
**केन्द्रीय 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

## Rajkot District
## Gujarat

पश्चिम मध्य क्षेत्र, अहमदाबाद

West Central Region, Ahmedabad

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TechnicalReportSeries

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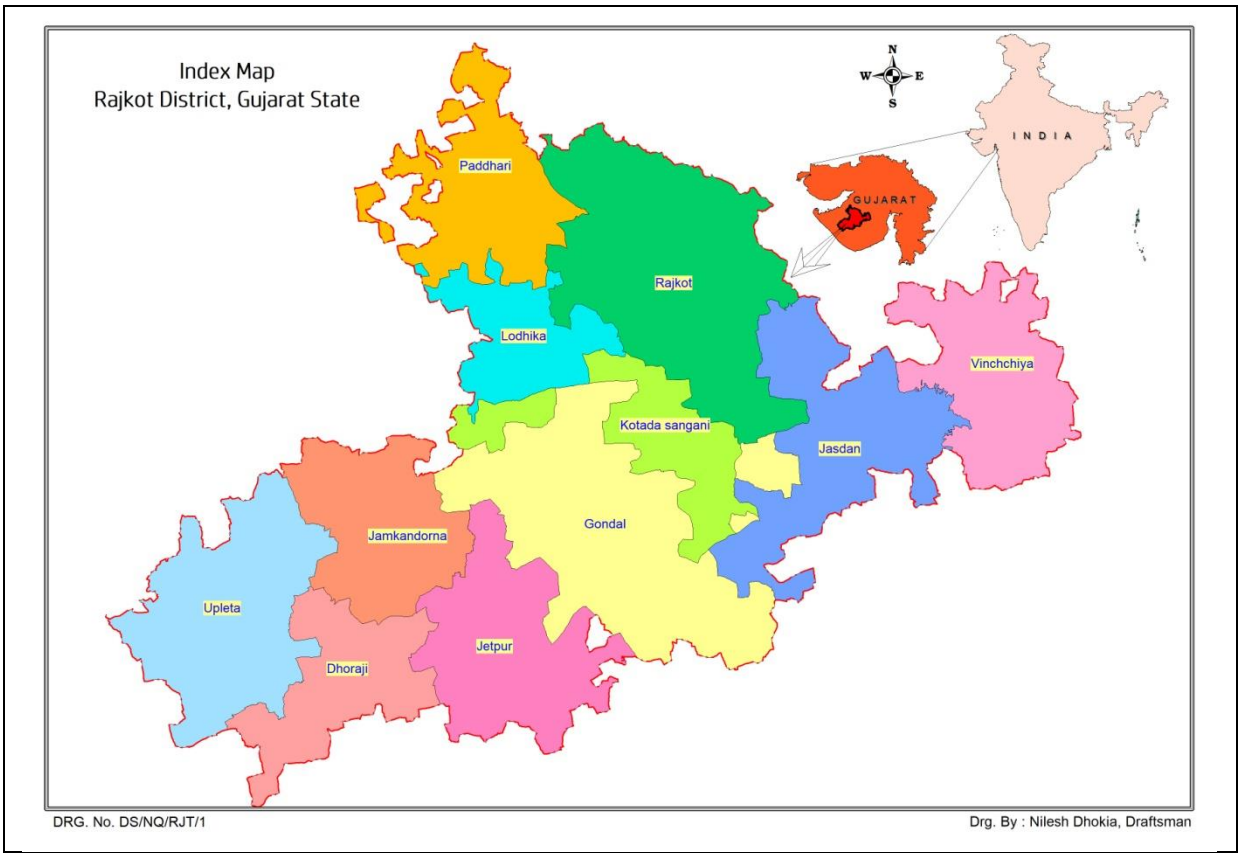


**Government of India**
**Ministry of JalShakti**
**Department of Water Resources, RD and GR Central Ground Water Board**
**West Central RegionAhmedabad**

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# AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES RAJKOT DISTRICT, GUJARAT STATE

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**AQUIFER MAP&MANAGEMENT PLAN OF**
**RAJKOT DISTRICT GUJARAT**
**(7753.65 sq. km)**

## RAJKOT DISTRICT AT GLANCE

| Sl.No | Items | Statistics |
|---|---|---|
| 1 | **General Information** | |
| | i) Geographical area (Sq. Km) | 7750 |
| | ii) Total Reporting Area(Sq. Km) | 7750 |
| | iii) Administrative Divisions (As on 3/2011)<br>Number of Talukas<br>Number of Villages | <br>11<br>598 |
| | iv) Populations (As per Census 2011) | 3,804,558 |
| | v) Average Annual Rainfall (mm) | 645 |
| 2. | **GEOMORPHOLOGY** | |
| | Major Physiographic Units: Pediments & Dissected Hills | |
| | Major Drainages: Bhadar, Aji, Machhu and Demai | |
| 3. | **LAND USE (Sq. Km)**(Source: Directorate of agriculture Season & Crops record 2018-19 ) | |
| | a) Forest area<br>b) Area under waste Land<br>c) Gross Cropped Area<br>d) Net area sown<br>e) Area Sown more than once<br>f) Cropping Intensity | 257<br>473<br>5658<br>5297<br>362<br>106.81% |
| 4. | **MAJOR SOIL TYPES:** Mostly of Inceptisol and Entisol order and of Othids, Ochrepts, Orthents, Fluvents, Psamments and Aquepts suborder. The soils are sandy, loamy sand, clayey and siltytype. | |
| 5. | **AREA UNDER FOOD CROPS (sq.km) (2018-19)**<br>Rice 4, Bajra-9, Jowar-6, Wheat-52, Maize-7,Total cereals-725,Total pulses-74.Total Pulses-77,Total Foodgrains-152,Total Oil seed-2548,Total Fiber Crops-2602.<br>(Source: Directorate of agriculture Season & Crops record 2018-19 ) | |
| 6. | **IRRIGATION BY DIFFERENT SOURCES** (Area in Hectares/ no of structures)<br>(Source: Directorate of agriculture Season & Crops record 2018-19 & MI Census data from NWRWS & KD) | |
| | Dug wells | 195500/83053 |
| | Tube wells/Bore wells | 135800/7155 |
| | Tanks/Ponds/Water conservation structures | 9300/104 |
| | Canals | 17200/50 |
| | Net Irrigated area(sq. km.) (2018-19) | 279,200 |
| | Gross Irrigated area (sq. km.) (2018-19) | 337,800 |
| 7. | NUMBERS OF GROUND WATER MONITORING WELLS. | |
| | a) CGWB-Dug Wells<br>b) CGWB-Piezometers | 34<br>05 |
| **8.** | **PREDOMINANT GEOLOGICAL FORMATIONS**: Deccan Trap basalt with Deccan traps the predominant geological formation. | |
| 9. | **Major Water Bearing Formations:** Weathered & Fractured Basalts. | |
| | Depth to water Level during 2019-20 | |

| | | | | | |
|---|---|---|---|---|---|
| | Period | Phreatic Aquifer (DTW) | | Semi-confined /Confined Aquifer (PZ head) | |
| | | Min | Max | Min | Max |
| | Pre Monsoon | 3.85 (Ukarda) | 30.21 (Vajdi) | NA | NA |
| | Post Monsoon | 0.10 (Ravki) | 26.40 (Mandalikpur) | NA | NA |
| | Long Term (10 Years) Water Level Trend (2011 to 2020) | | | | |
| | Trend | Pre-Monsoon | | Post- Monsoon | |
| | Rise (m/Yr) | 0.0184 (Dadvi) to 1.875 (Ambardi) | | 0.00018 (Kalithad1) to 1.4060(Juna Rajpipla) | |
| | Fall (m/Yr) | 0.00403 (Roghel) to 1.94702 (Dadar) | | 0.00060 (Jivapar) to 2.7018(Mandalikpur) | |
| 10. | **GROUND WATER EXPLORATION BY CGWB** (As on 31-03-2020) | | | | |
| | No of wells drilled (EW, OW, Pz, SH, Total)<br>EW 79, OW 34, PZ 8, Total: 121 | | | | |
| | Depth Range(m) | | | 29.8 to 500 | |
| | Discharge (Litres per minute) | | | 0.2 to 1980 | |
| | Transmissivity (m2/day) | | | 0.09 to 1100 | |
| 11 | **GROUND WATER QUALITY** | | | | |
| | Presence of chemical constituents more than permissible limit) | | | High Fluoride & Nitrate at isolated pockets | |
| | Type of water | | | Potable in general | |
| 12. | **DYNAMIC GROUND WATER RESOURCES** (As on 2017) | | | | |
| | Annual Replenishable Ground Water Resources (MCM) | | | 1565.53 | |
| | Net Ground water Availability (MCM) | | | 1487.26 | |
| | Projected Demand for Domestic and industrial Uses up to 2025 (MCM) | | | 34.44 | |
| | Stage of Ground Water Development (%) | | | 64.52 | |
| 13 | **GROUND WATER CONTROL AND REGULATION (3/2017)** | | | | |
| | Number of OE Blocks | | | Nil | |
| | Number of Critical Blocks | | | Nil | |
| | Number of Semi Critical Blocks | | | Nil | |
| | Number of Safe Blocks | | | 11 | |
| | Number of Saline Blocks | | | Nil | |
| | No. Of Blocks Notified by CGWA | | | Nil | |
| 14 | **MAJOR GROUND WATER PROBLEMS AND ISSUES** | | | | |
| | i) Low Groundwater Development<br>ii) Pollution Geogenic and Anthropogenic (Flouride & Nitrate in localised pockets)<br>iii) Limited Yield Potential in Hard Rock.<br>iv) Demand supply management. | | | | |

# AQUIFER MAP AND MANAGEMENT PLAN
# RAJKOT DISTRICT

## INTRODUCTION

Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical field and laboratory analyses are applied to characterize the quantity, quality and sustainability of ground water in aquifers. There has been a paradigm shift from "groundwater development" to "groundwater management". An accurate and comprehensive micro-level picture of groundwater in India through aquifer mapping indifferent hydrogeological settings will enable robust groundwater management plans at the appropriate scale to be devised and implemented for this common-pool resource. This will help achieving drinking water security, improved irrigation facility and sustainability in water resources development in large parts of rural India, and many parts of urban India as well. The aquifer mapping program is important for planning suitable adaptation strategies to meet climate change also. Thus the crux of NAQUIM is not merely mapping, but reaching the goal – that of ground water management through community participation.

**Objective:**

The primary objective of the Aquifer Mapping Exercise can be summed up as "Know your Aquifer, Manage your Aquifer". Demystification of Science and thereby involvement of stake holders is the essence of the entire project. The involvement and participation of the community will infuse a sense of ownership amongst the stakeholders. This is an activity where the Government and the Community work in tandem. Greater the harmony between the two, greater will be the chances of successful implementation and achievement of the goals of the Project. As per the Report of the Working Group on Sustainable Ground Water Management, "It is imperative to design an aquifer mapping programme with a clear-cut groundwater management purpose. This will ensure that aquifer mapping does not remain an academic exercise and that it will seamlessly flow into a participatory groundwater management programme. The aquifer mapping approach can help integrate ground water availability with ground water accessibility and quality aspects.

**Methodology:**

Methodology involves creation of database for each of the principal aquifer. Delineation of aquifer extent (vertical and lateral). Standard output for effective presentation of scientific integration of Hydrogeological, geophysical, geological, hydro chemical data facts and on GIS platform, identification of issues, manifestation of issues and formulation of strategies to address the issues by possible interventions at local and regional level.
The activities of the Aquifer Mapping can be grouped as follows.

### Data Compilation & Data Gap Analysis:

One of the important aspect of the aquifer mapping programme was the synthesis of the large volume of data already collected during specific studies carried out by Central Ground Water Board and various

Government organizations with a new data set generated that broadly describe an aquifer system. The data were assembled from the available sources, analyzed, examined, synthesized and interpreted. These sources were predominantly non-computerized data, which was converted into computer based GIS data sets and on the basis of available data, data gaps were identified.

### Data Generation:

There a strong need for generating additional data to fill the data gaps to achieve the task of aquifer mapping. This was achieved by multiple activities such as exploratory drilling, geophysical techniques, hydro-geochemical analysis, remote sensing, and hydrogeological surveys to delineate multi aquifer system to bring out the efficacy of various geophysical techniques and a protocol for use of geophysical techniques for aquifer mapping in different hydrogeological environs.

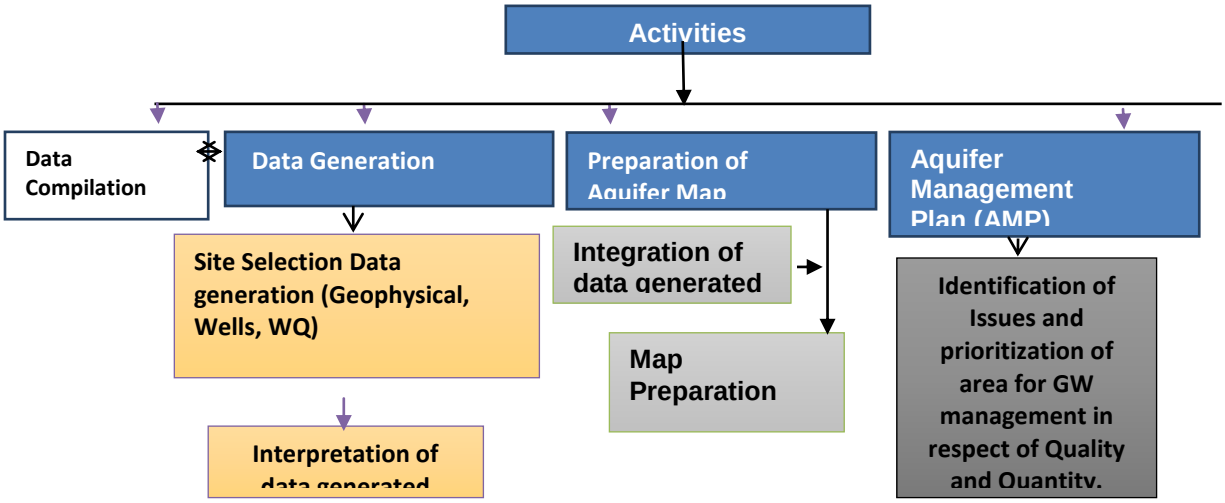
### Aquifer Map Preparation:

On the basis of integration of data generated from various studies of hydrogeology & geophysics, aquifers have been delineated and characterized in terms of quality and potential. Various maps have been prepared bringing out details of Aquifers, these are termed as Aquifer maps providing spatial variation (lateral & vertical) in reference to aquifer extremities (i.e. quality & quantity).

### Aquifer Management Plan Formulation:

Aquifer response Model has been utilized to identify a suitable strategy for sustainable development of the aquifer in the area.
All the above activities under the ground National Aquifer Mapping programme is depicted/elaborated in Annexure –I and presented in figure 1.

### Figure – 1 Activities under National Aquifer Mapping Programme



**Locations, Extent and Accessibility**

The district is situated in the Saurashtra region of Gujarat state and lies between 23°08' North latitude and 20º58' North latitude and 71º40' East longitude and 70º20' East longitude. Rajkot is the largest city in the Saurashtra region. This district is surrounded by Morbi district in north, Surendranagar and Rajkot districts in east, Amreli and Junagadh districts in south and Porbandar, Jamnagar district in west. Rajkot as an independent district came into existence on 1st May, 1960, consequent upon its reincorporation into the state of Gujarat. The districtderives its name from its headquarters, Rajkot City. Rajkot district has 11 Developmental Blocks / Talukas, 575 Gram Panchayats and 577 inhabited villages. The economy of Rajkot district mainly depends on agriculture. The city also contributes to the economy of the state with heavy and small scale industries. For administrative purpose, the district is divided into 11 Development Blocks or Talukas with their headquarters at Paddhari, Rajkot, Lodhika, Kotda Sangani, Jasdan, Gondal, Jamkandorna, Upleta, Dhoraji, Jetpur and Vicchiya for developmental purposes. Fig. 2 Location Map of Rajkot District.

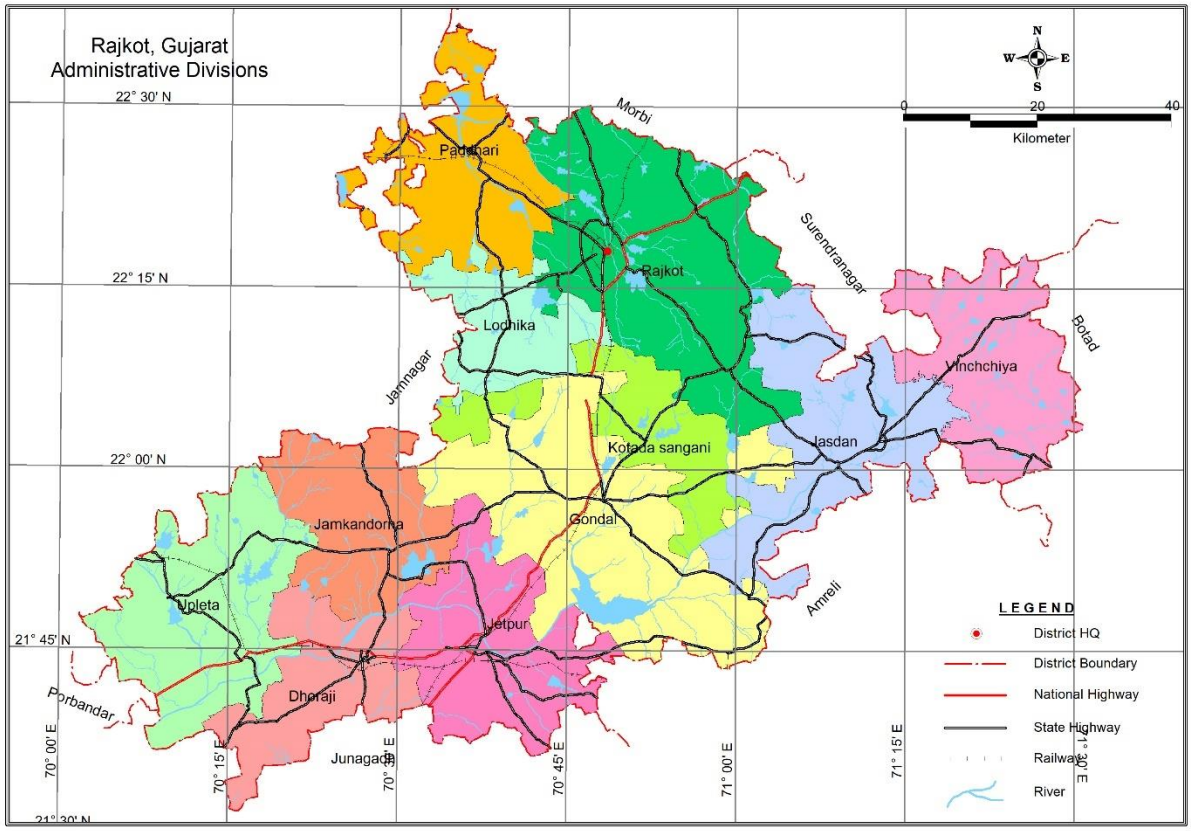



Figure 2. Administrative map of Rajkot district

Rajkot district is divided 11 talukas. Details of the Talukas and numbers of revenue villages are given in Table no: 1

Table: 1 Details of Taluka area & Villages of Rajkot District.

| Sr No | Name of Taluka | Area (Sq.Km) | No of Villages |
|---|---|---|---|
| **1** | Dhoraji | 484.94 | 30 |
| **2** | Gondal | 1193.62 | 81 |
| **3** | Jamkandorna | 560.29 | 50 |
| **4** | Jasdan | 833.42 | 53 |
| **5** | Jetpur | 627.58 | 47 |
| **6** | Kotada sangani | 447 | 42 |
| **7** | Lodhika | 373.23 | 38 |
| **8** | Paddhari | 599.33 | 58 |
| **9** | Rajkot | 1004.88 | 96 |
| **10** | Upleta | 839.24 | 51 |
| **11** | Vinchchiya | 510.3 | 52 |
| | **Total** | **7473.83** | **598** |

**Demographic Perticulars**

As per 2011 census, the total population of the district was 3,804,558 out of which population of female and male are 1,830,113 and 1,974,445 respectively. Rajkot is the 4th most populated district of Gujarat. District is predominantly urban and around 58.19% of the population resides in urban area. After the creation of Morbi district from Rajkot, the population of the district is calculated to be 30,15,229 of which 15,67,811 are Male and 14,47,418 are female.

## LAND USE PATTERNS, IRRIGATION & AGRICULTURE

*Seasons & Crops Record*, Rajkot District -year 2018-19, has been refereed for land use, irrigation & agriculture statistics of the district.

### Land Use Patterns

As per *Seasons & Crops Record*, 775000 hectares of land is accounted for land use record. Brief account of land use classification for the district, in general, is given in table No.2

.

Table No. 2 Land Use Classification of Rajkot District (2018-19)

| Sr No | Land Use Classification | | Area in Sq KM |
|---|---|---|---|
| 1 | Total Geographical Area | | 7750 |
| 2 | Total Reporting Area | | 7750 |
| 3 | Total Forest | | 257 |
| 4 | Not available for cultivation | Land put to Non-agricultural uses | 795 |
| | | Barren and Unculturable Land | 473 |
| 5 | Other uncultivated land excluding fallow land | Pasture & other grazing | 574 |
| | | Land under miscellaneous | 0 |
| | | Culturable Waste | 150 |
| | | Total | 724 |

| | | | |
|---|---|---|---|
| 6 | Fallow Land | Other Fallows | 7 |
| | | Current Fallows | 196 |
| | | Total | 203 |
| 7 | Net area sown | | 5297 |
| 8 | Area sown more than onces | | 362 |
| 9 | Gross Cropped area | | 5658 |
| 10 | Cropping (GCA/NAS) % | | 106.81 |

**Land Use & Season –Crop Record – Rajkot District – Year 2018-19 – Agriculture Directorate, Government of Gujarat.**

### Irrigation

Details of area irrigated by surface & ground water resources are given in table No 3

Table No. 3 Details of Irrigated Areas

| Source | Irrigated Area (Hectares) | |
|---|---|---|
| | Net | Gross |
| Tanks | 9200 | 9300 |
| Canals | 16500 | 17200 |
| **Total Surface Water** | **25,700** | **26,500** |
| Govt. Tube Wells | 89200 | 112300 |
| Pvt. Tube Wells | 20700 | 23500 |
| Dug Wells | 143600 | 195500 |
| **Total Ground Water** | **253,500** | **331,300** |
| | | |
| **Total Irrigated Area** | **279,200** | **337,800** |

### Agriculture

The district areas have varied agriculture crops, both food crops & non food crops. Main food crops consist of food grains such as wheat, *jowar, bajra*, maize etc., and pulses. Other food crops are fruits & vegetables. Non food crops consist of cotton, oil ground nut, castor, tobacco, fodder etc. As per *Season & Crops Records, there* were 565,800 hectares of gross area under various crops in the district, out these 529,700 hectares were under net crops area.

### Urban and Industrial area

Rajkot is the largest urban Centre, with a population of 1.33 million under the municipal corporation. Other four major centers are Gondal, Jetpur and Dhoraji.Rajkot taluka alone has more than 50 percent of the total district population, of which more than 90 % live in urban area.

Rajkot district is one of the most industrialized district in Gujarat State. It has established itself as a major manufacturing center for diesel engines, automobile components, gems and jewelries, a cluster of foundry units, a cluster of sari printing (Jetpur), and a cluster of ceramics (Morbi). Major manufacturing centers are Rajkot (Oil Engine Manufacture, Gold and Silver Ornaments),

Jetpur (Sari Printing), Gondal (Oil Extraction) and Jasdan (Cotton ginning and Pressing and Handicrafts.

## Rainfall and Climate

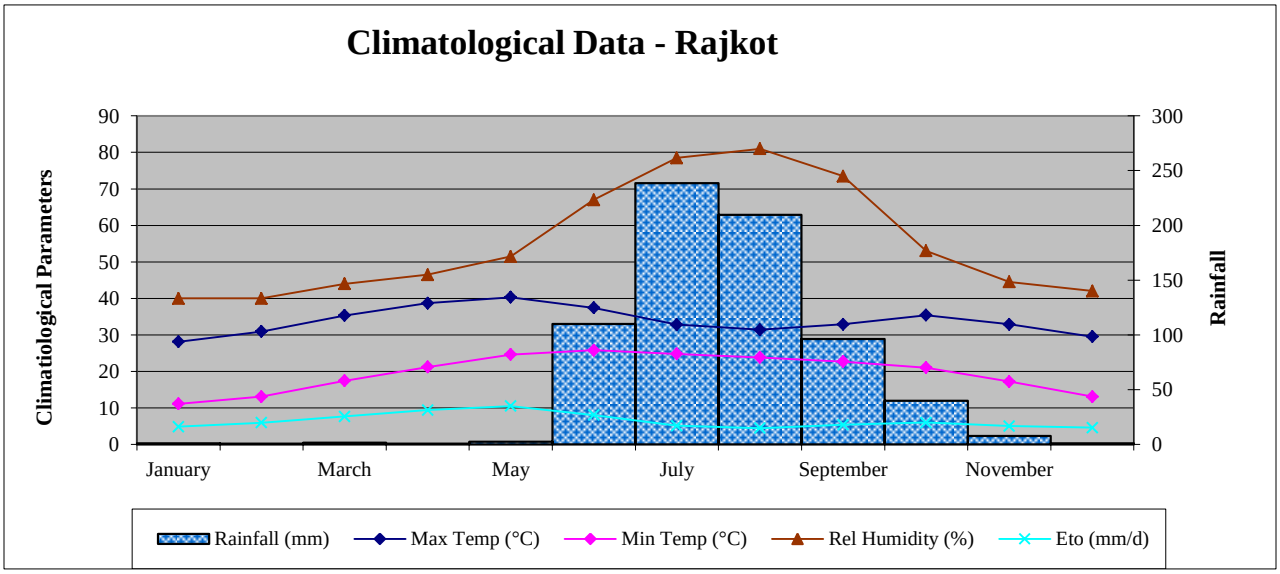
The district has semi-arid climate. Extreme temperatures, erratic rainfall and high evaporation are the characteristic features of this type of climate. Climatologically data of Rajkot IMD station (1951-1980) that is nearest is given in the table 4.

