
**केंद्रीय भूमि जल बोर्ड**

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

भारत सरकार

**Central Ground Water Board**

Department of Water Resources, River Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

# AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

## THANE DISTRICT, MAHARASHTRA

मध्य क्षेत्र, नागपुर

Central Region, Nagpur

Interim Report
2504/NQM/2022
कार्यालयीन उपयोग हेतु
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# CENTRAL GROUND WATER BOARD

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# AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN

## THANE DISTRICT, MAHARASHTRA

AAP 2022-23

मध्यक्षेत्र, नागपुर
Central Region, Nagpur

2022

# AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, THANE DISTRICT, MAHARASHTRA

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| | | |
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# THANE DISTRICT AT A GLANCE

| | | | |
|---|---|---|---|
| **1. GENERAL INFORMATION** | | | |
| | Geographical Area | : | 4,091 sq. km. |
| | Administrative Divisions (2014) | : | Taluka- 7; Thane,Kalyan,Murabd,Ulhasnagar Ambarnath,Bhiwandi,Shahapur |
| | Villages (Census 2011) | : | 807 Nos. |
| | Population (Census 2011) | : | 8070 thousand |
| | Rainfall 2022 | : | 2801.1 mm |
| | Normal rainfall | : | 2530 mm |
| | Long term rainfall Trend (1998-2022) | : | Rising trend 17.04 mm/year |
| **2. GEOMORPHOLOGY AND DRAINAGE** | | | |
| | Major Physiographic unit | : | a)Alluvium/Valley/Beach sand/Channel Bar<br>b) Denudational Hills of Sahaydri hill ranges<br>c) Highly Dissected Basaltic plateau<br>d) Highly Dissected Basaltic plateau<br>e) Moderately Dissected Basaltic plateau<br>f) Slightly Dissected Basaltic Plateau |
| | Major Drainage | : | Tributaries of Vaitarna and Ulhas River |
| **3. LAND USE (2020-21)** *(sources: DSA 2021)* | | | |
| | Forest Area | : | 1345.14 sq. km. (11.77%) |
| | Cultivable Area | : | 6043.76 sq. km. (52.81 %) |
| | Net Area Sown | : | 815.9 sq. km. (41.14 %) |
| | Area Sown more than once | | 55.14 Sq. km. (3.24%) |
| **4.** | **SOIL TYPE** | : | Sandy Loam Soil, Black Colored Soil, Lighter Colored soils, Coastal Soil |
| **5. PRINCIPAL CROPS (2020-21)** | | | |
| | Rice | | 561.21 sq. km. |
| | Pulses | : | 134.02 sq. km. |
| | Cerels | : | 609 sq. km. |
| | Oil Seeds | : | 3.2 sq. km. |
| **6.** | **HORTICULTURAL CROPS** | | |
| | Mango | : | 27.7 sq. km. |
| | Citrus fruit | : | 0.04 sq. km. |
| | Banana | : | 0.15 sq. km. |
| | Spices and vegetable | : | 32.78 sq. km. |
| 7. | **IRRIGATION BY DIFFERENT SOURCES (2006-07)** | | **Nos.** |
| | Surface Flow Schemes | : | 2637 |
| | Surface Lift Sources | : | - |
| | Net Irrigated Area | : | 106700 ha |
| **8. GROUND WATER MONITORING WELLS** (As on 31st March 2022) | | | |
| | Dug wells | : | 25 |
| | Piezometers | : | 1 |
| **9. GEOLOGY** | | | |
| | Recent | : | Alluvium (River Alluvium) |
| | Up. Cretaceous-Late Eocene | : | Deccan Traps Basalt |
| **10. HYDROGEOLOGY** | | | |
| | Major Water Bearing | : | **1. Hard Rock:** |

| | | | |
|---|---|---|---|
| | Formation | | **Deccan Traps Basalt-** Weathered, vesicular, fractured and Jointed basalt form aquifer. The depth of weathered mantle ranges from 1 to 8m and potential fractures normally are Limited to 20 to 60m depth range **Under Unconfined to Confined conditions.** |
| | | | 2. **Soft Rock**: **Alluvium**- Coastal alluvial sediment with calcareous materials occurs in the western part of the district along the Coast. The fluvial alluvium occurs along The river drainage. The thickness of Alluvium varies from few meters to 20m **UnderUnconfined to Confined conditions**. |
| | **Depth to water level in Shallow Aquifer** | | |
| | Pre-monsoon Depth to Water Level (May-2022) | : | 0.7 to 9.3 mbgl |
| | Post-monsoon Depth to Water Level (Nov.-2022) | : | 0.5 to 4.75mbgl |
| | **Depth to water level in Deeper Aquifer** | | |
| | Water Level | : | 1.4 to >50mbgl |
| | **Water level Trend (2013-22)** | | |
| | Pre- monsoon Water Level Trend (2013-2022) | : | Rise: 0.0015 to 0.64m/year |
| | | | Fall: 0.016 to 0.46m/year |
| | Post-monsoon Water Level Trend (2013-2023) | : | Rise: 0.0018 to 0.108 m/year |
| | | | Fall: 0.002 to 0.37 m/year |
| **11. GROUND WATER EXPLORATION (**As on March 2022) | | | |
| | | | **Basalt** |
| | Wells Drilled (CGWB) | : | EW 23, OW 5, Pz 4 **Total -32** |
| | Depth Range | : | 32 to 201 mbgl |
| | SWL | | 0.14 to 10 mbgl |
| | Discharge | : | 0.14 to 10 lps |
| | Transmissivity | : | 7.28 to 177.60 $m^2$/day |
| **12. GROUND WATER QUALITY:** In major part ground water is suitable for drinking and irrigation purposes except localized nitrate contaminated villages. | | | |
| **13. DYNAMIC GROUND WATER RESOURCES- (2022)** | | | |
| | Annual Extractable Ground Water Recharge | : | 163.69 MCM |
| | Total Extraction | : | 31.11 MCM |
| | Projected Demand (Domestic) | : | 7.13 MCM |
| | Stage of Ground Water Development | : | 19.00 % |
| | Category | | **Safe** |
| **14.** | **MAJOR GROUND WATER PROBLEMS AND ISSUES**<br>• Based on the rainfall analysis from 1998 to 2022 it is observed that, two times moderate drought were faced by the Thane district**.**<br>• Low Development of Ground Water Resources.<br>• Sustainability in Hard Rock Areas. | | |

| | | | |
|---|---|---|---|
| | • Ground Water Pollution from Industries. | | |
| **15.** | **Aquifer Management Plan** | | |
| | Demand side Management | : | 1094 ha. area proposed for Drip irrigation |
| | Expected Benefits | : | 11030 ha. area comes under Assured Ground Water Irrigation. |

# AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, THANE DISTRICT, MAHARASHTRA

**CONTENTS**

# AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, THANE DISTRICT

## 1. INTRODUCTION

National Aquifer Mapping (NAQUIM) has been taken up in XII five-year plan by CGWB to carry out detailed hydrogeological investigation on 1:50,000 scale. The NAQUIM has been prioritized to study Over-exploited, Critical and Semi-Critical blocks as well as the other stress areas recommended by the State Govt. Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical analyses is applied to characterize the quantity, quality and sustainability of ground water in aquifers.

The vagaries of rainfall, inherent heterogeneity & poor sustainability of hard rock aquifers, over exploitation of once copious alluvial aquifers, lack of regulatory mechanism, has had a detrimental effect on ground water scenario of the Country in last decade or so. Thus, prompting the paradigm shift from "**traditional ground water development concept**" to "**modern ground water management concept**".

Varied and diverse hydrogeological settings demand precise and comprehensive mapping of aquifers down to the optimum possible depth at appropriate scale to arrive at the robust and implementable ground water management plans. The proposed management plans will provide the **"Road Map"** for ensuring sustainable management and equitable distribution of ground water resources, thereby primarily improving drinking water security and irrigation coverage. Thus, the crux of NAQUIM is not merely mapping, but reaching the goal of ground water management through community participation. The aquifer maps and management plans will be shared with the administration of Thane district, Maharashtra for its effective implementation.

The activities under NAQUIM are aimed at:

- Identifying the aquifer geometry
- Aquifer characteristics and their yield potential
- Quality of water occurring at various depths
- Aquifer wise assessment of ground water resources
- Preparation of aquifer maps and
- Formulate ground water management plan

### 1.1 ABOUT THE AREA

Thane is the northern most district of Konkan region of Maharashtra State. It is situated in the eastern part of Maharashtra between North Latitude 18° 42' and 20° 20', and East Longitude 72° 45' and 73° 48'. The total area of the district is 4214 sq. km. and falls in parts of survey of India degree sheets 46D, 46H, 47A and 47E. It is bounded on south by Mumbai Upnagar and Raigad District, east by Pune and Ahmednagar district, on north by Thane districts, on west by Arebian Sea.

The district headquarters is located at Thane Town. For administrative convenience, the district is divided into 7 blocks viz., Thane, Kalyan, Murabd, Ulhasnagar, Ambarnath, Bhiwandi, Shahapur It has a total population of 80,70,032 as per 2011 Census. The district has 31 towns and 807 villages out of which 13 villages are uninhabited. The entire district lies in vaitarna and Ulas sub basins of Vaitarna basin. Waitarna, Ulas, Tansa, Bhor and Bhatsa are the main rivers flowing through the district. The district is well drained by Waitarna and Ulas rivers and their tributaries. The district is categorized as safe as per Ground Water Resources Estimation 2020. The Index and Administrative map of the Thane district is presented in **Fig. 1.1 and Fig. 1.2**.

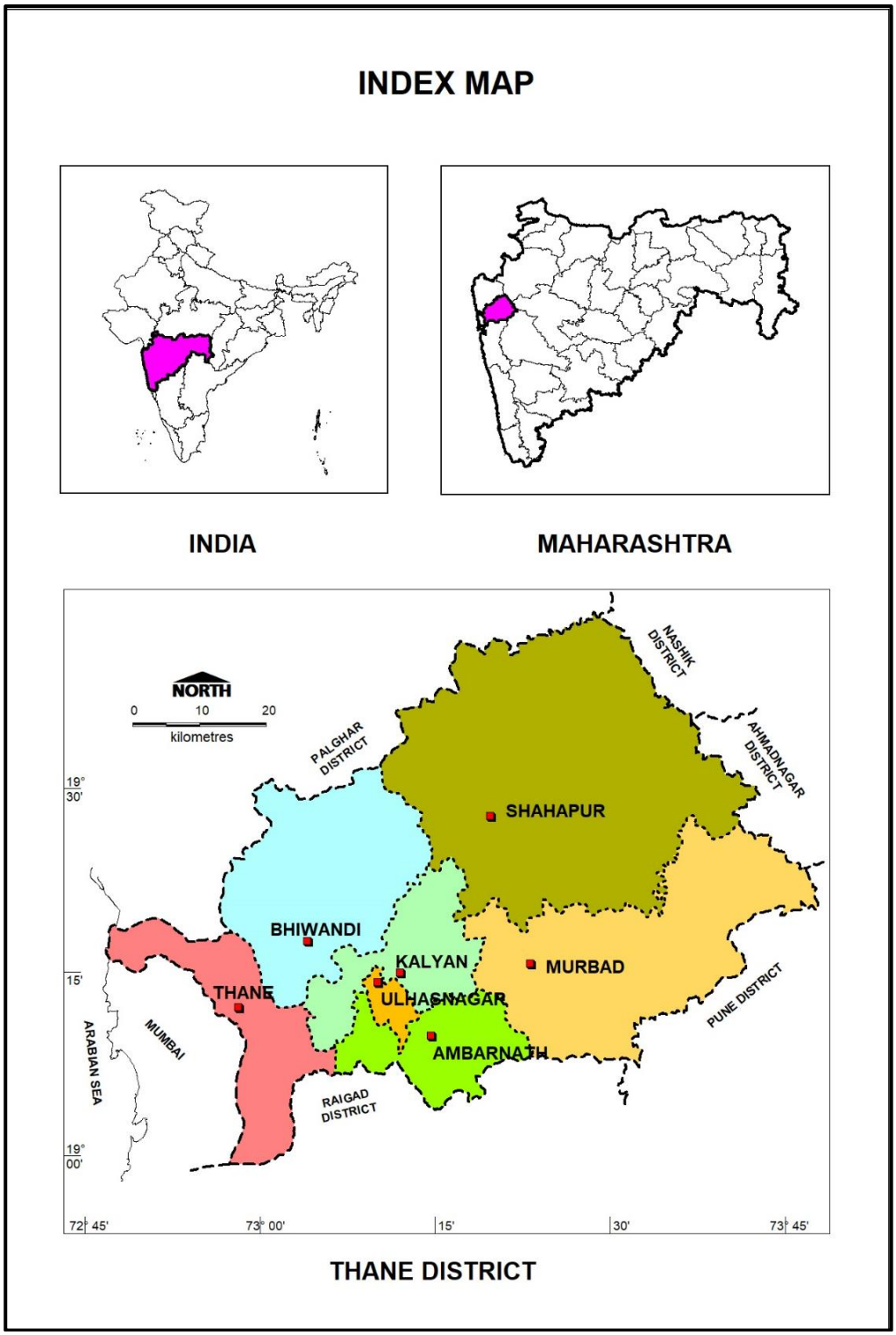



**Figure 1. 1 : Index map, Thane District**

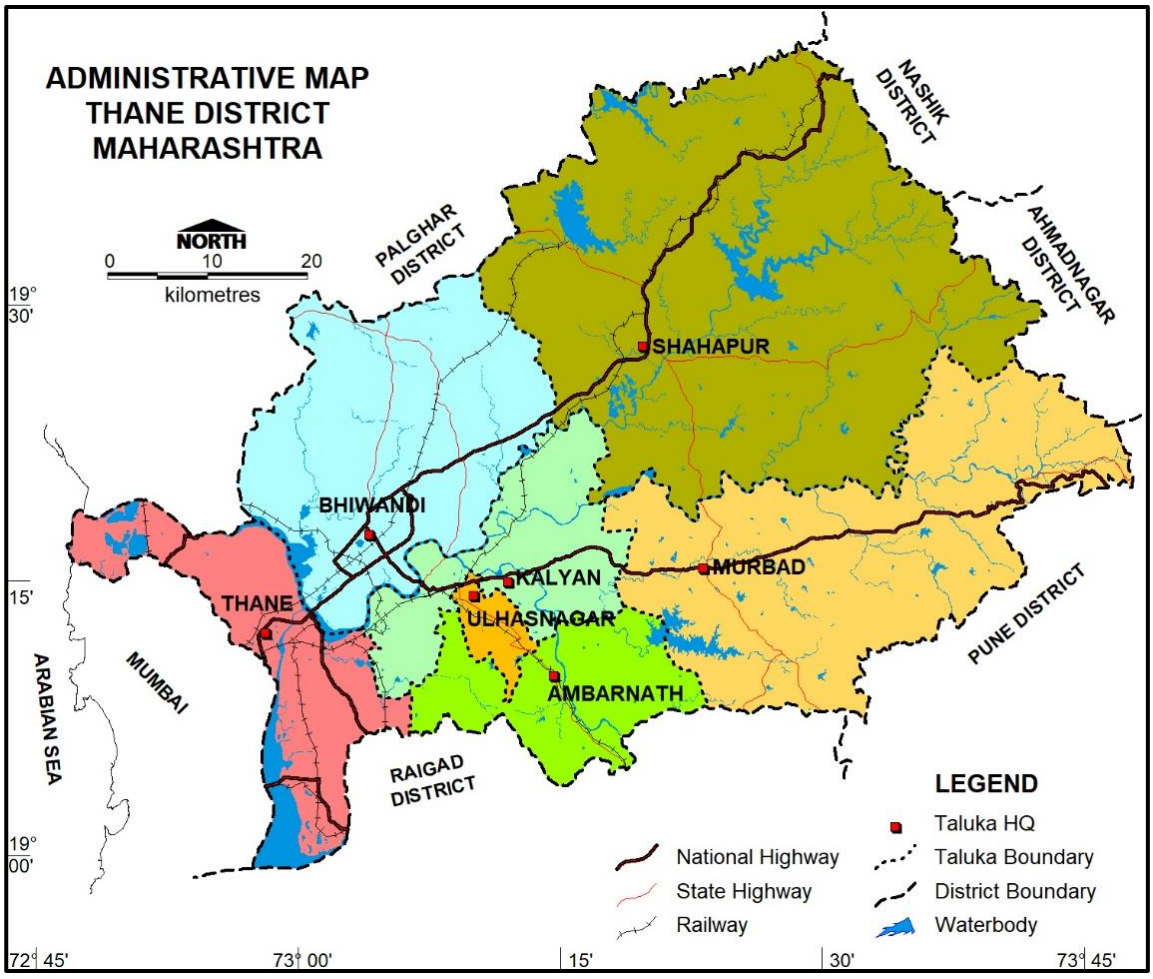



**Figure 1. 2 : Administrative map, Thane District**

Thane district has been taken up under NAQUIM study in the year 2022-23 (AAP 2022-23)

Ground water exploration in the district has been taken up in different phases since 1976. During 1976 to 1991 in three phases; total 23 Exploratory Wells (EW), 04 Observation Wells (OW). In addition to these 04 Piezometers (Pz) were also constructed for monitoring of ground water levels.

The ground water exploration has been carried out in hard rock areas occupied by Deccan Trap Basalt. To establish the geometry, disposition and potential of aquifers, ground water exploration down to the depth of 200 mbgl has constructed during the years 2009-2010 to 2011-12. A total of 23 EWs, 4 OWs and 4 Piezometers have been constructed till March 2012. Salient Features and details of Ground Water Exploration are given in **Annexure-I**.

To assess the ground water regime, 26 existing ground water monitoring stations of CGWB being monitored 4 times in a year are used to acquire micro level hydrogeological data to decipher the water level scenario, sub-surface lithological disposition and hydrogeological setup of shallow aquifer (Aquifer-I). The details of monitoring wells are given in **Annexure-III**. Locations of existing ground water monitoring stations and exploratory wells are shown in **Fig.1.3**.

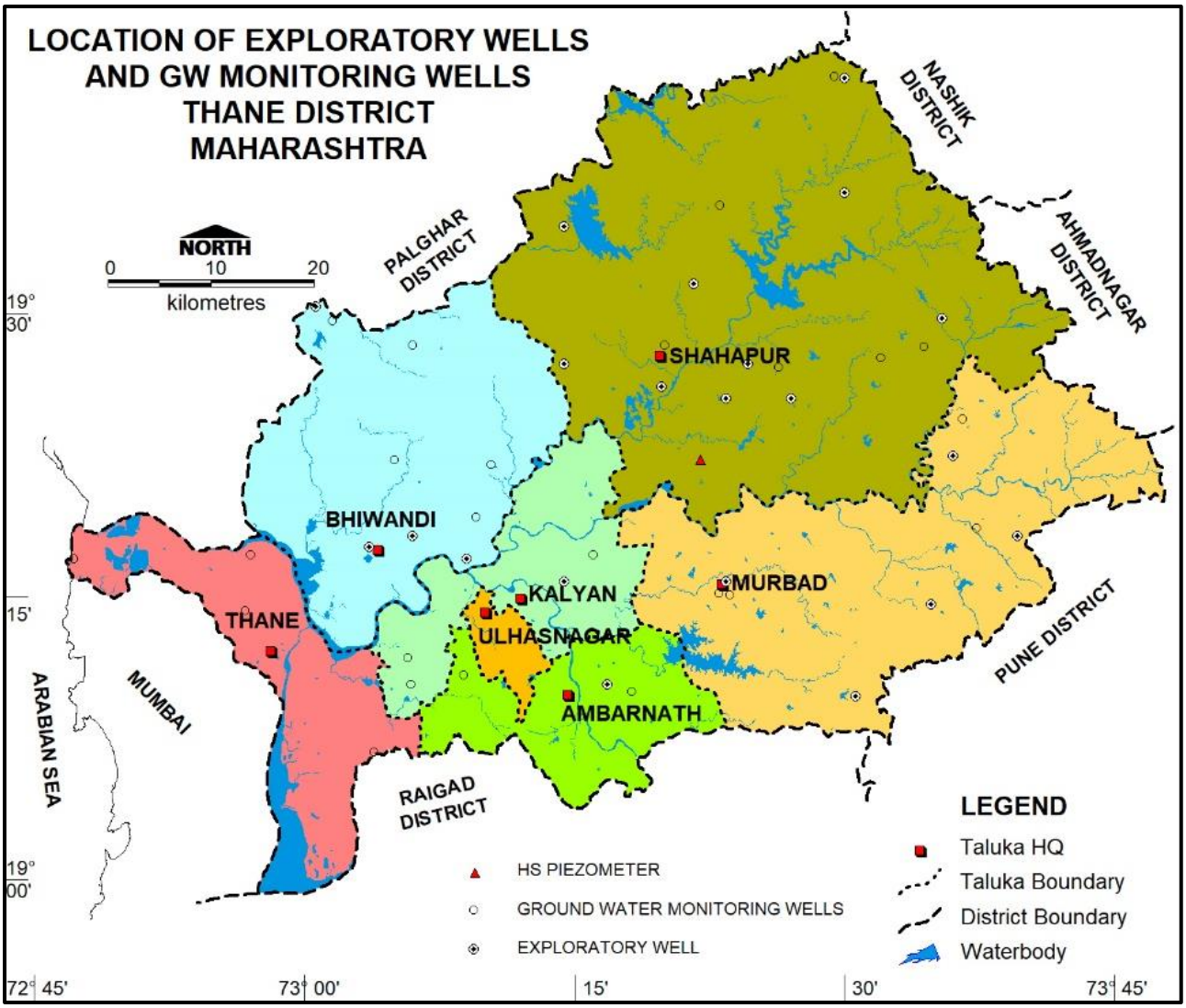



**Figure 1. 3: Locations of Existing Exploratory and Ground Water Monitoring Wells**

## 1.2 GEOMORPHOLOGY, DRAINAGE AND SOIL TYPES

The Thane district forms part of western slope of Sahayadri hill range. This hill range passes through the eastern part of the district. Major part of the district constitutes rugged and uneven topography, characterized by high hills and steep valleys. Physiographically, district can be divided into two broad divisions- Undulating Hilly Tract and Coastal Plain in western part. The area is drained by innumerable streams and tributaries of Vaitarna and Ulhas River. The four main tributaries of river Vaitarna are Surya, Tansa, Deharaja and Pinjal Rivers. Ulhas River is the other important river in the district. The flat terrain of Thane district lies generally with elevation less than 250 ml. **Fig. 1.4**

There are many creeks in the area prominent among them are Danda Creek in the southern most part, Mahim Creek, Ucheli Creek, Unbhat Creek, Chinchani-Tarapur Creek and Dahanu Creek in the northern end of the area. Mahim creek divides the village Mahim from village Kelwa. These creeks run from coastal inland up to a considerable distance carrying backwater. The Mahim, Satpati Akarbati areas area characterized by mangrove swamps and mud flats or marshy saline lands. The streams or the rivers carry very heavy load / flooded during the rainy season and flow up to January end every year. There are prominent salt pan areas located about 3km west of Kelve village close to Kelve-Makunsar road. The sea water inflows during high tide are used for salt preparation by natural evaporation process.

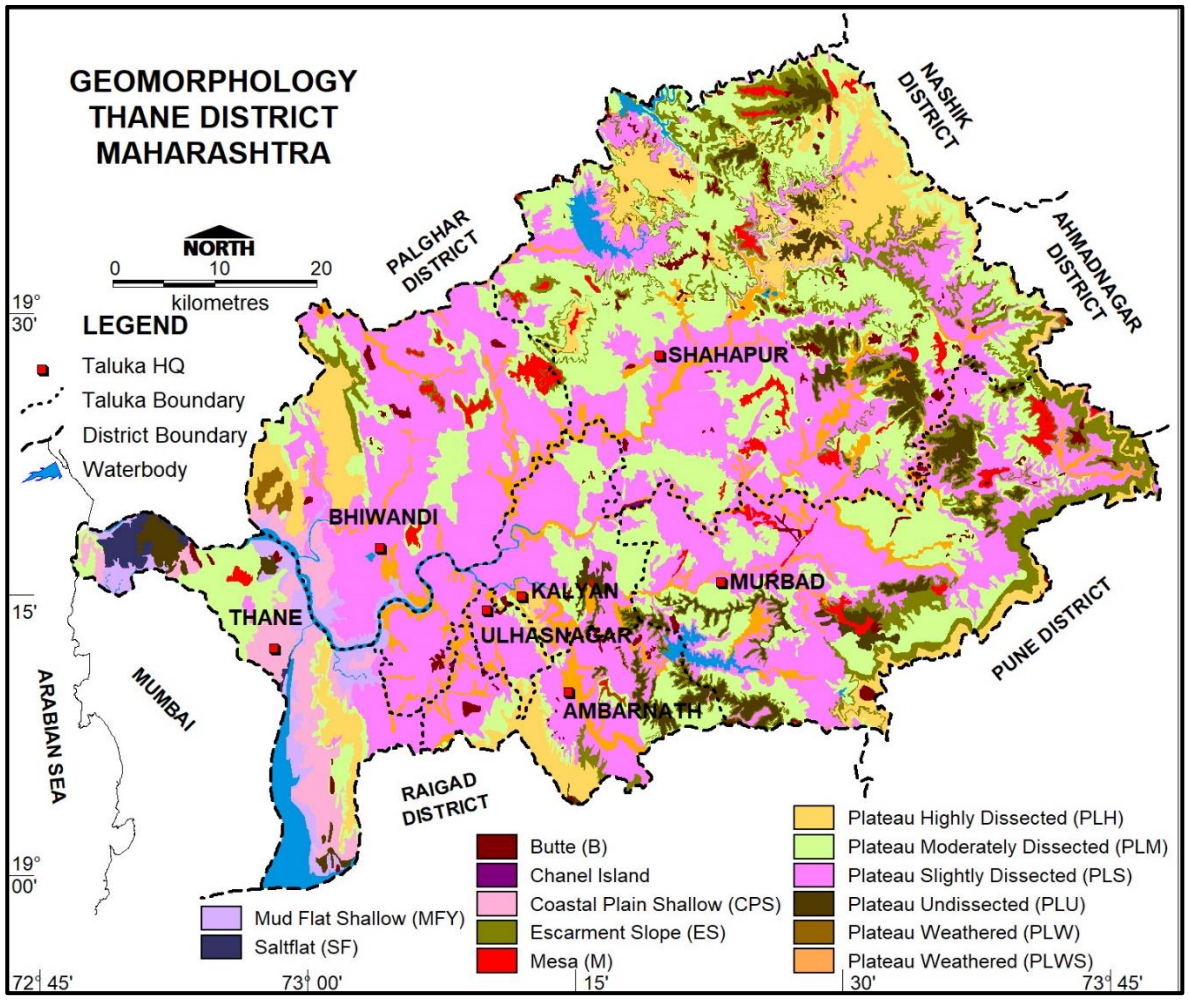



**Figure 1. 4: Geomorphology, Thane District**

The area is drained by innumerable streams and tributaries of Vaitarna and Ulhas River. The four main tributaries of river Vaitarna are Surya, Tansa, Deharaja and Pinjal Rivers. Ulhas River is the other important river in the district. The Drainage map is shown in **Fig. 1.5**

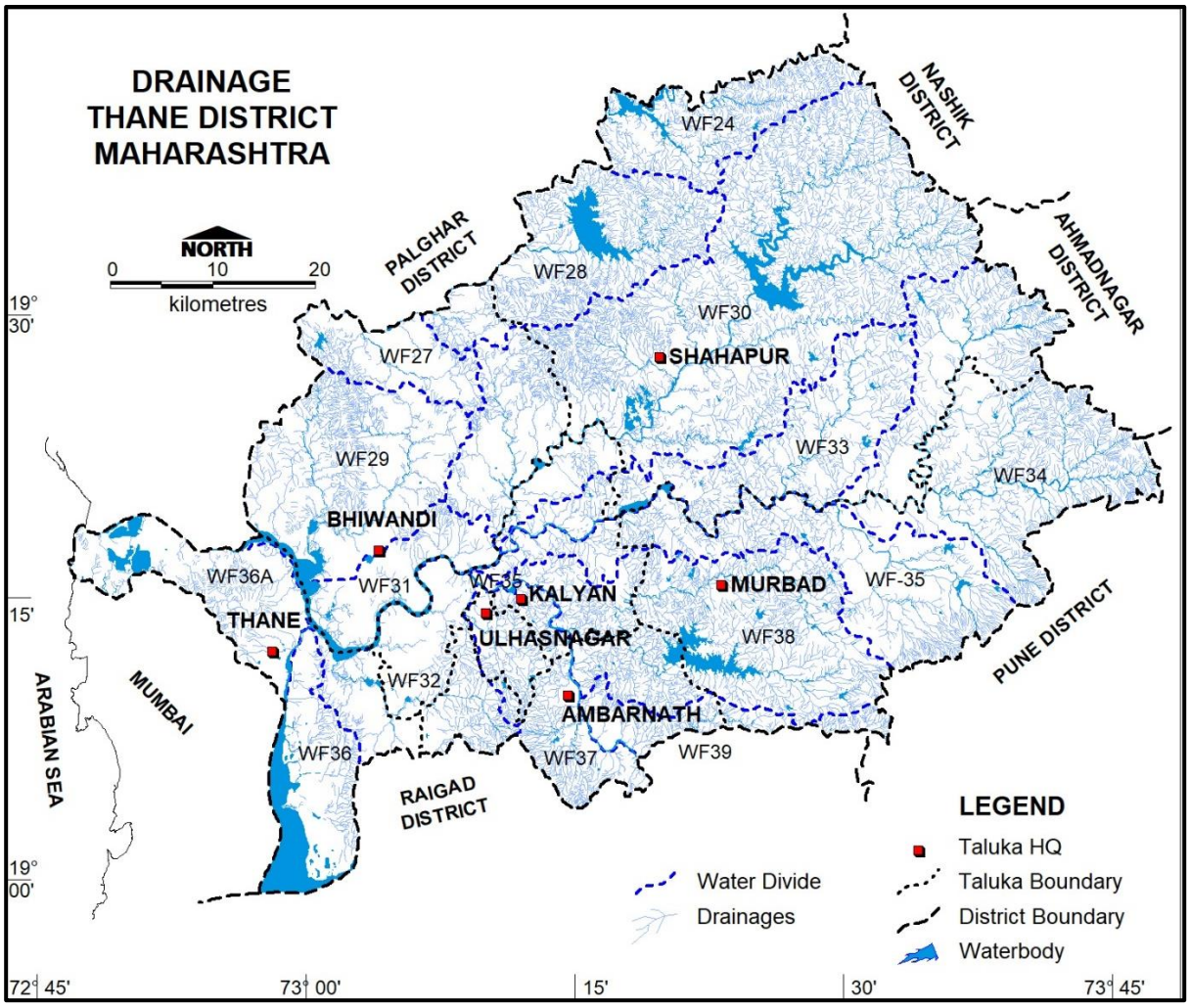



**Figure 1. 5: Drainage, Thane District**

Soil plays a very important role in the agricultural activities and forest growth of the area. The fertility of the soil from agricultural point of view depends upon the texture and structure which controls the retaining and transmitting capacity of the soil to hold the moisture content and various nutrients such as nitrogen, phosphorous and potassium present in the parent rock. The process of formation of the soil in the area is influenced by the climate, geology, vegetation, drainage and topography. The soil of Thane district is of various types. Each type of soil covering a well-defined track which displays different cropping pattern. Generally major part of the study area has black cotton soil called regur formed by weathering of trap rocks. It is rich in plant nutrients such as lime, magnesia, iron and alkaline on which cotton, jowar, bazra, tur etc. flourish. The soil varies both in texture and depth. The depth is generally shallow at the highland and hill slope and deeper in lowland and valley portion.

