For Official Use

Technical Report Series

DISTRICT GROUNDWATER BROCHURE
ANAND DISTRICT

GUJARAT

Compiled

by

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Government of India

Ministry of Water Resources

Central Ground Water Board

West Central Region

Ahmedabad

December 2013

ANAND DISTRICT AT A GLANCE

SL No	Items	Statistics
1	General Information	
	i) Geographical Area	2941 Sq Km
	ii) Administrative Divisions (As on 31/3/2011) Number of Taluka Number of Villages	 8 350
	iii) Populations (As per 2011 census)	20.90,276
	iv) Average Annual Rainfall	799.6 mm (IMD Normal)
2.	GEOMORPHOLOGY	
	Major Physiographic Units	Piedmont Plain Alluvial Plain Coastal Plain
	Major Drainages	Sabarmati River & Mahi River
3.	LAND USE	
	1. Forest area 2. Net area sown 3. Cultivable area	NIL 186600 ha 296500 ha
4.	MAJOR SOIL TYPES	
	Medium black and shallow black soil.	
5.	IRRIGATION BY DIFFERENT SOURCES (numbers of structures) (Source :Statistical abstract Gujarat 2011)	No.
	Dugwells (Irrigation purpose)	10532
	Total no. of wells including Tube wells.	15919
	Tanks/Ponds	-
	Canals	-
	Net Irrigated area (2006-07)	181500 ha
	Gross Irrigated area (2006-07)	241600 ha
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-03-2008) No of Dug Wells No of Piezometers	28 11 17
8.	PREDOMINANT GEOLOGICAL FORMATIONS	
	Alluvium	

9.	HYDROGEOLOGY						
	Major Water Bearing Formation: Alluvium, forming multi layer aquifer. Depth to water level during 2012 Pre-monsoon (3.15 to 26.56m bgl) Post-monsoon (1.05 to 23.54m bgl) Long term water level trend in 10 yrs (2003- 2012) in m/yrs Pre-Monsoon - Rise : 0.03 to 0.89 m/yr Fall: 0.03 to 0.64 m/yr Post Monsoon -Rise : 0.05 to 3.20 m/yr Fall: 0.007 to 0.3 m/yr						
10.	GROUND WATER EXPLORATION BY CGWB (As on 31 -03 -2012)						
	No of wellsdrilled (EW, OW, Pz, SH, Total)						
	EW 11	OW 18	Pz 21	SH 2	Total 52		
	Depth Range					Up to 300 m	
	Discharge					Up to 20 lps	
	Storativity (S)/ Specific yield (m^3/day)					1.3 e-06	
	Transmissivity					900 m^2/day	
11	GROUND WATER QUALITY					Range(Pre – Monsoon)	
						Min.	Max.
	Electrical Conductivity (m.mohs/cm. At 25 ;C)					790	4370
	PH					7.60	8.27
	Chloride (ppm)					78	1022
	Nitrate (ppm)					15	220
	Total Hardness (ppm)					200	780
	Type of water					Fresh and Saline	
12.	DYNAMIC GROUND WATER RESOURCES (2011)- in						
	Annual Replenisible Ground Water Resources					78878.88 MCM	
	Gross Annual Ground Water Draft					39016.43 MCM	
	Projected Demand for Domestic and industrial Uses upto 2025					6875 MCM	
	Stage of Ground Water Development					52.48%	
13	AWARENESS AND TRAINING ACTIVITY						
	Mass Awareness Programmes organized Date Place No of Participants					Not Organised	
	Water Management Training Programmes organized Date Place No of Participants					Not Organised	

14	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	
	Projects completed by CGWB (No & Amount spent)	None
	Projects under technical guidance of CGWB (Numbers)	None
15	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks	None
	Number of Critical Blocks	None
	Number of blocks notified	None
16	MAJOR GROUND WATER PROBLEMS AND ISSUES	
	➢Inherent salinity in western part ➢Water logging due to over application of canal water and shallow ground water levels ➢Awareness among the people regarding rainwater harvesting and artificial recharge is required ➢Salinity in Ground water in 64 habitats of the district ➢Fluoride problem in groundwater in 96 habitats of the district ➢Uniformity in pumping pattern required. ➢Judicious use of Canal and Ground Water Required by Conjunctive Use planning	

DISTRICT GROUND WATER BROCHURE
ANAND

1 Introduction

Anand district covers an area of 2941 sqkm, lies in the central part of the state. Anand district is situated between north latitudes 22°06' & 22°43' and east longitudes 72°20' & 73°12' and falls in the Survey of India degree sheet No. 46B and 46F. The district is bounded on the north by the Kheda District , on he west by Ahmedabad District and on the east by Vadodara District. The southern boundary of the district is marked by the Gulf of Khambat. Anand District is famous for the Agriculture Co-operative “The Amul” Milk Co-operative which is located at Anand the District Headquarter. The district falls under the canal command of Mahi Right Bank Canal Command Area (MRBC), and has an intensive network of canal. The Canal is fed by weir constructed on Mahi River at Waynesboro in Balasinor Taluka of Kheda District. The flow in the river is regulated by Kadana Dam situated upstream in the Panchmahals district.

1.1 Administrative Divisions

Administratively the district is divided into eight Talukas, Anand is the district headquarters. Location map of Anand district is given in figure -1. The Geographical areas and number of villages in different Talukas, as per the census records is given below in Table 1.

TABLE- 1 GEOGRAPHICAL AREA AND NO OF VILLAGES & TOWNS

Taluka	Rural Area	Urban Area	Total Area	No of Villages			Towns
	Sq. km			Inhibited	Un-inhb.	Total	
Tarapur	2676.33	264.67	2941	42	0	350	1
Sojitra	165.72	0	165.72	25	0	25	0
Umreth	215.73	20.2	235.93	36	0	36	1
Anand	332.51	108.65	441.16	39	0	36	5
Petlad	296.59	9.19	305.78	56	0	56	1
Khambat	773.74	80.24	853.98	57	0	57	1
Borsad	393.59	25.08	418.67	64	0	64	2
Anklav	167.39	21.31	188.7	31	0	31	1
Total	**2676.33**	**264.67**	**2941**	**350**	**0**	**350**	**12**

1.2 Demography

The total population of the district as per 2011 census is 20,90,276, which include 10,88,253 male and 10,02,023 female. The sex ratio is about 921 women per 1000 men. The Talukawise rural and urban population figures are presented in Table-2. The rural population of the district is 1,456,483 souls (7,59,314 male and 6,97,169 Female). The urban population is 6,33,793 Souls (3,28,939 male and 3,04,854 Female). Distribution of population, decadel growth rate, sex ratio & population density is given in the Table-3. The Literacy rate in the males for 2011 is 93.23 & in females is 77.76.