General climate of the district is sub-tropical and is characterized by three well-defined seasons, i.e. summer - from April to June, monsoon - from July to September, and winter - from October to March.

### Table 4

| Month | Max Temp (Deg.C) | Mini Temp (Deg.C) | Humidity (%) | Wind Speed Kmpd | Sunshine (Hours) | Solar Rad. (MJ/m2/d) | ET (mm/d) | Rainfall (mm) |
|---|---|---|---|---|---|---|---|---|
| January | **28.1** | **11.1** | **40.0** | **224.5** | **8.8** | **16.9** | **4.8** | **0.9** |
| February | **30.9** | **13.1** | **40.0** | **248.2** | **9.2** | **19.4** | **5.9** | **0.6** |
| March | **35.3** | **17.4** | **44.0** | **297.5** | **9.8** | **22.6** | **7.7** | **1.7** |
| April | **38.7** | **21.2** | **46.5** | **363.1** | **10.3** | **25.0** | **9.4** | **0.6** |
| May | **40.3** | **24.6** | **51.5** | **485.4** | **9.3** | **24.0** | **10.5** | **2.6** |
| June | **37.4** | **25.8** | **67.0** | **518.3** | **7.1** | **20.6** | **8.0** | **110.1** |
| July | **32.8** | **24.8** | **78.5** | **487.2** | **3.7** | **15.5** | **5.1** | **238.5** |
| August | **31.4** | **23.8** | **81.0** | **416.1** | **3.8** | **15.3** | **4.5** | **209.8** |
| September | **32.9** | **22.7** | **73.5** | **313.9** | **7.0** | **19.0** | **5.4** | **96.3** |
| October | **35.4** | **21.0** | **53.0** | **215.3** | **9.3** | **20.2** | **6.0** | **39.8** |
| November | **32.9** | **17.2** | **44.5** | **188.0** | **9.2** | **17.8** | **5.0** | **7.8** |
| December | **29.5** | **13.1** | **42.0** | **204.4** | **8.7** | **16.0** | **4.6** | **1.1** |
| **Total** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **709.8** |
| Average | 33.8 | 19.7 | 55.1 | 330.2 | 8.0 | 19.4 | 6.4 | - |

**Figure No-3 Climatological Data**



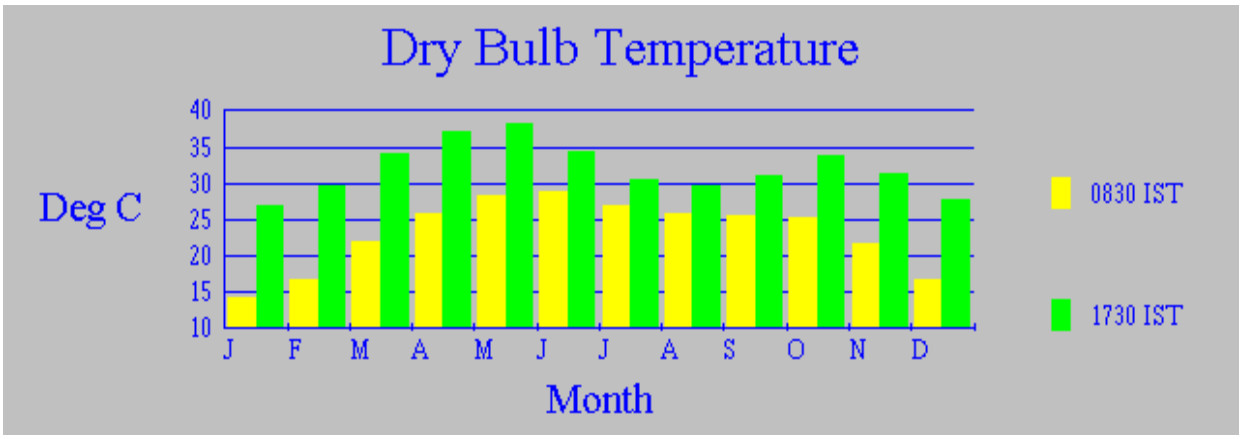



**Figure No-4 Dry Bulb Tempearture**

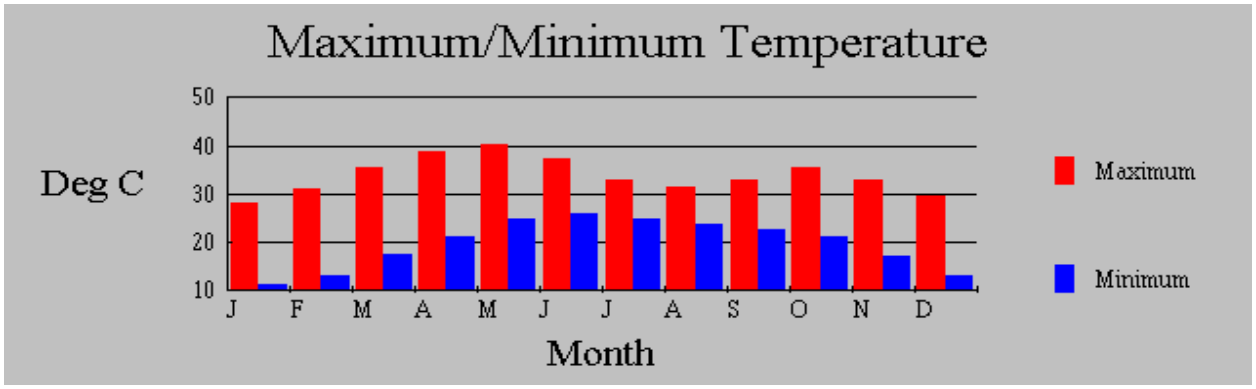



**Figure No-5 Maximum/Minimum Tempearture**

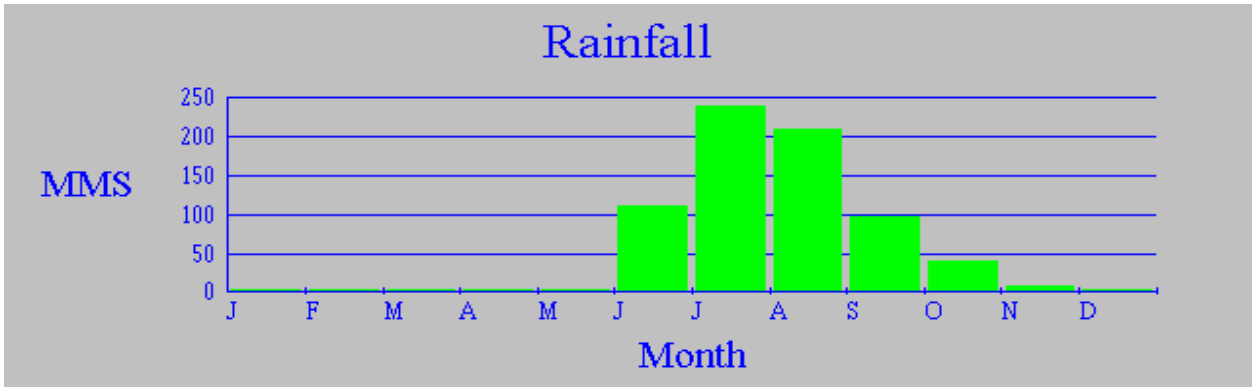



**Figure No-6 Rainfal**

## GEOMORPHOLOGY AND SOIL TYPE

Rajkot district is situated in the central part of Saurashtra peninsula. The northern part of the district bordering the Rann of Kachchh and the main underlying rock type is Deccan Trap basalt giving rise to rugged and rolling topography intersected by ridges formed by the dykes. Some of these ridges are as high as 300m AMSL. The most prominent ridge is situated along the northern boundary of the Bhadar River and runs along the basaltic dyke locally known as Sardhar Dyke. The elevations range from almost sea level to more than 300 m AMSL. The highest point is 304 m located near Bhadala in the east-central part of the district.

In the central part of the district comprising Paddhari, Lodhika, Jasdan, Rajkot, Jam Kandorna and Kotada Sanghani talukas, the soils are of clayey loam to clay type. They are moderately deep to deep and vary in colour from very dark brown to very dark greyish brown and reddish brown. The EC of the soils is generally less than 1.0 mmhos/cm and cation exchange capacity is between 40 and 60 me/100 gm of soil.

The soils in the southern part of the district comprising Jetpur, Dhoraji, Upleta and Gondal talukas are similar to the soils of the central part. They are clayey loam to clayey type, very dark grey to dark greyish and dark brown in colour and moderately deep (25 to 75 cm). The EC of the soils is generally less than 1.0 mmhos/cm and cation exchange capacity is between 30 and 35 me/100 gm of soil.

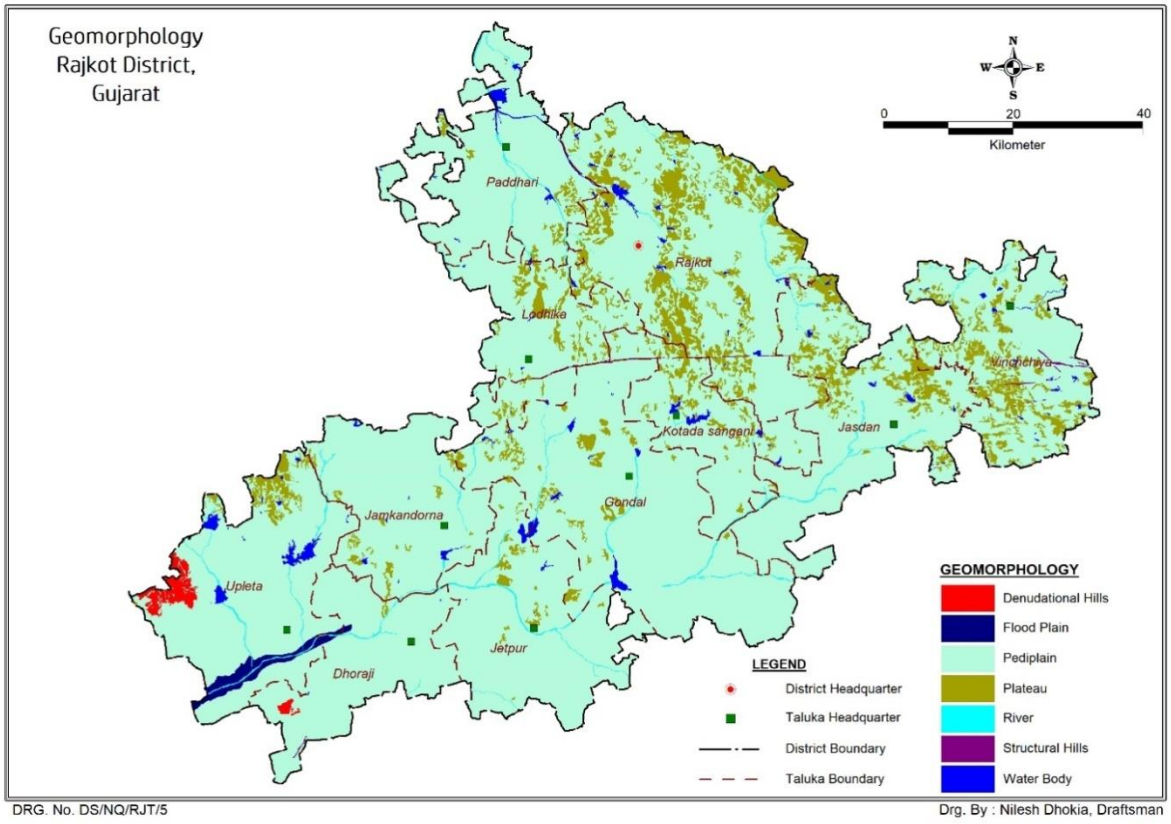



**Figure No-7 Geomorphology Map of Rajkot District**

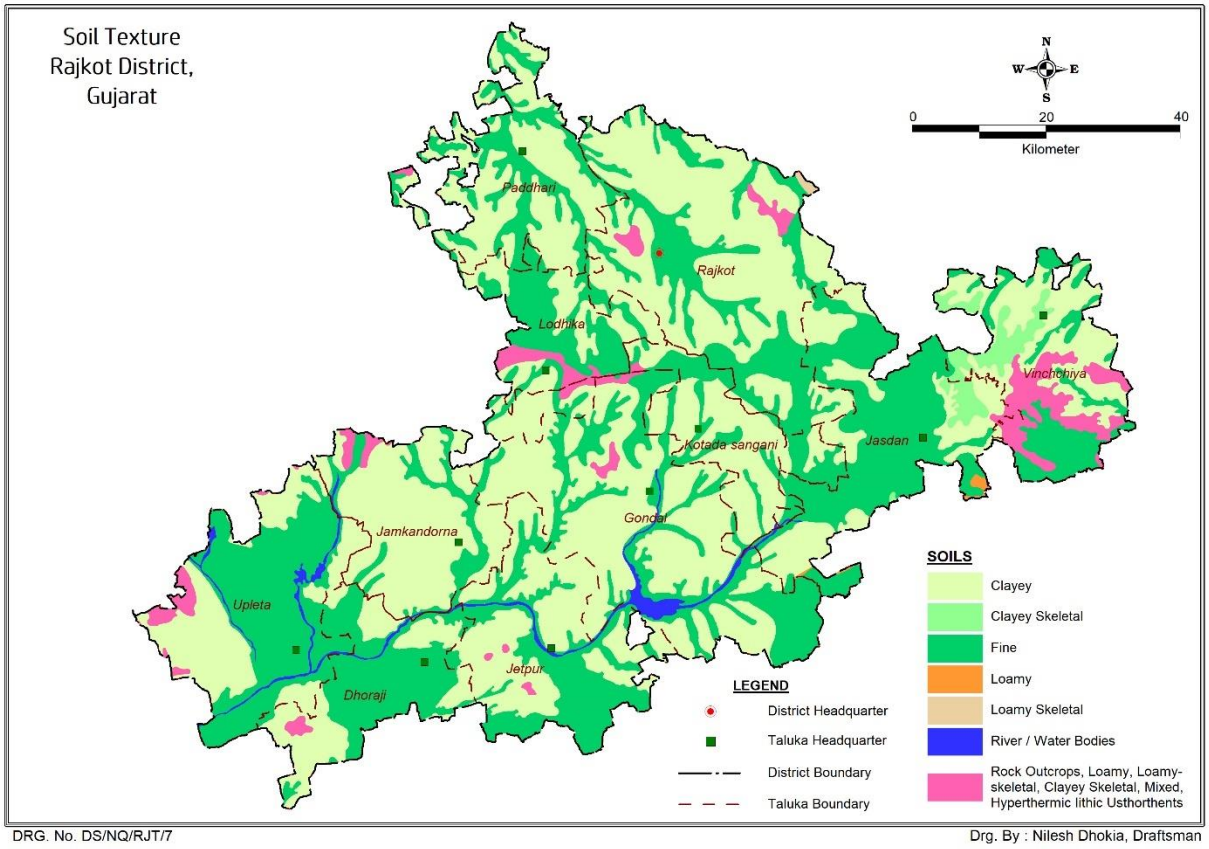



**Figure No-8 Soil Texture Map of Rajkot District**

## Drainage

There are three major rivers in the district. The river Bhadar, which emerges from Jasdan taluka and flows across the southern part of the district is the biggest of all. Other two major rivers Machhu and Aji, flow toward north. In addition to these, there are 14 rivulets which have swift and short run to the sea.

Water of the river is mainly used for agriculture and drinking purposes. Machhu River rises in the hills of Jasdan near village Khokhara in Chotila taluka of Surendranagar district. This is one of the North flowing rivers of Saurashtra in Gujarat state. It flows from district boundary of Surendranagar and Rajkot up to village Beti then flows towards North in Rajkot and finally meets in the little Ran of Kuchchh near Malia. Bhadar Riveroriginates from, near Jasdan and meets in Arabian Sea.

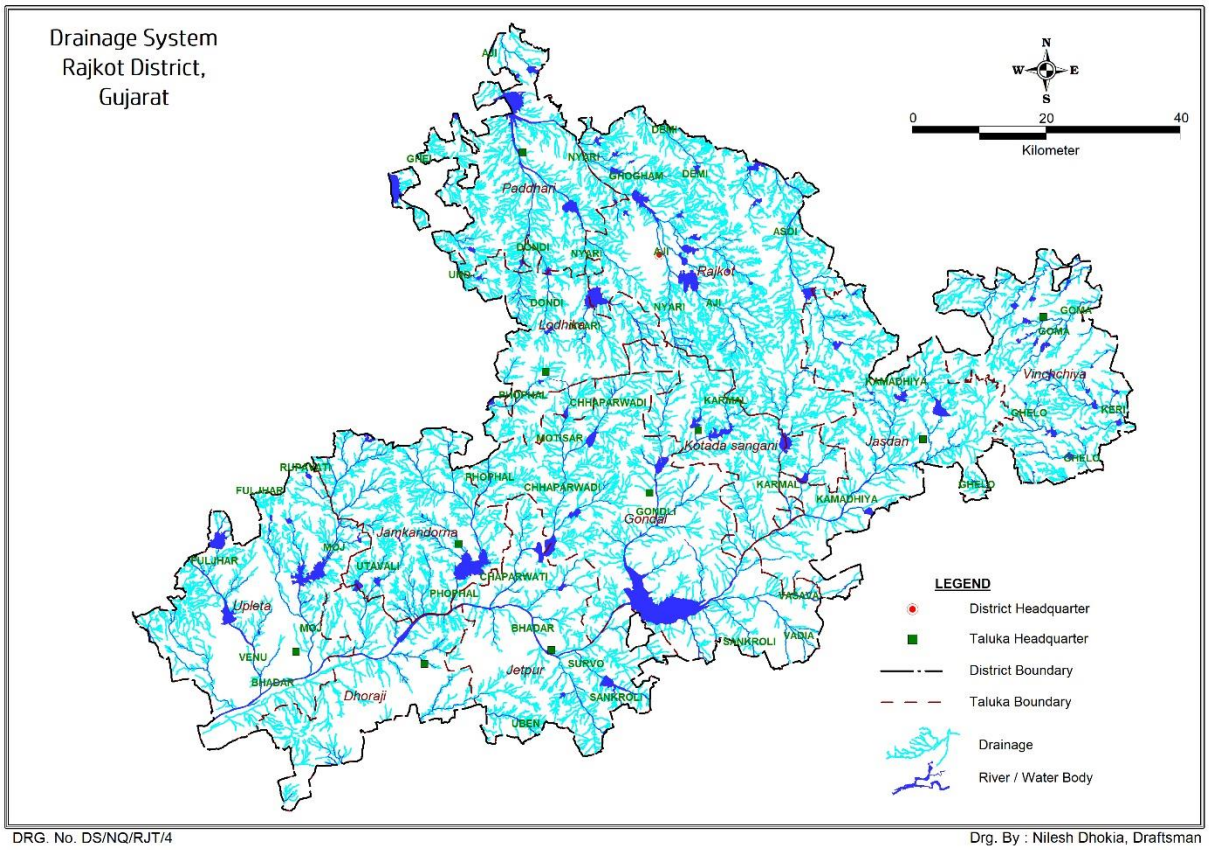



**Figure No-9 Drainage Map of Rajkot District**

## HYDROLOGY

### Surface Water Resources

Rajkot district has no perennial river. Narmada canal network is also important resource. It is primarily used as a supplement for drinking water supply. If and when water is available above household needs, it may be used for agriculture. However, as of now, its contribution to agricultureneeds is nil.The majority of the surface water in the district is created through canals from Aji andBhadar dams. Dhoraji has maximum command area under canal irrigation while Rajkot has the maximum number of sources of canal irrigation. Jasdan block has the majority of the community ponds in the district.

**STUDIES / ACTIVITY BY CGWB**

Systematic hydrogeological survey was first taken up by M. S. Jethra in 1984-85 when he covered about 2018 sq. km area in northern parts of district comprising Central part of of the district. Subsequently different workers of GSI and CGWB took up hydrogeological surveys in the district.

Table 5: Areas covered by hydrogeological surveys by different officers

| Area Covered | Geographical Area (sq. km) | Year | Officer |
|---|---|---|---|
| A. Systematic Hydrogeological Surveys | | | |
| Central parts | 2018 | 1984-85 | M. S. Jethra |
| Parts of district falling in Bhadar River Basin | | 1979-80 | M. R. Kulkarni |
| Parts of Jasdan taluka | 1693 | 1988-89 | Ahmad |
| B. Reappraisal Hydrogeological Surveys | | | |
| Entire Rajkot District | | 1988-89 | P. K. Jain<br>P.C.Panchbhaya<br>A.B.Kawade<br>K.Balakrishna |

## 2. GEOLOGY AND HYDROGEOLOGY

### GEOLOGY

The general geological succession of the rock formations occurring in the Rajkot district is as given below.

| Age | Formation | Lithology |
|---|---|---|
| Quaternery | Surface Soil/ Alluvium | Wind blown sand and Black cotton soil |
| Lower Eocene to Upper Cretaceous | Deccan Trap | Plutonic Basalt stratified lava flows comprising amygdoloidal basalt, fine grained porphyritic basalt and basaltic/doleritic dykes. |

Deccan trap occupies a major part inRajkot District and it covers most of the Saurashtra peninsula except along its fringes where Tertiary and Quaternary sediments and portion in North West where Mesozoic rock are exposed. The total thickness of Deccan Trap rocks, revealed through DSS of ONGC (Chowdhary LR, 2004; Kaila KL,1988) in Saurashtra ranges from 300 m to more than 900 m. The CGWB deep exploration has encountered more than 25 flows in explored depth of 500 m (Gupte PR, 2004). Most of the individual flows are 3 to 9 m thick, but some have thickness more than 25 m also. In North West part of exposure, older Jurassic sandstone is encountered at various depths of 200 to 450 mbgl. With average thickness of 300 m basaltic lava flows below ground level and except few volcanic plugs forming prominent hills & distinct high land and associated dykes swarms forming extensive & linear low laying ridges, mostly in southern part of Saurashtra, the Deccan Trap terrain exhibits overall relatively flat and low lying topography.

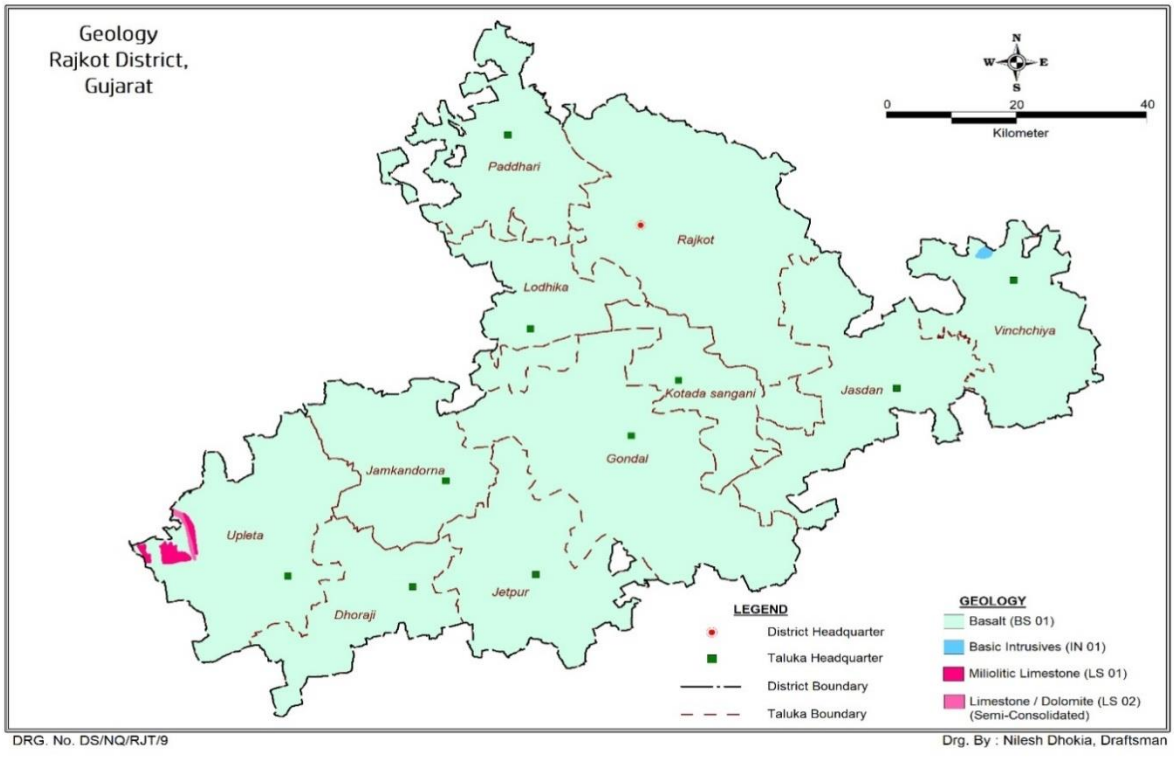



**Figure No-10 Geology Map of Rajkot District**

## HYDROGEOLOGY

Deccan Trap

Deccan trap occupies a major part of the district and forms the most important aquifer system. It generally forms a poor aquifer due to compactness and poor primary porosity. However, the upper weathered parts, which at places are up to 20 m thick, form good aquifer in the district. At deeper levels, the secondary porosity developed as a result of tectonic activities, in the form of joints, and fractures, shear zones, form repository of groundwater at many places. The dykes, particularly in the southern part of the district, play an important role in occurrence and movement of groundwater. At places, the dykes are highly weathered and themselves form potential aquifers. At other places where the dykes are more compact, they act as subsurface barrier for the groundwater flow and well constructed upstream of these dykes have yield good yields.

The groundwater in Deccan trap occurs under phreatic to confined conditions. The groundwater is generally tapped through dug wells varying in depth from 10 to 50 m. At places, dug-cum-bored wells are also constructing bores below the bottom of dug wells. The yield of dug wells and dug-cum-bored wells generally range from 20 to 100 m3/day.

