2019

Detailed Site Assessment Study Covering Soil Investigation and Topographic Study Including Geographical and Environmental Features of Chelora in Kannur District Kerala"

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EXECUTIVE SUMMARY

Introduction

The rapid urbanization, constant change in consumption pattern and social behaviour have increased the generation of municipal solid waste (MSW) in Kerala beyond the management capacity of the existing waste management systems. Therefore, there is an urgent necessity of improved planning and implementation of comprehensive MSW management systems for upgrading the environmental scenario of the State. KSIDC intends to develop MSW processing plants across the state under public private partnership (PPP) format with the assistance of Transaction Advisor. In this regard KSIDC has appointed IRGSSA to Worked on "Detailed Site Assessment Study Covering Soil Investigation and Topographic Study Including Geographical and Environmental Features of **Chelora in Kannur District** Kerala"on its behalf. The broad objectives of the Study are to determine a technically and economically viable solid waste management project for a phased implementation to meet the requirements of the year 2043. The specific objectives include: To analyze the existing solid waste management system in the study area; to carry out Environment Due diligence for the processing site and To Examine the Physical chemical and Environmental parameters of the processing site.

The major scope of work identified is summarized below: To undertake the representative testing (Physical and chemical) properties of Feedstock/MSW in the location identified for the project. To Study the existing geographical and environmental features of the site, site conditions including land details nearest substation for power evacuation, source of water available nearby i.e surface and ground water, topographic & Soil conditions. To Study on the Climatic conditions at the site identified for the project. Detailed study and submission of report on the existing system of solid waste management at the project area, which shall include details of available sources and calorific values of solid waste generated, existing primary collection system, proposed secondary collection points and storage, transportation system, disposal and treatment system etc. To recommend the proposed waste management plan covering projected waste generation for next 25 years, detailed technology description, leachate collection and removal system, project implementation plan etc. To study and analyze the site in terms of the soil capacity and prepare the layout plan for the proposed WtE plant including landfill site etc. To study other relevant site conditions related to SWM Rules 2016 and subsequent amendments. A very comprehensive approach & methodology has been adopted to carry out the six items mentioned in scope of work. Major approach includes: Step 1: Desk review; Step 2: Field visit; Step 3: Sample audit & testing and Step 4: Interaction with plant officials.

Site Conditions

The Proposed site is located at Chelora Zonal Office of the district. Average Elevation of site is 40-41 m (from sea level.) Contour map (topographic) of the site based on Aster DEM (Digital Elevation model). Contour map shows undulating formations which on ground truthing indicated municipal waste dumps. The site falls under the jurisdiction of Kannur Corporation.

Geologically coastal alluvium is seen in the western coastal tract of the district. The coastal plain is characterized by secondary soils, which are sandy and sterile with poor water holding capacity. The width of the zone is more in the central part i.e., in the Kannur area and it is almost narrow in both north and southern areas of the district. The marshy soil in the coastal plain supports mangrove vegetation and is found at the estuaries and backwater extending inland along their courses. The soil is composed of recent deposits predominantly marine with some fluvial sediment along the coastline. These soils are immature with high sand content. River alluvium is found along river valleys cutting across the extensive lateritic soils. The soil is very deep with surface texture ranging from sandy loam to clay. It is fertile, having water holding capacity and plant nutrients which are regularly replenished during floods. . **Hydrogeologically the site falls under Coastal alluvium suitable for filter point wells and dug wells. Highly potential aquifer yield goes upto 50 lps. Depth to water varies from 0.5 to 3 m.b.g.l. The site falls under Kavvayi river basin in Kannur district. Chelora Site is falls under Coastal Alluvium soil formation.**

The Proposed site falls in the corporation area of the Kannur district. The Seasonal fluctuation (0.0007 m to 0.8277 m) of the water table is due to variation in the rainfall, evapotranspiration, withdrawals for irrigation and other purposes, base flow, seepage from surface water bodies etc. The Decadal depth to water level in the Ground Water Monitoring Wells of CGWB during pre and post monsoon periods is shown in Figure 2.11 & Figure 2.12 respectively. The district has a net annual ground water availability of 479.11 MCM with a net availability of 250.35 MCM for the future use. The depth to water level is good for domestic & Industrial water supply. Overall the block is safe for ground water usages.

Climate

Kannur district receives a total annual rainfall of around 3438 mm. District experiences heavy rainfall during the South West monsoon season followed by North East monsoon. South West monsoon during June to September contributes 70 % of the total rainfall of the year. The northeast monsoon contributes only about 30%. Rainfall is considerably less during the period from January to May. The year to year variability of annual rainfall is around 28.2%. In general, the rainfall increases from the coast to the eastern hilly regions. Kannur district falls under wet type of climate based on Thornthwaite's climatic classification.

Current SWM Management

The Urban local body (ULB) in Kannur is responsible for collection, transportation and disposal of Solid Waste except untreated bio-medical waste and hazardous industrial waste. Storage and segregation of waste at source is not very prominent KMC. About 72 MT of Municipal solid waste is generated in Kannur Municipality every day. The per capita waste generation is estimated to be 300 gm/cap/day considering a population of 239420. Out of this about 56 tons is collected and Transported by the Municipality every day. Therefore, the collection efficiency is 78%.

Households generate 48% of the total MSW generated in the city. It is followed by commercial establishments, hotels, street sweeping & markets. Considering 50% of solid

waste generation from households & hotels, it is expected that the solid waste to be rich in organic content. The calorific value of the waste is more than 1500 Kcal/kg.

The Municipality has assigned the task for door to door collection systems by Haritha Karma Sena who has collected biodegradable waste from Households, Commercial Establishments, Hotels, Restaurents and Market Associations and sends it to dump site or Thumburmuzhi Aerobic composting unit. And Non-biodegradable waste collected from households and individual establishments are stored in the collection units. The Plastic wastes collected are transported to the plastic shredding unit in Chelora site and then later the final shreeded plastics are sold to clean Kerala Company. Other biodegradables waste will be sold to registered recyclers or utilization agencies. As part of a project supported by Central and State pollution Control Board, KMC has organized 55 Kudumbsree units (each unit consists of 2 members) Which have been formed in each of the selected ward of the city with the help of State Poverty Eradication Mission. The sweepers employed by the municipality could clean only the main roads and central areas daily. They keep the waste in small heaps which are removed by a hand cart crew and coverage is limited. KMC operates 45 numbers of secondary collection points out of which 21 are open collection points. A mixed fleet of vehicles which are under operation include JCB, covered tractor trailers, two compartment covered LCV, ordinary tractors and Dumper Placer. There are 26 vehicles out of which on an average 16 vehicles are in operation.

Waste segregation at source is not a general practice. Households which are given the bins segregate the organic and inorganic waste at source itself. Haritha Karma Sena (HKS), sub depots buying recyclables from HKS, and major depots sorting and selling waste to recyclers separate plastic, paper, glass and metal to an extent. Some of the households and commercial establishments also separate recyclables and sell directly to vendors. With door to door collection, Kudumbsree units also separate recyclables and sell to sub depots.

Kannur Municipal Corporation owns a dumping ground at Chelora, 16 km away from city centre, in Chelora Zonal Office. The current was previously a solid waste Dumping ground. The site currently is abandoned; however few old wastes can be seen. The site has compound walls on all sides. The site belongs to the Kannur Municipal Corporation. The site however has a proposed area for sewage treatment plant, Public Park in the front area and a constructed yet not functioning MRF plant.

It is proposed to develop the entire ISWM project with provision of only 10% rejects going into the landfill site. The entire project is being proposed on 9.70 Acres based on PPP format. Future waste projections from the year 2017 till 2041 have been carried out considering a catchment of 30 KM around Chelora site. Municipalities, which are covered in this catchment include, Kannur, Mattannur, Shreekandapuram, Taliparamba, and Thalassery. Assumptions, which have been made, are given below.

1. **Per capita waste generation - 380 gm**

2. **Total population for all municipalities (2017) - 469843 [(Kannur- 239420, Mattannur- 49014, Shreekandapuram- 17695, Taliparamba- 75936, Thalassery- 87778)]**
3. **Estimated waste per day - 133.91 tons**
4. **Collection Efficiency - 70% - 75%**

The total waste generated per annum ranges from 48,875 tons in 2017 to 95,938 tons in 2041.

Sl. No	SWM 2016 Criteria for Sanitary Landfill/Plant	Status	Remarks
1	100 meter away from river		
2	200 meter away from a pond		
3	200 meter away from Highways, Habitations, Public Parks and water supply wells	EIA required if sanitary landfill site is proposed with the plant (Operator's Responsibility)	Habitation just few meters from the site
4	20 km away from Airports or Airbase		
5	Within the flood plains as recorded for the last 100 years, zone of coastal regulation, wetland, Critical habitat areas, sensitive eco-fragile areas		
	Complied with EIA requirement		
	Complied		

The entire project is proposed to be completed in two stages in 24 months. Site is suitable for Integrated Solid Waste Management Facility provided safeguards are in place as per SWM Rules 2016.

CHAPTER – 1: INTRODUCTION & METHODOLOGY

1.1 Introduction

The rapid urbanization, constant change in consumption pattern and social behaviour have increased the generation of municipal solid waste (MSW) in Kerala beyond the management capacity of the existing waste management systems. Therefore, there is an urgent necessity of improved planning and implementation of comprehensive MSW management systems for upgrading the environmental scenario of the State. It requires detailed information on the quantity and character of MSW generated and their physical and chemical properties. This is to evolve appropriate waste management strategy based on the principles of reduce, reuse and recycle and design appropriate collection, transportation, and processing and disposal system by using reliable data on quantity and quality of MSW generated in the State. KSIDC intends to develop MSW processing plants across the state under public private partnership (PPP) format with the assistance of Transaction Advisor.

1.2 Need for Study

The overall goal of solid waste management is to collect, treat and dispose of solid wastes generated by all population groups in an environmentally and socially satisfactory manner using the most economical means available. Seven sites in the state have been identified to be developed as waste processing plants.

In this regard KSIDC has appointed IRGSSA to Worked on "Detailed Site Assessment Study Covering Soil Investigation and Topographic Study Including Geographical and Environmental Features of **Chelora in Kannur** District Kerala"on its behalf as per the following scope of work.

1.3 Objectives of Study

The broad objectives of the Study are to determine a technically and economically viable solid waste management project for a phased implementation to meet the requirements of the year 2043. Following are the specific objectives:

- To analyze the existing solid waste management system in the study area.
- To carry out Environment Due diligence for the processing site.
- To Examine the Physical chemical and Environmental parameters of the processing site

1.4 Scope of Work

The major scope of work identified is summarized below:

- To undertake the representative testing (Physical and chemical) properties of Feedstock/MSW in the location identified for the project.
- To Study the existing geographical and environmental features of the site, site conditions including land details nearest substation for power evacuation, source of water available nearby i.e surface and ground water, topographic & Soil conditions.
- To Study on the Climatic conditions at the site identified for the project.
- Detailed study and submission of report on the existing system of solid waste management at the project area, which shall include details of available sources and calorific values of solid waste generated, existing primary collection system, proposed secondary collection points and storage, transportation system, disposal and treatment system etc.
- To recommend the proposed waste management plan covering projected waste generation for next 25 years, detailed technology description, leachate collection and removal system, project implementation plan etc
- To study and analyze the site in terms of the soil capacity and prepare the layout plan for the proposed WtE plant including landfill site etc.
- To study other relevant site conditions related to SWM Rules 2016 and subsequent amendments.

1.5 Approach & Methodology

A very comprehensive approach & methodology has been adopted to carry out the six items mentioned in scope of work. Major approach includes the following steps:

Step 1: Desk review,
Step 2: Field visit,
Step 3: Sample audit
Step 4: Interaction with plant officials

These steps are based on the broad principles of Environmental Site Assessment and cover the following methodology:

- Review the present conditions and evaluate any likely processing site history.
- Evaluation of risks of neighboring properties upon the subject property
- Review of Metrological data and hydro geological data
- Interview of persons knowledgeable regarding the plant history
- Verification of the records through sample audit & field visit.
- Conclusions & Recommendations

These steps are based on the broad principles of Phase 1 Environmental Site Assessment and cover the following tasks.

Task 1: Site visit & due diligence as per MSW Rules 2016 & amendments
Task 2: MSW sample testing (2 samples)
Task 3: Secondary data collection
Task 4: Data compilation & data analysis

Task 5: Report Preparation

Steps 1 to 4 were carried out during 25th January to 29th January 2018 followed by the analysis of data, findings and compilation of the report.

1.6 Format of Report

The report consists of the following chapters:

Chapter 1: Introduction & Methodology
Chapter 2: Existing Condition at Site
Chapter 3: Existing systems of SWM in Study Area
Chapter 4: Proposed Management Plan for Site
Chapter 5: Conclusions

CHAPTER – 2: EXISTING CONDITION AT SITE

2.0 Introduction

The proposed project is the development of Municpal Solid Waste Management Facility Facility at Chelora Site. This chapter describes the existing site conditions particularly its location, physiography, topography, geology, soil & climatic conditions.

