arrived as 1.75 MLD by incorporating infiltration demand also. The project includes laying of sewerage network of 16940m of OD 280mm PE100 PN8, pumping main of 1416 m of OD 225mm PE100 PN10. The domestic sewage is collected by gravity through various underground pipes of diameter 280 mm PE100 PN8 and collected in 3 collection wells out of which one is existing and two are proposed. In this DER provision for giving sewer connections to households are also incorporated.

The total cost of project comes to Rs.6645 lakhs including 10 years O&M charges excluding power charges.

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PROJECT AT A GLANCE

ERNAKULAM DISTRICT- SEWERAGE PLAN AT A GLANCE	
Project Details	Construction of underground sewerage network and allied components in division 54 of Kochi Corporation to make use of the unutilized capacity of newly constructing STP at Elamkulam.
LSGI Covered under the scheme	Division No.54 of Kochi Corporation
Total Scheme Area	1.35 Sq.km
Total Population (Year 2011)	10740 Nos
Population Density	7955 No./Sq.km
Design Period	30 years
Number of Zones	5 Nos.
Number of Collection Wells	3 Nos. (1 No existing)
Total sewage Load to STP	1.75 MLD
Total Length of Network Pipe (including pumping main)	16940 m
Length of Pumping Main	1416 m
Total Cost of Project including 10years O&M	66.45 Crores

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ABSTRACTOFCOST		
Sl. No.	**ITEM**	**AMOUNT(INR)**
NETWORK & ALLIEDCOMPONENTS		
1	Sewerage network system including network pipe, manholes, pumping mai etc.	30,10,81,278.00
2	Collection wells, pump houses, grit chamber, etc.	2,55,91,845.00
3	Electromechanical items such as pump sets, etc.	20,01,265.00
4	Additional provision for header pipes, valves, MH covers, crane and lifting arrangements, etc in pump houses - 2 pump houses	30,00,000.00
5	Supplying and providing blower arrangement for aerationsuitable to collection well and all installation charge and electrical fittings, etc complete-2 Nos	4,00,000.00
6	Supply and erection of 65 KVA diesel generator set-2 Nos	12,20,000.00
7	Electrical installation, earthing, cabling, controlpannel, electric connections, KSEB documentation and Supporting structures-2 sets	20,00,000.00
8	Construction of compound wall, fixing gate at New well zone at Rail Nagar	15,00,000.00
9	Charges for effecting household sewer connections @16500/Each	3,30,00,000.00
10	Road restoration charges	14,39,93,320.00
11	Add 18% GST	9,24,51,187.00
12	Provision for shifting existing utilities	50,00,000.00
13	Provision for side protection work in cases where there are chances for land slide and damage to nearby compound walls and buildings.	15,00,000.00
14	Contingency (0.5%)	33,22,500.00
15	Unforeseen	54,43,475.00
16	O&M charges for10 years including GST	4,29,64,530.00
	Total Cost	**66,45,00,000.00**
	Rs Sixty Six Crores Forty Five Lakhs (including 10 years O&M and without power charge)	

CHAPTER-1
KOCHI CITY PROFILE

1.1 Introduction

Provision of drinking water and sanitation facilities has always been a key priority for the state as it is directly related with the health of the community. The state has achieved significant results in terms of improved water supply coverage through Kerala Water Authority. But the sanitation sector could not cope up with water supply sector.

Even though the demand for an underground sewer network for Kochi Municipal Corporation has been evolved way back in 1975 itself, due to various reasons the project as planned could not be materialized. The predominant mode of sewage disposal is through septic tanks. Other forms of night soil disposal include pit latrines, bore latrines etc. Because of a low lying terrain and relatively high ground water levels, sewage effluent disposal through individual soak pits is ineffective and a number of households have connected their latrines to existing drains and canals. Moreover, there are colonies (slums) in Cochin Corporation with population more than 1.50 lakhs, where there are poor sanitation facilities. This has resulted in the poor hygienic practice and potential health problem. The coverage of the existing sewerage system is only 5% of the Municipal Corporation area comprising sewer system with 1184 house connections, 2 sewage pumping stations & Sewage treatment Plant of 4.5 MLD capacity. The system covers about 12 km sewer network. The existing STP even though has a designed capacity of 4.5 MLD, now functioning with approximately 3 MLD capacity, is in very age old condition has to be replaced by a new STP of capacity 5 MLD which is under construction in the existing STP premises. In order to run the newly constructing STP with full capacity, an additional load of approximately 2 MLD is to be brought to the plant. To serve this additional load, Division No.54 (Elamkulam) of Kochi Corporation (area 1.35km^2) has been taken as project area and the project aims to lay the underground sewer lines and other allied components .

1.2 City Profile

The state of Kerala is a green strip of land located in the south west corner of India. It has only 1.18% of the total area of the country, but houses 3.43% of the country's population. It is the most densely populated states in the country with a density of population of 819 persons per sq.km.

Kochi, "The Queen of Arabian Sea," is the "The Commercial Capital of Kerala." The city is built up on a cluster of Islands and peninsulas join by the bustling town on the main land, Ernakulam.

1.2. 1. Topography

The area of Kochi city lies at 9°58'N latitude and 76°16'E longitude. The force of interaction between the sea, river and land has imparted a typical topography to the Kochi area with a predominance of water sheets and lagoons. More than 40% of the surface area of Kochi consists of water sheets formed by canals and the lagoons of the Kochi Estuary of the Vembanad Lake. The river Periyar empties into Kochi Channel and has given rise to number of islands lying in the back waters. The entire Kochi region consists of 32 islands, low and mid lands. The height above mean sea level in areas is only 1 metre on an average.

1.2.2 Geological condition.

Major portion of the project area lies in low land region. The soil in the low land region is mainly slushy, clayey and water logged. These clayey soil with poor aeration and drainage and are characterized by a deep black colour, extremely high content of organic matter and very high acidity. Coconut and paddy are main crops in this region. These soils are subject to periodical inundation with salt water and are highly acidic in nature.

1.2.3. Water Resources

1.2.3.1 Surface Source.

Periyar and Muvattupuzha are the major rivers flowing through the district. The source of water supply to Kochi Corporation isPeriyar and Muvattupuzha River.

1.2.3.2 Ground Water Potential.

Groundwater occurs under phreatic conditions in the shallow weathered portions whereas it occurs under semi confined to confined condition in the deep-seated fractures of the crystalline formation. The hard rock formations in general lack primary porosity. The water is stored in the secondary pores developed as a consequence of weathering in fractures, fissures and joints etc. The movement of groundwater is controlled by the extent of the interconnection of the fractures. In the shallow phreatic zone, the depth of dug wells varies from 3.4 to 14.8 mbgl (meters below ground level). The depth to water level in the wells ranges from 1.82 to 12.05 mbgl.

The seepage from the rivers and accumulation of ground water owing to heavy rains make the district relatively rich in groundwater sources. But the ground water in the low land areas are not suitable for drinking purposes due to salinity. In the coastal belt, there are thick sediments within which confined aquifers ranging in cumulative thickness of 3 to 41 meters occur within a maximum depth of 175 meters below ground level. These aquifers contain water of poor chemical quality. Survey conducted by the Quality Control Division of KWA reveals that iron and chloride (brackishness) contents are very high in the ground water available in this

area. As such the chances of tapping ground water by means of tube wells piercing these aquifers for meeting the water supply requirements of the area are remote.

1.2.4. Climate and Rainfall.

The district has a tropical humid climate. Four seasonal variations are experienced in the district viz. the south west monsoon season from June to September; North east monsoon season from October to December, a cool and pleasant climate during January and February and summer season from March to May.

The major rainfall in the district is from South-west Monsoon (Edavappathy or Kalavarsham). It contributes about 63% of the annual rainfall. During Thulavarsham (October to February) the average rainfall is estimated as 306.2mm. in October, 190.7 mm. in November, 15.6mm in December, 18.8mm in January and 19.6mm in February. Some stray rains occur in all the months from March to May. The annual rain fall in the district ranges from 250 to 360 cm.

The district experiences more or less uniform temperature throughout the year. Maximum temperature is experienced during summer season, ie. March to May which varies from 30°C to 33°C and minimum temperature in December ie. 25°C (average).

1.2.5. Demography.

The state of Kerala is a green strip of land located in the southwest corner of India. It is only 1.18% of the total area of the country, but houses 3.43% of the country's population. It is one of the most densely populated states in the country with a density of population of 819 persons per Sq. km. As per latest census figure, the state has registered a total population of 31.80 million and more than 25% of the population lives in urban areas. Demographically the state enjoys a very advanced status with rapidly declining birth and death rates, low infant mortality and very high literacy and health delivery system.

Kochi Corporation is surrounded by 4 Municipalities and 6 Grama Panchayaths. Kochi witnessed a rapid population growth during the past 30 years. The average decadal growth in Kochi Corporation is 7.83%. But the study during the last decade (2001-2011) shows decrease in growth.

1.2.6 Emerging Issues and Concerns.

Even though the natural growth rate of population does not show an exorbitant increase, the floating population in Kochi is to be considered while earmarking the infrastructural requirements. There is no intensive migration to any of the cities in Kerala mainly due to the following reasons.

- Employment opportunities in the main cities are not sufficient to exert a pulling effect

High land values in cities prohibit establishment of residences in cities especially among the middle and low-income categories.

- The homestead nature of holdings in sub urban areas allows fragmentation of property for new family housing.
- Availability of transport facilities allows daily commutation to the city from out lying areas and districts within a radius of about 100 km.

It must be noted that the daily commutation adds to the increased number of floating population in the core city. A transportation study conducted has shown that nearly 2.5 lakhs of people commute to the core city daily thereby increasing the pressure on civic amenities.

1.2.7. Literacy.

The sex wise education status of the population in the categories ofmost vulnerable (MV), just above vulnerable (JV), urban poor (UP), low income group (LIG), middle income group (MIG) and high income group (HIG). The educational status of the constituent areas was evaluated based on a sample survey. There is only negligible percentage of the population who are illiterate. About 2 % of the populations even in the most vulnerable group are graduates.

1.2.8 Population below Poverty Line.

The percentage of population below poverty is higher in the coastal areas, where fishermen constitute a major share of the population.

1.2.9 Future Population.

Kochi being the industrial and commercial capital of Kerala, the population growth in Kochi Municipal Corporation alone is expected to be 7.80% per decade. But the study during the last decade (2001-2011) shows no considerable increase in growth.

1.2.10 Economic Base.

The economy of the area is dependent on the activities of the Kochi Port. More than 60% of the tax revenue of the state comes from Kochi and hence Kochi is rightly called "Commercial Capital of Kerala." A number of industries are located in this district and the proximity and development potential of Kochi Port attracts private and public investments in port related activities. The economic activities and the population growth exert pressure on the available infrastructural facilities like water supply, sewerage, solid waste management etc. Approximately 34.3% of the population is the work force of the city.

1.2.11 Industries.

A major portion of commercial activities of the state including imports and exports take place in Kochi. Kochi Port Trust, Southern Command of Indian Navy, Kochi University, Kochi Shipyard etc. are located within the Kochi City Region. Apart from these a number of small,

medium and large-scale industries are located in and around Kochi. In the Kochi City the industrial use was only 1.71 % of the total land use in 1981. Medium-scale industries are concentrated along the foreshore areas and large-scale industries are concentrated at the north-eastern and south-eastern areas, about 10 to 15 km. off the central business district, in Eloor-Kalamasserry belt and Ambalamugal-Karimugal belt. Small-scale industries are spread all over the area. With the establishment of Gosree Bridges connecting the western Island to main land, large-scale industries worth 15000crores are at various stages of implementation at Vallarpadom -Puthuvypu area, the islands north of Kochi gut. "IT" industries are concentrating more around Kakkanad about 8 km. from the City. About 250 acres of land is being set apart for this.

Large quantity of potable water is necessary for all these 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. 85% 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.

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CHAPTER 2
SECTOR BACKGROUND, CONTEXT & BRIEF PROJECT RATIONALE

2.1 Kochi Sewerage Scheme - A Review

The sewerage system in the Corporation of Kochi is maintained by the Kerala Water Authority. Way back in 1966 the State Government has prepared a comprehensive water supply and sewerage scheme for Kochi Corporation and adjoining Panchayats which was taken up for implementation. The comprehensive Sewerage Project for Kochi Corporation was envisaged dividing the Corporation area into four different zones and dividing each zone into different blocks. The scheme as envisaged to cover the entire 94.88 sq.km. could not be implemented due to several administrative problems.

2.1.1. Network coverage

There is an existing sewerage systern in Kochi, which serves only a small central area of the Municipal Corporation. To date only some pockets in the centrally congested area of Ernakulam South is provided with sewerage system. The coverage of the existing sewerage system is only 5% of the Municipal Corporation area. An extent of 2.5 sq.km. in the main heart of the city ie. General Hospital area and 1.50 sq.km. in Gandhi Nagar area are covered by the existing sewerage system.

2.1.2. Details of the Existing Sewerage System in Ernakulam Town

The Sewerage system planned by the PHED in 1966 was taken up for Implementation in 1971. For the planning and implementation purposes the entire Municipal Corporation areas and Panchayaths was divided into four zones A, B, C, and D. Out of these zones, only a part of Zone B was commissioned. Zone B, which is further divided into five sewerage blocks (A, B, C, D and E) for planning purpose has only Block A (fully) and Block B (partially) functional at the moment and are connected to the existing STP of 4.5 MLD.

Seven pumping stations were envisaged to cover zone B, covering South of Ernakulam. Block A has one sewage pumping station (PS), which is constructed near Maharaja's College Ground for collecting sewage from Hospital zone, Corporation Office area, etc. The sewage is directly pumped to the existing STP. Block B, which also comprises of Gandhi Nagar Colony and Naval Campus, has a single sewage pumping station (PS-7) at Muttathil Lane, which pumps sewage from the aforesaid areas to the existing treatment plant. All other pumping stations of Zone B (PS-2, 3, 4, 5 and 6) are only planned and not constructed because of funds paucity. Existing sewerage system has 1184 household connections. Stoneware pipes of 150-225 mm diameters and RCC pipes of 250- 600 mm diameter were used. Details of sewage pumping station operation are indicated below:

- The existing sewer system now functioning in Ernakulam Town with pumping stations (PS 1) near Maharaja's College, pumping the sewage from Block A and the pumping main (2960m) to sewerage treatment plant of capacity 4.50 mld at Elamkulam will be retained.
- Also the existing sewer system now functioning in Ernakulam Town in Block B (part) with pumping main 600mm CI (cl LA) 560m from PS.7 to sewage treatment plant will also be retained. These two system covers about 12 km sewer system.

2.1.2.1 Sewage load coming to the STP from the existing network

The total load to the STP is coming from 2 pumping stations ie from No 1 pump house near Maharaja's College ground and from No7 pump house at Muttathil lane.

Load from No 1 pump house near Maharaja's College ground

The load calculated based on pumping time and discharge capacity of pum-pset used.

Table.2.1 Pumping Pattern in Existing No.1 Pump House

Pump No.	Discharge (LPS)	Time of	
		Start	Stop
1	38	6:00 AM	9:00 am
2	38	6:00 AM	9:00am
1	38	11.30 am	2.00 pm
2	38	11.30 am	2.00 pm
1	38	2.30 pm	3.30 pm
2	38	5.30 pm	2.30 pm
1	38	9.00 pm	6.30 pm

Total time of pumping 17 hours 30 minutes

Total quantity pumped from No1 PH=171/2x38*3600lit/day=2.39 MLD

No 7 Pump House Muttathil Lane

Pumping hours—9.30 AM to 11.30 AM and 2 PM to 4 PM.

Total 4 hrs with pumpset of discharge capacity 58 lps

otal quantity pumped from No7 PH=4 hours * 58 *60*60=0.84 MLD

Total sewage load reaching at STP=2.39+0.84=3.23 MLD,rounded to 3.25MLD.

The existing plant of 4.50 MLD is going to be discarded and a 5 MLD plant construction is going on under AMRUTH.

Hence unutilized capacity to be considered to run the newly constructing STP to full load is 5 MLD-3.25MLDie 1.75 MLD

2.1.3. Sewage Treatment Plant

The Sewage Treatment Plant located at Elamkulam is having a capacity of 4.50 MLD. The plant works in the activated sludge process of Treatment. The plant was commissioned as early in 1955. The maintenance of the sewage treatment plant at Elamkulam is done by KWA. The plant is working with Activated Sludge Process Technology.

Fig.2.1 Existing Sewage Treatment Plant of 4.5 MLD capacity - Primary Settling Tank and Aerators

The existing plant at Elamkulam having capacity 4.50mld is age old and going to be discarded. An STP of capacity 5 MLD is envisaged and its construction is progressing under AMRUT scheme. The technology for sewage treatment in the plant which is under construction is MBBR.

The MBBR bio film technology is efficient, compact and easy to operate. It can be an excellent solution as a stand- alone process. It can be used to specifically upgrade treatment potential of activated sludge process.

MBBR technology employs thousands of polyethylene bio-film 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 bio-film. Additionally, the bio-film attached to the mobile bio-carriers within the system automatically responds to load fluctuations.

Moving Bed Bio-film 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.

In Fluidized aerobic process a non-clogging bio-film 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 t reactor. This movement within the reactor is generated by providing aeration with the help of diffusers placed at the bottom of aerobic reactor. The thin bio-film 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 plant.

Fig-2.2 MBBR

Fig-2.3 MBBR Media

Sewage from South Ernakulam is treated at the STP of 4.50 MLD capacity at Fatima Road through an activated sewage process. The STP covers an area of 2 Hectare and treats sewage to achieve an effluent quality of 30 mg/l BOD and 50 mg/l suspended solids (confirmed by KWA). Effluent analysis is carried out by a private agency, once a month. Treated effluent is discharged into the Chettichira Lake. The existing STP will be discarded and construction of new 5 MLD STP is under progress. The physical statuses of certain components of new plant under construction are shown below.

Fig- No.2.4 Construction of 5 MLD STP under AMRUT

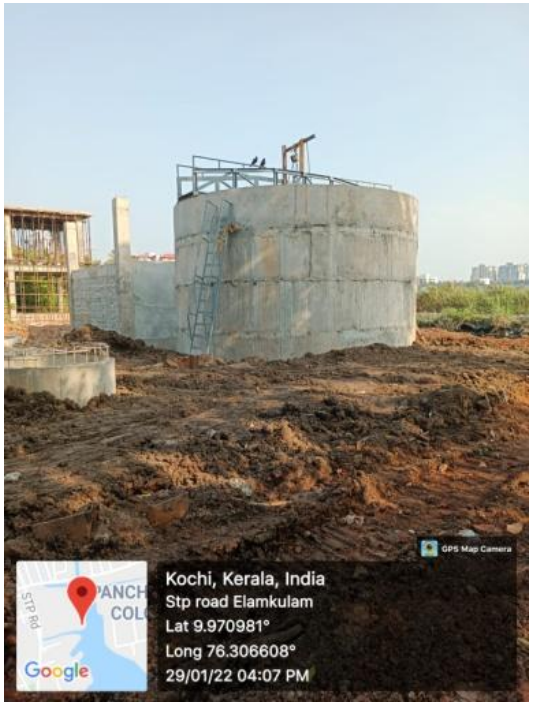

Fig- No.2.5 Construction of 5 MLD STP under AMRUT

2.2 User Coverage and Access to Users

The present network coverage is part of Divisions53, 54,62,66,67 and a total length of 12000 m of 150mm size and 200mm size. At present the connection fee Rs.2500 (Non-refundable) and the users have to get the work done up to the manhole or Y-branch as per the direction of KWA officers through licensed plumber The Kerala Water Supply and Sewerage Regulations and Kerala Water Authority Act applicable in the case of these connections.