Sandy soil and older alluvial deposits of the Vaitharna and Surya Rivers are also found in pockets along the banks of these rivers.

Most of the soils in the district can be considered as being derived from trap (Basaltic) rocks. The soil has been classified into three broad categories based on the characteristics and relationship with topographic set up. (1) Soil of Coastal Lands with Residual Hills - These soils are slightly deep, poorly drained, fine soils on gentle sloping land and very fine soil on sloping land. These soils are calcareous and occur along the coast of

Vasai, Palgarh and Dahanu., (2) Lighter Colored soils - These soils are occurring on the undulating, elongated hills and 5 intervening valleys. These are medium to deep grayish in color, poor in fertility, clayey to loamy in nature, shallow in depth and coarse in texture. These soils are known as Varkas and are suitable for rice.

The thematic map of soil distribution in the district is shown in **Fig. 1.6.**

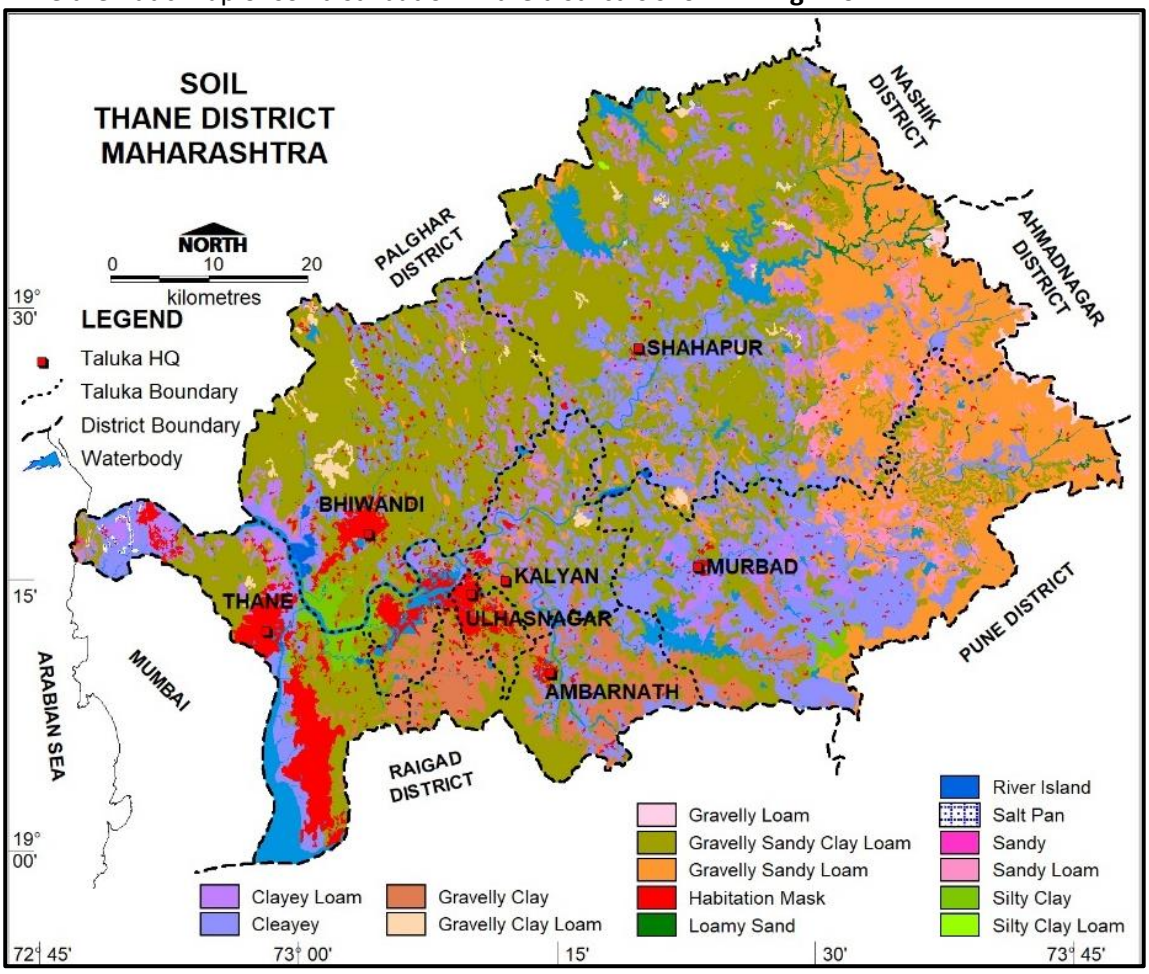



**Figure 1. 6 : Soil, Thane District**

**Soil Infiltration test:** To estimate the actual rate of infiltration in various soil types and their impact on recharge to ground water in Thane district, 2 soil infiltration tests were conducted at Vaishakra and Waret various soil types. The data has been analyzed and the salient features of the soil infiltration tests are presented in **Table 1.1.** The duration of the test is 140 minute and the infiltration rate in the area ranged from 0.3 to 1.8 cm/hr. Based on soil infiltration test it is observed that:

- Soils with low Infiltration rate shall be responsible for high runoff and become saturated during rain events. There will be less recharge to ground water. This, in turn, decreases soil strength and increases erosion potential.
- Soils that have less Infiltration rates lead to an increase in the overall volume of runoff. The excess run off caused by low Infiltration rate of soils may also contribute to local and regional flooding of streams and rivers or may result in accelerated soil erosion of fields or stream banks.
- Soil infiltration rate varies from 0.3 to 1.8 cm/hr.

**Table 1. 1: Salient Features of Infiltration Tests**

| S.No. | District | Block | Location | Latitude | Longitude | Rate of infiltration (cm/hr) |
|---|---|---|---|---|---|---|
| 1 | Thane | Murbhad | Vaishakra | 19.70409 | 73.21248 | 1.8 |
| 2 | Thane | Bhivandi | Waret | 19.900862 | 72.941147 | 0.3 |

## 1.3 CLIMATE AND RAINFALL

Climate of the district is characterized by high humidity throughout the year, an oppressive summer followed by well distributed and heavy rainfall during the southwest monsoon season. The cold season starts from December to February followed by summer from March to May. The southwest monsoon season is from June to September while October and November constitute the post monsoon season. The month with the highest relative humidity is July (89.00 %). The month with the lowest relative humidity is March (53.05 %). The rainfall is not uniform throughout the district. It is considerably more inland than on the coast. The district, however, receives heavy and assured rainfall.

Significant spatial variation in the normal rainfall ranging from less than 2100 mm/year to more than 2500 mm/year is observed. Minimum rainfall in the southern part of the district and gradually increases reaches maximum towards north and northern parts of district in parts of Shahapur and Bhiwandi blocks. Very insignificant rainfall variability is observed in the northern and northwestern parts of the district. Western part of the district shows heavy rainfall more than 2500 mm/year particularly Thane block. Central and eastern parts of the district in parts of Kalyan and Murbad blocks also receives maximum rainfall more than 2500 mm/year. Southern part of the district observes with strong isohyet gradients with rainfall between less than 2100 mm/year to 2500 mm/year particularly in parts of Ulhasnagar and Ambarnath blocks. The number of rainy days varying between 77 to 117 days.

The normal rainfall of the district is 2554 mm. Annual rainfall data of 1998-2022 is analysed and presented in Fig. 1.7. This indicates that Minimum rainfall occurred in 2009 (1883.1 mm) and maximum rainfall in 2005 (3871 mm). The rainfall trend analysis shows a rising trend @ 17.04 mm/year. The rainfall analysis show that the departure of annual rainfall from the normal rainfall, expressed in terms of percentage, varied from -26 to 51 percent. The departure percent analysed denotes the rainfall variation pattern occurred during the period 1998-2022. The area experienced 3 times (12%) excess rainfall, 20 times (80 %) normal rainfall and 2 time (8%) moderate drought conditions as given in Table 1.1. The coefficient of variation of the annual rainfall from the mean rainfall has been observed to be 18.4%. The isohyet map of the district is depicted in Figure 1.8.

**Table 1.2:** Long Term Rainfall Analysis (1998 to 2022) of Thane district

| **Period = 1998 to 2022** | | | | | | **No. of Years = 25** | | |
|---|---|---|---|---|---|---|---|---|
| **YEAR** | **AVERAGE** | **NORMAL** | **DEPARTURE** | **No. of Rainy Days** | **CATEGORY** | **Normal Rainfall** | **2554.024** | |
| 1998 | 2498.4 | 2558.6 | -2.35 | 116 | NORMAL | Standard Deviation | 493.9398 | |
| 1999 | 1962.3 | 2558.6 | -23.31 | 94 | NORMAL | COEFFICIENT OF VARIATION | 18.4 | |
| 2000 | 2502.5 | 2558.6 | -2.19 | 92 | NORMAL | MEAN | 2687.7 | |
| 2001 | 2370 | 2558.6 | -7.37 | 92 | NORMAL | MEDIAN | 2630.2 | |
| 2002 | 2385 | 2558.6 | -6.78 | 77 | NORMAL | SLOPE | 17.04 | |
| 2003 | 2669.4 | 2558.6 | 4.33 | 105 | NORMAL | INTERCEPT | 2466.2 | |
| 2004 | 2823.9 | 2558.6 | 10.37 | 90 | NORMAL | **EQUATION OF TREND LINE** | **y=17.04x + 2466.2** | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2005 | 3871 | 2558.6 | 51.29 | 95 | EXCESS | **CATEGORY** | **NUMBER OF YEARS** | **%OF TOTAL YEARS** |
| 2006 | 3079 | 2558.6 | 20.34 | 102 | NORMAL | **DEPARTURES** | | |
| 2007 | 2490.2 | 2558.6 | -2.67 | 91 | NORMAL | POSITIVE | 14 | 56.00 |
| 2008 | 2630.2 | 2558.6 | 2.80 | 92 | NORMAL | NEGATIVE | 11 | 44.00 |
| 2009 | 1883.1 | 2558.6 | -26.40 | 78 | MODERATE | **DROUGHTS** | | |
| 2010 | 2852.2 | 2558.6 | 11.48 | 112 | NORMAL | MODERATE | 2 | 8.00 |
| 2011 | 2847.7 | 2558.6 | 11.30 | 103 | NORMAL | SEVERE | 0 | 0.00 |
| 2012 | 2242.3 | 2558.6 | -12.36 | 95 | NORMAL | ACUTE | 0 | 0.00 |
| 2013 | 3062.8 | 2558.6 | 19.71 | 116 | NORMAL | **NORMAL & EXCESS R/F** | | |
| 2014 | 2546.9 | 2558.6 | -0.46 | 83 | NORMAL | NORMAL | 20 | 80.00 |
| 2015 | 1900 | 2558.6 | -25.74 | 94 | MODERATE | EXCESS | 3 | 12.00 |
| 2016 | 2684.4 | 2558.6 | 4.92 | 93 | NORMAL | Rainfall departure: EXCESS: > +25; NORMAL: +25 TO -25; MODERATE: -25 TO -50; SEVERE: -50 TO -75; ACUTE: < -75 | | |
| 2017 | 3388.3 | 2558.6 | 32.43 | 110 | EXCESS | | | |
| 2018 | 2425.5 | 2558.6 | -5.20 | 94 | NORMAL | | | |
| 2019 | 3734.9 | 2530 | 47.62 | 116 | EXCESS | | | |
| 2020 | 2559.5 | 2530 | 1.17 | 114 | NORMAL | | | |
| 2021 | 2982.8 | 2530 | 17.90 | 117 | NORMAL | | | |
| 2022 | 2801.1 | 2530 | 10.72 | 100 | NORMAL | | | |

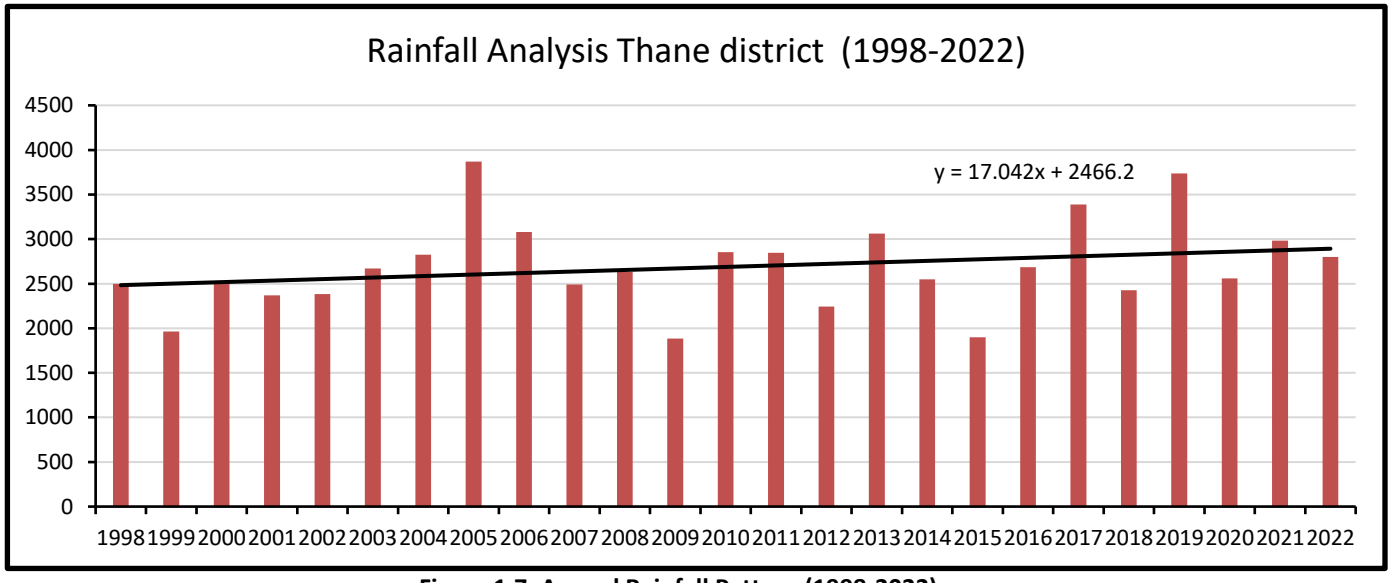



**Figure 1.7: Annual Rainfall Pattern (1998-2022)**

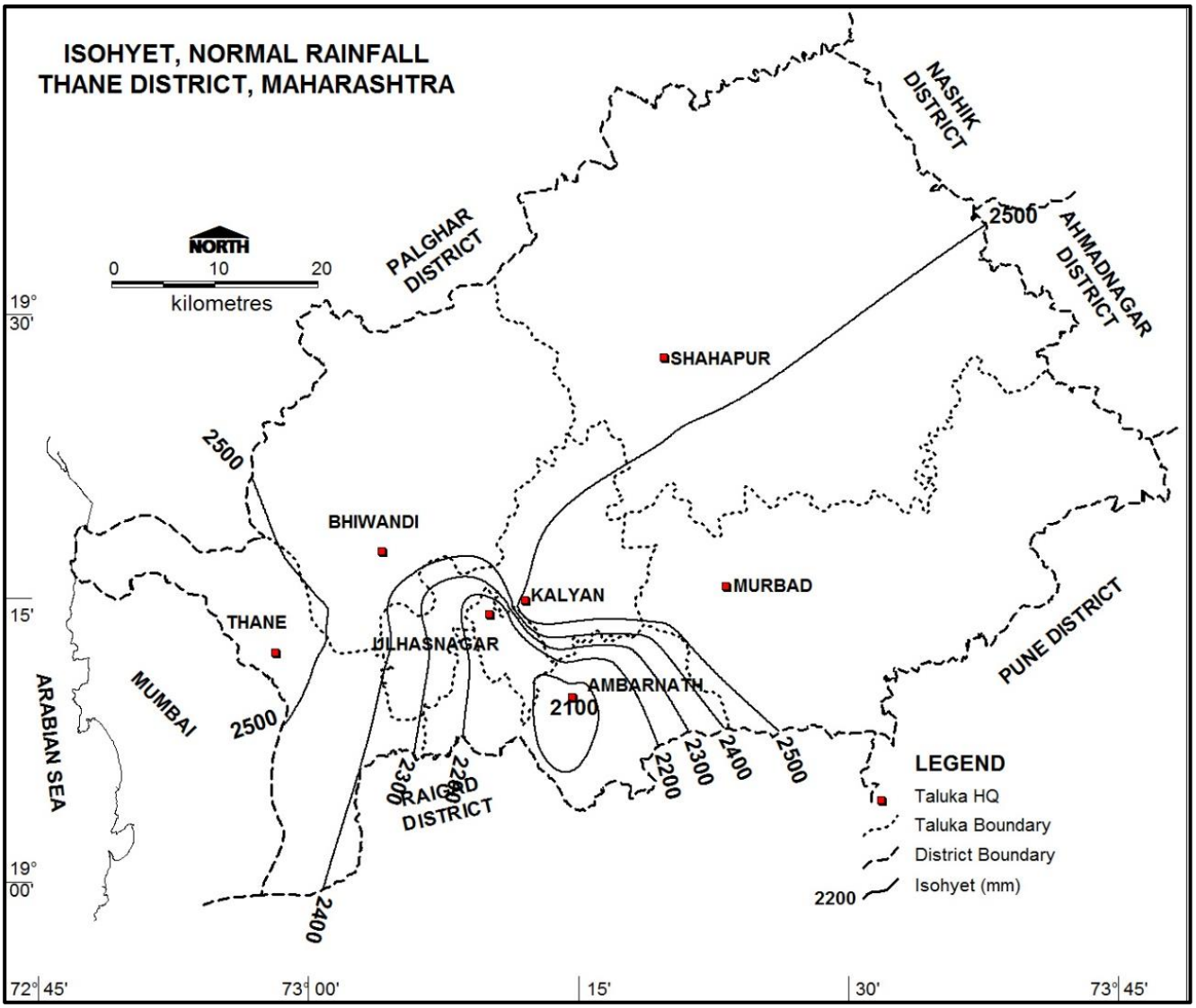



**Figure 1.8: The isohyet map of the Thane district**

**Table 1.2. Annual Block wise rainfall analysis (2013-2022)**

| Block | Normal Rainfall (mm) | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | Average Rainfall (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ambarnath | 2452.263 | 3264.8 | 2622.9 | 1982.1 | 2885.6 | 3552.7 | 2531.7 | 3980.5 | 3016.5 | 3454 | 3135 | 2974.3 |
| Bhivandi | 2576.708 | 2932.1 | 2347.8 | 1851.2 | 2506.7 | 3196.4 | 2399.2 | 3504.7 | 2646.7 | 3121 | 2673 | 2708.3 |
| Kalyan | 2501.25 | 3011.5 | 2658.9 | 1812.4 | 3020.9 | 3421 | 2262.2 | 3340.9 | 2031.1 | 2434.6 | 2633 | 2649.5 |
| Murbad | 2542.26 | 2957.2 | 2490.3 | 1707.4 | 2387.5 | 3621.3 | 2290.4 | 3883.2 | 2620.4 | 2976.6 | 2792 | 2747.7 |
| Shahapur | 2666.1 | 3037.6 | 2686.2 | 2031.5 | 2712.3 | 3387.4 | 2386 | 3719.6 | 2203.6 | 2854.1 | 2973 | 2768.4 |
| Thane | 2601.788 | 3332.1 | 2261.6 | 1893.4 | 2526.4 | 3165.2 | 2480 | 2554.4 | 0 | 3053.4 | 2680 | 2386.8 |
| Ulhasnagar | 2426.772 | 3080.4 | 2512.7 | 1902 | 2564.1 | 3891 | 2700 | 3891.1 | 2789.4 | 2855.1 | 2976 | 2861.3 |
| **Average** | 2538.2 | 3088.0 | 2511.5 | 1882.9 | 2657.6 | 3462.1 | 2435.6 | 3553.5 | 2186.8 | 2964.1 | 2837.4 | 2728.0 |

## 1.4 GEOLOGY

Geologically, all the rock formations of different geological ages (Archean to Recent) are found in Thane district. The district is endowed with rich minierals deposits like coal, iron ore, Limestone, barytes and chromites.The generalized geological sequence of the area is given in **Table 1.2**

A major part of district is covered with basalt lava flows generally called as Deccan trap. This volcanic activity was confined mainly to Upper Cretaceous to Lower Eocene age. Besides Deccan traps the formation like local alluvium, beach sand, coastal alluvium, laterites, trachytes & rhyolite cover very small area of the district. The main topographic features of this lava flows are flat topped hills and steps like terrace

Statigraphic sequences of the geological formation in the district is shown as below:-

**Table 1. 3: Generalized Geological sequence Thane district**

**(GSI: DRM FIRST EDITION 2001)**

| Formation | Age | Lithology | |
|---|---|---|---|
| Alluvium | Recent | clay, silt and sand | |
| Beach sand | Recent | sand and silt | |
| Laterite | Pleistocene | Laterite | |
| Dykes | --------- | Basic intrusion | |
| Deccan traps basalt | Eocene to upper cretaceous | Amygdularbasalt | |
| Rhyolite | Eocene to upper cretaceous | Rhyolite | |
| Trachyte | Eocene to upper cretaceous | Trachyte | |

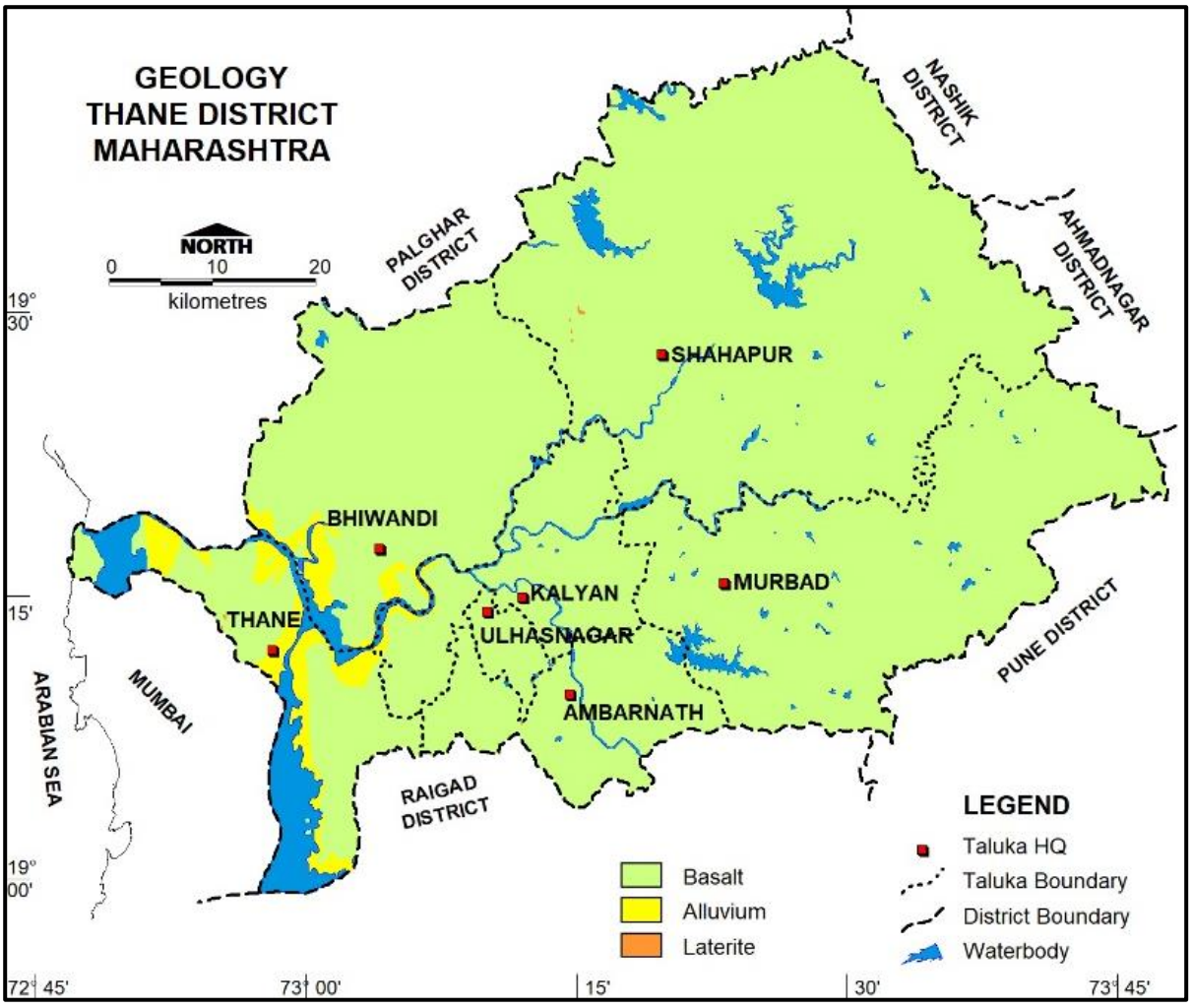



**Figure 1.** 9: **Geological Map, Thane district**

**Deccan Traps**

The basaltic lava flows of the Deccan Traps are the major rock formation of the area and total 8 flows have been demarcated from 509 to 987 m above MSL by G.S.I. Predominantly the Deccan Trap flows are simple “aa” types. The thickness of individual flow ranges from few meters to as much as 37 m. The “aa” flows generally show a thin zone of grayish basal clinker, a prominent middle section of dark dense rock and a top section of reddish altered breccia. The breccia comprises of angular and rounded reddish vesicular or massive trap pulverized rock material zeolites. The top surface of “aa” flows are represented by several centimetres of red bole. The middle dense section shows columnar or rectangular joints and conspicuous spheroidal weathering. All the Pahoehoe and “aa” flows are seen to have horizontal disposition with minor tilts here and there. In general they show a gentle easterly dip of 1 in 300 to 1 in 110.

Some of the flows are porphyritic in nature due to occurrence of plagioclase association with basalt. These lathes do not show any preferred orientation and occur randomly and also show criss-cross disposition. Each flow is characterized by the prominent units of vesicular and massive basalt. The flow contacts are demarcated based on (i) the occurrence of red or green bole or tuff (ii) chilled fine grained basalt at the base containing pipe amygdules (iii) highly vesicular and zeolitic upper parts (iv) textural and lithological characteristics and (v) distinct slope breaks.

The basaltic pile of the area is profusely intruded by dolerite and basaltic dykes, tuffs and agglomerates. The frequency of dykes is much more in the northern part where the N-S trending dykes are very conspicuous. Dykes trending NW-SE, NE-SW and E-W are also observed. Frequencies of dykes become relatively less in the south eastern part. At places triangular or rectilinear dykes’ pattern are noticed.

The weathered mantle of basalt is called the murrum. The vertical and areal extension of weathered zone is highly variable being thinner at hill slopes and highland and thick at valley. The average weathered thickness ranges from 1 to 4m.

**Laterite**

Laterite of Cainozoic age occurs as small isolated capping on the top of hill. It is reddish to brown in color and pisolitic in nature.

**Red Bole**

The horizons of red or green bole, ranging in thickness from less than a meter to a few meters, are exposed at different places and altitudes. They occur as the top undulating layers of the flow, consisting of clay like materials, generally red and green in few places known as `red bole' or green boles respectively. These red bole beds are fine grained, ferruginous and clayey in nature and indicate presence of vesicular or zeolitic trappean unit underneath. They generally serve as marker horizons to differentiate the different flows.

**Alluvium**

The alluvium consisting of a clay, sand and gravel mostly occur in small lenticular patches, mostly along the bank of rivers towards the northern and eastern part of the study area. The shallow alluvium ranges in thickness from less than a meter to 8 m and directly overlie the Deccan Trap. The loosely cemented sands and gravels are probably derived from the traps. Besides the above patches, thin alluvium covers are also found at the banks of small nala occurring in area. Alluvium is more potential for ground water than the Deccan Trap. Coastal alluvial sediments are calcareous in nature. The alluvium is found along the rivers draining the coast and along the creeks and is composed of gravel, silt and clay. It ranges in thickness from 10 to 20m. Along the coast, alluvium is composed of soft, low-density clay deposits commonly referred as mud flats.

**Subsurface Geology**

Different flows occur at different elevation. Each flow is characterized by the prominent units of vesicular and massive basalt. The flow contacts are demarcated based on (i) the occurrence of red or green bole or tuff (ii) chilled fine grained basalt at the base containing pipe amygdules (iii) highly vesicular and

zeolitic upper parts (iv) textural and lithological characteristics and (v) distinct slope breaks. The weathered mantle of basalt is called the murrum. The vertical and areal extension of weathered zone is highly variable being thinner at hill slopes and highland whreas thick in valley. The average weathered thickness ranges from 1 to 4m. The horizons of red or green bole, ranging in thickness from less than a meter to a few metres, are exposed at different places and altitudes. The shallow alluvium ranges in thickness from less than a meter to 18 m and directly overlie the Deccan Trap.

**Structures**

Normally the Deccan Trap formations are not structurally disturbed. However due to West Coast proximity some structural features were developed. Structural disturbance in the area manifest as joints, fractures and shear zones. Lineaments are plentiful in the study area. Vertical to almost vertical and horizontal to sub horizontal joints are the most common although inclined joints are found locally. In general two sets of lineaments (i.e., trending NE-SW and NW-SE) are observed in the area. Besides a set of lineaments having N-S trend is also observed in some localities. The bore wells / Tube wells located along the lineaments or the intersection yield more ground water than those sited elsewhere.

**Joints and Fractures**

Sudden cooling during the process of lava eruption has given rise to development of vesicles and joints due to evaporation of gases. The traps are cut by two to three sets of vertical joints having general trend along N-S, NW-SE direction and rarely toward E-W direction. Horizontal joints or joints parallel to the upper and lower surface of the flow are also found. Fractures and shear zones are found at several places.

**Dykes**

A number of basic dykes ranging in width from 5 to 10 m and 0.5 km to 1 Km in length have been observed in the area intruding the basaltic flow. They have vertical to sub vertical disposition. In the western part of the area, the dykes are generally following the major regional trend viz., NW-SE to NNW-SSE. They are highly fractured with two to three sets of joints. Dykes trend in the N-S and E-W direction in the eastern part of the area.

The basaltic flows are also intruded by dykes, which have similar mineralogical composition as basalt. The general trend of the dykes are N60°E - S60°W, N5° to 10°E – S5° to 10°W, N30°E – S30°W, N35°W – S35°E and E-W. They generally form minor surface divides in the area and as such contain less amount of water. However, occasionally they behave as conduits in favorable hydrogeological conditions.