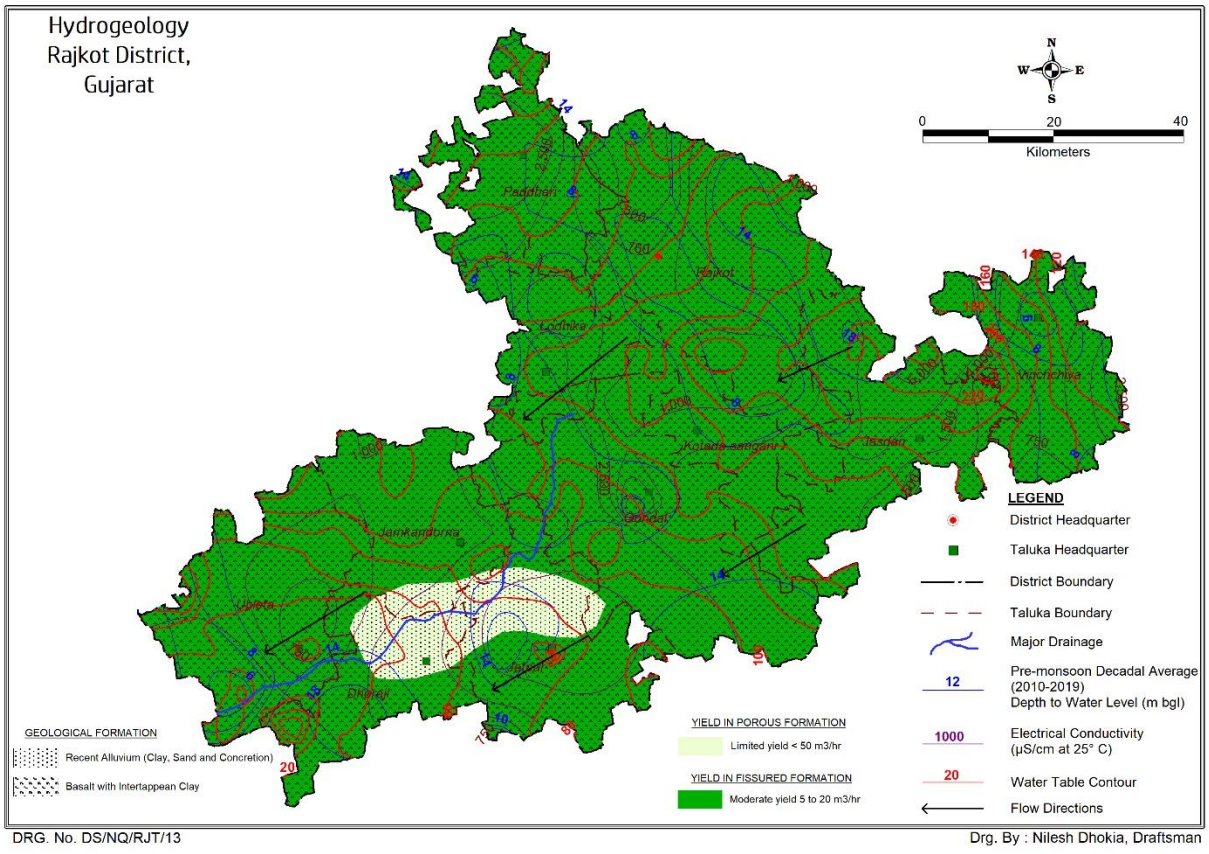



**Figure No-11 Hydrogeology Map of Rajkot District**

**Exploration Details**

The groundwater exploration in the district has been carried from 1969-72 and continued AAP 2017-18. The maximum depth of the borewells drilled is 598m at Lodika village. Details of the wells drilled up to March 2018 are given in table below.

Table 6: - Ground Water Exploration

| Salient Features | Exploratory Wells | Observation Wells | Piezometers |
|---|---|---|---|
| Total Nos. | 68 | 31 | **8** |
| Drill Depth range (mbgl) | 49.1 to 598 | 52.5 to 202.6 | 29.8 to 56.2 |
| Depth Constructed range (mbgl) | 49.1 to 598 | 36.9 to 201.6 | 29.8 to 56.2 |
| Static Water Level (mbgl) | 5 to 196.2 | - | 6 to 8.8 |
| Discharge (LPM) | 12 to 1320 | - | 22 to 1500 |

## GROUNDWATER REGIME MONITORING

Ground water regime monitoring is the basic component of groundwater management and it is carried out in parts of Rajkot district through National Hydrograph Network Stations (NHNS or NHS). NHSs are observation wells, comprising of dug wells and purpose built bore wells – known as piezometers. There are 34 Dug wells and 05 piezometers as part of the NHS from CGWB and 228 no of monitoring wells from GWRDC Ltd. The following maps have been generated to understand the behaviour of ground water regime.

### Depth to Water Level Pre monsoon (May 2019)

The figure 12 shows depth to water level map of Rajkot district, prepared on the basis of NHS data of May 2019. In major part of the district, the water level ranged in between 5 to 10 & 10 to 20 m bgl while some isolated patches of district showing shallow water of <2m and deep water level ranges 20 to 40 m. (Figure 12: DTW May 2019 map of Rajkot district.)

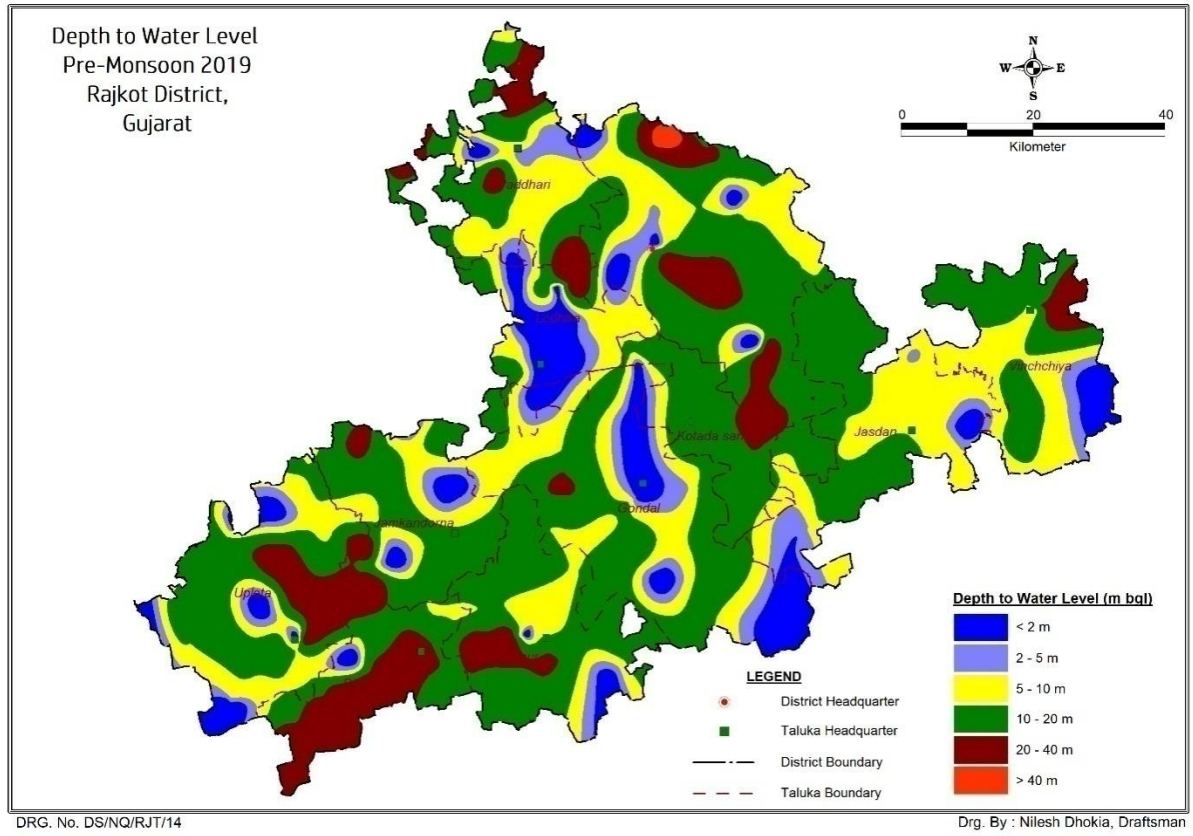



Figure 12: DTW May 2019 map of Rajkot district

**DEPTH to Water Level Post monsoon (Nov 2019)**

The figure 13 shows depth to water level map of Rajkot district, prepared on the basis of NHS data of November 2019. In major part of the district, the water level ranged in between 2 to 05 & 5 to 10 m bgl while some isolated patches of district showing shallow water of <2m and deep water level ranges 20 to 40 m. (Figure 13: DTW November 2019 map of Rajkot district.)

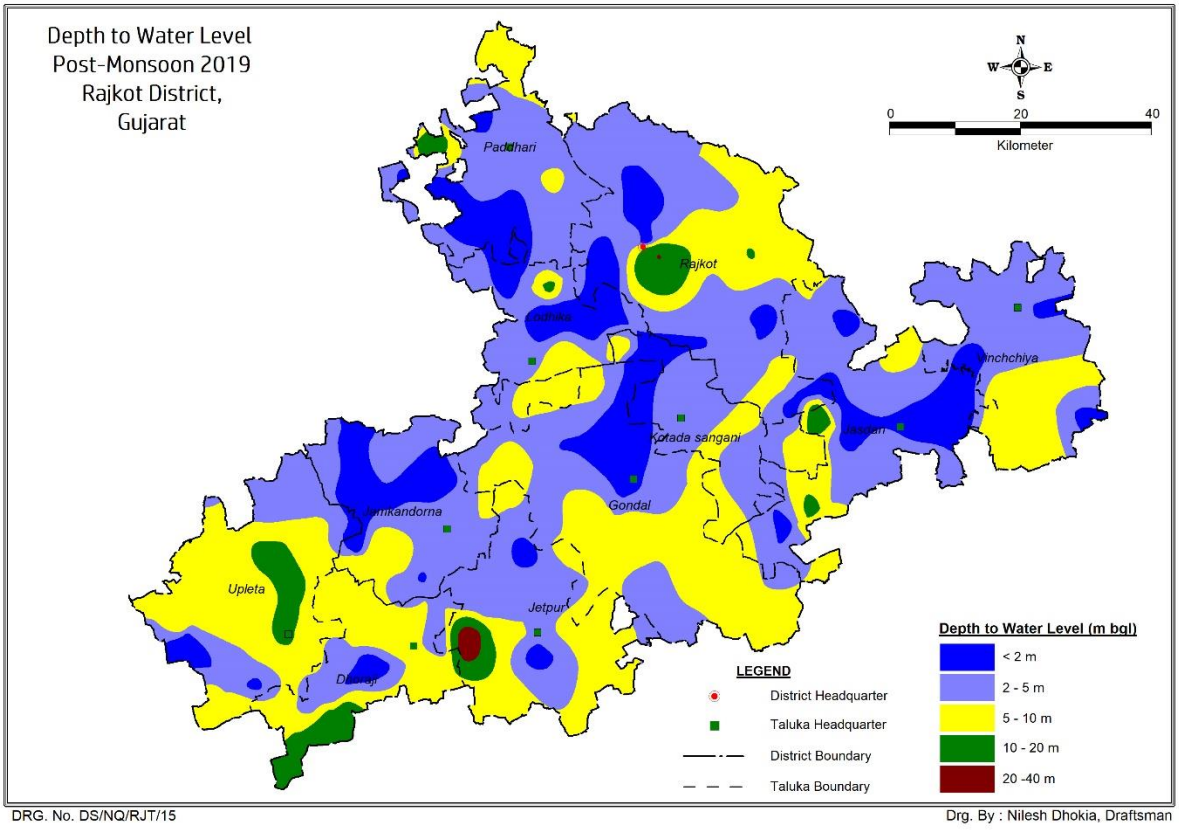



Figure 13: DTW November 2019 map of Rajkot district

**Pre vs Post Monsoon Fluctuation Map.**

Map showing Pre vs Post Monsoon Fluctuation water level map of May 2019 with November 2019 (Fig.14**)** shows rise in water level in the district from 4 mbgl to more than 6m bgl.

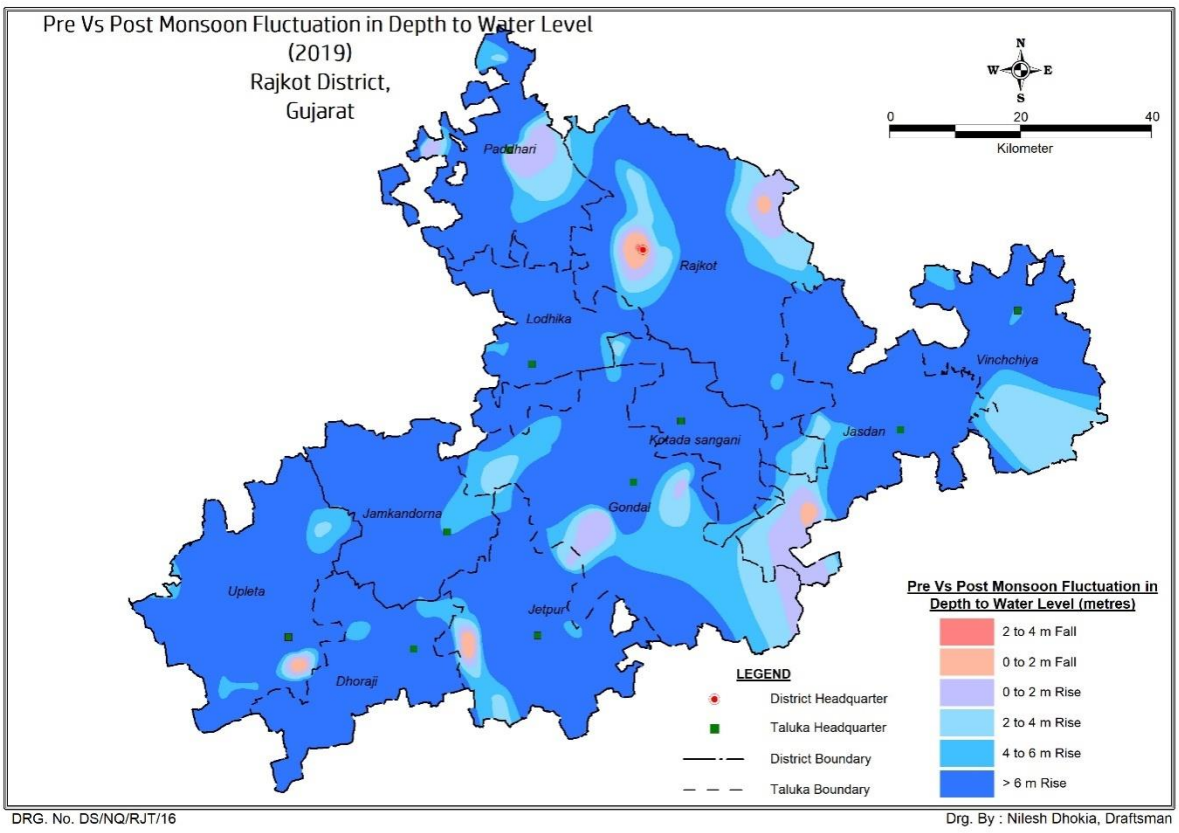



Figure 14: Pre Vs Post Monsoon Fluctuation map of Rajkot district

**Depth to Water Level (Decadal Mean Pre-Monsoon (2010-2019)**

MapshowingDepth to Water Level (Decadal Mean Pre Monsoon (2010-2019) (Fig 15) observed that major part of district were showing depth to water level ranges between 10 to 20m bgl.

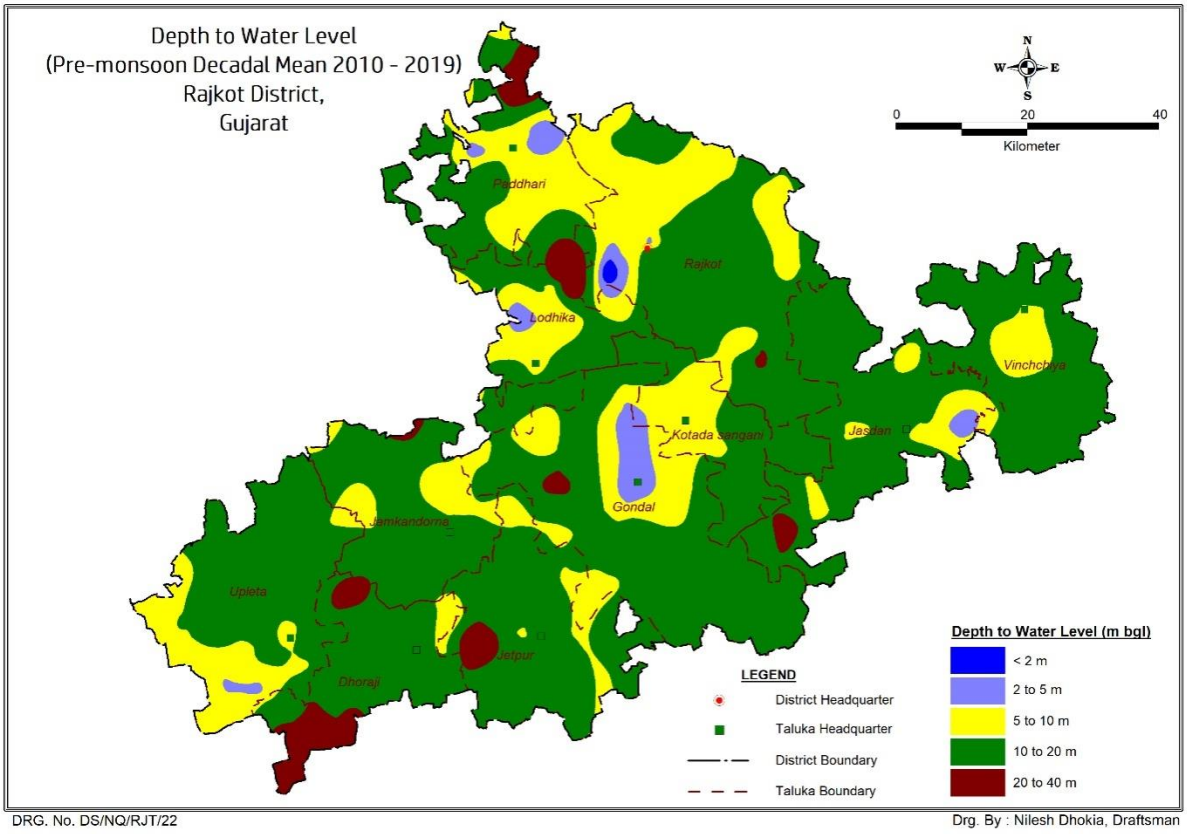



Figure 15: Pre Monsoon Decadal Mean 2010-19 map of Rajkot district

**Depth to Water Level (Decadal Mean Post-Monsoon (2010-2019)**

MapshowingDepth to Water Level (Decadal Mean Post Monsoon (2010-2019) (Fig 4) observed that major part of district were showing depth to water level ranges between 2 to 5 m & 10 to 20m bgl.

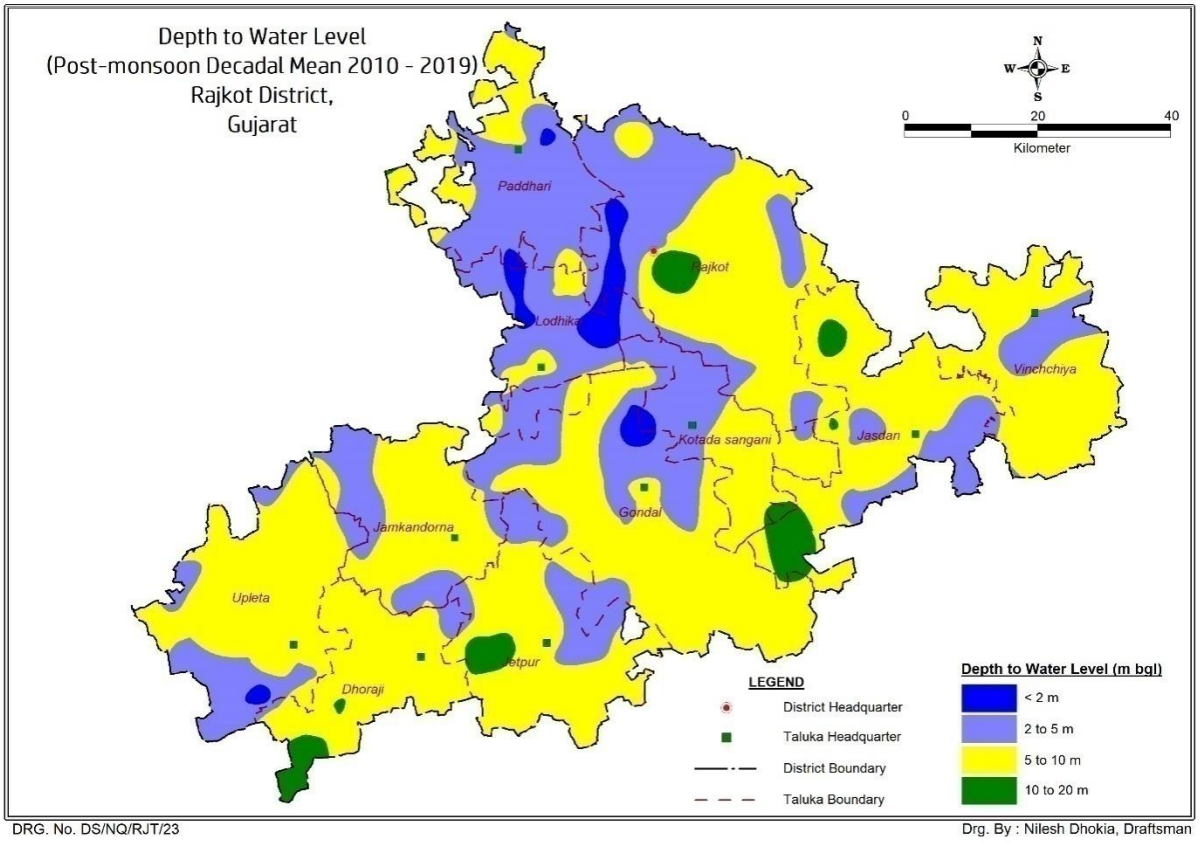



Figure 16: Post Monsoon Decadal Mean 2010-19 map of Rajkot district

**Water Level Trend (2011 – 2022)**

From the analysis of the water level trend of the Rajkot district from 2011 to 2022, it is observed that, during year, the water level has a rise of 0.13 m/yr (Gogavadar) to 0.74 m/yr (Movaiya) and also has a fall of 0.0213 m/yr (Morbi) to 0.326 m/yr (Macchukunda). Details of rise and fall during the year 2011 and 2022 is given in the Table no 7 and selected hydrographs are shown in Fig No 17 (A to G).