Figure-1

CENTRAL GROUND WATER BOARD, WCR, AHMEDABAD
ANAND DISTRICT
LOCATION MAP

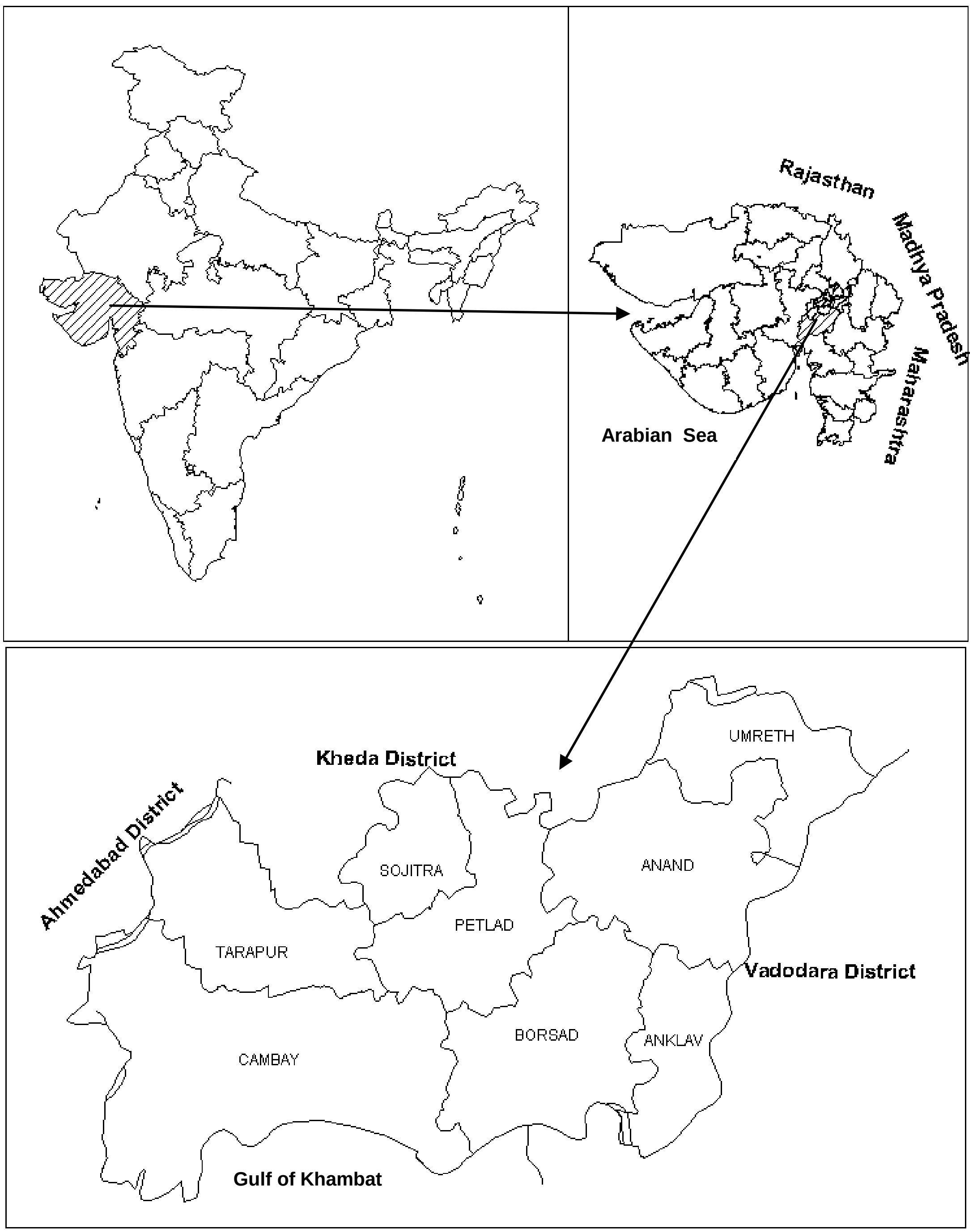


Table -2 : POPULATION AS PER CENSUS

	Urban Population			Rural Population			Total		
District	Male	Female	Total	Male	Female	Total	Male	Female	Total
Anand	328939	304854	633793	759314	697169	1456483	1088253	1002023	2090276

Table -3 DISTRIBUTIONS OF POPULATION, DECADEL GROWTH RATE, SEX RATIO & POPULATION DENSITY.

Population 2011			Percentage decadal growth rate 2001 to 2011	No. of females per 1000 males		Population density per sq. Km.	
Male	Female	Total		2001	2011	2001	2011
1088253	**1002023**	**2090276**	**12.57**	**910**	**921**	**631**	**711**

2 Previous Work

Geological mapping in the Delhi-Aravalli mountainous region in the north-eastern part of the district was carried out by geo-scientists from Geological Survey of India GSI), the prominent among them are Dr.A.M.Heron and P.K.Ghosh (Heron and Ghosh, 1938).

The area received attention of Petroleum Geologists as early as in the fifties when Oil and Natural Gas Commission (ONGC) carried out detailed exploration in the Cambay Basin. The geological mapping in parts of Anand District (erstwhile Kheda district) including the MRBC area has been carried out by the Geological Survey of India GSI) under its programme of the study of Quaternary geology during 1988-89 by B.K.Sareen & A.R.V.Chowdhury.

The ground water surveys in the area commenced in the sixties and have continued till date. V.V.Rane, G.Balasubramaniam , B.K.Singh, etc., of GSI carried out systematic hydrogeological survey between 1962-63 and 1970-71. R.N.Meshram of CGWB carried out systematic hydrogeological survey in 1981-82 and M.N.Khan & P.R.Gupte, of CGWB carried out reappraisal hydrogeological survey in 1984-85. During the year 1990-94, CGWB carried out studies for conjunctive use of surface and ground water in MRBC area to find out technical feasibility and economic viability of optimum utilisation of water resources.

The ground water studies by the Govt. of Gujarat in the MRBC area were taken up during the late sixties through the Ground Water Department, under the PWD. The Gujarat Water Resources Development Corporation (GWRDC) Ltd., carried out resource estimation and feasibility studies for construction of 250 tube wells in the command under Agricultural Refinance Development Corporation (ARDC) scheme in 1986. Specific studies on conjunctive use of surface and ground waters were taken up by the GWRDC during 1985-86.

The Water Technology Centre of Indian Agricultural Research Institute (IARI) carried out the resource analysis and prepared a plan for efficient water management for the MRBC area during the year 1983. The Space Application Centre (SAC) of Indian Space Research Organisation (ISRO) has done the study of MRBC area using the satellite imagery to identify the water logged and salinity affected areas in 1981.

3 Rainfall and climate

Temperatures vary considerable from season to season. As per climatological data of nearest Indian Meteorological Department (IMD) Station at Ahmedabad the summers are generally hot and winters are cool. Mean maximum temperature ranges between 28.4°C during January to about 41.8°C during May and the mean minimum temperatures vary between 11.7°C during January and 27°C during June.