2.1 Chelora Site

The proposed site is located at Chelora **between 11.902198° N, 75.438866° E** at an altitude of 40 to 41 meters above mean sea level (ASL). The site falls in Chelora Zonal Office at the Kannur District summarized in **Table 2.1**. The site is located on an undulating terrain just besides the Kannur-Mattannur Road. The proposed site is approximately 8 km parallel away from the sea shore. The area of the site is around 15 acres, the site location along with 100 meters to 200 meters buffer zone is shown in **Figure 2.3**. The Site is connected to Kannur-Mattannur Road with 600 meter long, 6 m wide Road. **(Figure 2.4)**

Table 2.1: Location Details of the Site

Site	Chelora, Chelora Zonal Office (15 Km from city centre)
District	Kannur
Location	**11.902198° N, 75.438866° E**
Altitude in meters (ASL)	40-41 mtr. (from Sea Level)
Land Area	15 Acres
Land Ownership	Kannur Municipal Corporation
Approach Road	600 meter long, 6 m wide.

Figure 2.1: Chelora Site Location

Figure 2.2: Chelora Site & Site Buffer

Figure 2.3: 100 m & 200 m Buffer Around Chelora Site

Figure 2.4: Access road to Site

2.2 Physiography & Topography

Kannur district can be divided physiographically into three distinct geomorphologic units viz the coastal plains and lowlands in the western part, the central undulatory terrain comprising the midland region and eastern highland region. The coastal plains occurs as a narrow belt of alluvial deposits running parallel to the coast with a maximum width of about 15 km. Midland region forms a plateau land at certain places covered by a thick cover of laterite. The hilly tract in the eastern part consists of highly rugged terrains. The Ezhimala peak (259.69m) with the characteristic N-S alignment is a distinct physiographic unit in the coastal plains. Minor cliffs of laterite generally rising to an elevation of 50 to 60 m above mean sea level are found at Mahe, Thalasserry and Bekal coast. The midland region presents a plateau land covered by a thick cover of laterite. This is immediately to the east of the coastal strip, rising from 40 to 100 m above msl. The valleys in the plateau are gorge like and V shaped cut by youthful streams. The hilly tract along the eastern part of the district constitutes the highland region and is highly rugged. Development of bad land topography along the margins of the valley is a common feature observed in the district. **The site falls in areas which are Coastal Plain.**

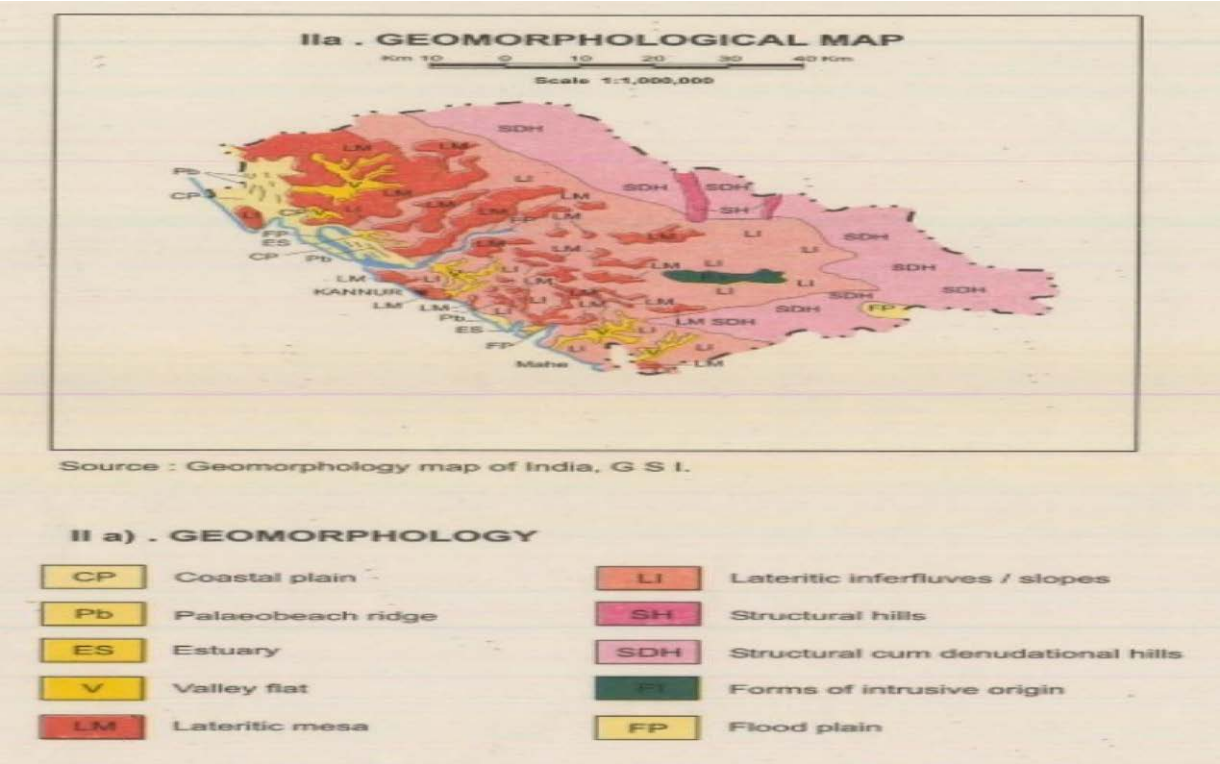


Figure 2.5: Geomorphological map of Kannur District

The Proposed site is located at Chelora Zonal Office of the district. Average Elevation of site is 40-41 m (from sea level.) Contour map (topographic) of the site based on Aster DEM (Digital Elevation model) is shown in Figure 2.6. Contour map shows undulating formations which on ground truthing indicated municipal waste dumps. The site falls under the jurisdiction of Kannur Corporation.

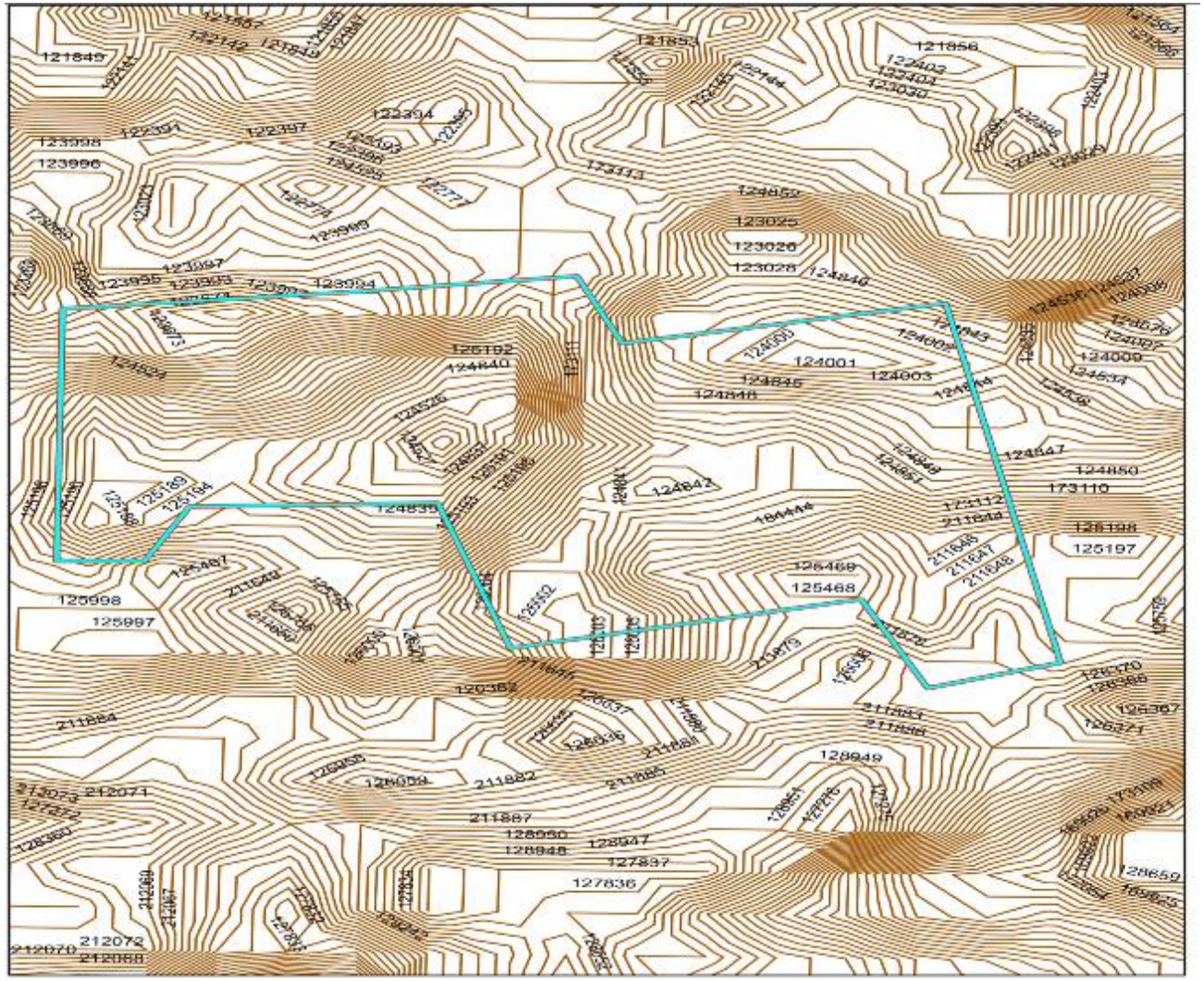


Figure 2.6: Topography of Existing Site

Drainage

Kannur district is mainly drained by the *Valapattanam* and *Anjarakandy* rivers. The other rivers are *Kuppam*, *Mahe*, *Thalasserry* etc. Dendritic is the common drainage pattern. The *Valapattanam* river, which is the longest in the district originates from Brahmagiri Reserve forest in Coorg district of Karnataka. The drainage area of the river in Kerala is 1321 sq.km. The *Anjarakandy* river originates from the Kannoth Reserve forest. The drainage area of the river is 412 sq.km.

Kannur district has 23,312 ha. Area under irrigation, which accounts about 8.01% of the gross irrigated area of the state. Kannur district is provided with one major irrigation Project along with some minor irrigation projects.

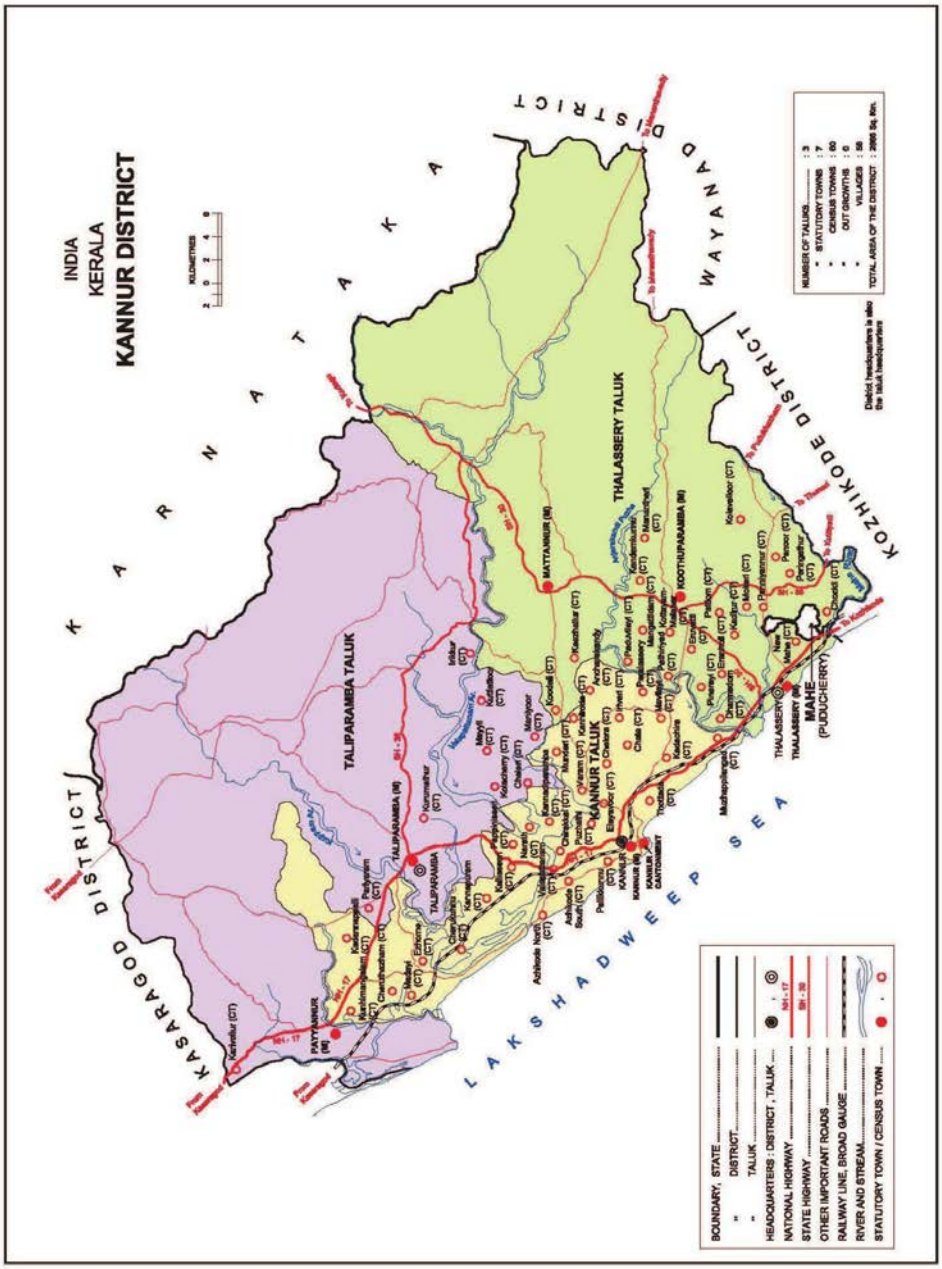


Figure 2.7: Drainage Pattern of District & the Proposed Site

The major irrigation scheme of the district is Pazhassi project. The command area fixed for Pazhassi project was 11525 ha of land. However only 8125 ha of land has been benefited through this project as on date. Ground water is also used for irrigation purposes. In addition to this, there are private tanks to facilitate the irrigation sector.