Table No Ground water trends in m/year for the period of 2011 to 2022 in the district of Rajkot

| Sr no | Location | Pre-Monsoon | | | Post-Monsoon | | | Annual | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Data Points | Rise | Fall | Data Points | Rise | Fall | Data Points | Rise | Fall |
| 1 | Patanvav | 10 | - | 0.3839 | 11 | 0.5356 | - | 42 | 0.2184 | - |
| 2 | Bhada jodiya | 9 | 0.0905 | - | 11 | 0.4393 | - | 38 | 0.3355 | - |
| 3 | Ganod | 11 | - | 0.2289 | 11 | 0.0124 | - | 40 | - | 0.0345 |
| 4 | Motagundala | 10 | 0.0683 | - | 11 | 0.2518 | - | 43 | 0.3978 | - |
| 5 | Dhoraji | 11 | 0.0165 | - | 10 | 0.638 | - | 41 | 0.3395 | - |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Upleta1 | 8 | 0.0143 | - | 8 | - | 0.7153 | 32 | - | 0.2029 |
| 7 | Pedhla | 8 | - | 0.5014 | 8 | 0.6732 | - | 33 | 0.1537 | - |
| 8 | Jetpur | 9 | - | 0.1564 | 10 | 0.0765 | - | 34 | - | 0.0578 |
| 9 | Jetpur pithad. | 9 | 0.0137 | - | 6 | - | - | 29 | 0.3315 | - |
| 10 | Virpur1 | 12 | - | 0.3094 | 11 | - | 0.2805 | 44 | - | 0.1934 |
| 11 | Jasapur | 12 | 0.0519 | - | 9 | 0.2023 | - | 38 | 0.1231 | - |
| 12 | Jamkandorna | 11 | 0.1827 | - | 11 | 0.2039 | - | 40 | 0.1185 | - |
| 13 | Chordi | 11 | - | 0.0677 | 10 | 0.3626 | - | 41 | 0.1076 | - |
| 14 | Umrali | 10 | - | 0.1618 | 9 | - | 0.0206 | 36 | - | 0.0816 |
| 15 | Jamwali | 9 | 0.0177 | - | 8 | - | 0.244 | 31 | - | 0.0759 |
| 16 | Gogavadar | 12 | - | 0.2528 | 10 | 0.1592 | - | 41 | 0.013 | - |
| 17 | Mota Dadwa | 10 | 0.1851 | - | 11 | 0.4231 | - | 41 | 0.3305 | - |
| 18 | Viranagar | 11 | - | 0.0303 | 9 | 0.8267 | - | 36 | 0.1114 | - |
| 19 | Jasdan | 12 | 0.0602 | - | 11 | 0.2172 | - | 43 | 0.1868 | - |
| 20 | Jasdan2 | 12 | 0.4531 | - | 10 | 0.4299 | - | 41 | 0.4817 | - |
| 21 | Dadia | 12 | - | 0.0038 | 10 | 0.3783 | - | 42 | 0.2145 | - |
| 22 | Halenda | 12 | 0.4275 | - | 11 | 0.2158 | - | 45 | 0.3104 | - |
| 23 | Ribda | 12 | 0.0926 | - | 11 | 0.5404 | - | 45 | 0.4013 | - |
| 24 | Lodhika | 12 | 0.0854 | - | 11 | 0.2891 | - | 42 | 0.2613 | - |
| 25 | Lalavadar | 12 | 0.9944 | - | 11 | 0.3877 | - | 45 | 0.5207 | - |
| 26 | Lodhika1 | 10 | 0.1612 | - | 9 | 0.1486 | - | 38 | 0.2011 | - |
| 27 | Kamlapur | 7 | - | - | 6 | - | - | 31 | 0.6051 | - |
| 28 | Bhadla | 10 | 0.2942 | - | 11 | 0.8219 | - | 42 | 0.4943 | - |
| 29 | Vinchhia | 12 | 0.1912 | - | 10 | 0.1279 | - | 41 | 0.143 | - |
| 30 | Rajkot1 | 9 | 0.4663 | - | 9 | - | 0.44 | 34 | 0.0216 | - |
| 31 | Ranpur1 | 9 | 0.1164 | - | 10 | 0.7696 | - | 40 | 0.6054 | - |
| 32 | Targhari | 10 | 0.4417 | - | 9 | 0.9246 | - | 38 | 0.4638 | - |
| 33 | Bhalgam | 11 | 0.3913 | - | 11 | 0.2113 | - | 42 | 0.3181 | - |
| 34 | Padadhari1 | 7 | - | - | 9 | 0.2114 | - | 35 | 0.2234 | - |
| 35 | Movaiya | 12 | 0.1969 | - | 9 | 0.5136 | - | 40 | 0.7397 | - |
| 36 | Khamta | 10 | 0.3953 | - | 10 | 0.6508 | - | 38 | 0.5722 | - |
| 37 | Neknam | 8 | 0.36 | - | 7 | - | - | 30 | 0.0798 | - |
| 38 | Chhatar | 12 | 0.0035 | - | 10 | 0.1566 | - | 40 | 0.0289 | - |
| 39 | Sindhavadar | 9 | - | 0.0496 | 11 | 0.5757 | - | 41 | 0.2922 | - |
| 40 | Kalyanpur2 | 9 | - | 0.2959 | 9 | 0.2082 | - | 37 | 0.1253 | - |
| 41 | Hadmatia | 11 | - | 0.1884 | 11 | - | 0.0905 | 39 | - | 0.1877 |
| 42 | Lajai | 9 | 0.1518 | - | 9 | 0.2191 | - | 35 | 0.1299 | - |
| 43 | Morvi | 12 | 0.005 | - | 10 | - | 0.3843 | 43 | - | 0.118 |
| 44 | Morbi | 12 | - | 0.1209 | 10 | 0.0084 | - | 41 | - | 0.0213 |
| 45 | Nichi mandal | 10 | - | 0.0637 | 11 | 0.0144 | - | 43 | 0.0501 | - |
| 46 | Modpar1 | 12 | 0.117 | - | 10 | 0.1879 | - | 41 | 0.1613 | - |
| 47 | Amar nagar | 10 | 0.0872 | - | 11 | 0.193 | - | 41 | 0.1697 | - |
| 48 | Mota dhansura | 12 | 0.0397 | - | 11 | 0.2812 | - | 44 | 0.0908 | - |
| 49 | Macchukunda | 8 | - | 0.5612 | 9 | - | 0.2859 | 33 | - | 0.3258 |
| 50 | Sarvad | 10 | 0.0287 | - | 9 | 0.0808 | - | 40 | 0.0413 | - |
| 51 | Malia | 9 | - | 0.4083 | 11 | 0.115 | - | 39 | - | 0.1997 |
| | Minimum | | 0.0035 | 0.0038 | | 0.0084 | 0.0206 | | 0.0130 | 0.0213 |
| | Maximum | | 0.9944 | 0.561 | | 0.925 | 0.715 | | 0.74 | 0.326 |

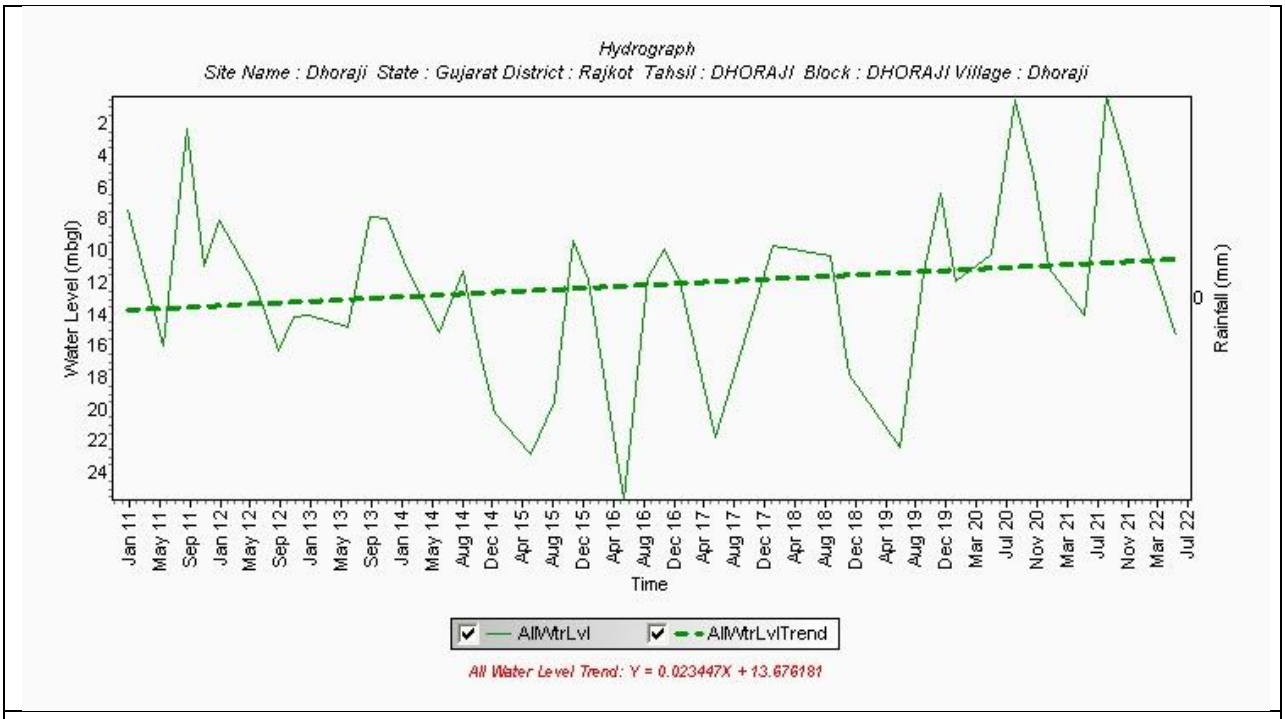



Fig. 17 (A) Rising trend 0.02344 m/month at Dhoraji

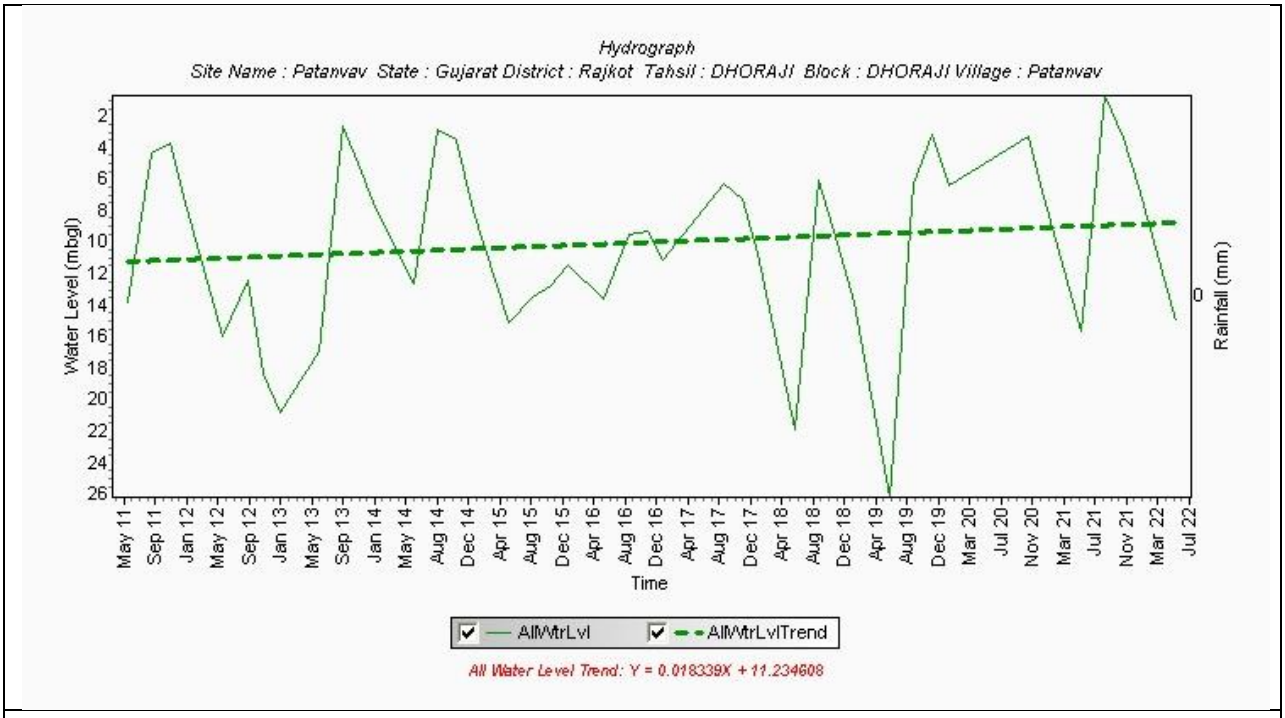



Fig. 17 (B) Rising trend 0.01833 m/month at Dhoraji

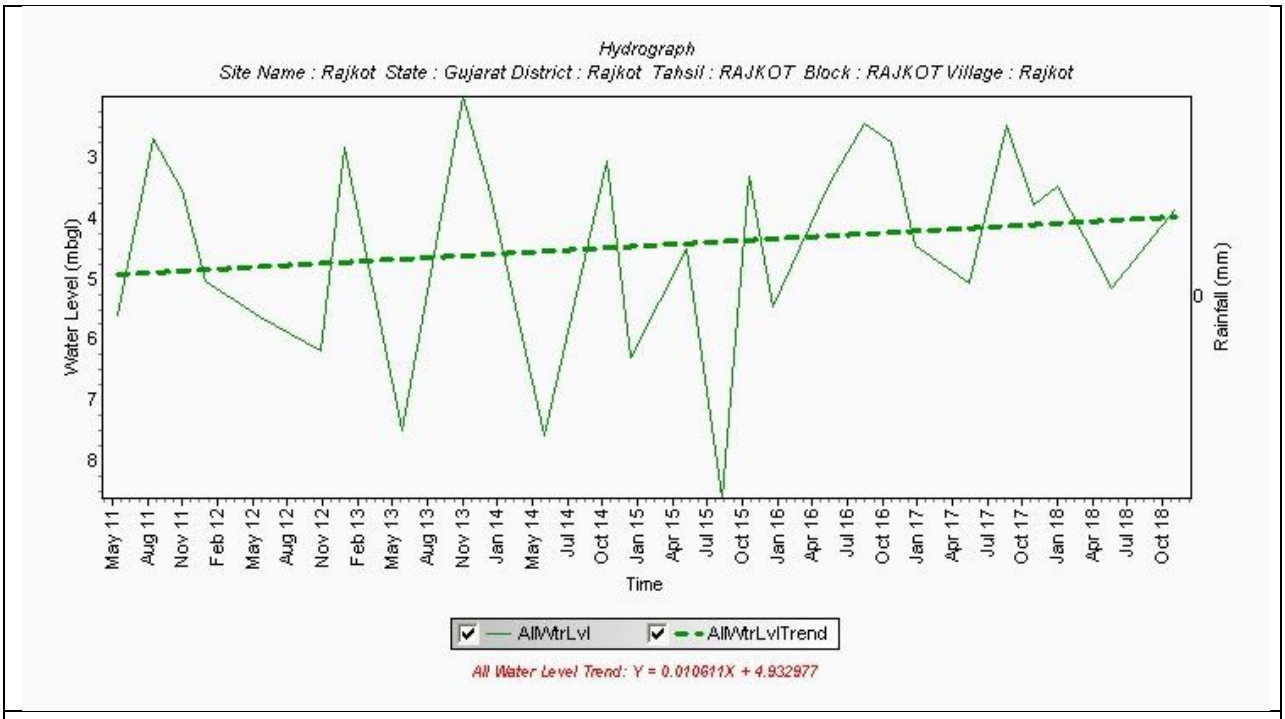



Fig. 17 (C) Rising trend 0.010611 m/month at Rajkot

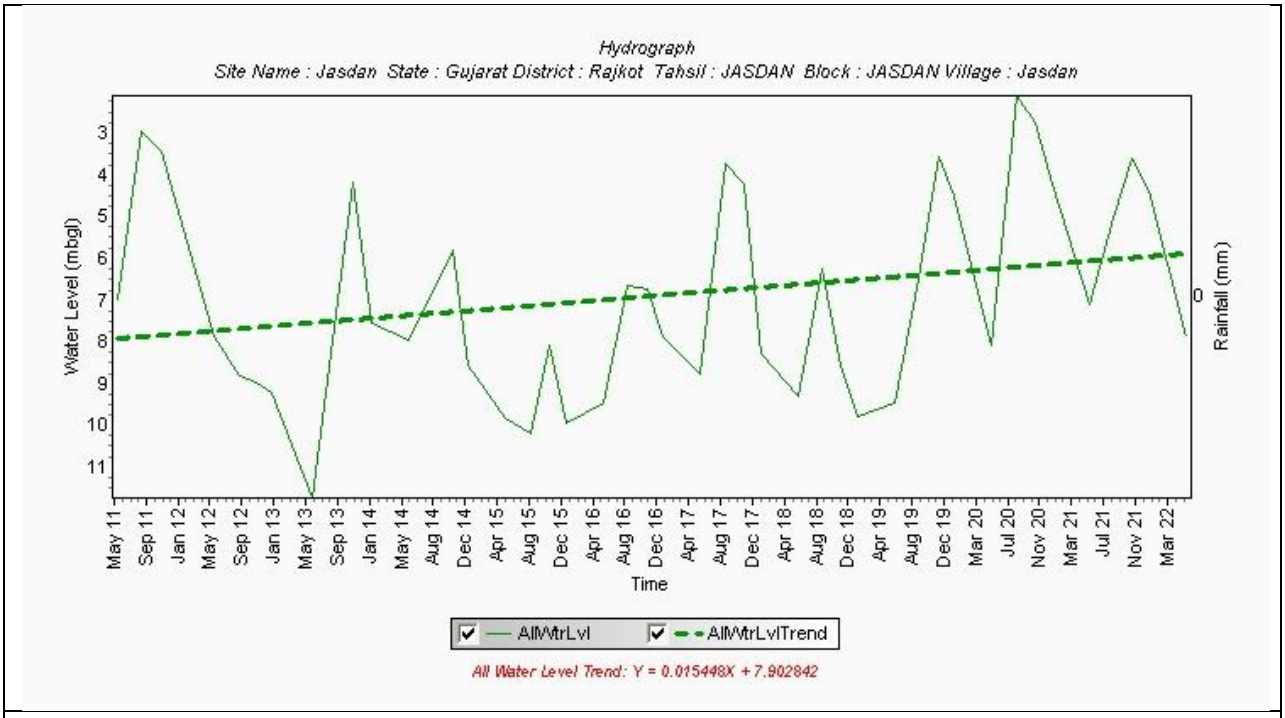



Fig. 17 (D) Rising trend 0.015448 m/month at Jasdan

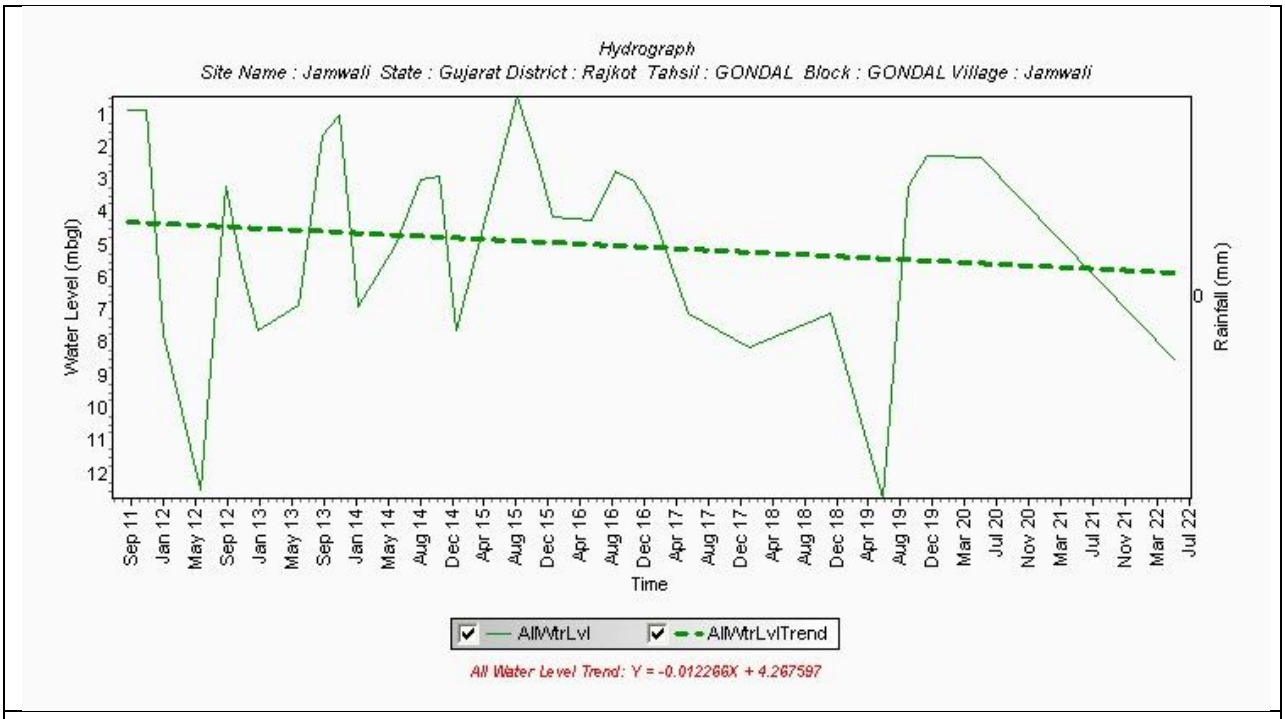



Fig. 17 (E) Falling trend 0.012266 m/month at Jamwali.

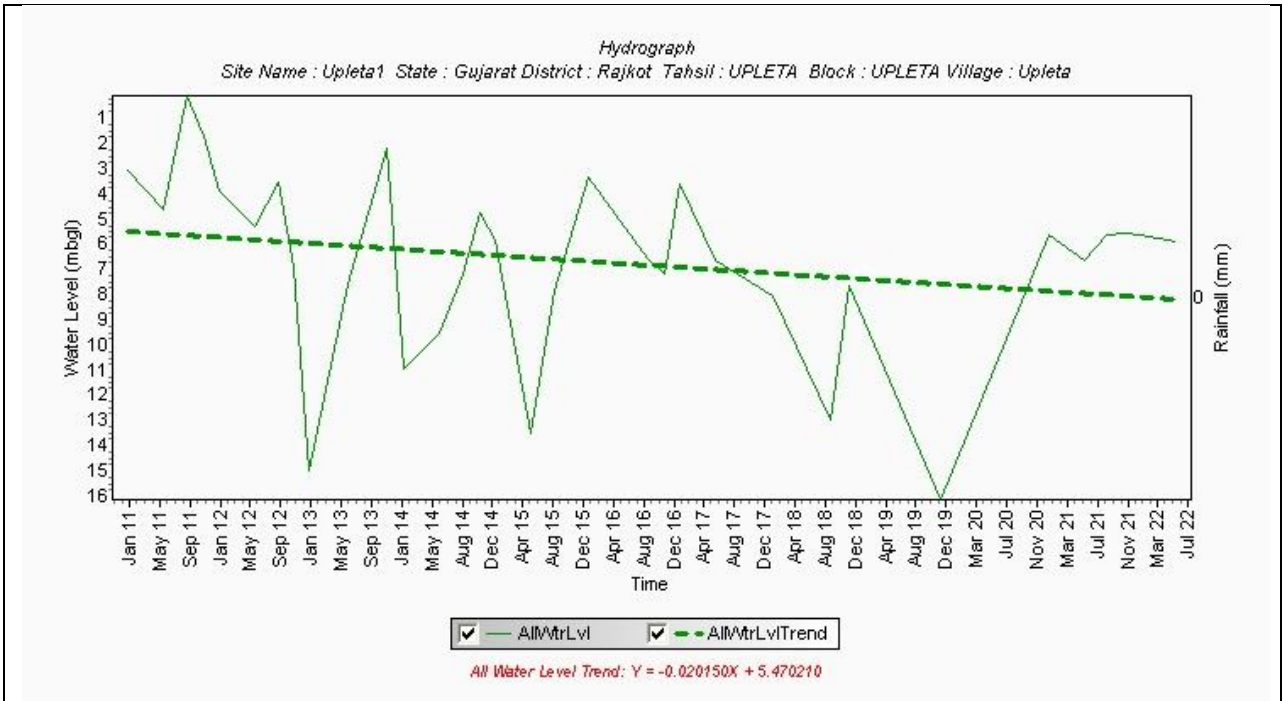



Fig. 17 (F) Falling trend 0.02015 m/month at Upleta

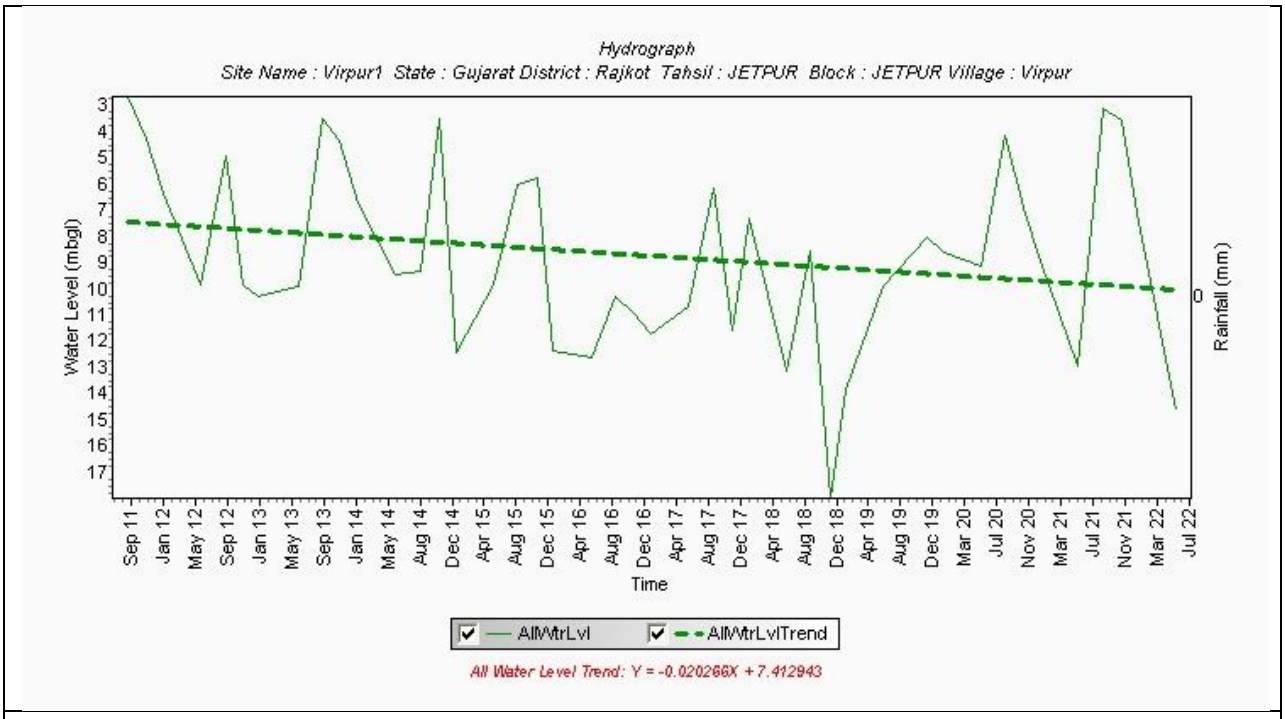



Fig. 17 (G) Falling trend 0.020266 m/month at Virpur

## 3. DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

In order to establish the three-dimensional disposition of aquifer system in the area, the existing data of litho logical logs of Exploratory wells studies carried out by CGWB and state Ground water Departments (GWRDC & GWSSB) were used to prepare a hydro geological cross section, Fence diagram and 3D Model. The data has been analyzed using Rockworks 16 software and is presented below in the Hydrogeological cross sections A-A' to E-E' and Solid Model of the district showing the depiction of Aquifer Groups up to 200m. Map showing section lines are presented in Fig. 18. The stratigraphic sections depicting Hard area weathered Aquifer depth of occurrence is from 0 to 15m and fractured aquifer depth of occurrence is from 10 to 180m.unconfined aquifer are placed at Figs 19 (A to E). Fence Diagram and 3D Solid Model of Rajkot district is depicted in Fig. 19 and 20, respectively.

A total of 46 exploratory wells and piezometers constructed by CGWB. And 46 litho logs are utilized to decipher the subsurface geometry of the aquifer by using Rockworks 16 software prepared hydro geological cross sections, Fence diagram and 3D Model up to the depth of 200 mbgl.