The relative humidity in Anand as per IMD varies between 32% during March and 79% during August. The wind velocity in the district varies from about 74 km/d during November and 174 km/d during June.

The potential Evapo-transpiration, calculated using Penman's Method varies between 3.2 mm/d during December and 7.8 mm/d during may.

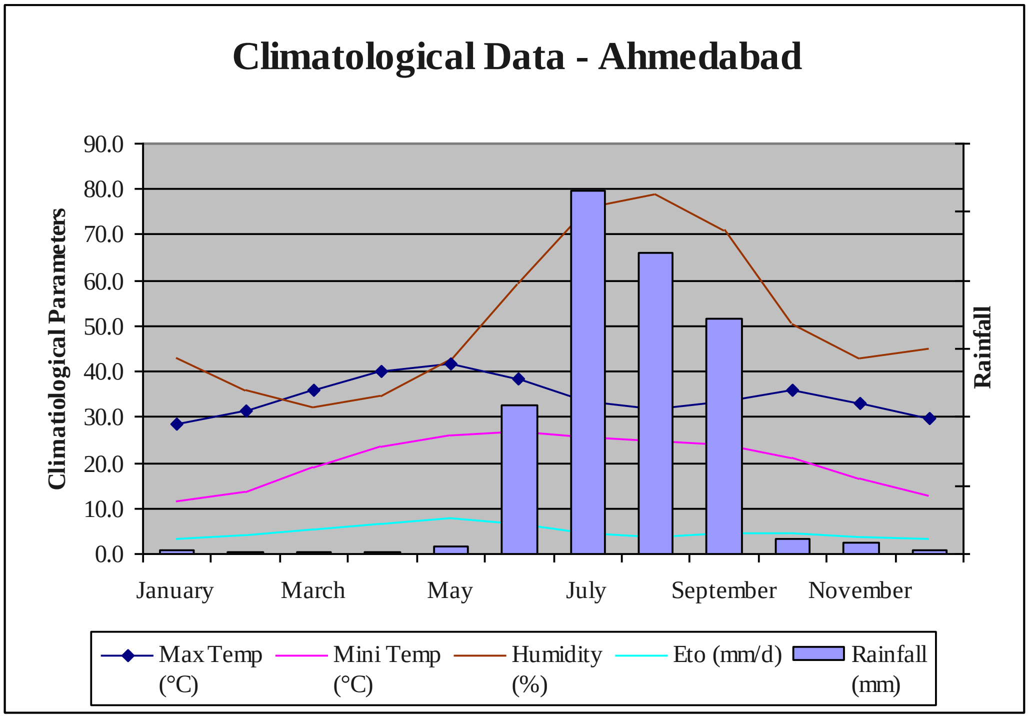
Long-term average annual rainfall for Ahmedabad IMD station is 799.6 mm. Most of the rainfall is received during south-west monsoon between June and September.

Table-3 : Climatological Data of Ahmedabad IMD Station

Climatological Data

Station:	Ahmedabad		District	Ahmedabad	
Altitude:	55	m AMSL	HA	13	**0.72**
Latitude:	23°04'	N	Longitude:	72°38'	E

Month	Max Temp (°C)	Mini Temp (°C)	Humidity (%)	Wind Spd. Kmpd	Sunshine (Hours)	Solar Rad. (MJ/m2/d)	Eto (mm/d)	Rainfall (mm)
January	28.4	11.7	43.0	100.1	9.6	17.5	3.4	2.6
February	31.3	13.8	36.0	101.8	10.2	20.5	4.2	1.1
March	36.0	18.8	32.0	108.7	9.3	21.7	5.3	1.0
April	39.9	23.4	34.5	120.8	10.0	24.5	6.6	0.9
May	41.8	26.2	42.5	158.7	10.6	25.9	7.8	6.0
June	38.4	27.0	59.5	174.2	8.8	23.2	6.7	108.7
July	33.3	25.7	76.0	150.1	4.6	16.8	4.4	265.3
August	31.9	24.8	79.0	124.2	4.3	16.0	3.9	219.8
September	33.4	24.1	71.0	103.5	6.7	18.5	4.4	171.9
October	35.8	20.9	50.5	74.2	9.5	20.3	4.4	10.8
November	33.2	16.5	43.0	79.4	9.7	18.1	3.6	8.9
December	29.8	13.0	45.0	91.4	9.5	16.7	3.2	2.6
Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**799.6**
Average	**34.4**	**20.5**	**51.0**	**115.6**	**8.6**	**20.0**	**4.8**	**-**



4 Geomorphology and Soil Type

The present physiographic set up is a combined result of diversified lithology, structure and denudational as well as depositional processes active in the area. Geomorphologically, the district can be broadly classified into following major zones:

1 Piedmont plain
2 Alluvial Plain &
3 The Coastal Plains (Bhal)

Piedmont plain: A belt of about 15-20 km width fringing the hilly terrain in the north east extending approximately 70-80 m amsl elevation constitute piedmont plain. This belt is characterised by moderate relief, shallow alluvium with at places boulder/gravel beds.

Alluvial Plain: It is the single most prominent geomorphic unit and covers the major part of the district. It forms part of the inter cratonic Cambay graben, where sediments have been deposited in a slow sinking basin. Wind as carrier has dumped or deposited sand and silt covering paleo-topography and older formations. It is a vast sandy tract characterised by gently sloping, slightly rolling to undulating topography owing to presence of blown sands at surface. Over all drainage density is low and most of the area, particularly the mid stream part of Mahi and Sabarmati river, is devoid of well developed drainage net work. River alluvium is observed along the rivers Mahi, Sabarmati, Vatrak in the form of channel or flood deposits. Terrain slope are moderate to low. Charotar plain lying between the rivers Shedi and Mahi in the central part is one of the richest agriculture belt of Gujarat. Bad land topography is observed all along the bank, with bank height 15-20 m, of river Mahi indicating active erosion.

Coastal Plains (Bhal Region): In the south-western part, mainly in Trapur and Khambat talukas, alluvial plain merges with the coastal Bhal area. BHAL in the local language means forehead where nothing grows. Such areas have saline soil and is monotonously flat with few isolated and continuous patches of marshy lands with salt encrustation, which are at places contiguous to the marshy lands of the gulf. In this conspicuous landform, terrain is monotonously flat & low lying with general elevations less than 30-40 m AMSL. Such areas are mostly wasteland and is devoid of vegetation. During monsoon period, such tract is covered by a large sheet of water.

5 Land Use and Cropping Pattern

In the district the as per the landuse data available for 2011 the area under Forest land is nil , land not available for cultivation is 73900 ha and other Uncultivable area excluding fallow land is 24800 ha, and fallow land is 9400 ha. Net area sown is 186600 ha, area sown more then once is 109900 ha, and total cropped area is 296500 ha. Cropping intensity in the district is 158.90%. The net area irrigated by Govt.canals (including panchyat canals) is 95700 ha. The net area irrigated bydifferent sources is 181500 ha, and percentage of net area irrigated to net area sown is 97.27%. The gross cropped area is 296500 ha, and gross irrigated area is 241600 ha. The percentage of gross area irrigated to gross cropped area is 81.48% and irrigation intensity is 133.11.