Key issues, importance of the project to the sector

Increasingly rapid urbanization and industrialization are causing more rapid rise in the pollution of water and in many areas of the country, it has resulted in major public health hazards as well as in general deterioration of natural water resources. Drinking water sources are often threatened by increasing concentration of pathogenic organisms, as well as by many of the new toxic chemicals disposed of by industry and agriculture.

In several cases, rivers and lakes have become recipients of putrescible organic substances far exceeding their natural purifying capacities resulting in deterioration of water supplies and far reaching economic and health consequences.

Kochi, the commercial capital of Kerala State is situated in the Deccan peninsular. The general elevation of the city varies from 1m above mean sea level. The topography of the city is characterized by a series of well-defined water bodies discharging into back waters. Most of them are in an advanced stage of deterioration due to encroachments, silting and waste dumping. They are now stagnant drainage channels.

Fig. No.2.6 Existing Drainage Channels flowing Sewage Water (City Channel)

The terrain is flat and the water table is generally high. The soil is mixture of sand and clay and silt having very low permeability.

2.3 Need for Sewage Treatment

Water is our most important resource. The available supply of fresh water is an absolute deadline beyond which no community, state or nation can ever go. When humanity runs out of clean water, everything stops. That is, the end of the road for a man and his activities. Saving our clean water is thus a must.

When untreated or inadequately treated wastewaters are discharged, these have adverse effect on the body of water into which these wastes are disposed. The type of treatment of wastewater would depend upon the use of effluent itself or of receiving body of water into which effluent is discharged. The degree of treatment of wastewater would further depend upon the discharge of receiving body of water. If small quantity of waste water is discharged in a river or into the sea, the degree of treatment would be much less than if the same quantity of wastewater is discharged into a small stream. When receiving body of water is already polluted because of discharge of waste into it, the extent of new discharge of waste into it would be limited.

Fig. No. 2.7 Existing City Channels with Stagnant Water

The body of water which receives the discharge of waste is generally classified according to the use to which the receiving waters are put to. The degree of treatment to waste would depend accordingly. The following are the general uses of receiving waters:

2.3.1 Water Supply

When receiving waters are to be used as raw water for water supply, it would require highest degree of waste water treatment. The quality of receiving water after the discharge of treated effluents of waste water shall meet minimum standards as per tolerance limits for inland surface waters for use as raw water for public water supply and for bathing Ghats. It

becomes generally necessary to disinfect the effluent before its discharge into receiving waters when these are to be used for water supply.

2.3.2 Bathing

The use of receiving waters for bathing purposes requires quality second to that needed for drinking purposes. In these waters aesthetic considerations are most important. The treated effluent in most of the cases would require disinfection prior to its discharge into receiving waters. Tolerance limits for inland surface water for use as Bathing Ghats, as per Indian Standard-2296 is to be followed.

2.3.3 Fishing

India has long coast line of 6535 km. Potential yield for fisheries has been estimated to 10million tons. India ranks seventh among fishing nations. A crucial element to extensive aqua culture is aeration. Circulation is essential in order to adjust and control the dissolved oxygen and provide high oxygen concentration throughout the living surrounding.

Sunshine, wind, temperature, plankton and other organisms create varying conditions in fish ponds. In fish ponds dissolved oxygen and oxygen consumptions are very unbalanced. Light cannot reach the bottom of the pond during day time; thus upper water level contains lot of dissolved oxygen and lower water level lacks necessary dissolved oxygen. Oxygen is consumed very rapidly in lower level but not enough is available for sufficient replacement.

Maintaining high dissolved oxygen levels is the major factor in high density, high yield aqua culture. The dissolved oxygen condition in the lower level must be improved.

This problem can be solved by using aeration to improve oxygen situation in lower water level, improve circulation, clean the water, maintain stable water quality and Increase metabolism to reach goal of high yield.

2.3.4 Agriculture and Industrial Uses

Receiving waters intended to be used for agriculture and industrial uses need usually less degree of treatment. An effective treatment accomplished through conventional methods is generally sufficient. Wherever waste water is intended to be reused, danger to human health shall be carefully taken into account and necessary measures adopted. In a country like India where it rains only in monsoon (4 months in a year) and agriculture is the main stay of national economy, maximum use of waste water must be made for irrigation after the treatment.

2.3.5 Disposal of Wastewater into Streams

In several cases streams are used for receiving waste waters. Under such a situation it is important to ensure that the receiving body of water does not become a source of public nuisance because of complete absence of oxygen. As already discussed the degree of treatment would depend upon the characteristics of the effluent intended to be disposed, quality and the intended use of the receiving waters. High degree of treatment would be needed in regions where sources of water are limited, stream flows are insufficient and loads of waste water are high. When waste waters are intended for reuse, the extent of treatment needed would depend upon the specific use for which they are intended.

2.3.5.1 Assimilative Capacity of Streams

Receiving waters i.e. stream, lakes and oceans when polluted with organic wastes, purify themselves under natural course and return to their original state provided the pollution caused by the discharge of biodegradable organic waste is within their assimilative capacity. When organic waste is discharged into the receiving body of water, settlable solids settle at the bottom and then undergo a process of gradual aerobic and anaerobic decomposition. The organic matter which travels downstream gets stabilized bio chemically by the micro-organisms which get the food from the nutrients present in waste water and natural aeration in the stream provides oxygen for the process. With the passage of time, physical, chemical and biological processes acting naturally restore the receiving waters to their original state. The important aspect of the treatment, therefore, is to ensure that the discharge of waste water must not interfere with the use for which receiving body of water is intended.

When the decision regarding the use of receiving water is taken and its standard of quality determined, then the effluents quality of waste water that can be discharged into receiving water is a function not only of this standard of quality and the flow in the stream but also the full restorative ability of that stream and natural forces acting in the stream to assimilate wastes and to purify itself.

The discharge of organic waste into a flowing body of water results in increase in turbidity of water. The BOD of the waste reduces the oxygen contents of the stream. The oxygen content is replenished by surface aeration and by the process of photosynthesis. In this process the green plants and algae, supply oxygen to water and remove carbon dioxide from it. When the turbidity is increased it obstructs the path of sun light which is necessary for photosynthesis process thus resulting in reduction of re-aeration capacity of the stream. High and turbulent flows of streams, low temperature and well balanced ecological system contribute to high assimilative capacity. When it is intended to maintain stream for its

determined use throughout the year, the critical period is the summer when flow is low, when assimilative capacity is the lowest and the requirements are generally the highest.

2.3.6 Disposal of Waste water into Lakes and Oceans

The marine disposal of waste waters needs different approach. Water in the lake or sea is generally colder than waste water. The waste water is thus less dense than lake or sea water. The tendency of waste water, therefore, when discharged into lake or sea, would be to remain at the surface thus becoming a source of greatest nuisance. Because of this phenomenon it becomes necessary to discharge waste water at as much depth as possible in order to obtain adequate dilution and mixing. It is important to carry out studies to arrive at the assimilative capacity of the receiving body of water. Accordingly, the degree of treatment required for waste water prior to its disposal into the lake or ocean can be determined.

Marine disposal of waste water appears quite attractive due to economic reason because disposal into lake or ocean provides high dilution, thus requiring less degree of treatment. Even when the dilution available is adequate, a minimum preliminary treatment such as screening and sedimentation would be necessary to prevent floating of matter on the surface of water, fouling the water and causing nuisance.

2.4 Types of Treatment

The objective of waste water treatment is to remove pollutants from waste and to bring the quality of effluent to a desired standard. It is therefore necessary to know the characteristics of raw waste water, its mode of use or disposal of effluent to determine the degree of treatment required. Different types of treatment provide different percentage removal of BOD and suspended solids. In general, the treatments are classified as primary, secondary and tertiary. The general yard sticks for evaluating the performance of sewage treatment plants is the degree of reduction in BOD, COD, Suspended solids etc.

2.4.1 Primary Treatment

Any material which can possibly enter the sewer lines through the sanitary system in the homes or through manholes on the sewer line or in any other manner will be delivered to the treatment plant. Such materials may include refuse of every type, garbage, rags, pieces of wood, cans and children play things. These materials would injure subsequent equipment, clog piping or wrap around pump impellers and interfere with treatment process. The object of the provision of a primary treatment is to provide protection to the subsequent treatment units and to enhance the efficiency of subsequent treatment processes.

2.4.2 Secondary treatment (Biological Treatment)

The overall objectives of biological treatment of domestic wastewater are

- To Transform (i.e. oxidize) dissolved and particulate biodegradable constituents into acceptable end products.
- Capture and incorporate suspended and non settleable colloidal solids into biological floc or bio film.
- Transform or remove nutrients such as nitrogen and phosphorus.

CHAPTER-3

PROJECT DEFINITION, CONCEPT AND SCOPE

3.1 Scope of the work

The existing plant at Elamkulam having capacity 4.50mld is age old and going to be discarded. An STP of capacity 5 mld is envisaged and its construction is progressing under AMRUT scheme. In order to make use of the full capacity of the proposed plant additional network and allied components are taken under this project. For this the nearby area (the area that not covered at present) which is in the Division No.54 of Kochi Corporation has been selected for this purpose.

The extent of area covered is 1.35 square kilo meters having a population of 10740 (as per census 2011). As the trend of population growth of Kochi Corporation shows decreasing, the treatment facility for the present load can be used for the next 30 years also. Considering the per capita water usage as 150 LPCD, UFW and non-domestic consumption, total water usage is calculated as 2.01 MLD. Taking 85% of water consumption as sewerage produced, the total sewerage load is arrived as 1.75 MLD incorporating infiltration demand also. The project includes laying of sewerage network of 16940 m, pumping main of 1416 m and construction of 2 Nos of collection wells. The domestic sewage is collected by gravity through various underground pipes of diameter 280mm OD PE 100 PN 8 and collected in 3 collection wells out of which one is existing and two are proposed.

The underutilization of the existing STP is attributed to limited connections to the KWA's networks. At present there are only 1184 connections existing. On completion of the proposed work approximately 2000 numbers of sewer connections to the households and more than 45 numbers to multi storied apartments can be provided and thereby revenue in terms of centage of water charge can be realized. The one time connection charge will also boost the revenue of KWA.

The sewer network proposed will improve

- Improve the quality of life
- Improvement in the unhygienic condition and safety to health
- Economic gains as the investment in sewerage system will be less compared to the cost of maintaining separate household sanitation system for each household and the gains resulting from improved health, less illness and more workdays will be significantly high.

- Improvement in environment by arresting pollution in the air and ground water and the reduction in nutrient level in the surrounding water bodies.

3.2 Land

The proposed proposal is to lay sewerage network lines through roads and to collect the sewage in collection wells. In roads, at an interval of 30m, man holes are proposed to avoid choking of sewer lines and to perform maintenance work. The sewage from an area is carried through pipes under gravity to collect in collection wells. In this project three collection wells are included of which two wells are to be constructed and the remaining to make use of an existing well. Out of the new two wells one is proposed to construct in the premises of existing STP at Elamkulam and another new well is proposed to construct at a land nearby Rail Nagar where approximately 5 cents is demarcated for sewerage scheme.

3.3 Collection and Conveyance System

3.3.1 Sewer Network

The proposed sewerage project for the service area comprises of collection, transmission and treatment of sewage and disposal. Engineering decisions are required to specify the area and population to be served, the design period, the per capita sewage flow, ground water infiltration, unauthorized roof water connection, nature and location of the treatment facilities and the method of disposal / utilization of the effluent. The type, quality and quantity of the materials for construction are also to be looked into. This project is prepared with adequate details for timely and proper implementation of the project.

3.3.2 Population Forecasting

Demographic forecasting is an important topic: population, household and related forecasts form the basis of social and economic planning and are fundamental to many other forecasting exercises. The many uses of population forecasts give rise to choices on several dimensions. Population forecasting is also highly uncertain. During the twentieth century, fertility was the most important component in determining population size. However, forecasting fertility proved to be difficult in the post-World War II era: neither the “baby booms” of the 1950s nor “baby busts” of the 1970s were foreseen. Neither was the post-war rapid decline in mortality foreseen. Both mortality and migration forecasting were naïve: for decades, official population forecasts widely assumed that mortality would not improve, at least beyond the immediate future, and migration was treated as an uninteresting constant.

Water supply projects and sewerage projects are designed for 30 years. After 30 years the system needs renovation or to make a new system to accommodate load at that time.

There are several methods developed for forecasting population but none of them are perfect. The population growth may change based on several factors such as attitude of community, social status, onset of pandemic diseases, war etc. which are unpredictable.

3.3.3 Design Period

Sewerage projects under normal circumstances are designed for a period of 30years. The projected population including floating population in the year 2021 is 10740 and as the trend of population growth of Kochi Corporation shows decreasing rate, the treatment facility for the present load can be used for the next 30 years also.

Considering immediate implementation this project is designed for the population in 2021 taking the base period as 2011.

3.3.4 Estimation of Sanitary Sewage

Sanitary sewers are provided to carry the spent water of the community with some ground water and fraction of storm run-off, to the point of treatment and disposal.

The factors which affect the quality of sewage are

1. Per capita Sewage flow
2. Peak factor
3. Ground water infiltration
4. Unauthorized roof water connection.

3.3.4.1 Per capita Sewage flow:

The entire spent water of the community contributes to the total flow in a sanitary sewer. Since some water is lost due to evaporation and seepage, only 85% of the average water supply is taken as sewage flow. The per capita water supply of Kochi City is 150 lpcd. So the per capita sewage flow is taken as 127.5 lpcd (DWF).

Table No.3.1 Sewerage Generation from Project Area

Water Consumption @150lpcd for 10740	1.611	MLD
Floating population	0.226	MLD
Non-Domestic	0.128	MLD
Total water demand	1.965	MLD
Sewerage generated (@85% of Water demand)	1.67	MLD
Infiltration demand	0.08	MLD
Total sewage load produced	1.75	MLD

3.3.4.2 Peak Factor

There may be hourly variations in flow and also seasonal variations. The peak factor or ratio of maximum to average flow depends on the contributory population. Evidently the peak factor trends to reduce with increase in population, since the different habits and customs of several group of people in large population, trend to reduce the variations in demand pattern. The recommended values as per CPHEEO manual are as follows.

Table -3.2 Peak Factor Values

Sl.No.	Population	Peak Factor
1	Upto 20,000	3.00
2	20,000 to 50,000	2.50
3	50,000 to 7,50,000	2.25
4	Above 7,50,000	2.00

3.3.4.3 Ground water infiltration:

The flow in the sanitary sewers may include certain flows due to infiltration of ground water through joints. The suggested value for ground water infiltration for sewers laid below ground water table is as follows.

Table -3.3 Ground Water Infiltration

Norm	Minimum	Maximum
Litres/hectare/day	5000	50000
Litres/kilometer of sewer/day	500	5000
Liters/day/manhole	250	500

Infiltration in litres / Ha / day - 5000 to 50000. A value of 5000 litres / ha / day is adopted for design as per CPHEEO manual in the tool kit. However a higher infiltration rate is expecting due to the higher ground water table and nearness to backwaters.

3.3.4.4 Unauthorized roof water connection

The flow in the sanitary sewers may include certain flows due to unauthorized roof water connections from the households. Whereas the CPHEEO is of opinion that with

strict rules and regulations this should be banned. Hence this flow is taken as zero Hence the flow through the server is calculated as follows.

Table -3.4 Peak Flow Calculation

1	Peak Flow	PF x DWF + GW Infiltration
2	Average Flow	2 DWF + GW Infiltration
3	Minimum Flow	DWF + GW Infiltration

3.3.4.5 Hydraulics of sewer

A properly functioning sewer has to carry the peak flow for which it is designed and transport suspended solids in such a manner that the deposits in a sewer are the minimum. Open channel flow or gravity flow is assumed in the collection sewer lines and closed conduit flow or pressure flow is assumed in pumping mains.

The various factors which are to be considered in the design of gravity sewer lines are

1. Selection of pipes
2. Depth of flow
3. Velocity of flow
4. Minimum and Maximum cover

3.3.4.6 Selection Pipes

In the selection of pipes, the various aspects such as the life, the suitability of the pipe as a sewage carrier its resistance to corrosion against the soil in which it is laid, availability, economy, easiness for installation and maintenance are considered. The following pipes are generally used for gravity sewers.

- Stone ware or vitrified clay pipes
- R.C.C. Pipes
- A.C. Pipes
- PVC /UPVC Pipes
- HDPE Pipes
- GRP Pipes.

The soil strata of Kochi Corporation are very slushy & water logged. These stoneware pipes are available in length of 60cm and the jointing is done by cement mortar. Even though the Stone ware pipes are economical, it is practically very difficult to lay the pipes in the slushy soil & waterlogged in and around the project area. Nowadays, the availability of stone ware pipes are less. *Hence, HDPE PE 100, PN 8 pipes are proposed for the sewer lines with diameter 280 mm (OD).*

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

3.3.4.8 Depth of flow:

From the consideration of ventilation in waste water flow, the sewers are not allowed to run full. All the sewers are designed in such a way that the maximum depth of flow at ultimate

peak flow is limited to 0.80 diameters. Whenever the depth of flow exceeds 0.80 D, either the diameter or the slope of the pipe is changed to adjust the depth of flow.

3.3.4.9 Velocity of flow:

The velocity of flow in the sewers lines are to be adjusted in such a way that there is minimum deposition in the line and no scouring occurs in the line. A minimum velocity of 0.6 m/s and maximum velocity of 2.00 m/s is adopted for design. The slopes of the pipes lines are adjusted to get the minimum / maximum velocity. In the Kochi Corporation and surrounding areas alluvial soils are found in major portions. The water table is also high. So trenching in this area will be difficult. Hence in order to limit the depth of cutting, the slopes in the 160mm pipes are adjusted in such a way that as far as possible the velocity in the line gets minimum self-cleaning velocity. But in certain initial stretches, the velocity is less than 0.6m/sec, to avoid silting in the upper reaches due to less flow, flushing will be necessary and has to be provided periodically.

3.3.4.10 Minimum and maximum cover

The minimum earth cover over the pipe line shall be 1.00 m. Due to the difficulty in trenching in the water logged area, the maximum depth of cutting is restricted to 4.50m, with few exemptions, where the depth of cutting slightly exceeds above 4.50m.