2.3 Geology & Soil

The district can be broadly divided into seven geological belts trending NW-SE viz., (i) northern belt of Charnockite group extending further north and east to the adjacent districts, (ii) north central belt of Wayanad schist complex, (iii) Central belt of Peninsular Gneissic Complex extending to the southeast, (iv) south central belt of Vengad Group, equivalent to Dharwars, (v) southernmost belt of Migmatite Complex which extends further south to the adjacent district, (vi) Sedimentary (Warkalli Beds) in the western part near the coast and (vii) Quaternary sediments along the coast. The lithology of Kannur district is grouped under Precambrian, late Tertiary and Quaternary periods and the Precambrian rocks dominate over the other two. Charnockite Group, includes pyroxene granulite, charnockite (hypersthene granulite) and hornblende-diopside granulite. While hornblende granite and charnockite occupy large areas, pyroxene granulite occurs as linear bodies in the southeast. Hornblendebiotite gneiss constitutes the litho unit of Migmatite Complex. It has a large areal extent along the coast, south of Kannur. Towards east and southeast, discrete metasedimentary and ultramafic sequences which have been designaed as Wayanad Schist Complex and are considered equivalent of Sargur Group of Karnataka. They occur as isolated bands within charnockite and gneiss. Their contacts are generally discordant due to later folding, metamorphism and migmatisation. The group comprises quartzite, magnetite quartzite, garnet-kyanite-sillimanite gneiss, quart-mica-kyanite schist, quartz-sericite schist, amphibolite, kyanite-sillimanite-sericite quartzite, metaultramafites. Garnetkyanite-sillimanite gneiss/schist is widespread in the east, whereas the other members of Wayanad Complex occur as linear bands, lensoidal bodies and vestiges to the West Peninsular Gneisic Complex, represented by hornblende-biotite gneiss comprise of a complex suite of gneisses and granites, representing the anatectic phase of migmatisation of schist complex. East of Kannur extending upto Tellichery in the south, a large body of quartz-mica schist is separated from the other schistose rocks by a conglomerate horizon extending over 8km. This lithounit known as Vengad Formation, characterised by lack of migmatisation, presence of primary structres and absence of high grade minerals, is correlatable with rocks of Dharwar Super Group. Large bodies of anortjosite, gabbro, granite and granophyre from the post Vengad basic and acid intrusives. Dolerite dykes trending NW-SE represent the younger basic intrusives. Late Tertiary sedimentary rocks (Warkalli beds) occur as isolated patches along the coast near Kannur, Pazhayangadi and east of Payyannur. They comprise variegated clays and friable sandstone. At Kannur and Pazhayangadi, carbonaceous clay with thin seams of lignite is reported towards bottom of the sedimentary sequence. The Tertiaries as well as the basement rocks are extensively lateritised. The pebble bed, reported near Valapatnam along the bank of Valapatanam river, is considered to be of Quaternary age. Quaternary alluvial deposit occur along the coast and in the valleys. They constitute palaeo-marine deposit (Guruvayur Formation), fluvial deposit (Periyar Formation) of Valapatnam and Dharmadom rivers, fluvio-marine deposits (Viyyam Formation) and

beach deposits (Kadappuram Formation). The geology of the district given above may be read with the "Geology of Kerala" which is given for better understanding of geological succession and stratigraphic sequence. **Hydrogeologically the site falls under Coastal alluvium suitable for filter point wells and dug wells. Highly potential aquifer yield goes upto 50 lps. Depth to water varies from 0.5 to 3 m.b.g.l. The site falls under Kavvayi river basin in Kannur district.**

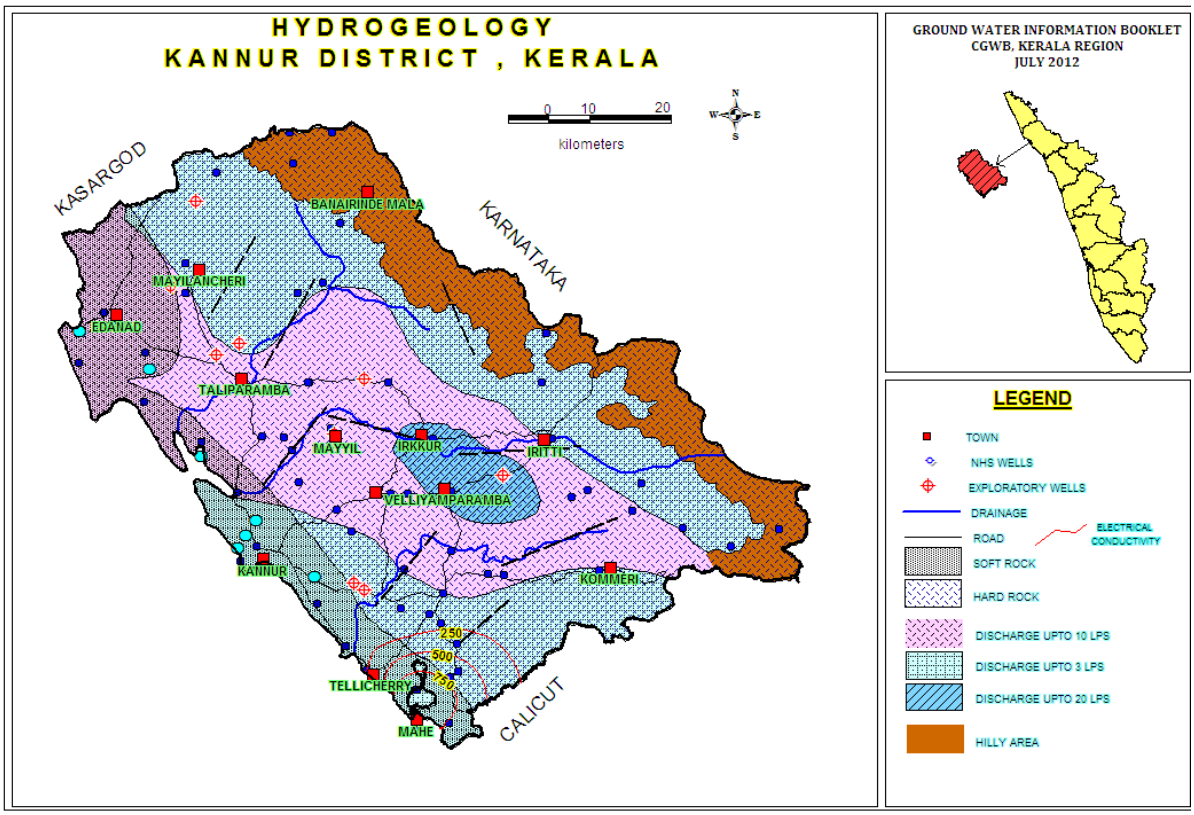


Figure 2.8: Hydrogeology Kannur District Kerala

Soil types

There are mainly four types of soil observed in the district.

(1) Lateritic soil
(2) Brown hydromorphic soil
(3) Coastal and river alluvium
(4) Forest Loamy soil

Lateritic soil – The predominant soil in the district is lateritic soil, which is the weathered product derived under humid tropical conditions. It occurs mainly in the midland and hilly areas characterized by rugged topography. They range from sandy loam to red loam.

Brown hydromorphic soil – These are confined to the valleys between undulating topography in the midlands and in the low lying areas of the coastal strip in the district. These soils are brown in colour and the surface texture varies from sandy loam to clay. They have been formed as a result of transportation and deposition of materials from

adjoining hill slopes and also through deposition by rivers.

Coastal and river alluvium – The coastal alluvium is seen in the western coastal tract of the district. The coastal plain is characterized by secondary soils, which are sandy and sterile with poor water holding capacity. The width of the zone is more in the central part i.e., in the Kannur area and it is almost narrow in both north and southern areas of the district. The marshy soil in the coastal plain supports mangrove vegetation and is found at the estuaries and backwater extending inland along their courses. The soil is composed of recent deposits predominantly marine with some fluvial sediments along the coastline. These soils are immature with high sand content. River alluvium is found along river valleys cutting across the extensive lateritic soils. The soil is very deep with surface texture ranging from sandy loam to clay. It is fertile, having water holding capacity and plant nutrients which are regularly replenished during floods.

Forest Loamy soil – These soils are found in the eastern hilly areas of the district and are characterised by a surface layer rich in organic matter. They are generally acidic and are dark reddish brown to black in colour with loam to silty loam texture. **Chelora Site is falls under Coastal Alluvium soil formation.**

A soil sample of the proposed site was taken for the lab analysis. The results of the different parameters are summarized in **Table 2.2**. The soil has been found to little acidic with major hazardous elements like Cd, Hg, Cv, Ni & Lead much below 0.1 mg/kg. The Soil has reasonable C:N ratio.

Table 2.2: Soil Properties at Dumpsite

Parameter	Results
pH	5.68
Moisture	8.1%
Cadmium as Cd	<0.01mg/kg
Iron as Fe	2579 mg/kg
Manganese as Mn	123.96 mg/kg
Copper as Cu	<0.1 mg/kg
Zinc as Zn	60.77 mg/kg
Mercury as Hg	<0.1 mg/kg
Chromium as Cr	<0.1 mg/kg
Nickel	<0.1 mg/kg
Lead	<0.01 mg/kg
C:N Ratio	23:2

2.4 Ground Water Scenario

Groundwater occurs under phreatic conditions in weathered mantle of the crystalline rocks, laterites and unconsolidated coastal sediments. It occurs under semi confined to confined conditions in the deep-seated fractured aquifers of the crystalline rocks and Tertiary sediments.

Hydrogeology

Kannur district is underlain by charnockites, pyroxene granulites, garnetiferous gneisses, hornblende biotite gneisses and schistose rocks overlain by Tertiaries and coastal alluvium along the coast ranging in age from Archaean to Recent. These rocks have undergone weathering and lateritisation. The hydrogeological units encountered in the district are (i) consolidated formations (weathered and fractured crystallines) (ii) Semi consolidated sediments equivalent to Warkalies of Southern Kerala and Laterite formations and (iii) unconsolidated formations (Recent alluvium occurring along the coast).

Consolidated formations

The weathered and fractured rocks in the crystalline formations form potential phreatic shallow aquifers and are composed essentially of charnockites, hornblende gneisses, schists and other intrusives. In the phreatic crystalline formations the depth to water level varies from 2.14 to 19.95 m bgl during premonsoon and from 1.28 to 19.03 m bgl during post monsoon period. The wells located in charnockites vary in depth from 6 to 13 m bgl. The thickness of weathered zone in the district is in the range of 3 to 20 m. The degree of weathering is generally low in charnockite areas. The gneissic rocks are highly weathered and well jointed and form good water bearing zones. The yield of the wells ranges from 10 to 20 m3 / day. They can sustain pumping only for an hour and recuperation rate is very poor.

The deeper fractured crystalline aquifers are under semi confined to confined conditions. They are tapped through bore wells for domestic, agriculture purposes. The potential fractures are encountered at depth varying from 10 to 120 mbgl. The Board has constructed 12 Exploratory Wells in the district. Depth of wells ranges from 86 to 200 m bgl and the discharge ranges from 0.62 to 840 lpm. The details of wells drilled in hard rock area of the district.

Semi consolidated formations

Tertiaries, equivalent to Vaikom beds of Southern Kerala occur along the coastal region of the district from Dharmadam (8 kms south of Kannur) up to the district boundary in the north. These are found to be lateritised on the top. Tertiaries are not potential aquifers in this district as they do not have potential fracture zones. Laterite is considered to be the marker horizon to differentiate between Tertiary and Recent alluvial sediments. The thickness of laterite ranges from 10 to 20 m. Laterite constitutes a potential aquifer in the mid land regions of the district. Due to the porous nature of laterites, the dug well tapping laterite get recharged fast and also the recharge water escapes as sub surface flow and water level falls quite fast especially in wells located in topographic highs and steep slopes. The depth of dug wells in the laterite range from 8 to 23 m.bgl. Depth to water level varies from 4 to 20 m.bgl during pre-monsoon and 1.5 to 19 m.bgl during post monsoon period. The yield of the wells ranges from 15 to 30 m3/day.

Dug wells tapping laterites in the coastal area do not exist in the district as laterites

occur at considerable depth below the coastal alluvium.

Unconsolidated formations

The coastal alluvium comprising of sand, silt and clay forms potential phreatic aquifers in the district. It occurs all along the coast and in the valleys and is extensively developed by a large number of dug wells and filter point wells. As per the data of bore holes drilled by CGWB, thickness of alluvium is generally low in Kannur district except around Muzhappilangad where it is more than 20 m**.** The depth to water level in the dug wells during pre-monsoon ranges from 1.66 to 2.35 m.bgl and 0.76 to 2.0 m.bgl during post monsoon period. The details of wells drilled in sedimentary area of Kannur.

Figure 2.9: Geohydrology of Kannur

(Source: District Resource map, Kannur district, Geological Survey of India)

Water Level Fluctuation

The Decadal mean depth to water level in the pre monsoon and post monsoon periods and the hydrogeology of Kannur district.