The crops are cultivated in all three seasons. The main kharif crops are paddy and Juwar. Wheat and pulses are the main rabi crops. The main crops taken during summer are Juwar and groundnut. The two seasonals, namely tobacco and cotton are spread over the kharif and rabi seasons. Sugarcane is the main perennial crop.

6 Ground Water Scenario

6.1 Geology

Quaternary, Post Miocene and Tertiary sediments in the area were deposited over a sinking basement. The main formation is of quaternary age, formed by alluvium deposited by Mahi, Sabarmati and Watrak rivers. They comprise multilayered formations of gravel, sand, clay and kankars intermixed at places. The clay and sand horizons form alternate layers having pinching and swelling nature. The kankars, pebbles and the gravels form lenses. Thickness of alluvium increases from north and north west towards south and south west direction. Alluvium is underlain by Deccan traps in general with intervening blue clays at some places. The general geological succession is as given below.

Era	Age	Lithology
Quaternary	Recent and Pleistocene	Unconsolidated pebble, gravel, sand, silt and clay.
	Pliocene	Gray to reddish clay, claystone and sandstone.
~~UNCONFORMITY~~~~~~~~~~~~~~~~~~		
Tertiary	Miocene	Gray shale, claystone and conglomerate.
	Eocene	Dark gray to black, carbonaceous shale.
~~UNCONFORMITY~~~~~~~~~~~~~~~~~~		
Cretaceous	Upper	Basalt.

6.2 Hydrogeological Setting

The Anand district lies in the Cambay basin situated between Saurashtra Crater and Aravali Swell and Deccan Shield in the east. The basin comprises both marine and non-marine formations. Major part of the district is underlain by alluvium which inturn is underlain by Tertiary sedimentary formations with in The Cambay Sedimentary Basin. The alluvium mainly consists of fine to coarse grained sand, gravel, silt, clay and Kankar. The thickness of alluvium gradually increases from piedmont zone in the northeast towards west and southwest. Maximum thickness of alluvium in the district is estimated to be about 250-300 m in the south, central part.

Ground water occurs both under phreatic and confined conditions in arenaceous horizons that form a multi-layered aquifer system. The occurrence and movement of ground water is mainly controlled by inter-granular pore spaces. Two major aquifers can be identified within the explored depth. Ground water in the upper unit occurs under phreatic conditions, which at places becomes semi-confined to confined. The lower unit, comprising a few hundred metres of alternating sandy and clayey horizons, forms a multiple confined aquifer system. The general disposition of these aquifers in the study area is as follows.

Description	Aquifer	Depth (m bgl)
Hydrogeological Unit I	Phreatic	Less than 40
Hydrogeological Unit II	Confined I	40 - 195
	Confined II	205 - 275

Towards east and northeast, in the piedmont plain, the nature of sediments is more uniform and only phreatic aquifer is present. This belt forms the principal recharge zone for the deeper aquifers. The argillaceous beds in the central and western parts, mainly act as confining layers.

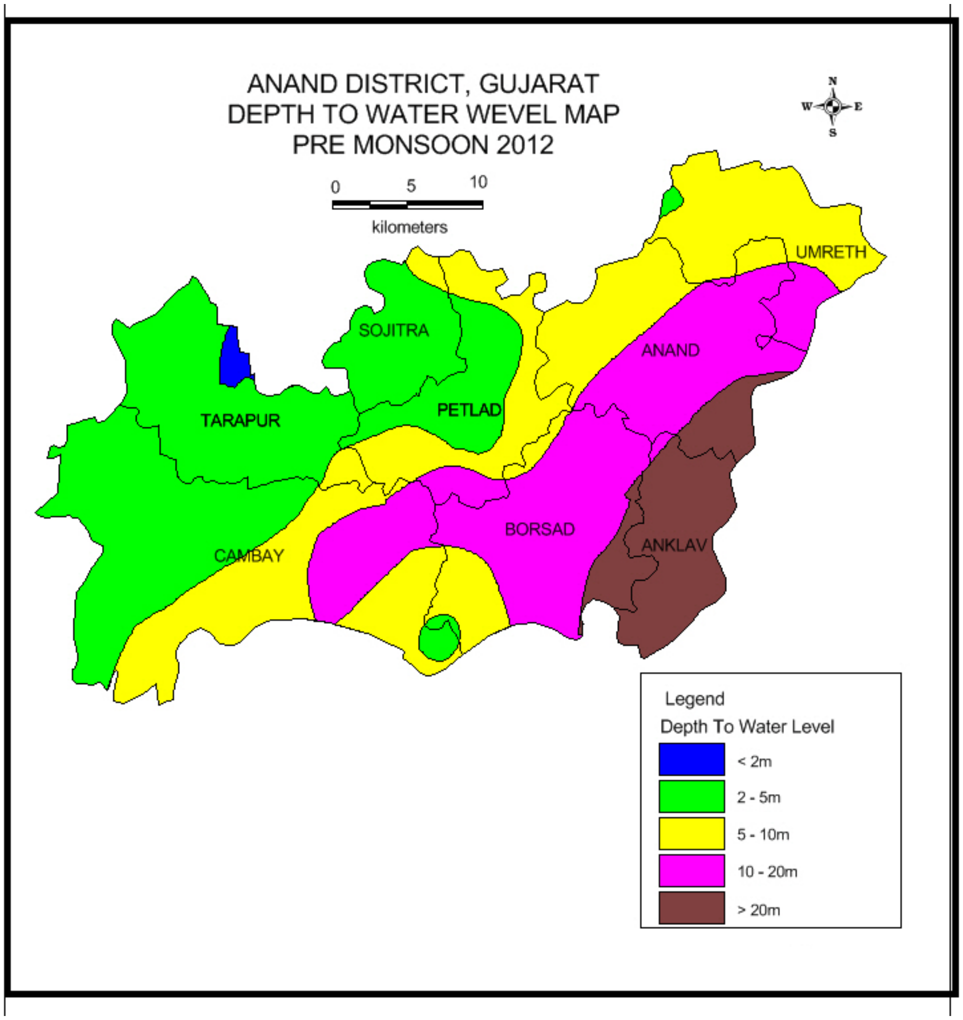
Ground water is extensively developed by dug, dug-cum-bored and tube wells in areas underlain by alluvium. Depth of dug and dug-cum-bored wells varies from 5 m to 38 mbgl whereas depth to water level, in general, varies from 5 to 15 mbgl.

