



For official use  
Technical Report Series

**GROUNDWATER BROCHURE**  
**Daman**  
**UT of DAMAN & DIU**

**Compiled**  
**By**

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**Government of India**  
**Ministry of Water Resources**  
**CENTRAL GROUND WATER BOARD**  
**West Central Region**  
**Ahmedabad**

**September 2013**

UT OF DAMAN AT A GLANCE

SL No.	Items	Statistics	
<b>1</b>	<b>General Information</b>		
	i) Geographical Area	<b>72 Sq.Km</b>	
	ii) Administrative Divisions (As on 31/3/2007) Number of District (Admn Area) Number of Villages	<b>1</b> <b>1</b> <b>22</b>	
	iii) Populations (As per 2011 census)	<b>160,885</b>	
	iv) Average Annual Rainfall (Decadal Average(2001-2011))	<b>2061 mm</b>	
<b>2.</b>	<b>GEOMORPHOLOGY</b>		
	Major Physiographic Units	<b>Gently undulating topography with small hillocks</b>	
	Major Drainages	<b>Daman Ganga</b>	
<b>3.</b>	<b>LAND USE</b>		
	a) Forest area b) Net area sown c) Cultivable area	<b>1.23 Sq.Km</b> <b>2.70 Sq.Km</b> <b>28.32 Sq.Km</b>	
<b>4.</b>	<b>MAJOR SOIL TYPES</b>	<b>Black cotton soils &amp; Alluvial soil</b>	
<b>5.</b>	<b>AREA UNDER PRINCIPAL FOODGRAIN CROPS</b>	<b>27.85 Sq. Km.</b>	
<b>6.</b>	<b>IRRIGATION BY DIFFERENT SOURCES</b> (Areas and numbers of structures) (Source :Statistical abstract Gujarat 2006)	<b>No.</b>	<b>Area</b>
	Dugwells	<b>68</b>	
	Tube wells/Bore wells	<b>11</b>	
	Canals		<b>2.87 Sq.Km</b>
	Other Sources		
	Net Irrigated area (Sq Km) (2002-03)	<b>2.29 Sq.Km</b>	
	Gross Irrigated area (Sq Km) (2002-03)	<b>2.42 Sq.Km</b>	
<b>7.</b>	<b>NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-03-2009)</b> No of Dug Wells No of Piezometers	<b>10</b> <b>1</b>	
<b>8.</b>	<b>PREDOMINANT GEOLOGICAL FORMATIONS</b>		
	<b>a) Deccan trap (Hard rock)</b> <b>b) Coastal Alluvium</b>		
<b>9.</b>	<b>HYDROGEOLOGY</b>		
	<b>Major Water Bearing Formation: Deccan trap and Alluvium</b> <b>Depth to water level during 2011</b> <b>Pre-monsoon 4.08- 8.40 (m bgl)</b> <b>Post-monsoon 0.98- 5.38 (m bgl)</b>		

<b>10.</b>	<b>GROUND WATER EXPLORATION BY CGWB (As on 31 -03 -2012)</b>				
	<b>No of wells drilled (EW, OW, Pz, SH, Total)</b>				
	<b>EW</b>	<b>OW</b>	<b>Pz</b>	<b>SH None</b>	<b>Total</b>
			1		
	Depth				<b>32 mbgl</b>
	Discharge				<b>1.65 lps</b>
	Storativity (S)				-
	Transmissivity (m <sup>2</sup> /day)				-
<b>11</b>	<b>GROUND WATER QUALITY</b>				
	Presence of chemical constituents more than permissible limit ( e.g. EC,F,As,Fe )				<b>For drinking – No For Irrigation: Sodium Alkalinity Hazard Ion toxicity</b>
	Type of water				<b>Potable to slightly brackish</b>
<b>12.</b>	<b>DYNAMIC GROUND WATER RESOURCES (2009 )</b>				
	Total Annual Ground Water Recharge				<b>9.86 mcm.</b>
	Net Annual Ground Water Availability				<b>8.87 mc</b>
	Gross Annual Ground Water Draft				<b>7.72 mcm</b>
	Projected Demand for Domestic and industrial Uses up to 2025				<b>2.89 mcm</b>
	Stage of Ground Water Development				<b>87.03 % (Semi Critical)</b>
<b>15</b>	<b>GROUND WATER CONTROL AND REGULATION</b>				
	Number of OE Blocks				<b>NONE</b>
	Number of Critical Blocks				<b>NONE</b>
	Number of blocks notified				<b>NONE</b>
<b>16</b>	<b>MAJOR GROUND WATER PROBLEMS AND ISSUES</b>				
	<ul style="list-style-type: none"> <li>i) <b>Salinity in Ground water near coast and creeks.</b></li> <li>ii) <b>The flood discharge and effluent seepage of streams are lost by way of surface runoff.</b></li> <li>iii) <b>There is intense ground water development in basaltic and alluvium aquifer.</b></li> <li>iv) <b>There is scope for artificial recharge in alluvial aquifers around Moti Daman area.</b></li> </ul>				