The gravity sewers all designed for the peak flow. Manning's formulae for open channel flow is used for the design of gravity sewers. The coefficient of roughness "n" used in the Manning's formulae is as follows:

- Stoneware pipes = 0.015
- PVC pipes = 0.011
- R.C. C. Pipes = 0.015
- PE Pipes =0.011

3.3.4.11 Laying Sewerage lines through Roads

The project aims to lay sewerage lines through various roads in division No.54 (Elamkulam) of Kochi Corporation to collect sewage in collection wells and then to pump it to the existing STP at Elamkulam for further treatment. The entire ward is divided into 5 zones for the purpose of design. They are

1. Zone – 1 Bhattathirippad Road (Sannidhi Road) area
2. Zone – 2 Elamkulam KaippillyApartment area
3. Zone – 3 Elamkulam New Well Area
4. Zone – 4 Elamkulam No.7 Pump House area
5. Zone – 5 Elamkulam STP Well area

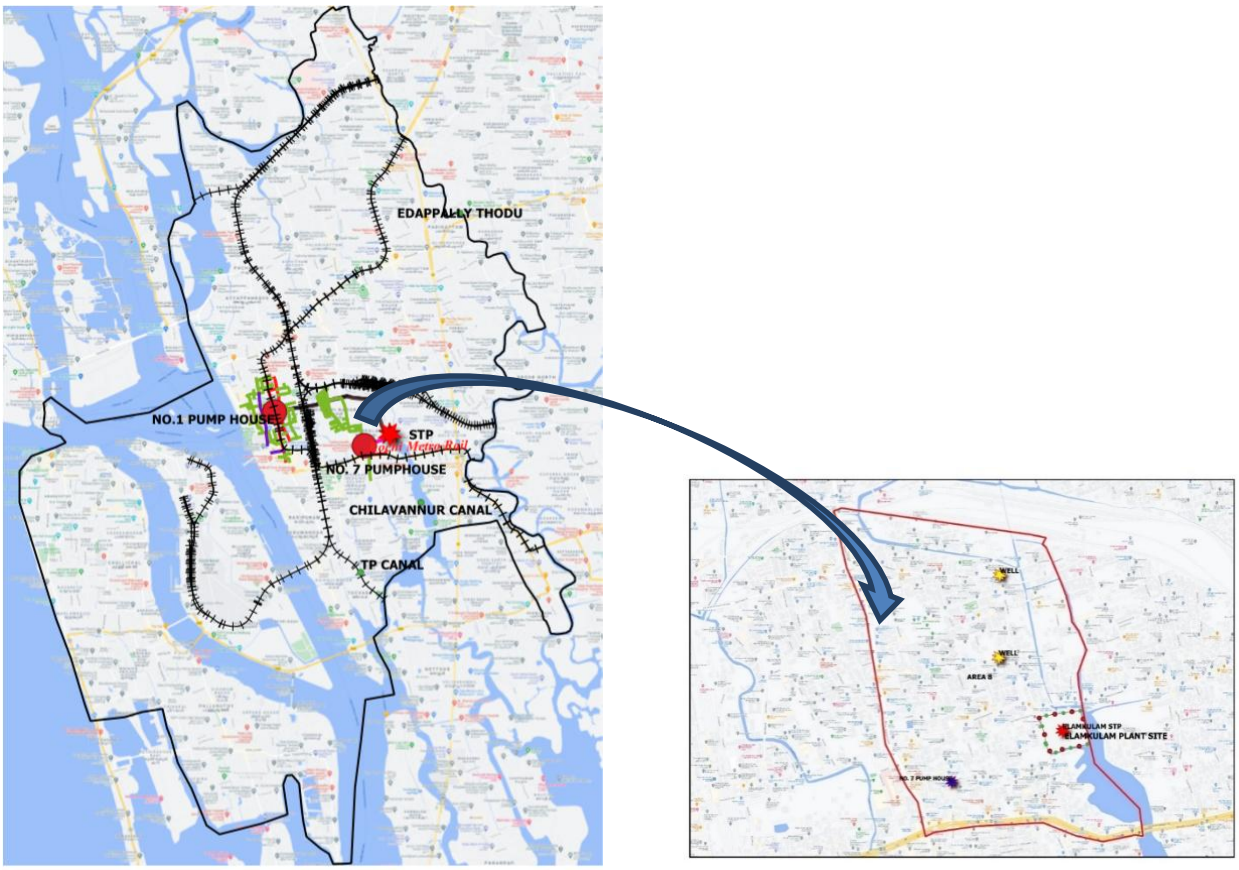

Fig-3.1 Kochi Corporation Map & Project Area

Zone-1 Bhattathirippad Road (Sannidhi Road) area

This zone starts from Kaloor-Kadavanthra Road and ends in Bhattathirippad Road (existing man holes).The sewage load generated in this zone is 0.62LPS.

There are a number of flats present in the proposed area. The details given in appendix.

Zone – 2 Elamkulam KaippillyApartment area

The zone has boundary South Jawahar Nagar 4th cross road, West Mukkadayil road, North Jawahar Nagar avenue road and East Jawahar Nagar 3rd cross road. Separate drawing with

zone boundary, manhole details, direction of flow, etc. are attached. In this zone, sewage from Jawahar Nagar are routed through Mukkadayil Road and then to Jawahar Nagar Road and finally to the existing man hole at Bhattathirippad Road. Other branches are Cross Road-4, Jawahar Nagar Cross Road-3, Cross Road-4B etc, and are leads to Jawahar Nagar Avenue Road and to Bhattathirippad Road. Sewage from N.Park Avenue are routed to Bhattathirippad Road.The sewage load generated in this zone is 1.94 LPS.

Zone-3 Elamkulam New Well Area

This zone lies with North boundary Railway line, East boundary St.Sebastian road , South boundary Nethaji Nagar road and West boundary Kaloor- Kadavanthra road.Separate drawing with zone boundary, manhole details,direction of flow ,etc. are attached.

A new collection well and pumping station is proposed nearby the junction where Kumaranasan Road and FathimaChurch Road meets (node no.436). Sewage from Panorama Residency, VV Road are routed through Kumaranasan Road, Canal Road, VV Road and reaches to proposed collection well and from there it is pumped to the existing STP at Elamkulam. Sewage from Nethaji Nagar, Kumaranasan Nagar routed to Kumaranasan Nagar Road, Nethaji Nagar Road and meets at Fathima Church Road. There are several branches joining these main Roads. The sewage load generated in this zone is 7.30 LPS.

Fig. No. 3.2 Location of Proposed well nearby Rail Nagar

Zone-4

The zone boundary is Kaloor- Kadavanthra road in West, Subhash ChandraBose road in North, East end facing to Blossom cochin road and Sahodaran Ayyappan road in South.Separate drawing with zone boundary, manhole details, direction of flow, etc. are attached. The sewage in this zone is planning to collect by gravity lines to feed to No 7 pump house at Muttathil lane.

The Muttathil lane infront of the No7 pump house is having existing manholes and it is proposed to connect the sewer lines from the boundaries of this zone to the manholes at the starting of the road on either side. The existing pipe line connecting the manholes to pump house is 600 mm diameter and the manholes are at depth of 4.53m.The sewage load generated in this zone is 5.23 LPS.

Zone-5 Elamkulam STP Well area

The zone boundary are South Sahodaran Ayyappan road, West Blossom Cochin road, East Chilavannoor Canal, North facing Kumaransan Nagar 4th cross road. Separate drawing with zone boundary , manhole details,direction of flow ,etc are attached.

In this zone sewage from all branches are connected to Fathima Church Road and planned to reach to new well proposed in the STP premises. The sewage load generated in this zone is 5.05 LPS.

3.4 Sewer Appurtenance – Manholes

Sewer appurtenances are devises necessary in addition to pipes and conduits, for the proper functioning of the sanitary sewers. These include ordinary manholes, Junction manholes, drop manholes, siphon's etc.

Man holes are provided at every 30m intervals to facilitate manual cleaning. For higher diameter pipes, in straight lengths, the interval has been increased up to 90 m maximum. Manholes are also provided at every change of alignment, gradient and diameter. Junction man holes are proposed at junctions where two or more lines meet.

Circular man holes are proposed in all the cases. An internal diameter of 900mm is proposed for man holes up to 1.65m depth, 1200 mm for man holes from 1.65m to 2.3m and 1500mm for man holes from 2.3m to 9m depth as per IS 4111 part. Inverted siphons are proposed at places, where the sewer lines have to cross obstructions like railway lines, water bodies etc. Number of manholes proposed in this project is as follows.

Table No.3.5 No. of Manholes in the Project area with different Diameter

	0.9m Dia	1.2m Dia	1.5m Dia
Sannithi Road	12	8	10
Kaippilly	24	12	16
Elamkulam New Well	106	33	57
Elamkulam No.7	57	33	43
STP Well	61	26	49

3.5 Sewage Pumping Stations - Collection well and pump house

The pump houses proposed are located in vacant lands, but to minimize the extend of land to be acquired and it is proposed to provide submerged wet well pumps and circular pump houses. Normally detention period upto 30 minutes is allowed for the sewage in the collection well, before being pumped into the Treatment plant. In this proposal detention period of two hours is taken and the reason for the same is furnished in 5.3 (Design of collection wells, page 53). Three numbers pump sets with 100% standby are to be housed in each pump house to meet DWF, 2DWF and 3DWF. There are 2new Pump Houses in this proposal. One in Elamkulam new well zone and another in STP well zone. The sewage from nearby area of No.7 pump house is proposed to collect at No.7 pump house (existing) and will be pumped through the existing pumping main to existing STP.

CHAPTER-4

DESIGN OF SEWERAGE SYSTEM COMPONENTS

The components of the sewerage system have to be designed for economy, functioning to the expected level etc. The main components of the project are listed below.

1. Sewerage Network – For collecting sewerage from user end and to transport it to the main trunk and finally to collection wells.
2. Man Holes – It is required to provide man holes in the sewer line at an interval of 30m to make clear the lines if clogging or choking occurs. Flushing can also be done in man holes.
3. Collection wells – These wells collect sewerage from network and from there are pumped to the STP. It also serves as storage tank in the case of minimum flow condition to avoid frequent starting and stopping of pump sets.
4. Pumping mains – The pumping main carries sewerage from collection well to STP under pressure.
5. Pump sets – These are used to create a driving force to transport sewerage from collection well to STP with the aid of power.

4.1 Design of Sewerage Network

5.1.1 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 3 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 5m and hence sewage lifting stations are provided making use of the manholes itself. The network is proposed with pipe size ranging from 180 mm to 355mm outer diameter HDPE pipe.

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 modeling 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 invert levels are fixed with minimum cover 1m above the sewer lines and zones are maintained minimum slopes wherever natural slopes are not supporting. Keeping the maximum depth of cutting the manholes are converted to lifting stations with 1m storage below the invert levels of the pipe. The model generated is being analyzed and corrected for designed flow with flow routing error below tolerance limit meeting velocity criteria between 0.6m/s and 3 m/s. The link capacity also checked and kept below 70%.

The project area is divided into 5 different zones based on the natural flow directions, ridges etc. for routing. The main roads are identified and ground levels have been extracted from available water supply data. The junction points and control points were cross-checked with field survey data with DGPS equipment as the water supply details taken years back. 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. The selected area consists of so many flats counting to almost 44 Nos. having dwelling units ranging from 6 Nos to 75 Nos. The details of flats are given in Annexure-2.

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 flats 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 zones are attached in Annexure-3.

280 mm OD HDPE pipes 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 zones are as follows.