**Table No: - 08 Data integration**

| S.No. | Data | Aquifer | Total Data Points | Source | |
|---|---|---|---|---|---|
| | | | | CGWB | GWRDC |
| **1** | Panel Diagram (3-D) | 1 no | 46 | Expl:46 | - |
| **2** | Hydrogeological Cross Sections | 05 no | 46 | Expl:46 | - |
| **3** | Fence/panel Diagrams | 1 no | 46 | Expl:46 | - |
| **4** | Depth of weathering | 1 no | 46 | Expl:46 | - |
| **5** | Depth of fracturing | 1 no | 46 | Expl:46 | - |
| **7** | Depth to Water Level Maps (2019) | Combine | 197 | 37 | 156 |
| **8** | Long term water | Combine | 197 | 37 | 156 |
| **9** | Water quality pre-2019 & post-2019 | Combine | 108 | 26 | 82 |

**Conceptualization of Aquifer system in 2D**

Ten hydrogeological cross sections are drawn from North-East to South-West and North-West to South-East directions across the area represented in Figs 19 (A to E)

Litho logical logs of subsurface are correlated based on the position and depth of the geological formations and prepared ten cross sections one fence diagram and one 3D solid model of Rajkot district.

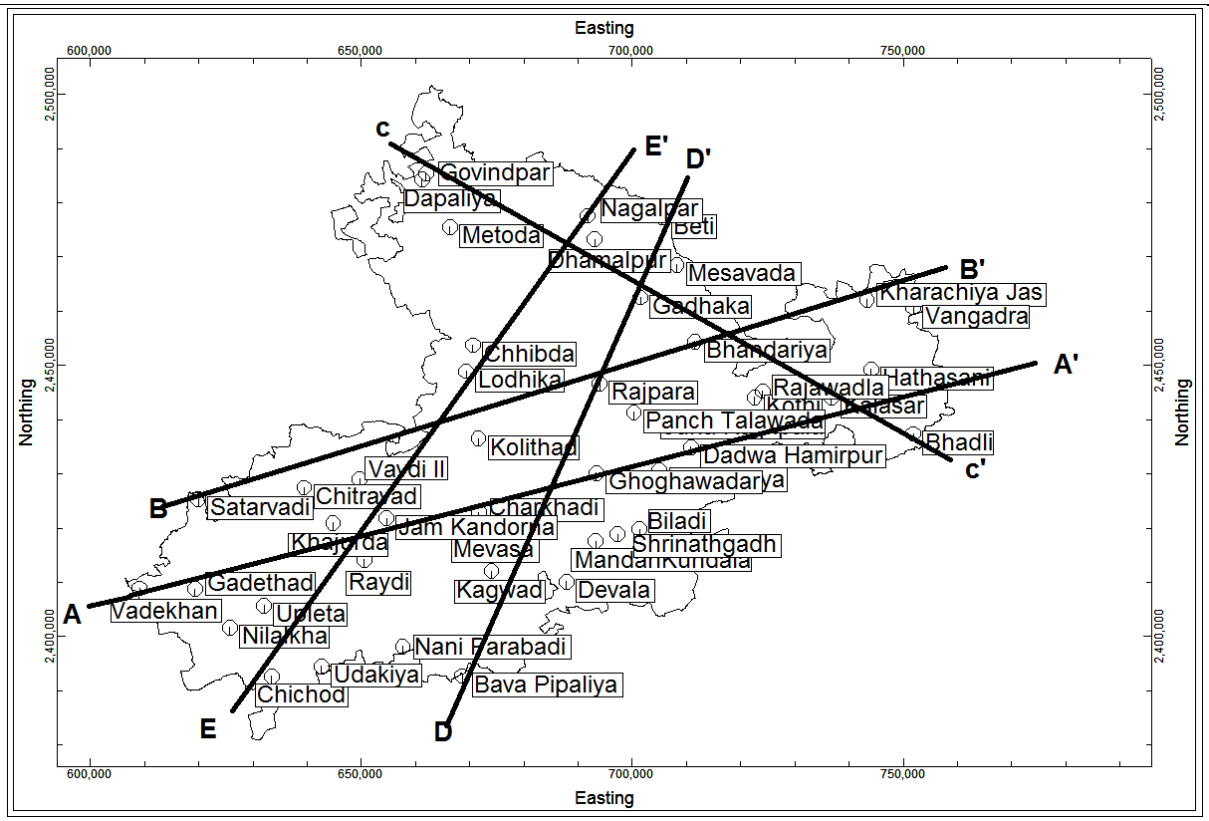
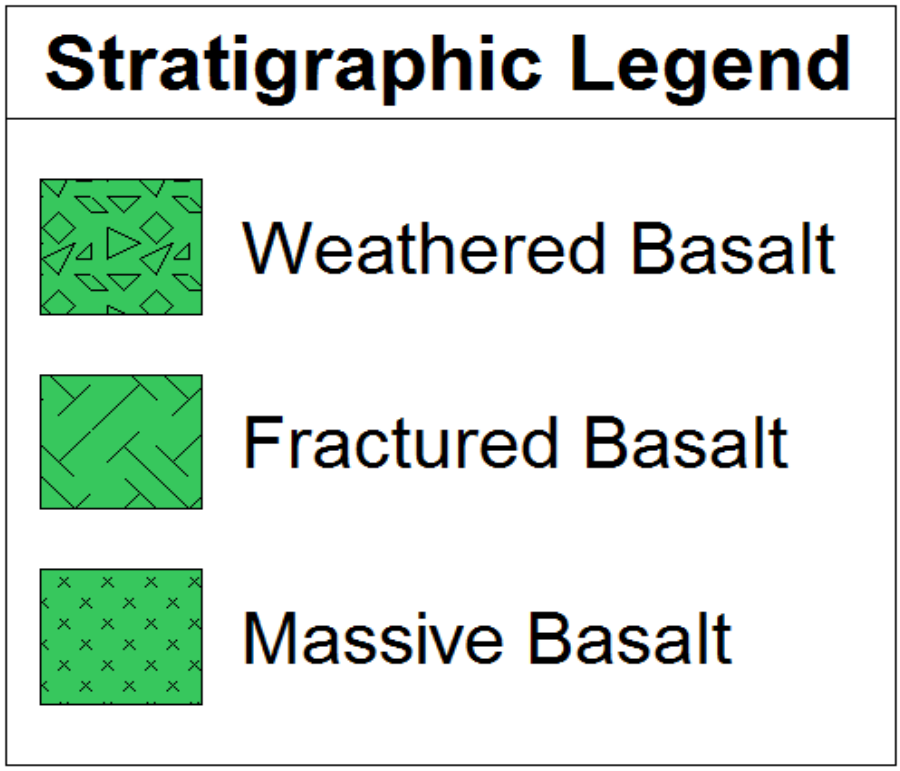
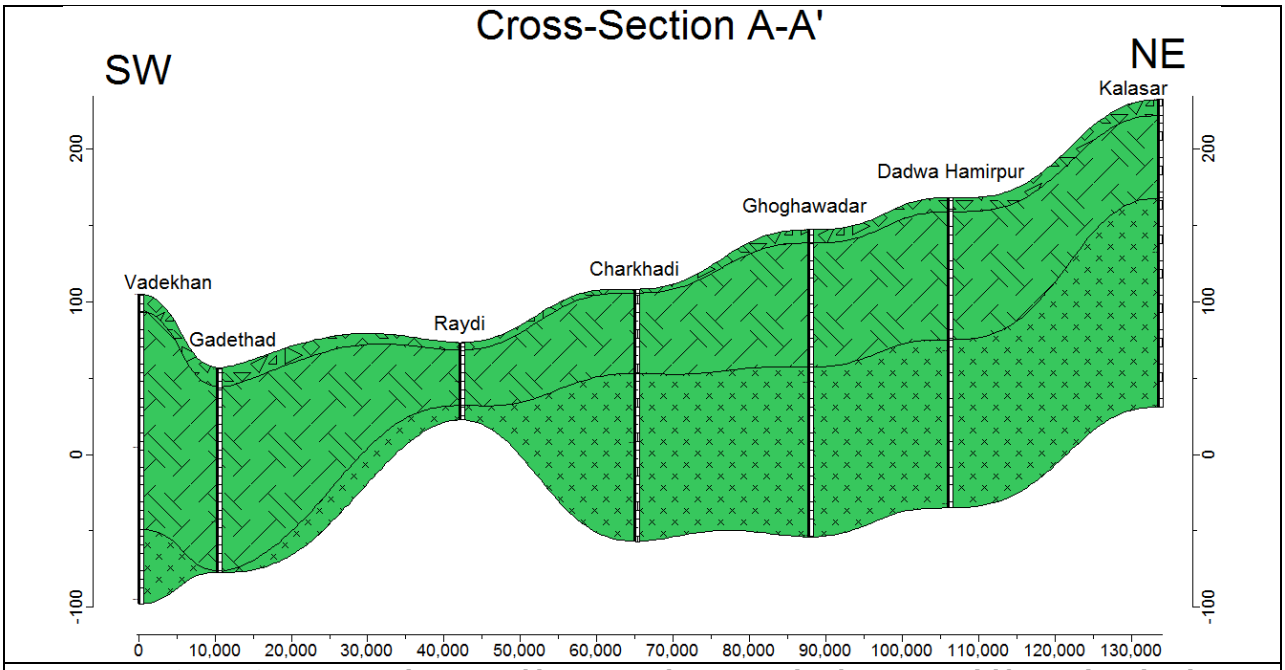
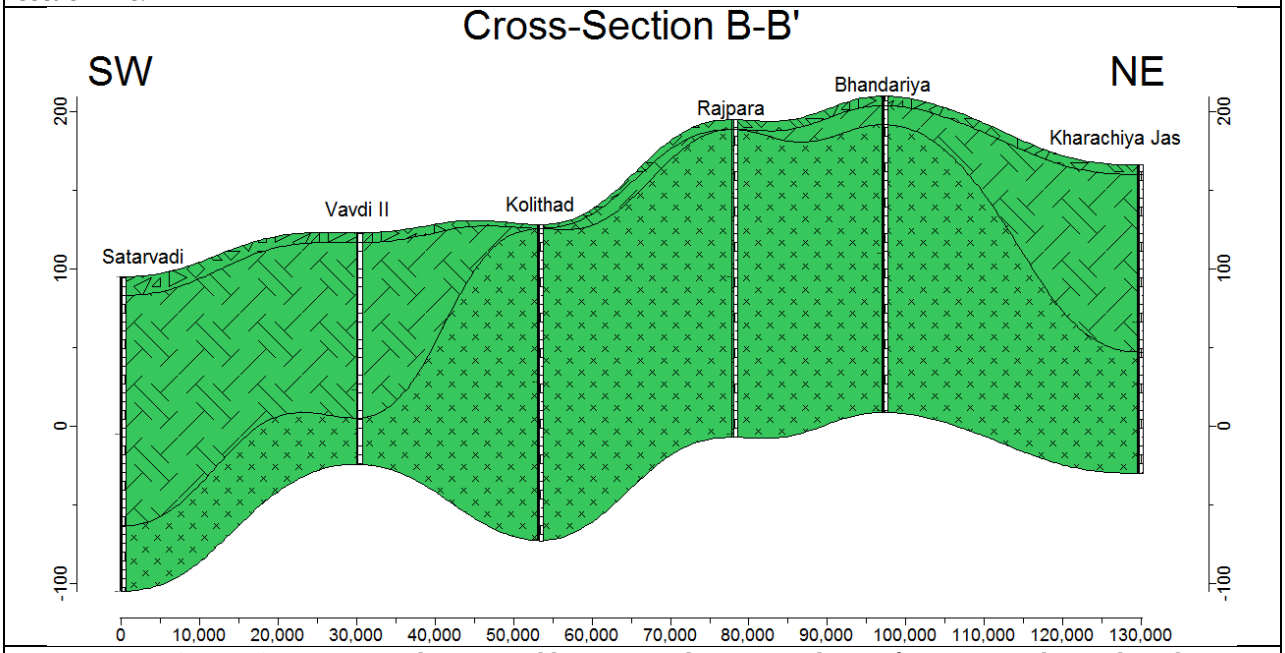



Fig No :18 Map Showing Section Lines of Rajkot District

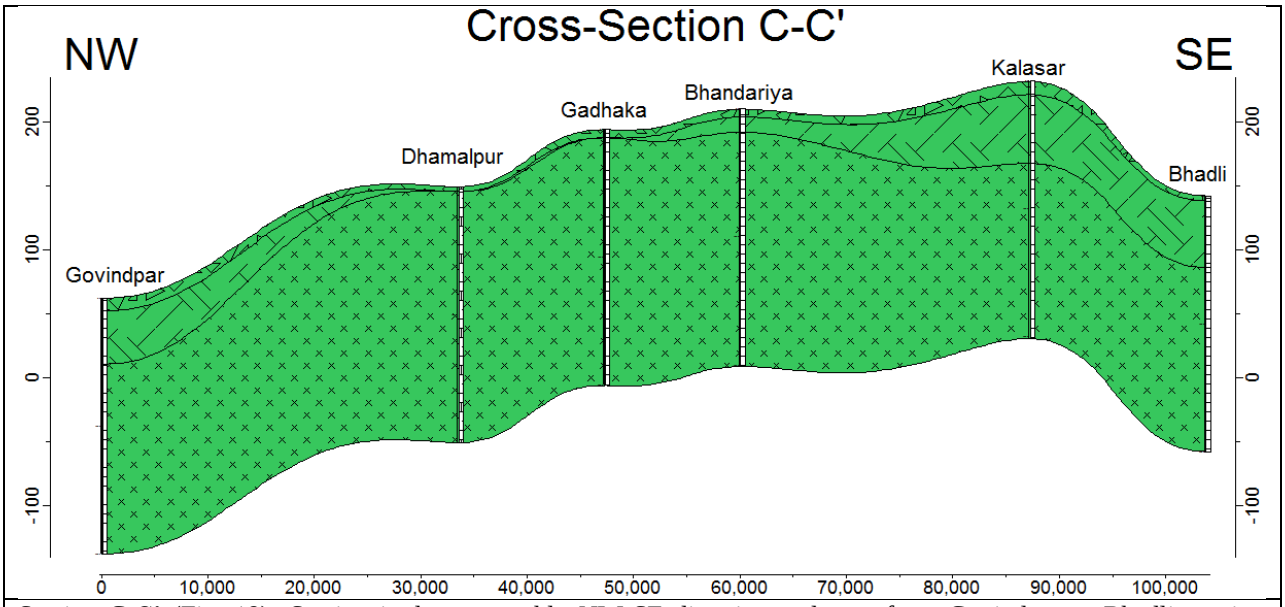




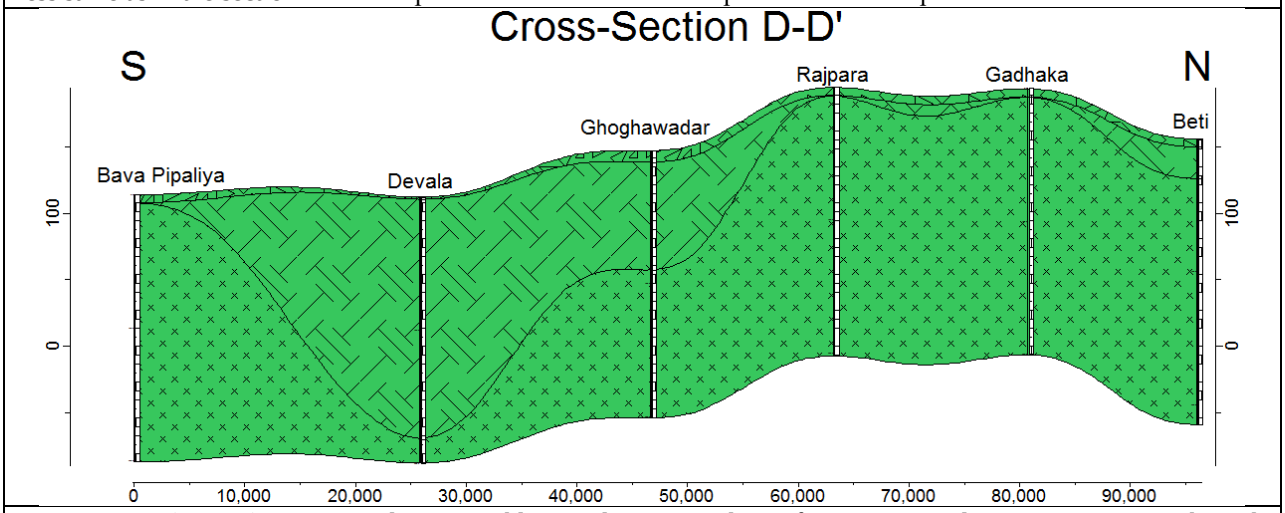

Section A-A' (Fig. 19)- Section is drawn roughly NE-SW direction and in between Vadekhan and and Kalasar, pa through Gadethad, Raydi,Charkhadi,Ghogawadar and Dadwa Hamirpur. Section is represented geologically, from se it is deciphered that basalt (weathered & Fractured Basalt) forms the major aquifer system in the district along d section line.



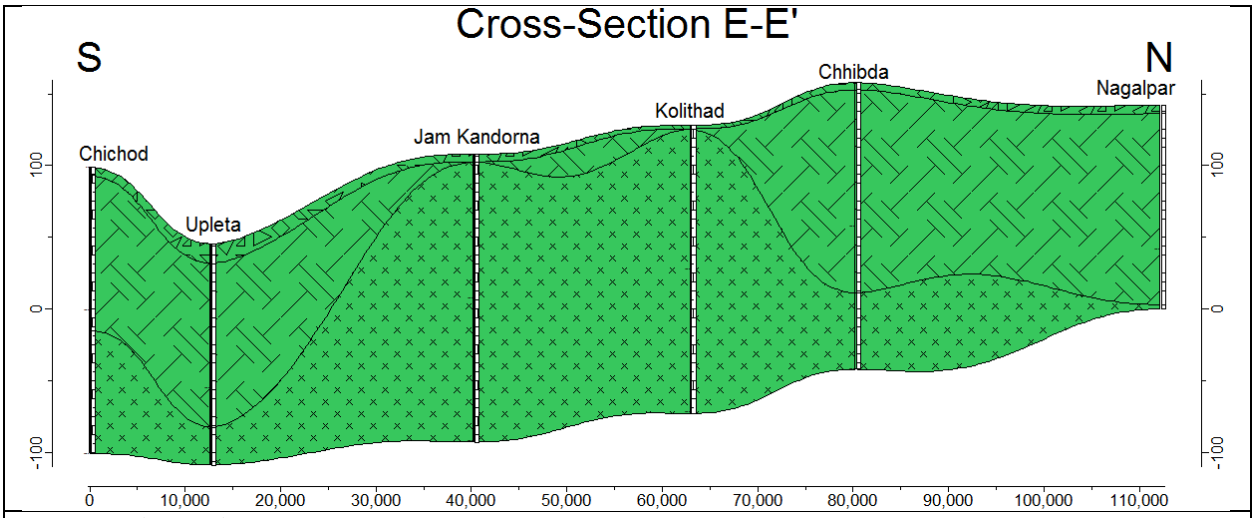

Section B-B' (Fig. 19)- Section is drawn roughly NE-SW direction and start from Satarvadi to Kharachiya Jas passing through Vavdi, Kolithad, Rajpara and Bhandariya. Geological formation (aquifer system) encountered more or less same as in the section A-A' except variation of thickness and position of out crops.




Section C-C' (Fig. 19)- Section is drawn roughly NW-SE direction and start from Govindpar to Bhadli passing through Dhamalpur,Gadhaka,Bhandariya and Kalasar). Geological formation (aquifer system) encountered more or less same as in the section A-A' except variation of thickness and position of out crops.




Section D-D' (Fig. 19)- section is drawn roughly N-S direction and start from Bava Pipaliya to Berti passing through Devala,Ghoghavadar, Rajpara and Gadhaka. Geological formation (aquifer system) encountered more or less same as in the section A-A' except variation of thickness and position of out crops.




Section E-E' (Fig. 19)-section is drawn roughly N-S direction and start from Chichod to Nagalpar passing through Upleta,Jam kandorna, Kolithad and Chibda. Geological formation (aquifer system) encountered more or less same as in the section A-A' except variation of thickness and position of out crops.

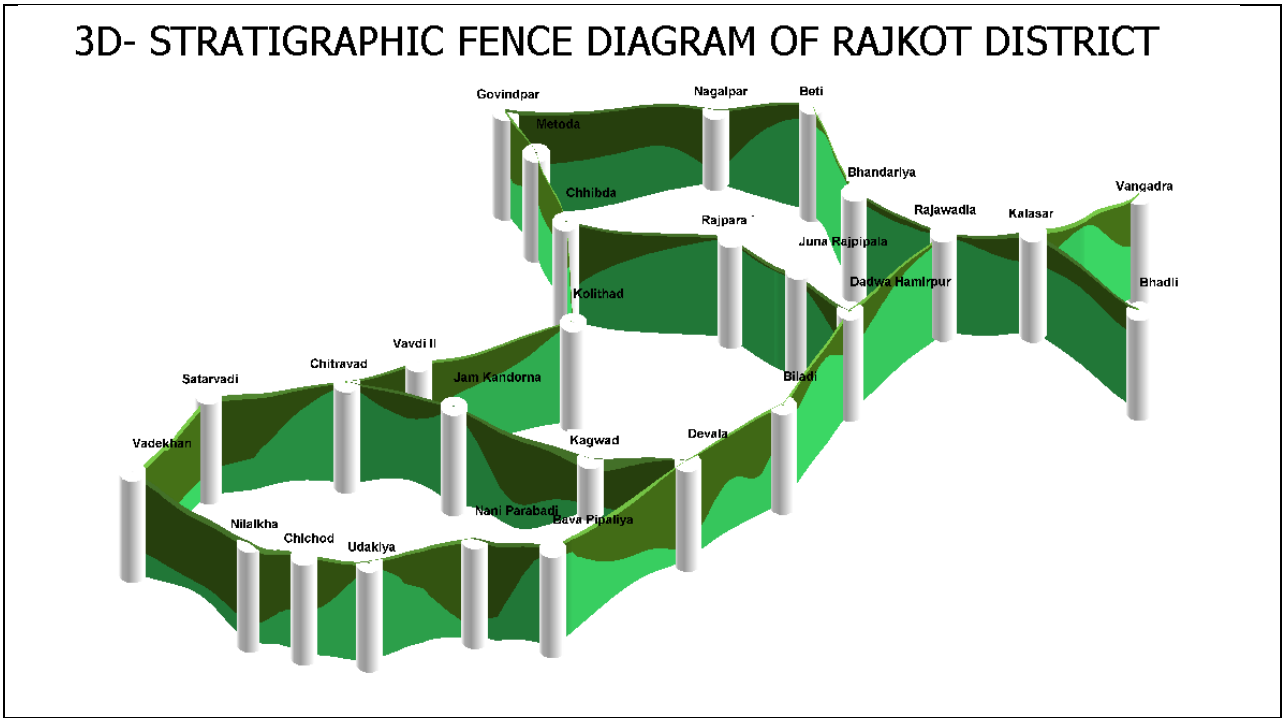



**Fig No:20 RAJKOT DISTRICT FENCE DIAGRAM**

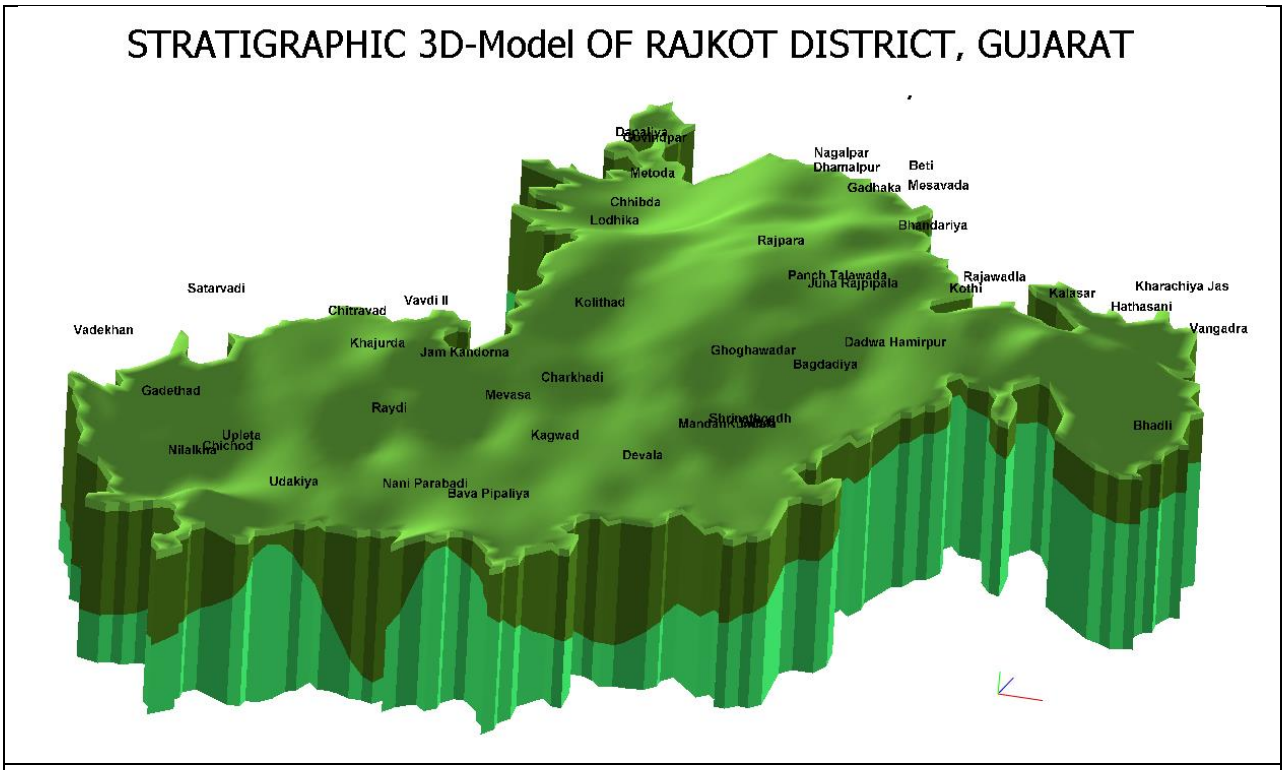



**Fig No:21 RAJKOT DISTRICT 3D AQUIFER DISPOSITION**

Finally, the study of these sections revels that the identification and delineating the Aquifers vertically and laterally.The study of these 2D sections, Fence and 3D solid model reveals that there is a basaltic formation with weathered rocks followed by fracture basalts and lower most formation is Massive basalts in all the talukas.The weathered basalts varies in thickness from 4.2 to 15m. And the fractured/ jointed basalts encontered in between 10m to 180m.