Daman is a small port on the Arabian Sea. It is a Union Territory under UT of Daman & Diu and the capital of the UT. Daman is situated between north latitudes 20°22' & 20°29'58" and east longitudes 72°49'42" & 72°54'43" and falls in Survey of India toposheet No. 46 D/15. It covers an area of 72 sq. km. Its length measures 11 km from extreme north to south and the width measures 8 km. from east to west. The UT is bounded on the north, east and south by Valsad district of Gujarat state and west by Arabian Sea.

The river Daman Ganga passing through the middle of Daman divided it in to two parts namely Moti Daman and Nani Daman. The altitude is 12 m amsl. The Kolak river flows along the northern boundary and the Kalu nadi forms the southern boundary. These three rivers flowing almost parallel to each other enter Daman from south east and follow almost westerly course. There are 22 villages, 10 village panchayats, one municipal council and one town under the Daman district.

The total population of the district as per 2011 census is 160,855, which includes 124,461 male and 66,394 female. The sex ratio is about 591 female per 1000 male. The rural population is 32,251 and urban population is 158,604.

The mean minimum temperature is 12°C and the mean maximum temperature is 37°C. Due to proximity of the sea the humidity is generally high being 100% in the monsoon period and around 24% during summer. The winds are generally moderate except during late summer and monsoon period when they are very strong. The maximum wind speed is 30 km/hr.

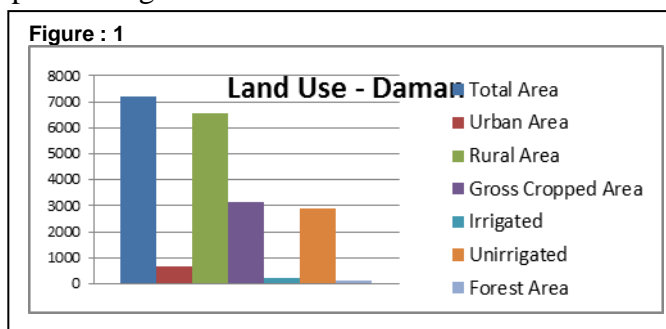
### 1. Land Use Pattern & Rainfall

The rapid urbanization and industrialization during last two decades is observed in change land use pattern of the Daman area. Concurrent groundwater development has also lead to lead to adverse negative impact on the available limited freshwater resources. Under these circumstances, it becomes important to effectively manage the available freshwater resources. For sustainable development and better management of the aquifer system, the information on existing land use pattern, groundwater development structures and hydrogeological features of the area is essential. The brief account of each of these attributes, as per available data is described as follows.

The Daman district has total geographical area of 7200 hectare, comprising of Daman as main town and other 20 villages. Out of total areas of 7200ha, nearly 4 % areas is barren and uncultivated land ; mostly it is marshy land normally inundated during high tides. There is about 39 % (2832 ha) of land is under cultivation. Food crops, mainly Bajra, wheat and millet are as main crop are depends on rainwater and main crops are comprises Orchards, Coconut, chicku and Mango Plantations and vegetable gardens etc. The details of the land use pattern is given as table below table 1 and also depicted graphically in figure -1.