## 2. HYDROGEOLOGY

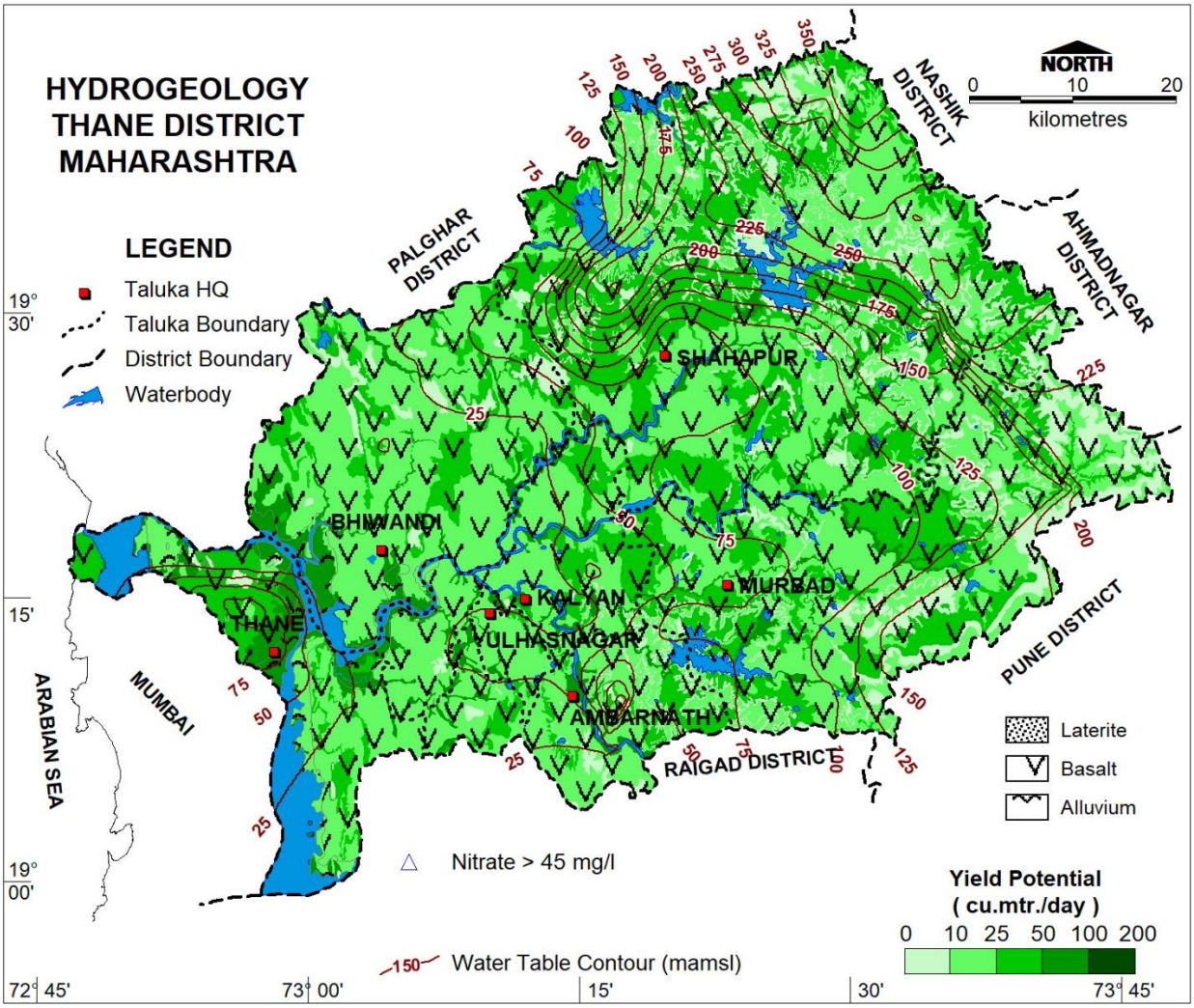



**Figure 2. 1: Hydrogeology, Thane District**

Deccan trap Basalt of Upper Cretaceous to Lower Eocene age is the major rock type covering about 80% of the district, coastal alluvium is other formation occurring only in western end of the district. A map depicting hydrogeology of Thane district is presented in **Fig. 2.1.**

**Deccan Trap Basalt**

Ground water in Deccan Traps mostly occurs in the weathered and fractured parts down to 10-15m depth. At places potential zones are encountered at deeper levels in the form of fractures and inter-flow zones which are generally confined down to 60-80m in the district. The weathered portions of both vesicular and massive units have better porosity and permeability. Intensity of weathering is less in hilly region as seen in the eastern part of the district while it is higher in plain area. The yield of dug wells tapping phreatic aquifer ranges between 18 to 152cum/day, which have 5-12m depth range. The bore wells are generally drilled down to 40 to 60m tapping weathered and fracture/vesicular zones, these wells have a discharge of 2 to 4lps. It is noticed and reported that the yields of the wells drastically get reduced in summer months beginning form March up June end.

**Alluvium**

These are developed in the western part of the area along the coast and river courses and are lacustrine in nature. Along the coast, alluvium consists of clayey and mud deposits. The quality of water is slightly brackish and pumping from this formation has to be restricted to prevent ingression of seawater. The alluvium constitutes the potential aquifer in the area. The yield of dug wells ranges between 122 to 252cum/day, which have 8-16m depth range. The bore wells are generally drilled down to 20 to 30m

tapping weathered and fracture/vesicular zones, these wells have a discharge of 4 to 6lps.

Springs details

There are volcanic springs associated with volcanic rocks and fissure springs resulting from fractures extending to a great depth in the earth's crust. When such springs are thermal in their water temperature they are called Hot Springs. During the course of field survey a number of Hot Springs were observed in and around SE part of the area near Vajreshwari, Ganesh Puri etc. These are the parts of water shed number WF-27 and WF-26. These areas are underlain by basaltic rocks having two sets of fractures in NNW and NE direction. The ground elevation in the area is between 20m to 25m amsl. The area is drained by Tansa River. Numbers of Hot Springs at Ganeshpuri are located along the river bed where massive basalt is exposed. The thermal water flowing from the hot spring has the temperature range of 42°C to 55°C. The discharge varies from 20 to 60 lpm. Ganeshpuri being the pilgrimage center, the devotees for bathing and other domestic use are utilizing the hot spring water. Besides, the spring water has got therapeutic importance. The locations of important hot springs are Paduspada (19°42': 73°4'), and Kokrene (19°43': 72°5').

**Water table contour**

Based on the Premonsoon water level data, a Premonsoon water table contour map has been prepared and presented in **figure 2.2**. The map depicts occurrence and movement of ground water in the district. The ground water flow lines are marked to show the direction of ground water flow. The elevation of water table ranges from 25 to 350 m amsl and generally follows the topography. In general, the ground water movement is towards the south -west. The ground water movement is generally sluggish in the alluvial areas with high permeable zones and in the areas of convergent ground water flow. Such areas have been demarcated as ground water potential zones. In area of low permeability, the water table contours are closely spaced indicating steep gradient.

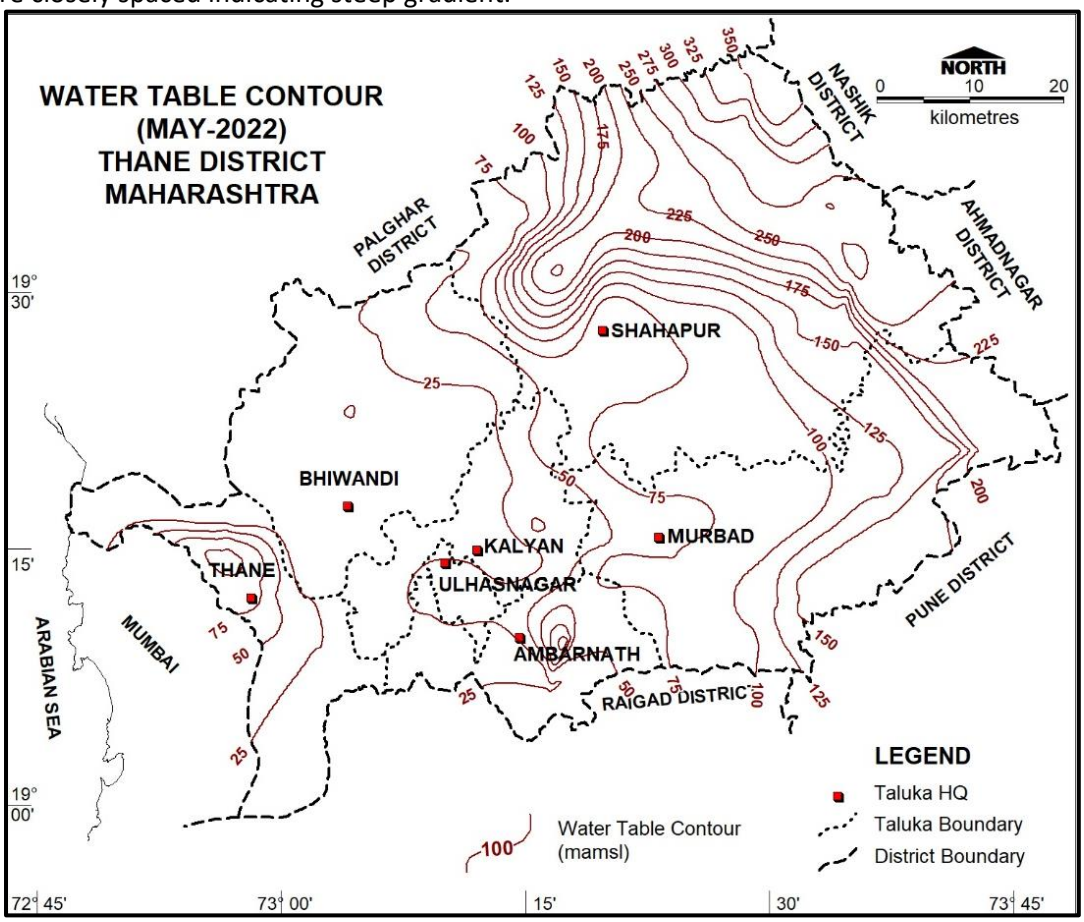



**Figure 2.2: Water table contour map, Thane District.**

### 2.1.1 Aquifer Geometry and Characterisation

Based on the ground water exploration data the existing aquifer systems in the area may be divided into two namely phreatic and deeper aquifer. Depth of occurrence of Aquifer -I and II is depicted in **Fig. 2.4** and yield in the **Fig. 2.6**

**Basalt Aquifer system:**

Ground water occurs under both phreatic and semiconfined condition. Dug well generally tap the weathered, jointed and fractured zones of the basaltic aquifers and in bore wells fractured part is more promising aquifer. The shallow aquifers are tapped by dug wells; depth of dug wells varies between 8 to 30 mbgl and thickness of weathered zones varies between 5 to 30 m. average yield potential of the aquifer varies from 0 to 200 $m^3$/day. Bore wells are not common in the district due to poor ground water potential of deeper aquifers of Deccan Traps and their yield varies between 2 and 20 m3/ hr.

**Table 2. 1: Aquifer Characteristic of Major aquifers of Thane district**

| **Major Aquifers** | **Basalt (Deccan Trap) (BS 01)** | |
|---|---|---|
| **Type of Aquifer (Phreatic/Semiconfined/Confined)** | **Aquifer-I (Phreatic)** | **Aquifer-II (Semiconfined/ confined)** |
| **Depth to Bottom of Aquifer (mbgl)** | 8-30 | 16-195 |
| **Weathered/Fractured rocks thickness (m)** | 5-18 | 1-9 |
| **Yield Potential** | 0 to 200 $m^3$/day | 1 to 3.3 lps |
| **Specific Yield (Sy)/ Storativity (S)** | 0.02 | 0.0082 to 0.0986. |
| **Transmissivity (T) ($m^2$/day)** | - | 7.28 to 177.60 m2/day |

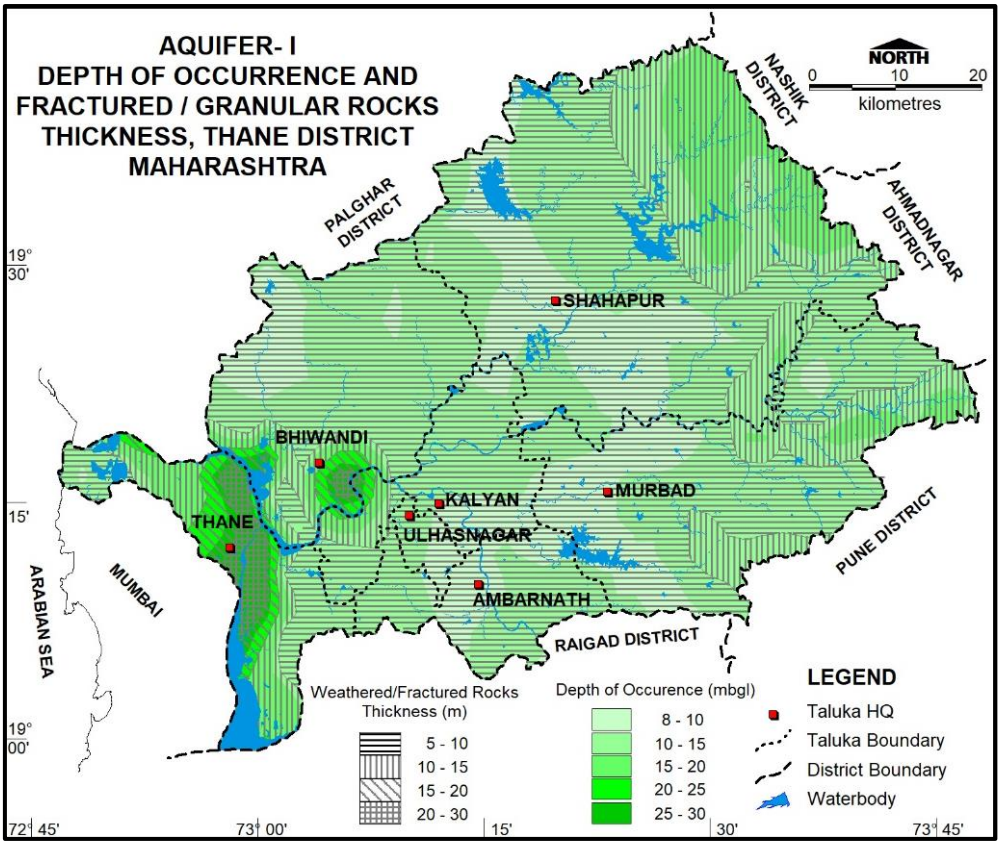



**Figure 2. 3: Depth of Occurrence and weathered Zone/ Fractured rock thickness-Aquifer-I**

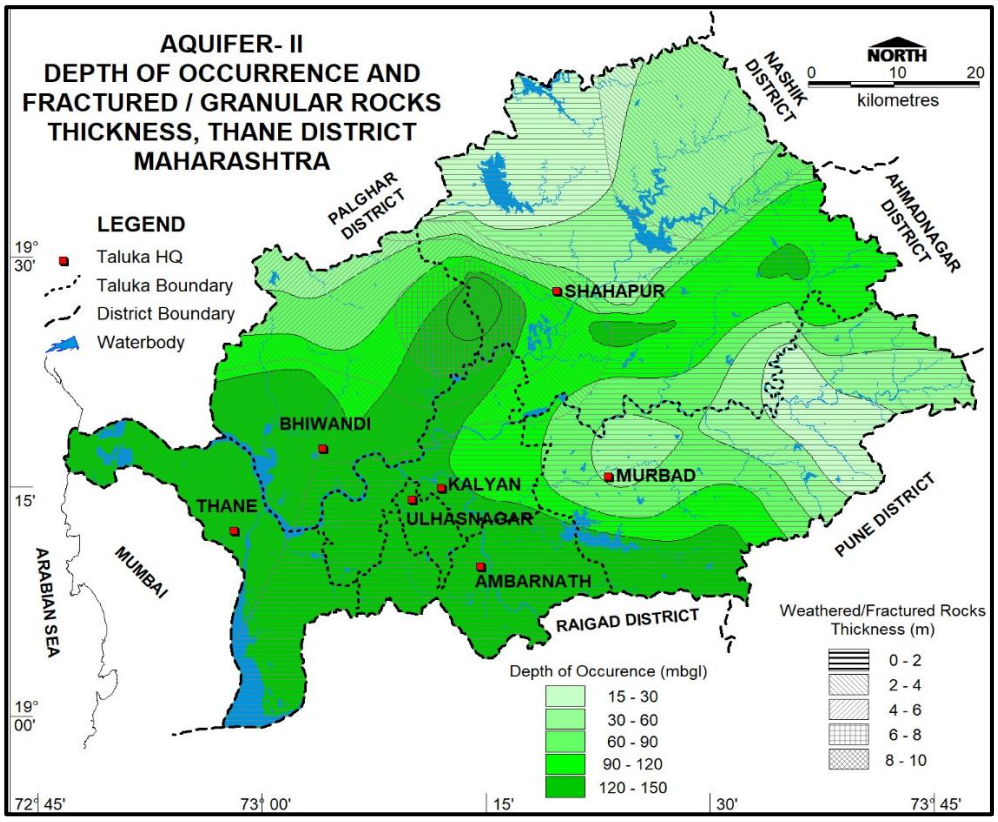



**Figure 2. 4: Depth of Occurrence and weathered Zone/ Fractured rock thickness-Aquifer-II**

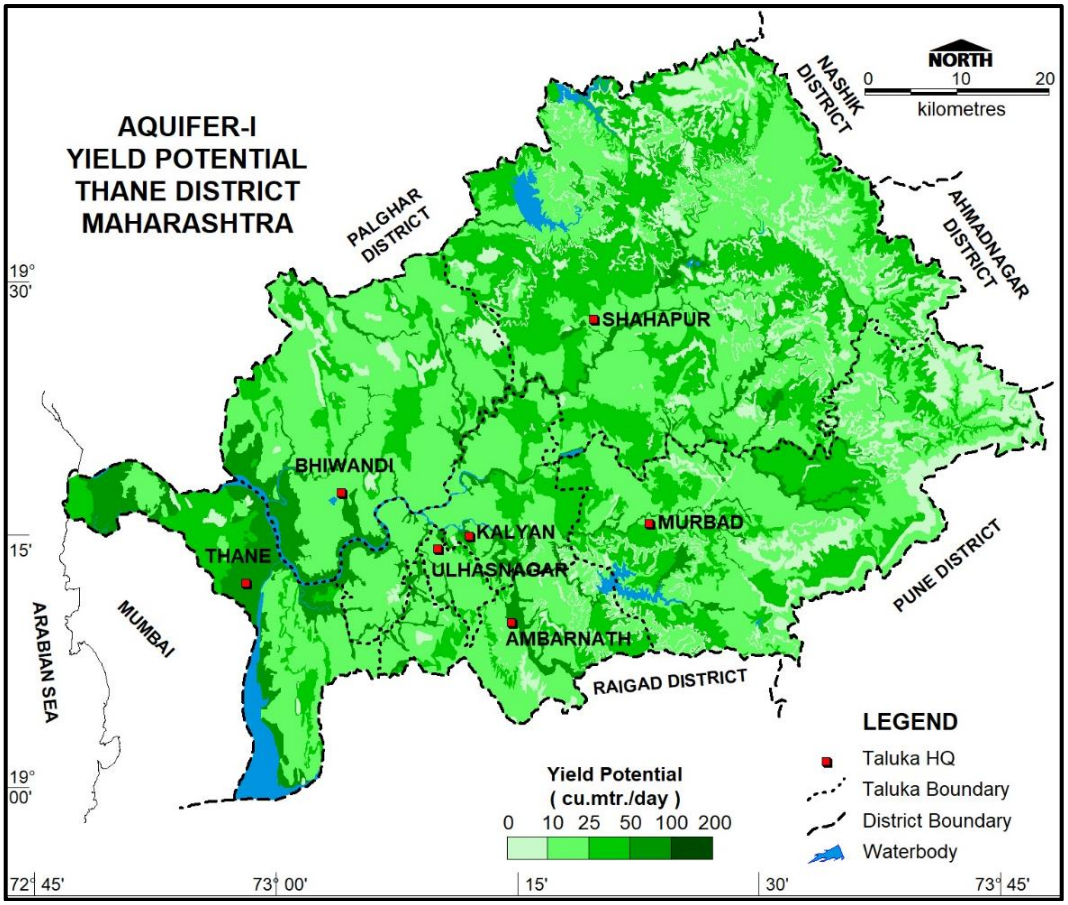



**Figure 2. 5: Yield Potential Aquifer-I**

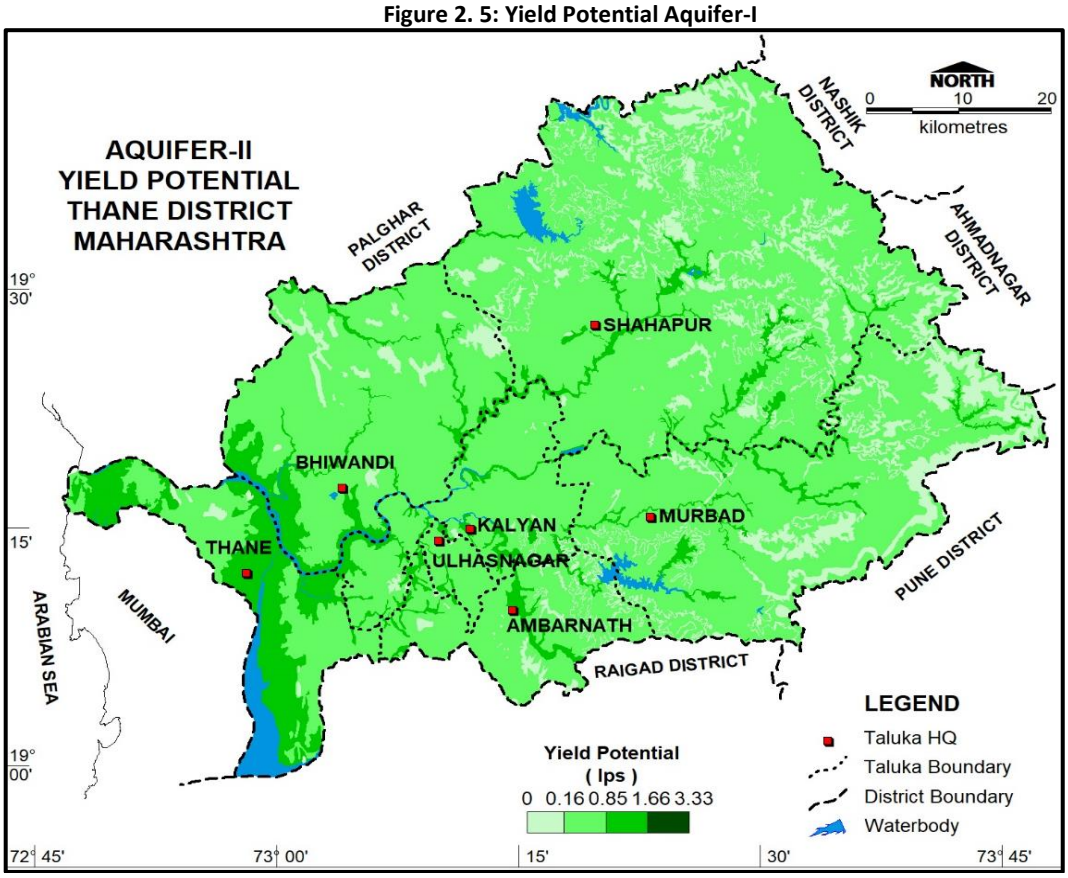



**Figure 2. 6: Yield Potential, Aquifer-II**

## 2.2 AQUIFER PARAMETERS

Based on drilled exploratory wells, the aquifer performance test conducted on some these wells indicate that the Specific Capacity ranges from 1.23 to 62.05, Transmissivity ranges from 7.28 to 177.60 $m^2$/day whereas Storativity varies between 0.0082 and 0.0986.

### 2.3 3-D AND 2-D AQUIFER DISPOSITION

Based on the existing data, aquifer disposition in 3D, Fence diagram, 3D bar diagram, various hydrogeological sections have been prepared along section lines to understand the subsurface disposition of aquifer systems and are shown in **Fig. 2.7 to 2.13.**

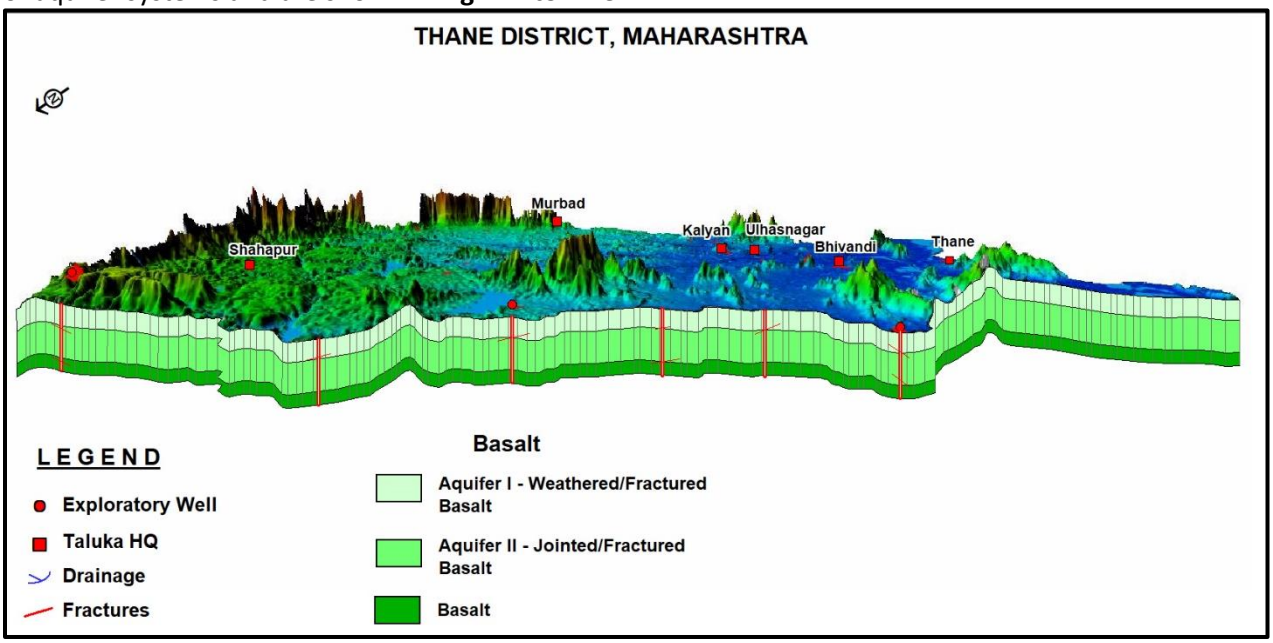



**Fig.2.7: 3D Aquifer Disposition**

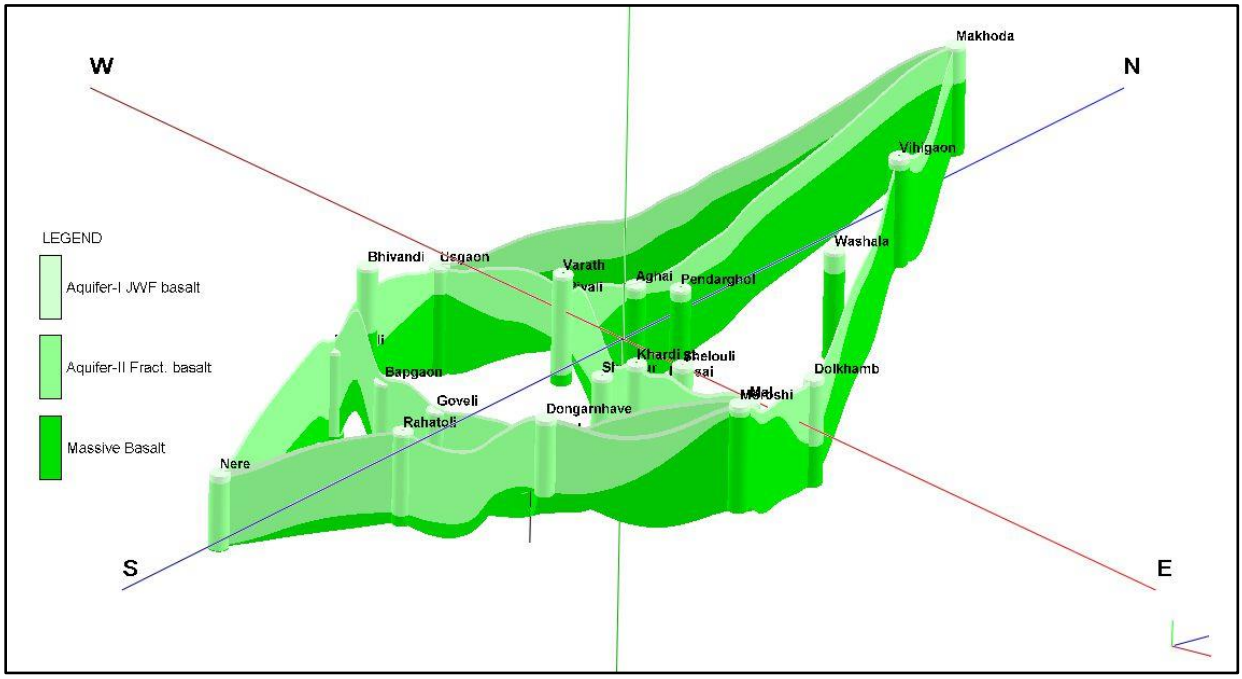



**Fig. 2.8: 3D Fence of Thane district.**

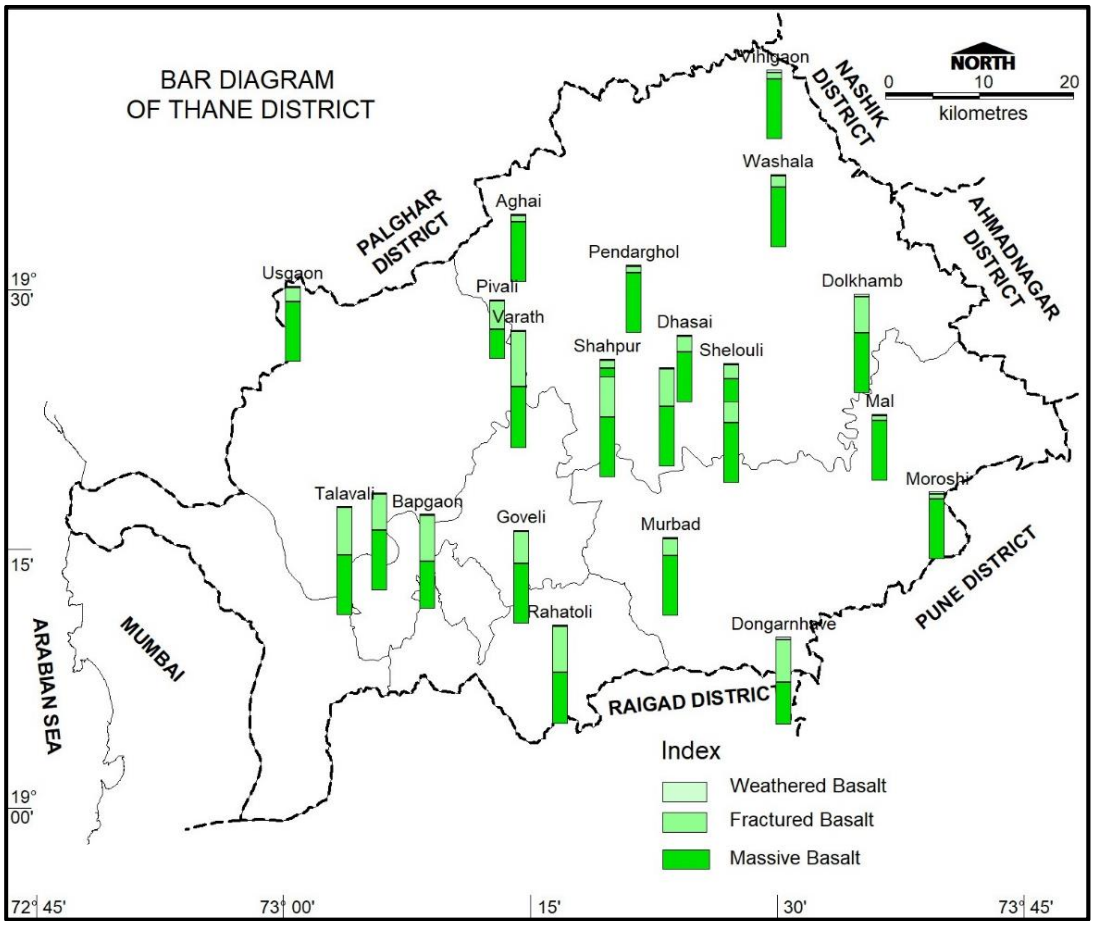
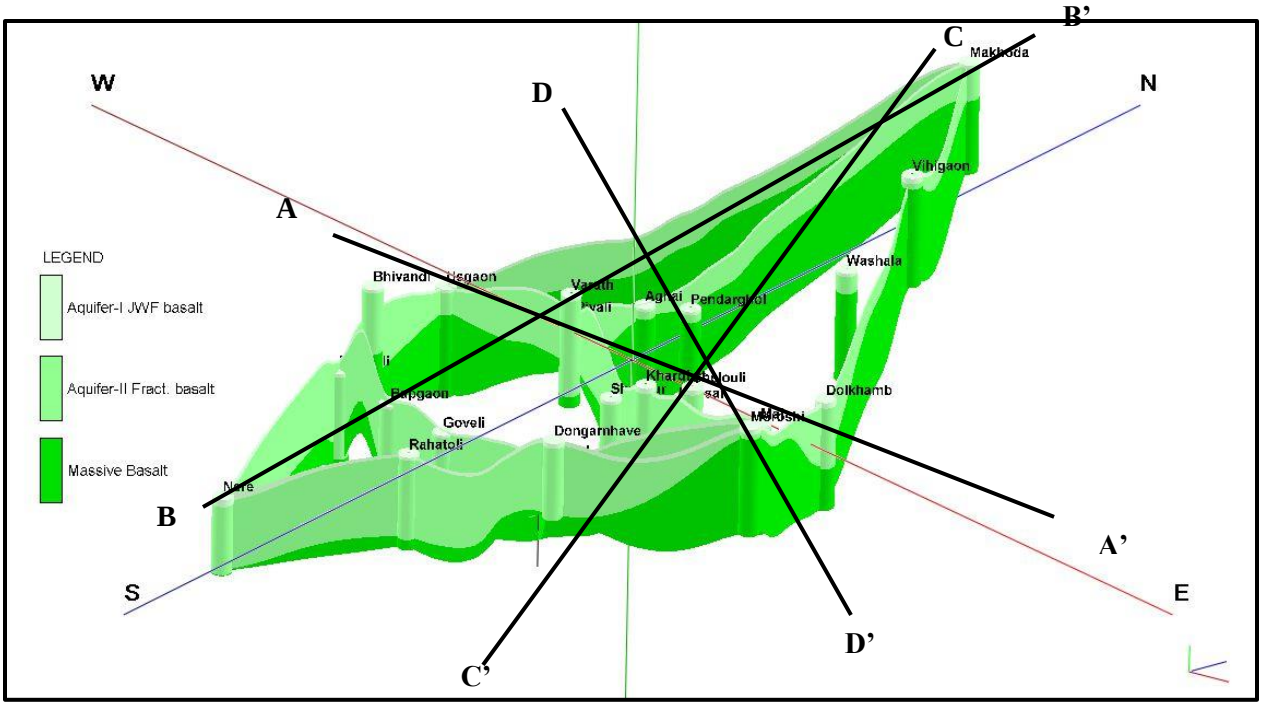