The long term water level fluctuation (2002 – 2011) in the district have been analysed using the historical data of observation wells in the district. The trend analysis for the pre monsoon period indicates that the water levels are showing a rising trend in about 75 % of the wells analysed and it ranges from 0.0007 to 0.8277 m/yr. Declining trend of water levels ranging from 0.0033 to 0.5056 m/yr have been observed in about 25 % of wells in the district. During post monsoon period, rising trend is observed in about 70 % of the wells analysed in the district. The rise is in the range of 0.0064 to 0.04912 m/yr. Declining trend of water levels ranging from 0.008 - 0.1936 m/yr have been observed in about 30 % of wells in the district. Kannur Municipal Corporation area falls in Safe of ground water

(Figure 2.13).

The Proposed site falls in the corporation area of the Kannur district (Figure 2.10). The Seasonal fluctuation (0.0007 m to 0.8277 m) of the water table is due to variation in the rainfall, evapotranspiration, withdrawals for irrigation and other purposes, base flow, seepage from surface water bodies etc. The Decadal depth to water level in the Ground Water Monitoring Wells of CGWB during pre and post monsoon periods is shown in Figure 2.11 & Figure 2.12 respectively. The district has a net annual ground water availability of 479.11 MCM with a net availability of 250.35 MCM for the future use. The depth to water level is good for domestic & Industrial water supply. Overall the block is safe for ground water usages.

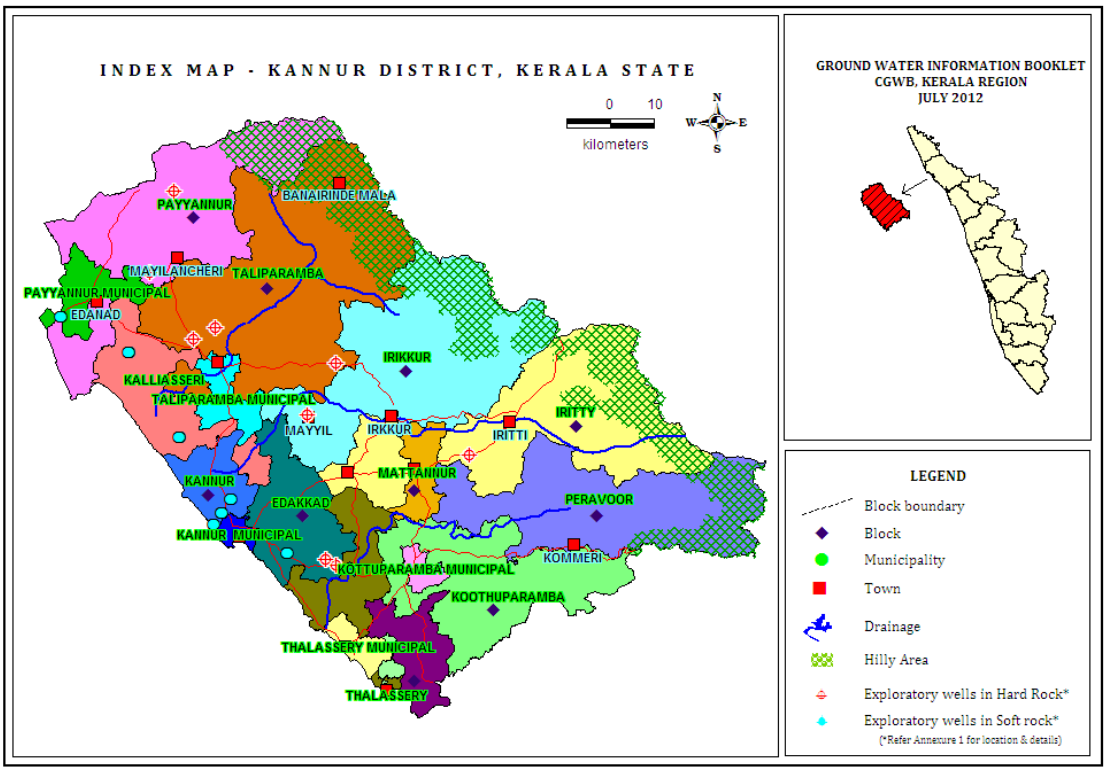


Figure 2.10: Index map of Kannur District

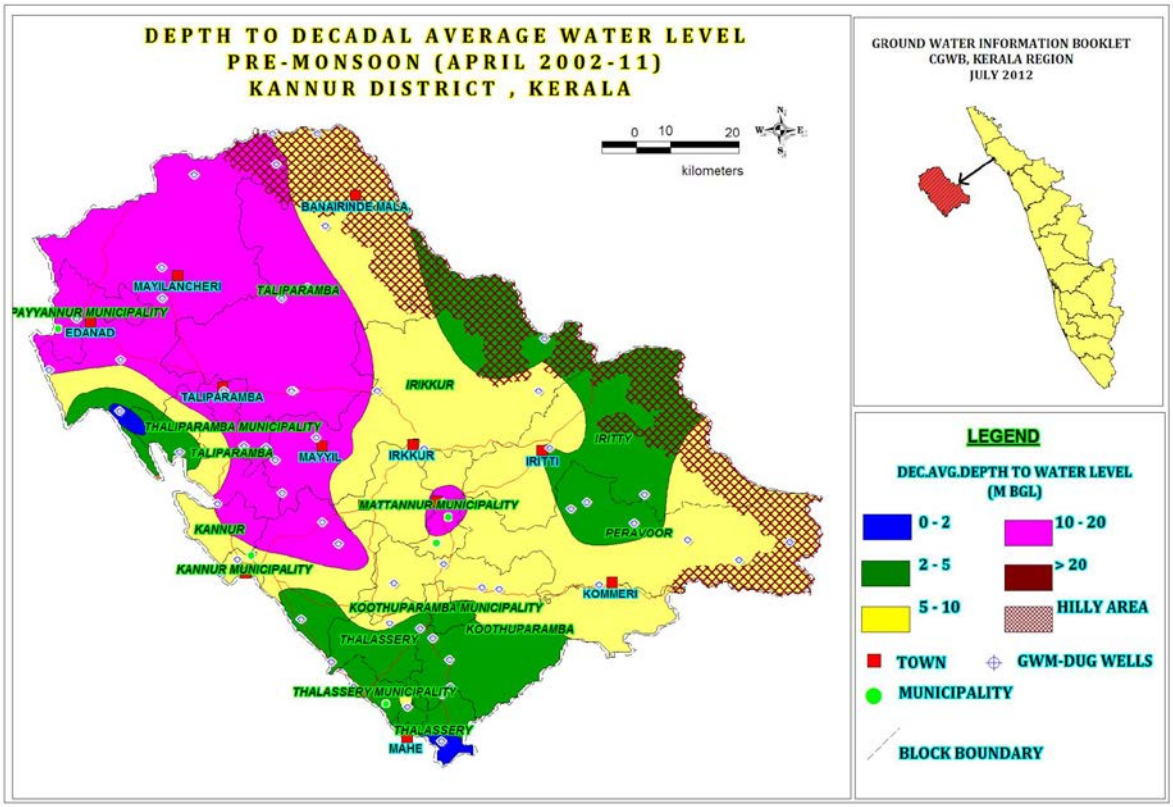


Figure 2.11: Depth to Decadal Average Water Level - Premonsoon (April 2002-11)

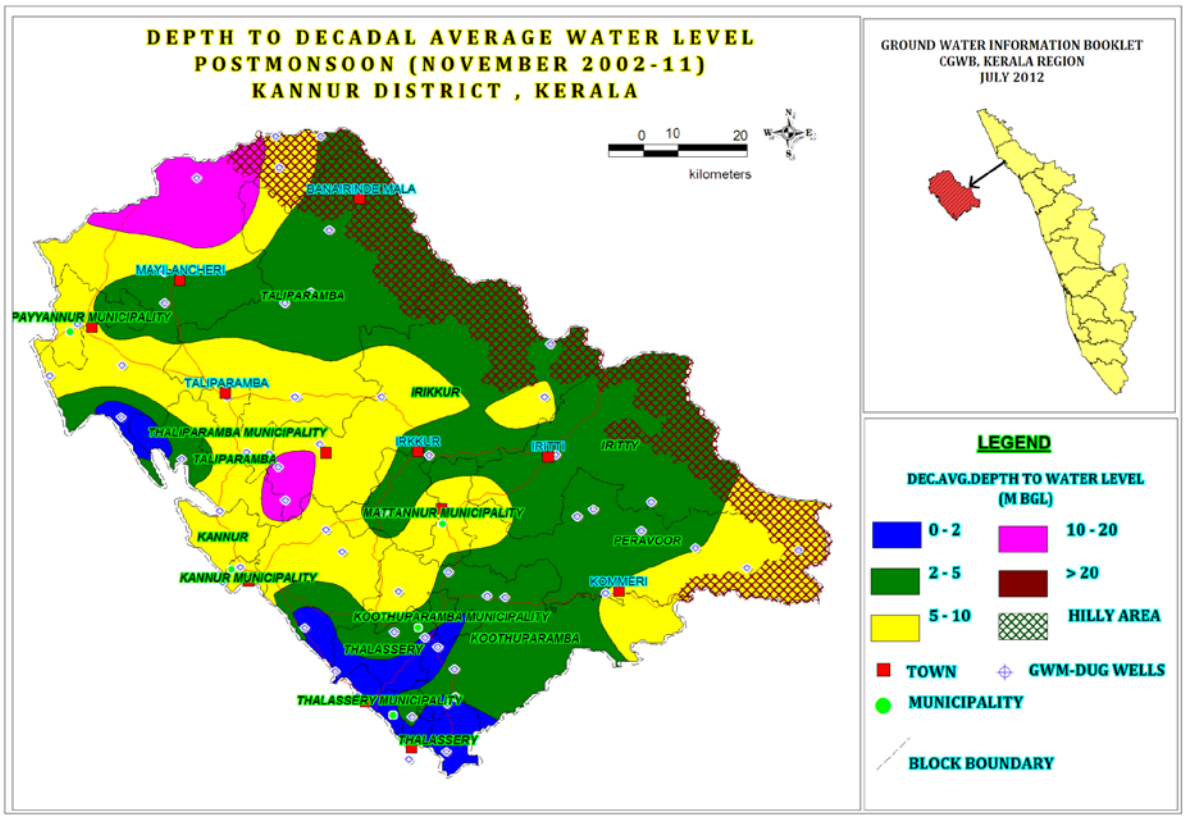


Figure 2.12: Depth to Decadal Average Water Level – Post-monsoon (Nov-2002-2011)

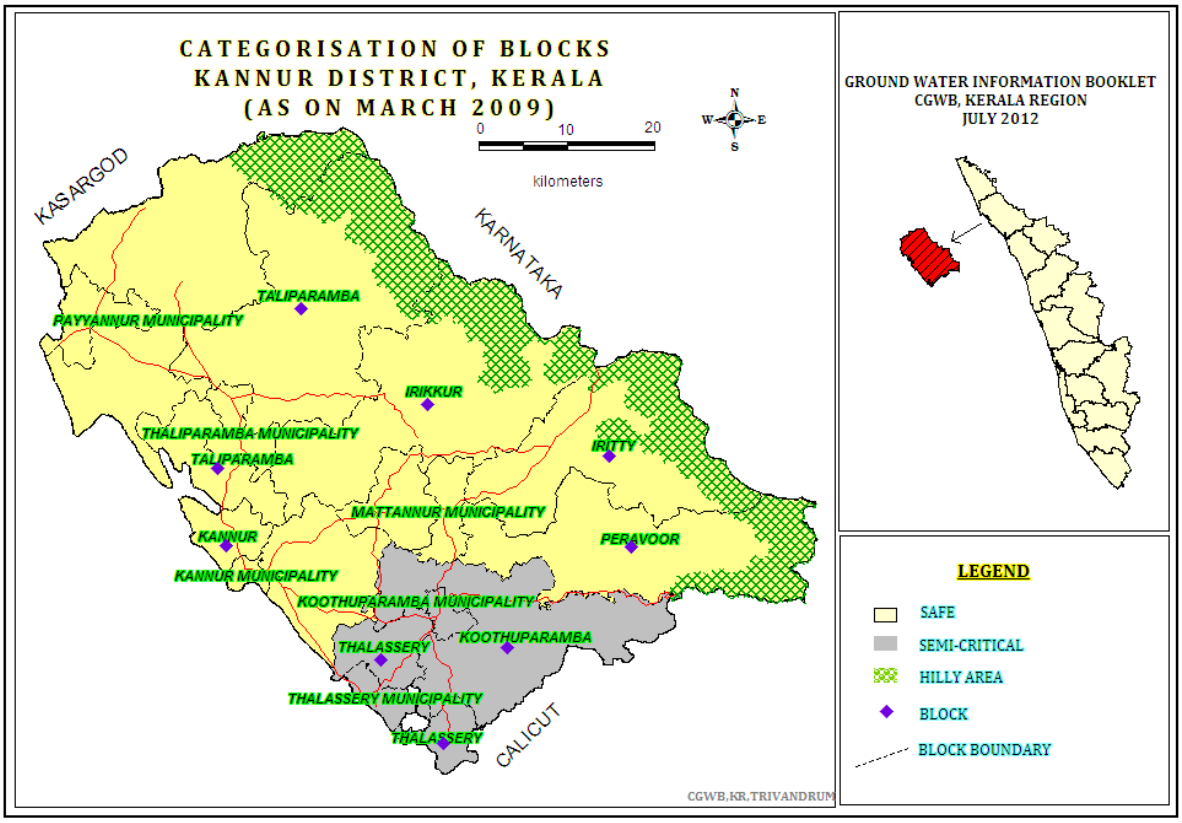


Figure 2.13: Categorisation of Blocks in Kannur District

2.5 Climatic Conditions

Climatic condition of the Kannur district has been described in terms of Rainfall, Temperature, Relative Humidity, Evaporation, Sunshine, Wind and Temperature.