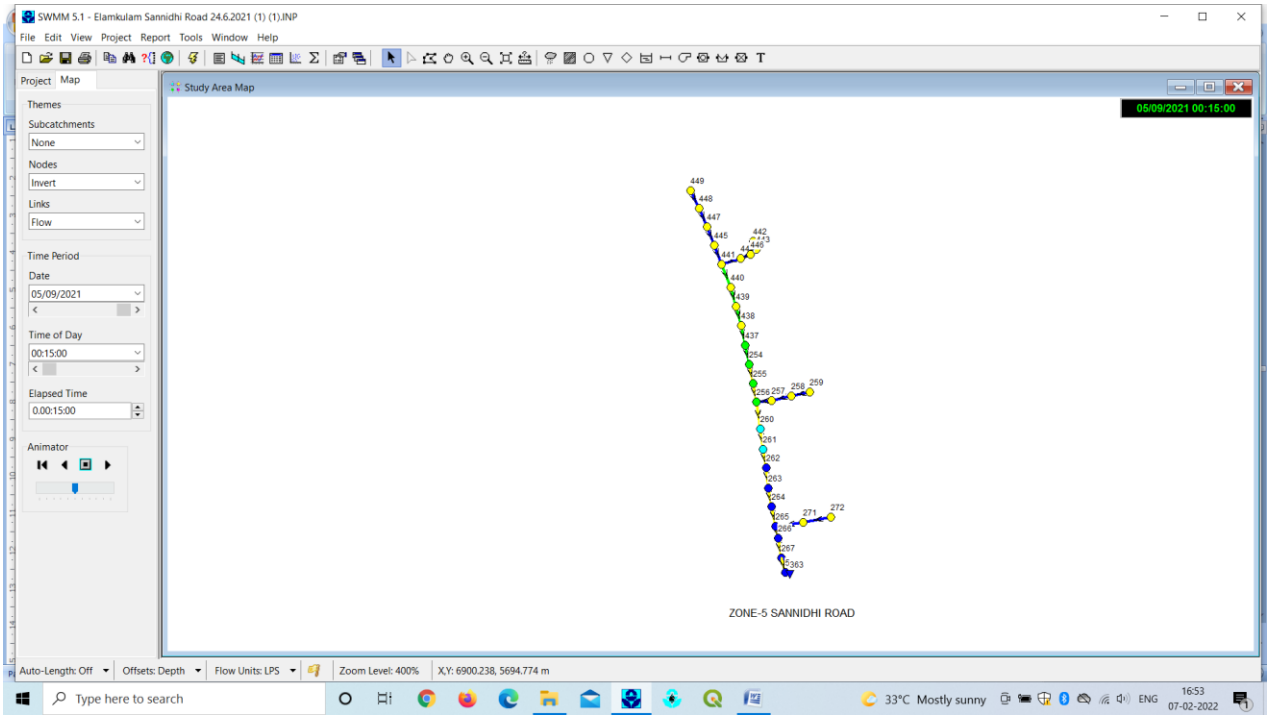

Fig.4.1 Zone-1 Sannidhi Road Area

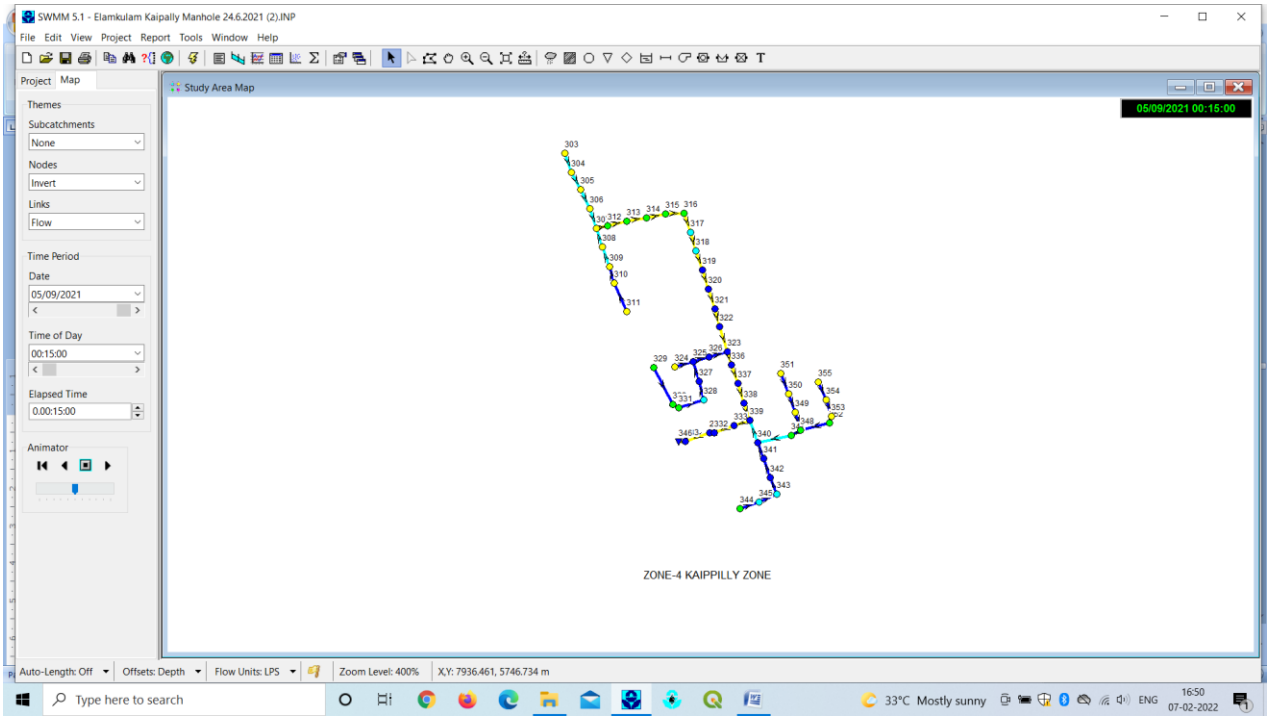

Fig.4.2 Zone – 2 Elamkulam KaippillyApartment area

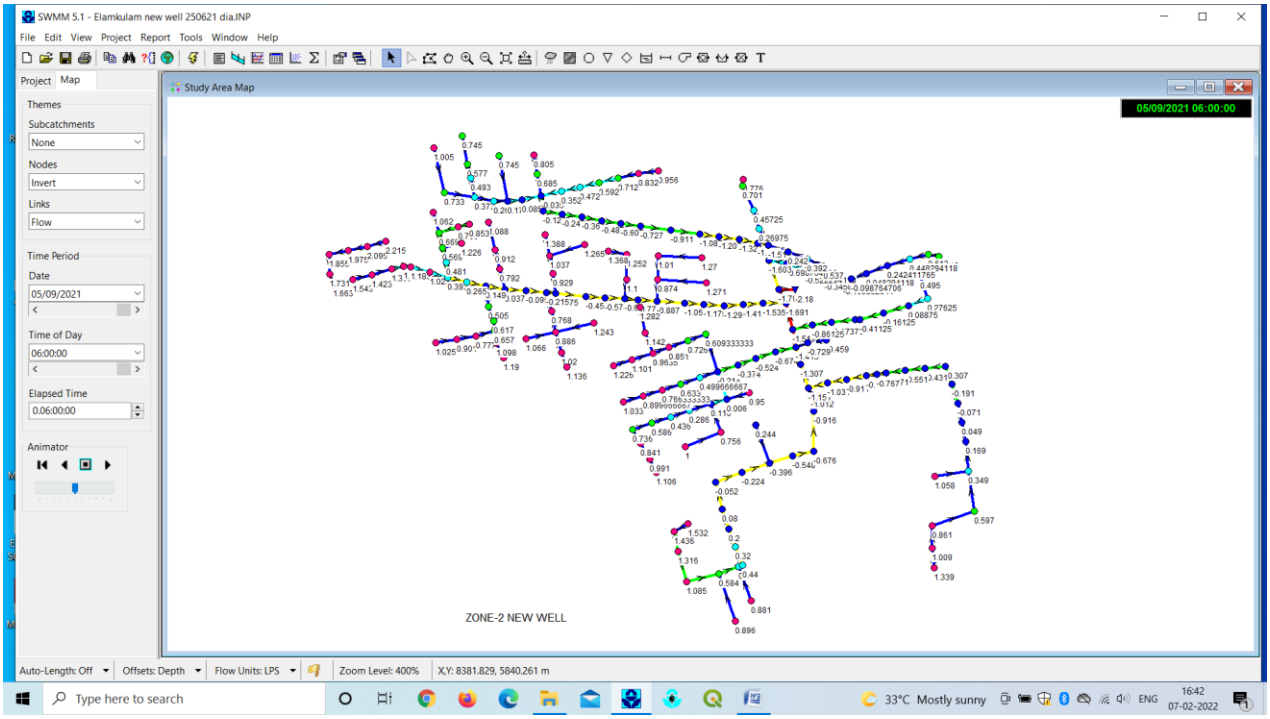

Fig.4.3 Zone – 3 Elamkulam New Well Area

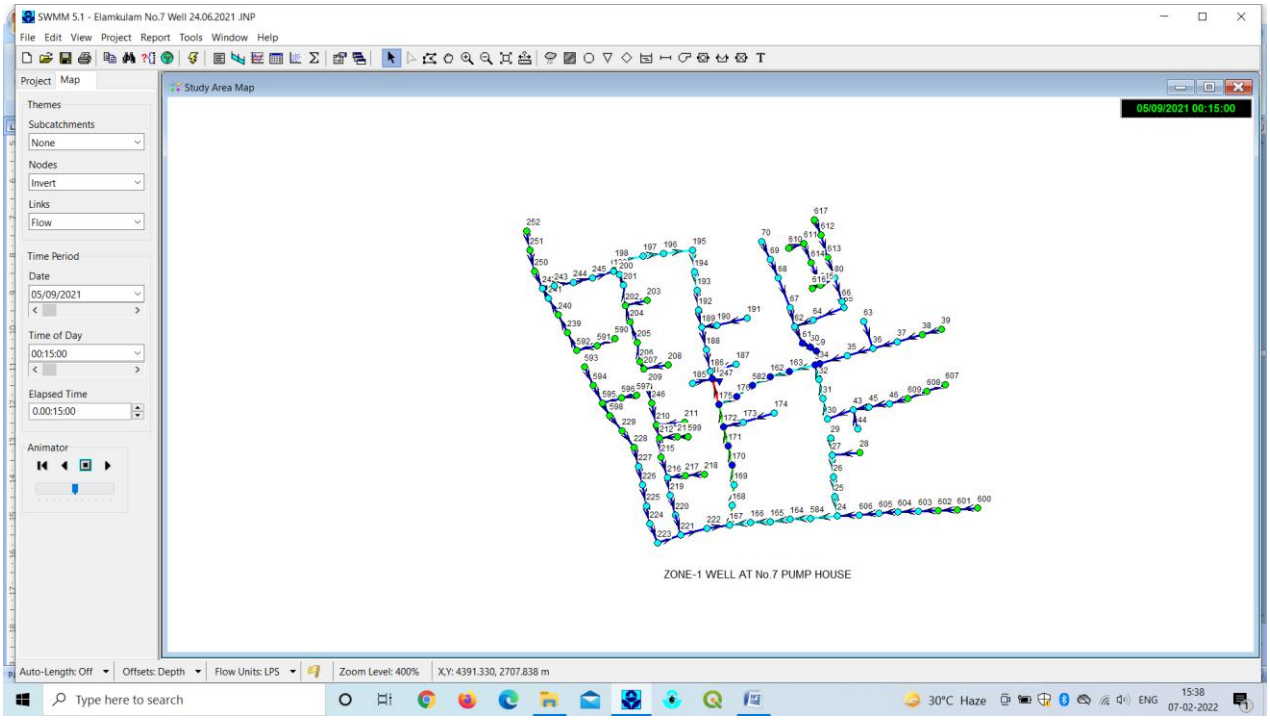

Fig.4.4 Zone – 4 Elamkulam No.7 Pump House area

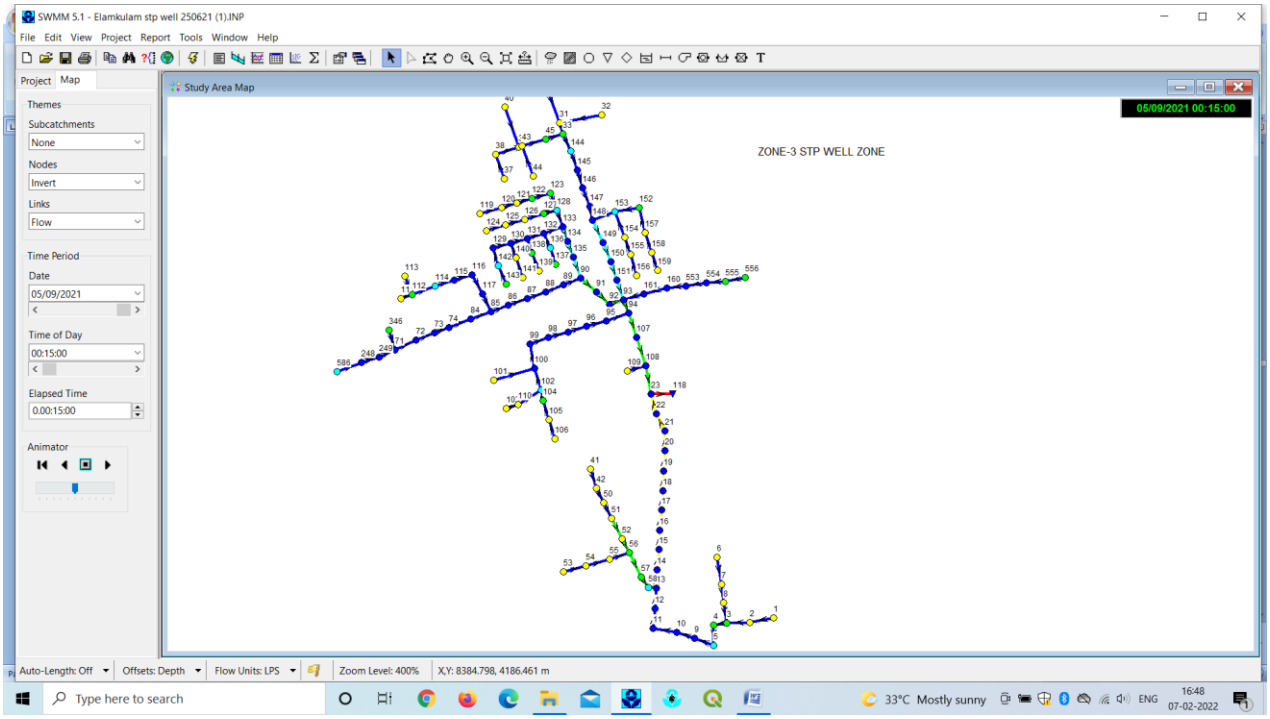

Fig.4.5 Zone – 5 Elamkulam STP Well area

4.2 Pumping Main

In the project there are 3 Nos. of collection wells proposed. Out of this three collection wells, one is existing (No.7 Well cum Pumping Station, Muttathil Lane). The other two wells, one is located in the premises of existing STP at Elamkulam and the other is near by

Rail Nagar. The pumping main is designed to carry sewerage from these wells to STP which is under construction in the premises of existing STP.

EPANET software is used to design pumping mains. In this software, minor losses as well as major losses are taken into account. The software is capable of modeling system.

New Well to STP Pumping main and STP Well to STP Pumping Main

Length of Pumping main = 1046m, 370m respectively.

Peak Flow (3DWF) = 16.8708 LPS, 21.90 LPS respectively

Assuming a velocity of 1m/s,

146.5mm ID pipe is to be used.

Hence HDPE PN-10 Pipe with OD 225mm.

HDPE PN-10 Pipe with OD 225mm for a length of 1416 m is proposed as pumping main.

4.3 Pump Sets

Submersible Pump sets are proposed in this project due to simplicity of operation and absence of suction head.

(a) For Well at STP Premises

Static Delivery Head = 8m , Peak Flow = 16.87 LPS

Depth of well = 5.5m, Total Head = 13.5m (including losses)

Length of Pumping Main = 370m (225mm HDPE)

Efficiency = 80%

HP of Pump set = 4.78HP with 100% standby. Say 5 HP Pump sets-2Nos.

(b) For Well at Rail Nagar

Static Delivery Head = 8m , Peak Flow = 21 LPS

Depth of well = 8m (excluding 1m residual head)

Total Head = 55m (including losses)

Efficiency = 80%

Dry Weather Flow = 7.03LPS with a total head of 20m

2 DWF = 14.06 LPS with a total head of 20m

HP of Pump set (DWF)= 2.433HP Say 3 HP.

HP of Pump set (2 DWF)= 8.517HP Say 10 HP.

HP of Pump set (3 DWF)= 20.08HP Say 25 HP.

Submersible Pump Sets of capacity

25HP Pump Set- 2 Nos. (1No. as Standby), 10HP Pump Set- 2 Nos.(1No. as Standby), are required.

The two pumping stations ate to be provided with Diesel Generator set with rating 63.50kVA are required as power back up.

4.4 Design of Collection Wells

Existing Scenario

There are two collection wells in the existing Sewerage system.

1- No1 Pump house near Maharaja's College Ground

It is a unit comprising wet well and dry well having volume of 625. 82m^3.The pump house has 4 Nos of pump-sets having a discharge of 38lps out of which 2 Nos are standby. It is known that the load from this pump house is around 2350m3/day.

2-No7 Pump house at Muttathil Lane

This pump-house has wet well and dry well with volume of 432.95m3 having 2 Nos. of pump-sets out of which one is standby. As per the pumping hours and rate of discharge it is known that the load from this pump house is around 900 m3/day .

Presently the STP is functioning with sewage load of 3250 m3/day. For utilizing the unutilized capacity of new 5 MLD plant, sewer network to be expanded to cater additional load of 1750 m^3/day.

For this the area in Kochi Corporation Division 54 has been selected and divided into 5 zones in which the load from 3 zones Kaippally, Bhattathiripad, No 7 well zone are proposed to collect at existing No 7 pump house at Muttathil lane, total of 623.34 m^3/day. Hence total load to No 7 pump-house will be enhanced to 1523.34 m^3/day.

Two additional collection wells are proposed in this project. The newly constructing 5 MLD STP under AMRUT is having an equalization tank of capacity 600m³. In order to meet the peak flow demand, it is observed that additional storage facility is needed. As the construction of most of the components of new STP were started, there is no space available for incorporating another equalization tank. Hence to manage the peak flow, a detention period of 2 hours is taken in the proposed new wells. As the detention period is beyond the standard limit, provision for aeration is also included in the project.

New Collection wells proposed

Existing Scnario

There are two existing collection wells cum pumping stations in Ernakulam Sewerage system

1 No.1 pump house near Maharaja's College Ground

It has dry well and wet well. Also the shape like 8 ie. It has 2 Nos. wet and 2 Nos. Dry Wells.

Volume of Wet Well (for 1No.)

Outer Diameter, D	=		11	m
Inner Diameter, d	=		7.9	m
Depth, h	=		6.8	m
Volume, V	=	$\pi(D^2-d^2)h/4$		m3
	=	312.9120531		m3

Hence total volume of No.1 pump house wet well

=	2x312.91205m3		
=	625.8241062	m3	

This pump house has 4 Nos. of pumpsets having a discharge of 38 LPS out of which 2 Nos. are standby.

It is known that Load from this pump house is around 2360 m3/Day

pumping scheduled at 16 hrs. with 2 pump sets and 1 hr. with single pump set.

2 No.7 pump house near Muttathil Lane

It has both dry well and wet well.

Volume of Wet Well

Outer Diameter, D	=		11	m
Inner Diameter, d	=		6.5	m
Depth, h	=		7	m
Volume, V	=	$\pi(D^2-d^2)h/4$		m3
	=	432.9507376		m3

This pump house has 2 Nos. of pumpsets having a discharge of 225 LPS out of which 1 No. is standby.

It is known that Load from this pump house is approximately 900 m3/Day

Present pumping rate is scheduled for 4hrs. At a throttled rate of discharge around 62.5 LPS. 62.5 LPS

Thus presently the treatment plant is functioning with the sewage load 3216m3/day.

Therefore for utlizing the underutilized capacity of new STP of 5 MLD, the sewer network is proposed to be expanded.

The proposed area covers division No.54 of Kochi Corporation adjoining to the existing sewer network covered area.

The propsed sewer network is being designed in 5 zones. The expected sewage load of 623.34 m3/day, 630.73 m3/day, 485.88 m3/day from the area is being collected at three locations viz. existing No.7 Pump House collection well, well proposed at Rail Nagar, proposed well at STP compound.

DESIGN OF COLLECTION WELLS

3 Load connecting to No.7 Pump House through SA Road and SC Boss Road is

Load	=	4.68584	LPS

Load connecting to No.7 Pump House through Man Hole nearby Kaippilly Apartment is

Load	=	1.93712	LPS

Load connecting to No.7 Pump House through Man Hole of Bhattathirippad Road is

Load	=	0.5916	LPS

Additional load to No.7 Pump House	=	7.21456	LPS
	=	623.338	m3/Day
Total Load at No.7 Pump House collection well	=	1523.338	m3/Day
		17.63123	LPS
Peak Factor	=	3	

Max. Rate of pumping at Peak Flow Time = 3x17.631227 LPS

	ie.	52.89368	LPS

Presenly with 225 LPS pump set, pumping is being carried out by throttilng discharge valve to get a discharge of 62.5 LPS

New proposal for replacing the pump set with 58 LPS has already been submitted by maintenance division.

Volume of No.7 Pump House wet well	=	432950.7	Litres
Peak Flow	=	52.89368	LPS
Storage capacity	=	2.273695	Hours

Thus the existing collection well at No.7 pump house can accommodate additional load

No.1 Pump House

Load	=	2360	m3/Day
	or	27.31481	LPS
Average Load	=	27.31481	LPS
Peak Factor	=	3	

Rate of pumping at Peak Flow Time =3x27.314815 LPS

	ie.	81.94444	LPS

New proposal for replacing the pump set with 58 LPS has already been submitted by maintenance division.

Hence either new proposed pump set having a discharge 58 LPS with one existing pump set

having a discharge 38 LPS may be operated simultaniously or two existing with pum sets with discharge 38 LPS each may simultaniously operated to meet the total peak

	Volume of No.1 Pump House wet well		=	625824.1	Litres
	Peak Flow		=	81.94444	LPS
	Storage capacity		=	2.121438	Hours
	Thus the existing collection well at No.1 pump house can accommodate additional load				
	New STP capacity =	5 MLD	=	57.87037	LPS
	Equilization tank capacity of new STP			660	m3
	Considerng the present pattern of pumping, proposed load can be accomodated providing necessary storage capacity of 2 hrs. for peak load at the additional collection wells also.				
4	Load coming to new collection well at STP		=	5.6236	LPS
	Peak Factor		=	3	
	Peak Load		=	16.8708	LPS
				60.73488	m3/Hr.
	Well -3	Volume for a storage period of 2 hrs. (Peak Demand)	=	121.4698	m3
	Depth		=	2	m
	Area required		=	60.73488	m2
	Diameter		=	8.795981	m
			Say	8.8	m
	INVERT OF OUTFALL		-2.5		
	GL OF OUTFALL		2		
	EXPECTED INVERT FROM GL		4.5		
	INVERT SEWER		4.5	M	
	CLEARANCE		0.5	M	
	INVERT DEPTH FROM GL		8	M	
5	Load coming to new collection well at Rail Nagar		=	7.30016	LPS
	Peak Factor		=	3	
	Peak Load		=	21.90048	LPS
				78.84173	m3/Hr.
	Well -4	Volume for a storage period of 2 hrs. (Peak Demand)	=	157.6835	m3
	Depth		=	2	m
	Area required		=	78.84173	m2
	Diameter		=	10.0192	m
			Say	10.1	m
	INVERT OF OUTFALL		-2.5		
	GL OF OUTFALL		2.4		
	EXPECTED INVERT FROM GL		4.9		
	INVERT SEWER		5	M	
	CLEARANCE		0.5	M	
	INVERT DEPTH FROM GL		8.5	M	

Both collection wells shall be provided with blower and aeration arrangements during storage.

CHAPTER 5

PROJECT COST

5.1 Land Development

The required land for construction of one collection well is available with KWA. For constructing another well in the new well zone, approximately 5 cents of land is demarcated for sewerage scheme.

5.2 Physical Infrastructure

5.2.1 Installation of pump sets

The total pump set capacity required for the 2 pumping stations as per the economic size design for intermediate demand is 25 HP. All the pump sets are submersible non-clogging type. The cost is worked out as Rs.11.59 lakhs including 100% standby. Detailed estimate appended. The pumpsets provided in the existing collection well cum pump house at Muttathil lane is having higher capacity to pump the additional sewer load to be reached in the well on completion of the proposed work. If there will be any damages to the existing pump sets by that time, new pump-sets having required lps incorporating the additional load has to be installed.

5.2.2 Collection Well cum Pump Houses

There are 3 Nos. of wells out of which 1 No. is existing (No.7 Pump house), and 2 nos. are to be constructed in the premises of existing STP and nearby Rail Nagar. The diameter is 8.8m and 10.10m and depth 8m and 8.5m respectively. Provision for pump lifting equipment are included in the estimate. The total cost is Rs.255.92 lakhs. Provision for compound wall amounting to Rs.15.00 lakhs is also included in the estimate. Provision for header pipes, valves, crane and lifting arrangements are also included amounting to Rs.30 lakhs. Detailed estimate enclosed.

5.2.3 Sewer Network& RCC Manholes & Sewage Pumping mains

The total length of sewer network as per the detailed design is 16940 m of 280 mm(OD)HDPE pipe is proposed in the project. Total numbers of 260 manholes of 900mm diameter for a depth up to 1.65m, 112 Nos. of 1200mm diameter for a depth up to 2.30m, 175 Nos. of 1500mm diameter for a depth up to 4.50m are proposed.

Total length of 1416m of HDPE PN-10 pipes are proposed for pumping mains with OD 225mm.

The total cost is Rs.3022.40 lakhs including embedding charges of HDPE pipes and cost of pipes and RCC Man Holes, provision for temporary restoration of road surface such as relaying of paver blocks, PCC, WMM are also included as per DSR 2018 rates.

5.2.4 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.1499.33 lakhs. Apart from this provision for temporary restoration such as relaying the dismantled paver blocks, PCC and WMM are also included in order to make the roads motorable as soon as the completion of network laying, to avoid public protest.

5.2.5 Power Allocation and Other Allied Works.

Provision for power connection to the proposed two collections well cum pumping stations, power backup (DG Sets), Aeration blowers and allied works, statutory remittances to various departments are also included in the estimate. The estimated cost is Rs.34.50 Lakhs.

5.3 Cost of Shifting Utilities

The proposed area being the heart of city, the utilities such as communication cables, water supply Pipe line, Electricity cables, etc. are to be shifted for laying the sewer lines. Hence provision has been included in the estimate for an amount of Rs.50 lakhs.

5.4 Contingency

A provision for contingency charges also included in the estimate.

The centage charge @2.5% and DPR preparation charge @10% has been included in the estimate. The total cost of project comes to Rs.66.45 crores O&M cost for 10 years without power charges..

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CHAPTER-6
CONCLUSION

Safe water supply and hygienic sanitation facilities are the two basic essential amenities, the community needs on a top priority for healthy living. Sanitation has always been more unfortunate than its twin brother water supply. The water supply will have a measurable impact on health only if it is linked with sanitation facilities. The investigation for a comprehensive sewerage scheme to convey and dispose waste water through underground sewerage network for Cochin Corporation was initiated long back, but the actual ground achievement is only 5% coverage. The present project is for supplying additional load to operate newly constructing 5 MLD STP with full capacity at Elamkulam under AMRUT scheme by discarding the existing old age 4.5 MLD STP. The project will cover an area of 1.35 km^2 in Cochin Corporation and the benefitted population is 10740. In this project sewer network of 16940 m of 280 mm HDPE PE 100 PN 8 and man holes of diameters 900mm,1200mm and 1500 mm of 260, 112,175 numbers respectively and 1416 m of pumping main of 225 mm OD HDPE PE 100 PN 10 are included. Three collection wells are included in which one is the existing and 2 new numbers are proposed. Out of the new two wells one is proposed to construct in the premises of existing STP at Elamkulam and another new well is proposed to construct at a land nearby Rail Nagar where approximately 5 cents is demarcated for sewerage project.

Safe disposal of sewerage produced will mitigate health issues. This project will reduce mosquito problems by preventing stagnated water in canals. By giving proper treatment to the sewerage and wastewater, eutrophication will be prevented and thereby increasing clear water in the water bodies. The wastewater with low pH will affect the life span of water bodies. The acidic wastewater entering to the water body will attack shelled animals and further attack aquatic life. If wastewater and sewerage are treated to the safe disposal level, it will save water bodies and thereby health of the neighborhood people will be increased.

On completion of the proposed work approximately 2000 numbers of sewer connections to the households and more than 45 numbers to multi storied apartments can be provided and thereby revenue in terms of centage of water charge can be realized. The one time connection charge will also boost the revenue of KWA.

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CHAPTER 7
ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROJECT

7.1 Introduction:

In Kochi city, wastewater disposal is the main environmental issue that has created unsanitary conditions, odor and mosquito problems within the city, which causes nuisance to the residents and affects their health. This is due to the overflow of the septic tanks on streets and public places.

Therefore, it is planned to make utilize the designed capacity of the new Sewage Treatment Plant (STP) which is now under construction at Elamkulam in Kochi City which will be replacing the existing STP. This proposed project is to fully utilize its5 MLD capacity by providing additional network and allied components to an area of 1.35 km^2 adjacent to the existing treatment plant location which is not covered by existing network.

7.2Brief Description of Project Size, the Process, and Location

The land to be used for the collection well and for Pump House is belonging to the Kerala Water Authority and one land which demarcated for sewerage scheme. Wastewater from a part of division No.54 of the Kochi Corporation will reach to the proposed collection well cum pump houses by gravity and thereafter by pumping up to the new STP under construction at Elamkulam.