**Figure 2.9: 3D Bar Diagram**



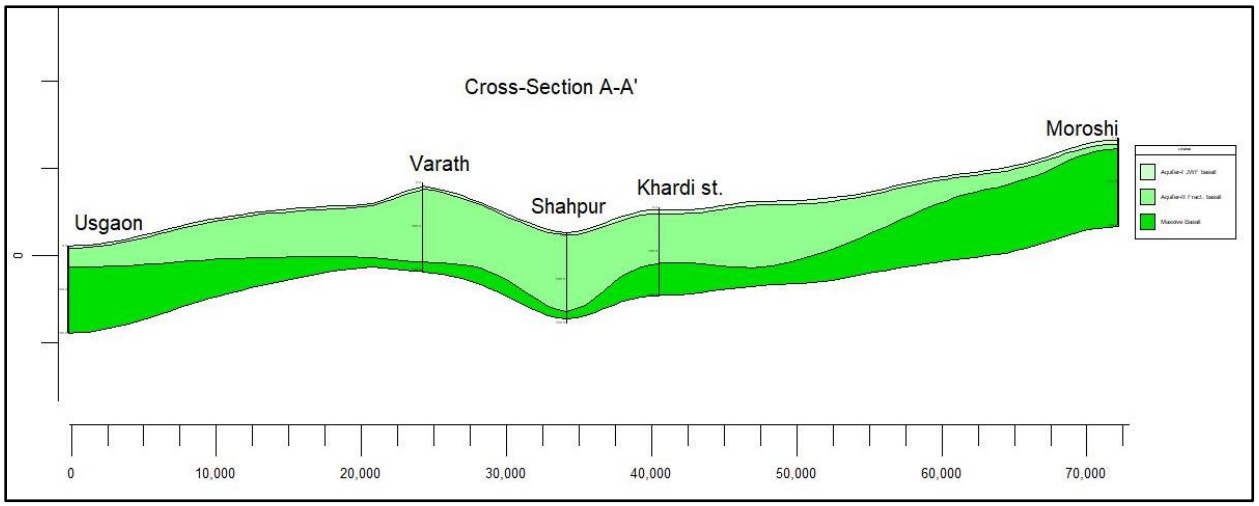




**Figure 2.10: Lithological section (A-A')**

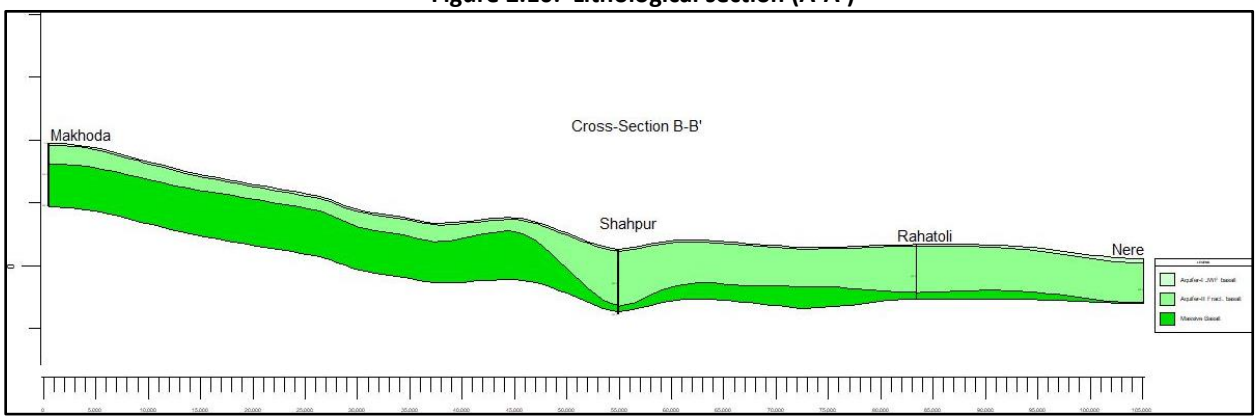



**Figure 2.11: Lithological section (B-B')**

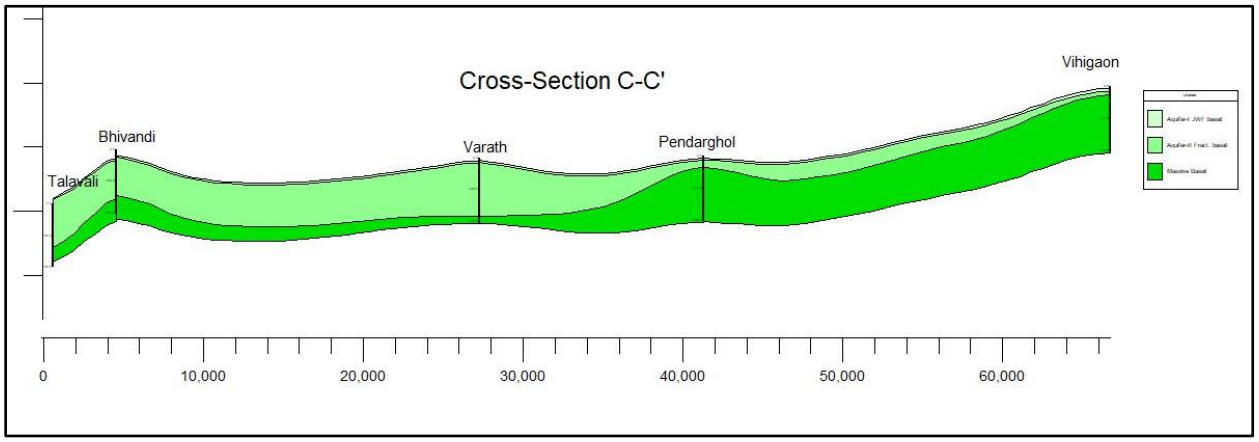



**Figure 2.12: Lithological section (C-C')**

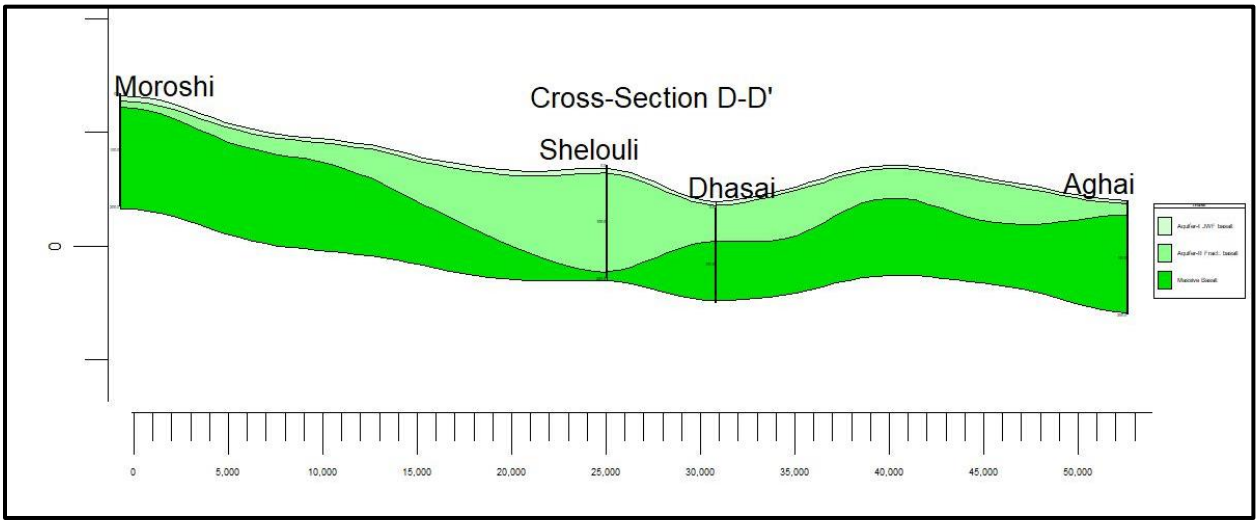



**Figure 2.13: Lithological section (D-D')**

## 3. WATER LEVEL SCENARIO

### 3.1 DEPTH TO WATER LEVEL (AQUIER-I/SHALLOW AQUIFER)

Central Ground Water Board periodically monitors 26 Ground Water monitoring wells four times a year i.e., in May (Premonsoon), August, November (Postmonsoon) and January in the district.

The depth to water levels during May 2022 were found ranging from 0.7 (Thane, Shahapur block) to 9.3 mbgl (Kasgaon, ambarnath block). Shallow water level within 2 mbgl are observed in small isolated patches in .Water levels between 2 and 5 mbgl have been observed inmajor part of the district .The depth to water level between 5 to 10 mbgl has been observed in parts of Shahapur,bhivandi, ambarnath and Murbad blocks The premonsoon depth to water level map is depicted in **Fig. 3.1.**

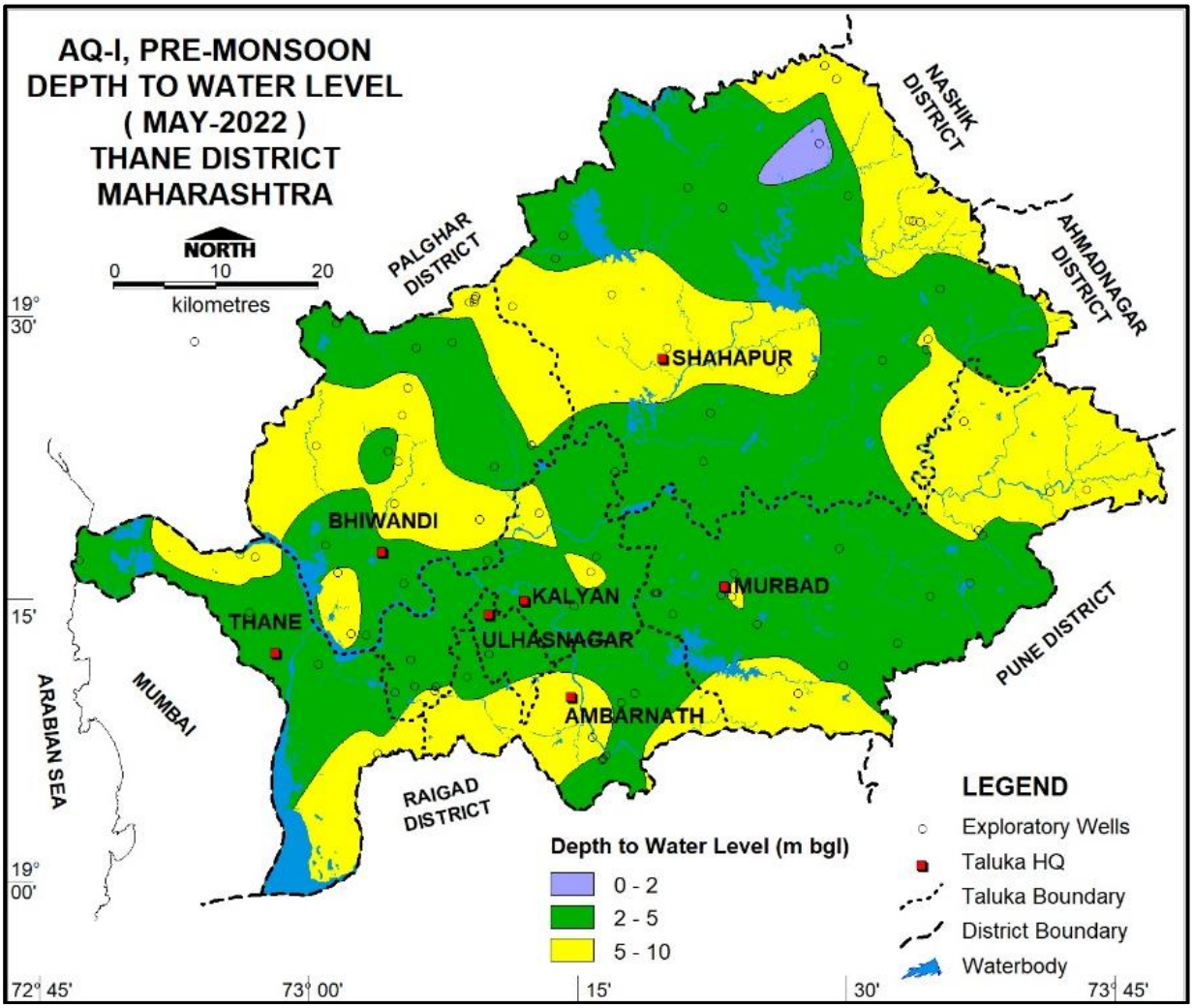



**Figure 3. 1: DTWL, Shallow Aquifer (May 2022)**

The depth to water levels during Nov. 2022 were found ranging from 0.5 (Cherfully, Sahapurblock) to 4.75 mbgl (Uttan, Thane block). Shallow water level within 2 mbgl are observed inmajor part in Sahapur and Murbad blocks. Water levels between 2 and 5 mbgl have been observed in major part of the district. Shahapur,bhivandi, ambarnath and Murbad blocks The Postmonsoon depth to water level map is depicted in **Fig. 3.2.**

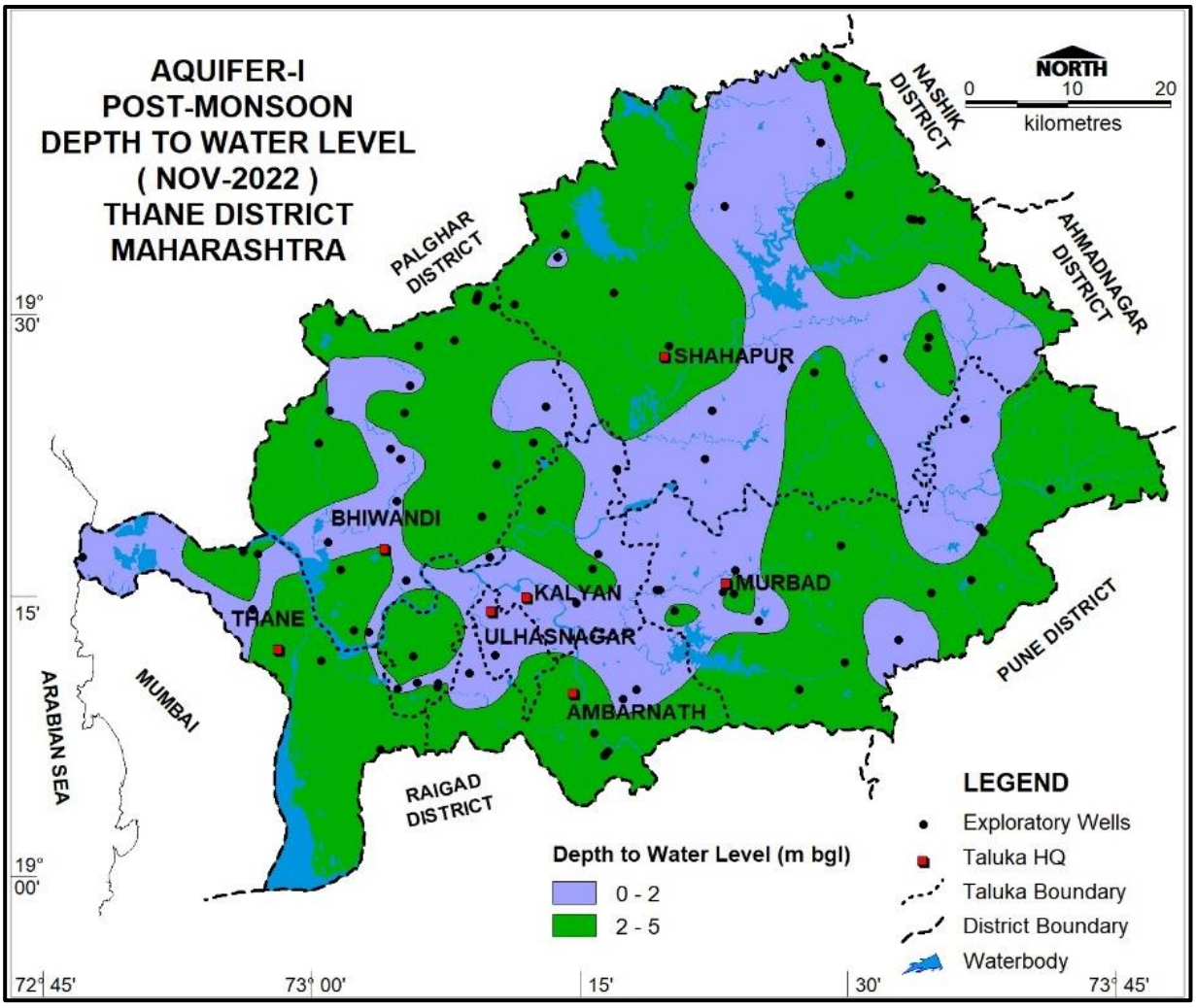



**Figure 3. 2: DTWL, Shallow Aquifer (Nov 2022)**

## 3.2 DEPTH TO WATER LEVEL (AQUIER-II/DEEPER AQUIFER)

The depth to water levels AquiferII were found ranging from 1.4 (Talavali, Bhivandi block) to more than 50 mbgl (Shelouli, Shahapur block). Shallow water level within 2 mbgl are observed in Bhiwandi and Thane blocks. Water levels between 2 and 5 mbgl have been observed in North-southern parts of the district. Water level 5-10 mbgl have been observed in the south-eastern parts of the district and water level 10- more than 30 mbgl observed in the North-Eastern parts of the district.The depth to water level map is depicted in **Fig. 3.3.**

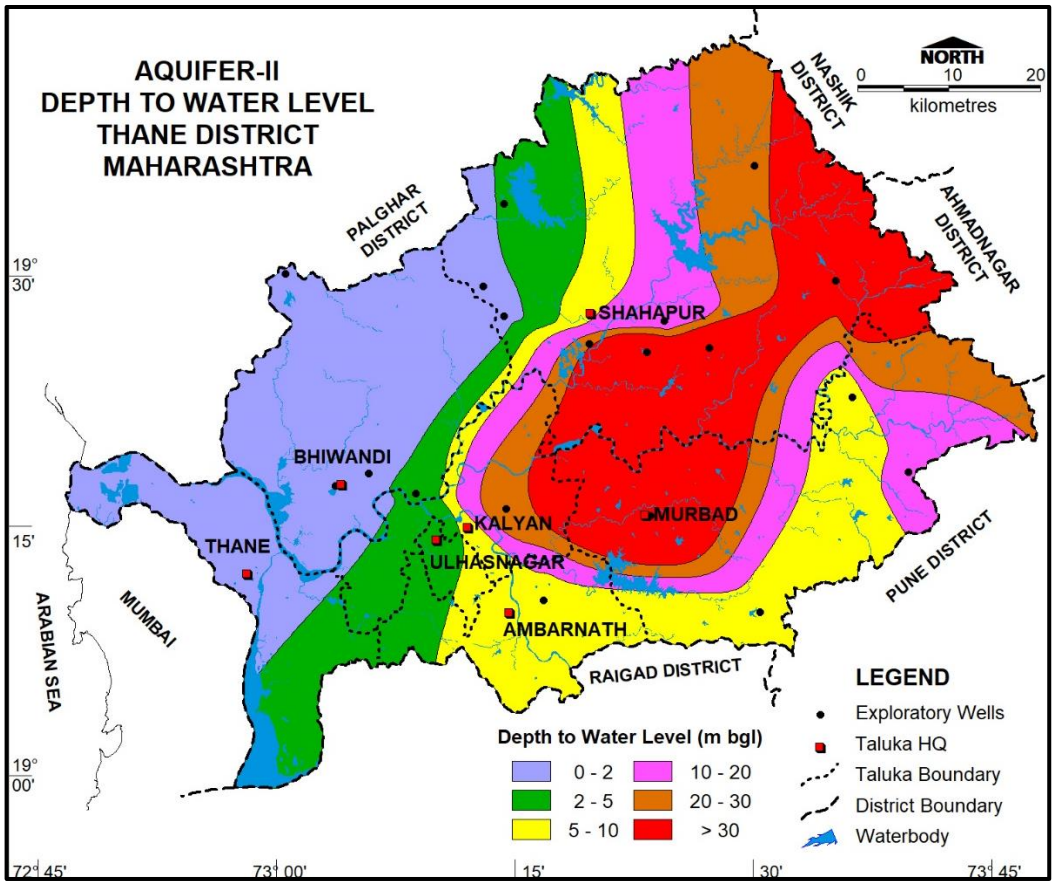



**Figure 3.3: DTWL, Deeper Aquifer.**

## 3.3 WATER LEVEL TREND (2013-2022)

During pre-monsoon period, falling water level trend has been recorded at 20 stations ranging from 0.016(Ghodbandar, Thane block) to 0.46m/year (Dahisar, Thane block) while Rising trend was observed in 28 stations varying from 0.0015(Washind, Sahapur block) to 0.64 m/year (Shivale, Murbad block).

During pre-monsoon period, decline in water level trend less than 0.20 m/year has been observed in 1376 sq. km. i.e., 30 % of the of the district. Decline of more than 0.20 m/year has been observed in 241 sq. km., i.e. 5% of the district, isolated patches are observed in Sahapur and Murbad block. Rise in water level trend less than 0.20 m/year has been observed in 1742 sq. km i.e., 39 % of the of the district. Rise in water level trend more than 0.20 m/year has been observed in 744 sq. km i.e., 16% of the of the district area as isolated patches in Murbad, Bhiwandi and Ulhasnagar blocks. **(Fig.3.4)**

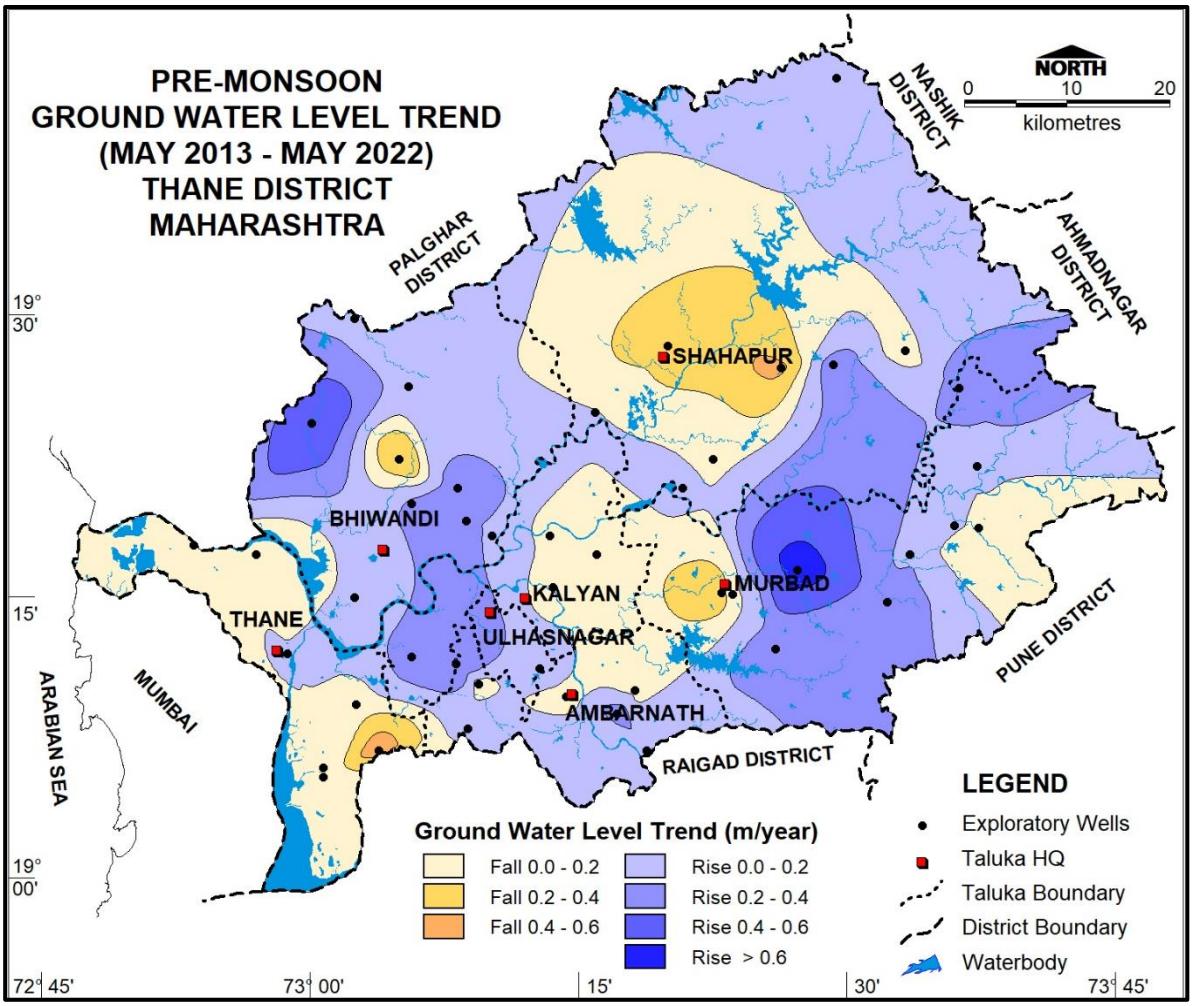



**Figure 3. 4: Pre-monsoon Decadal Trend (2013-22)**

During post-monsoon period, falling water level trend has been recorded at 36 stations ranging from 0.002 (Inde, Murbad block) to 0.37m/year (Dahisar, Thane block) while Rising trend was observed in 12 stations varying from 0.0018 (Dapode, Bhiwandi block) to 0.108 m/year (Sesne, Sesne block).

During post-monsoon period, decline in water level trend less than 0.20 m/year has been observed in 3405 sq. km. i.e., 83 % of the of the district. Decline of more than 0.20 m/year has been observed in 140sq. km., i.e. 3% of the district, isolated patches are observed in Thane and Sahapur blocks. Rise in water level trend less than 0.20 m/year has been observed in 565 sq. km i.e., 13 % of the of the district, isolated patches are observed in Thane and Murbad blocks. **(Fig.3.5)**

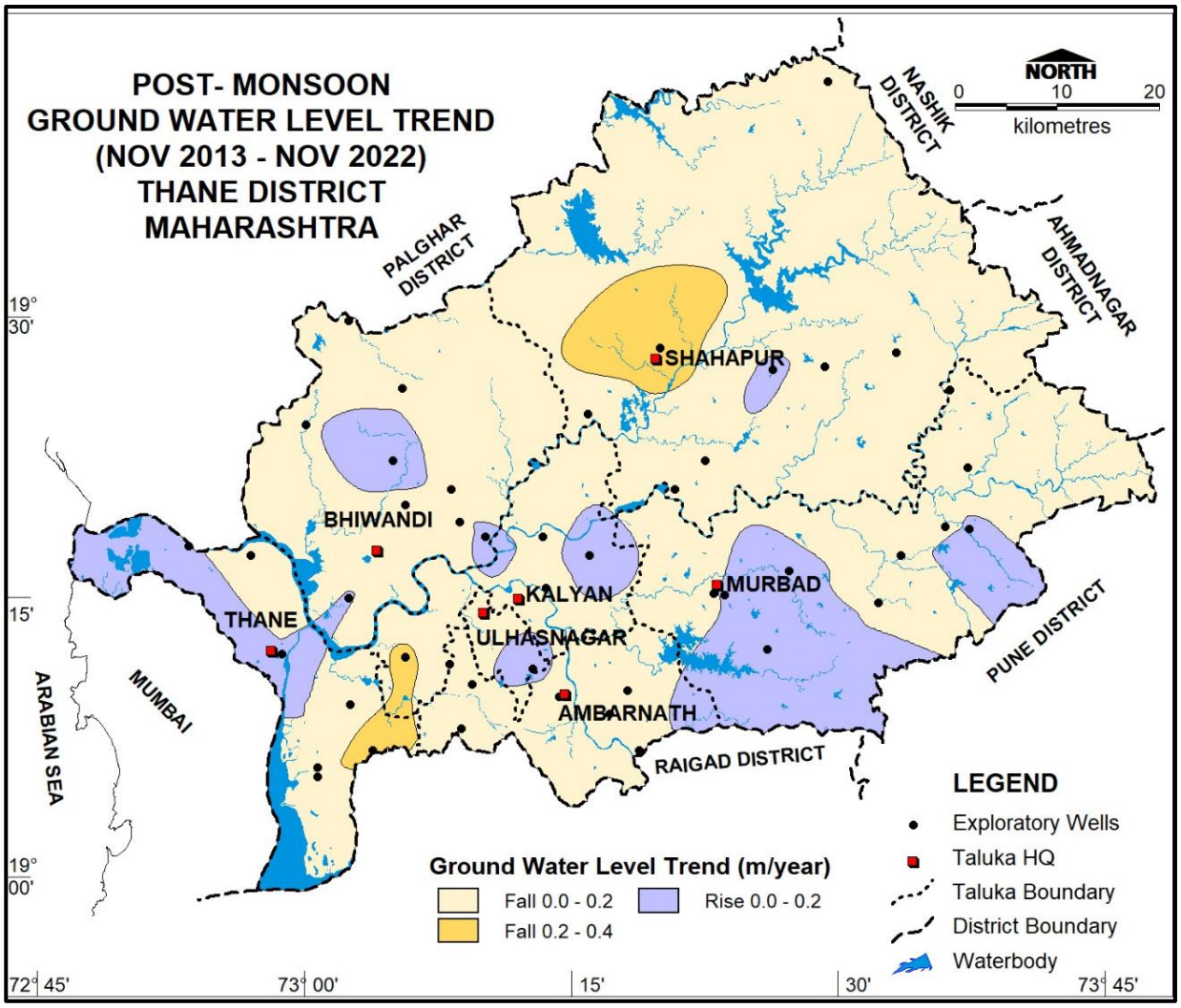



**Figure 3. 5: Post-monsoon Decadal Trend (2013-22)**

## 3.4 HYDROGRAPH ANALYSIS

The variation in short term and long-term water level trends may be due to variation in natural recharge from rainfall and withdrawal of groundwater for various agricultural, domestic and industrial requirements. The analysis of hydrographs shows that the annual rising limbs in hydrographs indicate the natural recharge of groundwater regime due to monsoon rainfall, as the monsoon rainfall is the sole source of natural recharge to the ground water regime. However, continuous increase in the groundwater draft is indicated by the recessionary limb. The figure 3.7 shows selected hydrographs (time series) of water levels.