**Aquifer Characterization and Disposition.**

On the basis of Hydogeological cross sections the following salient features of aquifer system in the area is summarised below Table No :-09

| Aquifer Characteristics and Disposition | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stratigraphy | Aquifer | Lithological character | Depth of occurrence Aquifer (mbgl) | Thickness Range (m) | Water Level Range (m) | TDS Mg/l | Discharge lps | Transmissivity m2/day | Nature of Aquifer | Quality |
| Cretaceous | Weathered Basalt | Basalts | 0 to 15 | 0 to 15 | 5 to 8 | 500 to 600 | 1 to 3 | 0.5 to 20 | Phreatic | Good |
| | Fractured Basalt | Basalts | 10 to 180 | 10 to 180 | 8 to 90 | 500 to 6000 | 1 to 10 | 0.5 to 100 | Fractured | Good |

## 4. HYDROCHEMISTRY

The ground water in major part of the district is suitable for domestic, irrigation and industrial purposes for both in phreatic and confined aquifers within 200 m depth. Deccan trap occupies a major part of the district and forms the most important aquifer system.

The chemical quality of groundwater in shallow aquifer of the district has been analyzed based on the water samples collected during National Hydrographs Monitoring Stations (NHS) and NAQUIMstudies in May 2019 and the range of major constituents and parameters are given below in table 10. The ground water is in general alkaline in nature. Distribution of Electrical Conductivity and Nitrate & Fluoride concentrations has been shown in figure (22) and (23) respectively.

Table No: 10

| **Summarised Chemical Data of Rajkot District**. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Chemical Parameters** | **pH** | **EC** | **TH** | **TDS** | **Cl** | **NO3** | **F** |
| **Min** | 7.25 | 507 | 150 | 339.69 | 35.5 | 0.1 | 0 |
| **Max** | 8.7 | 6690 | 1520 | 4030 | 2112 | 235.7 | 4.8 |
| **Average** | 8.22 | 1896.79 | 316.92 | 1224.75 | 402.53 | 14.25 | 0.78 |
| * **All values are in mg/l except pH and EC in µS/cm at 25°C** | | | | | | | |

Rajkot district is one of the most industrialized district in Gujarat State. It has established itself as a major manufacturing center for diesel engines, automobile components, gems and jewelries, a cluster of foundry units, a cluster of sari printing (Jetpur), and a cluster of ceramics (Morbi). Major manufacturing centers are Rajkot (Oil Engine Manufacture, Gold and Silver Ornaments), Jetpur (Sari Printing), Gondal (Oil Extraction) and Jasdan (Cotton ginning and Pressing and Handicrafts.

No major chemical quality problem reported so far, but looking at the quality problems in other parts of the Gujarat due industrial set up, enforcing regulatory measures mandatory before releasing of industrial effluents only after due treatment in ETPs and solid waste disposal at designated sites.

**Hydrogen Ion Concentration (pH)**

The pH is an indicator of acidity of the water. The shallow ground water in the district is generally alkaline with pH more than 7. The value of pH ranges between 7.25 & 8.7 in the district.

**Iso Conductivity Map:**

As per the BIS standards [IS 10500: 2012] for drinking water, acceptable limit and permissible limit of Total Dissolve Solid (TDS) are 500 mg/l and 2000 mg/l respectively.

Iso conductivity Map of the district shown below in (Fig.22), Due to Basaltic Nature of the district has EC value within Permissible limit i.e. almost all talukas except extreme western region of Upleta taluka show EC value more than permissible limit.

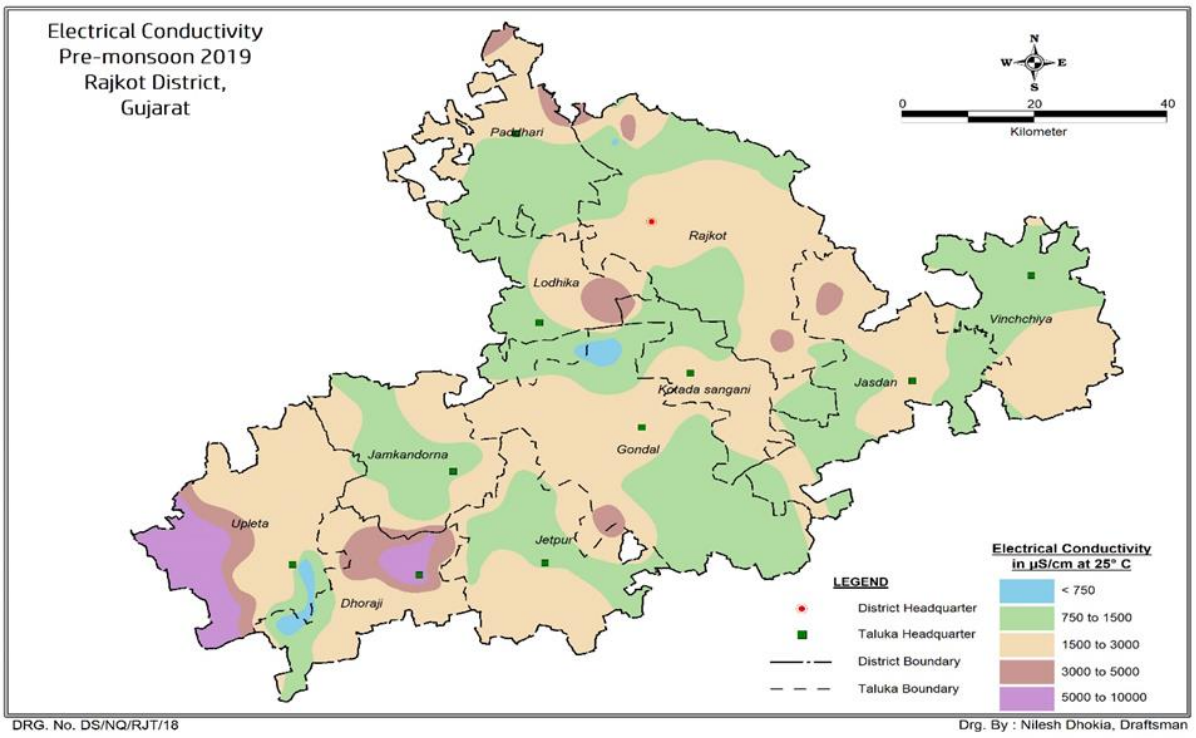



Fig No:22 Electrical Conductivity Map of Rajkot District.

**Total Dissolved Solid (TDS )**

Total Dissolved Solid is an overall parameter indicating salinity of ground water. The Total Dissolved Solid of ground water varies from 340 mg/l to about 4030 mg/l.

**Nitrate (NO3)**

Nitrate concentration in the ground water in district varies between 0.1 mg/l and 235.7 mg/l. There are Nine stations where these values are more than the limits as per BIS drinking water standards (45 mg/l).

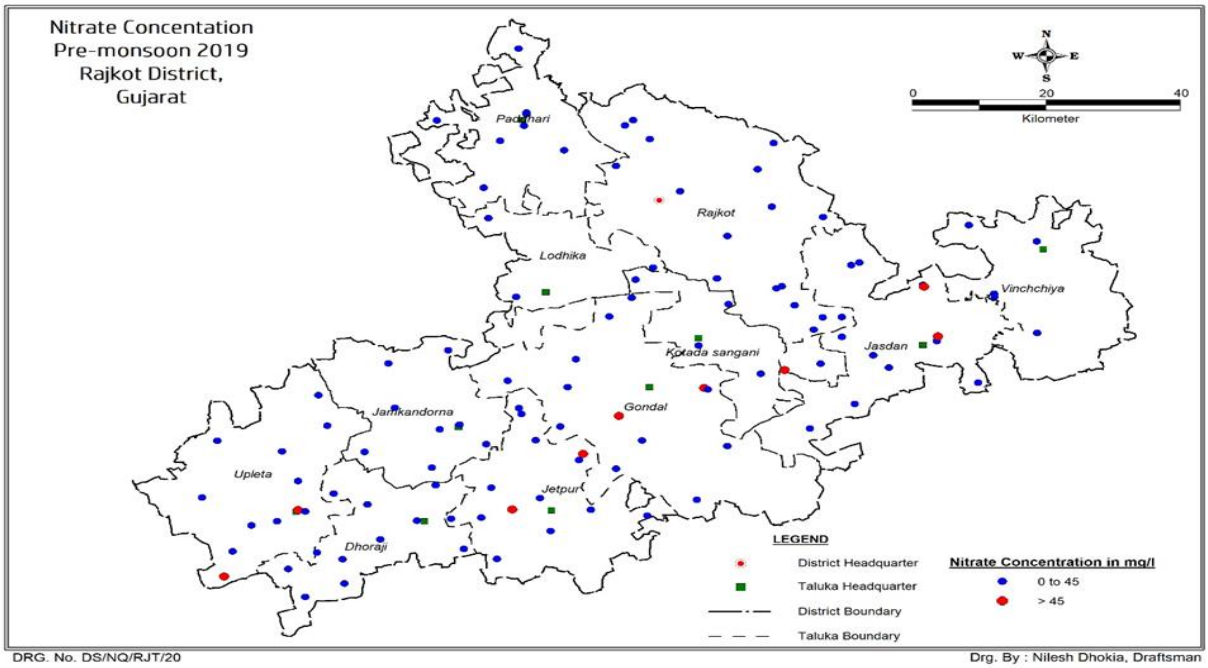



Fig No:23 Nitrate Concentration Map of Rajkot District.

**Fluoride (F)**

Fluoride concentration in ground water varies between almost 0.1 mg/l and 4.8 mg/l. Concentration of fluoride more than the permissible limit i.e. 1.5mg/l is observed at only in 3 stations.

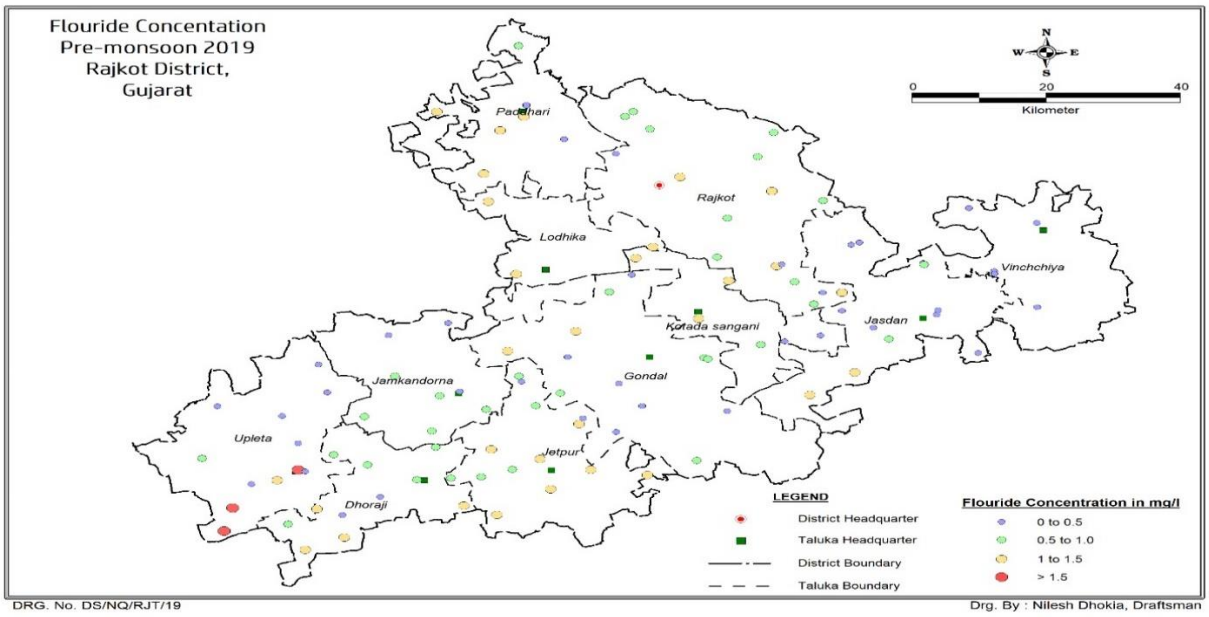



Fig No:24 Flouride Concentration Map of Rajkot District.

## 5. GROUND WATER RESOURCES

The ground water resources of the district were calculated as on March 2017 in collaboration with the Government of Gujarat using the methodology suggested by Ground Water Resource Estimation Committee (GEC-15). These resources were computed after reorganization of the districts.

### Ground Water Recharge

The Annual Ground Water Recharge varies from 7197.63ha.m (Vinchchiya taluka) to 27968.37ha.m (Gondal Taluka). The Gross Annual Ground Water Recharge in the district is 156553.76ha.m. The net available recharge after leaving natural discharge from monsoon period varies from 6837.74ha.m (Vinchchiya taluka ) to 26569.96ha.m (Gondal Taluka). The net available recharge in the district is 148726.07ha.m.

### Ground Water Draft

The ground water draft from irrigation and Domestic /Industrial sources is presented in Table: 10. The Existing Gross Ground Water Draft for all uses varies from 4313.90ha.m (Vinchchiya taluka) to 16670.50ha.m (Gondal Taluka). The Gross Ground Water Draft for All uses in the district is 95955.75ha.m.

### Level of Ground Water Development & Stage

The stage of ground water development at year 2017, for all the talukas of the Rajkot district computed range from 62.06 % to 67.94 % and 11 units of assessment (talukas) have been categorized as *Safe*, based on the stages of ground water development and the long-term trend of pre and post monsoon ground water levels. The average stage of groundwater development for district is 64.52%. Taluka wise ground water resources and categorization for each assessment unit is presented in table 11.

| Table No-11 Taluka Wise Ground Water Resources, Availability, Utilization and Stage of Ground Water Development (2017) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sl. No | Assessment Unit Name | Ground Water Recharge(Ham) | | | | Total Annual Ground Water (Ham) Recharge (10=6+7+8+9) | Total Natural Discharges (Ham) | Annual Extractable Ground Water Recharge (Ham) (12=10-11) | Current Annual Ground Water Extraction(Ham) | | | | Annual GW Allocation for Domestic Use as on 2025 | Net Ground Water Availability for future use (18=12-13-14-17) | Stage of Ground Water Extraction (%) (19=(16/12) *100)) | Categorization (OE/Critical/Semicritical/Safe) |
| | | Monsoon Season | | Non-monsoon season | | | | | Irrigation Use | Industrial Use | Domestic Use | Total Extraction (16=13+14+15) | | | | |
| | | Recharge from Rainfall | Recharge from Other Sources | Recharge from Rainfall | Recharge from Other Sources | | | | | | | | | | | |
| 1 | 4 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 1 | Dhoraji | 10195.43 | 1835.87 | 0.00 | 2096.82 | 14128.13 | 706.41 | 13421.72 | 8588.50 | 39.16 | 221.92 | 8849.58 | 304.00 | 4490.06 | 65.93 | Safe |
| 2 | Gondal | 21764.09 | 3003.15 | 0.00 | 3201.13 | 27968.37 | 1398.42 | 26569.96 | 16189.20 | 72.20 | 409.11 | 16670.50 | 560.00 | 9748.56 | 62.74 | Safe |
| 3 | Jamkandorna | 9679.13 | 2025.03 | 0.00 | 1443.88 | 13148.04 | 657.40 | 12490.64 | 7959.30 | 19.75 | 111.94 | 8090.99 | 153.00 | 4358.59 | 64.78 | Safe |
| 4 | Jasdan | 9239.77 | 2919.05 | 0.00 | 1553.68 | 13712.51 | 685.63 | 13026.88 | 8263.70 | 79.42 | 450.05 | 8793.17 | 616.00 | 4067.76 | 67.50 | Safe |
| 5 | Jetpur | 12425.83 | 1962.42 | 0.00 | 1539.18 | 15927.43 | 796.37 | 15131.06 | 8973.60 | 62.48 | 354.08 | 9390.16 | 484.00 | 5610.98 | 62.06 | Safe |
| 6 | Kotadasangani | 6030.14 | 1485.84 | 0.00 | 1042.10 | 8558.08 | 427.90 | 8130.17 | 4939.40 | 22.87 | 129.60 | 5091.87 | 177.00 | 2990.90 | 62.63 | Safe |
| 7 | Lodhika | 5882.23 | 1432.01 | 0.00 | 855.95 | 8170.19 | 408.51 | 7761.68 | 4791.10 | 14.52 | 82.26 | 4887.87 | 177.00 | 2779.06 | 62.97 | Safe |
| 8 | Paddhari | 8978.78 | 2378.88 | 0.00 | 1830.77 | 13188.43 | 659.42 | 12529.01 | 8360.50 | 18.91 | 107.14 | 8486.55 | 147.00 | 4002.60 | 67.74 | Safe |
| 9 | Rajkot | 16346.52 | 2983.14 | 0.00 | 1042.81 | 20372.46 | 1018.62 | 19353.84 | 12220.80 | 31.57 | 178.92 | 12431.29 | 269.00 | 6832.46 | 64.23 | Safe |
| 10 | Upleta | 10879.82 | 1913.64 | 0.00 | 1389.04 | 14182.50 | 709.13 | 13473.38 | 8648.30 | 45.23 | 256.33 | 8949.86 | 351.00 | 4428.84 | 66.43 | Safe |
| 11 | Vinchchiya | 4323.93 | 1960.63 | 0.00 | 913.07 | 7197.63 | 359.88 | 6837.74 | 4136.90 | 27.00 | 150.00 | 4313.90 | 206.00 | 2467.84 | 63.09 | Safe |
| | | **115745.68** | **23899.65** | **0.00** | **16908.43** | **156553.76** | **7827.69** | **148726.07** | **93071.30** | **433.12** | **2451.34** | **95955.75** | **3444.00** | **51777.66** | **64.52** | |

## 6. GROUND WATER RELATED ISSUES and REASONS FOR ISSUES

### Issues

### Deep water levels

Deep water levels (> 20 m bgl) are observed during pre as well as post-monsoon season in 04 no and 02 no of the wells respectively.

Out of 189 wells analyzed, 76 wells during pre-monsoon 105 wells during post monsoon shown falling trend in the last 10 years (@-0.004 to -3.34 m/yr and -0.006 to -2.70
m/yr) respectively.

### Pollution (Geogenic and Anthropogenic)

Ground water in both Phreatic and confined Aquifers is Potable and fit for domestic, drinking, irrigation and other industrial purposes but higher concentration of Fluoride and Nitrate is observed in shallow aquifer at localised pockets.

### Sustainability

In Rajkot district, the main aquifers being hard rock the yield depends on the thickness of weathered mantle and persistence of jointing, fracturing which is not uniform in nature. The yield from bore wells have reduced over a period of time and some bore wells which used to yield sufficient quantity of water have gone dry due to low rainfall.

### Reasons for Issues

**Sustainability**: Absence of primary porosity, negligible development of secondary porosity, low rainfall, de saturation of weathered zone and urbanization.

**Geo-genic pollution (Fluoride)**: Higher concentration of fluoride in ground water is attributed due to source rock,

# 7. MANAGEMENT STRATEGIES IN RAJKOT DISTRICT

**Management plan**

The uneven distribution of groundwater availability and its utilization indicates that a single management strategy cannot be adopted and requires integrated hydrogeological aspects along with socio-economic conditions to develop appropriate management strategy. The study suggests notable measures for sustainable groundwater management, which involves a combination of various measures given below.

a) Supply side measures
b) Demand side measures

**SUPPLY SIDE INTERVENTIONS**

**ARTIFICIAL RECHARGE TO GROUND WATER AND WATER CONSERVATION PLAN**

**IDENTIFICATION OF RECHARGE AREA**

An area of about 1951.20 sq. km has been identified in District Rajkot of Gujarat State. Deccan trap basalt/intrusive is the water bearing geological formations occurring in the district. The thickness of available unsaturated zone (below 6 m bgl) is computed on basis of Post monsoon (2011-20) decadal average depth to water level map (Fig 25). Based on the decadal average depth to water level of post monsoon period (2011-20) data and long term trend of ground water level (2011-20) four categories were identified as follows.

Area showing declining trend > 0.10 cm / year and water level between 6-9 m bgl.
Area showing declining trend 0 to 0.10 cm / year and water level between 6 -9 m bgl.
Area showing declining trend > 0.10 cm / year and water level between > 9 m bgl.
Area showing declining trend 0 to 0.10 cm / year and water level between > 9 m bgl.

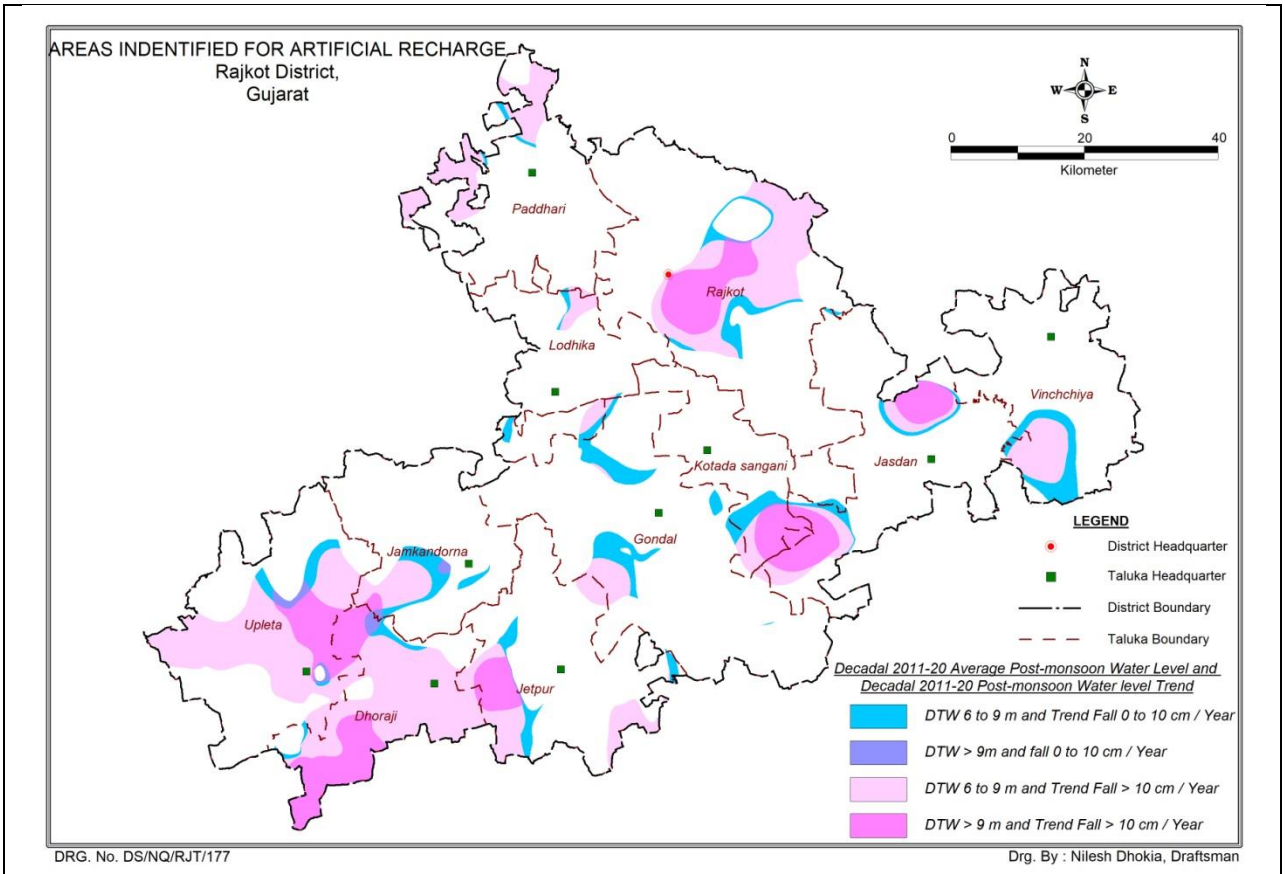



Fig. – 25: Feasible area for Artificial recharge

**Table no: 12 Identification of area feasible for Artificial Recharge in Rajkot District, Gujarat**

| S.No. | Taluka | Aquifer | Area (DTW > 9m; Trend 0 to 10cm / year (Sq.km.) | Area (DTW > 9m; Trend > 10cm / year (Sq.km.) | Area(DTW < 9m; Trend 0to10cm/year (Sq.km.) | Area (DTW < 9m; Trend > 10cm / year (Sq.km.) | Area feasible for artificial recharge (Sq.km.) | Geographical Area (in sq.km) |
|---|---|---|---|---|---|---|---|---|
| 1 | Dhoraji | Basalt | 5.93 | 146.17 | 11.80 | 257.70 | 421.60 | 489.30 |
| 2 | Gondal | Basalt | -- | -- | 78.55 | 40.11 | 118.66 | 1207.42 |
| 3 | Jamkandorna | Basalt | 5.10 | 5.37 | 32.24 | 52.58 | 95.29 | 572.27 |
| 4 | Jasdan | Basalt | -- | 95.15 | 23.57 | 49.18 | 167.90 | 771.76 |
| 5 | Jetpur | Basalt | 1.43 | 43.90 | 25.36 | 101.21 | 171.90 | 685.35 |
| 6 | Kotada sangani | Basalt | -- | 40.51 | 29.51 | 26.58 | 96.60 | 449.60 |
| 7 | Lodhika | Basalt | -- | -- | 3.34 | 18.05 | 21.39 | 376.05 |
| 8 | Paddhari | Basalt | -- | -- | 5.57 | 115.01 | 120.58 | 601.20 |
| 9 | Rajkot | Basalt | 1.865 | 107.4 | 38.18 | 148.6 | 296.045 | 1172.60 |
| 10 | Upleta | Basalt | 11.6 | -- | 21.9578 | 293.5 | 327.0578 | 805.54 |
| 11 | Vinchchiya | Basalt | -- | -- | 47.7152 | 66.48 | 114.1952 | 622.53 |
| | | **Total** | **25.92** | **438.50** | **317.79** | **1169.00** | **1951.20** | **7753.65** |

A total of 1951.20 sq. km area spread over the district in the isolated patches having water level & trend as above is computed (Table 12 ) and same is depicted as suitable areas for artificial recharge.