The depth to ground water in the vicinity of the Mahi river in the east is deepest and gradually become shallower towards west. The general depth to ground water is between 5 and 10 mbgl. The average fluctuation, between premonsoon and postmonsoon seasons, recorded during the studies is of the order of 3m. It varies from 0.60m to 10.26m. The quality of ground water is generally suitable for irrigation, and the hydrogeological conditions are conducive to ground water development through dug wells, dug-cum-bored wells and tube wells.

6.3 Ground Water Regime Monitoring

Groundwater regime monitoring are being carried out four times in a year during May, August, November & January. In all 27 hydrograph stations (12 Open wells & 15 purpose build Piezometers) spread over the entire district were monitored during the 2012. The groundwater level during the premonsoon period (May 2012) ranged from 3.15 m to 26.56 mbgl. Depth to water level map for the pre-monsoon period 2012 is given in figure- 2.

Figure-2



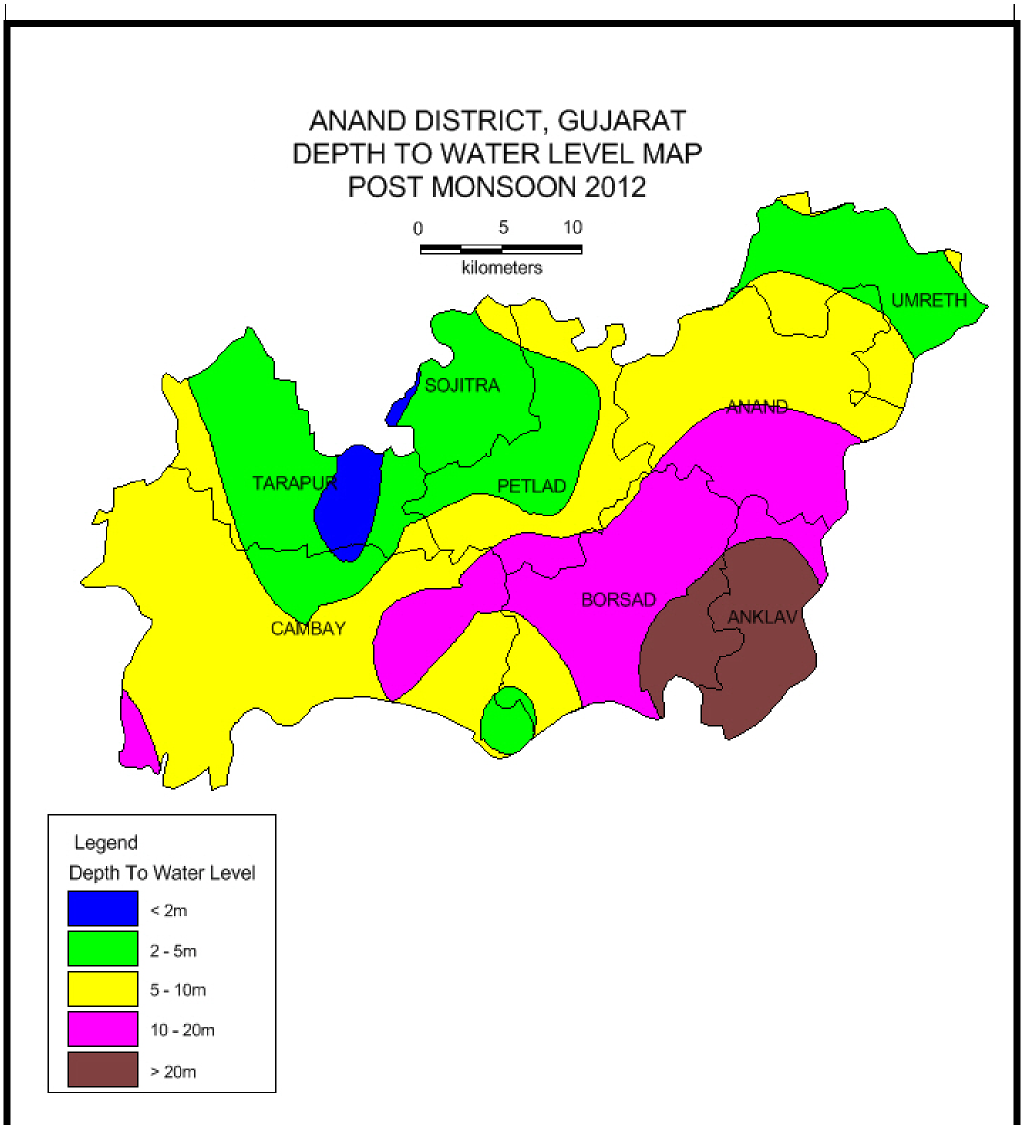
Shallowest water level of 3.15 mbgl was recorded in Laxmipura village and the deepest water level of 21.63 mbgl was recorded in Navapura village of the district. The range of groundwater level in the district is table -4.

Table -4 Range Of Groundwater Level in Anand District During Pre monsoon May 2012.

District	No of well analysed	DTWL mbgl		No of well in different Ranges & %				
		Min	Max	0 to 2 (m)	2 to 5(m)	5 to 10(m)	10 to 20(m)	20 to 40(m)
Anand	12	3.15	26.56	NIL	5	2	3	2
				-	41.367	16.66	25.0	16.66

The groundwater level during the post-monsoon period (Nov 2012) ranges from 1.05 m to 26.56 mbgl. Spatial distribution of groundwater level in the district is shown in figure 3. Shallowest water level of 1.05 mbgl was recorded in Laxmipura village and the