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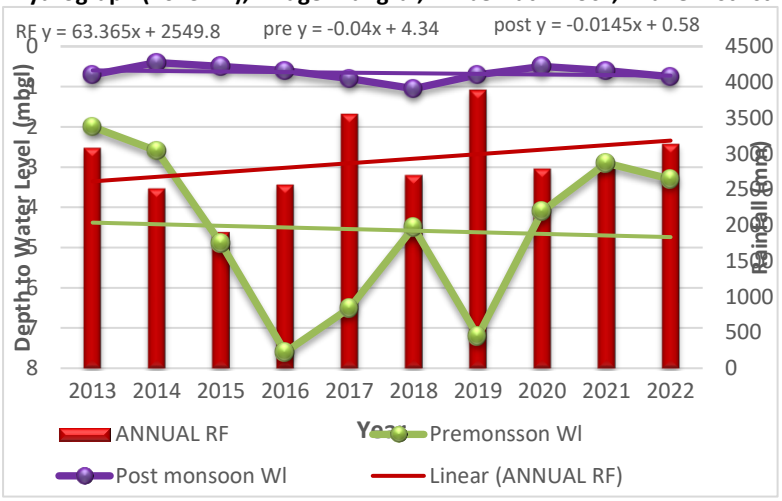
<td>Hydrograph (2013-22), village Mangrul, Ambernath Block, Thane District<br> 
</td>
<td>Formation: Basait<br>Type of Well: Dug Well<br>Premonsoon and postmoonsoon Water level trends showing falling trend @ 0.04 m/year and 0.014 m/year respectively.<br>Rising Rainfall trend @63.36 mm/ year<br>Water level behaviour in conformity to rainfall, rainfall trend affecting recharge</td>
</tr>
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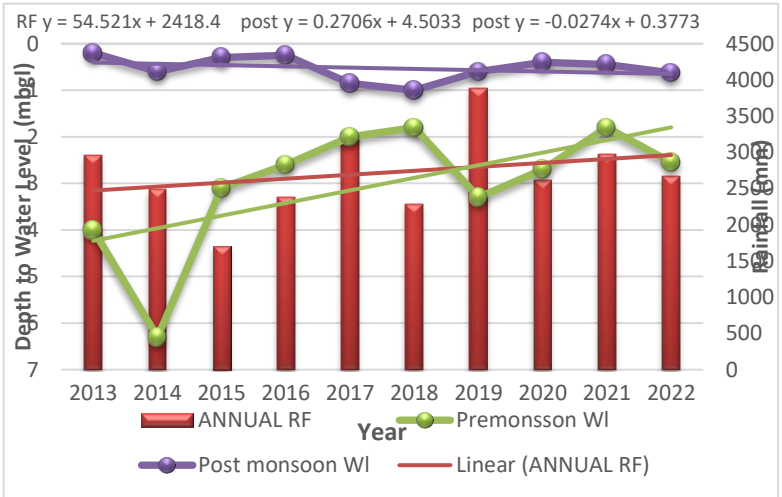
<td>Hydrograph (2013-22), village Borivali T Padgha, Bhiwandi Block, Thane District<br> 
</td>
<td>Formation: Basalt<br>Type of Well: Dug Well<br>Premonsoon and postmoonsoon Water level trends showing rising trend @ 0.27m/year and falling 0.02m/year respectively.<br>Rising Rainfall trend @54mm/ year<br>Water level behaviour in conformity to rainfall, rainfall trend affecting recharge</td>
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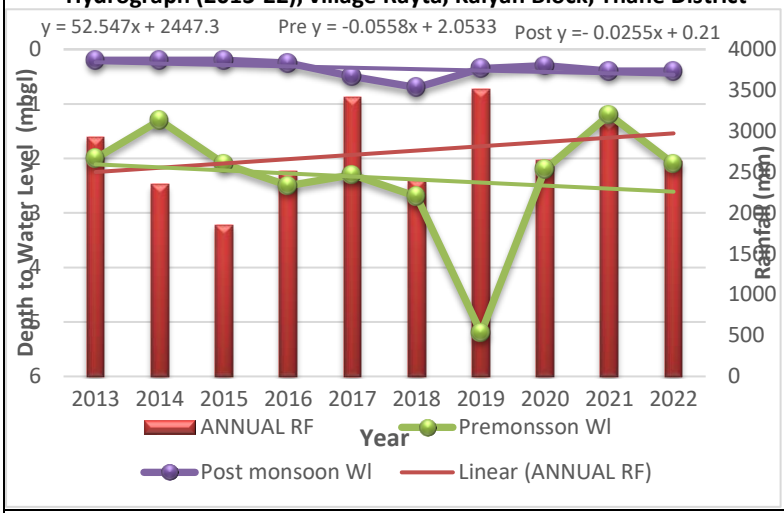
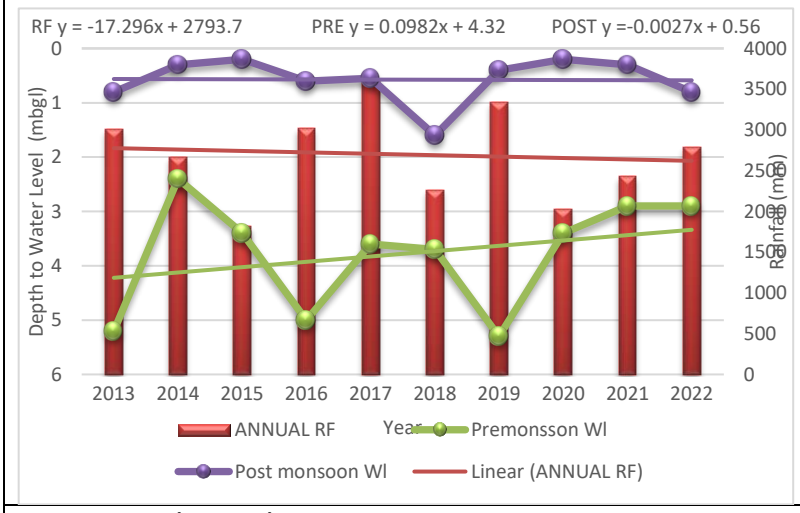
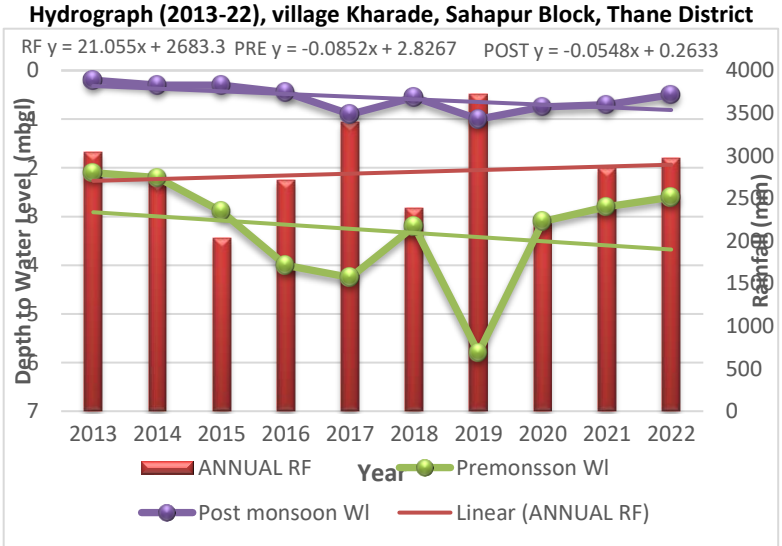
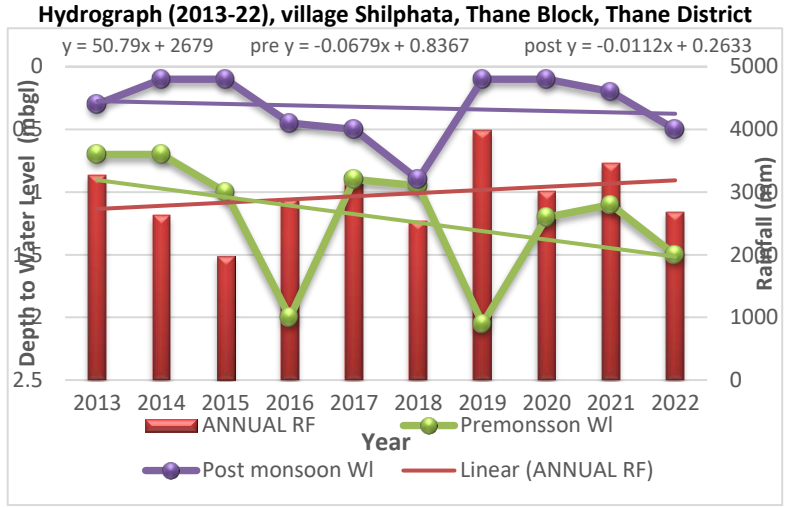
|---|---|
| **Hydrograph (2013-22), village Rayta, Kalyan Block, Thane District**<br>  | Formation: Basalt<br>Type of Well: Dug Well<br>Premonsoon and postmoonsoon Water level trends showing falling trend @ 0.055 m/year and 0.025m/year respectively.<br>Rising Rainfall trend @52.54 mm/ year<br>Water level behaviour in conformity to rainfall. |
| **Hydrograph (2013-22), village Tokavade, Murbad Block, Thane District**<br>  | Formation: Basalt<br>Type of Well: Dug Well<br>Premonsoon and postmoonsoon Water level trends showing rising trend @ 0.09m/year and falling 0.002 m/year respectively.<br>Falling Rainfall trend @17.29 mm/ year<br>Water level behaviour in conformity to rainfall, rainfall trend affecting recharge |
| **Hydrograph (2013-22), village Kharade, Sahapur Block, Thane District**<br>  | Formation: Basalt<br>Type of Well: Dug Well<br>Premonsoon and postmoonsoon Water level trends showing falling trend @ 0.08m/year and 0.05m/year respectively.<br>Rising Rainfall trend @21.05mm/ year<br>Water level behaviour in conformity to rainfall, rainfall trend affecting recharge |




Formation: Basalt
Type of Well: Dug Well
Premonsoon and postmoonsoon Water level trends showing falling trend @ 0.06 m/year and 0.01m/year respectively.
Rising Rainfall trend @50.7 mm/ year
Water level behaviour in conformity to rainfall.

**Figure 3.** 7**: Behavior of water level with time**

## 4. GROUND WATER QUALITY

Ground water sampling is being done every year from GWM wells during pre-monsoon period (May). In May 2022, 19 samples have been collected from GWM wells of Thane district. Under NAQUIM study, 28 samples from KOW wells have been collected for ground water quality. The GWM wells and KOW wells both represent the shallow aquifer. The ground water quality data of total 47 water samples from GWM wells and KOW wells have been utilised to decipher the water quality scenario of shallow aquifer of Thane district whichis described below in detail.

The minimum, maximum and the average values of the chemical parameters analysed in the 47 ground water samples are summarized in **Table-1** and water quality data is presented in **Annexure-V**.

**Table-4.1: Minimum, Maximum and Average Values of Parameters in Ground Water of Shallow Aquifer**

| Sr. No. | Parameters | Minimum | Maximum | Average |
|---|---|---|---|---|
| 1 | pH | 6.43 | 8.24 | 7.52 |
| 2 | Electrical Conductivity (EC) µS/cm @ 25°C | 156 | 2424 | 614 |
| 3 | Total Dissolved Solid (TDS) mg/L | 100 | 1551 | 393 |
| 4 | Total Hardness (TH) mg/L | 75 | 855 | 229 |
| 5 | Calcium ($Ca^{++}$) mg/L | 18 | 180 | 51 |
| 6 | Magnesium ($Mg^{++}$) mg/L | 4 | 98 | 25 |
| 7 | Sodium ($Na^{+}$) mg/L | 5 | 168 | 30 |
| 8 | Potassium ($K^{+}$) mg/L | 0.22 | 55 | 7 |
| 9 | Carbonate ($CO_3^{--}$) mg/L | 0 | 0 | 0 |
| 10 | Bi-Carbonate ($HCO_3^{-}$) mg/L | 61 | 519 | 230 |
| 11 | Chloride ($Cl^{-}$) mg/L | 7 | 603 | 66 |
| 12 | Nitrate ($NO_3^{-}$) mg/L | BDL | 46 | 8 |
| 13 | Sulphate ($SO_4^{--}$) mg/L | BDL | 56 | 19 |
| 14 | Fluoride ($F^{-}$) mg/L | 0.13 | 0.83 | 0.27 |
| 15 | Uranium (U) µg/L | BDL | 2.96 | 0.29 |

(BDL- Below Detection Limit)

### 4.1.1 Distribution of pH

The range and average value of pH of the ground water samples of shallow aquifer indicates that the ground water in Thane district is predominantly alkaline in nature. The pH values also indicate that the $CO_2$ dissolved in water exists mainly in the form of $HCO_3^-$. This is also clear from the concentration of $HCO_3^-$ and $CO_3^{2-}$ ions in the ground water. Under the natural condition, the pH of ground water is usually found in the range of 6.5 to 8.5. However, low pH (<6.5) found in the ground water may be due to the availability of $CO_2$ in environment in which the water is existing. Sometimes, it may also be due to the percolation of strongly acidic wastewater from anthropogenic sources to groundwater.In Thanedistrict, pH range was found to be between 6.43 and 8.24 with average pH being 7.52. pH less than desirable limit of 6.5 is observed at only 1 location in KOW well at Aaptewadi, Ambarnath. pH more than 8.5 is not observed at any locationin Thane district.

### 4.1.2 Distribution of Electrical Conductivity (EC) and Total Dissolved Solids (TDS)

The measurement of EC of water gives an idea about the ions concentration in the water. As the concentration of dissolved ions increases, the water becomes more conductive and also shows rise in TDS values. EC and TDS are interrelated as mostly inorganic substances are dissolved in ground water. The TDS is computed as sum of ions concentration in ground water. It is also an important parameter to assess the quality of water.

The average values of EC and TDS of the samples suggest that the groundwater in majority of the 47 wells is fresh and potable in nature. It is observed that the EC and TDS of ground water of shallow aquifer in Thane district are within permissible limit as prescribed by Bureau of Indian Standards (BIS). The EC is in the range of 156 – 2424 µS/cm with the average EC being 614 µS/cm and TDS is in the range of 100– 1551 mg/L with the average TDS being 393 mg/L.

### 4.1.3 Distribution of Total Alkalinity

The total alkalinity of water is its acid neutralizing capacity and primarily a function of carbonate, bicarbonate and hydroxide content of water. It is expressed in terms of $CaCO_3$. The range and average concentration values of carbonate and bicarbonate ions indicate that the alkalinity of ground water is mainly due to the bicarbonate ion. The total alkalinity in Thane districtis found in the range of 61 – 519 mg/L with the average being 230 mg/L. Total alkalinity is observed to be more than desirable limit of 200 mg/L in 27 locations but within maximum permissible limit of 600 mg/L.

### 4.1.4 Distribution of Total Hardness (TH)

The total hardness (TH) is the sum of calcium (Ca) and magnesium (Mg) concentration expressed in terms of $CaCO_3$ in mg/L. The carbonate and bicarbonate salts of Ca and Mg give temporary hardness to ground water while a chloride and sulphate salt gives permanent hardness. The total hardness in Thane districtis found in the range of 75 – 855 mg/L with the average being 229 mg/L. Total hardness more than desirable limit of 200 mg/L is observed in 26 locations in Thane district with one location i.e. Kolimb in Kalyan block with TH more than maximum permissible limit of 600 mg/L.

### 4.1.5 Distribution of Chloride (Cl) and Sulphate ($SO_4$)

As Maharashtra State is covered mainly by Basalt, the possibility of Cl and $SO_4$ in ground water from aquifer material is low. It is observed that the chloride content in the ground water samples of Thane districtis found in the range of 7 – 603mg/L with the average being 66 mg/L. Majority of locations have chloride concentration within the desirable limits as prescribed by BIS, i.e. 250 mg/L. Only 2 locations have been found with chloride concentration more than the desirable limit but well within the maximum permissible limits i.e. 1000 mg/L. The sulphate concentration in all 47 samples of Thane district was within the desirable limit as prescribed by BIS, i.e. 200 mg/L. The range of sulphate concentration was found to

be BDL –56 mg/L with the average being 19 mg/L. The average values of Cl and $SO_4$ also show that the potability of ground water is less affected due to these ions.

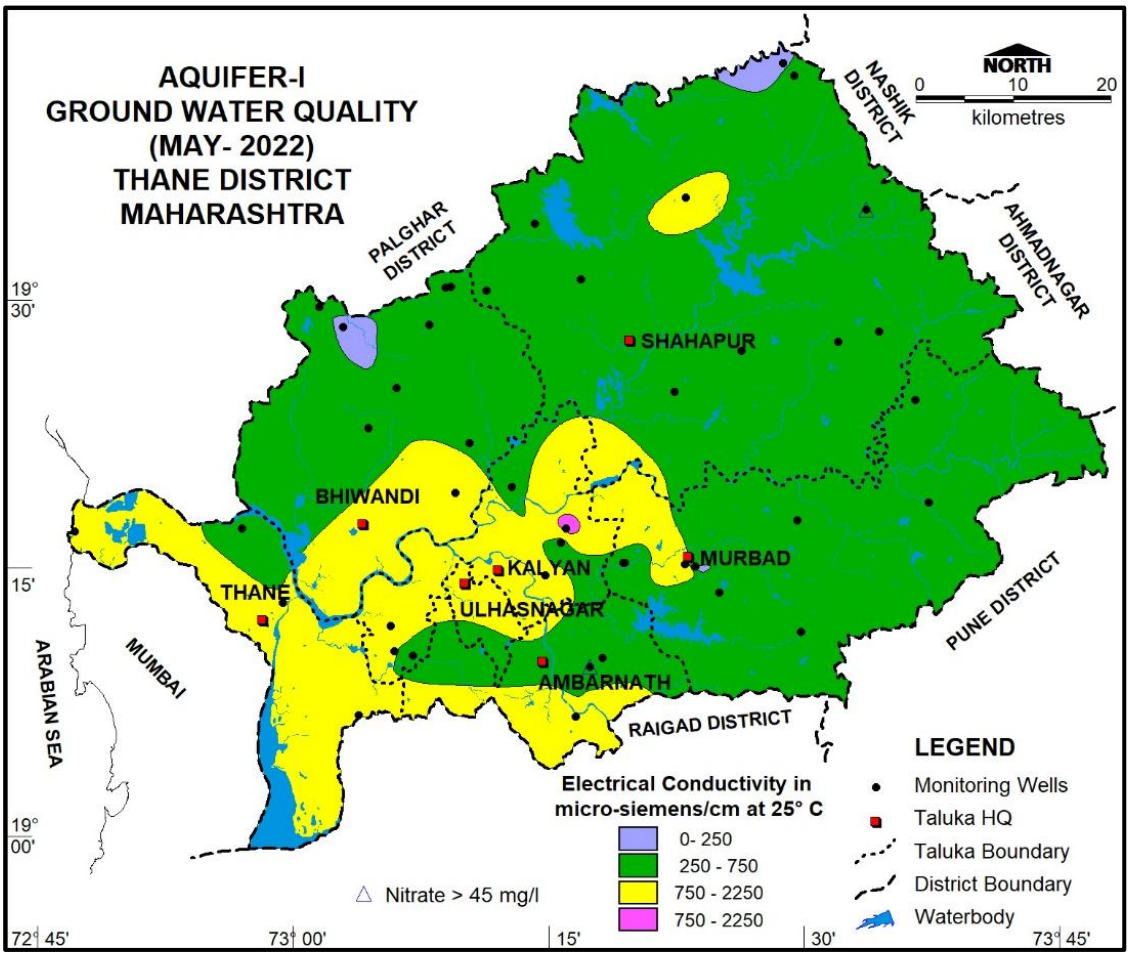



**Figure 4. 1: Ground Water Quality, Aquifer-I**

### 4.1.6 Distribution of Nitrate ($NO_3$)

Under natural geochemical condition, nitrate rarely becomes a major ion in the ground water. Nitrogen in the form of dissolved nitrate, is a nutrient for vegetation and an essential element to all life. The major contribution in ground water is from sewage, waste disposal, nitrate fertilizer and decaying of organic matter.The nitrate content in the ground water samples of Thane district is found in the range of BDL – 46 mg/L with the average being 8 mg/L. Anthropogenic contamination of nitrate ($NO_3$) is observed above the maximum permissible limits of 45 mg/L in only 2 locations at Aaptewadi and Kothala.

### 4.1.7 Distribution of Fluoride (F)

The concentration of fluoride in Thane district is found in the range of 0.13 – 0.83 mg/L with the average being 0.27 mg/L. The concentrationof fluoride in shallow basaltic aquifer is low. All the 47 wells of Thane district have concentrations of fluoride less than desirable limit of 1 mg/L. The source of fluoride in ground water is inherent fluoride bearing minerals present in the geological formation existing in the area.

### 4.1.8 Distribution of Uranium (U)

CGWB had decided to conduct ground water quality monitoring for Uranium through its Ground Water Monitoring Stations (GWMS) established throughout the country to generate background ground water quality data for U throughout India after an article titled "Large-Scale Uranium Contamination of Ground Water Resources in India" was published in 'Environmental Science and Technology letter' in May 2018. Based on the report, uranium concentration above the permissible/guideline value of WHO, 2011 (30 ppb) had been observed in ground water in some pockets of 16 States in India. As a part of this activity, the CGWB, Central Region (CR), Nagpur, had also carried out the ground water quality monitoring during AAP 2019-20. Since 2021 all the collected ground water samples have been analysed for Uranium contamination. In the water quality of Thane district, the Uranium concentration was found to be in the range of BDL –2.96 ppb which indicated no Uranium contamination in Thane district of Maharashtra.The groundwater in Thane district is safe for drinking as far as U concentration in groundwater is concerned.

## 4.2. SUITABILITY OF GROUND WATER FOR DRINKING PURPOSE

The suitability of ground water for drinking purpose is determined keeping in view the effects of various chemical constituents in water on the biological system of human being. The standards proposed by the Bureau of Indian Standards (BIS) for drinking water (IS-10500-2012) were used to determine the suitability of ground water for drinking purpose. The ground water samples are classified on the basis of constituents falling below desirable limit (<DL), in the range of desirable and maximum permissible limit (DL-MPL) and above maximum permissible limit (MPL) for drinking water purpose.

The classification of ground water samples of shallow aquiferfor drinking water purpose is shown in **Table-4.2** and graphical representation is shown in **Figure-**4.2

**Table-4.2: Classification of Ground Water Samples of Shallow Aquifer as per BIS Drinking Water Standards**

| Parameter | Drinking water Standards (IS-10500-2012) | | Total Samples | Samples < DL | | Samples between DL and MPL | | Samples > MPL | |
|---|---|---|---|---|---|---|---|---|---|
| | DL | MPL | | Samples | % | Samples | % | Samples | % |
| pH | 6.5-8.5 | - | 47 | 1 | 2.13 | 46 | 97.87 | 0 | 0 |
| TDS (mg/L) | 500 | 2000 | 47 | 36 | 76.60 | 11 | 23.40 | 0 | 0 |
| TH (mg/L) | 200 | 600 | 47 | 21 | 44.68 | 25 | 53.19 | 1 | 2.13 |
| Ca (mg/L) | 75 | 200 | 47 | 42 | 89.36 | 5 | 10.64 | 0 | 0 |
| Mg (mg/L) | 30 | 100 | 47 | 34 | 72.34 | 13 | 27.66 | 0 | 0 |
| Cl (mg/L) | 250 | 1000 | 47 | 45 | 95.74 | 2 | 4.26 | 0 | 0 |
| $SO_4$ (mg/L) | 200 | 400 | 47 | 47 | 100 | 0 | 0 | 0 | 0 |
| $NO_3$ (mg/L) | 45 | No relax | 47 | 45 | 95.74 | - | - | 2 | 4.26 |
| F (mg/L) | 1 | 1.5 | 47 | 47 | 100 | 0 | 0 | 0 | 0 |

(DL= Desirable Limit; MPL= Maximum Permissible Limit)

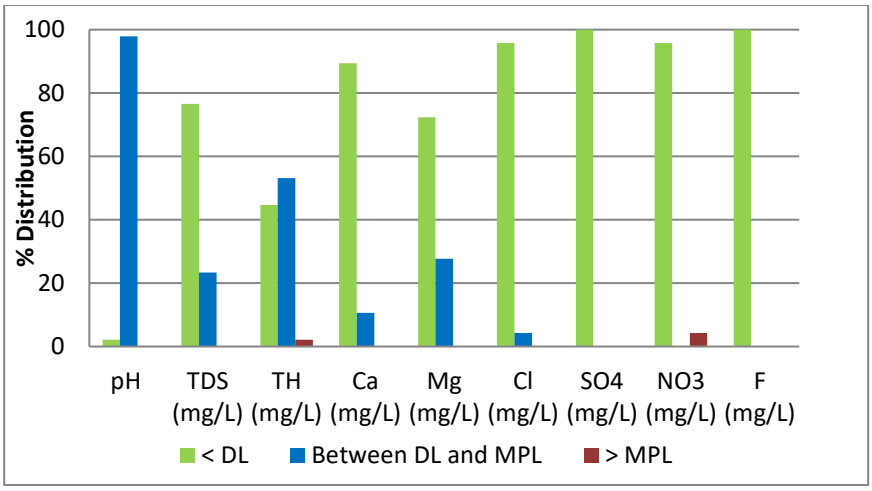



**Figure 4.2: Percentage Distribution of Ground Water Samples as per BIS Drinking Water Standards.**

As seen in **Table-4.2**, the Ground water quality of Thane district shallow aquifer is good and potable in general.

### 4.3. SUITABILITY OF GROUND WATER FOR IRRIGATION PURPOSE

The quality of water used for irrigation is an important factor in crop productivity, its yield and quality. The irrigation water quality depends primarily on the presence of dissolved salts and their concentrations. The Electrical Conductivity (EC), Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the most important quality criteria as per Bureau of Indian Standards (BIS) for quality of irrigation water (IS-11624-1986, Reaffirmed 2009), which influence the water quality and its suitability for irrigation.

**Electrical Conductivity (EC)**

The concentration of dissolved ions in the water is best represented by the parameter electrical conductivity. In relation to hazardous effects of the total salt concentration (EC), the irrigation water can be classified into four major groups-

**Low Salinity Water** (EC: Below 1500 µS/cm): Suitable for sensitive crops.
**Medium Salinity Water** (EC: 1500 – 3000 µS/cm): Suitable for semi-tolerant crops.
**High Salinity Water** (EC: 3000 – 6000 µS/cm): Suitable for tolerant crops.
**Very High Salinity Water** (EC: >6000 µS/cm): Not suitable for irrigation.

It is clear from **Table-4.3** that majority samples fall under low salinity, 3 locations havemedium salinity water and 1 location has high salinity water. This shows that the ground water from shallow aquifer of Thane district is safe to use for irrigation.

**Table-4.3: Classification of Ground water of Shallow Aquifer for Irrigation based on EC values**

| Sr. | Class | Range of EC in µS/cm | No. of samples | % of samples |
|---|---|---|---|---|
| 1 | Low Salinity Water | < 1500 | 43 | 91.49 |
| 2 | Medium Salinity Water | 1500 – 3000 | 4 | 8.51 |
| 3 | High Salinity Water | 3000 – 6000 | 0 | 0 |
| 4 | Very High Salinity Water | > 6000 | 0 | 0 |

| | | |
|---|---|---|
| Total | 47 | 100 |

**Sodium Adsorption Ratio (SAR)**

Since Calcium and Magnesium replace Sodium more readily than vice versa, the ratio reflects the Sodium hazard. The SAR indicates the relative activity of the Sodium ions in exchange reactions with the soil. Irrigation water with a high SAR will cause the soil to tighten up. The Sodium Adsorption Ratio (SAR) can be calculated from following formula-

$$\text{Sodium Absorption ratio} = \frac{Na^{+}}{\left[\frac{(Ca^{++} + Mg^{++})}{2}\right]^{1/2}}$$

(Here, the concentrations of cations are expressed in meq/L).

In relation to hazardous effects of SAR, the irrigation water quality is given in **Table-4**.4

**Table-4.4: Classification of Ground water of Shallow Aquifer for Irrigation based on SAR values**

| Sr. | Class | SAR Value | No. of samples | % of samples |
|---|---|---|---|---|
| 1 | Low | 0-10 | 47 | 100 |
| 2 | Medium | 10-18 | 0 | 0 |
| 3 | High | 18-26 | 0 | 0 |
| 4 | Very high | >26 | 0 | 0 |
| Total | | | 47 | 100 |

All the water samples of shallow aquifer have SAR values less than 10 and are considered good for irrigation.

**Residual Sodium Carbonate (RSC):**

The RSC index of irrigation water and soil water is used to indicate the alkalinity hazards for soil. RSC is considered to be superior to SAR as a measure of sodicity particularly at low salinity levels. Calcium reacts with bi-carbonate and precipitates as $CaCO_3$. Magnesium salt is more soluble and so there is less tendency for it to precipitate. When Calcium and Magnesium are lost from the water, the proportion of Sodium is increased resulting in the increase in sodium hazard. This hazard is evaluated in terms of RSC.

$$\text{Residual Sodium Carbonate} = (CO_3^{--} + HCO_3^{--}) - (Ca^{++} + Mg^{++})$$

(All the ionic concentrations in the above equation are expressed in meq/L).

In relation to hazardous effects of RSC, the irrigation water quality is given in **Table-4.5**.