Kannur district receives a total annual rainfall of around 3438 mm. District experiences heavy rainfall during the South West monsoon season followed by North East monsoon. South West monsoon during June to September contributes 70 % of the total rainfall of the year. The northeast monsoon contributes only about 30%. The distribution of rainfall during year 2006 to 2011 is shown in **Table 2.3** Rainfall is considerably less during the period from January to May.

Table 2.3: Annual Rainfall in Kannur district, Kerala (2007-2011)

Year	Jan	Fab	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
2006	0	0	16	5	617	735	674	491	570	267	97.5	2	3475
2007	0.1	0.2	0	45.4	213.4	949.8	1115.9	783.8	595.6	315.1	72.3	0.2	4091.8
2008	0	0.6	250.2	23.7	56.6	725.8	483.6	480.3	396.4	392.5	3	9.8	2822.5
2009	0	0	9.3	97.2	169.6	625.3	1456.2	299.5	320.5	200.3	306.8	48.7	3533.4
2010	19.	0	9.4	65.3	137	843.	959.	511	269.	342.	338.	2.3	3497

Year	Jan	Fab	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
	1					9	6		3	3	1		.3
2011	0	0	0	90.3	44.3	1093.8	852.5	647.5	436.4	214.5	91.4	0.5	3471.2

The year to year variability of annual rainfall is around 28.2%. In general, the rainfall increases from the coast to the eastern hilly regions. Kannur district falls under wet type of climate based on Thornthwaite's climatic classification

Meteorological Parameters

Apart from the rainfall, the meteorological parameters play an important role in groundwater balance estimation and other types of relevant studies.

Temperature

The temperature is more during the months of April to May and is less during December and January. The average mean monthly maximum temperature ranges from 28.4 to 36.90C and minimum temperature ranges from 19.7 to 23.90C.

Relative Humidity

Relative humidity is more during south west monsoon season (ie June to September). It is more during morning hours and is less during evening hours. Humidity ranges from 77 to 88 % in the district.

Evaporation

Evaporation is more during summer months of March to May and low during the months of June to November. The mean evaporation ranges from 2.6 to 5.7 mm/day.

Sunshine Hours

Generally good sunshine hours are recorded in the month of November to May. January to March records the maximum sunshine hours of more than 9.1 hours/day. The months of June to August records the minimum sunshine due to cloudy sky.

Wind

Wind speed ranges from 2.1 to 3.3 km per hour with mean speed of 2.6 km/hr. The wind speed is high during the period from March to June and low during the period from September to December.

Potential Evapotranspiration (PET)

The monthly PET ranges from 124.5 to 170.6 mm. PET values are lower than the monthly rainfall during the months of May to October indicating water surplus for possible recharge into groundwater regime during these months.

CHAPTER – 3: EXISTING SYSTEM OF SOLID WASTE MANAGEMENT

3.0 Introduction

Existing Solid Waste Management (SWM) System has been described considering current situation of Solid waste, its generation, its physical & chemical characteristics & its current system of collection, treatment & disposal.

3.1 Present Situation- Kannur Municipal Corporation

The Urban local body (ULB) in Kannur is responsible for collection, transportation and disposal of Solid Waste except untreated bio-medical waste and hazardous industrial waste. Storage and segregation of waste at source is not very prominent KMC. Health department of the ULB is responsible for solid waste management. ULB has a net work of community collection points and this waste is collected manually into a fleet of vehicles. Waste is also collected through Door to Door, Dustbins and Community bins. Most of the waste is thrown into open spaces/drains/water bodies. The waste collected from the door to door, is being deposited in a waste dumping yard at Chelora.

3.2 Sources and Quantity of Solid Waste Generated

About 72 MT of Municipal solid waste is generated in Kannur Municipality every day. The per capita waste generation is estimated to be 300 gm/cap/day considering a population of 239420. Out of this about 56 tons is collected and Transported by the Municipality every day. Therefore, the collection efficiency is 78%. Source-wise generation of solid waste generated in the city is described in **Table 3.1**

Table 3.1: Source wise quantity of Solid Waste generated in Municipality Area

Sr. No.	Source	Total Waste (Tonnes/day)	% of Total
1	Households	34.56	48
2	Commercial Establishment	7.92	11
3	Marriage Hall	0.72	1
4	Hotels	7.92	11
5	Markets	4.32	6
6	Institutions	3.6	5
7	Street Sweeping	6.48	9
8	Hospitals	1.44	2
9	Slaughter House	0.72	1
10	C & D Waste	4.32	6
		72	**100**

Table 3.1 indicates that households generate 48% of the total MSW generated in the city. It is followed by commercial establishments, hotels, street sweeping & markets. Considering 50% of solid waste generation from households & hotels, it is expected that the solid waste to be rich in organic content.

Table 3.2: Physical Characteristics of MSW

Parameters	% to total Weight
Paper	2.81
Plastic	3.72
Metals	1.25
Glass	0.84
Rubber &Leather	0.95
Inerts	0.96
Ash & Fine earth	2.61
Compostable organic matter	86.34
Batteries/Pesticides/hazardous medicines	0.51
Others	0.01
Total	100.00

Table 3.3: Chemical Properties of the Solid Waste

Sr. No.	Parameter	Results
1	pH	4.13
2	Density	1.0010 g/m^3
3	Calorific Value	1539 Kcal/Kg
4	Total Phosphate	1808 mg/kg
5	Total Nitrogen	1244 mg/kg
6	Total Potassium	972 mg/kg
7	Total Organic Carbon	34.69%
8	Copper	<0.1 mg/kg
9	Iron	244 mg/kg
10	Nickel	<0.1 mg/kg
11	Zinc	31.28 mg/kg
12	Chromium	<0.1 mg/kg
13	Lead	<0.1 mg/kg
14	Cadmium	<0.1 mg/kg
15	C :N Ratio	71.2

Two sample of MSW were collected from the site as well as from the catchment area. Their physical and chemical analysis, which were carried out are summarized (Average Value) in **Table 3.2 and Table 3.3. Table 3.2 indicates that the waste is rich in organic content, while Table 3.3 indicates that the calorific value of the waste is more than 1500 Kcal/kg.**

3.3 Primary Collection

As part of a project supported by Central and State pollution Control Board, KMC has organized 55 Kudumbsree units (each unit consists of 2 members) Which have been

formed in each of the selected ward of the city with the help of State Poverty Eradication Mission. **The primary waste collection is carried by Push cart, Auto Tipper, Tipper Trucks and Dumper Placer in these wards (Figure 3.1).**

Figure 3.1: Primary Collection System

3.4 Street Sweeping

The sweeping operation managed by Health Circles, covers only the main roads and certain parts of city centre area on a daily basis. The streets branching off from main roads are swept on alternate days or once in a week.

The sweepers employed by the municipality could clean only the main roads and central areas daily. They keep the waste in small heaps which are removed by a hand cart crew and coverage is limited.

3.5 Secondary Collection and Storage

KMC operates 45 numbers of secondary collection points out of which 21 are open collection points. KMC aims at reducing the collection points by vehicle to vehicle transfer. Major markets are provided with dumper containers.

3.6 Transportation of waste

A mixed fleet of vehicles which are under operation include JCB, covered tractor trailers, two compartment covered LCV, ordinary tractors and Dumper Placer. There are 26 vehicles out of which on an average 16 vehicles are in operation. (Figure 3.5)

Figure 3.2: Waste Transportation

3.7 Door to Door Collection System

The Municipality has assigned the task for door to door collection systems by Haritha Karma Sena who has collected biodegradable waste from Households, Commercial Establishments, Hotels, Restaurents and Market Associations and sends it to dump site or Thumburmuzhi Aerobic composting unit. And Non-biodegradable waste collected from households and individual establishments are stored in the collection units. The Plastic wastes collected are transported to the plastic shredding unit in Chelora site and then later the final shreeded plastics are sold to clean Kerala Company. Other biodegradables waste will be sold to registered recyclers or utilization agencies.

Figure 3.3: Door to Door Collection System

With the introduction of door step collection, and awareness campaigns, the community participation is improving as seen from the increasing participation. About 50% households participate in door to door collection. The Residents' Associations play a key role in participating in this programmes. The ward level committee set up during the Model Project Implementation has been instrumental in promoting participation in the initial stages.

3.8 Segregation and Storage at Source

Waste segregation at source is not a general practice. Households which are given the bins segregate the organic and inorganic waste at source itself. Haritha Karma Sena (HKS), sub depots buying recyclables from HKS, and major depots sorting and selling waste to recyclers separate plastic, paper, glass and metal to an extent. Some of the households and commercial establishments also separate recyclables and sell directly to vendors (Figure 3.4). With door to door collection, Kudumbsree units also separate recyclables and sell to sub depots. Though the opportunities of rag pickers reduce due to the direct collection by the door to door crew, the percentage of segregation of recyclables has increased.

Figure 3.4: Waste Segregation

3.9 Disposal and Treatment of Waste

Kannur Municipal Corporation owns a dumping ground at Chelora, 16 km away from city centre, in Chelora Zonal Office. The current was previously a solid waste Dumping ground. The site currently is abandoned; however few old wastes can be seen. The site has compound walls on all sides. The site belongs to the Kannur Municipal Corporation. The site however has a proposed area for sewage treatment plant, Public Park in the front area and a constructed yet not functioning MRF plant. The existing plant layout is shown in **Figure 3.7**.

Figure 3.5: Dumpsite at Chelora

Non-biodegradables waste viz., plastic products are processed at MRF Shredding unit. Other non-biodegradables waste viz., glass, paper, e-waste are collected and utilized for commercial purposes.

Figure 3.6: Plastic Shredding Unit at Chelora

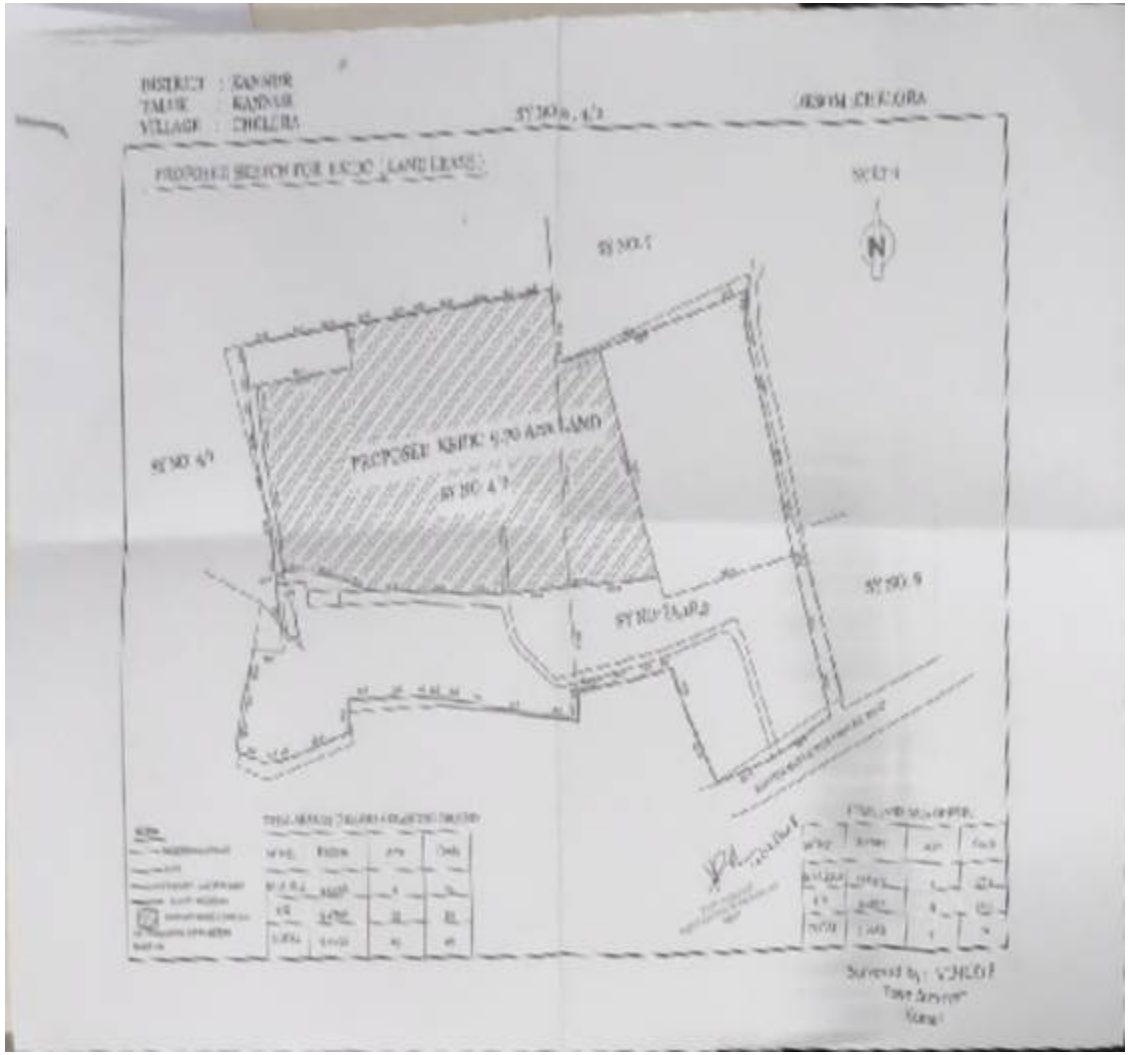


Figure 3.7: Existing Plant Layout

CHAPTER – 4: PROPOSED MANAGEMENT PLAN

4.1 Introduction

Management of municipal solid waste and adoption of processing technologies are dependent on the quantity and characteristics of the total waste generated in a local authority, the financial resources available and in-house capability of local authorities to oversee project implementation. The Integrated Solid Waste Management (ISWM) system proposes a waste management hierarchy with an aim to reduce the amount of waste being disposed, while maximizing resource conservation and resource efficiency. Based on the suggested waste management hierarchy and an assessment of Kannur Municipality, it is proposed to develop the entire project as shown in **Figure 4.1**.