**Table-13 Computation of volume of unsaturated zone available for recharge**

| S.No. | Taluka | Aquifer | Volume MCM : DTW > 9 m ; Trend 0 to 10 cm / year | Volume MCM DTW > 9 m ; Trend > 10 cm / year | Volume MCM DTW 6 to 9 m ; Trend 0 to 10 cm / year | Volume MCM DTW 6 to 9 m ; Trend > 10 cm / year | Volume of unsaturated zone available for artificial recharge |
|---|---|---|---|---|---|---|---|
| | | Average Depth unsaturated below 6 m bgl (Excluding clay & impervious hard zones) | 6 m | 6 m | 3 m | 3 m | |
| 1 | Dhoraji | Basalt | 35.58 | 877.02 | 35.41 | 773.10 | 1721.11 |
| 2 | Gondal | Basalt | 0.00 | 0.00 | 235.64 | 120.33 | 355.97 |
| 3 | Jamkandorna | Basalt | 30.60 | 32.20 | 96.72 | 157.74 | 317.26 |
| 4 | Jasdan | Basalt | 0.00 | 570.90 | 70.70 | 147.54 | 789.14 |
| 5 | Jetpur | Basalt | 8.56 | 263.40 | 76.08 | 303.63 | 651.67 |
| 6 | Kotada sangani | Basalt | 0.00 | 243.06 | 88.54 | 79.74 | 411.34 |
| 7 | Lodhika | Basalt | 0.00 | 0.00 | 10.01 | 54.15 | 64.16 |
| 8 | Paddhari | Basalt | 0.00 | 0.00 | 16.71 | 345.03 | 361.74 |
| 9 | Rajkot | Basalt | 11.19 | 644.40 | 114.54 | 445.80 | 1215.93 |
| 10 | Upleta | Basalt | 69.60 | 0.00 | 65.87 | 880.50 | 1015.97 |
| 11 | Vinchchiya | Basalt | 0.00 | 0.00 | 143.15 | 199.44 | 342.59 |
| | | **Total** | **155.53** | **2630.98** | **953.36** | **3507.00** | **7246.87** |

## SUB-SURFACE STORAGE SPACE AND WATER REQUIREMENT

Further, while calculating the total volume of unsaturated zone available for recharge, clay & massive non porous intervening zones have been deleted from the total thickness of potential zone for recharge. Average specific yield data of above formations, as per norm of GWRE were considered to compute volume of water required for recharge to saturate dry zones. Storage space volume available in aquifers is 7246.87 MCM. On the basis of specific yield factor of major aquifer system considered, the volume of water required for artificial recharge to fully saturate aquifer (below 6 m bgl) in each talukas areas is around 144.94 MCM (Table 13).

**Table-14 Computation of volume of unsaturated zone available for recharge.**

| Sr No | Taluka | Aquifer | Volume of unsaturated zone avilable for artificial recharge MCM | Specific yiled factor | Volume of water required for recharge MCM | Volume of rain water planned for Artificial recharge (MCM) |
|---|---|---|---|---|---|---|
| 1 | Dhoraji | Basalt | 1721.11 | 0.02 | 34.42 | |
| 2 | Gondal | Basalt | 355.97 | 0.02 | 7.12 | |
| 3 | Jamkandorna | Basalt | 317.26 | 0.02 | 6.35 | |
| 4 | Jasdan | Basalt | 789.14 | 0.02 | 15.78 | |
| 5 | Jetpur | Basalt | 651.67 | 0.02 | 13.03 | |
| 6 | Kotada sangani | Basalt | 411.34 | 0.02 | 8.23 | |
| 7 | Lodhika | Basalt | 64.16 | 0.02 | 1.28 | |
| 8 | Paddhari | Basalt | 361.74 | 0.02 | 7.23 | |
| 9 | Rajkot | Basalt | 1215.93 | 0.02 | 24.32 | |
| 10 | Upleta | Basalt | 1015.97 | 0.02 | 20.32 | |
| 11 | Vinchchiya | Basalt | 342.59 | 0.02 | 6.85 | |
| | | **Total** | **7246.87** | | **144.94** | |

## SOURCE WATER AVAILABILITY

The availability of source water, one of the prime requisites of artificial recharge. Gujarat State has been adopted concept of managed aquifer recharge in the state. While planning/finalization of Master plan for Artificial Recharge (2020) to Ground water in Gujarat state it was said that efforts shall be made for supplying surplus water from surface storage for recharging. Also it is expected that under climatic change effect due to change in hydrology more rain fall water may be available. Considering this 15 MCM of surplus surface water is provisioned for artificial recharge in Rajkot district. 15 MCM of surplus surface water was apportioned with taluka wise and for Rajkot district 15 MCM of surplus surface water is considered for artificial recharge through 499 no of recharge shafts and 01 no of existing defunct tube wells which can be used as injection wells in Rajkot district.

| Table No: 15 Feasibility of Artificial Recharge in Rajkot District As per master Plan Gujarat 2020. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sr No | **District Name** | **Area of District in sqkm** | **Decadal Average (2011-20) Post Monsoon Depth to Water Level (m bgl)** | **Area Feasible for Artificial Recharge** | **Volume of unsaturated zone avilable for recharge (MCM)** | **Volume of Water required for recharge (MCM)** | **Surplus Runoff Available District (As per Master Plan 2020) (MCM** | **Balance Volume of Surplus Local / Distant Sources avilable for recharge (MCM)** | **Additional Percolation Tank Structure Proposed Recharge Capacity @0.14 MCM** | **Additional Check Dam Structure Proposed Recharge Capacity @0.05 MCM** | **PT** | **CD** | **Total Coast (Rs Cores)** |
| 1 | **Rajkot** | 7753.65 | 6.44 | 1951.20 | 7246.89 | 144.94 | 15.00 | 0.00 | As per Masterplan 2020 for Artificial Recharge to Ground Water in Gujarat state, 15 MCM of surplus surface water is provisioned for artificial recharge through 499 no of recharge shafts and 01 no of existing defunct tube wells which can be used as injection wells in Rajkot district. Ground water recharge of 1500 ham (through recharge shafts and defunct tube wells ) is expected for the district Additional Artificial Recharge Structures are not recommended as Surplus Runofff is not available. | | | | |

**Ground Water Development Plan**

As per GWRE 2017 total 11 no blocks of Rajkot district are under safe category Ground water stage of development ranges from 62.06 % (Jetpur) to 67.94 % (Padhari). Furthher development to elevate the stage of ground water development is not advisable, since the district is already reached stage more than 60% in all blocks.

**Demand side intervention**

To prevent forther ground water dvelopment, water conservation activities like on farm activities and farm ponds are recommended in the district. By these activities where groundwater extraction can be developed in between 58.18% to 64.60% i.e., under safe category.

19512 Ha area is proposed for on farm activities (Laser levelling/Bench terracing/Contour banding) and 3885 no of farm ponds are recommended which will serve dual purpose of irrigation and recharge to ground water. Ground water recharge of 1950.7 ham (through on farm activities) is expected for the district. 3424.33 ham saving of ground water through WUE measures & farm ponds activities is expected for the district.

**Table-16 Water Conservation interventions in Rajkot District of Gujarat State**

| Sr No | Block | On farm Activities (Area in ha) | Water Use Efficiency (WUE) Measures | No of Farm ponds (30 m x 30m x 1.5 m) |
|---|---|---|---|---|
| 1 | Dhoraji | 4216.04 | 933 | 710 |
| 2 | Gondal | 1186.57 | 1518 | 1050 |
| 3 | Jamkandorna | 952.86 | 738 | 480 |
| 4 | Jasdan | 1678.953 | 279 | 155 |
| 5 | Jetpur | 1718.96 | 1126 | 595 |
| 6 | Kotada sangani | 966.02 | 623 | 70 |
| 7 | Lodhika | 213.863 | 337 | 295 |
| 8 | Paddhari | 1205.795 | 1394 | 110 |
| 9 | Rajkot | 2960.45 | 1981 | 75 |
| 10 | Upleta | 3270.578 | 662 | 55 |
| 11 | Vinchchiya | 1141.952 | 356 | 290 |
| | **Total** | **19512.041** | **9947** | **3885** |

**Farm Ponds**

A farm pond is a large hole dug out in the earth, usually square or rectangular in shape (Fig. 26), which harvests rainwater and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond. The size and depth depend on the amount of land available, the type of soil, the farmer's water requirements, the cost of excavation, and the possible uses of the excavated earth. Water from the farm pond is conveyed to the fields manually, by pumping, or by both methods.

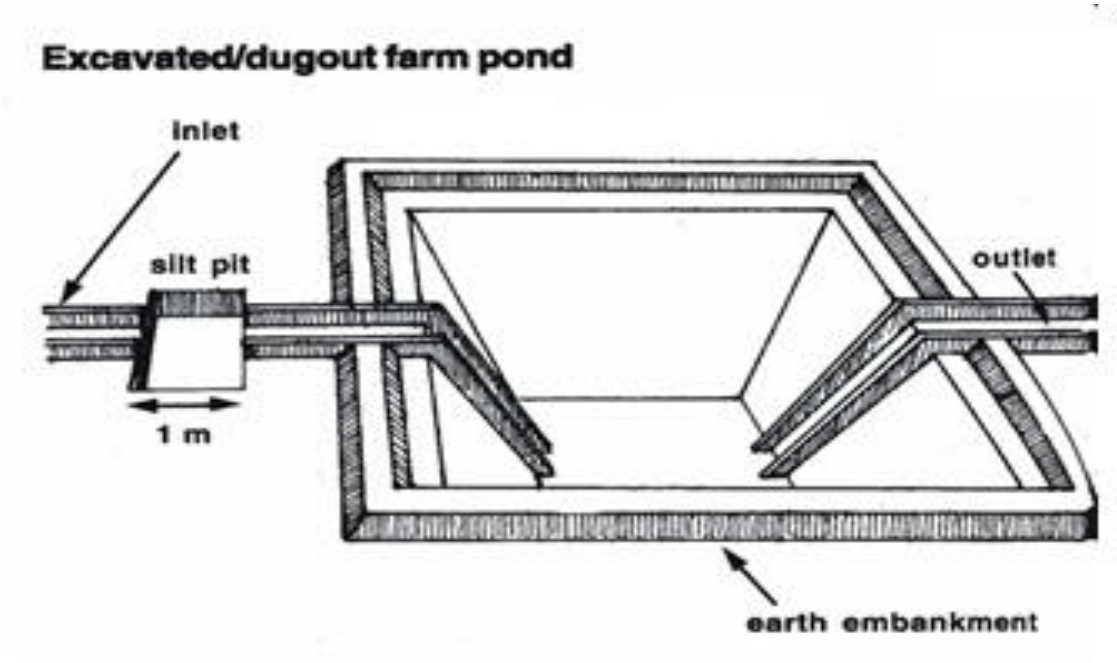



**Fig. 26: Thematic diagram of Farm pond**

**Advantages of Farm Ponds**

- They provide water to start growing crops, without waiting for rain to fall.
- They provide irrigation water during dry spells between rainfalls. This increases the yield, the number of crops in one year, and the diversity of crops that can be grown.
- Bunds can be used to raise vegetables and fruit trees, thus supplying the farm household with an additional source of income and of nutritious food.
- Farmers are able to apply adequate farm inputs and perform farming operations at the appropriate time, thus increasing their productivity and their confidence in farming.
- They check soil erosion and minimize siltation of waterways and reservoirs.
- They supplies water for domestic purposes and livestock
- They promote fish rearing.
- They recharge the ground water.
- They improve drainage.
- The excavated earth has a very high value and can be used to enrich soil in the fields, levelling land, and constructing farm roads

It is proposed to construct 3885 farm ponds as per the specification (30 x 30 x 1.5 m). Farm ponds can be constructed in the village at feasible location. Dimension of the farm pond depends on land holdings.

**Table No-17 Projected Status of Groundwater Resource after implementation of GW Management Plan of Rajkot District of Gujarat state**

| Sr No | Taluka | Net G.W. Availability (Ham) | Additional Recharge from Recharge interventions (ham) | Total Net G.W. Availability after intervention (Ham) | Existing G.W Draft for all purpose (ham) | Conservation of Ground water through WUE, on farm activity & farm ponds (ham) | Net GW draft after interventions (ham) | Present stage of G.W. Development (%) | Projected stage of GW development after implementation of conservation measures (in %) | Projected stage of GW development after & implementation of conservation measures & Recharge measures (in %) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Dhoraji | 13421.72 | 517.60 | 13939.32 | 8849.58 | 535.65 | 8313.93 | 65.93 | 60.06 | 59.64 |
| 2 | Gondal | 26569.96 | 361.60 | 26931.56 | 16670.50 | 583.62 | 16086.89 | 62.74 | 60.28 | 59.73 |
| 3 | Jamkandorna | 12490.64 | 206.3 | 12696.94 | 8090.99 | 291.23 | 7799.75973 | 64.78 | 61.97 | 61.43 |
| 4 | Jasdan | 13026.88 | 335.4 | 13362.28 | 8793.17 | 161.02 | 8632.14865 | 67.50 | 65.42 | 64.60 |
| 5 | Jetpur | 15131.06 | 297.9 | 15428.96 | 9390.16 | 413.71 | 8976.45187 | 62.06 | 58.66 | 58.18 |
| 6 | Kotadasangani | 8130.17 | 186.6 | 8316.77 | 5091.87 | 149.26 | 4942.61061 | 62.63 | 60.08 | 59.43 |
| 7 | Lodhika | 7761.68 | 96.4 | 7858.08 | 4887.87 | 146.52 | 4741.35153 | 62.97 | 60.92 | 60.34 |
| 8 | Paddhari | 12529.01 | 240.6 | 12769.61 | 8486.55 | 276.54 | 8210.00513 | 67.74 | 64.90 | 64.29 |
| 9 | Rajkot | 19353.84 | 497.00 | 19850.84 | 12431.29 | 423.87 | 12007.42 | 64.23 | 61.11 | 60.49 |
| 10 | Upleta | 13473.38 | 495.1 | 13968.48 | 8949.86 | 253.61 | 8696.25679 | 66.43 | 63.01 | 62.26 |
| 11 | Vinchchiya | 6837.74 | 216.2 | 7053.94 | 4313.90 | 189.30 | 4124.60075 | 63.09 | 59.33 | 58.47 |
| | | 148726.07 | 3450.70 | 152176.77 | 95955.75 | 3424.33 | 92531.42 | 64.55 | 61.43 | 60.81 |

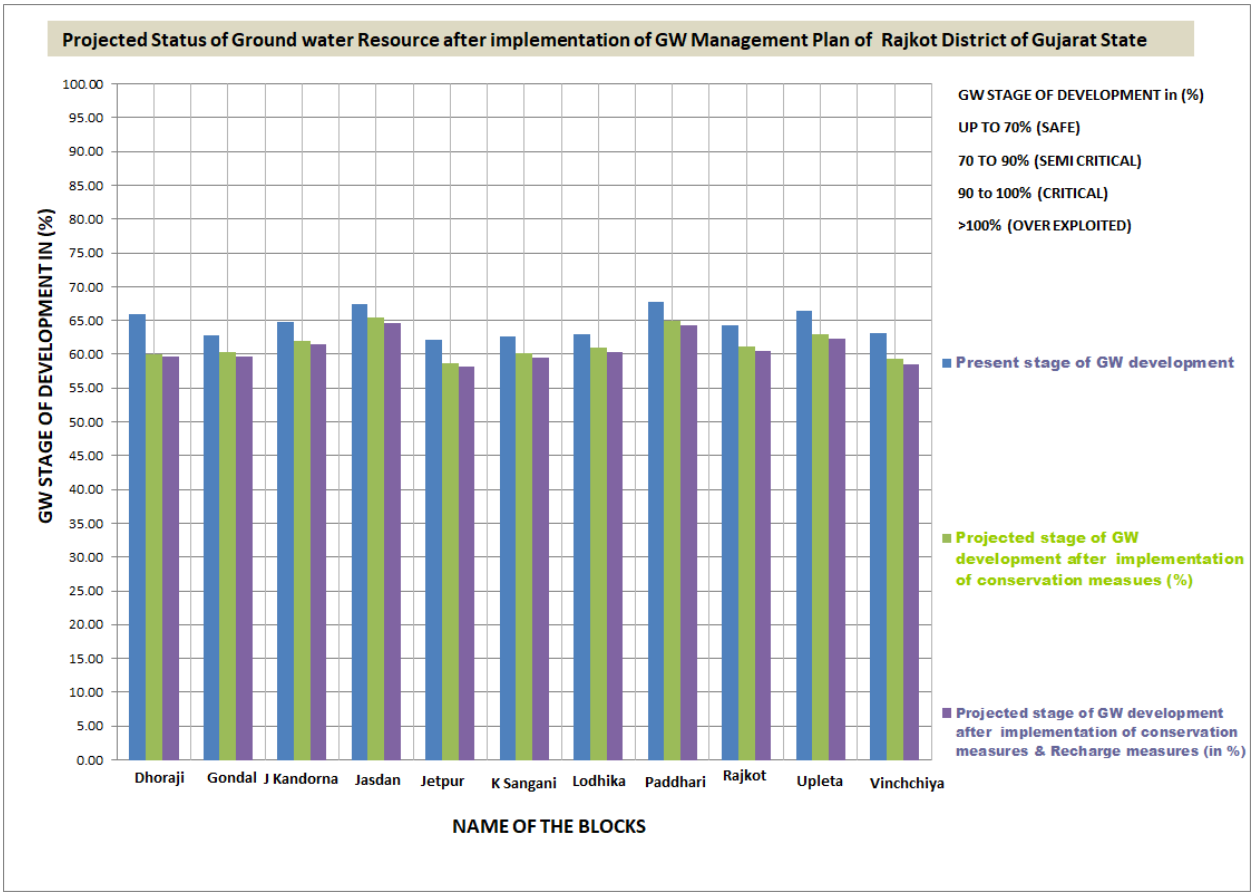



Fig. 27: Projected Status of Ground Water Resourses after implementation of GW management Plan.

| Table- 17 Summary of Interventions and Expected Benefits of Rajkot district of Gujarat State | |
|---|---|
| **Interventions Recommended** | |
| On-farm Activities (ha) | 19512.04 ha |
| Water Use Efficiency (WUE) Measures | 9947 ha |
| No of Farm Ponds | 3885 |
| **Expected Benefits** | |
| Expected Annual Recharge(Through On farm activities) | 1950.70 ham |
| Expected Annual Recharge(Recharge Shaft & Defunct Tube wells) | 1500 ham |
| Conservation from On-farm Activities, WUE Measures & Farm Ponds | 3424.33 ham |
| **Total Recharge/ Saving** | **6875.03 ham** |

## 8. CONCLUSION AND RECOMMENDATIONS

- Artificial recharge structures like recharge shafts and Defunct Tube well are suggested as 15 MCM surplus surface water is provisioned as per the data provided by the State Water Resources Department.

- To prevent Over Exploitation, water conservation activities like On farm activities , farm ponds and Micro irrigation system (Sprinkler/drip) are recommended.

- As a conservation measure, farmers should be encouraged and educated to adopt modern irrigation techniques like drip, sprinkler irrigation etc. to effect minimum withdrawal and maximum utilisation of groundwater.

- The water quality in general is good. However higher EC values and fluoride concentration is observed in isolated pockets. Ground water in such areas may be used after blending with surface water. In areas where ground water has higher concentration of Nitrate is observed, necessary sanitation measures should be adopted.

- If surface water is not available in aforesaid areas with quality issues there water supply tube wells may be constructed tapping deeper aquifer after casing the Phreatic aquifer.

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| Annexure 1 Rajkot Pre/Post_WL &Avg WL & Water Table & Fluctuation (Un Confined) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sr No | Well No | District | Taluka | Village | Geology | LAT_Y | LONG_X | MP | RL | TOTAL DEPTH | May_20_WL | Oct_20_WL | PRE_AVG_2010-19 | POST_AVG_2010-19 | WTE_PRE | FLUC_PRE_POST |
| 1 | W213840070154001 | Rajkot | Dhoraji | Patanvav | Not Available | 21.64444 | 70.26111 | | 81.7 | 34.64 | | | 15.61 | 7.67 | 55.5 | 23 |
| 2 | W213945070203001 | Rajkot | Dhoraji | Bhada jodiya | Not Available | 21.6625 | 70.34167 | | 61 | 30.38 | | | 16.04 | 10.21 | 31.5 | 27.2 |
| 3 | W214030070104501 | Rajkot | Upleta | Ganod | Not Available | 21.675 | 70.17917 | | 31 | 13.8 | 6.74 | | 4.64 | 3.39 | 22 | 5.9 |
| 4 | W214405070300501 | Rajkot | Jetpur | Motagundala | Basalt | 21.73472 | 70.50139 | | 81.4 | 18.44 | | | 9.24 | 6.04 | 63.75 | 15.2 |
| 5 | W214445070170901 | Rajkot | Upleta | Dhoraji | Not Available | 21.74583 | 70.28583 | | 44 | 27 | 10.2 | | 15.05 | 9.83 | 21.6 | 16.1 |
| 6 | W214455070163001 | Rajkot | Upleta | Upleta1 | Not Available | 21.74861 | 70.275 | | 45.7 | 28.4 | | | 5.26 | 4.95 | 45.7 | -16.16 |
| 7 | W214505070353001 | Rajkot | Jetpur | Pedhla | Not Available | 21.75139 | 70.59167 | | 97.7 | 30.01 | | | 19.61 | 11.27 | 72.25 | 18.1 |
| 8 | W214522070371001 | Rajkot | Jetpur | Jetpur | Basalt | 21.75611 | 70.61944 | | 89.6 | 56.2 | 4.98 | | 8.22 | 5.36 | 89.6 | -7.2 |
| 9 | W214630070380001 | Rajkot | Jetpur | Jetpur pithad. | Basalt | 21.775 | 70.63333 | | 84 | 21.1 | | | 12.1 | 4.91 | 84 | 0 |
| 10 | W215100070414501 | Rajkot | Jetpur | Virpur1 | Basalt | 21.85 | 70.69583 | | 114 | 18.65 | 9.13 | | 10.49 | 7.98 | 104.07 | 1.9 |
| 11 | W215330070290001 | Rajkot | Jamkandorna | Jasapur | Not Available | 21.89167 | 70.48333 | | 99 | 15 | 9.8 | | 12.92 | 7.92 | 87.5 | 8.1 |
| 12 | W215500070445501 | Rajkot | Gondal | Chordi | Basalt | 21.91667 | 70.74861 | | 127.3 | 12.01 | 9.15 | | 10.33 | 6.67 | 117.9 | 0 |
| 13 | W215510070361501 | Rajkot | Jetpur | Umrali | Not Available | 21.91944 | 70.60417 | | 101.3 | 14.05 | | | 8.75 | 4.33 | 89.2 | 7.8 |
| 14 | W215600070460001 | Rajkot | Gondal | Jamwali | Basalt | 21.93333 | 70.76667 | | 131 | 14.81 | 2.33 | | 6.05 | 3.24 | 118.25 | 10.5 |
| 15 | W215800070523001 | Rajkot | Gondal | Gogavadar | Basalt | 21.96667 | 70.875 | | 155 | 12.55 | 8.35 | | 10.6 | 5.33 | 149 | 0.2 |
| 16 | W215954070593801 | Rajkot | Gondal | Mota Dadwa | Basalt | 21.99833 | 70.99389 | | 164.3 | 16.8 | | | 11.26 | 5.64 | 155.07 | 6.6 |
| 17 | W220110070393701 | Rajkot | Gondal | Kalithad1 | Not Available | 22.01944 | 70.66028 | | 126.8 | 16 | 3.5 | | 5.91 | 3.3 | 119.3 | 4.1 |
| 18 | W220130071073001 | Rajkot | Jasdan | Viranagar | Basalt | 22.025 | 71.125 | | 181 | 25.01 | 5.2 | | 10.84 | 6.43 | 172.42 | 7.55 |
| 19 | W220330071131501 | Rajkot | Jasdan | Jasdan2 | Not Available | 22.05833 | 71.22083 | | 205 | 24.5 | 5.55 | | 11.4 | 6.25 | 195.2 | 8.2 |
| 20 | W220530070440 | Rajko | Gondal | Dadia | Not | 22.091 | 70.733 | | 153 | 25.01 | 10.27 | | 12.76 | 6.91 | 140.23 | 7.4 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 001 | t | | | Available | 67 | 33 | | | | | | | | | |
| 21 | W220530071030001 | Rajkot | Rajkot | Halenda | Not Available | 22.09167 | 71.05 | | 212 | 17 | 1.7 | | 9 | 3.02 | 205.67 | 5.8 |
| 22 | W220730070460001 | Rajkot | Gondal | Ribda | Not Available | 22.125 | 70.76667 | | 173 | 25.01 | 8.82 | | 11.57 | 6.62 | 163 | 5.4 |
| 23 | W220800071181501 | Rajkot | Vinchchiya | Lalavadar | Basalt | 22.13333 | 71.30417 | | 255 | 22.01 | 5.06 | | 12.11 | 5.99 | 248.87 | 4.3 |
| 24 | W220830070383001 | Rajkot | Lodhika | Lodhika1 | Basalt | 22.14167 | 70.64167 | | 159 | 12.7 | 7.57 | | 8 | 5.49 | 159 | -2.4 |
| 25 | W220845071120001 | Rajkot | Jasdan | Kamlapur | Not Available | 22.14583 | 71.2 | | 243 | 21 | 10.65 | | 7.21 | 6.47 | 243 | 0 |
| 26 | W220907071115901 | Rajkot | Jasdan | Kamlapur1 | Not Available | 22.15194 | 71.19972 | | 245 | 20 | 6.05 | | 6.2 | 4.4 | 230.4 | 11.8 |
| 27 | W221100071053001 | Rajkot | Jasdan | Bhadla | Basalt | 22.18333 | 71.09167 | | 230 | 20.94 | 12.7 | | 14.52 | 11.56 | 211.4 | 13.9 |
| 28 | W221230071224501 | Rajkot | Vinchchiya | Vinchhia | Basalt | 22.20833 | 71.37917 | | 171 | 12.83 | 2.18 | | 5.41 | 2.8 | 164.35 | 4 |
| 29 | W221430070384501 | Rajkot | Lodhika | Khirsara1 | Basalt | 22.24167 | 70.64583 | | 125 | 20.1 | 11.8 | | 10.5 | 4.27 | 110.8 | 8.9 |
| 30 | W221800070480001 | Rajkot | Rajkot | Rajkot1 | Basalt | 22.3 | 70.8 | | 133 | 19 | | | 8.1 | 4.54 | 125.93 | -2.1 |
| 31 | W221820070483001 | Rajkot | Rajkot | Rajkot | Basalt | 22.30556 | 70.80833 | | 118.3 | 29.8 | | | 4.44 | 2.85 | 118.3 | 0 |
| 32 | W222200070554501 | Rajkot | Rajkot | Ranpur1 | Basalt | 22.36667 | 70.92917 | | 164 | 26 | 17.81 | | 12.19 | 9.62 | 164 | -2.4 |
| 33 | W222300070400001 | Rajkot | Paddhari | Targhari | Basalt | 22.38333 | 70.66667 | | 84 | 16.45 | 5.62 | | 6.38 | 4.85 | 76.4 | 4.3 |
| 34 | W222400070474501 | Rajkot | Rajkot | Gavridad | Basalt | 22.4 | 70.79583 | | 108 | 29 | | | 5.59 | 3.41 | 101.09 | 3.4 |
| 35 | W222650070363002 | Rajkot | Paddhari | Padadhari1 | Basalt | 22.44722 | 70.60833 | | 70 | 17.5 | 5.6 | | 4.65 | 3.89 | 59.8 | 7.2 |
| 36 | W222700070363001 | Rajkot | Paddhari | Movaiya | Basalt | 22.45 | 70.60833 | | 70 | 21 | 2.06 | | 11.93 | 6.94 | 58.7 | 6.8 |
| 37 | W222830070330001 | Rajkot | Paddhari | Khamta | Basalt | 22.475 | 70.55 | | 73 | 17.5 | 8.1 | | 11.15 | 6.73 | 56.85 | 15.2 |
| | | | | | | | | | | | | | | | | |