**Table-4.5: Classification of Ground water of Shallow Aquifer for Irrigation based on RSC values**

| Sr. | Class | RSC Value | No. of samples | % of samples |
|---|---|---|---|---|
| 1 | Low | < 1.5 | 47 | 100 |
| 2 | Medium | 1.5 – 3.0 | 0 | 0 |
| 3 | High | 3.0 – 6.0 | 0 | 0 |
| 4 | Very high | >6.0 | 0 | 0 |
| Total | | | 47 | 100 |

From the table it is observed that 100 % of the samples of shallow aquifer show RSC values less than 1.5 meq/L. Overall, the ground water quality of Thane district is suitable for irrigation purpose based on above study.

**4. DISCUSSION ON TRACE ELEMNENTS CONTENT**

From the area under investigation, 11 water samples were analyzed for selected trace elements viz. Mn, Cr, Fe, Zn, Pb, Cu, Cd, As, Se and Ni content. All the ground water samples contain Copper, Lead, Cadmium, Arsenic, Selenium and Nickelbelow the desirable limit of BIS for the drinking water.The concentration of Manganese found in the ground water of study area is in the range of BDL to 0.459 mg/L. Only one (9.09%) sample is found to contain Mn above the BIS permissible limit of 0.3 mg/l.The chromium content in study area varies from BDL to 0.403 mg/L. Only one (9.09%) sample is found tocontain chromium above the permissible limit of BIS (0.05 mg/L) for the drinking water. Iron in ground water generally exists as Fe(II) but may oxidised to Fe(III) when ground water is under aerobic condition. In the study area, the iron content in ground water varies from BDL to 0.683 mg/L. Total 36.36% samples are found containing Fe above the BIS permissible limit (0.3 mg/l). Thus, it can be concluded that the ground water quality in major part of the study area is affected by excess of iron. After proper treatment of iron contamination, the ground water of area is suitable for drinking purpose from other trace elemental contamination point of view.

# 5. GROUND WATER RESOURCES

## 5.1 GROUND WATER RESOURCES – AQUIFER-I

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Thane district based on GEC-2015 methodology. Block wise ground water resources are given in Table 5.1, and graphical representations of the resources on the map are shown in **Figure-5.1**.

Ground Water Resource estimation was carried out for 2334.47 sq. km. area out of which 104.92 sq. km. is under canal command and 2229.54 sq. km. is in non-command. As per the estimation, the Annual extractable ground water resources is 163.69 MCM.The total Extraction is estimated at 31.11 MCM with irrigation sector having a draft of 23.97 MCM and Domestic use having draft of 7.14 MCM. The net ground water availability for future use is estimated at 132.58 MCM. Stage of ground water development varies from 9.46 % (Murbad) to 42.3 % (Ulhasnagar). The overall stage of ground water development for the district is 19 %. Block wise assessments indicate that all the blocks in the district fall under "Safe" category.

**Table 5. 1: Ground water resources, Aquifer-I (Shallow aquifer), Thane district (2022) (in MCM)**

| Administrative Unit | Annual Extractable Ground Water Recharge | Annual Ground Water Extraction-irrigation use | Annual Ground Water Extraction-industrial use | Annual Ground Water Extraction-domestic use | Total Extraction | Annual GW Allocation for Domestic Use as on 2025 | Net Ground Water Availability for future use | Stage of Ground Water Extraction | Category |
|---|---|---|---|---|---|---|---|---|---|
| Ambarnath | 17.32 | 2.86 | 0.00 | 0.64 | 3.50 | 0.64 | 13.81 | 20.2% | Safe |
| Bhivandi | 27.97 | 10.07 | 0.00 | 1.27 | 11.3 | 1.27 | 16.63 | 40.54% | Safe |
| Kalyan | 8.17 | 1.21 | 0.00 | 0.41 | 1.63 | 0.41 | 6.54 | 19.94% | Safe |
| Murbad | 35.88 | 2.11 | 0.00 | 1.28 | 3.39 | 1.28 | 32.48. | 9.46% | Safe |
| Shahapur | 60.18 | 5.17 | 0.00 | 1.97 | 7.14 | 1.97 | 53.03 | 11.87% | Safe |
| Thane | 13.32 | 2.21 | 0.00 | 1.5 | 3.73 | 1.52 | 9.58 | 28.04% | Safe |
| Ulhasnagar | 0.82 | 0.33.29 | 0.00 | 0.17 | 0.35 | 0.1 | 0.47 | 42.30% | Safe |
| **Total** | **163.69** | **23.97** | **0.00** | **7.1** | **31.11** | **7.13** | **132.58** | **19%** | **Safe** |

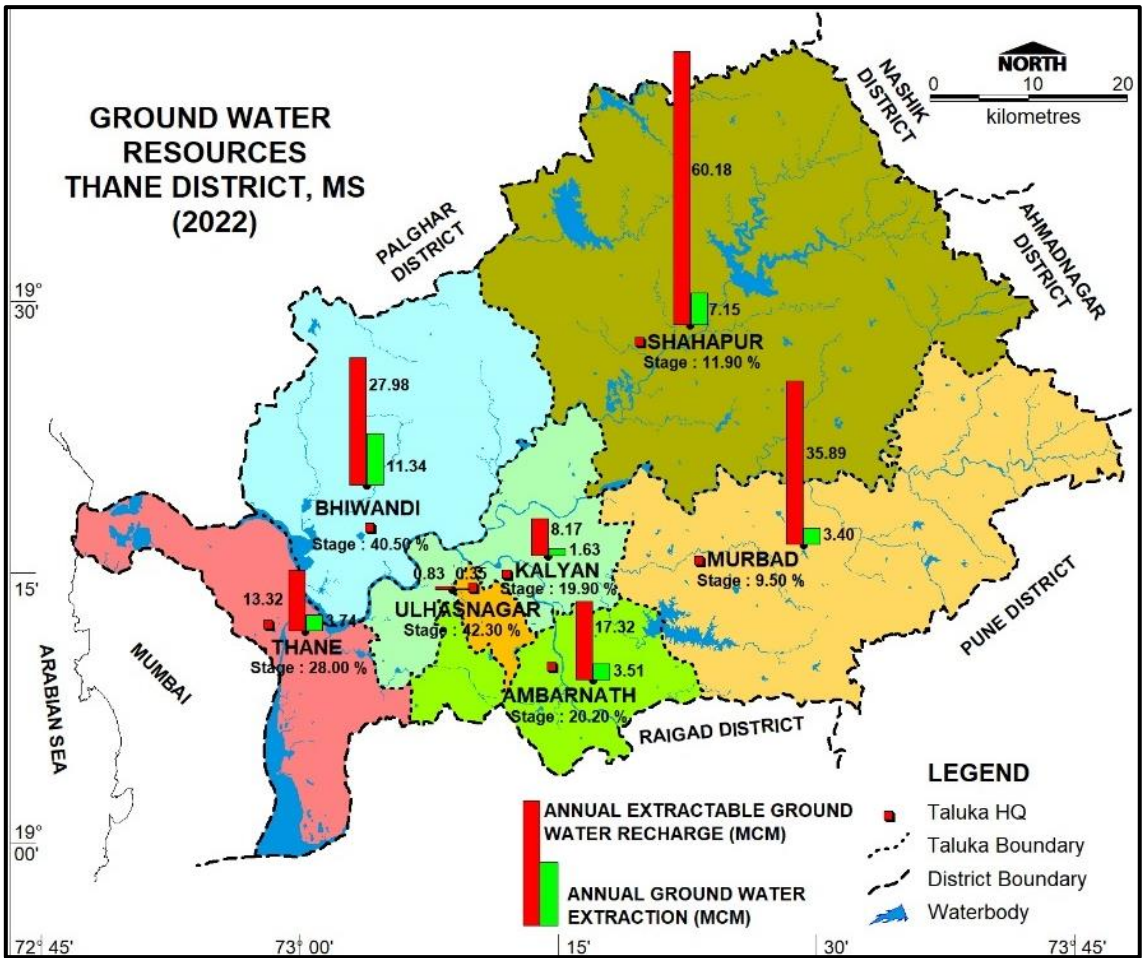


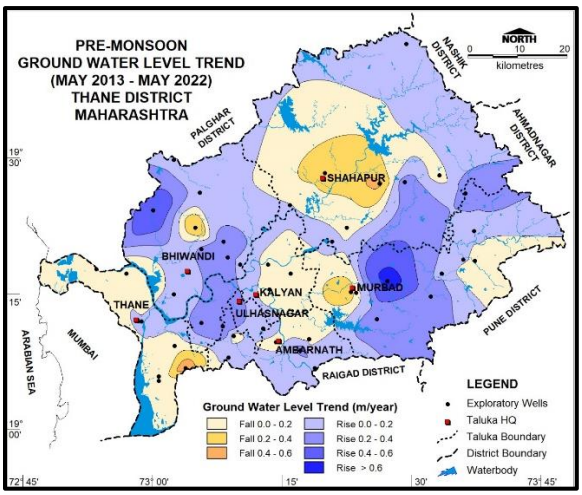

**Figure 5. 1: Ground Water Resources (2022), Thane district**

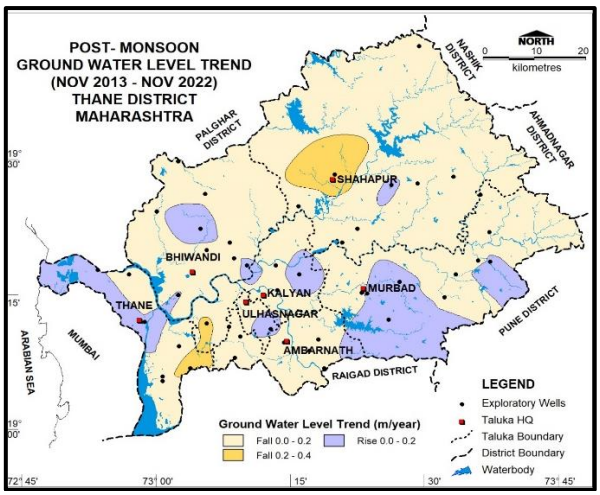
## 6. GROUND WATER RELATED ISSUES

### 6.1 DECLINING WATER LEVEL TREND

The ground water exploitation has resulted in decline of water levels over the period of time. In During pre-monsoon period, decline in water level trend less than 0.20 m/year has been observed in 1376 sq. km. i.e., 30 % of the of the district. Decline of more than 0.20 m/year has been observed in 241 sq. km., i.e. 5% of the district, isolated patches are observed in Sahapur and Murbad block

During post-monsoon period, decline in water level trend less than 0.20 m/year has been observed in 3405 sq. km. i.e., 83 % of the of the district. Decline of more than 0.20 m/year has been observed in 140sq. km., i.e. 3% of the district, isolated patches are observed in Thane and Sahapur blocks.



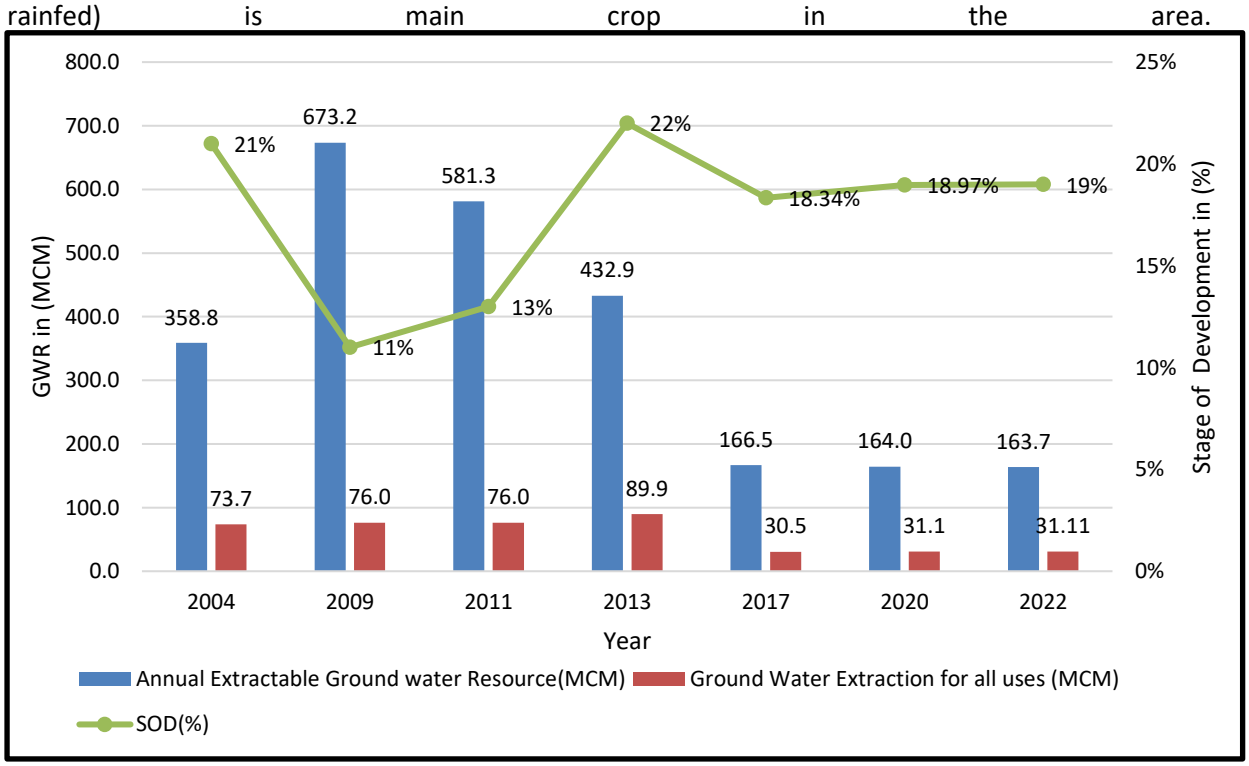



## 6.2 SUSTAINABILITY IN HARD ROCK AREAS

The major part of the district is occupied by hard rock formations (that inherently consist of limited extent of porous and pervious zone; absence of primary porosity; predominance of secondary porosity that has evolved from prevailing erratic joint pattern, absence of primary porosity and also, low rainfall results in poor sustainability of the aquifers. However, the erratic nature of existing joints/fractures pattern results in highly varying yield capacities of the aquifers in the area.

## 6.3 GROUND WATER RESOURCES-Low Ground Water Development

Eventhough the district continous to be safe category; the Stage of ground water development has decrease over the period of time from 2004 to 2020 from 21 % (2004) to 19 % (2022) but no singnificant changes in SOD has been observed over the time. In Thane district, Ground water draft for domestic and industrial purposes is contiously increased from 12.32 mcm to 15.16 mcm from 2004 to 2013.After 2013 district has been slip into Palghar District. Similarly Ground water draft of irrigation purposes is also increased from 61.3 mcm to 74.7 mcmi.e., 2004 to 2013. Low devlopement of GW resources in irrigation sector may be due to less cultivable area availableand karif crops (rice-rainfed) is main crop in the area.



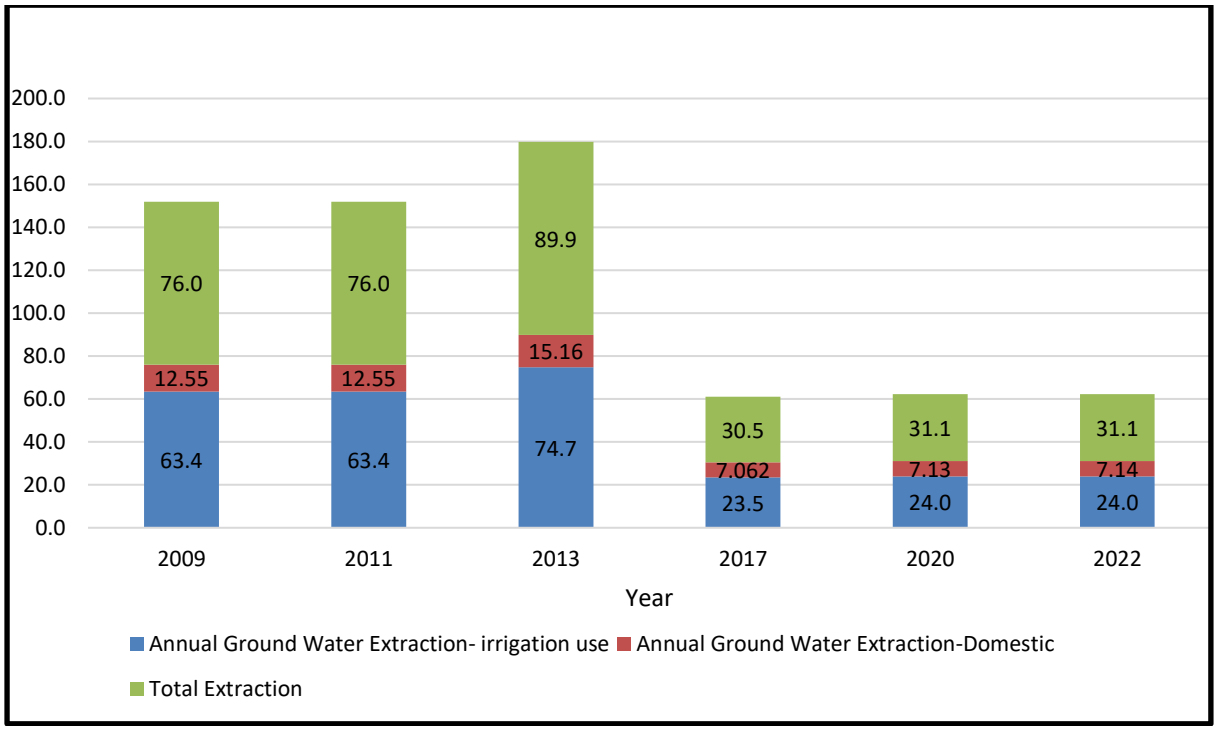



**Figure 6. 1: Draft Vs Availability Over the time**

## 6.4 Ground Water Pollution from Industries

Since Thane is one of the most industrially developed district in the State, the pollution by industries is an important threat to the ground water regime, hence the special studies were carried out in the district to ascertain the pollution threat. In view of the ground water quality problems in the resulting from Industrial activity, the studies were undertaken by C.G.W.B, CR in year 1990 to evaluate the impact of industrialization on ground water in Thane-Belapur industrial belt, Kairna, Khadi Pada and Ghansoli areas. It is observed that the ground water is of Magnesium Chloride (Mg-Cl) type, whereas in affected area it is of Sodium Chloride (Na-Cl) type. The chloride anion is predominant in both the areas, and among cations, magnesium is predominant in unaffected areas and sodium is predominant in affected area. This indicates possibility of ground water pollution by addition of sodium cations in the affected area due to hectic industrial activity. Further, the average value of TDS in unaffected area is 760 mg/l where as in the affected area it is 975 mg/l. Also change in pH from 7.71 to 8.18 indicates deterioration of ground water quality in the area and percolation of industrial effluents to ground water.

## 7. GROUND WATER MANAGEMENT PLAN

A comprehensive ground water resources management plan has been proposed to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management. The supply side management is proposed based on surplus surface water availability and the unsaturated thickness of aquifer whereas the demand side management is proposed by use of micro irrigation techniques and change in cropping pattern.

### 7.1. SUPPLY SIDE MANAGEMENT

The supply side management of ground water resources can be done through the artificial recharge by utilization of surplus runoff available within river sub basins and micro watersheds. Also, it is necessary to understand the unsaturated aquifer volume available for recharge. But in case of Thane district, the entire area having water level is less than 3 m and stage of ground water development varies from 9.4 % (Murbad) to 42.30 % (Ulhasnagar). The overall stage of ground water development for the district is 19.00 % only as per Ground water resource estimation 2022. Hence Supply-side management plan is not recommended in Thane district.

### 7.2 DEMAND SIDE MANAGEMENT

The Demand Side Management is proposed in areas where the Stage of Ground Water Development is relatively high and adopting micro-irrigation techniques for water intensive crops (Sugarcane) or change in cropping pattern or both are required to save water.

Considering the low stage of ground water development in the district, demand side interventions have not been proposed in only 20% of total Horticulture crop /Orchard area. However, this is the right time to further enhance the micro irrigation practices in the selected areas to manage the resources perceiving the future demand of resources. So only 20% area (1094 ha) of total Horticulture crop/Orchard area of all the blocks except Thane and Ulhasnagar blocks are proposed for micro irrigation and that would save a total of 4.37 MCM water **(Table.7.3).** Change in cropping patterns is not proposed in any of the blocks. **Fig 7.2** depicts the proposed demand side interventions.

**Table 7.3: Area proposed for Micro irrigation Techniques and water saving through Demand side interventions**

| Block | Horticulture crop/Orchard | Total Volume of Water expected to be saved (MCM) |
|---|---|---|
| Ambarnath | 249 | 0.99 |
| Bhivandi | 326 | 1.30 |
| Kalyan | 88 | 0.35 |
| Murbad | 195 | 0.78 |
| Shahapur | 236 | 0.94 |
| Thane | 0 | 0.00 |
| Ulhasnagar | 0 | 0.00 |
| **Grand Total** | 1094 | 4.37 |

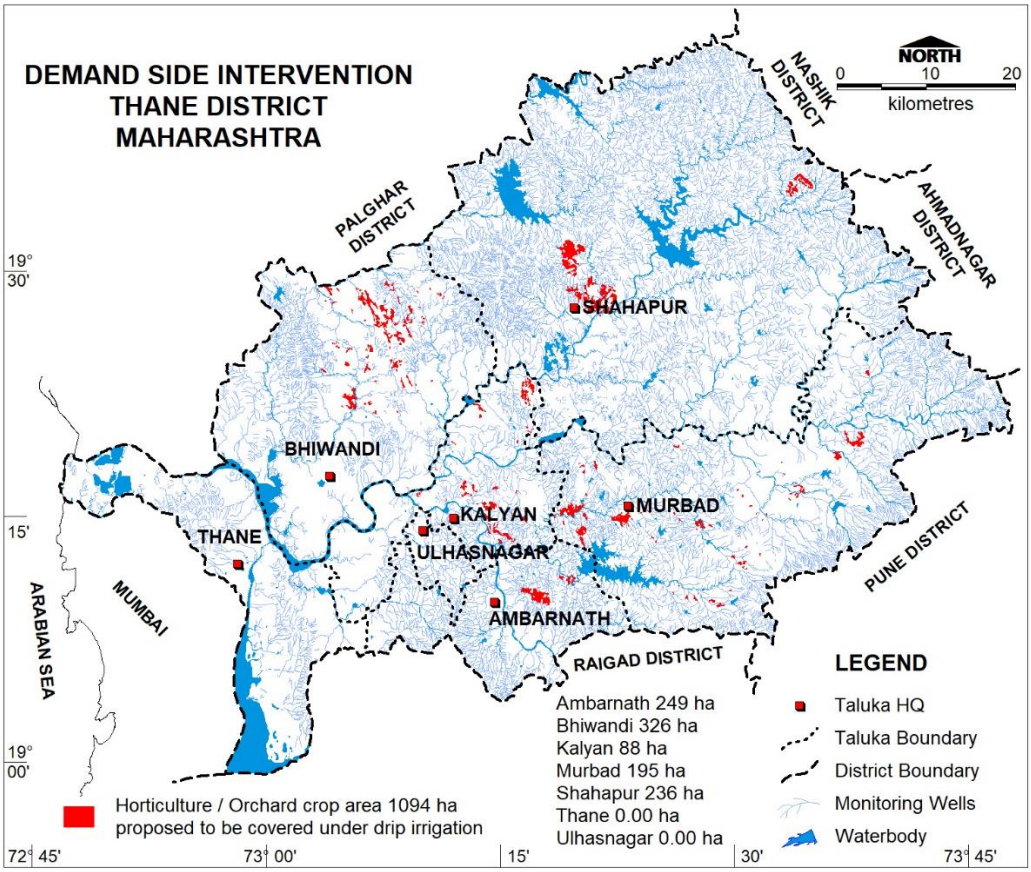



**Figure 7. 1: Demand Side Intervention**

## 7.3 EXPECTED BENEFITS

The impact of implementation of groundwater management plans on the groundwater system in the district is evaluated and the outcome shows significant improvement in groundwater scenario in all blocks (Table 7.3). The Stage of ground water development gets reduced and comes below 60%.

**Table 7. 1: Expected benefits after management options**

| Taluka | **Balance Ground water Available/ required to bring stage of GWD to 60% (MCM)** | **Volume of water expected to be saved due to Demand Side Interventions MCM** | **Total GW Extraction after Demand side intervention (MCM)** | **Stage of development after Demand side interventions** | **Balance Ground water Available/ required to bring stage of GWD to 60% (MCM)** | **Additional Area (sq.km.) proposed to be brought under assured GW irrigation with av. CWR of 0.65 m till 60% stage of GWD is achieved** |
|---|---|---|---|---|---|---|
| Ambarnath | 6.91 | 0.99 | 2.51 | 14.47 | 7.91 | 12.17 |
| Bhivandi | 5.44 | 1.30 | 10.04 | 35.88 | 6.75 | 10.38 |
| Kalyan | 3.31 | 0.35 | 1.28 | 15.52 | 3.66 | 5.63 |
| Murbad | 18.28 | 0.78 | 2.62 | 7.25 | 19.06 | 29.32 |
| Shahapur | 28.96 | 0.94 | 6.21 | 10.31 | 29.91 | 46.02 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Thane | 4.26 | 0.00 | 3.74 | 28.05 | 4.26 | 6.55 |
| Ulhasnagar | 0.15 | 0.00 | 0.35 | 42.30 | 0.15 | 0.23 |
| **T0TAL** | **67.30** | **4.37** | **26.74** | **21.97** | **71.70** | **110.30** |

## 7.4. DEVELOPMENT PLAN

The ground water development plan has been proposed with the view of developing the additional ground water resources available after supply side interventions to bring the stage of ground water development up to 60%. The 71.7 MCM volume of ground water generated can bring additional 11030 ha. Kharif Crop area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 4304 Dug wells and 719 Bore wells. Block wise details are given in Table 7.4. The area feasible for ground development is shown in **Fig. 7.2.**

**Table 7. 2: Block wise additional area under assured GW Irrigation**

| Block | GW Resources Available for Development and Bring Stage of GWD upto 60% from present SOD (MCM) | Proposed no. of DW (@ 1.5 ham for 90% of GWR Available) | Proposed no. of BW* (@ 1.0 ham for 10% of GWR Available) | Additional area that can be brought under assured GW irrigation with av. CWR of 0.65 m |
|---|---|---|---|---|
| **AMBARNATH** | 7.91 | 475 | 79 | 1217 |
| **BHIVANDI** | 6.75 | 405 | 68 | 1038 |
| **KALYAN** | 3.66 | 220 | 37 | 563 |
| **MURBAD** | 19.06 | 1144 | 191 | 2932 |
| **SHAHAPUR** | 29.91 | 1795 | 299 | 4602 |
| **THANE** | 4.26 | 256 | 43 | 655 |
| **ULHASNAGAR** | 0.15 | 9 | 2 | 23 |
| **TOTAL** | **71.7** | **4304** | **719** | 11030 |

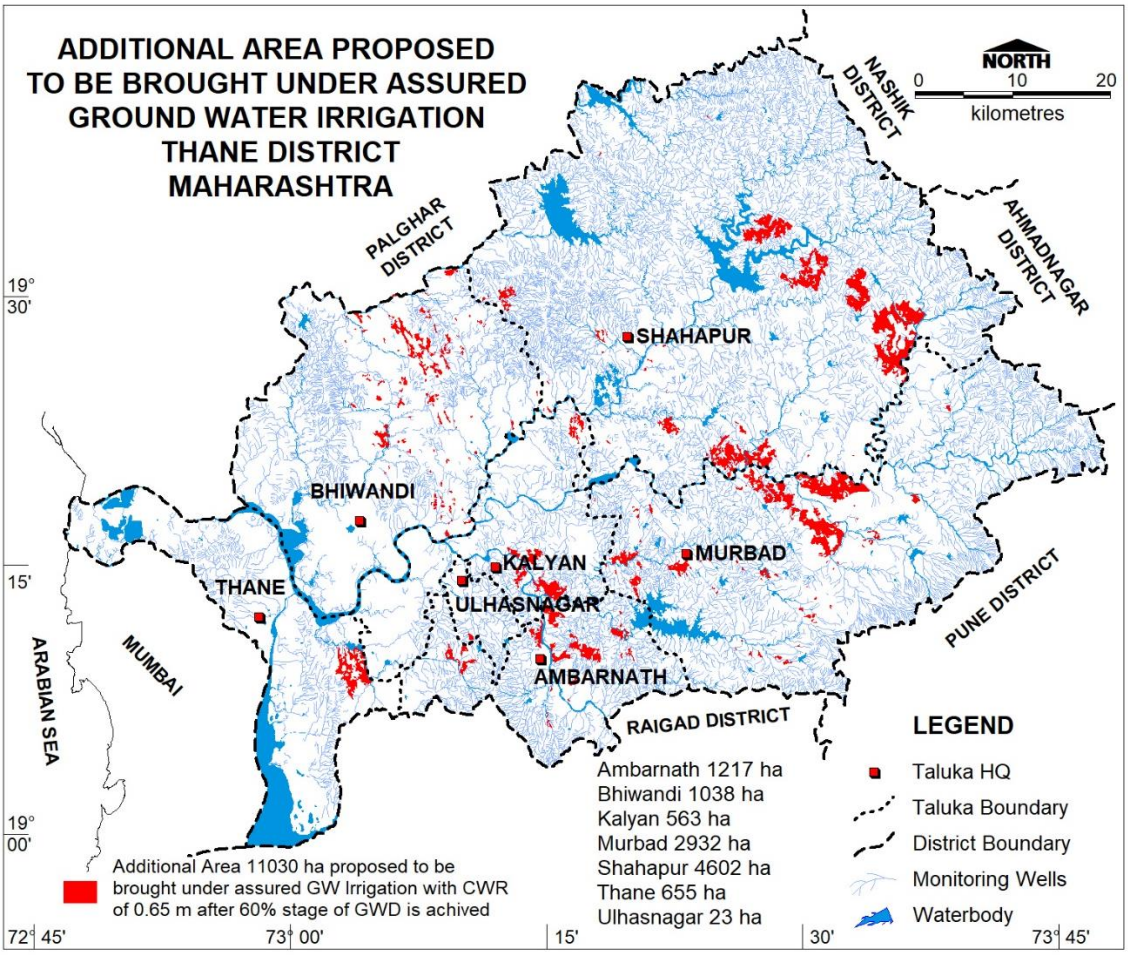



**Figure 7. 2: Additional area Proposed to be bought under Assured GW irrigation**

## 8. SUM UP

The study was carried out based on the data available in-house as well as acquired from State Govt. departments and in pursuit to fill up the data gaps, generated data in-house; prepared GIS maps for various themes. All the available data was brought on GIS platform and an integrated approach was adopted for preparation of block wise aquifer maps and aquifer management plans of the district.

Thane district covering an area of about 4091 sq. km. with 2106 sq. km. being hilly terrain is occupied by Basalt formations. The potential aquifers are form of weathered/ jointed/ Fractured Basalt. The weathered thickness of the Basaltic aquifer is 5 to 18 m. In major part ground water is suitable for drinking and irrigation purposes except localized nitrate contaminated

The stage of ground water development of the district is 19%. The area has witnessed low yield potential of aquifers, Low development of GW resources and Declining Water level trend the major issues in the district.

The management plan has been proposed to manage the ground water resources and to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management.