Figure-3



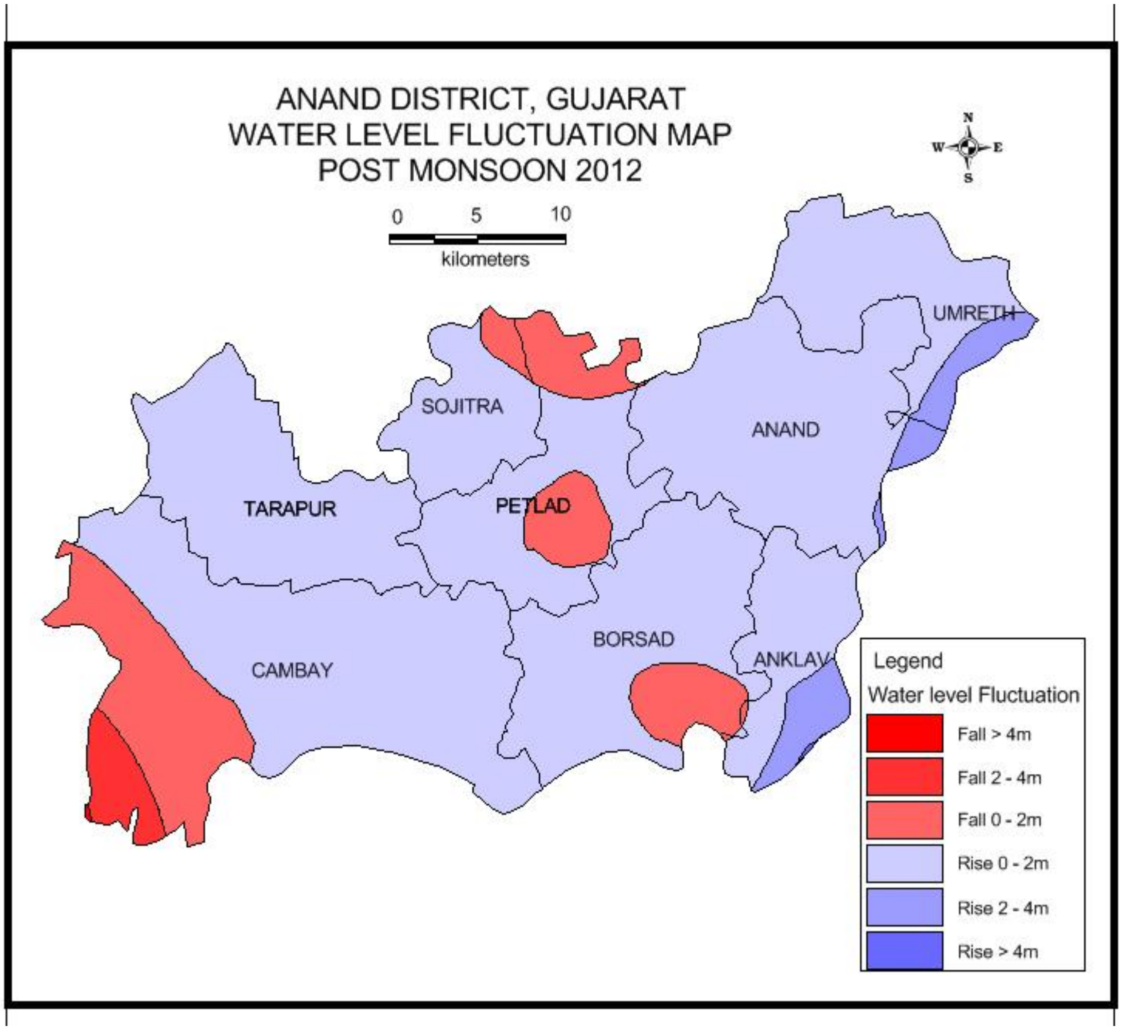
deepest water level of 26.56 mbgl was recorded in Navapura village of the district. The range of groundwater level in the district is table-5.

Table -5 Range Of Groundwater Level In Anand District During Post Monsoon November 2012.

District	No of well analysed	DTWL mbgl		No of well in different Ranges & %					
		Min	Max	0 to 2 (m)	2 to 5(m)	5 to 10(m)	10 to 20(m)	20 to 40(m)	>40(m)
Anand	11	1.05	26.56	NIL	6	1	2	2	-
				-	54.54	9.09	18.18	18.18	-

Seasonal Water level fluctuation between May 2012 to November 2012 shows the rise of water level of less than 2 to 4m. Ninety one percentages (91%) of the wells in the district showed rise in the groundwater level between May to November 2012. Rise in the district ranges from 1.05 to 3.54 m and fall is not observed in any well, only one well show neither rise nor fall in the water level. Minimum rise of 1.05 m was recorded in Bandhani village and the Maximum rise of 3.54 was recorded in Ghora village. 54.54% wells recorded rise between 0 to 2 m and 36.36 % wells recorded rise between 2 to 4m between May to November 2012. Fall was not recorded in any station. Water level fluctuation map for the pre and post-monsoon 2012 is given in figure-4.

Figure-4



Long term water level trend during pre-monsoon period (2003 to 2012) shows rise in water level between 0.05 to 0.89 m/yr and fall between 0.03 to 0.64 m/yr. Long term water level trend during post monsoon period shows rise in water level from 0.05 to 0.34m/yr. And fall from 0.007 to 0.34m/yr.

6.4 Ground Water Potential

The yield of wells tapping alluvium is in general high and ranges from 200 to 1000 m3/day for 3 to 5 m draw down. Pumping tests conducted on dug well show that the discharges of wells vary from 7.2 to 98 m3/hr for 0.28 to 9.23 m draw down. The sp. cap. of wells ranged from 13 to 1670 lpm/m. The aquifer parameters of phreatic aquifer were determined by conducting controlled pumping tests conducted on well-fields constructed by CGWB at select locations mainly in the district. The results show that the transmissivity of aquifer ranges from 500 to 2300 m3/day and hydraulic conductivity varies from 10 to 80 m/day. The specific yield of the aquifer varies from 6 to 12%. In the south western part, in Tarapur/Khambat taluka in BHAL area, very limited development of ground water resources is observed in spite of very shallow water table because of the salinity.

The tube wells are one of the main ground water withdrawal structures tapping both shallow as well as confined aquifers. Tube wells range in depth from 40 to 180 m with an average depth of about 150 m. The tube wells are shallow that is less than 80 m depth in the piedmont/ recharge area where thickness of alluvium is restricted and bed rock &/or tertiary clay occur below it. However in central and western parts tube wells are deep, more than 120 m depth.

Depth to water level (piezometric surface) of deeper confined aquifers ranges from near surface in Bhal area in the western part to about 40-45 mbgl in the north western part. The discharges of tube wells vary from 12 to 45 lps for small draw downs. The average yield of a 150 m deep tube well is around 30 lps for economic draw downs. The transmissivity of deeper aquifer varies from 300 to more than 1200 m2/day.

Free flowing artesian wells were reported earlier, in fifties, in western part of the district. Their depths were more than 300 mbgl and reportedly yielded ground water of inferior quality. However, free flowing wells are not observed at present.

6.4.1 Ground Water Movement

The water table elevation for phreatic aquifer for pre-monsoon shows that the general gradient of water table is towards south west, i.e. Gulf of Khambat. The steeper gradients are observed along Mahi river whereas the gentler gradients are in the central parts. However, in Bhal area the water table gradients are almost flat.

The piezometric heads in the confined aquifer range from 40 m amsl in the north-eastern parts to 10 m amsl in the south-western parts. Steep gradients in south-eastern, gentle gradients in the central to south-western are seen.

6.4.2 Ground Water Quality

The ground water quality in both phreatic and confined aquifer is generally good, the values of EC in water samples collected from hydrogrph stations varies from 790 to 4370 micromhos/cm at 25°C.

In Bhal area the quality of ground water in phreatic aquifer is brackish to Saline. The ground water quality in confined aquifer is in general within permissible limits, however, the deep exploratory wells indicated presence of saline aquifer.

The quality deteriorates gradually from northeastern part to south-western part of the command.

Ground water quality in shallow aquifer is being monitored through Ground Water Monitoring Stations in the district. Analysis of ground water quality data for May 2012 is presented in the table- 6.