The wastewater treatment technology to be used at the newly constructing STP is envisaged as MBBR Technology. It significantly reduces the BOD, nitrogen, phosphorous, toxic substances and other pollutants found in the wastewater.

7.2.1 Importance of the Project for the Local Community

Wastewater disposal is the pressing environmental issue for the inhabitants of Kochi City, which is going to be solved by the establishment of the sewerage network provided in the area. Currently households discharge their wastewater in septic tanks, which often overflow and create unhealthy conditions in the city. It has already created nuisance and social problems among the inhabitants. The residents of the city are keen to have an environmentally sound solution to their wastewater disposal problem. Clean environment will improve the health standards of the local people. The establishment of a sewer network in the city and treatment of wastewater in the STP will eliminate the spread of diseases, prevent risks of contamination of

their surface and groundwater resources and contribute in the preservation of the quality of the environment. The treated wastewater might be used for forestation and agricultural purposes.

Moreover, waste water disposal into the drains and canals is the main environmental issue that has created unsanitary conditions, odor, mosquito problems within the selected area and this in turn affecting the health of the inhabitants. The main canal in the vicinity of the project area is Chettichira Kayal (portion of Chilavannoor canal).

7.2.2 Objectives of the Project

The new project envisages to make utilization of the unutilized capacity of the new STP under construction thereby environmentally safe disposal of the wastewater from the selected area for upgrading the sanitary and health standards of the inhabitants.

7.2.3 Long-term objectives of STP project are to:

- Prevent the spread of diseases, including the limitation of the mosquito population,
- Prevent the prevalence of conditions offensive to sight and smell,
- Control the contamination of water resources
- Prevent and control soil and groundwater pollution.

7.2.4 Specific objectives of the project are to

- To ensure the use of designed capacity of newly constructing STP for disposal of more sewage from households.
- Manage the pathogenic risk inherent in wastewater to meet the effluent dischargestandards set by the CPHEEO, Ministry of Urban, Government of India and World Health Organization.
- Manage the safe disposal of sludge.

7.2.5 Description of the Surrounding Environment of the Project

The Kochi Corporation is located in the central portion of Kerala State, which lies 9^{o} 58'N latitude and76°16'E longitude at an elevation of 1m from mean sea level. The proposed STP will be located in KWA's own land at 500mts north side of the existing STP and the area is less density populated in the city. A small creek of Vembanad lake is passing through the site. There is an asphalt road passing along the site. There are no permanent surface water sources in the project area, including the project site.

There are no notable industrial activities in the project area. The wastewater generates from these places will not affect wastewater characteristics arriving to the STP. Farming activities near the site are nil. There are no fruit farms located near the site. Households of the project area

get their fresh water from KWA's piped supply and its treatment plant is located 25 km away and its source 'Periyar River' is passing 25km away from the city. The climate of the project area is humid, with 3 to 4 dry months and winters of 2-3 months' duration. There will be 2 rainy seasons with a total of 4 to 5 months. The prevailing wind direction in the area is from West to East. The average annual rainfall in the area recorded as 3000mm.

The Project area, including the proposed site, has a less biodiversity. Coconut trees, mango trees, jackfruit trees, plantain trees and small house gardens including vegetable gardens are seen in the project area. But only waste plants and very small trees are present at the site and its surroundings of the proposed STP. No notable animals and birds are seen living in the area.

The Indian Constitution says, "it shall be duty of every citizen of India to protect and improve the environment including forests, lakes, rivers, wild life, and to have compassion for living creatures".

7.3 Mandatory Clearance

The project would need the clearances from GoK and PCB Clearance from the Kerala State Pollution Control Board under the Air Act, the Water Act and the Cess Act, if stipulated by the State Pollution Control Board (PCB) while giving the NOC. As the construction of new 5MLD under AMRUTH scheme has obtained all the statutory clearances there is no need for approaching them afresh.

7.4 Effects Created During Construction and Earth Work for Networks:

During the construction phase of the project, moderate quantities of earth will be excavated and soil disturbance will take place. There will be chances of sliding earth when the earthwork excavation takes place for networks and minor damages can be expected to compound walls and drains. To avoid such situations adequate measures will be taken for side protections. If the excess soil is not utilized for landscaping, during the wet season soil erosion will result at the site. On the other hand, if the excavated soil is haphazardly dumped, this will cover trees and will block canals in the downstream direction and create unsightly scenes at the project site.

Apart from the above utility damages such as disruption of water supply, drains, electricity due to shifting of cables if required and cables for land communications. Above all, traffic diversions, inconvenience to pedestrians and nearby inhabitants fortaking own vehicles during those days, dust and noise also to bear during earthwork excavation for pipe laying. But maximum care is to be taken to avoid damages and disruptions to the utilities are planned and minimum diversions and inconvenience will help to achieve the goal.

7.4.1 Human Use Values

Health and Safety, Design and Pre-Construction Stage

Little impact on health and safety has been envisaged during this stage. A little dust will be produced due to earth excavation through roads, site clearance and this do not make any changes in general but adequate measures are taken to construction labour or other person in exposure. Effects of dust can be mitigated by proper watering and accidents by falling in trenches during night hours can be mitigated by proper fencing and back filling of trenches during day time itself.

Construction Stage

Excessive production of noise during construction may cause disturbance to the residents living in the nearby areas (if exposed for a very long period). The disposal of solid wastes from the construction labour colony and stagnant water bodies created due to construction activities may create an unhealthy site that have potential for causing health problems.

Operational Stage

In the operational phase, from the side of network and manholes, there will not be any problems. But the collection wells may create some odor which can be reduced by proper aeration during storage time. Since the pumps used are having low HP rating and are submersible type, noise production will be minimum. Still constant noise produced by the pumps could create health problems to the workers if adequate precautions are not taken. The positive impact of the project will be the safe disposal of sewerage produced from the area which will reduce health problems to the local population and bring in economic prosperity.

7.4.2 Mitigation Measures

The main mitigation means will concentrate on careful designing and use of locally available construction material. For instance, the excavated soil from the site will be utilized in landscaping. The provision for disposing the surplus soil from the work site is included in the estimate.

In addition, a proper drainage system for the rain runoff will be established atthe site. In addition, measures will be taken to buffer shock flows of wastewater, suchas accidental entry of rainwater runoff into the sewage network and then to the STP.

A proper co-ordination with Corporation of Kochi, Road authorities, KSEB, BSNL, Traffic Authorities and District Administration to avoid all possible minor bottle necks during construction. A public hearing for getting more data regarding their issues with the project will

be conducted later. Strict and adequate measures will be taken to avoid sliding of earth during earth work for pipeline works and polluting of natural sources if any nearby during dewatering for networks. At most care will be taken to avoid traffic diversions and inconvenience to pedestrians and nearby residents.

Odor control measures proposed

Various measures proposed to reduce the generation and release of odors from the collection wells. They include

- Odor complaint response and investigation
- Routine sewer maintenance
- Chemical addition
- Aeration by means of blower to avoid formation of sullage.

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ANNEXURE-1

POPULATION FORECASTING

The main methods for population forecasting are

1. Arithmetical Increase Method
2. Geometrical Increase Method
3. Incremental Increase Method
4. Decreasing Rate Method
5. Simple Graphical Method
6. Comparative Graphical Method
7. Master Plan or Zoning Method
8. Logistic Curve Method
9. ApportionmentMethod

Kochi Corporation is thickly populated and can be assumed that distribution of population is even. The following data from census regarding population are available.

Area of Kochi Corporation – 94.88 km^2

Area of proposed area – 1.35 km^2

The proposed area is 1.42% of total Corporation area.

Population Data

Census Year	Population of Kochi Corporation	Population Density	Population in the Project Area
1971	439066	4628	6247
1981	513249	5409	7303
1991	564589	5951	8033
2001	595834	6280	8478
2011	618645	6520	8802

Since the project area is small, population was projected to the year 2011 with four different methods and compared with actual value.

1	Arithematical Increment method			
	Year	Population	Difference	
	1971	6247		
	1981	7303	1056	
	1991	8033	730	

	2001	8478	445	
	Total		2231	
	Mean Difference		743.666667	
Population forecasted to 2011			=8478+744=9222	
2. Geometriical Increment method				
	Year	Population	Difference	% increment
	1971	6247		
	1981	7303	1056	16.90411397
	1991	8033	730	9.995892099
	2001	8478	445	5.539648948
	Average decadal increment			10.81321834
Population forecasted			=8478+(8478*10.81)=9395	
3. Incremental increment Method				
	Year	Population	Difference	Incremental increase
	1971	6247		
	1981	7303	1056	
	1991	8033	730	-326
	2001	8478	445	-285
	Total		2231	-611
	Average		743.666667	-305.5
Population forecasted= 8478+1x(743.66+-305.5)=8916				

4. Decrease Rate/Growth Rate Method					
	Year	Population	Difference	% Increase in Population	% Decrease in Population
	1971	6247			
	1981	7303	1056	16.90411397	

	1991	8033	730	9.995892099	6.908221876
	2001	8478	445	5.539648948	4.456243151
	Total		2231	32.43965502	11.36446503
Average			743.666667	10.81321834	5.682232513

Population forecasted=8478+(5.5396-5.6822)x8478/100=8466

Population forecasted using several methods

Year	Population	Method	Actual Population in 2011	Forecasted Population to 2011	% Error
1971	6247	Arithmetical	8802	9221	4.759596
1981	7302	Geometrical	8802	9394	6.72502
1991	8033	Incremental increase	8802	8916	1.289269
2001	8477	Decrease rate	8802	8465	-3.82853

From the result, it is clear that the value nearing to actual value is forecasting with Incremental increase method.

ANNEXURE-2

LIST OF FLATS IN THE PROJECT AREA

Sl.No.	Name of Flat	No. of Units
1	Rose Garden Flats	12
2	Star Garden	20
3	KB Apartment	37
4	Royal Avanue	6
5	Areena Apartment	12
6	Royal Avanue	6
7	PriyadarsiniApartments	15
8	Shreya Apartments (Muttathil Lane)	8
9	Spring Dale	6
10	Jerusalem Residency	24
11	Orchid park apartment	12
12	Meridian Apartment	12
13	Jawahar Jewel	6
14	Jawahar Jewel	12
15	Rock Residency	6
16	Jerusalem Retrear	21
17	Sree Gajanana Apartment	15
18	Golden Heights Apartment	48
19	RDS Oasis	73
20	Betrons Tower	21
21	Abad Silver Crust	52
22	TiknarPetels	30
23	Clear way	54
24	Clear way	54
25	Asset Portico	18
26	RDS Oasis	73

Sl.No.	Name of Flat	No. of Units
27	Asset Le Grande	65
28	Blue Moon Apartment	15
29	Grande	65
30	Skyline Topaz	96
31	Glaxy Luxor	40
32	Kamadhenu Apartments	10
33	Mather Elcastillo	74
34	SFS Homes	57

I	**Network Design and Allied Components for the Unutilized Capacity of STP at Elamkulam**									
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.								
		20% of road length	20%	16940	1.2		4065.60	m^2		
		manholes0.9m dia	20%	260	1.7	0.5	88.40	m^2		
		1.2 mdia	20%	112	2.5	1.3	56.00	m^2		
		1.5 m dia	20%	175	2.8	1.6	98.00	m^2		
		Total					4308.00	m^2		
		Say		4308	m^2			@Rs	110.71	**476,939.00**
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.								
		20% of road length	3388	1.2		0.15	609.84	m^2		
		manholes0.9m dia20%	52	1.7	0.5	0.15	6.63	m^2		
		1.2 mdia20%	22	2.5	1.3	0.15	10.92	m^2		
		1.5 m dia20%	35	2.8	1.6	0.15	23.52	m^2		
		Total					650.91	m^2		
		Say		650.91	m^3			@Rs	2983.59	**1,942,049.00**
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								
		60% of road length	60%	16940	1.2		12196.80	m^2		
		pumping main		1416	0.7		991.20			
		manholes0.9m dia(60%)(260)	156	1.7	0.5		132.60			
		1.2 mdia(60%)(112*2.5)	67	2.5	1.3		218.40			
		1.5 m dia(60%)(175)	105	2.8	1.6		470.40			
		Total					14009.40	m^2		
		Say		14009.4	m^2			@Rs	360.94	**5,056,553.00**
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								
		Zone 1 Sannidhi road	1	854	1.2	1.45	1485.96	m^3		
		Bedding	1	854	1.2	0.1	102.48	m^3		
		Zone 2Kaippilly	1	1530	1.2	1.39	2552.04	m^3		
		Bedding	1	1530	1.2	0.1	183.60	m^3		
		New well zone	1	6319	1.2	1.37	10388.44	m^3		
		Bedding	1	6319	1.2	0.1	758.28	m^3		
		No7 well	1	4009	1.2	1.5	7216.20	m^3		
		Bedding	1	4009	1.2	0.1	481.08	m^3		
		STP	1	4228	1.2	1.5	7610.40	m^3		
		Bedding	1	4228	1.2	0.1	507.36	m^3		
		Pumping main								
		New well to STP	1	1046	0.7	1.3	951.86	m^3		
		STP well	1	370	0.7	1.3	336.70	m^3		
		Total					32574.40	m^3		
		Deductions								

		Man hole 900 mm dia	260	1.4	1.2	1.5	655.20	m^3		
		Man hole 1200 mm dia	112	1.8	1.2	1.5	362.88	m^3		
		Man hole 1500 mm dia	175	2.2	1.2	1.5	693.00	m^3		
		Total deduction					1711.08	m^3		
		Total less deduction					30863.32	m^3		
				30863.32	m^3		30863.32	@Rs	555.51	**17,144,883.00**
5	100.1.2	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		
		Zone 1 Sannidhi road	1	691	1.2	0.79	655.07	m^3		
		Zone 2Kaippilly	1	974	1.2	0.84	981.79	m^3		
		New well zone	1	3579	1.2	0.86	3693.53	m^3		
		No7 well	1	2789	1.2	0.9	3012.12	m^3		
		STP well	1	2836	1.2	0.91	3096.91	m^3		
							11439.42	m^3		
		Deductions								
		manhole-900	244	1.4	1.2	0.27	110.68	m^3		
		manhole-1200	111	1.8	1.2	1.01	242.16	m^3		
		manhole-1500	175	2.2	1.2	1.5	693.00	m^3		
		Total deduction	1	244	1.2	0.84	1045.84	m^3		
		Total less deduction					10393.58	m^3		
		Say		10393.58	m^3		10393.58	@Rs	661.88	**6,879,305.00**
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		
		Zone 1 Sannidhi road	1	118	1.2	0.29	41.06	m^3		
		Zone 2Kaippilly	1	132	1.2	0.19	30.10	m^3		
		New well zone	1	962	1.2	0.49	565.66	m^3		
		No7 well	1	790	1.2	0.58	549.84	m^3		
		STP well	1	761	1.2	0.66	602.71	m^3		
							1789.37	m^3		
		Deductions						m^3		
		Man hole 1500 mm dia	175	2.2	1.2	0.32	147.84	m^3		
		Total less deduction					1641.53	m^3		
				1641.53			1641.53	@Rs	768.25	**1,261,104.00**
7	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	5506.8			11013.60	m		
							11013.60	m		
		Say		11013.6	m			@Rs	31.39	**345,717.00**
8	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	12849.2			25698.40	m		

		Total					25698.40	m		
		Say		25698.4	m			@Rs	106.03	**2,724,801.00**
9	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.								
						avg ht				
		Zone 1 Sannidhi road	2	854		2.123	3626.08	m^2		
		Zone 2Kaippilly	2	1530		1.94	5936.40	m^2		
		New well zone	2	6319		1.94	24517.72	m^2		
		No7 well	2	4009		2.1518	17253.37	m^2		
		STP well	2	4284		2.162	18524.02	m^2		
		Total					69857.59	m^2		
		Deductions for manholes								
			520	2		1.7	1768.00			
			224	2.4		2	1075.20			
			350	2.8		2.5	2450.00			
							5293.20			
		Total less deduction		5293.20				@Rs	749.13	**3,965,295.00**
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								
		pumping main	2	1416		1.2	3398.40	m^2		
		Say		3398.4	m^2			@Rs	152.95	**519,785.00**
11	100.98.139 KWA	Supply of PE Pipe, PE100, PN8, 180 mm dia, conforming to IS 4984/2016								
		For connection from chamber to manholes	1188	13			15444.00	m		
		Say		**15444**	m		@	Rs	1160.72	**17,926,160.00**
12	100.98.143 KWA	Supply of PE Pipe, PE100, PN8, 280 mm dia, conforming to IS 4984/2016.								
		Zone 1 Sannidhi road	1	854			854.00			
		Zone 2Kaippilly	1	1530			1530.00			
		New well zone	1	6319			6319.00			
		No7 well	1	4009			4009.00			
		STP Well	1	4228			4228.00	m		
		Total					16940.00	m		
		Say		**16940**	m		@	Rs	2801.70	**47,460,798.00**
13	100.98.161 KWA	Supply of PE Pipe, PE100, PN10,225mm dia, conforming to IS 4984/2016.								
		Pumping main New well to STP	1	1046			1046.00	m		
		Well at STP premises	1	370			370.00			
		Total					1416.00	m		
		Say		**1416**	m		@	Rs	2228.42	**3,155,443.00**

14	KWA 100.10.6	Laying PE 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 PE pipes								
		connection chamber to manhole		Qty same as supply item 12			15444.00	m		
		Total					15444.00	m		
		Say		**15444**	m		@	Rs	**265.55**	**4,101,201.00**
15	100.10.8 KWA	Laying PE 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 225 mm dia								
		pumping main								
		Same as 23	1	1416			1416.00			
		Say		**1416**	m		@	Rs	**377.28**	**534,227.00**
16	KWA 100.10.10	Laying PE 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 - 280 mm OD PE pipes								
		For sewer network	1	Qty same as supply item 13			16940.00	m		
		Total		**16940**			16940.00			
		Say		**16940**	m		@	Rs	**519.78**	**8,805,145.00**
17		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 .2.6+O	250mm dia	4				4.00	No.s	20504.62	**82,018.00**
18	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)								
		To support delivery pipe	12	1	1	1	12.00			
		Header pipe	2	6	1	1	12.00			
		Total					24.00	m3		
		Say		24	m3			@Rs	7990.86	**191,781.00**
19	5.9.1	Centering and shuttering including strutting, etc. and removal of form for: Foundations, footings, bases of columns, etc for mass concrete								
		To support delivery pipe/anchor block	12	4		1	48.00			
		to support Header pipe/Anchor block	2	14		1	28.00			
		Total					76.00	m3		
		Say		76	m3			@Rs	335.31	**25,484.00**
20	5.22.4	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth level								
		Anchor block @50 kg/m3	1	24		50	1200.00			
		Total					1200.00	m3		
		Say		1200	m3			@Rs	98.30	**117,960.00**
21	18.59. 3	Providing and fixing C.I double acting air valve of approved quality with bolts, nuts, rubber insertion etc. complete (The tail pieces, tapers etc. if required will be paid separately):100 mm dia								