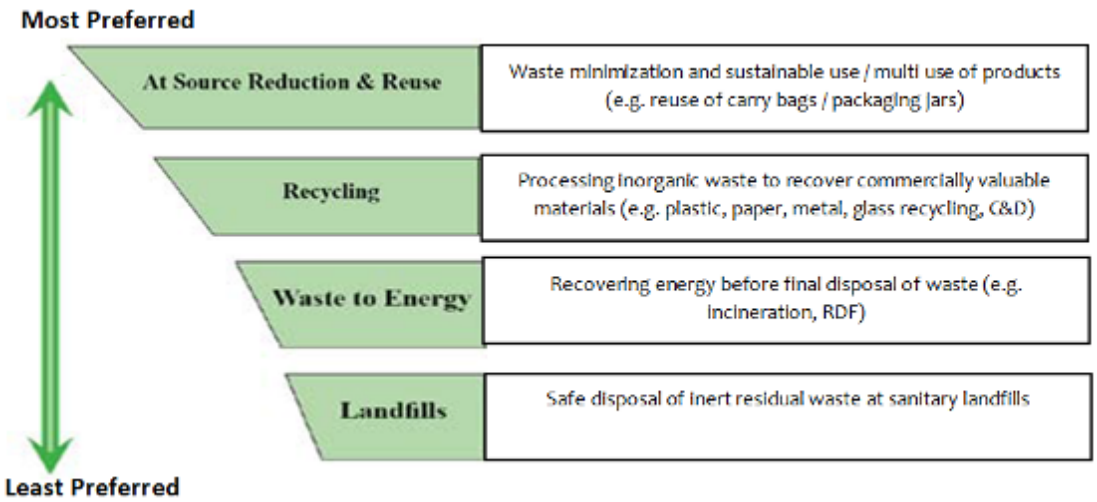


Figure 4.1: Integrated Solid Waste Management (ISWM) System

It is proposed to develop the entire ISWM project with provision of only 10% rejects going into the landfill site. The entire project is being proposed on 9.70 Acres based on PPP format.

4.2 Future Waste Projections

Future waste projections from the year 2017 till 2041 have been carried out considering a catchment of 30 KM around Chelora site. Municipalities, which are covered in this catchment include, Kannur, Mattannur, Shreekandapuram, Taliparamba, and Thalassery (Figure 4.2). Assumptions, which have been made, are given below.

1. **Per capita waste generation - 380 gm**
2. **Total population for all municipalities (2017) - 469843 [(Kannur- 239420, Mattannur- 49014, Shreekandapuram- 17695, Taliparamba- 75936, Thalassery- 87778)]**
3. **Estimated waste per day - 133.91 tons**
4. **Collection Efficiency - 70% - 75%**

Table 4.1: Waste Projection for 25 Years

Year	Per Capita Waste	Waste (TPD) (70-75% collection efficiency)	Total Waste/ year	Landfill able waste/Year
				10%
2017	380	133.91	48,875	4,888
2018	385	137.72	50,268	5,027
2019	390	141.65	51,701	5,170
2020	395	145.68	53,174	5,317
2021	401	149.84	54,690	5,469
2022	406	154.11	56,248	5,625
2023	411	158.50	57,852	5,785
2024	417	163.01	59,500	5,950
2025	422	167.66	61,196	6,120
2026	428	172.44	62,940	6,294
2027	434	177.35	64,734	6,473
2028	439	182.41	66,579	6,658
2029	445	187.61	68,476	6,848
2030	451	192.95	70,428	7,043
2031	457	198.45	72,435	7,243
2032	463	204.11	74,499	7,450
2033	469	209.92	76,622	7,662
2034	476	215.91	78,806	7,881
2035	482	222.06	81,052	8,105
2036	488	228.39	83,362	8,336
2037	495	234.90	85,738	8,574
2038	502	241.59	88,181	8,818
2039	508	248.48	90,694	9,069
2040	515	255.56	93,279	9,328
2041	522	262.84	95,938	9,594

The total waste generated per annum ranges from 48,875 tons in 2017 to 95,938 tons in 2041.

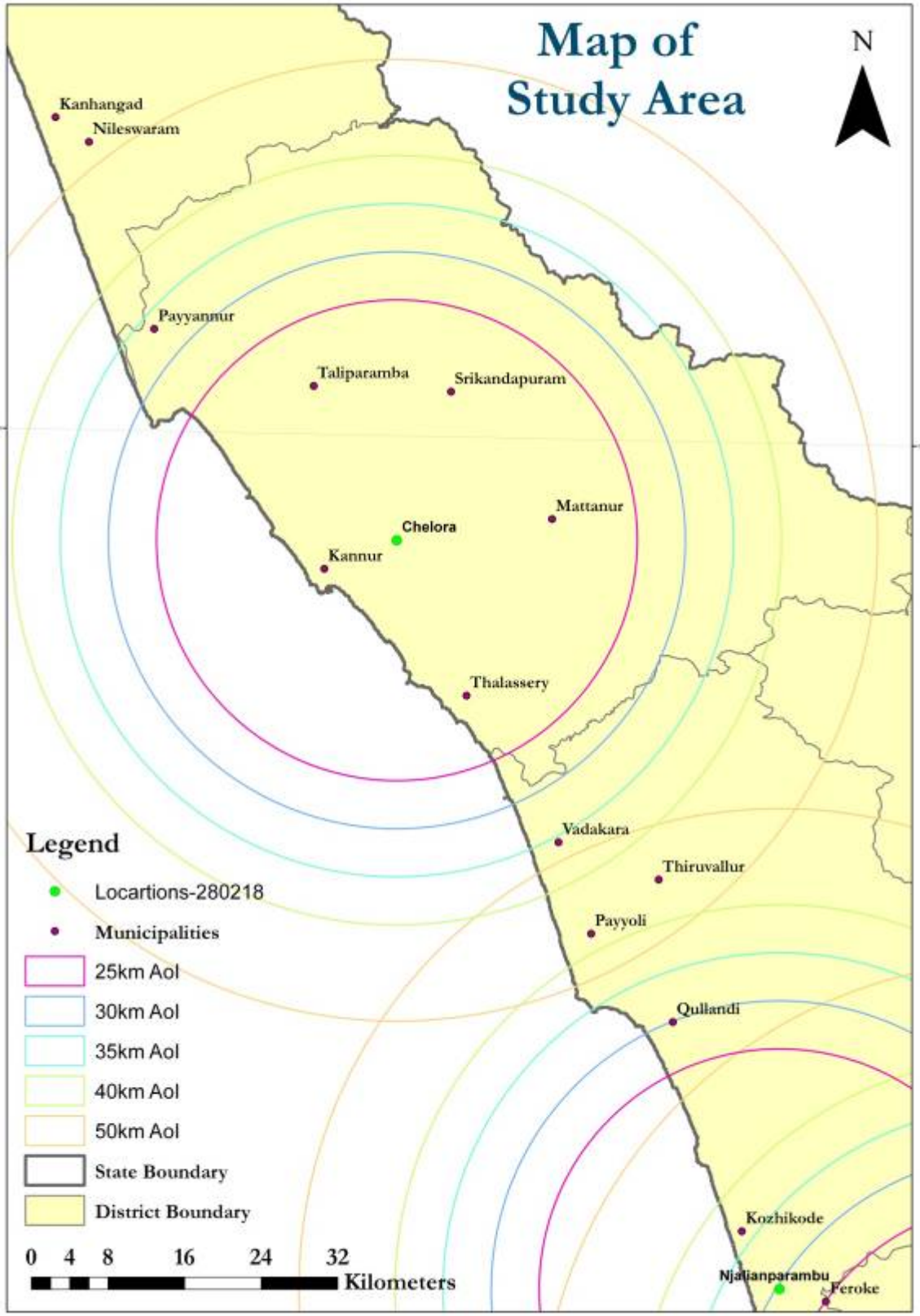


Figure 4.2: Catchment Area of Proposed ISWM Facility

4.3 Detailed Technology Description

Based on MSW composition of KMC and evaluation of the technological options indicate that waste can be reduced by 60% to 90% through a number of options. These include waste to energy (WTE) either through biomethanation or incineration. **Further Considering the space constraints at the site location, one option have been identified Option 1 Bio gas Plant with Sanitary Landfill as shown in Figure 4.4. to give the proposed operator an idea about the Technology. A case study of incineration has been described below though the operator can choose any option.**

Case Study: WTE through Incineration

WTE power plant can be designed to produce 10 MW Power (Gross) at generator terminals. Under RDF Option, the waste will be converted into rich calorific value. Residue Derived Fuel (RDF) can also be used as fuel for the WTE power plant where as under Direct Option, the waste will be directly burned after segregation and mixing it with the fresh waste to maintain the required calorific value of the waste to the extent of ≥ 1200 kcal/kg. **Considering technology neutral nature of the project, the operator has the choice to choose its technology.**

Ash coming out of Hot Air Generator (HAG) and power plant boiler (both bottom ash and fly ash) will be used for C&D Plant. If there is a demand, it will be given to building contractors / fly ash brick manufacturers or recycled through contractors in C&D Plant. Depending on the viability, inert fraction can be disposed to landfill site. Recyclable matter coming out of RDF plant would be given to Recycling units. Storage space for such items would be provided in the plant.

The power plant will be operating throughout the year except for the period during which the boiler will be taken up for inspection and maintenance. This means that the power plant will be potentially available for power generation for about 333 days. The plant shall be designed as environmentally clean plant so that the liquid effluents, solid effluents and gaseous effluents from the plant will meet the standard as applicable on date. **Figure 4.3** gives the process flow and scheme for waste to energy from MSW.

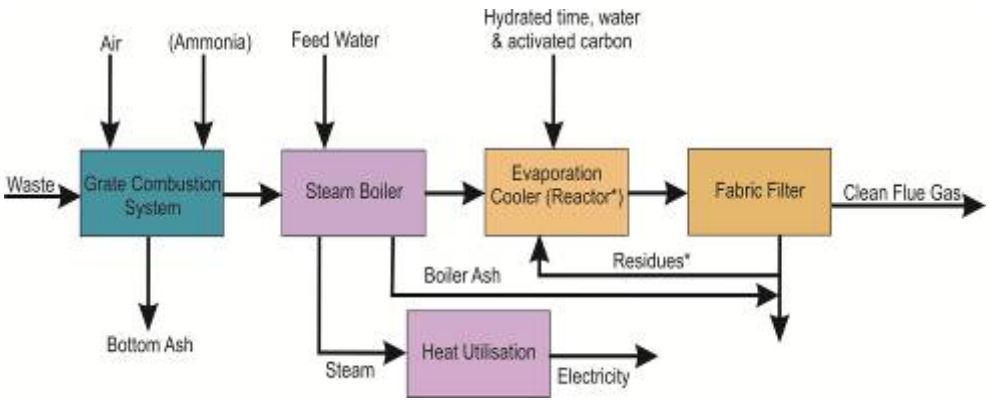


Figure 4.3: Waste to Energy Flow Chart

Based on the above flow chart for broad Waste to Energy Power Plant, an indicative layout plan has been prepared & shown in Figure 4.4.

Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, land filling shall be done following proper norms & regulations. A green belt has been proposed around the landfill site.

Figure 4.4 indicates are requirements of power plant, auxiliaries, power substation and landfill site. Considering 10% inert reaching the site, it is expected that landfill site will have a life of minimum ten to twelve years. However, the operator is expected to minimize the inert through innovative its use.