As a part of Supply side Management, Thane district, the entire area having water level is less than 3 m and stage of ground water development varies from 9.4 % (Murbad) to 42.30 % (Ulhasnagar). The overall stage of ground water development for the district is 19.00 % only as per Ground water resource estimation 2022. Hence Supply-side management plan is not recommended in Thane district.

As a part of Demand side Management, micro-irrigation techniques are to be adopted in 1094 ha. Horticulture crop area/Orchard thereby saving a total of 4.37 MCM/year. Change in cropping patterns is not proposed in any of the blocks.

The ground water development plan has been proposed in view of the developing additional ground water resources available after supply side interventions to bring the stage of ground water development up to 60%. The 71.7 MCM/year volume of ground water generated can bring 11030 ha. Additional area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 4304 Dug wells and 719 Bore wells.

Watershed treatment through contour trenching, Nala bunding and gully plugging are proposed in suitable locations to retain or improve the soil moisture for a long time.

Form ponds, Contour trenches, contour bund, graded bund, and other soil water conservation techniques to be carried out in all cultivable area so that maximum rain water is harvested and percolated to augment ground water and this will also help in sustainable springs for longer period during non-monsoon season for augmentation of runoff water in hilly areas.

Intercropping cultivation excess available water can be used effectively to produce greater yield per unit area of the land.

Under spring shed development, construction of percolation tank in the recharge area of the spring is proposed, this may help to improve the sustainability of spring in lean period for public use.

For prevention of Sea water intrusion in coastal areas only low discharge pumping or intermittent pumping are only allowed.

Conjuctive use of water is planned in Command area.

IEC activities and capacity building activities needs to be aggressively propagated to establish the institutional framework for participatory ground water management. These types of programmes have helped the general public to understand the problems, that they will face in future if the ground water is continued to be exploited in unplanned way and also sewage wastes is not properly managed resulting in ground water pollution.

These interventions also need to be supported by regulations for deeper aquifer and hence it is recommended to regulate/ban deeper tube wells/bore wells of more than 60 m depth in these blocks,

so that the deeper ground water resources are protected for future generation and also serve as ground water sanctuary in times of distress/drought.

# ANNEXURES

**Annexure V: Salient Features of Ground Water Exploration (CGWB), Thane District.**

| S.no | Block/ Taluka | Village | Longitude | Latitude | Type of Well EW/ OW/ Pz | Depth Drilled ( m bgl) | Casing depth ( m bgl) | Geology | Aquifer | Aquifer Zones encountered (mbgl) | S.W.L ( m.bgl ) | Discharge( lps) | Drawdown (m) | T ($m^2$ /day) | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Murbad | Moroshi | 73.66222 | 19.3 | EW | 200 | | Basalt | FMB | 18.0-19.0 | 12 | 0.38 | | | |
| 2 | Bhiwandi | Talavali | 73.06222 | 19.28583 | EW | 200 | | Basalt | FMB | 158.0-159.0 | 1.4 | 0.38 | | | |
| 3 | Murbad | Mal | 73.60389 | 19.37389 | EW | 200 | | Basalt | FMB | 15.0-16.0 | 5.2 | 0.471 | | | |
| 4 | Shahapur | Dolkhamb | 73.58639 | 19.48889 | EW | 200 | | Basalt | FMB | 122.0-123.0 | 36 | Traces | | | |
| 5 | Murbad | Khewatre-Mahaj | 73.57778 | 19.23972 | EW | 200 | | Basalt | - | | - | nil | | | |
| 6 | Murbad | Dongarnhave | 73.50694 | 19.16139 | EW | 143 | | Basalt | FMB | 142.0-143.0 | 5.5 | 10 | | | |
| 7 | Murbad | Dongarnhave | 73.50694 | 19.16139 | OW | 142 | | Basalt | FMB | 28.7-29.7,123.0-124.0 | 6 | 1.37 | | | |
| 8 | Panvel | Nere | 73.16694 | 19.00917 | EW | 142 | | Basalt | FMB | 12.6-13.60,139.0-140.0 | 7.1 | 13.5 | | | |
| 9 | Panvel | Nere | 73.17 | 19.00917 | OW | 142 | | Basalt | | | | 2.16 | | | |
| 10 | Murbad | Murbad | 73.39222 | 19.25639 | EW | 200 | 5.7 | Basalt | FMB | 56-57 | >50 | Traces | | | |
| 11 | Kalyan | Goveli | 73.24111 | 19.26306 | EW | 200 | 4.5 | Basalt | VB | 106-107 | 26.5 | 0.431 | >50 | | |
| 12 | Bhiwandi | Bapgaon | 73.14611 | 19.27833 | EW | 160 | 5.6 | Basalt | FVB FMB | 30-31& 150-151 | 2.3 | 0.651 | >50 | | |

| S.no | Block/ Taluka | Village | Longitude | Latitude | Type of Well EW/ OW/ Pz | Depth Drilled ( m bgl) | Casing depth ( m bgl) | Geology | Aquifer | Aquifer Zones encountered (mbgl) | S.W.L ( m.bgl ) | Discharge( lps) | Drawdown (m) | T ($m^2$ /day) | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | Ambarnath | Rahatoli | 73.28028 | 19.17278 | EW | 172 | 5.7 | Basalt | FMB FVB | 27-28, 152-153 | 4.9 | 13.5 | 30 | | |
| 14 | Ambarnath | Rahatoli | 73.28028 | 19.17278 | OW | 200 | 5.7 | Basalt | FMB FVB | 27-28 & 147-148 | 7.55 | 1.37 | 25 | | |
| 15 | Shahapur | Dhasai | 73.40639 | 19.44944 | EW | 169 | 5.7 | Basalt | FVB | 52-53 | 15.2 | 5.77 | >50 | | |
| 16 | Shahapur | Dhasai | 73.40639 | 19.44944 | OW | 200 | 5.7 | Basalt | - | | - | Dry | - | | |
| 17 | Shahapur | Shelouli | 73.45361 | 19.4225 | EW | 200 | 5.7 | Basalt | WVB | 194-195 | >50 | 0.38 | >50 | | |
| 18 | Shahapur | Shelouli | 73.45361 | 19.4225 | PZ | 80.6 | 5.7 | Basalt | WVB | 44.50-45.50 | >50 | 0.38 | >50 | | |
| 19 | Shahapur | Khardi st. | 73.38833 | 19.41833 | EW | 200 | 5.7 | Basalt | FMB FMB | 78-79 & 126-127 | >50 | 0.621 | >50 | | |
| 20 | Shahapur | Khardi st. | 73.38833 | 19.585 | PZ | 80 | 5.7 | Basalt | - | | - | Dry | - | | |
| 21 | Shahapur | Pendargh ol | 73.355 | 19.51667 | EW | 200 | 5.7 | Basalt | - | | - | Dry | - | | |
| 22 | Shahapur | Aghai | 73.23833 | 19.56528 | EW | 200 | 5.7 | Basalt | - | | - | Traces | - | | |
| 23 | Shahapur | Varath | 73.23833 | 19.45417 | EW | 205 | 6.6 | Basalt | WFB | 40.9-44.00, 132.40-135.50, 181.20-184.20 | 1.54 | 2.64 | 49 | | |

| S.no | Block/ Taluka | Village | Longitude | Latitude | Type of Well EW/ OW/ Pz | Depth Drilled ( m bgl) | Casing depth ( m bgl) | Geology | Aquifer | Aquifer Zones encountered (mbgl) | S.W.L ( m.bgl ) | Discharge( lps) | Drawdown (m) | T ($m^2$ /day) | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | Shahapur | Varath | 73.23833 | 19.45417 | OW | 143 | 6.1 | Basalt | WFB | 59.20-62.30, 138.50-112.00, | 1.54 | 3.17 | 58 | | |
| 25 | Shahapur | Vihigaon | 73.49722 | 19.70278 | EW | 203 | | Basalt | | | | Dry | | | |
| 26 | Shahapur | Washala | 73.50139 | 19.60278 | EW | 203 | 6.1 | Basalt | FB | 34.90-37.90 | | Traces | | | |
| 27 | Bhiwandi | Bhivandi | 73.09722 | 19.29861 | EW | 202 | 6.1 | Basalt | FB | 118-121 | | Negligible | | | |
| 28 | Bhiwandi | Usgaon | 73.00972 | 19.49611 | EW | 201 | 6.1 | Basalt | FB | 41-47 | | 0.03 | | | |
| 29 | Shahapur | Shahpur | 73.32833 | 19.42639 | EW | 200 | 6.1 | Basalt | FB | 25.70-28.70, 187.30-190.40 | | 0.14 | | | |
| 30 | Shahapur | Shahpur | 73.32833 | 19.42639 | PZ | 32 | 6.1 | Basalt | FB | 12.20-13.20, 17.50-18.30, 26.50-27.00 | | 0.11 | | | |
| 31 | Shahapur | Pivali | 73.21667 | 19.48333 | PZ | 102 | 5.6 | Basalt | | 86.00-95.80 | | 0.005 | | | |
| 32 | Mokhada | Makhoda | 73.36667 | 19.91667 | EW | 203 | 6.1 | Basalt | FB | 65-66 | | 0.78 | | | |

**Annexure VII: Water level Data of monitoring wells in Thane District**

| s.no | District | Taluka | Village/Location | Lattitude | Longitude | altitude (masl) | DTW (mbgl) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | May-22 | Nov-22 |
| 1 | Thane | Ambarnath | Ambarnath | 19.19833 | 73.16767 | 41.2 | 3.2 | 1.82 |
| 2 | Thane | Ambarnath | Bandhanwadi | 19.16611 | 73.11694 | 18.7 | 6.3 | 2.48 |
| 3 | Thane | Ambarnath | Aaptewadi | 19.15561 | 73.29028 | 139 | 4.3 | 1.48 |
| 4 | Thane | Bhivandi | sagao | 19.51322 | 73.28169 | 232.8 | 6.3 | 3.42 |
| 5 | Thane | Bhivandi | Igashi | 19.47139 | 73.13325 | 51.8 | 3.7 | 2.75 |
| 6 | Thane | Shahapur | khorgaon | 19.50592 | 73.14892 | 37.1 | 5.6 | 2.41 |
| 7 | Thane | Shahapur | aatgaon | 19.50278 | 73.18933 | 74.2 | 7.3 | 3.46 |
| 8 | Thane | Shahapur | Pachghar | 19.47183 | 72.89439 | 33.2 | 3.8 | 1.86 |
| 9 | Thane | Shahapur | Mugaon | 19.37592 | 73.07353 | 28.5 | 3 | 1.46 |
| 10 | Thane | Murbad | saralgaon | 19.29103 | 73.49322 | 81.4 | 3 | 2.3 |
| 11 | Thane | Murbad | Shiraval | 19.22444 | 73.41667 | 84.3 | 3.6 | 1.86 |
| 12 | Thane | Murbad | Sakurli | 19.18806 | 73.49667 | 121 | 3 | 2.5 |
| 13 | Thane | Ambarnath | Khoni | 19.16972 | 73.11778 | 23.1 | 2 | **1.02** |
| 14 | Thane | Ambarnath | Kasgaon | 19.12528 | 73.26306 | 18 | 9.3 | 4.4 |
| 15 | Thane | Shahapur | Taharpur | 19.54481 | 73.22906 | 67.9 | 4.6 | 1.86 |
| 16 | Thane | Kalyan | Vavghar | 19.35833 | 73.28472 | 65.3 | 3.1 | 1.88 |
| 17 | Thane | Shahapur | Palshin | 19.60692 | 73.35242 | 209.2 | 3.8 | 2.02 |
| 18 | Thane | Shahapur | Kasara, khurd | 19.64564 | 73.47411 | 288.6 | 0.7 | 0.82 |
| 19 | Thane | Shahapur | Vashali | 19.59969 | 73.50086 | 283.1 | 4.2 | 2.4 |
| 20 | Thane | Shahapur | Kothala | 19.57792 | 73.5575 | 282 | 8.9 | 3.78 |
| 21 | Thane | Shahapur | Talvadi | 19.51797 | 73.58656 | 279.5 | 2.5 | 1.45 |
| 22 | Thane | Murbad | Nadhai | 19.26903 | 73.39489 | 72.9 | 4.7 | 1.93 |

| s.no | District | Taluka | Village/Location | Lattitude | Longitude | altitude (masl) | DTW (mbgl) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | May-22 | Nov-22 |
| 23 | Thane | Murbad | Potgaon | 19.25175 | 73.32461 | 48 | 2 | 1.12 |
| 24 | Thane | Murbad | Musali belpada | 19.23306 | 73.33833 | 82 | 3.2 | 2.09 |
| 25 | Thane | Murbad | Masha-malyachapada | 19.16417 | 73.45472 | 93.7 | 7 | 3.9 |
| 26 | Thane | Murbad | Khopiwali | 19.2075 | 73.54694 | 163.7 | 3.8 | 1.4 |
| 27 | Thane | Murbad | Mahaj | 19.24917 | 73.57722 | 140.3 | dry | 2.4 |
| 28 | Thane | Murbad | Dahigaon | 19.26083 | 73.61444 | 156.7 | 2.9 | 3.3 |
| 29 | Thane | Murbad | Vaishak | 19.30222 | 73.62639 | 132.7 | 4 | 3.21 |
| 30 | Thane | Murbad | Moroshi | 19.34056 | 73.68889 | 146.6 | 6.2 | 3.02 |
| 31 | Thane | Murbad | Anjangaon | 19.34194 | 73.72278 | 216.2 | 6 | 2.88 |
| 32 | Thane | Bhivandi | Pimpalgaon | 19.26003 | 73.08847 | 9.1 | 4.1 | 1.95 |
| 33 | Thane | Bhivandi | Anjura | 19.21639 | 73.03944 | 9.6 | 6.2 | 2.86 |
| 34 | Thane | Bhivandi | Bharadi | 19.21436 | 73.0535 | 4.2 | 4 | 1.87 |
| 35 | Thane | Bhivandi | Rahnal | 19.26972 | 73.02722 | 12.6 | 5.2 | 2.48 |
| 36 | Thane | Bhivandi | Vadghar | 19.29333 | 73.01556 | 5 | 2.2 | 0.98 |
| 37 | Thane | Bhivandi | Tembhavali | 19.33 | 73.07917 | 18 | 5.5 | 1.96 |
| 38 | Thane | Bhivandi | Chimpipada | 19.38064 | 73.00706 | 26.5 | 7.2 | 3.92 |
| 39 | Thane | Bhivandi | Mahapoli | 19.40778 | 73.08639 | 28.8 | 5.7 | 2.86 |
| 40 | Thane | Bhivandi | Nandkar | 19.28042 | 73.16628 | 13.7 | 4 | 1.85 |
| 41 | Thane | Bhivandi | Dahole | 19.38139 | 73.20639 | 27.4 | 5 | 2.46 |
| 42 | Thane | Bhivandi | Aawalipada | 19.43167 | 73.09194 | 27 | 5.5 | 1.8 |
| 43 | Thane | Sahapur | Aghai | 19.56438 | 73.23662 | 72.2 | 3.5 | 2.2 |
| 44 | Thane | Sahapur | Kulhe | 19.44311 | 73.46847 | 89.9 | 5 | 2.45 |
| 45 | Thane | Sahapur | Awalpada | 19.47422 | 73.57547 | 167.2 | 5.7 | 3.25 |
| 46 | Thane | Sahapur | Shirgaomn | 19.40941 | 73.37312 | 54.6 | 3.8 | 1.3 |
| 47 | Thane | Sahapur | Vihigaon | 19.71321 | 73.47956 | 357.7 | 6.1 | 2.03 |

| s.no | District | Taluka | Village/Location | Lattitude | Longitude | altitude (masl) | DTW (mbgl) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | May-22 | Nov-22 |
| 48 | Thane | Kalyan | Guravali | 19.32191 | 73.21366 | 25.6 | 5.2 | 2.48 |
| 49 | Thane | Kalyan | Navagaon vapsi | 19.2701 | 73.26223 | 60.8 | 6.6 | 3.13 |
| 50 | Thane | Kalyan | Dahegaon | 19.24008 | 73.2469 | 21.3 | 2.95 | 1.68 |
| 51 | Thane | Kalyan | Nilaje | 19.1648 | 73.08011 | 8.2 | 2.75 | 1.98 |
| 52 | Thane | Thane | Gaimuk | 19.28545 | 72.9364 | 10.1 | 7.6 | 1.4 |
| 53 | Thane | Ambarnath | Goregaon | 19.10944 | 73.27667 | 27.7 | 4.6 | 3.42 |
| 54 | Thane | Ambarnath | Goregaon | 19.10667 | 73.27389 | 29.7 | 4.7 | 3.25 |
| 55 | Thane | Ambarnath | Goregaon | 19.10528 | 73.27306 | 39.1 | 4.9 | 3.28 |
| 56 | Thane | Ambarnath | Goregaon | 19.10528 | 73.27306 | 39.1 | 5 | 2.78 |
| 57 | Thane | Bhivandi | Sagaon | 19.51139 | 73.15472 | 42.3 | 8 | 3.4 |
| 58 | Thane | Bhivandi | Sagaon | 19.50917 | 73.15444 | 47.7 | 7.5 | 2.52 |
| 59 | Thane | Bhivandi | Sagaon | 19.50611 | 73.15389 | 41.4 | 4 | 3.58 |
| 60 | Thane | Shahapur | Kothala | 19.57722 | 73.56833 | 275.7 | 8.1 | 3.4 |
| 61 | Thane | Shahapur | Kothala | 19.5775 | 73.56111 | 302.7 | 8 | 3.88 |
| 62 | Thane | Shahapur | Kothala | 19.5775 | 73.56111 | 302.7 | 7.5 | 4 |
| 63 | Thane | Murbad | Potgaon | 19.25167 | 73.32167 | 49 | 1.8 | 2.9 |
| 64 | Thane | Murbad | Potgaon | 19.25139 | 73.32306 | 50.6 | 3 | 1.46 |
| 65 | Thane | Ambarnath | Palegaon | 19.18917 | 73.00889 | 43 | 4 | 2 |
| 66 | Thane | Bhiwandi | Amangaon ( Amne) | 19.31639 | 73.15889 | 31.1 | 7.3 | 2.58 |
| 67 | Thane | Bhiwandi | Ambadi | 19.46667 | 73.1 | 27 | | 4.7 |
| 68 | Thane | Bhiwandi | Angaon | 19.36667 | 73.08333 | 15 | 6 | |
| 69 | Thane | Thane | Bhaindarpada | 19.28333 | 72.95 | 2 | 6.023 | 1.75 |
| 70 | Thane | Shahapur | Cherfully | 19.46667 | 73.33333 | 61 | 6.65 | 1.98 |
| 71 | Thane | Thane | Dahisar Mori | 19.11111 | 73.06389 | 19.8 | 5.28 | 4.75 |
| 72 | Thane | Kalyan | Hetutane | 19.17 | 73.09861 | 12.3 | 2.8 | 2.85 |
| 73 | Thane | Ambarnath | Katolwadi (Mulgaon) | 19.16389 | 73.30278 | 74.7 | 3.9 | 1.67 |

| s.no | District | Taluka | Village/Location | Lattitude | Longitude | altitude (masl) | DTW (mbgl) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | May-22 | Nov-22 |
| 74 | Thane | Shahapur | Khardi-1 | 19.58889 | 73.38444 | 233.2 | 2.55 | 1.3 |
| 75 | Thane | Kalyan | Kolimb (KOLAM) | 19.28333 | 73.26667 | 41 | 4.2 | 1.63 |
| 76 | Thane | Murbad | Murbad | 19.25 | 73.38333 | 72 | 2.28 | 1.5 |
| 77 | Thane | Ambarnath | Navali-1 | 19.17806 | 73.14694 | 26.9 | 3.8 | 1.8 |
| 78 | Thane | Shahapur | Nishanpada | 19.45556 | 73.53333 | 154.7 | 3.7 | 0.55 |
| 79 | Thane | Bhiwandi | Padghe-1 | 19.3625 | 73.17222 | 16.7 | 3.92 | 1.32 |
| 80 | Thane | Murbad | Pasheri | 19.24806 | 73.39333 | 75.7 | 6.95 | 2.3 |
| 81 | Thane | Shahapur | Pendharichapada | 19.465 | 73.57361 | 168.3 | 4.52 | 3.43 |
| 82 | Thane | Kalyan | Pimpleshwar | 19.19333 | 73.095 | 19 | 3.7 | 3.5 |
| 83 | Thane | Shahapur | Sathgaon | 19.44722 | 73.43889 | 89.7 | 5.8 | 3.7 |
| 84 | Thane | Shahapur | Shendrun_Pz | 19.36667 | 73.36667 | 100 | | 1.3 |
| 85 | Thane | Murbad | Shiroshi-1 | 19.40194 | 73.60889 | 139.7 | 8.6 | 5.6 |
| 86 | Thane | Shahapur | Talempada (Bihigaon) | 19.70139 | 73.49028 | 381.1 | 7.9 | 1.8 |
| 87 | Thane | Murbad | Tokavade (Tokoda) | 19.30694 | 73.62222 | 126.1 | 5.3 | 3.15 |
| 88 | Thane | Thane | Uttan | 19.28028 | 72.78639 | 9.3 | 3.8 | 1.15 |
| 89 | Thane | Bhiwandi | Vajreshwari | 19.48778 | 73.02528 | 23.1 | 3.05 | 0.5 |
| 90 | Thane | Thane | Yeur | 19.23472 | 72.94472 | 110.2 | 3.28 | 2.15 |

**Annexure VIII: Long term ground water level trend of monitoring wells in Thane District (2013-2022**

| S.NO | Block | Village | Lat_decimal | long decimal | AGENCY NAME | Pre-monsoon trend (m/year) | | Post-monsoon trend(m/year) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FALL | RICE | FALL | RICE |
| 1 | Bhiwandi | Angaon | 19.3666667 | 73.0833333 | CGWB | -0.4064 | | | 0.0752 |
| 2 | Thane | Bhaindarpada | 19.2833333 | 72.9500000 | CGWB | -0.1790 | | -0.1923 | |
| 3 | Shahapur | Cherfully | 19.4666667 | 73.3333333 | CGWB | -0.2700 | | -0.2670 | |
| 4 | Thane | Dahisar | 19.1111111 | 73.0638889 | CGWB | -0.4663 | | -0.3791 | |
| 5 | Ambarnath | Katolwadi (Mulgaon) | 19.1638889 | 73.3027778 | CGWB | -0.0168 | | -0.0428 | |
| 6 | Kalyan | Kolimb | 19.2833333 | 73.2666667 | CGWB | -0.0909 | | | 0.0203 |
| 7 | Murbad | Murbad | 19.2500000 | 73.3833333 | CGWB | -0.2664 | | -0.0362 | |
| 8 | Murbad | Pasheri | 19.2480556 | 73.3933333 | CGWB | -0.0258 | | | 0.0527 |
| 9 | Kalyan | Pimpleshwar | 19.1933333 | 73.0950000 | CGWB | | 0.2801 | -0.2267 | |
| 10 | Shahapur | Sathgaon | 19.4472222 | 73.4388889 | CGWB | -0.4188 | | | 0.0145 |
| 11 | Shahapur | Talempada (Bihigaon) | 19.7013889 | 73.4902778 | CGWB | | 0.1076 | -0.0638 | |
| 12 | Murbad | Tokavade (Tokoda) | 19.3069444 | 73.6222222 | CGWB | -0.1479 | | | 0.0051 |
| 13 | BHIWANDI | Akoli | 19.4902778 | 73.04166667 | GSDA | | 0.1397 | -0.01757576 | |
| 14 | BHIWANDI | Awale | 19.4305556 | 73.09166667 | GSDA | | 0.1738 | -0.04645161 | |
| 15 | AMBARNATH | Badlapur | 19.1583333 | 73.23888889 | GSDA | -0.0361 | | -0.02969697 | |
| 16 | BHIWANDI | Bapgaon | 19.3125 | 73.14583333 | GSDA | | 0.3167 | -0.04030303 | |
| 17 | BHIWANDI | Bhinar | 19.3277778 | 73.09444444 | GSDA | | 0.2188 | -0.02739394 | |
| 18 | BHIWANDI | Borivali T. Padgha | 19.3416667 | 73.1375 | GSDA | | 0.2706 | -0.01757576 | |
| 19 | MURBAD | Bursunge | 19.4291667 | 73.60416667 | GSDA | | 0.2676 | -0.01848485 | |
| 20 | BHIWANDI | Dapode | 19.2458333 | 73.04166667 | GSDA | | 0.0203 | | 0.001818182 |
| 21 | THANE | Ghodbandar | 19.2916667 | 72.89166667 | GSDA | -0.0164 | | | 0.01969697 |
| 22 | MURBAD | Inde | 19.2833333 | 73.55833333 | GSDA | | 0.1727 | -0.00272727 | |

| S.NO | Block | Village | Lat_decimal | long decimal | AGENCY NAME | Pre-monsoon trend (m/year) | | Post-monsoon trend(m/year) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FALL | RICE | FALL | RICE |
| 23 | AMBARNATH | Kanhor | 19.1430556 | 73.28611111 | GSDA | | 0.3061 | -0.03151515 | |
| 24 | AMBARNATH | Karav | 19.1111111 | 73.31388889 | GSDA | | 0.0797 | -0.02 | |
| 25 | AMBARNATH | Katrap | 19.1833333 | 73.21388889 | GSDA | | 0.1009 | | 0.023939394 |
| 26 | SHAHAPUR | Kharade | 19.4625 | 73.55416667 | GSDA | -0.0852 | | -0.05484848 | |
| 27 | THANE | Kopar Karane | 19.0958333 | 73.0125 | GSDA | -0.0395 | | -0.01060606 | |
| 28 | THANE | Kopari | 19.0875 | 73.0125 | GSDA | -0.0273 | | -0.05909091 | |
| 29 | AMBARNATH | Mangrul | 19.1697222 | 73.1575 | GSDA | -0.0400 | | -0.01454545 | |
| 30 | AMBARNATH | Newale | 19.1875 | 73.13611111 | GSDA | | 0.4024 | -0.02636364 | |
| 31 | BHIWANDI | Pimpalshet | 19.3986111 | 73.00138889 | GSDA | | 0.5530 | -0.00393939 | |
| 32 | KALYAN | Rayta | 19.2541667 | 73.22638889 | GSDA | -0.0558 | | -0.02545455 | |
| 33 | BHIWANDI | Sange | 19.3 | 73.16944444 | GSDA | | 0.1554 | | 0.015151515 |
| 34 | MURBAD | Sasne | 19.2 | 73.43333333 | GSDA | | 0.2521 | | 0.108484848 |
| 35 | SHAHAPUR | Shendrun | 19.3666667 | 73.375 | GSDA | -0.0327 | | -0.01454545 | |
| 36 | AMBARNATH | Shil To Chon | 19.1305556 | 73.14722222 | GSDA | | 0.0685 | -0.02909091 | |
| 37 | THANE | Shilphata | 19.1513889 | 73.04305556 | GSDA | -0.0679 | | -0.01121212 | |
| 38 | MURBAD | Shivale | 19.2694444 | 73.45416667 | GSDA | | 0.6479 | | 0.004545455 |
| 39 | MURBAD | Talegaon | 19.3611111 | 73.62083333 | GSDA | | 0.1148 | -0.01818182 | |
| 40 | SHAHAPUR | Tembhare | 19.3416667 | 73.34722222 | GSDA | | 0.0397 | -0.03727273 | |
| 41 | THANE | Thane | 19.1958333 | 72.97916667 | GSDA | | 0.0055 | | 0.007272727 |

| S.NO | Block | Village | Lat_decimal | long decimal | AGENCY NAME | Pre-monsoon trend (m/year) | | Post-monsoon trend(m/year) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FALL | RICE | FALL | RICE |
| 42 | MURBAD | Thunepada | 19.2416667 | 73.5375 | GSDA | | 0.2972 | -0.01090909 | |
| 43 | KALYAN | Titwala | 19.3 | 73.22361111 | GSDA | -0.0436 | | -0.01818182 | |
| 44 | MURBAD | Tokavde | 19.3083333 | 73.6 | GSDA | | 0.0982 | -0.01879032 | |
| 45 | SHAHAPUR | Varaskol | 19.3611111 | 73.62083333 | GSDA | | 0.0855 | -0.06666667 | |
| 46 | SHAHAPUR | Vehaloli | 19.45 | 73.4875 | GSDA | | 0.2101 | -0.06727273 | |
| 47 | SHAHAPUR | Vihigaon | 19.45 | 73.4875 | GSDA | | 0.3726 | -0.03121212 | |
| 48 | SHAHAPUR | Washind | 19.4080556 | 73.26527778 | GSDA | | 0.0016 | -0.07909091 | |