| Annexure 2 Rajkot Pre Monsoon Water Quality_2019 ( Un Confined ) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sr Np | **Well No** | **District** | **Taluka** | **Village** | **LAT_Y** | **LONG_X** | **pH** | **EC** | **TH** | **TDS** | **Cl** | **NO3** | **F** |
| 1 | CGWB | Rajkot | Upleta | Kutiyana | 21.63056 | 70.16667 | 7.25 | 5830 | 1291 | 3906 | 1439 | 148 | 1.7 |
| 2 | CGWB | Rajkot | Upleta | Ganod | 21.675 | 70.17917 | 7.86 | 5660 | 800 | 3792.2 | 1242.5 | 36.26 | 3.5 |
| 3 | CGWB | Rajkot | Dhoraji | Patan Vav | 21.64444 | 70.26111 | 8.18 | 607 | 190 | 406.69 | 35.5 | 3.6 | 0.68 |
| 4 | CGWB | Rajkot | Upleta | Upleta | 21.74861 | 70.275 | 8.36 | 2715 | 200 | 1819.05 | 284 | 89 | 4.8 |
| 5 | CGWB | Rajkot | Upleta | Dhorajee | 21.74583 | 70.28583 | 7.97 | 541 | 200 | 362.47 | 85.2 | 2.83 | 0.37 |
| 6 | CGWB | Rajkot | Dhoraji | Bhada Jodiya | 21.6625 | 70.34167 | 7.67 | 1698 | 390 | 1137.66 | 461.5 | 5.81 | 0.42 |
| 7 | CGWB | Rajkot | Jamkandorna | Jasapar | 21.89167 | 70.48333 | 7.82 | 1265 | 580 | 847.55 | 184.6 | 33.88 | 0.65 |
| 8 | CGWB | Rajkot | Jetpur | Mota Gundala | 21.73472 | 70.50139 | 8.14 | 570 | 150 | 381.9 | 56.8 | 8 | 0.86 |
| 9 | CGWB | Rajkot | Jetpur | Pedhla | 21.75139 | 70.59167 | 7.77 | 2550 | 1020 | 1708.5 | 639 | 48.03 | 0.55 |
| 10 | CGWB | Rajkot | Jetpur | Umrali | 21.91944 | 70.60417 | 7.97 | 1821 | 490 | 1220.07 | 369.2 | 44.62 | 0.47 |
| 11 | CGWB | Rajkot | Paddhari | Targhari | 22.44722 | 70.60833 | 7.98 | 1700 | 610 | 1139 | 355 | 28.52 | 0.49 |
| 12 | CGWB | Rajkot | Paddhari | Movaiya | 22.45 | 70.60833 | 8.14 | 1991 | 560 | 1333.97 | 390.5 | 36.94 | 0 |
| 13 | CGWB | Rajkot | Jetpur | Virpur | 21.85 | 70.69583 | 8.12 | 1706 | 540 | 1143.02 | 262.7 | 148.25 | 0.25 |
| 14 | CGWB | Rajkot | Gondal | Dadiya | 22.09167 | 70.73333 | 8.03 | 507 | 190 | 339.69 | 42.6 | 37.9 | 0.52 |
| 15 | CGWB | Rajkot | Gondal | Chordi | 21.91667 | 70.74861 | 7.86 | 2490 | 840 | 1668.3 | 653.2 | 53.73 | 0.25 |
| 16 | CGWB | Rajkot | Gondal | Ribda | 22.125 | 70.76667 | 7.83 | 961 | 410 | 643.87 | 149.1 | 38.6 | 0.25 |
| 17 | CGWB | Rajkot | Gondal | Gogavadar | 21.96667 | 70.875 | 8.19 | 969 | 320 | 649.23 | 113.6 | 46.07 | 0.51 |
| 18 | CGWB | Rajkot | Rajkot | Sardhar | 22.14583 | 70.98889 | 8.18 | 1868 | 410 | 1251.56 | 269.8 | 31.99 | 0.19 |
| 19 | CGWB | Rajkot | Gondal | Motadadva | 21.99833 | 70.99389 | 8.15 | 1454 | 570 | 974.18 | 248.5 | 86 | 0.37 |
| 20 | CGWB | Rajkot | Rajkot | Halenda | 22.09167 | 71.05 | 8.21 | 1323 | 510 | 886.41 | 234.3 | 14.95 | 0.49 |
| 21 | CGWB | Rajkot | Jasdan | Bhadla | 22.18333 | 71.09167 | 7.82 | 3407 | 900 | 2282.69 | 923 | 27.54 | 0.42 |
| 22 | CGWB | Rajkot | Jasdan | Virnagar | 22.025 | 71.125 | 8.29 | 1008 | 360 | 675.36 | 156.2 | 16.94 | 0.35 |
| 23 | CGWB | Rajkot | Jasdan | kamlapur | 22.14583 | 71.2 | 7.76 | 4196 | 1520 | 2811.32 | 1050.8 | 235.7 | 0.55 |
| 24 | CGWB | Rajkot | Jasdan | Jasdan | 22.05833 | 71.22083 | 8.03 | 1649 | 600 | 1104.83 | 319.5 | 53.5 | 0.34 |
| 25 | CGWB | Rajkot | Vinchchiya | Lalavadar | 22.13333 | 71.30417 | 7.96 | 710 | 290 | 475.7 | 42.6 | 7.63 | 0.13 |
| 26 | CGWB | Rajkot | Jetpur | Mota Gundala | 21.73472 | 70.50139 | 8 | 4257 | 980 | 2852.19 | 1136 | 39.64 | 0.45 |

| Annexure-3 Rajkot Distrcit Exploration Data | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sl No.** | **Location** | **Block** | **District** | **EW/ OW** | **Lat** | **Long** | **Depth drilled (m bgl)** | **Depth of Construction (m bgl)** | **Major Lithology Encountered** | **Casing (m)** | **Zone Encountered (m bgl)** | | | | | | **SWL (m bgl)** | **Discharge (lps)** | **RDD** | **T (m2/ day** | **EC ( µs/ cm at 25°)** |
| | | | | | | | | | | | **0-50** | **50-100** | **100-150** | **150-200** | **200-250** | **250-300** | | | | | |
| 1 | Hathasani | Vichhiya | Rajkot | EW | 22.1316 | 71.3661 | 252.6 | 252.6 | Basalt | 10 | | | 128.90-130 | 162.50-163.50 | 205.20-209.30 | | 196.2 | 0.3 | NA | NA | 1000 |
| 2 | Rajawadla | Jasdan | Rajkot | EW | 22.0979 | 71.1715 | 197.6 | 197.6 | Basalt | 4.35 | | 69-70 | 117.8 | 120.8 | 197.10-200.10 | 233.70-236.70 | 57.95 | Negligible | NA | NA | NA |
| 3 | Rajpara | Kotda Sangani | Rajkot | EW | 22.1146 | 70.8805 | 202 | 202 | Basalt | 6.1 | | | | | | | 148.36 | Negligible | NA | NA | NA |
| 4 | Nagalpar | Rajkot | Rajkot | EW | 22.3939 | 70.8626 | 142.1 | 142.1 | Basalt | 5.8 | | | 136-139 | | | | 5 | 10.6 | 2.7 (7th min) | 46.95 | 404 |
| 5 | Dadwa Hamirpur | Gondal | Rajkot | EW | 22.0064 | 71.0422 | 203 | 203 | Basalt | 9.17 | 8.35-11.35 | 90.20-93.00 | | 190-193 | | | 4.33 | 3.3 | 22.09(5th min) | 1.56 | 120 |
| 6 | Panch Talawada | Kotda Sangani | Rajkot | EW | 22.0658 | 70.9409 | 203 | 203 | Basalt | 7.9 | | | | | | | 31.5 | Negligible | NA | NA | NA |
| 7 | Mesavada | Rajkot | Rajkot | EW | 22.3103 | 71.0211 | 200 | 200 | Basalt | 6 | | | | | | | 7.4 | 0.36 | NA | NA | 3180 |
| 8 | Beti | Rajkot | Rajkot | EW | 22.3894 | 70.9958 | 215.4 | 215 | Basalt | 6 | | | | | | | 18.92 | 3.68 | 40.73(2nd min) | 1.75 | 906 |
| 9 | Juna Rajpipala | Kotda Sangani | Rajkot | EW | 22.0161 | 71.0122 | 203 | 203 | Basalt | 8.4 | | | | | | | 39.11 | Negligible | NA | NA | 1000 |
| 10 | Bagdadiya | Kotda Sangani | Rajkot | EW | 21.968 | 70.9854 | 203 | 203 | Basalt | 8.9 | | | | | | | 11.5 | Negligible | NA | NA | 1800 |
| 11 | Ghoghawadar | Gondal | Rajkot | EW | 21.965 | 70.8726 | 201 | 201 | Basalt | 8.7 | 14.65 to 15.50 | 87 to 89.90 | | | | | 12.5 | 1.5 | 62.73(10th min) | 0.14 | 1447 |
| 12 | Dapaliya | Paddhari | Rajkot | EW | 22.4577 | 70.5664 | 205 | 205 | Basalt | 6.12 | 3-148 | | 150.5-182.5 | | | | 28.9 | 0.1 | | | 5780 |
| 13 | Metoda | Paddhari | Rajkot | EW | 22.3776 | 70.6156 | 201 | 201 | Basalt | 3 | Mar-89 | | | | | | 2.58 | Negligible | | | 1120 |
| 14 | Udakiya | Dhoraji | Rajkot | EW | 21.6482 | 70.3786 | 200 | 200 | Basalt | 6 | 03-Sep | | | | | | 28.86 | 0.48 | | | 750 |
| 15 | Khajurda | Jamkandorna | Rajkot | EW | 21.8871 | 70.4013 | 201 | 201 | Basalt | 6 | | | | | | | 58.68 | 0.88 | | | 1040 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | Mevasa | Jetpur | Rajkot | EW | 21.876 | 70.5949 | 200 | 200 | Basalt | 9.5 | | 80-94, 94-135, 144-163, 163-171 | | | | | 16.81 | Negligible | | | 1340 |
| 17 | Bava Pipaliya | Jetpur | Rajkot | EW | 21.6298 | 70.6295 | 201 | 201 | Basalt | 6.1 | | | | | | | 10.5 | Negligible | | | |
| 18 | MandanKundala | Gondal | Rajkot | EW | 21.8515 | 70.8701 | 193 | 193 | Basalt | 6 | | 28-64 | | | | | 17.18 | Negligible | | | 910 |
| 19 | Lodhika | Lodhika | Rajkot | EW | 22.1372 | 70.6418 | 194 | 194 | Basalt | 6 | | | | | | | 10.01 | Negligible | | | |
| 20 | Bhandariya | Jasdan | Rajkot | EW | 22.1823 | 71.0514 | 201 | 201 | Basalt | 6 | Mar-18 | | | | | | 54.33 | Negligible | | | 2530 |
| 21 | Kharachiya Jas | Jasdan | Rajkot | EW | 22.2477 | 71.3607 | 196 | 196 | Basalt | | 3-16, 16-31, 31-52, | 52-60, 60-87, 87-119 | | 119-196 | | | 9.42 | Negligible | | | |
| 22 | Dhamalpur | Rajkot | Rajkot | EW | 22.3542 | 70.875 | 200 | 200 | Basalt | 3.6 | | | | | | | 62.24 | 1.04 | | | 1930 |
| 23 | Gadhaka | Rajkot | Rajkot | EW | 22.2565 | 70.9555 | 300.8 | 300.8 | Basalt | 6.3 | | | | | | | - | Negligible | - | - | - |
| 24 | Devala | Gondal | Rajkot | EW | 21.785 | 70.8167 | 200 | 200 | Basalt | 1.5 | 9.25-13.35,16.35-22.45 | | 102.0-119.0 | 161.0-165.0, 175-182.0 | | | 8.4 | 7 | | 1100 | 3000 |
| 25 | Charkhadi | Gondal | Rajkot | EW | 21.9667 | 70.65 | 165 | 165 | Basalt | 2.5 | 25.0,37.0 | 55 | | | | | 4.05 | 18 | | 253 | 2300 |
| 26 | Kalasar | Jasdan | Rajkot | EW | 22.0861 | 71.2944 | 201 | 201 | Basalt | 10.35 | 10.40-22.60 | 52.10-64.30 | | | | | 3.37 | 16.6 | | 517 | 560 |
| 27 | Kothi | Jasdan | Rajkot | EW | 22.0875 | 71.1569 | 201 | 201 | Basalt | 5 | 8.40-11.40 | | | | | | 2.9 | 5 | | 4 | 3175 |
| 28 | Kolithad | GONDAL | Rajkot | OW | 22.025 | 70.6625 | 201 | 201 | Basalt | 2.3 | Negligible | | | | | | 6.14 | 0.75 | | 0.3 | 5986 |
| 29 | Shrinathgadh | Kotda Sangani | Rajkot | EW | 21.8833 | 70.9167 | 201 | 201 | Basalt | 4 | 7.40-12.50,40.43 | 68.40-70.40 | | 165-167 | | | 9.96 | 3 | | 15.82 | 710 |
| 30 | Raydi | Jamkandorna | Rajkot | EW | 21.8247 | 70.4567 | 50 | 50 | Basalt | 5 | 4.30-12.50,28.70-30.80,38.90- | | | | | | 8 | 25 | | 326 | 816 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 40.90 | | | | | | | | | |
| 31 | Vavdi II | Jamkandorna | Rajkot | EW | 21.9594 | 70.4494 | 147 | 147 | Basalt | 6.4 | | 81.0-82.0,90.70-91.70 | 117.20-118.20 | | | | 23.1 | 18 | | 129.3 | 4800 |
| 32 | Jam Kandorna | Upleta | Rajkot | EW | 21.8892 | 70.3347 | 201 | 201 | Basalt | 5.3 | Negligible | | | | | | 14.22 | 0.25 | | 0.7 | 1000 |
| 33 | Gadethal | Upleta | Rajkot | EW | 21.7778 | 70.1797 | 133 | 133 | Basalt | 12.6 | | | 105.0,133.0 | | | | 20.5 | 10 | | 75.2 | 1900 |
| 34 | Vadekhan | Upleta | Rajkot | EW | 21.7806 | 70.0553 | 203 | 203 | Basalt | 11.3 | 30.70-32.80 | 82.60-83.60 | 146.60-147.70 | 151.70-153.80 | | | 9.72 | 2.5 | | 15.8 | 850 |
| 35 | Upleta | Upleta | Rajkot | EW | 21.75 | 70.2769 | 154 | 154 | Basalt | 13.5 | 17.5 | 73.5 | 128 | 153.5 | | | 12.48 | 18 | | 55.83 | 8400 |
| 36 | Nilalkha | Upleta | Rajkot | EW | 21.7139 | 70.2158 | 200 | 200 | Basalt | 13.2 | | 50 | 92 | 165 | | | 6.78 | 10 | | 22.6 | 40000 |
| 37 | Chitravad | Jamkandorna | Rajkot | EW | 21.9461 | 70.3503 | 203 | 203 | Basalt | 3.5 | Negligible | | | | | | 2.64 | 0.05 | | 0 | 4000 |
| 38 | Kagwad | Jetpur | Rajkot | EW | 21.8042 | 70.6833 | 104 | 104 | Basalt | 28.9 | | | 86.70, 94.80 | | | | 68.9 | 4.4 | | | |
| 39 | Chichod | Dhoraji | Rajkot | EW | 21.6319 | 70.2894 | 500 | 500 | Basalt | | 10.5 | | 114 | | | | 90 | 1.5 | | | 700 |
| 40 | Nani Parabadi | Dhoraji | Rajkot | EW | 21.68 | 70.5236 | 311 | 311 | Basalt | | 15 | | | 183 | | 293.0, 308.0 | 93.6 | 18 | | | 2830 |
| 41 | Bildi | Gondal | Rajkot | EW | 21.8981 | 70.9817 | 500 | 500 | Basalt | | 27 | | | | | 358 | 21.6 | 0.25 | | | 6700 |
| 42 | Amrapur | Kotda Sangani | Rajkot | EW | 22.2114 | 71.3131 | 376 | 376 | Basalt | | | | | | | 374 | 8.02 | 12 | | | 5840 |
| 43 | Bhadli | Jasdan | Rajkot | EW | 22.0736 | 71.4533 | 299 | 299 | Basalt | | 5.0, 13.50 | 56 | | | | | 8.56 | 10.5 | | | 1336 |
| 44 | Vangadra | Jasdan | Rajkot | EW | 22.2433 | 71.4706 | 334 | 334 | Basalt | | | | 100 | | | 283 | 84.2 | 12 | | | 3910 |
| 45 | Chhibda | Lodhika | Rajkot | EW | 22.1806 | 70.6542 | 215 | 215 | Basalt | | 6.5, 20.0 | | 147.5 | | | | 44.2 | 20 | | | 2890 |
| 46 | Govindpar | Paddhari | Rajkot | EW | 22.3947 | 70.57 | 500 | 500 | Basalt | | 16.5 | 51.5 | | | | | 13.62 | 0.8 | | | 1800 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47 | Satarvadi | Upleta | Rajkot | EW | 21.9283 | 70.1611 | 247 | 247 | Basalt | | 19.5 | | | 158.5 | 204.0, 234.0 | | 51 | 25 | | | 1308 |
| 48 | Vadali | Upleta | Rajkot | EW | 21.9486 | 70.2703 | 500 | 500 | Basalt | | | | | | | 484 | - | 0.2 | | | 1200 |

| Annexure-4 Rajkot District_Rockworks_Lat_Long | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sr No | Bore | Long | Lat | Elevation | CollarElevation | TotalDepth | Easting | Northing |
| 1 | Hathasani | 71.3661 | 22.1316 | 206 | 206 | 200 | 744055 | 2449293 |
| 2 | Rajawadla | 71.1715 | 22.0979 | 220 | 220 | 198 | 724029 | 2445261 |
| 3 | Rajpara | 70.8805 | 22.1146 | 195 | 195 | 202 | 693976 | 2446710 |
| 4 | Nagalpar | 70.8626 | 22.3939 | 142 | 142 | 142 | 691748 | 2477615 |
| 5 | Dadwa Hamirpur | 71.0422 | 22.0064 | 168 | 168 | 203 | 710821 | 2434944 |
| 6 | Panch Talawada | 70.9409 | 22.0658 | 193 | 193 | 203 | 700277 | 2441385 |
| 7 | Mesavada | 71.0211 | 22.3103 | 181 | 181 | 200 | 708194 | 2468568 |
| 8 | Beti | 70.9958 | 22.3894 | 156 | 156 | 215 | 705471 | 2477293 |
| 9 | Juna Rajpipala | 70.9722 | 22.055 | 196 | 196 | 203 | 703523 | 2440230 |
| 10 | Bagdadiya | 70.9854 | 21.968 | 152 | 152 | 203 | 705011 | 2430614 |
| 11 | Ghoghawadar | 70.8726 | 21.965 | 147 | 147 | 201 | 693364 | 2430135 |
| 12 | Dapaliya | 70.5664 | 22.4577 | 72 | 72 | 205 | 661176 | 2484331 |
| 13 | Metoda | 70.6156 | 22.3776 | 78 | 78 | 201 | 666334 | 2475516 |
| 14 | Udakiya | 70.3786 | 21.6482 | 67 | 67 | 200 | 6,42,659 | 23,94,522 |
| 15 | Khajurda | 70.4013 | 21.8871 | 103 | 103 | 201 | 644768 | 2420991 |
| 16 | Mevasa | 70.5949 | 21.876 | 88 | 88 | 200 | 664785 | 2419957 |
| 17 | Bava Pipaliya | 70.6295 | 21.6298 | 114 | 114 | 201 | 668648 | 2392736 |
| 18 | MandanKundala | 70.8701 | 21.8515 | 123 | 123 | 193 | 693259 | 2417564 |
| 19 | Lodhika | 70.6418 | 22.1372 | 158 | 158 | 194 | 669321 | 2448928 |
| 20 | Bhandariya | 71.0514 | 22.1823 | 210 | 210 | 201 | 711508 | 2454435 |
| 21 | Kharachiya Jas | 71.3607 | 22.2477 | 166 | 166 | 196 | 743298 | 2462143 |
| 22 | Dhamalpur | 70.875 | 22.3542 | 149 | 149 | 200 | 693080 | 2473235 |
| 23 | Gadhaka | 70.9555 | 22.2565 | 194 | 194 | 200 | 701512 | 2462521 |
| 24 | Devala | 70.8167 | 21.785 | 112 | 112 | 200 | 687826 | 2410135 |
| 25 | Charkhadi | 70.6621 | 21.9018 | 108 | 108 | 165 | 671699 | 2422887 |
| 26 | Kalasar | 71.2944 | 22.0861 | 232 | 232 | 201 | 736733 | 2444140 |
| 27 | Kothi | 71.1569 | 22.0875 | 209 | 209 | 201 | 722538 | 2444088 |
| 28 | Kolithad | 70.6625 | 22.025 | 128 | 128 | 201 | 671592 | 2436528 |
| 29 | Shrinathgadh | 70.909 | 21.8627 | 131 | 131 | 201 | 697264 | 2418854 |
| 30 | Raydi | 70.4567 | 21.8247 | 73 | 73 | 50 | 650558 | 2414136 |
| 31 | Vavdi II | 70.4494 | 21.959 | 123 | 123 | 147 | 649663 | 2429041 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 4 | | | | | |
| 32 | Jam Kandorna | 70.497 | 21.8936 | 108 | 108 | 201 | 654650 | 2421804 |
| 33 | Gadethad | 70.154 | 21.7788 | 56 | 56 | 133 | 619307 | 2408789 |
| 34 | Vadekhan | 70.0553 | 21.7806 | 105 | 105 | 203 | 609100 | 2408916 |
| 35 | Upleta | 70.2769 | 21.75 | 45 | 45 | 154 | 632041 | 2405701 |
| 36 | Nilalkha | 70.2158 | 21.7139 | 35 | 35 | 200 | 625753 | 2401654 |
| 37 | Chitravad | 70.3503 | 21.9461 | 98 | 98 | 203 | 639441 | 2427475 |
| 38 | Kagwad | 70.6833 | 21.8042 | 98 | 98 | 104 | 674008 | 2412105 |
| 39 | Chichod | 70.2894 | 21.6319 | 99 | 99 | 200 | 633442 | 2392638 |
| 40 | Nani Parabadi | 70.5236 | 21.68 | 77 | 77 | 200 | 657631 | 2398183 |
| 41 | Biladi | 70.9482 | 21.8707 | 130 | 130 | 200 | 701305 | 2419791 |
| 42 | Bhadli | 71.4396 | 22.023 | 142 | 142 | 200 | 751832.2 | 2437384 |
| 43 | Vangadra | 71.4433 | 22.2334 | 141 | 141 | 200 | 751839.7 | 2460694 |
| 44 | Chhibda | 70.6542 | 22.1806 | 158 | 158 | 200 | 670548.1 | 2453747 |
| 45 | Govindpar | 70.5742 | 22.468 | 62 | 62 | 200 | 661966.4 | 2485480 |
| 46 | Satarvadi | 70.1611 | 21.9283 | 95 | 95 | 200 | 619916 | 2425345 |
| | | | | | | | | |