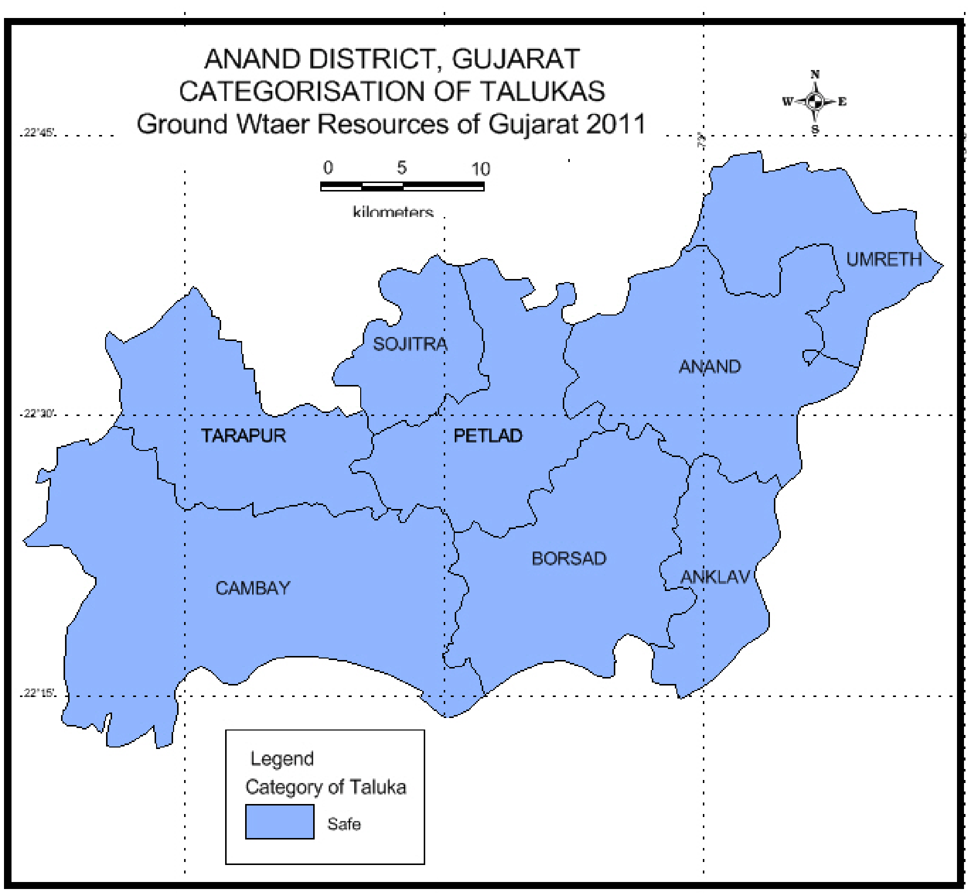
Table- 6 Range of Different Chemical Constituents in Groundwater

Chemical Constituents	Minimum	Maximum
PH	7.60	8.27
Ca (ppm)	2.8	164
Mg (ppm)	12	156
Na (ppm)	95	865
K (ppm)	1.4	14.5
Cl (ppm)	78	1022
No3 (ppm)	15	220
So4 (ppm)	4	275
HCO3 (ppm)	293	1086
TH (ppm)	200	780
EC (□ S/cm)	790	4370
Fluoride (ppm)	0.23	2.0
Alkalinity(ppm)	240	890
SAR	2.1	18.4
Fe	0.01	0.34
TDS	712	2928

6.4.3 Ground Water Resources

The ground water resources potential as on March 2012 of Anand district and stage of development are presented in table 6. None of the taluka in the district are overexploited. The stage of categorisation is shown in Figure-5.

Figure-5



The level of ground water development varies from 17.09 % (Tarapur Taluka) to 63.27 % (Anklav Taluka). Overall level of ground water development in the district is 52.48%.

Prime source of ground water irrigation in the district are dug wells, shallow and deep tube wells and canals.Net irrigated area is about 181500 ha. Irrigation intensity is 133.11 %. Net irrigated area through canals is 95700 ha. The detailed data of the ground water resources is given in Annexure-I

7 Ground Water Management Strategy

7.1 Water Conservation and Artificial Recharge

Anand district is occupied by only minor rivers and streams and no major rivers occur in the district. However, it is bounded by two perennial rivers i.e. Mahi and Sabarmati Rivers. The area is irrigated in all the three seasons and about 1000 MCM of surface water is applied through a net work of canals of MRBC canal system. The ground water are sallow in major part of the district excepting along the Mahi River where deep water levels of about 25 mbgl are observed. Rainwater harvesting in these deep water level area can be adopted to stabilise ground water levels.

8 Ground Water Related Issues and Problems

8.1 Insitu Salinity:

The western area of Anand district occupying parts of Khambat and tarapur Taluka are known as Bhal Area, they have inherently saline soil.

8.2 Industrial Pollution:

The noteworthy notified industrial areas are Anand, Vallabh Vidhya Nagar, Khmabhat, Tarapur, Petlad, Vasad. Industries are mainly agriculture based which include Amul brand – Gujarat Milk Co-Operative Federation. There are also oil producing areas in Khambat and Borsad talukas. Although there are no major polluting industries in the district yet quality of ground water is to be monitored in the industrial areas to avoid any pollution due to industries.

8.3 Inadequate sewerage disposal and Industrial waste:

Problems relating to inadequate sewerage disposal and industrial waste are posing great environmental hazards in small urban areas, resulting into degradation and depletion of freshwater resources.

8.4 Salinity ingress:

Under natural system, two main rivers of the district, the Mahi and Sabarmati has tidal ingress up to few kilometres inland from their estuarine zone. With construction of major dam on Mahi (1970) and Sabarmati Dharoi (1973), there has been drastic reduction in flow of river in down stream area of dam. Coupled with ever increasing high ground water development, the base flow is reducing drastically since last two decades and ultimately tidal water ingress came several kilometres inland.

8.5 Water-Logging & Soil Salinity:

Large areas of western part of the Anand district have shallow ground water levels and face problem of water logging and ground water salinity. These area are formed of fine soil and display poor drainage. Due to over application of canal irrigation there is a gradual shallowing of water table over the years, this has caused increase in salinity of soils.