			2				2.00			
		Total					2.00	No.s		
		Say		2	No.s			@Rs	9644.04	**19,288.00**
22	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 18.4km pipe laying & 952 manholes (210 days , 8pump 5HP)	8	1600	5	0.746	47744.00	Kwh		
		Total					47744.00	Kwh		
		Say		47744	Kwh			@Rs	36.95	**1,764,141.00**
23	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 pipe laying & manholes (110days , 6no.pump 10HP)	6	880	10	0.746	39388.80	Kwh		
		Total					39388.80	Kwh		
		Say		39388.8	Kwh			@Rs	18.44	**726,329.00**
24	100.7.3	Bailing out water with engine and pumpset above 10 HP upto 20 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 pipe laying & manholes (110days , 6no.pump 20HP)	6	880	20	0.746	78777.60	Kwh		
		Total					78777.60	Kwh		
		Say		78777.6	Kwh			@Rs	9.22	**726,329.00**
25	100.9 8.100 8	Engaging Coolie - Bailing out water and controlling traffic								
			3	180			540.00	day		
		Say		540	Day			@Rs	878.76	**474,530.00**
26	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				
		Zone 1 Sannidhi road	12	2	2	1.5	72.00	m^3		
		Zone 2Kaippilly	24	2	2	1.5	144.00	m^3		
		New well zone	106	2	2	1.5	636.00	m^3		
		No7 well	57	2	2	1.5	342.00	m^3		
		STP	61	2	2	1.5	366.00	m^3		
		Manholes 1.20 m dia								
		Zone 1 Sannidhi road	8	2.4	2.4	1.5	69.12	m^3		
		Zone 2Kaippilly	11	2.4	2.4	1.5	95.04	m^3		
		New well zone	33	2.4	2.4	1.5	285.12	m^3		
		No7 well	33	2.4	2.4	1.5	285.12	m^3		
		STP Well	26	2.4	2.4	1.5	224.64	m^3		
		Manholes 1.50 m dia								
		Zone 1 Sannidhi road	10	2.8	2.8	1.5	117.60	m^3		
		Zone 2Kaippilly	16	2.8	2.8	1.5	188.16	m^3		

		New well zone	57	2.8	2.8	1.5	670.32	m^3		
		No7 well	43	2.8	2.8	1.5	505.68	m^3		
		Well at STP Premises	49	2.8	2.8	1.5	576.24	m^3		
		Total					4577.04	m^3		
		Say		4577.04	m3			@Rs	214.03	**979,624.00**
27	2.6.1+ 2.26.1	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 2nd depth								
		Manholes 0.9 m dia								
			NO	L	B	Avg ht				
		Zone 1 Sannidhi road	10	2	2	0.38	15.20			
		Zone 2Kaippilly	18	2	2	0.31	22.32			
		New well zone	73	2	2	0.33	96.36			
		No7 well	39	2	2	0.35	54.60	m^3		
		Well at STP Premises	41	2	2	0.37	60.68			
		Manholes 1.20 m dia								
		Zone 1 Sannidhi road	8	2.4	2.4	0.96	44.24			
		Zone 2Kaippilly	11	2.4	2.4	1.08	68.43			
		New well zone	33	2.4	2.4	0.98	186.28			
		No7 well	33	2.4	2.4	1	190.08	m^3		
		Well at STP Premises	26	2.4	2.4	1.05	157.25			
		Manholes 1.50 m dia								
		Zone 1 Sannidhi road	10	2.8	2.8	1.5	117.60			
		Zone 2Kaippilly	16	2.8	2.8	1.5	188.16			
		New well zone	57	2.8	2.8	1.5	670.32			
		No7 well	43	2.8	2.8	1.5	505.68	m^3		
		Well at STP Premises	49	2.8	2.8	1.5	576.24			
		Total					2953.43	m^3		
		Say		2953.432	m^3		2953.43	@Rs	320.40	**946,280.00**
28	2.6.1+ 2*2.26.1	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 3 rd depth								
		Manholes 1.50 m dia								
		Zone 1 Sannidhi road	9	2.8	2.8	0.62	43.75	m^3		
		Zone 2Kaippilly	15	2.8	2.8	0.46	54.10	m^3		
		New well zone	57	2.8	2.8	0.67	299.41	m^3		
		No7 well	41	2.8	2.8	0.78	250.72	m^3		
		Well at STP Premises	49	2.8	2.8	0.64	245.86	m^3		
		Total					893.84	m^3		
				893.8384			893.84	@Rs	426.77	**381,463.00**
29	2.6.1+ 3*2.26.1	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 4th depth								
		Manholes 1.50 m dia								
		New well zone	5	2.8	2.8	0.29	11.37			

		No7 well	6	2.8	2.8	0.32	15.05	m^3		
		Well at STP Premises	6	2.8	2.8	0.34	15.99			
		Total					42.41	m^3		
							42.41	@Rs	533.14	**22,613.00**
30	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(260Nos)	1	8		451.2	3609.60	m^2		
		Manhole 1.2m dia(112 nos.)	1	9.6		280.35	2691.36			
		Manhole 1.5m dia(175 nos.)	1	11.2		644.07	7213.58			
		Total					13514.54	m^2		
		Say		13514.544	m^2			@Rs	749.13	**10,124,150.00**
31	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	260	2	2	0.15	156.00	m^3		
		Manhole 1.2m dia	112	2.4	2.4	0.15	96.77			
		Manhole 1.5m dia	175	2.8	2.8	0.15	205.80			
		connection chamber to manhole	1094	1.2	1.2	0.15	236.30			
		Total					694.87	m^3		
		Say		694.872	m^3			@Rs	7211.15	**5,010,826.00**
32	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	260	1.8	1.8	0.35	294.84	m^3		
		1.20m dia manholes -mat	112	2.2	2.2	0.4	216.83			
		1.50m dia manholes -mat	175	2.6	2.6	0.45	532.35			
		0.90m dia manholes -cover slab(circular 3.14/4*1.5*1.5*0.3)	260	2.01		0.35	182.87			
		1.20m dia manholes -cover slab(circular	112	3.14		0.35	123.09			
		1.50m dia manholes -cover slab(circular 3.14/4*2.1*2.1*0.3)	175	4.52		0.35	276.95			
		sewer chamber -mat	1094	1	1	0.2	218.80			
		sewer chamber -cover slab	1094	1	1	0.2	218.80			
		Sewer chamber walls	1094	3.2	0.2	0.6	420.10			
		Deduct Manhole cover 600mm dia	547	0.28		0.35	54.10			
		Total					2430.52	m^3		
		Say		2430.52	m^3			@Rs	9968.10	**24,227,705.00**

33	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.	260	0.64		0.2	33.06			
		1.20m dia manholes(3.14/4*1.2*1.2*.2	112	1.13		0.25	31.65			
		1.50m dia manholes (3.14/4*1.5*1.5*0.3)	175	1.77		0.3	92.73			
		Deductions								
		0.90m dia hole -pipe portion((3.14/4*0.15*0.15)*	260	0.0314		0.3	-2.45			
		Channel portion-0.9*(0.9+0.15)/2*0.05	260	0.9	0.525	0.05	-6.14			
		1.200m dia hole -pipe portion((3.14/4*0.15*0.15)*	112	0.0314		0.4	-1.41			
		Channel portion 1.2*(1.20+0.15)/2*0.1	112	1.2	0.675	0.1	-9.07			
		1.500m dia hole -pipe portion((3.14/4*0.15*0.15)*	175	0.0314		0.5	-2.75			
		Channel portion 1.5*(1.50+0.15)/2*0.15	175	1.2	0.825	0.15	-25.99			
		Total					109.64	m^3		
		Say		109.638105	m^3			@Rs	7990.86	**876,103.00**
34	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	1	0.90275		321.2	586.98	m^3		.
		1.2m dia manhole - side wall- steining	1	1.413		218.75	287.99			.
		1.50m dia manhole - side wall- steining	1	2.03315		539.07	1199.51			.
		Total					2074.48	m^3		
		Deduction- Man hole pipe portions								
		intersection manhole with 4 pipes	28	0.0314		0.25	-0.22			
		intersection manhole with 3 pipes	375	0.0314		0.25	-2.94			
		intersection manhole with2 pipes	722	0.0314		0.25	-5.67			
		manhole with 1 pipe	101	0.0314		0.25	-0.79			
							-9.62			
							2084.11			
		Say		2084.11	m^3			@Rs	8557.76	**17,835,271.00**
35	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 of Concrete	1		4624.27	m^3	110.00	kg/m^3	508669.37	
		Total							508669.37	
		Say		**508669.3739**	kg		@	Rs	**100.60**	**51,173,538.00**
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		4624.27	m^3	340.00	kg/m^3	1572250.79	
		Total							1572250.79	

		Say		**31445.01584**	bags		@	Rs	**67.80**	**2,131,815.00**
37	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	260	7.2		0.35	655.20	m^2		
		1.20m dia manholes -mat	112	8.8		0.4	394.24	m^2		
		1.50m dia manholes -mat	175	10.4		0.45	819.00	m^2		
		Sewer chamber -mat	1094	4		0.2	875.20	m^2		
		Total					2743.64	m^2		
		Say		2743.64	m^2			@Rs	335.31	**919,970.00**
38	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 dia260 manholes - walls	1	7.22		321.20	2319.71	m^2		
		1.20m 112 dia manholes - walls	1	9.42		218.75	2060.63	m^2		
		1.50m dia 175 manholes - walls	1	11.62		539.07	6262.92	m^2		
		Sewer chamber -outside	1094	4.00		0.60	2625.60	m^2		
		Sewer chamber -inside	1094	3.20		0.60	2100.48	m^2		
		Total					15369.33	m^2		
		Say		**15369.32666**	m^2		@	Rs	**717.20**	**11,022,932.00**
39	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 dia260 manholes - walls	1	2.83		321.20	907.71	m^2		
		1.20m dia 112 manholes - walls	1	3.77		218.75	824.25	m^2		
		1.50m dia 175 manholes - walls	1	4.71		539.07	2539.02	m^2		
		Sewer chamber -inside	1094	2.40		0.60	1575.36	m^2		
		Total					5846.34	m^2		
		Say		**5846.3409**	m^2		@	Rs	**570.29**	**3,334,119.00**
40	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	260	0.63585			165.32	m^2		
		1.20m dia manholes -mat	112	1.1304			126.60	m2		
		1.50m dia manholes -mat	175	1.76625			309.09	m^2		

		Sewer chamber -mat	1094	0.36			393.84	m2		
		Total					994.86	m^2		
		Say		**994.85955**	m^2		@	Rs	**439.51**	**437,256.00**
41	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 manholes -260	1	2.83		321.20	907.71	m^2		
		1.20m dia manholes -112	1	3.77		218.75	824.25	m^2		
		1.50m dia manholes -175	1	4.71		539.07	2539.02	m^2		
		Sewer chamber	1094	2.40		0.60	1575.36	m^2		
		Total					5846.34	m^2		
		Say		**5846.34**	m^2		@	Rs	**401.21**	**2,345,615.00**
42	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	520			520.00	No		
		1.20m dia manholes -	1	224			224.00	No		
		1.50m dia manholes	1	350			350.00	No		
		Total					1094.00	No		
		Say		1094	No			@Rs	545.00	**596,230.00**
43	19.21.1	Making connection of drain or sewer line with existing manhole including breaking into and making good the walls, floors with cement concrete 1:2:4 mix(1 cement:2 coarse sand: 4 graded stone aggregate 20 mm nominal size) cement plastered on both sides with cement mortar 1:3 (1 cement: 3 coarse sand) finished with a floating coat of neat cement and making necessary channels for the drain etc. complete.For pipes 100 to 250 mm diameter								
			5 Nos				5.00	Nos.		
		Say		5.00	No			@Rs	733.88	**3,669.00**
44	OD	Conveying from casting yard and fixing the RCC cover slab of various size dia, 25 cm thick including cost of 5kg cement/each								
		Total	547							
		Say		547	No			@Rs	469.82	**256,992.00**
45	100.41.33	Supplying and fixing 500mm dia CI manhole cover with frame(medium duty) charges including all cost, labour charges etc complete.								
		Total	547							
		Say		547	No			@Rs	7507.08	**4,106,373.00**
46	OD	Taking connection for manholes and chambers								
			1	2370			2370.00	Nos.		
		Total					2370.00	Nos.		
		Say		**2370.00**	Nos.		@	Rs	**756.40**	**1,792,668.00**
47	1.2.2	Removal of excess earth by lorry for minimum mechanical conveyance, labour including loading,unloading and stacking for lead less than 0.50 km								
		Qty vide EWE for pipe laying			42898.43					
		man holes					8466.72			
		Say 2 times for taken away and brought back(pipe	2	42898.43			85796.86			
		Total					94263.59			
		Deductions								

		deduction for pipe and manholes	1	0.06		16940	1042.56			
		0.90m dia manhole - side wall - steining	1	1.54		451.2	694.22			
		1.2m dia manhole - side wall- steining	1	2.01		280.35	563.39			
		1.50m dia manhole - side wall- steining	1	2.83		644.07	1825.20			
							4125.36			
		Total less deduction					90138.23		.	.
		Say 75%	75%	90138.23					**238.34**	**16,112,659.00**
48	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	500.00			500.00	m^3		
		Say		500.00	m^3			@Rs	355.18	**177,590.00**
49	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								
							500.00	m^3		
		Total					500.00	m^3		
		Say		500	m^3	CI	35.59	@Rs	525.82	**356,480.00**
50	16.84	Laying old cement concrete interlocking paver blocks of any design/ shape laid in required line, level, curvature, colour and pattern over and including 50 mm thick compacted bed of coarse sand, filling the joints with fine sand etc. all complete as per the direction of Engineer-in-charge. (Old CC paver blocks shall be supplied by the department free of cost.)								
		Qty vide item 1					4308.00	m^2		
		Say		4308	m2			@Rs	381.62	**1,644,019.00**
51	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 : 6 graded stone aggregate 40 mm nominal size)								
		Qty vide item 2					650.91	m^2		
		Say		650.91	m2			@Rs	7211.15	**4,693,810.00**
52	16.79	Providing , laying spreading and compacting graded stone aggregate (size range 53 mm to 0.075 mm) to wet mix macadam (WMM) specification including premixing the material with water at OMC in mechanical mix plant, carriage of mixed material by tipper to site, for all leads & lifts, laying in uniform layers with mechanical paver finisher in sub - base / base course on well prepared surface and compacting with vibratory roller of 8 to 10 tonne capacity to achieve the desired density, complete as per specifications and directions of Engineer - in- Charge.								
		60% of road length	1	10164.00	1.2	0.3	3659.04	m^2		
		pumping main(100%)	1	1416.00	0.7	0.3	297.36	m^2		
		manholes0.9m dia60%	1	156.00	1.7	0.5	132.60	m^2		
		1.2 mdia60%	1	67.20	2.5	0.3	50.40	m^2		
		1.5 m dia60%	1	105.00	2.8	0.3	88.20	m^2		
		Total					4227.60	m^2		
		Say		4227.6	m3			@Rs	3109.15	**13,144,243.00**
53	OD	Supply, erection, testing, and commissioning of new generation non clog Submersible motor pump set having suitable discharge and head, including all accessories such as cost of the panel board with an ammeter, voltmeter, phase indicating lamps, change over switch, main switch, cost of soft starter, cable from panel board to starter, starter to motor, capacitors suction pipe, foot valve, Non return valve, suction and delivery pipes of required length, pressure gauge, earthing and wiring materials, cables etc. complete.								
		New Well Zone (25HP Motor pump set)	2	25.00			50.00			

		Total					50.00	HP		
		Say		50.00	HP			@Rs	18961.49	**948,075.00**
54	OD	Supply, erection, testing, and commissioning of new generation non clog Submersible motor pump set having suitable discharge and head, including all accessories such as cost of the panel board with an ammeter, voltmeter, phase indicating lamps, change over switch, main switch, cost of soft starter, cable from panel board to starter, starter to motor, capacitors suction pipe, foot valve, Non return valve, suction and delivery pipes of required length, pressure gauge, earthing and wiring materials, cables etc. complete.								
		New Well Zone (25HP Motor pump set)	2	10.00			20.00	HP		
		STP Well Zone (10HP Pump set)	2	10.00			20.00	HP		
		STP Well Zone (5HP Pump set)	2	5			10.00	HP		
		Total					50.00	HP		
		Say		50.00	HP			@Rs	21063.80	**1,053,190.00**
		TOTAL FOR NETWORK								**303,082,543.00**
II	**CIVIL CONSTRUCTION -COLLECTION WELLS**									
(A)	**COLLECTION WELL -STP zone**									
Item No.	**Item Code**	**Description**	**No**	**L**	**B**	**H**	**V**	**Unit**	**Rate**	**Amount**
1	OD	Fabricating MS Kerb of size using 8 mm thick MS plate including cost of MS plate and 10mm dia anger bar welded to the kerb and conveyance charges of MS plate, all fabrication charges, charges of painting outer side of the steel work with two or more coat deluxe multi surface paint to give an even shade over an under coat of primer erection tying anger bar with reinforcement placing in position etc. complete.								
		(3.14*8.80)	**1**	29.52	**m**					
		Say		29.52	m			@Rs	10142.86	**299,377.00**
2	100.37.1	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 STP zone	1	10.00	10	1.5	150.00	m^3		
		Say		150.00	m^3					
							150.00	@Rs	451.72	**67,758.00**
3	OD (100.3.7.12)	Sinking wells of dia 8.8m inside all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and lbour for the same including dumping the spoil beyond the initial lead of 50m etc. complete total depth 1.5 to 3m.								
		Collection well STP zone	1	1.50	m					
				1.50	m			@Rs	65792.38	**98,689.00**
4	OD (100.3.7.13)	Sinking well (in or under water) of dia8.8m inside all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and lbour for the same including dumping the spoil beyond the initial lead of 50m etc. complete total depth 3 to 4.5m								
		Collection well STP zone	1	1.50	m					
				1.50	m			@Rs	70044.59	**105,067.00**
5	OD (100.3.7.14)	Sinking well (in or under water) of dia8.8m inside all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and lbour for the same including dumping the spoil beyond the initial lead of 50m etc. complete total depth 4.5 to 6m.								
		Collection well STP zone	1	1.50	m					
				1.50	m			@Rs	74302.11	**111,453.00**
6	OD (100.3.7.15)	Sinking well excavation (in or under water) of dia8.8m inside all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and lbour for the same including dumping the spoil beyond the initial lead of 50m etc. complete total depth 6 to 7.5m.								
		Collection well STP zone	1	1.50	m					
				1.50	m			@Rs	78554.31	**117,831.00**

7	OD (100.3.7.16)	Sinking well excavation (in or under water) of dia8.8m inside all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and lbour for the same including dumping the spoil beyond the initial lead of 50m etc. complete total depth 7.5 to 9.0m.								
		Collection well STP zone	1	1.50	m					
				1.50	m			@Rs	82811.84	**124,218.00**
8	5.9.12 + 5.9.14	Centering and shuttering including strutting, etc. and removal of form for: Well steining (Add 20% for circular works)								
		up to ground level outer	1	30.46		8.5	258.89	m^2		
		up to ground level inner	1	27.63		8.5	234.87	m^2		
		above ground level outer	1	30.46		1.00	30.46	m^2		
		above ground level inner	1	27.63		1.00	27.63	m^2		
		Cover slab	1	88.20			88.20	m^2		
		Cover slab side	1	33.28		0.20	6.66	m^2		
		Total					646.71	m^2		
		Say		**646.71**	m^2		@	Rs	**299.63**	**193,772.00**
9	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 STP Well								
		Kerb	1	29.52	0.3	0.5	4.43	m^3		
		Bottom slab(3.14/4*(9.7)	1	73.86		0.45	33.24	m^3		
		wall(3.14/4*(9.7^2-8.8^2))*H	1	9.11		8.00	72.91	m^3		
		Cap of hemispere	1	6.15		0.5	3.08	m3		
		Total					113.65	m3		
		Dedn(kerb)					5.00	m3		
		Total					108.65	m^3		
		Say		**108.65**	m^3		@	Rs	**9968.10**	**1,083,080.00**
10	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 above GL (3.14/4*(6.9^2-6^2))*H	1	13.07		1.00	13.07	m^3		
		Top slab incl.cantilever beam(3.14/4*(7.8)^2*0.2	1	88.20		0.2	17.64	m^3		
		Main beam	2	9.70	0.45	0.7	6.11	m3		
		Total					36.82	m^3		
		Deduction								
		Manhole	4	0.60	0.45	0.2	0.22	m^3		