Table : 1 Details of Land Use

<b>Total Area (ha)</b>	<b>7200</b>	
<b>Urban Area (ha)</b>	<b>650</b>	<b>9%</b>
<b>Rural Area (ha)</b>	<b>6550</b>	<b>91%</b>
<b>Gross Cropped Area</b>		
<b>Area</b>	<b>3131.15</b>	<b>43%</b>
<b>Irrigated (ha)</b>	<b>242.44</b>	<b>3%</b>
<b>Unirrigated (ha)</b>	<b>2888.71</b>	<b>40%</b>
<b>Forest Area (ha)</b>	<b>123.45</b>	<b>2%</b>



## **1.1 Rain fall**

The rainfall occurs during the southwest monsoon, starting from June and extending up to October. The rainfall is inconsistent, with average annual rainfall 2061mm. Long term monthly means of annual rainfall distribution shows that over 95 % of the rainfall occur between mid-June to mid-September due to southwest monsoon. July is the rainiest month with nearly 900 mm of average rainfall. The rainfall characteristics have a strong impact on the groundwater level and quality of UT of Daman

## **2. Geomorphology and Soil Type**

It has a gently undulating topography with a few isolated hillocks ranging in height from 34 to 49m amsl with the exception of 111 m high hill occupying an area of more than a sq.km. towards east of village Dalwada. The general topographic gradient is towards west-northwest.

### **2.1 Soil**

The soils in the area can be divided into two groups based on their origin. The soils all along the coast and the banks of the creek are alluvial soils where as in rest of the area the soils are derived from the weathering of basaltic rocks.

The coastal soil, as they are deposited in saline water, is saline and alkaline with almost uniform texture which is clayey loam to silty loam. The soils are dark grey to black in colour. Both pH and Electrical conductivity values are extremely high. These soils are difficult to reclaim due to higher content, low permeability, high water table and high salinity.

Depending upon the degree of weathering, the basaltic soils show wide variation in texture. The first stage of weathering of basalts gives rise to light soil comprising pieces of weathered basalt (locally known as maroom). The depth of such soil varies from few cm to 50 cm. The colour of the soil is dark yellowish brown in plateau, and around the hillocks, whereas the colour is brownish black to black cotton in the flat valleys. The texture of the soil is medium to fine textured. They are non calcareous with moderate water holding capacity.