## Annexure- IV: Ground Water Quality data of Shallow Aquifer of Thane District

| S.N | BLOCK | VILLAGE | Well Type | Lat | Long | pH | EC (µS/cm) | TDS | TH | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ | $NO_3$ | F | U (ppb) | SAR | RSC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | mg/L | | | | | | | | | | | | | | |
| 1 | Thane | Bhaindarpada | NHS | 19.283 | 72.950 | 6.96 | 631 | 404 | 225 | 60 | 18 | 30 | 1 | 0 | 195 | 67 | 29 | 25 | 0.36 | 0.16 | 0.87 | -1.3 |
| 2 | Murbad | Murbad | NHS | 19.250 | 73.383 | 7.43 | 1031 | 660 | 345 | 74 | 39 | 57 | 6 | 0 | 378 | 110 | 25 | 6 | 0.35 | 1.79 | 1.34 | -0.7 |
| 3 | Kalyan | Kolimb (Kolam) | NHS | 19.283 | 73.267 | 7.14 | 2424 | 1551 | 855 | 180 | 98 | 168 | 6 | 0 | 372 | 603 | 10 | 10 | 0.23 | 2.60 | 2.50 | -11.0 |
| 4 | Shahapur | Talempada | NHS | 19.701 | 73.490 | 7.29 | 473 | 302 | 215 | 54 | 19 | 12 | 5 | 0 | 232 | 14 | 29 | 4 | 0.36 | BDL | 0.35 | -0.5 |
| 5 | Shahapur | Nishanpada | NHS | 19.456 | 73.533 | 7.69 | 342 | 219 | 160 | 36 | 17 | 9 | 1 | 0 | 183 | 14 | 11 | BDL | 0.27 | BDL | 0.29 | -0.2 |
| 6 | Shahapur | Sathgaon | NHS | 19.447 | 73.439 | 7.50 | 334 | 214 | 165 | 40 | 16 | 9 | 0 | 0 | 183 | 14 | 5 | 1 | 0.38 | BDL | 0.32 | -0.3 |
| 7 | Bhiwandi | Padgha | NHS | 19.363 | 73.172 | 7.32 | 649 | 415 | 215 | 48 | 23 | 34 | 21 | 0 | 275 | 43 | 25 | 2 | 0.26 | 0.02 | 1.00 | 0.2 |
| 8 | Murbad | Tokavade (Tokoda) | NHS | 19.307 | 73.622 | 7.55 | 368 | 236 | 145 | 36 | 13 | 18 | 1 | 0 | 201 | 14 | 7 | 1 | 0.26 | BDL | 0.65 | 0.4 |
| 9 | Thane | Dahisar Mori | NHS | 19.111 | 73.064 | 7.49 | 1411 | 903 | 535 | 124 | 55 | 61 | 1 | 0 | 421 | 209 | 54 | 6 | 0.30 | 2.96 | 1.14 | -3.8 |
| 10 | Ulhasnagar | Katolwadi (Mulgaon) | NHS | 19.164 | 73.303 | 7.64 | 546 | 350 | 225 | 60 | 18 | 17 | 4 | 0 | 250 | 28 | 18 | 1 | 0.28 | 0.01 | 0.49 | -0.4 |
| 11 | Murbad | Pasheri | NHS | 19.248 | 73.393 | 7.48 | 226 | 145 | 100 | 24 | 10 | 7 | 1 | 0 | 122 | 7 | 2 | 2 | 0.26 | BDL | 0.29 | 0.0 |
| 12 | Kalyan | Hetutane | NHS | 19.170 | 73.099 | 7.69 | 790 | 505 | 340 | 70 | 40 | 25 | 5 | 0 | 372 | 50 | 21 | 1 | 0.34 | 0.14 | 0.59 | -0.7 |
| 13 | Kalyan | Pimpleshwar | NHS | 19.193 | 73.095 | 7.43 | 1332 | 852 | 490 | 100 | 58 | 78 | 1 | 0 | 244 | 323 | 31 | 2 | 0.79 | 0.93 | 1.53 | -5.8 |
| 14 | Bhiwandi | Amangaon (Amne) | NHS | 19.316 | 73.159 | 7.74 | 1467 | 939 | 420 | 94 | 45 | 99 | 55 | 0 | 519 | 174 | 53 | 44 | 0.32 | 2.05 | 2.10 | 0.1 |
| 15 | Murbad | Shiroshi-1 | NHS | 19.402 | 73.609 | 7.39 | 563 | 360 | 230 | 50 | 26 | 16 | 25 | 0 | 275 | 32 | 12 | 7 | 0.30 | BDL | 0.45 | -0.1 |
| 16 | Shahapur | Pendharichapada | NHS | 19.465 | 73.574 | 7.49 | 373 | 238 | 160 | 36 | 17 | 10 | 1 | 0 | 183 | 14 | 9 | 3 | 0.27 | BDL | 0.34 | -0.2 |
| 17 | Shahapur | Khardi-1 | NHS | 19.589 | 73.384 | 7.63 | 790 | 505 | 240 | 52 | 27 | 58 | 12 | 0 | 323 | 82 | 20 | 4 | 0.28 | 0.47 | 1.62 | 0.5 |
| 18 | Bhiwandi | Vajreshwari | NHS | 19.488 | 73.025 | 7.44 | 370 | 237 | 175 | 40 | 18 | 12 | 0.2 | 0 | 171 | 25 | 21 | 2 | 0.35 | BDL | 0.40 | -0.7 |
| 19 | Thane | Uttan | NHS | 19.280 | 72.786 | 7.80 | 1223 | 783 | 320 | 70 | 35 | 118 | 4 | 0 | 476 | 121 | 53 | 3 | 0.83 | 0.82 | 2.87 | 1.4 |
| 20 | | Aghai | KOW | 19.564 | 73.237 | 7.39 | 404 | 259 | 205 | 30 | 32 | 14 | 0 | 0 | 140 | 85 | 16 | 3 | 0.36 | BDL | 0.44 | -1.8 |
| 21 | | Shirgaomn | KOW | 19.409 | 73.373 | 7.52 | 591 | 378 | 230 | 40 | 32 | 26 | 1 | 0 | 262 | 32 | 22 | 26 | 0.22 | BDL | 0.75 | -0.3 |
| 22 | | Vihigaon | KOW | 19.713 | 73.480 | 7.50 | 182 | 116 | 75 | 18 | 7 | 9 | 1 | 0 | 98 | 11 | BDL | 4 | 0.16 | BDL | 0.43 | 0.1 |
| 23 | | Guravali | KOW | 19.322 | 73.214 | 7.47 | 614 | 393 | 235 | 52 | 26 | 21 | 17 | 0 | 293 | 35 | 28 | 8 | 0.17 | BDL | 0.59 | 0.1 |
| 24 | | Navagaonvapsi | KOW | 19.270 | 73.262 | 7.51 | 437 | 280 | 165 | 32 | 21 | 12 | 2 | 0 | 183 | 25 | 15 | 12 | 0.16 | BDL | 0.41 | -0.3 |
| 25 | | Dahegaon | KOW | 19.240 | 73.247 | 7.43 | 893 | 572 | 300 | 46 | 45 | 45 | 3 | 0 | 317 | 96 | 33 | 7 | 0.15 | BDL | 1.14 | -0.8 |
| 26 | | Guravali | KOW | 19.322 | 73.214 | 7.45 | 540 | 346 | 205 | 40 | 26 | 15 | 12 | 0 | 256 | 25 | 17 | 6 | 0.18 | BDL | 0.47 | 0.1 |
| 27 | Ambarnath | Ambarnath | KOW | | | 6.82 | 183 | 117 | 90 | 20 | 10 | 8 | 3 | 0 | 61 | 35 | 4 | 8 | 0.13 | 0.06 | 0.36 | -0.8 |
| 28 | Ambarnath | Bandhanwadi | KOW | 19.166 | 73.117 | 7.40 | 479 | 307 | 230 | 54 | 23 | 11 | 0 | 0 | 275 | 18 | 10 | 3 | 0.17 | BDL | 0.32 | -0.1 |

| S.N | BLOCK | VILLAGE | Well Type | Lat | Long | pH | EC (µS/cm) | TDS | TH | Ca | Mg | Na | K | $CO_3$ | $HCO_3$ | Cl | $SO_4$ | $NO_3$ | F | U (ppb) | SAR | RSC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | mg/L | | | | | | | | | | | | | | |
| 29 | Ambarnath | Aaptewadi | KOW | 19.156 | 73.290 | 6.43 | 489 | 313 | 140 | 36 | 12 | 20 | 5 | 0 | 79 | 46 | 15 | 46 | 0.15 | BDL | 0.73 | -1.5 |
| 30 | Bhivandi | Sagao | KOW | 19.513 | 73.282 | 8.23 | 598 | 383 | 235 | 64 | 18 | 18 | 18 | 0 | 256 | 43 | 32 | 13 | 0.16 | BDL | 0.52 | -0.5 |
| 31 | Bhivandi | Igashi | KOW | 19.471 | 73.133 | 7.66 | 606 | 388 | 245 | 56 | 26 | 17 | 2 | 0 | 287 | 28 | 12 | 2 | 0.25 | BDL | 0.47 | -0.2 |
| 32 | Bhivandi | Bharadi | KOW | 19.214 | 72.990 | 7.53 | 761 | 487 | 300 | 70 | 30 | 37 | 6 | 0 | 293 | 60 | 56 | 5 | 0.24 | BDL | 0.92 | -1.2 |
| 33 | Bhivandi | Khaniwali | KOW | 19.413 | 73.101 | 7.42 | 404 | 259 | 175 | 50 | 12 | 12 | 8 | 0 | 214 | 18 | 8 | 3 | 0.26 | 0.12 | 0.40 | 0.0 |
| 34 | Shahapur | Khorgaon | KOW | 19.506 | 73.149 | 7.53 | 377 | 241 | 150 | 30 | 18 | 10 | 0.3 | 0 | 140 | 28 | 9 | 7 | 0.22 | BDL | 0.37 | -0.7 |
| 35 | Shahapur | Aatgaon | KOW | 19.503 | 73.189 | 7.57 | 368 | 236 | 150 | 40 | 12 | 14 | 2 | 0 | 165 | 35 | 8 | 2 | 0.20 | BDL | 0.51 | -0.3 |
| 36 | Shahapur | Pachghar | KOW | 19.472 | 72.894 | 7.93 | 156 | 100 | 75 | 20 | 6 | 5 | 0.5 | 0 | 61 | 25 | 4 | 2 | 0.15 | BDL | 0.27 | -0.5 |
| 37 | Shahapur | Mugaon | KOW | 19.376 | 73.074 | 7.64 | 507 | 324 | 195 | 40 | 23 | 29 | 2 | 0 | 262 | 35 | 10 | 3 | 0.25 | BDL | 0.91 | 0.4 |
| 38 | Murbad | Saralgaon | KOW | 19.291 | 73.493 | 8.24 | 476 | 305 | 195 | 40 | 23 | 16 | 4 | 0 | 183 | 53 | 18 | 4 | 0.19 | BDL | 0.50 | -0.9 |
| 39 | Murbad | Shiraval | KOW | 19.224 | 73.417 | 7.40 | 363 | 232 | 160 | 36 | 17 | 10 | 4 | 0 | 183 | 18 | 2 | 7 | 0.18 | 0.01 | 0.35 | -0.2 |
| 40 | Murbad | Sakurli | KOW | 19.188 | 73.497 | 7.62 | 379 | 243 | 90 | 26 | 6 | 42 | 17 | 0 | 153 | 35 | 8 | 29 | 0.17 | 0.03 | 1.92 | 0.7 |
| 41 | Ambarnath | Goregaon | KOW | 19.109 | 73.277 | 7.53 | 878 | 562 | 360 | 84 | 36 | 12 | 0 | 0 | 336 | 82 | 19 | 2 | 0.17 | BDL | 0.28 | -1.7 |
| 42 | Bhivandi | Sagao | KOW | 19.506 | 73.154 | 7.46 | 500 | 320 | 205 | 36 | 28 | 12 | 1 | 0 | 201 | 46 | 18 | 3 | 0.18 | BDL | 0.37 | -0.8 |
| 43 | Shahapur | Kothala | KOW | 19.578 | 73.561 | 7.47 | 242 | 155 | 75 | 24 | 4 | 21 | 19 | 0 | 67 | 32 | 8 | 45 | 0.28 | 0.46 | 1.07 | -0.4 |
| 44 | Shahapur | Kothala | KOW | 19.578 | 73.561 | 7.49 | 792 | 507 | 320 | 70 | 35 | 8 | 5 | 0 | 232 | 71 | 29 | 11 | 0.19 | 0.54 | 0.20 | -2.6 |
| 45 | Shahapur | Kothala | KOW | 19.578 | 73.561 | 7.54 | 216 | 138 | 75 | 20 | 6 | 28 | 20 | 0 | 104 | 35 | 9 | 7 | 0.19 | BDL | 1.40 | 0.2 |
| 46 | Murbad | Potgaon | KOW | 19.252 | 73.325 | 7.99 | 732 | 468 | 225 | 50 | 24 | 43 | 1 | 0 | 244 | 71 | 30 | 1 | 0.17 | 0.25 | 1.25 | -0.5 |
| 47 | Murbad | Potgaon | KOW | 19.251 | 73.323 | 8.03 | 367 | 235 | 90 | 20 | 10 | 42 | 0.4 | 0 | 92 | 53 | 26 | 1 | 0.51 | BDL | 1.94 | -0.3 |

**Annexure- IV A : Heavy metal data of Shallow Aquifer of Thane District.**

| Sl. No. | District | Location/Village | Latitude (N) | Longitude (E) | Cr (ppm) | Mn (ppm) | Fe (ppm) | Ni (ppm) | Cu (ppm) | 67 Zn (ppm) | As (ppm) | Se (ppm) | Cd (ppm) | Pb (ppm) | U (ppb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Thane | Aghai | 19.564 | 73.237 | 0.001 | 0.039 | 0.202 | 0.000 | 0.002 | 0.013 | 0.000 | 0.000 | 0.000 | 0.002 | 0.167 |
| 2 | Thane | Shirgaomn | 19.409 | 73.373 | 0.001 | 0.024 | 0.171 | 0.000 | 0.002 | 0.005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.197 |
| 3 | Thane | Guravali | 19.322 | 73.214 | 0.001 | 0.023 | 0.218 | 0.001 | 0.004 | 0.016 | 0.000 | 0.000 | 0.000 | 0.000 | 0.214 |
| 4 | Thane | Aaptewadi | 19.156 | 73.290 | 0.003 | 0.002 | 0.043 | 0.000 | 0.001 | 0.012 | 0.000 | 0.000 | 0.000 | 0.001 | 0.071 |
| 5 | Thane | Sagao | 19.513 | 73.282 | 0.003 | 0.007 | 0.170 | 0.001 | 0.002 | 0.017 | 0.000 | 0.000 | 0.000 | 0.001 | 0.505 |
| 6 | Thane | Aatgaon | 19.503 | 73.327 | 0.002 | 0.459 | 0.683 | 0.001 | 0.002 | 0.023 | 0.000 | 0.000 | 0.000 | 0.001 | 0.361 |
| 7 | Thane | Potgaon | 19.252 | 73.325 | 0.001 | 0.031 | 0.208 | 0.001 | 0.001 | 0.010 | 0.000 | 0.000 | 0.000 | 0.001 | 0.167 |
| 8 | Thane | Pimpalgaon | 19.260 | 73.088 | 0.403 | 0.022 | 0.384 | 0.001 | 0.002 | 0.010 | 0.000 | 0.000 | 0.000 | 0.001 | 0.425 |
| 9 | Thane | Vajreshwari | 19.469 | 73.065 | 0.019 | 0.013 | 0.322 | 0.001 | 0.001 | 0.011 | 0.000 | 0.000 | 0.000 | 0.001 | 0.077 |
| 10 | Thane | Kothala | 19.578 | 73.561 | 0.003 | 0.030 | 0.565 | 0.001 | 0.008 | 0.015 | 0.000 | 0.000 | 0.000 | 0.002 | 0.428 |
| 11 | Thane | Sagao | 19.506 | 73.154 | 0.000 | 0.000 | 0.004 | 0.000 | 0.000 | BDL | 0.000 | 0.000 | 0.000 | 0.000 | 0.179 |
| | | | | **MAX** | 0.403 | 0.459 | 0.683 | 0.001 | 0.008 | 0.023 | 0.000 | 0.000 | 0.000 | 0.002 | 0.505 |
| | | | | **MIN** | 0.000 | 0.000 | 0.004 | 0.000 | 0.000 | BDL | 0.000 | 0.000 | 0.000 | 0.000 | 0.071 |
| | | | | **AVERAGE** | 0.040 | 0.059 | 0.270 | 0.001 | 0.002 | 0.012 | 0.000 | 0.000 | 0.000 | 0.001 | 0.254 |

**Annexure-V: Details of Key Observation Wells of Thane District.**

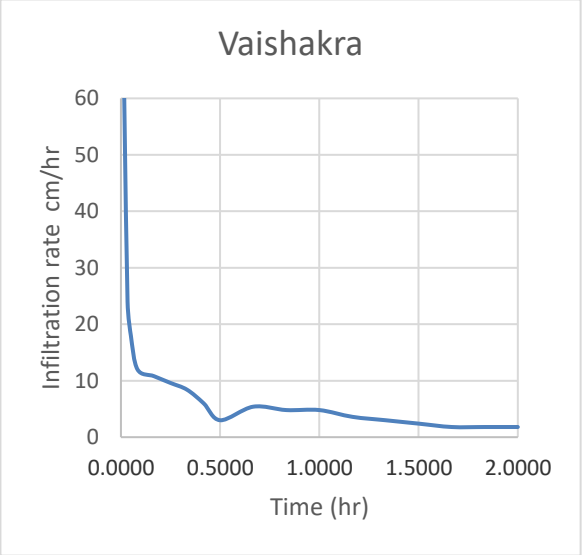
| Sl. No. | well no. | District | Taluka | Village/Location | Lattitude | Longitude | D.T.W. (Pre - 2022) (m bgl) | D.T.W. (Post - 2022) (m bgl) | EC (Pre - 2022) | EC (Post - 2022) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | KOW-AB-1 | Thane | Ambarnath | Ambarnath | 19.19833 | 73.16767 | 3.2 | 1.82 | 110 | 128 |
| 2 | KOW-AB-3 | Thane | Ambarnath | Bandhanwadi | 19.16611 | 73.11694444 | 6.3 | 2.48 | | 209 |
| 3 | KOW-AB-4 | Thane | Ambarnath | Aaptewadi | 19.15561 | 73.29027778 | 4.3 | 1.48 | 331 | 320 |
| 4 | KOW-BH-6 | Thane | Bhivandi | sagao | 19.51322 | 73.28169444 | 6.3 | 3.42 | 487 | 398 |
| 5 | KOW-BH-7 | Thane | Bhivandi | Igashi | 19.47139 | 73.13325 | 3.7 | 2.75 | 475 | 372 |
| 8 | KOW-SH_7 | Thane | Shahapur | khorgaon | 19.50592 | 73.14891667 | 5.6 | 2.41 | 297 | 251 |
| 9 | KOW-SH_10 | Thane | Shahapur | aatgaon | 19.50278 | 73.18933333 | 7.3 | 3.46 | 310 | 259 |
| 10 | KOW-SH_16 | Thane | Shahapur | Pachghar | 19.47183 | 72.89438889 | 3.8 | 1.86 | 165 | 142 |
| 11 | KOW-SH_18 | Thane | Shahapur | Mugaon | 19.37592 | 73.07352778 | 3 | 1.46 | 728 | 646 |
| 12 | KOW-MB-19 | Thane | Murbad | saralgaon | 19.29103 | 73.49322222 | 3 | 2.3 | 458 | 404 |
| 13 | KOW-MB-23 | Thane | Murbad | Shiraval | 19.22444 | 73.41666667 | 3.6 | 1.86 | 215 | 182 |
| 14 | KOW-MB-25 | Thane | Murbad | Sakurli | 19.18806 | 73.49666667 | 3 | 2.5 | 223 | 194 |
| 15 | KOW-AB-2 | Thane | Ambarnath | Khoni | 19.16972 | 73.11777778 | **2** | **1.02** | | 249 |
| 16 | KOW-AB-5 | Thane | Ambarnath | Kasgaon | 19.12528 | 73.26305556 | 9.3 | 4.4 | 475 | 392 |
| 17 | KOW-SH-8 | Thane | Shahapur | Taharpur | 19.54481 | 73.22905556 | 4.6 | 1.86 | 377 | 328 |
| 18 | KOW-K-9 | Thane | Kalyan | Vavghar | 19.35833 | 73.28472222 | 3.1 | 1.88 | 1624 | 1428 |
| 19 | KOW-SH_11 | Thane | Shahapur | Palshin | 19.60692 | 73.35241667 | 3.8 | 2.02 | 385 | 320 |
| 20 | KOW-SH_12 | Thane | Shahapur | Kasara, khurd | 19.64564 | 73.47411111 | 0.7 | 0.82 | 335 | 382 |
| 21 | KOW-SH_13 | Thane | Shahapur | Vashali | 19.59969 | 73.50086111 | 4.2 | 2.4 | 125 | 90 |
| 22 | KOW-SH_14 | Thane | Shahapur | Kothala | 19.57792 | 73.5575 | 8.9 | 3.78 | 165 | 128 |
| 23 | KOW-SH_15 | Thane | Shahapur | Talvadi | 19.51797 | 73.58655556 | 2.5 | 1.45 | 73 | 70 |
| 25 | KOW-MB-20 | Thane | Murbad | Nadhai | 19.26903 | 73.39488889 | 4.7 | 1.93 | 271 | 246 |
| 26 | KOW-MB-21 | Thane | Murbad | Potgaon | 19.25175 | 73.32461111 | 2 | 1.12 | 345 | 308 |

| Sl. No. | well no. | District | Taluka | Village/Location | Lattitude | Longitude | D.T.W. (Pre - 2022) (m bgl) | D.T.W. (Post - 2022) (m bgl) | EC (Pre - 2022) | EC (Post - 2022) |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | KOW-MB-22 | Thane | Murbad | Musali belpada | 19.23306 | 73.33833333 | 3.2 | 2.09 | 387 | 327 |
| 28 | KOW-MB-24 | Thane | Murbad | Masha-malyachapada | 19.16417 | 73.45472222 | 7 | 3.9 | 427 | 481 |
| 29 | KOW-MB-26 | Thane | Murbad | Khopiwali | 19.2075 | 73.54694444 | 3.8 | 1.4 | 345 | 360 |
| 30 | KOW-MB-27 | Thane | Murbad | Mahaj | 19.24917 | 73.57722222 | dry | 2.4 |  | 361 |
| 31 | KOW-MB-28 | Thane | Murbad | Dahigaon | 19.26083 | 73.61444444 | 2.9 | 3.3 | 151 | 1661 |
| 32 | KOW-MB-29 | Thane | Murbad | Vaishak | 19.30222 | 73.62638889 | 4 | 3.21 | 750 | 604 |
| 33 | KOW-MB-30 | Thane | Murbad | Moroshi | 19.34056 | 73.68888889 | 6.2 | 3.02 | 270 | 262 |
| 34 | KOW-MB-32 | Thane | Murbad |  | 19.34194 | 73.72277778 | 6 | 2.88 | 375 | 302 |
| 35 | KOW-BH-33 | Thane | Bhivandi | Pimpalgaon | 19.26003 | 73.08847222 | 4.1 | 1.95 | 1324 | 1080 |
| 36 | KOW-BH-34 | Thane | Bhivandi | Anjura | 19.21639 | 73.03944444 | 6.2 | 2.86 | 487 | 401 |
| 37 | KOW-BH-35 | Thane | Bhivandi | Bharadi | 19.21436 | 73.0535 | 4 | 1.87 | 618 | 540 |
| 38 | KOW-BH-36 | Thane | Bhivandi | Rahnal | 19.26972 | 73.02722222 | 5.2 | 2.48 | 851 | 780 |
| 39 | KOW-BH-40 | Thane | Bhivandi | Vadghar | 19.29333 | 73.01555556 | 2.2 | 0.98 | 727 | 628 |
| 40 | KOW-BH-41 | Thane | Bhivandi | Tembhavali | 19.33 | 73.07916667 | 5.5 | 1.96 | 1315 | 1260 |
| 41 | KOW-BH-42 | Thane | Bhivandi | Chimpipada | 19.38064 | 73.00705556 | 7.2 | 3.92 | 664 | 618 |
| 42 | KOW-BH-43 | Thane | Bhivandi | Mahapoli | 19.40778 | 73.08638889 | 5.7 | 2.86 | 762 | 698 |
| 43 | KOW-BH-44 | Thane | Bhivandi | Nandkar | 19.28042 | 73.16627778 | 4 | 1.85 | 436 | 496 |
| 44 | KOW-BH-47 | Thane | Bhivandi | Aawalipada | 19.43167 | 73.09194444 | 5.5 | 2.46 | 965 | 1018 |
| 45 | KOW-BH-45 | Thane | Bhivandi | Dahole | 19.38139 | 73.20638889 | 5 | 1.8 | 555 | 490 |
| 46 | KOW-TN-1 | Thane | Sahapur | Aghai | 19.56438 | 73.23662222 | 3.5 | 2.2 | 286 | 220 |
| 47 | KOW-TN-2 | Thane | Sahapur | Kulhe | 19.44311 | 73.46847 | 5 | 2.45 | 412 | 432 |
| 48 | KOW-TN-3 | Thane | Sahapur | Awalpada | 19.47422 | 73.57547 | 5.7 | 3.25 | 415 | 218 |
| 49 | KOW-TN-4 | Thane | Sahapur | Shirgaomn | 19.40941 | 73.37311944 | 3.8 | 1.3 | 566 | 434 |
| 50 | KOW-TN-5 | Thane | Sahapur | Vihigaon | 19.71321 | 73.47956111 | 6.1 | 2.03 | 168 | 172 |
| 51 | KOW-TN-6 | Thane | Kalyan | Guravali | 19.32191 | 73.21366389 | 5.2 | 2.48 | 670 | 496 |
| 52 | KOW-TN-7 | Thane | Kalyan | Navagaon vapsi | 19.2701 | 73.26223333 | 6.6 | 3.13 | 428 | 486 |

| Sl. No. | well no. | District | Taluka | Village/Location | Lattitude | Longitude | D.T.W. (Pre - 2022) (m bgl) | D.T.W. (Post - 2022) (m bgl) | EC (Pre - 2022) | EC (Post - 2022) |
|---|---|---|---|---|---|---|---|---|---|---|
| 53 | KOW-TN-8 | Thane | Kalyan | Dahegaon | 19.24008 | 73.2469 | 2.95 | 1.68 | 1684 | 1820 |
| 54 | KOW-TN-9 | Thane | Kalyan | Nilaje | 19.1648 | 73.08010833 | 2.75 | 1.98 | 562 | 622 |
| 55 | KOW-TN-10 | Thane | Thane | Gaimuk | 19.28545 | 72.9364 | 7.6 | 3.42 | 332 | 368 |
| 56 | KOW-BH-46 | Thane | Bhivandi | Khaniwali | 19.41278 | 73.21805556 | 1.4 | 1.55 | 327 | 436 |
| 57 | PL-AB-1 | Thane | Ambarnath | Goregaon | 19.10944 | 73.27666667 | 4.6 | 3.25 | 737 | 640 |
| 58 | PL-AB-2 | Thane | Ambarnath | Goregaon | 19.10667 | 73.27388889 | 4.7 | 3.28 | 4.7 | 420 |
| 59 | PL-AB-3 | Thane | Ambarnath | Goregaon | 19.10528 | 73.27305556 | 4.9 | 2.78 | 404 | 382 |
| 60 | PL-AB-4 | Thane | Ambarnath | Goregaon | 19.10528 | 73.27305556 | 5.6 | 3.4 | 370 | 390 |
| 61 | PL-BH-1 | Thane | Bhivandi | Sagaon | 19.51139 | 73.15472222 | 8 | 2.52 | 360 | 470 |
| 62 | PL-BH-2 | Thane | Bhivandi | Sagaon | 19.50917 | 73.15444444 | 5.8 | 3.58 | 420 | 628 |
| 63 | PL-BH-3 | Thane | Bhivandi | Sagaon | 19.50611 | 73.15388889 | 4 | 3.4 | 770 | 746 |
| 64 | PL-SH-1 | Thane | Shahapur | Kothala | 19.57722 | 73.56833333 | 8.1 | 3.88 | 156 | 170 |
| 65 | PL-SH-2 | Thane | Shahapur | Kothala | 19.5775 | 73.56111111 | 8 | 4 | 666 | 490 |
| 66 | PL-MB-2 | Thane | Murbad | Potgaon | 19.25167 | 73.32166667 | 1.8 | 1.46 | 614 | 586 |
| 67 | PL-MB-3 | Thane | Murbad | Potgaon | 19.25139 | 73.32305556 | 4.2 | 2 | 289 | 328 |
| 68 | PL-AB-1 | Thane | Ambarnath | Palegaon | 19.18917 | 73.00888889 | 4 | 2.58 | 131 | 190 |

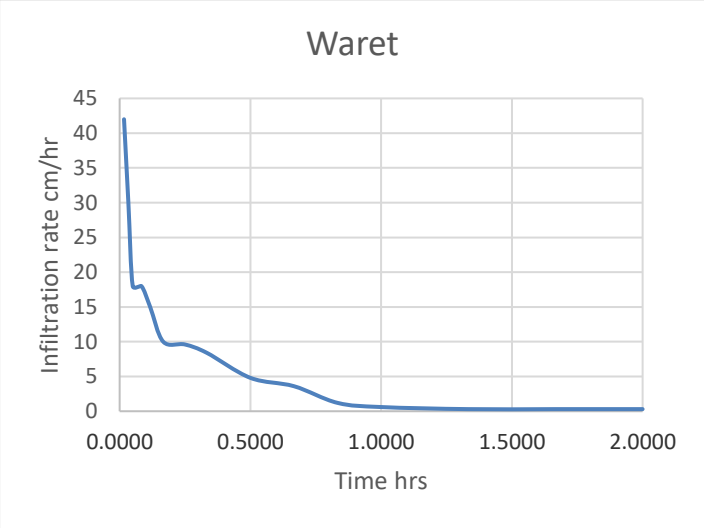
**Annexure-VI: Details of Soil infiltration tests of Thane District.**

| | |
|---|---|
| Date | **17-12-2022** |
| Unique ID no. | Thane-1 |
| Village | **Vaishakra (Khadakpada)** |
| Taluka | **Murbhad** |
| District | **Gondia** |
| Coordinates | **19.307899, 73.623489** |
| Elevation/RL (mamsl) | 130 |
| Initial water level | 29 |
| Geology | Decan Basalt |
| Soil Type | Clayey loam |
| Final Infiltration Rate ( cm/hr ) | 1.8 |
| Total Precipitation | 10.4 |




| S.no | Duration (min) | Cum Time (min) | Water level Depth (cm) | Infiltrated water depth (cm) | Infiltration rate (cm/hr) |
|---|---|---|---|---|---|
| 1 | **1.00** | **1** | **28.00** | **1.00** | 60 |
| 2 | **1.00** | **2** | **28.60** | **0.40** | 24 |
| 3 | **1.00** | **3** | **28.70** | **0.30** | 18 |
| 4 | **2.00** | **5** | **28.60** | **0.40** | 12 |
| 5 | **5.00** | **10** | **28.10** | **0.90** | 10.8 |
| 6 | **5.00** | **15** | **28.20** | **0.80** | 9.6 |
| 7 | **5.00** | **20** | **28.30** | **0.70** | 8.4 |
| 8 | **5.00** | **25** | **28.50** | **0.50** | 6 |
| 9 | **10.00** | **30** | **28.50** | **0.50** | 3 |
| 10 | **10.00** | **40** | **28.10** | **0.90** | 5.4 |
| 11 | **10.00** | **50** | **28.20** | **0.80** | 4.8 |
| 12 | **10.00** | **60** | **28.20** | **0.80** | 4.8 |
| 13 | **10.00** | **70** | **28.40** | **0.60** | 3.6 |
| 14 | **10.00** | **80** | **28.50** | **0.50** | 3 |
| 15 | **10.00** | 90 | **28.85** | **0.40** | 2.4 |
| 16 | **10.00** | **100** | **28.70** | **0.30** | 1.8 |
| 17 | **10.00** | 110 | **28.70** | **0.30** | 1.8 |
| 18 | **10.00** | 120 | **28.70** | **0.30** | 1.8 |

| | |
|---|---|
| Date | **19-12-2022** |
| Unique ID no. | Thane-2 |
| Village | **Waret** |
| Taluka | **Bhivandi** |
| District | **Thane** |
| Coordinates | **19.458829, 73.084036** |
| Elevation/RL (mamsl) | 30.66 |
| Initial water level | 20 |
| Geology | Decan Basalt |
| Soil Type | Clay loam |
| Final Infiltration Rate (cm/hr) | 0.3 |
| Total Precipitation | 5.7 |




| S.no | Duration (min) | Cum Time (min) | Water level Depth (cm) | Infiltrated water depth (cm) | Infiltration rate (cm/hr) | Remarks |
|---|---|---|---|---|---|---|
| 1 | **1.00** | **1** | **19.30** | **0.70** | 42 | |
| 2 | **1.00** | **2** | **19.50** | **0.50** | 30 | |
| 3 | **1.00** | **3** | **19.70** | **0.30** | 18 | |
| 4 | **2.00** | **5** | **19.40** | **0.60** | 18 | |
| 5 | **2.00** | **7** | **19.50** | **0.50** | 15 | |
| 6 | **3.00** | **10** | **19.50** | **0.50** | 10 | |
| 7 | **5.00** | **15** | **19.20** | **0.80** | 9.6 | |
| 8 | **5.00** | **20** | **19.30** | **0.70** | 8.4 | |
| 9 | **10.00** | **30** | **19.20** | **0.80** | 4.8 | |
| 10 | **10.00** | **40** | **19.40** | **0.60** | 3.6 | |
| 11 | **10.00** | **50** | **19.80** | **0.20** | 1.2 | |
| 12 | **10.00** | **60** | **19.90** | **0.10** | 0.6 | |
| 13 | **20.00** | **80** | **19.90** | **0.10** | 0.3 | |
| 14 | **20.00** | **100** | **19.90** | **0.10** | 0.3 | |
| 15 | **20.00** | **120** | **19.90** | **0.10** | 0.3 | |