		Total					0.22	m^3		
		Total after deduction					36.60	m^3		
		Say		**36.60**	m^3		@	Rs	**9886.00**	**361,828.00**
11	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	108.6546	120.00	kg/m^3	13038.55	kg		
		Quantity as per item No.4	1	36.6	100.00	kg/m^3	3660.00	kg		
		Total					16698.55	kg		
		Say		**16698.55**	kg		@	Rs	**100.60**	**1,679,920.00**
12	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	108.6546	340.00	kg/m^3	36942.56	kg		
		Quantity as per item No.4	1	36.6	330.00	kg/m^3	12078.00	kg		
		Total					49020.56	kg		
		Say		**980.41**	bags		@	Rs	**67.80**	**66,467.00**
13	4.1.8	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)								
		Bottom pluging (3.14*D^2*H/4)	1	60.79		0.3	18.24	m3		
		Say		**18.24**	m^2		@	Rs	**6814.89**	**124,284.00**
14	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)								
		Bottom pluging(3.14*D^2*H	1	60.79		0.2	12.16	m3		
		Say		**12.16**	m^2		@	Rs	**7990.86**	**97,154.00**
15	5.1.2	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size								
		Counter Weight	1	60.79		0.5	30.40	m3		
		Say		**30.40**	m^2		@	Rs	**9085.14**	**276,145.00**
16	4.15	Extra for laying concrete in or under water and or liquid mud including cost of pumping or bailing out water and removing slush etc. complete. Note for item No. 4.15 : - The quantity will be calculated by multiplying the depth measured from the sub-soil water level upto centre of gravity of concrete under sub-soil water level with quantity of concrete in cum executed under the sub-soil water. The depth of centre of gravity shall be reconed correct to 0.10 m 0.05 m or more shall be taken as 0.10 m and less than 0.05 m ignored								
		Same 4.1.8,4.1.3	1				30.40	m3		
		Say		**30.40**	m^2		@	Rs	**935.37**	**28,431.00**
17	5.9.5	Centering and shuttering including strutting, etc. and removal of form for: Lintels, beams, plinth beams, girders bressumers and cantilevers								
		TopBeam (3.14*D)Well slab	2	9.70		1.4	27.16	m^2		
		Total					27.16	m^2		
		Say		**27.16**	m^2		@	Rs	**649.82**	**17,648.98**
18	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								
			32				32.00	No.		
		Say		**32.00**	No.		@	Rs	**545.00**	**17,440.00**

19	14.72	Providing and fixing double scaffolding system (cup lock type) on the exterior side, upto seven story hight made with 40 mm dia. M.S. tube 1.5 m centre to centre, horizontal & vertical tubes joining with cup & lock system with M.S. tubes, M.S. tube challies, M.S. clamps and M.S. staricase system in the scaffolding for working platform etc. and maintaining it in a serviceable condition for the required duration as approved and removing it there after. The scaffolding system shall be stiffened with bracings, runners, connection with the building etc wherever required for inspection of work at required location with essential safety features for the workmen etc. complete as per directions and approval of Engineer- in Charge. The elevational area of the scaffolding shall be measured for payment purpose. The payment will be made once irrespective of duration of scaffolding. Note:- This item to be used for maintenance work judicially, necessary deduction for scaffolding in the existing item to be done .								
			1	27.63		7.01	193.70	m^2		
		Total					193.70	m^2		
		Say		**193.70**	m^2		@	Rs	**303.65**	**58,818.00**
20	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	27.63		9	248.69	m^2		
		Bottom slab(3.14/4*d^2)	1	60.79			60.79	m^2		
		Top slab (3.14*D^2/4)	1	88.20			88.20	m^2		
		Total					397.68	m^2		
		Deduction								
		Manhole	4	0.60	0.45		1.08	m^2		
		Total					1.08	m^2		
		Total after deduction					396.60	m^2		
		Say		**396.60**	m^2		@	Rs	**401.21**	**159,121.00**
21	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	27.63		4.5	124.34	m^2		
		Total					124.34	m^2		
		Say		**124.34**	m^2		@	Rs	**570.29**	**70,912.00**
22	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	60.79			60.79	m^2		
		Total					60.79	m^2		
		Say		**60.79**	m^2		@	Rs	**439.51**	**26,718.00**
23	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	396.60					**396.60**	
		Say		**396.60**	m2		@	Rs	**222.91**	**88,406.00**

24	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.								
			1	10.00	10	8.5	850.00	m^3		
		Dedn	1	73.86		8.5	627.82	m^3		
		Net	1				222.18	m^3		
		Say		**222.18**	m^3		@	Rs	**258.57**	**57,450.00**
25	1.2.2	Removal of excess earth by lorry for minimum mechanical conveyance, labour including loading, unloading and stacking for lead less than 0.50 km								
		Quantity as per item (all kind of soil)	1	627.82			627.82	m^3		
		Say		**627.82**	m^3		@	Rs	**238.34**	**149,634.00**
26	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								
		(5nos*5*.746*10*120)					22380.00	kwh		
		Say		**22380.00**	kwh		@	Rs	**36.95**	**826,902.00**
27	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								
		7nos*10*.746*10*80)					41776.00	kwh		
		Say		**41776.00**	kwh		@	Rs	**18.44**	**770,359.00**
28	100.7.3	Bailing out water with engine and pumpset above 10 HP upto 20 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.								
		(7nos*20*.746*10*75)	1				78330.00	kwh		
		Say		**78330.00**	kwh		@	Rs	**9.22**	**722,212.00**
29	100.98 .1008	Engaging cooliee for controlling traffic, bailing out water, etc.								
			1				50.00	No.		
		Say		**50.00**	No.		@	Rs	**878.76**	**43,938.00**
30	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		**4.00**	No.		@	Rs	**1561.12**	**6,244.00**
31	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	34			0.75	5.17	kg	131.84	
		Horizontal 0.25m c/c-32mm dia	3	33.28			3.17	kg	316.53	
		Say		**448.37**	kg		@	Rs	**186.03**	**83,409.00**
32	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	34	0.75		0.05	1.28	m2		
		Horizontal pipe	3	33.28		0.032	3.20	m2		
		Say		**4.47**	m2		@	Rs	**148.13**	**662.00**
33	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	243.16		4.5	1094.23	m3		
		Say		**1094.23**	Kilo litre		@	Rs	**209.76**	**229,523.00**
		Total								**8,164,871.00**
II B	**COLLECTION WELL -Rail Nagar Well**									

Item No.	Item Code	Description	No	L	B	H	V	Unit	Rate	Amount
1	OD	Fabricating MS Kerb of size using 8 mm thick MS plate including cost of MS plate and 10mm dia anger bar welded to the kerb and conveyance charges of MS plate, all fabrication charges, charges of painting outer side of the steel work with two or more coat deluxe multi surface paint to give an even shade over an under coat of primer erection tying anger bar with reinforcement placing in position etc. complete.								
		(3.14*10.7)	**1**	36.42	**m**					
				36.42				@Rs	10142.86	**369,444.00**
2	100.37.1	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								
		Rail Nagar Well	1	11.30	11.3	1.5	191.54	m^3		
		Say		191.54	m^3					
				191.54	m^3		191.54	@Rs	451.72	**86,522.00**
3	OD (100.3.7.12)	Sinking wells of dia 10.10m inside all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and lbour for the same including dumping the spoil beyond the initial lead of 50m etc. complete total depth 1.5 to 3m.								
		Rail Nagar Well	1	1.50	m					
				1.50	m			@Rs	83935.21	**125,903.00**
4	OD (100.3.7.13)	Sinking well (in or under water) of dia 10.10 m inside all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and lbour for the same including dumping the spoil beyond the initial lead of 50m etc. complete total depth 3 to 4.5m								
		Rail Nagar Well	1	1.50	m					
				1.50	m			@Rs	89364.85	**134,047.00**
5	OD (100.3.7.14)	Sinking well (in or under water) of dia 10.10m inside all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and lbour for the same including dumping the spoil beyond the initial lead of 50m etc. complete total depth 4.5 to 6m.								
		Rail Nagar Well	1	1.50	m					
				1.50	m			@Rs	94801.29	**142,202.00**
6	OD (100.3.7.15)	Sinking well excavation (in or under water) of dia10.10m inside all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and lbour for the same including dumping the spoil beyond the initial lead of 50m etc. complete total depth 6 to 7.5m.								
		Rail Nagar Well	1	1.50	m					
				1.50	m			@Rs	100230.92	**150,346.00**
7	OD (100.3.7.16)	Sinking well excavation (in or under water) of dia10.10m inside all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and lbour for the same including dumping the spoil beyond the initial lead of 50m etc. complete total depth 7.5 to 9.0m.								
		Rail Nagar Well	1	1.50	m					
				1.50	m			@Rs	105667.36	**158,501.00**
8	OD (100.3.7.16)	Sinking well excavation (in or under water) of dia10.10m inside all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and lbour for the same including dumping the spoil beyond the initial lead of 50m etc. complete total depth 9 to 10.5m.								
		Rail Nagar Well	1	0.50	m					
				0.50	m			@Rs	111103.80	**55,552.00**
7	5.9.12 + 5.9.1.4	Centering and shuttering including strutting, etc. and removal of form for: Well steining								
		up to ground level outer	1	34.54		9	310.86	m^2		
		up to ground level inner	1	31.71		9	285.43	m^2		
		above ground level outer	1	34.54		1.00	34.54	m^2		
		above ground level inner	1	31.71		1.00	31.71	m^2		

		Cover slab	1	111.16			111.16	m^2		
		Cover slab side	1	37.37		0.20	7.47	m^2		
		Total					781.17	m^2		
		Say		**781.17**	m^2		@	Rs	**299.63**	**234,059.00**
8	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 3								
		Kerb	1	33.60	0.3	0.5	5.04	m^3		
		Bottom slab(3.14/4*(10.1)	1	94.99		0.45	42.74	m^3		
		wall(3.14/4*(11^2-10.1^2))*H	1	14.91		9.50	141.62	m^3		
		Cap of hemispere	1	100.24		0.5	50.12	m3		
		Total					239.52	m3		
		Dedn(kerb)					6.00	m3		
		Total					233.52	m^3		
		Say		**233.52**	m^3		@	Rs	**9968.10**	**2,327,732.00**
9	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 above GL (3.14/4*(D^2-d^2)*H	1	14.91		1.00	14.91	m^3		
		Top slab incl.cantilever beam(3.14/4*(11.9)^2*0.2	1	111.16		0.2	22.23	m^3		
		Main beam	2	11.00	0.45	0.8	7.92	m3		
		Total					45.06	m^3		
		Deduction								
		Manhole	4	0.60	0.45	0.2	0.22	m^3		
		Total					0.22	m^3		
		Total after deduction					44.84	m^3		
		Say		**44.84**	m^3		@	Rs	**9886.00**	**443,288.00**
10	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	233.518025	120.00	kg/m^3	28022.16	Kg		
		Quantity as per item No.4	1	44.84	100.00	kg/m^3	4484.00	Kg		
		Total					32506.16	Kg		
		Say		**32506.16**	kg		@	Rs	**100.60**	**3,270,209.00**
11	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	233.518025	340.00	kg/m^3	79396.13	Kg		

		Quantity as per item No.4	1	44.84	330.00	kg/m^3	14797.20	Kg		
		Total					94193.33	Kg		
		Say		**1883.87**	bags		@	Rs	**67.80**	**127,717.00**
12	4.1.8	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)								
		Bottom pluging(3.14*D*D*H	1	80.08		0.3	24.02	m3		
		Say		**24.02**	m^2		@	Rs	**6814.89**	**163,716.00**
13	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)								
		Bottom pluging(3.14*D*D*H	1	80.08		0.2	16.02	m3		
		Say		**16.02**	m^2		@	Rs	**7990.86**	**127,978.00**
14	5.1.2	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size								
		Counter Weight	1	80.08		0.5	40.04	m3		
		Say		**40.04**	m^2		@	Rs	**9085.14**	**363,759.00**
15	4.15	Extra for laying concrete in or under water and or liquid mud including cost of pumping or bailing out water and removing slush etc. complete. Note for item No. 4.15 : - The quantity will be calculated by multiplying the depth measured from the sub-soil water level upto centre of gravity of concrete under sub-soil water level with quantity of concrete in cum executed under the sub-soil water. The depth of centre of gravity shall be reconed correct to 0.10 m 0.05 m or more shall be taken as 0.10 m and less than 0.05 m ignored								
		Same 4.1.8,4.1.3	1				40.04	m3		
		Say		**40.04**	m^2		@	Rs	**935.37**	**37,451.00**
17	5.9.5	Centering and shuttering including strutting, etc. and removal of form for: Lintels, beams, plinth beams, girders bressumers and cantilevers								
		TopBeam (3.14*D)Well slab	2	10.10		1.6	32.32	m^2		
		Total					32.32	m^2		
		Say		**32.32**	m^2		@	Rs	**649.82**	**21,002.00**
18	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								
			32				32.00	No.		
		Say		**32.00**	No.		@	Rs	**545.00**	**17,440.00**
19	14.72	Providing and fixing double scaffolding system (cup lock type) on the exterior side, upto seven story hight made with 40 mm dia. M.S. tube 1.5 m centre to centre, horizontal & vertical tubes joining with cup & lock system with M.S. tubes, M.S. tube challies, M.S. clamps and M.S. staricase system in the scaffolding for working platform etc. and maintaining it in a serviceable condition for the required duration as approved and removing it there after. The scaffolding system shall be stiffened with bracings, runners, connection with the building etc wherever required for inspection of work at required location with essential safety features for the workmen etc. complete as per directions and approval of Engineer- in Charge. The elevational area of the scaffolding shall be measured for payment purpose. The payment will be made once irrespective of duration of scaffolding. Note:- This item to be used for maintenance work judicially, necessary deduction for scaffolding in the existing item to be done .								
			1	31.71		6.4	202.97	m^2		
		Total					202.97	m^2		
		Say		**202.97**	m^2		@	Rs	**303.65**	**61,632.00**
20	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	31.71		9.5	301.28	m^2		
		Bottom slab(3.14/4*d^2)	1	80.08			80.08	m^2		
		Top slab (3.14*D*D/4)	1	111.16			111.16	m^2		
		Total					492.52	m^2		

		Deduction								
		Manhole	4	0.60	0.45		1.08	m^2		
		Total					1.08	m^2		
		Total after deduction					491.44	m^2		
		Say		**491.44**	m^2		@	Rs	**401.21**	**197,173.00**
21	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	31.71		4.5	142.71	m^2		
		Total					142.71	m^2		
		Say		**142.71**	m^2		@	Rs	**570.29**	
22	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	80.08			80.08	m^2		
		Total					80.08	m^2		
		Say		**80.08**	m^2		@	Rs	**439.51**	**35,195.00**
23	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	491.44			491.44	m^2		
		Say		**491.44**	m2		@	Rs	**222.91**	**109,548.00**
24	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.								
			1	11.60	11.60	9	1211.04	m^3		
		Dedn	1	94.99		9	854.87	m^3		
		Net	1				356.18	m^3		
		Say		**356.18**	m^3		@	Rs	**258.57**	**92,096.00**
25	1.2.2	Removal of excess earth by lorry for minimum mechanical conveyance, labour including loading, unloading and stacking for lead less than 0.50 KM								
		Quantity as per item (all kind of soil)	1	854.87			854.87	m^3		
		Say		**854.87**	m^3		@	Rs	**238.34**	**203,749.00**
26	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								
		(5nos*5*.746*10*120)					22380.00	kwh		
		Say		**22380.00**	kwh		@	Rs	**36.95**	**826,902.00**

27	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								
		(7nos*10*.746*10*90)					46998.00	kwh		
		Say		**46998.00**	kwh		@	Rs	**18.44**	**866,654.00**
28	100.7.3	Bailing out water with engine and pumpset above 10 HP upto 20 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								
		(7nos*20*.746*10*90)	1				93996.00	kwh		
		Say		**93996.00**	kwh		@	Rs	**9.22**	**866,654.00**
29	100.98 .1008	Engaging cooliee for controlling traffic, bailing out water, etc.								
			1				70.00	No.		
		Say		**70.00**	No.		@	Rs	**878.76**	**61,513.00**
30	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		**4.00**	No.		@	Rs	**1561.12**	**6,244.00**
31	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	38			0.75	5.17	kg	147.35	
		Horizontal 0.25m c/c-32mm dia	3	2.83			3.17	kg	26.88	
		Say		**174.22**	kg		@	Rs	**186.03**	**32,410.00**
32	13.48.3	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:								
		vertical pipe	38	0.75		0.05	1.43	m2		
		Horizontal pipe	3	2.83		0.032	0.27	m2		
		Say		**1.70**	m2		@	Rs	**148.13**	**251.00**
33	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	80.08		4.5	360.35	m3		
		Say		**360.35**	Kilo litre		@	Rs	**209.76**	**75,586.00**
		Total								**11,792,475.00**

III Grit Chamber

Item No.	Item Code	Description	No	L	B	H	V	Unit	Rate	Amount
1	100.98 .1000	Engaging Bandhani								
		Say	2	2.00			4.00	Nos		
				6.00	Nos		4.00	@Rs	971.71	**5,830.00**
2	2.8.1	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.								
		Inlet chamber- Collection well 2 Nos	2	4.30	2.05	1.5	26.45	m^3		
		Say		26.45	m^3			@Rs	296.94	**7,854.00**
3	2.8.1+ 2.26.1	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up 1.50 to 3.0 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil								
		Collection well STP zone	1	4.30	2.5	1.5	16.13	m^3		

		Collection well(Rail nagar)	1	4.30	2.5	1.5	16.13	m^3		
		Say		32.26	m^3					
							32.26	@Rs	403.31	**13,011.00**
4	2.8.1+ 2.26.1 *2	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift 3.00 to 4.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil								
		Collection well STP zone	1	4.30	2.5	1.5	16.13	m^3		
		Collection well(Rail nagar)	1	4.30	2.5	1.5	16.13	m^3		
		Say		32.26	m^3					
							32.26	@Rs	509.68	**16,442.00**
5	2.8.1+ 2.26.1 *3	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift 4.50 to 6.0 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil								
		Collection well STP zone	1	4.30	2.5	1	10.75	m^3		
		Collection well(Rail nagar)	1	4.30	2.5	0.5	5.38	m^3		
		Say		16.13	m^3					
							16.13	@Rs	616.05	**9,937.00**
7	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.								
		Collection well STP zone	1	12.70		5.5	69.85	m^2		
		Collection well(Rail nagar)	1	12.70		5	63.50	m^2		
		Total					133.35	m^2		
		Say		**133.35**	m^2		@	Rs	**749.13**	**99,897.00**
8	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)								
		Inlet chamber	2	4.10	2.15	0.2	3.53			
		Total					3.53	m^3		
		Say		**3.53**	m^3		@	Rs	**7211.15**	**25,455.00**
9	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/m^3.Excess/less cement used as per design mix is payable/recoverable separately).								
		Settling portion	2	2.00	1.25	0.15	0.60	m^3		
			2	4.10	1.85	0.20	3.03	m^3		
		Total					3.63	m^3		
		Say		**3.63**	m^3		@	Rs	**9968.10**	**36,184.00**