## **3. Hydrogeology**

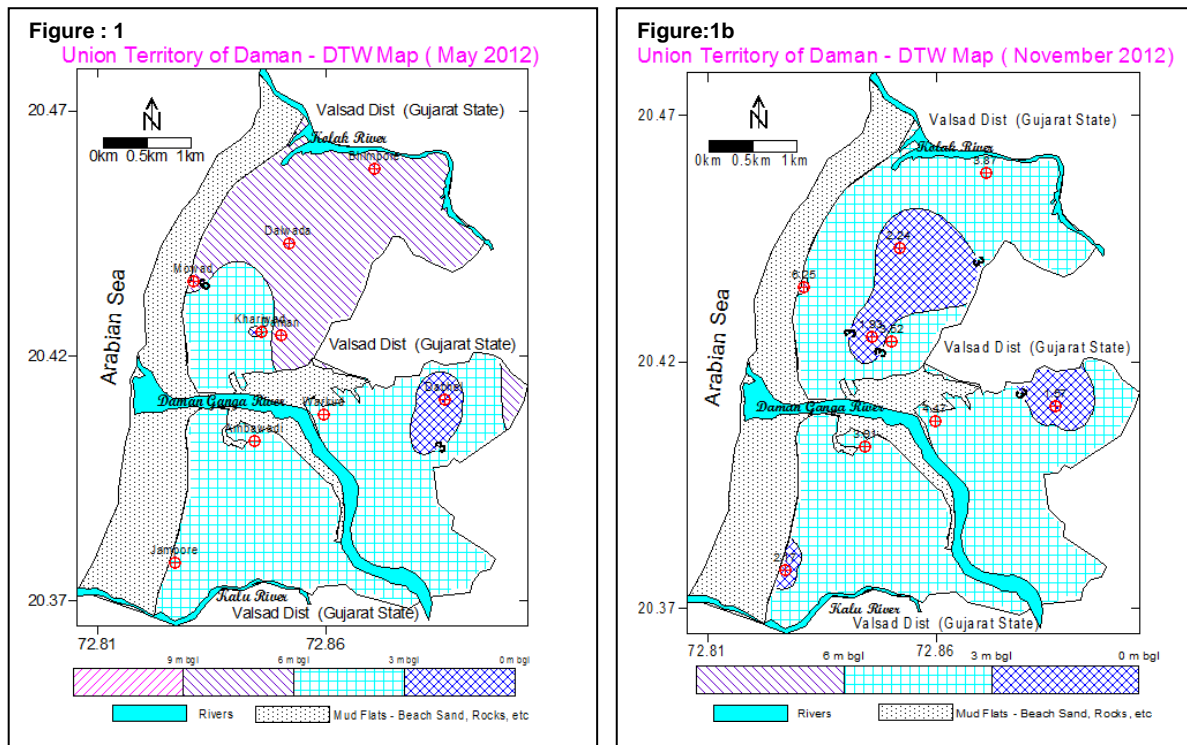
### **3.1 Geological features:**

Basalt is the main basement rock which occurs at variable depths in most parts of Moti Daman and also exposed at surface in the north west part of Daman namely in Marwad, Devka, Kadiya. Basaltic ridges having elevation of about 111m amsl are exposed in and around Kunta and Wankad villages. Basalt sheet rocks are exposed in river beds of Daman Ganga, Kalu and kolak rivers bordering UT of Daman. Alluvial deposits are found overlying the basalts, all along Moti Daman area and also in Dabhel and Kachigam areas having depth of 12 to 40m bgl. Alluvium deposits are river terrace type along the banks of river Daman Ganga.

The basalt occurs in the form of flows comprising massive and compact basalt in the bottom and gradually passes into vesicular basalt at the top. The basalts vary in colour from dark green to pink and show different sets of joints. All the joint systems are restricted to the individual flow seldom cutting across other flows. The surface weathering is characterised by spheroidal weathering.

### 3.2 Groundwater Conditions

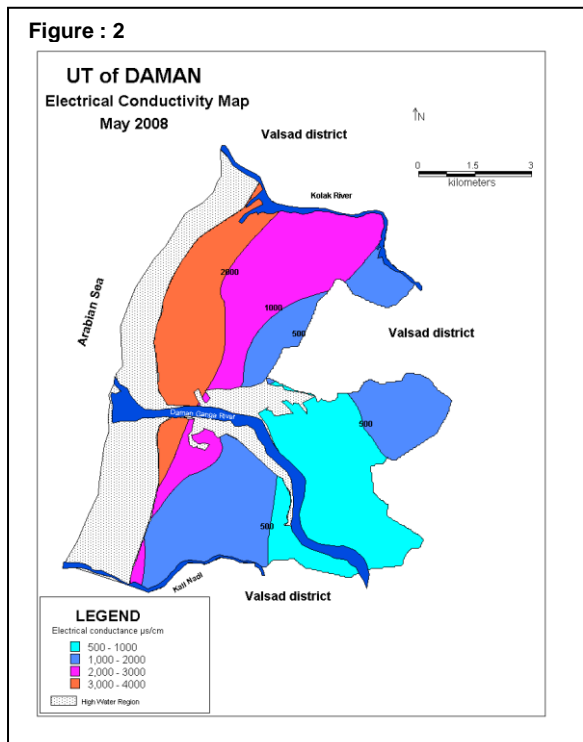
Ground water occurs in both the basaltic and alluvial formations. In Moti Daman area and Warkund, Dabhel and Kachigam areas of Nani Daman, alluvium forms the unconfined aquifer system. However, in Nani Daman area this aquifer has become desaturated and do not sustain irrigation/domestic requirement. The DTW map of unconfined aquifer for May 2012 & November 2012 is presented in figure 1a & 1b respectively.



In alluvial formation ground water occurs in unconfined condition, water level range from 2m bgl to 10m bgl. The basaltic rock is encountered at variable depth of 20m bgl to 40m bgl underlying the alluvial formation. Ground water occur in alluvium aquifer, gets recharged from rainfall infiltration and it is also assumed that the river Daman Ganga and other perennial rivers like Kalu and Kolak contribute to a large extent during monsoon period. The movement of ground water is controlled by the topographic features. The yield of the wells in both the basaltic and the alluvial formations are moderate, varying from 30 m<sup>3</sup> to 300m<sup>3</sup>/day. DTW map of Daman area is presented in figure -1.