Landfill Design Facilities (Refer Annexure – 1)

The conceptual landfill design is based on geological and hydro-geological conditions, projected waste generations volumes along with procedures to reduce potential impacts to the existing natural and social environment of the site. The basic steps include:

1. Landfill sizing
2. Site layout
3. Landfill layout
4. Leachate management
5. Landfill gas management

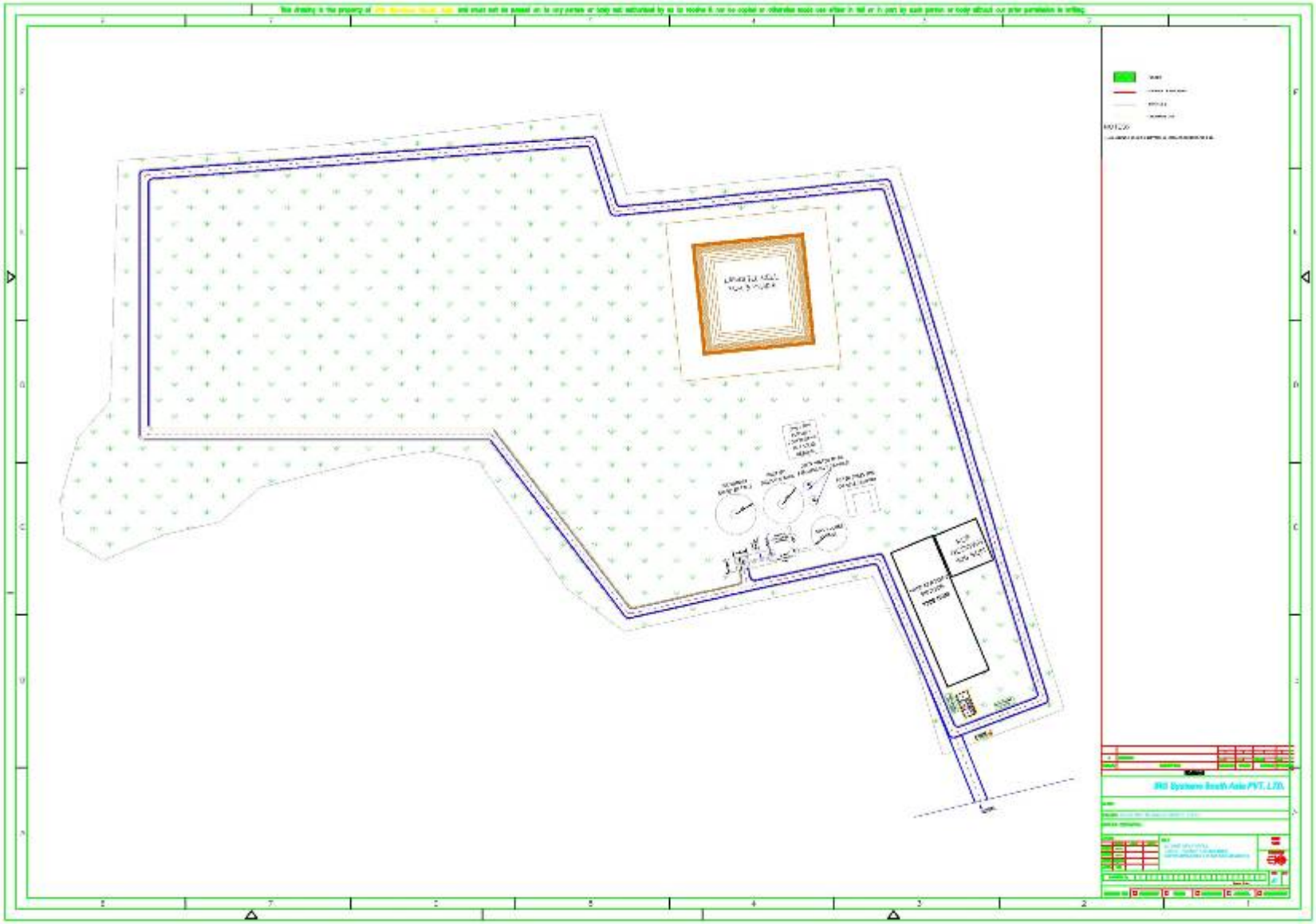


Figure 4.4: Layout Plans for Processing and Disposal of waste

The liner system for landfill site at Chelora is based on MoEF&CC recommendations. As per MoEF&CC "Construction of a non-permeable lining system at the base and wall of waste disposal site area - For landfill receiving residues of waste processing facilities or mixed waste or waste having contamination of hazardous material (such as aerosol, bleaches, polishes, batteries, waste oils, paint products and pesticides) minimum liner specification shall be a composite barrier having 2.5mm High Density Polyethylene (HDPE) geomembrane or equivalent overlying 90cm of soil (clay/amended soil) having permeability coefficient not greater than 1X10-7cm/sec."

Therefore for the landfill site liner system of following specifications has been recommended complying Municipal Solid Waste Management Rules 2016.

The liner system will comprise of following layers below waste

- A drainage layer of 300 mm thick granular material of permeability not greater than 10^{-2} cm/sec.
- A 200 mm thick protective clay layer
- A HDPE geomembrane liner of thickness 2.5mm
- A 6 mm thick Synthetic clay liner
- A 1000mm compacted soil at most of bottom

Main components of liner system are clay/amended soil layer and geomembrane liner and performance of landfill largely depends on this liner system.

Daily Cover at Landfill: The daily soil cover required would have to be stored at site in a demarcated area. If the soil is not available from the site itself it will have to be brought from outside and stacked or drain silt and waste from road sweeping. The soil of 100 to 150 mm should be applied on the waste coming in.

Intermediate Cover: Waste should be covered at the end of each working day with a daily cover. If a stretch of waste is not to be filled over in the immediate future (for example - for one week), it should be covered with a thicker interim cover. Prior to the commencement of monsoon season, an intermediate cover of 40-65 cm thickness of soil should be placed on the landfill with proper compaction and grading to prevent infiltration during monsoon. The intermediate cover will follow the slopes and grading of the underlying waste. Placement of tarpaulin covers may be required at locations where either stagnation is observed or at locations where there is a possibility of erosion of the interim cover.

Final Cover System: The landfill cover system will extend above the elevations denoted in drawing. The average height of the waste would be 25 m above the embankment. The Landfill will be capped as per the SWM 2016 Rules.

4.4 Leachate Collection and Removal System

An effective leachate collection and removal system is a pre-requisite for landfill sites. For existing sites, the installation of an improved collection and removal system should be considered in the light of data obtained by way of the environmental monitoring. **(Annexure – 1).**

The leachate collection system (LCS) consists of three main components; a drainage layer, a series of collector pipes, and a non-woven Geotextile separator layer. These components are discussed in more detail below.

The leachate collection system and its components will be laid over the HDPE geomembrane. The LCS layer consists of a 300 mm thick gravel drainage layer of 12-25 mm sized rounded gravel and perforated HDPE pipes embedded in this gravel layer. The HDPE pipes will collect the leachate and are connected to a leachate evaporation pond. The gravel layer will be laid according to the slopes mentioned in the base soil liner layer.

The Header pipes have a slope of 1% to one side. The header pipes are then connected to the Leachate collection chambers from where the leachate would be pumped onto the incoming waste. The Leachate collection pipes must be wrapped in Non-woven Geotextile so as to reduce the clogging of the pipes.

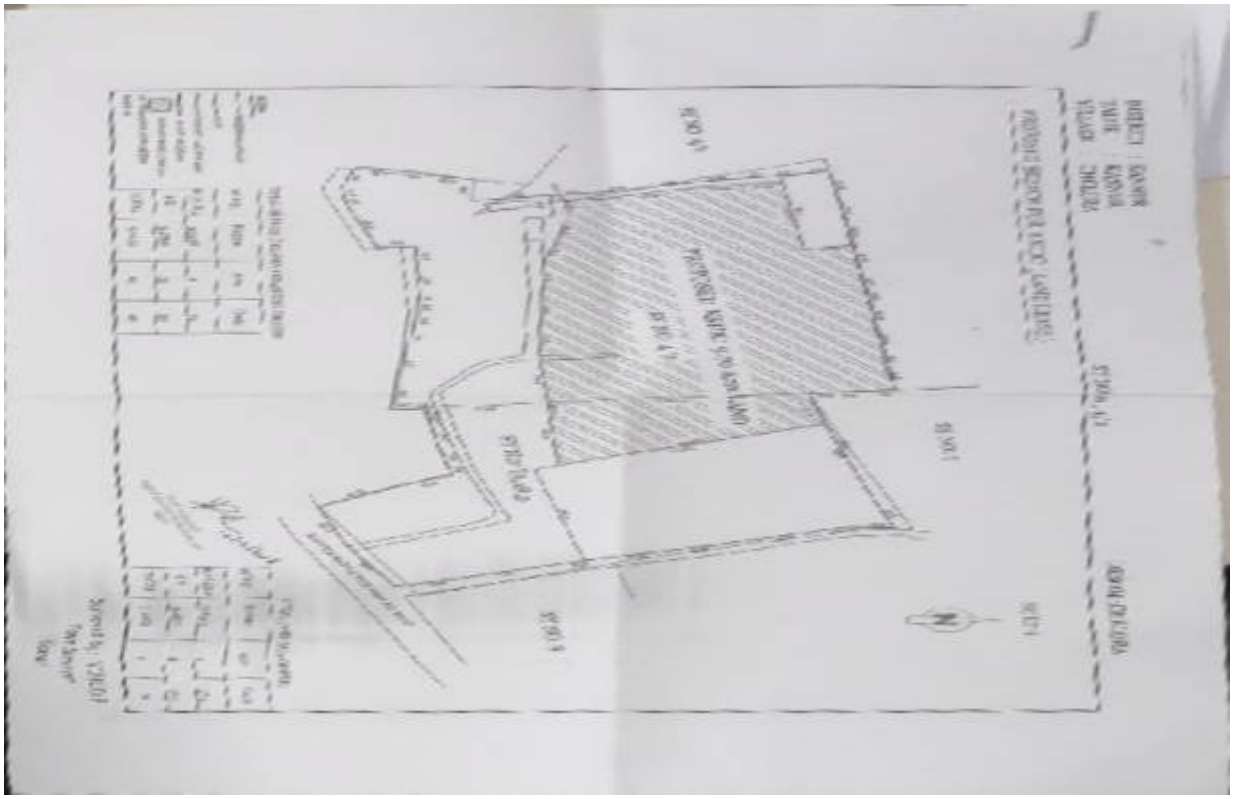
A weekly operating record of leachate management systems shall be kept in the post-closure period. Periodic inspection of the leachate collection systems (2 to 4 times a year) is to be undertaken to identify broken pipes, leakage of gas (if any) and damaged or clogged wells/sumps. Repair work will require skilled manpower and shall be carried out by the agencies operating the gas treatment and leachate treatment facilities. It may be necessary to install new gas extraction wells and leachate collection wells if the damaged / clogged facilities are inaccessible and irreparable.

4.5 Closure of Landfill Site and Post Closure Plan

Determination of the end-use of a landfill site is an essential part of the plan for landfill closure and post-closure maintenance. Closure and Post closure care involves the routine inspection of the completed landfill site, maintenance of infrastructure and environmental monitoring. The authority shall inspect all facilities during the closure and post closure period at least once a year. The authority/concessionaire that operates the sanitary landfill shall be responsible for post closure activities and monitoring.

4.6 Project Implementation Plan

A project implementation plan has been prepared consisting of two stages i.e. stage 1 & stage 2. **Figure 4.5** indicates the comparison of existing condition versus proposed project layout. **Figure 4.6** indicates the location of stage 1 and stage 2. **Figure 4.7** indicates the complete project implementation plan with the completion of stage 1 in 24 months.



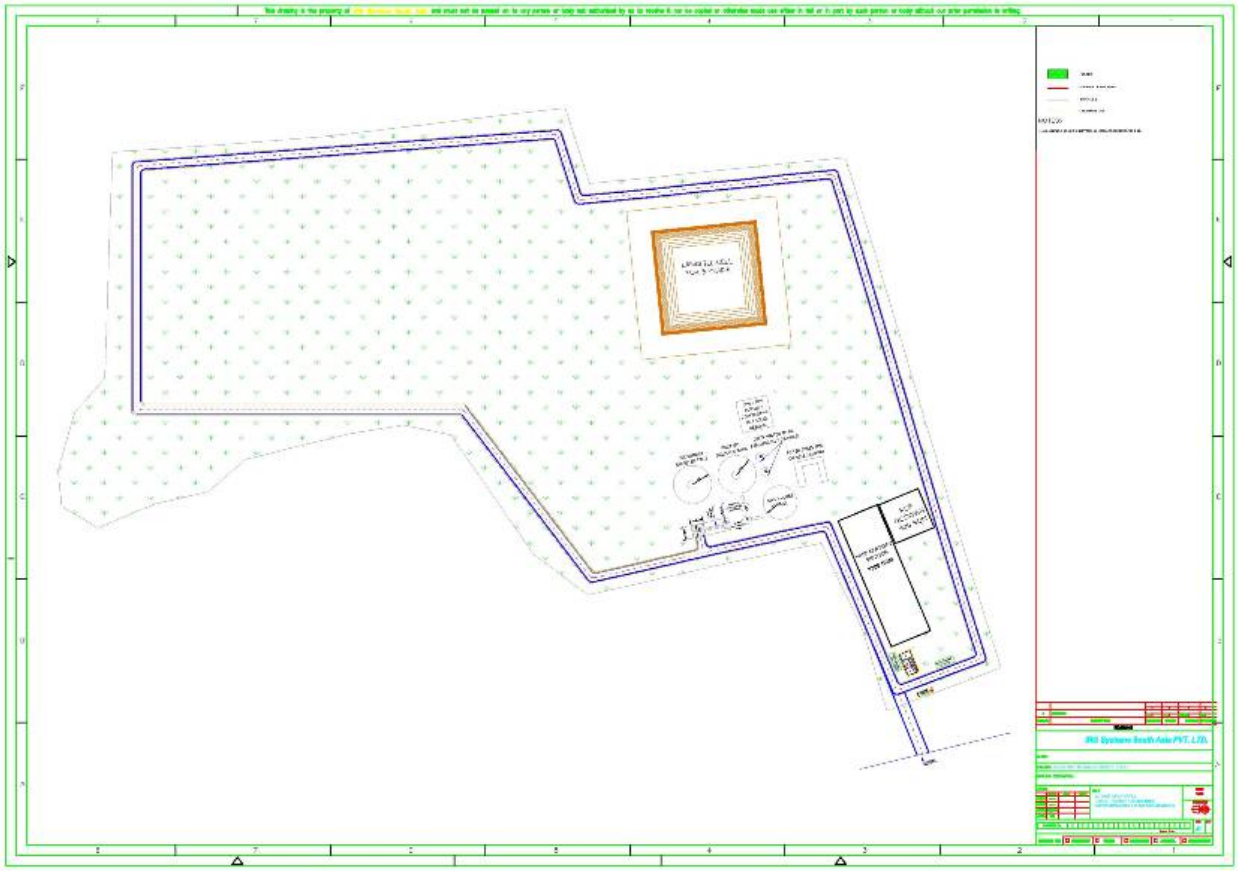


Figure 4.5: Layout Plans for Processing and Disposal of Waste Versus Existing Site