10	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).								
		Collection well(STP)	1	10.30	0.2	5.5	11.33	m^3		
		Collection well(Rail nagar)	1	10.30	0.2	5	10.30	m^3		
		Intermediate wall	1	1.25	0.20	5.5	6.88	m3		
			1	1.25	0.2	5	6.25	m^3		
		Top slab	2	4.10	1.85	0.15	2.28	m^3		
		Total					2.28	m^3		
		Dedn for man hole	2	0.25		0.15	0.07	m^3		
		Total after deduction					2.21	m^3		
		Say		**2.21**	m^3		@	Rs	**9886.00**	**21,810.00**
11	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	3.63	m^3		120.00	kg/m^3	435.60	
		Quantity as per item No.4	1	2.21	m^3		100.00	kg/m^3	220.61	
		Total						Kg	656.21	
		Say		**656.21**	kg		@	Rs	**100.60**	**66,017.00**
12	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	3.63	m^3		340.00	kg/m^3	1234.20	
		Quantity as per item No.4	1	2.21	m^3		330.00	kg/m^3	728.03	
		Total							1962.23	
		Say		**39.24**	bags		@	Rs	**67.80**	**2,661.00**
13	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete								
		(2*2*4.1)	4	4.10		0.2	3.28	m^2		
			4	1.85		0.2	1.48	m^2		
		Total					4.76	m^2		
		Say		**4.76**	m^2		@	Rs	**335.31**	**1,596.00**
14	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.								
		Outer walls	1	7.80		5.5	42.90	m^2		
			1	7.80		5	39.00	m^2		
		Inner walls	1	11.60		5.5	63.80	m^2		
			1	11.60		5	58.00	m^2		
		Total					203.70	m^2		
		Say		**203.70**	m^2		@	Rs	**717.20**	**146,094.00**
15	13.7.1	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)								
		Collection well(STP)	1	11.60		5.5	63.80	m^2		
		Collection well(Rail nagar)	1	11.60		5	11.60	m^2		
		Bottom slab	2	4.30	2.6		22.36	m2		
		Total					97.76	m^2		
		Say		**97.76**	m^2		@	Rs	**401.21**	**39,222.00**

16	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								
				2.00			2.00	No.		
		Say		**2.00**	No.		@	Rs	**1561.12**	**3,122.00**
17	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 item code 13.7.1	1	97.76			97.76	m^2		
		Say		**97.76**	m^2		@	Rs	**222.91**	**21,792.00**
18	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								
		Say		**35.00**	No.		@	Rs	**545.00**	**19,075.00**
19	100.31.2.5+OD	Supplying,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) : 200 mm diameter. Class II".Data derived from item no.18.31.4.2of DAR								
		Say		**2.00**	Nos		@	Rs	**13732.23**	**27,464.00**
21	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								
		(2chamber*5*5*.746*10*15)					5595.00	kwh		
		Say		**5595.00**	kwh		@	Rs	**36.95**	**206,726.00**
22	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								
		(2chambers3*10*.746*10*15)					6714.00	kwh		
		Say		**6714.00**	kwh		@	Rs	**18.44**	**123,808.00**
23	100.98.1008	Engaging cooliee for controlling traffic, bailing out water, etc.								
							40.00	No.		
		Say		**40.00**	No.		@	Rs	**878.76**	**35,150.00**
24	100.52.S.1	Sub Data for providing Earth filled cement bags including cutting of the Earth, filling, conveying and placing in position								
							30.00	m^3		
		Say		**30.00**	m^3		@	Rs	**3760.18**	**112,805.00**
		Total								**1,041,952.00**
IV		**CONSTRUCTION OF PUMP HOUSE**								
1	5.2.2	Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. up tot floor five level excluding cost of centering, shuttering, finishing and reinforcement : 1:1.5:3(1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size)								
		STP well (Coloumn)	6	0.45	0.3	4.5	3.65	m^3		
		Rail Nagar (Coloumn)	6	0.45	0.3	4.5	3.65	m^3		
		Total					7.30	m^3		
		Say		7.3	m^3			@Rs	10954.04	**79,964.00**
2	5..3	Reinforced cement concrete work in beams, suspended floors, roofs, having slope up to 150 landings, balconies, shelves, chajjas, lintels, bands, plain window sills, staircases and spiral stair cases up to floor five level excluding the cost of centering, shuttering, finishing and reinforcement, with1:1.5:3 (1 cement : 1.5 coarse sand (Zone III) : 3 graded stone aggregate 20 mm nominal size).								

		STP well								
		Pump house lintel	1	30.458	0.2	0.3	1.83	m^3		
		Sunshade allround	1	32.342	0.6	0.075	1.46	m^3		
		Beam top of PH	3	9.7	0.3	0.7	6.11	m^3		
		Roof slab	1	3.14	24.5025	0.12	9.23	m^3		
		Rail Nagar Well								
		Pump house lintel	1	34.54	0.2	0.3	2.07	m^3		
		Sunshade allround	1	36.424	0.6	0.075	1.64	m^3		
		Beam top of PH	3	11	0.3	0.9	8.91	m^3		
		Roof slab	1	3.14	31.36	0.12	11.82	m^3		
		Total					43.07	m^3		
		Say		43.07	m^3			@Rs	11492.88	**494,998.00**
3	5.9.3	Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform								
		STP well - Sunshade	1	32.342	0.675		21.83	m^2		
		Roof Slab	1	3.14	24.5025		76.94	m^2		
		Rail Nagar Well- Sunshade	1	36.424	0.675		24.59	m^2		
		Roof Slab	1	3.14	31.36		98.47	m^2		
		Total					221.83	m^2		
		Say		221.83	m^2			@Rs	815.78	**180,964.00**
4	5.9.5	Centering and shuttering including strutting, etc. and removal of form for: Lintels, beams, plinth beams, girders bressumers and cantilevers								
		STP well - Lintel	1	30.458	0.4		12.18	m^2		
		Beam	3	9.7	1.4		40.74	m^2		
		Rail Nagar Well- Lintel	1	34.54	0.4		13.82	m^2		
		Beam	3	11	1.8		59.40	m^2		
		Total					126.14	m^2		
		Say		126.14	m^2			@Rs	649.82	**81,968.00**
5	5.9.6	Centering and shuttering including strutting, etc. and removal of form for:Columns, Pillars, Piers, Abutments, Posts and Struts								
		STP well (Coloumn)	6	1.5		4.5	40.50	m^2		
		Rail Nagar (Coloumn)	6	1.5		4.5	40.50	m^2		
		Total					81.00	m^2		
		Say		81.00	m^2			@Rs	863.64	**69,955.00**
6	5.22.6	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								
			1	43.07		110	4737.70	Kg		
			1	7.30		140	1022.00	Kg		
		Total					5759.70	Kg		
		Say		5759.7	Kg			@Rs	98.30	**566,179.00**
7	6.3.1	Brick work with common burnt clay machine moulded perforated bricks of classdesignation 12.5 conforming to IS: 2222 in superstructure above plinth level up tofloor five level in cement mortar 1:6 (1 cement : 6 coarse sand): With F.P.S. (non modular) bricks(from floor 2 level up to floor 5 level)								
		STP well - outer wall	1	30.458	0.20	4.5	27.41	m^3		
		parapet	1	34.226	0.10	0.1	0.34	m^3		
		inside partition wall	5	8.8	0.20	2.5	22.00	m^3		
		window(-)	-6	1.00	0.20	1.5	-1.80	m^3		

		Door(-)	-3	1.50	0.20	2.2	-1.98	m^3		
		Ventilator over window	-6	1.00	0.20	0.5	-0.60	m^3		
		Lintel	-1	30.46	0.20	0.3	-1.83	m^3		
		Rail Nagar - outer wall	1	34.54	0.20	4.5	31.09	m^3		
		parapet	1	38.308	0.10	0.1	0.38	m^3		
		inside partition wall	5	10.1	0.20	2.5	25.25	m^3		
		window(-)	-6	1.00	0.20	1.5	-1.80	m^3		
		Door(-)	-3	1.50	0.20	2.2	-1.98	m^3		
		Ventilator over window	-6	1.00	0.20	0.5	-0.60	m^3		
		Lintel	-1	34.54	0.20	0.3	-2.07	m^3		
		Total					93.81	m^3		
		Say		93.81	m^3			@Rs	9090.29	**852,760.00**
8	9.1.1	Providing wood work in frames of doors, windows, clerestory windows and other frames, wrought framed and fixed in position with hold fast lugs or with dash fasteners of required dia & length (hold fast lugs or dash fastener shall be paid for separately).Second class teak wood								
		STP well								
		window-horizontal	12	1.2	0.12	0.06	0.10	m^3		
		window-vertical	18	1.5	0.12	0.06	0.19	m3		
		Doorhorizontal	6	1.70	0.12	0.06	0.07	m^3		
		vertical	6	2.20	0.12	0.06	0.10	m^3		
		Ventilator over window	12	1.20	0.12	0.06	0.10	m3		
		vertical	12	0.50	0.12	0.06	0.04	m^3		
		Rail Nagar								
		window-horizontal	12	1.2	0.12	0.06	0.10	m^3		
		window-vertical	18	1.5	0.12	0.06	0.19	m3		
		Doorhorizontal	6	1.70	0.12	0.06	0.07	m^3		
		vertical	6	2.20	0.12	0.06	0.10	m^3		
		Ventilator over window	12	1.20	0.12	0.06	0.10	m3		
		vertical	12	0.50	0.12	0.06	0.04	m^3		
		Total					1.23	m^3		
		Say		1.22688	m^3			@Rs	153237.78	**188,004.00**
9	9.5.1.1	Providing and fixing panelled or panelled and glazed shutters for shutters for doors, windows and clerestory windows, including ISI marked M.S. pressed butt hinges bright finished of required size with necessery screws, excluding panelling which will be paid for separately, all complete as per direction of Engineer - in-charge.Second class teak wood Providing and fixing panelled or panelled and glazed shutters for doors, windows and clerestory windows fixing with butt hinges of required size with necessary screws, excluding panelling which will be paid for separately, all complete as per direction								
		STP well								
		window	6	1.00		1.50	7.29	m^2		
		Door	3	1.50		2.20	8.61	m^2		
		Ventilator over window	6	1.00		0.50	2.01	m^2		
		Rail Nagar								
		window	6	1.00		1.50	7.29	m^2		
		Door	3	1.50		2.20	8.61	m^2		
		Ventilator over window	6	1.00		0.50	2.01	m^2		

		Total					35.81	m^2		
		Say		35.808	m^2			@Rs	4253.25	**152,300.00**
10	13.9.1	Cement plaster 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement. 12 mm cement plaster								
		STP well								
		Ceiling	1	3.14		19.36	60.79	m^2		
		Sunshade	1	3.14		29.70	93.27	m^2		
		Rail Nagar								
			1	3.14		25.50	80.08	m^2		
			1	3.14		37.21	116.84	m^2		
		Total					350.98	m^2		
		Say		350.98	m^2			@Rs	412.13	**144,649.00**
11	13.9.2	Cement plaster 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement. 20 mm cement plaster								
		STP well								
		Outer wall	1	30.46		4.5	137.06	m^2		
		Inside wall	1	27.63		4.50	124.34	m^2		
		Partioin wall	10	8.80		2.50	220.00	m^2		
		Partion wall top	5	8.80		0.20	8.80	m^2		
		Deduction - Window	-6	1.00	1.25	1.50	-11.25	m^2		
		Door	-3	1.50	1.25	2.20	-12.38	m^2		
		Ventilator over window	-6	1.00	1.25	0.50	-3.75	m^2		
		Rail Nagar								
		Outer wall	1	34.54		4.50	155.43	m^2		
		Inside wall	1	31.71		4.50	142.71	m^2		
		Partioin wall	10	10.10		2.50	252.50	m^2		
		Partion wall top	5	10.10		0.20	10.10	m^2		
		Deduction - Window	-6	1.00	1.25	1.50	-11.25	m^2		
		Door	-3	1.50	1.25	2.20	-12.38	m^2		
		Ventilator over window	-6	1.00	1.25	0.50	-3.75	m^2		
		Total					996.18	m^2		
		Say		996.18	m^2			@Rs	542.29	**540,218.00**
12	13.60.	Wall painting with acrylic emulsion paint of approved brand and manufacture to give an even shade: Two or more coats on new work								
		item 13.9.1	1	350.98			350.98	m^2		
		item 13.9.2	1	996.18			996.18	m^2		
		Total					1347.16	m^2		
		Say		1347.16	m^2			@Rs	151.39	**203,947.00**
13	13.48.2	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting wood work with Deluxe Multi Surface Paint of required shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.75 ltr/10 sqm of approved brand and manufacture								
		STP well								
		window	6	1.00	2.25	1.5	20.25	m^2		
		Door	3	1.50	2.25	2.2	22.28	m^2		
		Ventilator over window	6	1.00	2.25	0.5	6.75	m^2		

		Rail Nagar								
		window	6	1.00	2.25	1.5	20.25	m^2		
		Door	3	1.50	2.25	2.2	22.28	m^2		
		Ventilator over window	6	1.00	2.25	0.5	6.75	m^2		
		Total					98.56	m^2		
		Say		98.56	m^2			@Rs	153.28	**15,107.00**
14	11.53	Providing and fixing Glass mossaic tiles at finished plain wall surface of size 20 mm x 20 mm x 4 mm in all colour, design, fixing in customize design as per direction of Engineer-in-charge. The glass mosaic tiles to be fixed on the wall surface with the help of approved adhesive applied at the rate of 2.5 kg per sqm and grouting of the same. The rate is inclusive of all operation, material and required pattern approved by Engineer-in-charge.								
		STP well	1	19.36		3.14	60.79	m^2		
		Skiring total alround	1	9.70	0.10	3.14	3.05	m^2		
		Skirting wall	10	8.80	0.10		8.80	m^2		
		Rail Nagar	1	25.50		3.14	80.08	m^2		
		Skiring total alround	1	11.00	0.10	3.14	3.45	m^2		
		Skirting wall	10	10.10	0.10		10.10	m^2		
		Total					166.27	m^2		
		Say		166.27	m^2			@Rs	3826.01	**636,151.00**
15	11.37	Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer), of 1st quality conforming to IS : 15622, of approved make, in colours such as White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand), including pointing the joints with white cement and matching pigment etc., complete.								
		STP well -Toilet	1	1.50		1.50	2.25	m^2		
		wall	1	6.00		1.50	9.00	m^2		
		Rail Nagar - toilet	1	1.50		1.50	2.25	m^2		
		wall	1	6.00		1.50	9.00	m^2		
		Total					22.50	m^2		
		Say		22.5	m^2			@Rs	1091.02	**24,548.00**
16	17.2.1	Providing and fixing white vitreous china pedestal type water closet (European type W.C. pan) with seat and lid, 10 litre low level white P.V.C. flushing cistern, including flush pipe, with manually controlled device (handle lever), conforming to IS : 7231, with all fittings and fixtures complete, including cutting and making good the walls and floors wherever required:W.C. pan with ISI marked white solid plastic seat and lid								
		STP & Rail	2				2.00	No		
		Say		2.00	No			@Rs	6192.67	**12,385.00**
17	17.7.3	Providing and fixing wash basin with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require: White Vitreous China Wash basin size 550x400 mm with a pair of 15 mm C.P. brass pillar taps								
		STP & Rail	2	2.00			4.00	No		
		Say		4.00	No			@Rs	3351.04	**13,404.00**
18	10.6.3	Supplying and fixing rolling shutters of approved make, made of required size M.S. laths, interlocked together through their entire length and jointed together at the end by end locks, mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete, including the cost of providing and fixing necessary 27.5 cm long wire springs manufactured from high tensile steel wire of adequate strength conforming to IS: 4454 - part 1 and M.S. top cover of required thickness for rolling shutters.80x0.90 mm M.S. laths with 0.90 mm thick to cover								
		STP & Rail	2	1.50		2.40	7.20	m^2		
		Say		7.20	m^2			@Rs	3124.26	**22,495.00**

19	9.120.2	Providing and fixing factory made panel PVC door shutter consisting of frame made out of M.S. tubes of 19 gauge thickness and sized of 19 mm x 19 mm for styles and 15x15 mm for top & bottom rails. M.S. frame shall have a coat of steel primers of approved make and manufacture. M.S. frame covered with 5 mm thick heat moulded PVC 'C' channel of size 30 mm thickness, 70 mm width out of whicj 50 mm shall be flat and 20 mm shall be tapered in 45 degree angle on both side forming styles and 5mm thick, 95 mm wide PVC sheet out of which75 mm shall be tapered in 45 degree on th inner side to form top and bottom rail and 115 mm wide PVC sheet out of which 75 mm shall be flat and 20 mm shall be tapered on both sides to form lock rail. Top, bottom and lock rails shall be provided both side of the panel. 10 mm (5 mmx2) thick, 20 mm wide cross PVC sheet be provided as gap insert for top rail & bottom rail. paneling of 5 mm thick both side PVC sheet to be fitted in the M.S. frame welded /sealed to the styles & rails with 7 mm (5 mm + 2 mm) thick x 15 mm wide PVC sheet beading on inner side, and joined together with solvent cement adhesive. An additional 5 mm thick PVC strip of 20 mm width is to be stuck on the interior side of the 'C' Channel using PVC solvent adhesive etc. complete as per direction of Engineer -in-charge, manufacture's specification & drawing.30 mm thick pre laminated PVC door shutters								
		STP & Rail	2	1.00		2.20	4.40	m^2		
		Say		4.40	m^2			@Rs	2852.54	**12,551.00**
20	OD (LS)	Supplying and fixing syntex tank and laying pvc pipes, valve, taps, etc. for plumbing arrangements to the WC, including all materials and all labour charges including taking necessary KWA water connection.								
		STP & Rail	2				2.00	No		
		Say		2.00	No		LS	@Rs	80000.00	**160,000.00**
21	OD (LS)	Electrical wiring arrangements for lights, plug points and fan points.								
		STP & Rail	2				2.00	No		
		Say		2.00	No		LS	@Rs	70000.00	**140,000.00**
										4,592,547.00
V		**Additional provision for header pipes, valves, MH covers, crane and lifting arrangements,etc in pump houses-2 pump houses**								
									Ls	**3,000,000.00**
VI		**Supplying and providing blower arrangement for aeration suitable to collection well and all installation charge and electrical fittings,etc complete- 2 Nos**								
									LS	**400,000.00**
VII		**Supply and erection of 63 KVA diesel/petrol generator set- 2 Nos**								
									LS	**1,220,000.00**
VIII		**Electrical installation,earthing, cbling,control pannel, electric connections, KSEB doccumentation and supporting structures-2 sets**								
									LS	**2,000,000.00**
IX		**Construction of compound wall, fixing gate at New well zone at Rail Nagar**								
									LS	**1,500,000.00**
X		**Charges for effectiong house hold sewer connections @16500/Each**								**33,000,000.00**
XI		**Road restoration charges**								
1		Shoulder cutting								
			1094	1.1	1.1		1323.74			
								@Rs	1366.76	**1,809,234.88**
2		Concrete road								
			1	3671.2	1.8		6608.16			
		Say		6608.16	m^2			@Rs	4887.00	**32,294,078.00**
3		100mm thick interlocjing tiled road surface								
			1	3671.2	1.8		6608.16			
		Say		6608.16	m^2			@Rs	3747.10	**24,761,436.00**
3		Tar road surface restoration charges								
			1	7037.4	1.8		12667.32			

		Say		12667.32	m^3			@Rs	3086.87	**39,102,370.00**
4		BM & BC road surface restoration charges								
			1	7037.4	1.8		12667.32			
								@	3633.46	**46,026,201.00**
		TOTAL FOR ROAD RESTORATION								**143,993,320.00**
		Total								**513,787,708.00**
		Add GST 18%								**92,481,787.00**
XII		**Provision for shifting existing utilities**							**LS**	**5,000,000.00**
XIII		**Provision for side protection work in cases where there is chances for land slide and damage to nearby compound walls and buildings.**							**LS**	**1,500,000.00**
XIV		**Contingency to meet emergency situations (0.5%)**							**LS**	**3,322,500.00**
XV		**O& M charges for 10 years**								**42,964,530.00**
XVI		**Unforeseen**							**LS**	**5,443,475.00**
		Grand Total								**664,500,000.00**

ASST. ENGINEER
PPD CAMP OFFICE
KOCHI-18

ASSISTANT EXECUTIVE ENGINEER-I
SEWERAGE CIRCLE
KERALA WATER AUTHORITY
KOCHI-11

Executive Engineer
Sewerage Circle
Kochi - 11

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

Superintending Engineer
Kerala Water Authority
Sewerage Circle
Kochi - 11