9 Awareness and Training Activity

Till now no mass awareness programme has been conducted in the district

10 Areas Notified by CGWA/SGWA

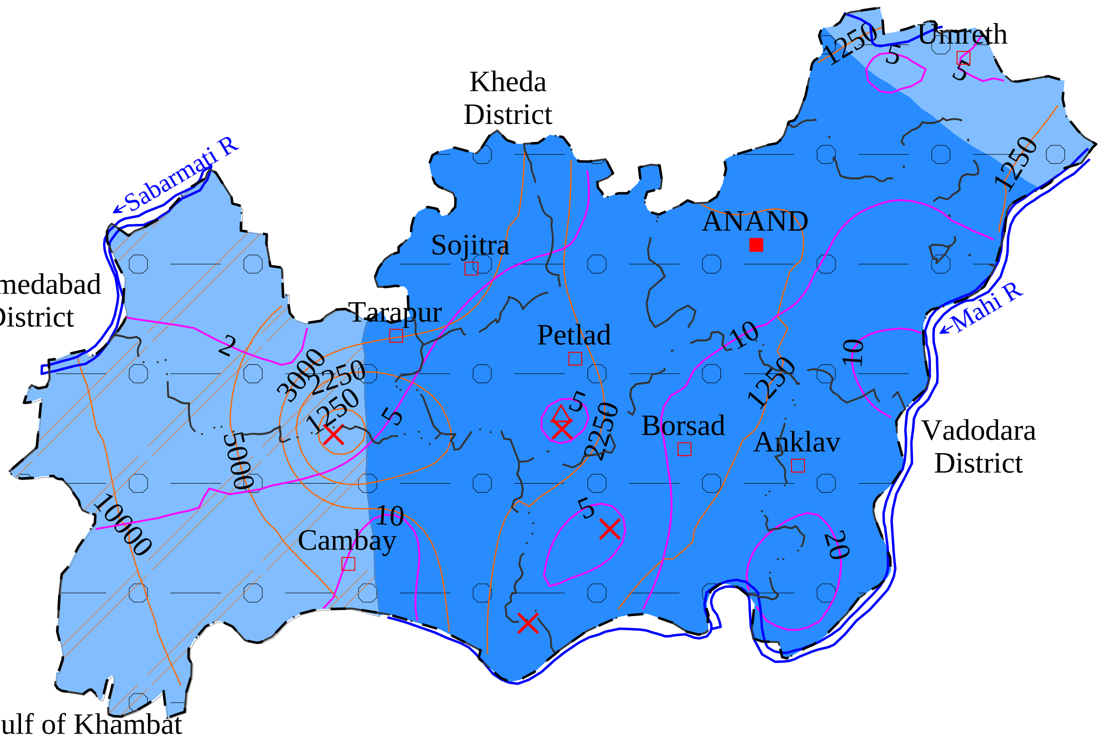
No Takukla talukas have been notified by CGWA.

11 Recommendations

- There is an urgent need for management of the surface as well as ground water resources available and conjunctive use of ground water is to be adopted in the district.
- Creating awareness among the farmers regarding water conservation through judicious use of water and adoption of efficient irrigation techniques like drip/sprinkler irrigation.
- The land holding of the group of farmers under public tube well irrigation should be brought under the provision of the change in crops, irrigation practices and installation of drip/sprinkler irrigation technique. soft term institutional finances to the farmers and liberal subsidies in equipments are suggested.
- Resorting to artificial recharge practices by diverting surplus run-off during monsoon into ponds, percolation tanks,. Spreading basins, abandoned dug wells etc. is suggested.
- Taking up artificial recharge at suitable place will help in stablising the ground water regime through appropriate techniques with active community participation.
- Institutional finance and appropriate technology should be freely made available to any individual or cooperative group of farmers that undertake resource augmentation and management measures.

Plate-I

HYDROGEOLOGICAL MAP
ANAND DISTRICT
GUJARAT



Legend

	Wells Feasible	Rigs Suitable	Depth of Well (m)	Discharge (lpm)	Artificial Recharge Structure Suitable
Soft Rock Aquifer	Dug Well Shallow Tubewell	Manual Direct Rotary, Reverse Rotary	10- 20 50-100	50- 300 500-1000	Percolation Tanks/ Ponds, Recharge Wells,
Soft Rock Aquifer	Dug Well Deep Tubewell	Manual Direct Rotary Reverse Rotary	10- 25 100-200	400-600 800-1200	Percolation Tanks/ Ponds, Recharge Wells, Recharge Shaft
Saline Area	Not Suitable except localised fresh water pockets				
20	Pre-monsoon Decadal mean (1993-2000) Depth to Water Level (mbgl)		2000	Electrical Conductivity (µS/cm at 25° C)	
X	Fluoride > Maximum Permissible Limit (1.5 mg/l)		□	Nitrate > Maximum Permissible Limit (100 mg/l)	
	Drainage		■ /□	District/Taluka HQ	

Annexure –I

TALUKA WISE GROUND WATER RESOURCES, AVAILABILITY, UTILIZATION AND STAGE OF GROUND WATER DEVELOPMENT (AS ON MARCH 2011)

District : Anand

Sr .No.	Taluka	ANNUAL REPLENISHABLE GROUND WATER RESOURCE (mcm)					Natural Discharge during non-monsoon season (mcm) (5 % of 7)	Net Annual Ground Water Availability (mcm) (7- 8)	ANNUAL GROUND WATER DRAFT (mcm)			Projected Demand for Domestic and Industrial uses upto 2025 (mcm)	Ground Water Availability for future irrigation (mcm) {(9)-(10+13)}	Stage of Ground Water Development (%) (12/9) * 100	Category
		Monsoon		Non Monsoon		Total Annual Ground Water Recharge (3+4+5+6)			Irrigation	Domestic And Industrial uses	Total (10 + 11)				
		Recharge from rainfall	Recharge from other sources	Recharge from rainfall	Recharge from other sources										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Anand	8532.18	3371.52	0.00	3648.25	15551.95	777.60	14774.35	6560.00	1553.90	8113.90	2083.00	6131.35	54.92	Safe
2 #	Anklav	3088.34	1400.45	0.00	1464.83	5953.62	595.36	5358.26	2982.20	407.81	3390.01	546.00	1830.06	63.27	Safe
3	Borsad	4966.10	4700.98	0.00	4757.05	14424.14	721.21	13702.94	7260.80	1053.00	8313.80	1412.00	5030.14	60.67	Safe
4	Cambay	4524.07	3068.32	0.00	2492.64	10085.03	504.25	9580.78	4764.60	493.56	5258.16	662.00	4154.18	54.88	Safe
5	Petlad	4063.65	4000.09	0.00	4618.63	12682.37	634.12	12048.25	6742.00	803.08	7545.08	1077.00	4229.25	62.62	Safe
6 #	Sojitra	2545.01	1506.56	0.00	1900.51	5952.07	595.21	5356.87	1484.80	181.95	1666.75	244.00	3628.07	31.11	Safe
7	Tarapur	2671.82	1019.44	0.00	1237.70	4928.96	246.45	4682.52	657.00	143.26	800.26	192.00	3833.52	17.09	Safe
8	Umreth	4169.43	2555.46	0.00	2575.86	9300.74	465.04	8835.71	3437.00	491.47	3928.47	659.00	4739.71	44.46	Safe
Total		**34560.59**	**21622.82**	**0.00**	**22695.47**	**78878.88**	**4539.23**	**74339.65**	**33888.40**	**5128.03**	**39016.43**	**6875.00**	**33576.25**	**52.48**	**Safe**