Project Development Schedule

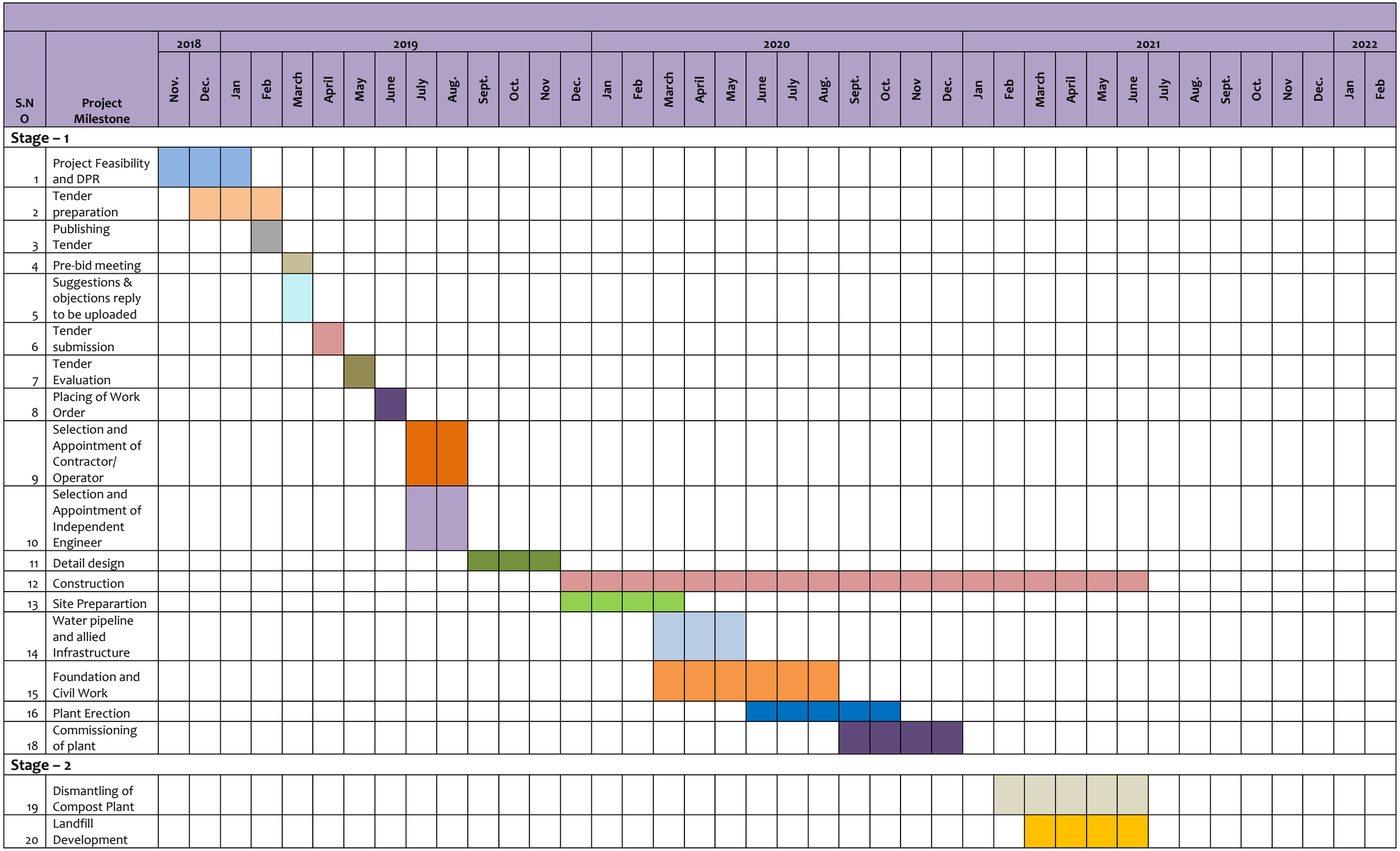


Figure 4.6: Stage Wise Project Milestone for Development of Waste to Energy (WtE) Project

Note: Above Schedule is dependent on clearances and approvals

CHAPTER – 5: CONCLUSION

5.0 Site Conditions

The Proposed site is located at Chelora Zonal Office of the district. Average Elevation of site is 40-41 m (from sea level.) Contour map (topographic) of the site based on Aster DEM (Digital Elevation model). Contour map shows undulating formations which on ground truthing indicated municipal waste dumps. The site falls under the jurisdiction of Kannur Corporation.

Geologically coastal alluvium is seen in the western coastal tract of the district. The coastal plain is characterized by secondary soils, which are sandy and sterile with poor water holding capacity. The width of the zone is more in the central part i.e., in the Kannur area and it is almost narrow in both north and southern areas of the district. The marshy soil in the coastal plain supports mangrove vegetation and is found at the estuaries and backwater extending inland along their courses. The soil is composed of recent deposits predominantly marine with some fluvial sediment along the coastline. These soils are immature with high sand content. River alluvium is found along river valleys cutting across the extensive lateritic soils. The soil is very deep with surface texture ranging from sandy loam to clay. It is fertile, having water holding capacity and plant nutrients which are regularly replenished during floods. . **Hydrogeologically the site falls under Coastal alluvium suitable for filter point wells and dug wells. Highly potential aquifer yield goes upto 50 lps. Depth to water varies from 0.5 to 3 m.b.g.l. The site falls under Kavvayi river basin in Kannur district. Chelora Site is falls under Coastal Alluvium soil formation.**

The Proposed site falls in the corporation area of the Kannur district. The Seasonal fluctuation (0.0007 m to 0.8277 m) of the water table is due to variation in the rainfall, evapotranspiration, withdrawals for irrigation and other purposes, base flow, seepage from surface water bodies etc. The Decadal depth to water level in the Ground Water Monitoring Wells of CGWB during pre and post monsoon periods is shown in Figure 2.11 & Figure 2.12 respectively. The district has a net annual ground water availability of 479.11 MCM with a net availability of 250.35 MCM for the future use. The depth to water level is good for domestic & Industrial water supply. Overall the block is safe for ground water usages.

5.1 Climate

Kannur district receives a total annual rainfall of around 3438 mm. District experiences heavy rainfall during the South West monsoon season followed by North East monsoon. South West monsoon during June to September contributes 70 % of the total rainfall of the year. The northeast monsoon contributes only about 30%. Rainfall is considerably less during the period from January to May. The year to year variability of annual rainfall is around 28.2%. In general, the rainfall increases from the coast to the eastern hilly regions. Kannur district falls under wet type of climate based on Thornthwaite's climatic classification.

5.2 Current SWM Management

The Urban local body (ULB) in Kannur is responsible for collection, transportation and disposal of Solid Waste except untreated bio-medical waste and hazardous industrial waste. Storage and segregation of waste at source is not very prominent KMC. About 72 MT of Municipal solid waste is generated in Kannur Municipality every day. The per capita waste generation is estimated to be 300 gm/cap/day considering a population of 239420. Out of this about 56 tons is collected and Transported by the Municipality every day. Therefore, the collection efficiency is 78%.

Households generate 48% of the total MSW generated in the city. It is followed by commercial establishments, hotels, street sweeping & markets. Considering 50% of solid waste generation from households & hotels, it is expected that the solid waste to be rich in organic content. The calorific value of the waste is more than 1500 Kcal/kg.

The Municipality has assigned the task for door to door collection systems by Haritha Karma Sena who has collected biodegradable waste from Households, Commercial Establishments, Hotels, Restaurents and Market Associations and sends it to dump site or Thumburmuzhi Aerobic composting unit. And Non-biodegradable waste collected from households and individual establishments are stored in the collection units. The Plastic wastes collected are transported to the plastic shredding unit in Chelora site and then later the final shreeded plastics are sold to clean Kerala Company. Other biodegradables waste will be sold to registered recyclers or utilization agencies. As part of a project supported by Central and State pollution Control Board, KMC has organized 55 Kudumbsree units (each unit consists of 2 members) Which have been formed in each of the selected ward of the city with the help of State Poverty Eradication Mission. The sweepers employed by the municipality could clean only the main roads and central areas daily. They keep the waste in small heaps which are removed by a hand cart crew and coverage is limited. KMC operates 45 numbers of secondary collection points out of which 21 are open collection points. A mixed fleet of vehicles which are under operation include JCB, covered tractor trailers, two compartment covered LCV, ordinary tractors and Dumper Placer. There are 26 vehicles out of which on an average 16 vehicles are in operation.

Waste segregation at source is not a general practice. Households which are given the bins segregate the organic and inorganic waste at source itself. Haritha Karma Sena (HKS), sub depots buying recyclables from HKS, and major depots sorting and selling waste to recyclers separate plastic, paper, glass and metal to an extent. Some of the households and commercial establishments also separate recyclables and sell directly to vendors. With door to door collection, Kudumbsree units also separate recyclables and sell to sub depots.

Kannur Municipal Corporation owns a dumping ground at Chelora, 16 km away from city centre, in Chelora Zonal Office. The current was previously a solid waste Dumping ground. The site currently is abandoned; however few old wastes can be seen. The site has compound walls on all sides. The site belongs to the Kannur Municipal Corporation. The site however has a proposed area for sewage treatment plant, Public Park in the front area and a constructed yet not functioning MRF plant.

It is proposed to develop the entire ISWM project with provision of only 10% rejects going into the landfill site. The entire project is being proposed on 9.70 Acres based on PPP format. Future waste projections from the year 2017 till 2041 have been carried out considering a

catchment of 30 KM around Chelora site. Municipalities, which are covered in this catchment include, Kannur, Mattannur, Shreekandapuram, Taliparamba, and Thalassery. Assumptions, which have been made, are given below.

5. **Per capita waste generation - 380 gm**
6. **Total population for all municipalities (2017) - 469843 [(Kannur- 239420, Mattannur- 49014, Shreekandapuram- 17695, Taliparamba- 75936, Thalassery- 87778)]**
7. **Estimated waste per day - 133.91 tons**
8. **Collection Efficiency - 70% - 75%**

The total waste generated per annum ranges from 48,875 tons in 2017 to 95,938 tons in 2041.

Sl. No	SWM 2016 Criteria for Sanitary Landfill/Plant	Status	Remarks
1	100 meter away from river		
2	200 meter away from a pond		
3	200 meter away from Highways, Habitations, Public Parks and water supply wells	EIA required if sanitary landfill site is proposed with the plant (Operator's Responsibility)	Habitation just few meters from the site
4	20 km away from Airports or Airbase		
5	Within the flood plains as recorded for the last 100 years, zone of coastal regulation, wetland, Critical habitat areas, sensitive eco-fragile areas		
	Complied with EIA requirement		
	Complied		

The entire project is proposed to be completed in two stages in 24 months. Site is suitable for Integrated Solid Waste Management Facility provided safeguards are in place as per SWM Rules 2016.

Annexure – 1

Landfill Design Calculations

Design of Land Fill Site Trenches for Town			
TOTAL AREA FOR LANDFILL SITE:-		**Acres**	
Design Criteria	**Formula**	**Design for disposal of waste from the year 2017 to 2021**	
Waste to be disposed of in to land fill site up to design period of 30 years	W_{d25} or W_{d1}	33153.42	Tons
Density of compacted waste	d	0.70	Tons / cum
Volume of waste required to be disposed of	V_{25} or $V_1 = W_{d25}$ or W_{d1}/d	47362.03	Cum
Depth of land fill below ground	D_b	5.00	meter
Height of land fill above ground	D_u	15.00	meter
Thickness of liners & filter media	t_l	1401.50	mm
Top length of one trench	L	120.00	meter
Top width of trench	B	120.00	meter
Side slope above meter from ground (H:V)	S_s	3.00	
Side slope blew meter from ground (H:V)	S_s	3.00	
Bottom length of trench	$L_b = L - (2xS_sxD_b)$	90	meter
Bottom width of trench	$B_b = B - (2xS_sxD_b)$	90	meter
Top length of fill above from ground	$L_u = L - (2xS_sxD_u)$	30	meter
Top width of fill above from ground	$B_u = B - (2xS_sxD_u)$	30	meter
Volume of waste filled in one trench	$V_{t1} = [\{(LxB)+(L_bxB_b)\}xD_b/2\} + [\{(LxB)+(L_uxB_u)\}xD_u/2\}]$	171,000	Cum
Number of trenches required (aasuming 100% collection efficiency)	$N_t = V_{25}$ or V_1 / V_{t1}	0.28	
Say	as per drawing one trench would be developed os same volume	1	No.

Calculation of leachate quantity

Landfill plan area of year 2018	39254.5 m^2
Average annual rainfall (2018)	3481.87 mm
Average rainfall for one month period	290.16 mm/month
Assuming 50% or rainfall turning as leachate.	
Hence, Average volume of leachate collected	135.28 m^3/month


JCB





































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SCRAP GRINDER


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എയ്റോബിക് കമ്പോസ്റ്റ് യൂണിറ്റ്
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