### 3.3 Groundwater Quality

The quality of ground water is good in general in the entire Daman district except coastal strip of Marwad, Devka and Kadiya where basalt forms the main aquifer system. The area having alluvium deposits and also in coastal dunal areas ground water quality is fresh. In general the water levels in the rivers even during monsoon being kept low by tidal influence of the sea, there is very little possibility of sub-surface salinity ingress. The flushing of salts due to heavy rains and subsequent high infiltration, keep the salinity of the soils as well as that of ground water within limits. The chloride content of the ground water is also within limits where as fluoride and iron, the main constituents which are harmful for domestic use, are almost absent. The iso conductance map of Daman area (May 2012 is presented in figure – 2.



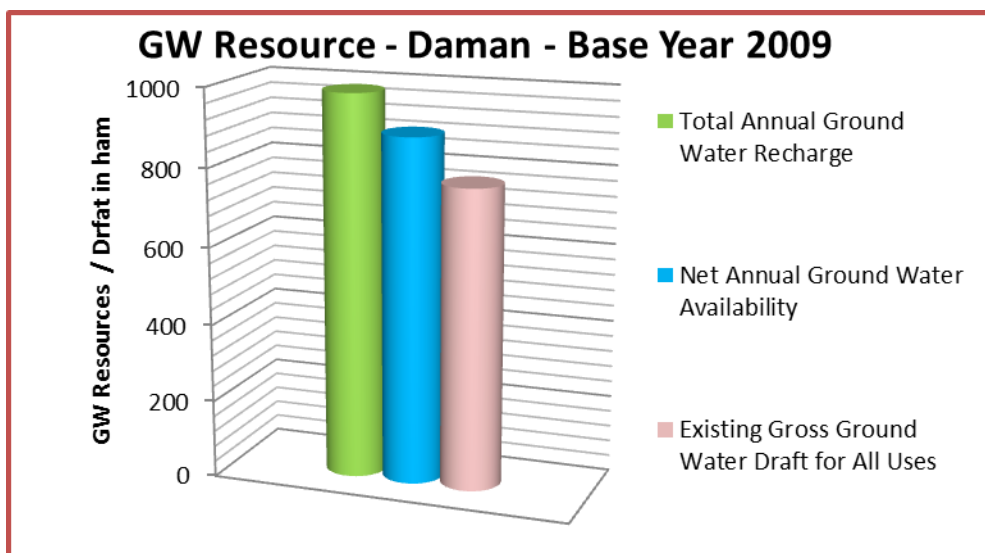
#### 4. Ground Water Resources Estimation

As per the Ground Water Resource Estimation Methodology 2009 the total groundwater recharge in the UT of Daman is 986 ham. About 99 ham is accounted natural discharge and net annual groundwater availabilities is 887 ham. The overall gross ground water draft is 772 ham which includes 580 ham for irrigation and 192 ham for domestic purposes. About 28 ham is available for future irrigation development. The overall ground water stage of development of UT of Daman is 87 %. Hence the Daman District comes under SEMI CRITICAL category. The ground water resources potential as on March 2009 of Daman District and stage of development are presented in the Table No.2 and graphically in fig-3.

**Table: 2 Groundwater resources of Daman District – (UT of Daman & Diu)**

S No.	Attributes	Base Year 2009
1)	Total Annual Ground Water Recharge	986(ham/year)
2)	Net Annual Ground Water Availability	887 (ham/year)
3)	Existing Gross Ground Water Draft for All Uses	772 (ham/year)
4)	Stage of Ground Water Development	87.03 %
5)	Categorisation	Semi Critical

Fig -3



## 5. Conclusions and recommendations

Groundwater in Daman District is developed mainly by dug wells and dug-cum-tube wells. Most of the dug wells are used for domestic and irrigation purposes. However very few dugwells that are located in the elevated regions are used for public drinking water supply. The demand of for domestic, industrial and partly for irrigation purposes are being met from the Damanganga irrigation project.

The flood discharge in the minor streams during monsoon should be arrested by construction of small check dams on these streams. It will help in increasing yields of irrigation wells in the neighbouring areas.

Adoption of Roof Top Rainwater Harvesting in urban areas of Daman district, mainly in areas, where the alluvial aquifer has been desaturated like Dabhel, Kachigam, Wankad and Kunta villages. In these areas regulatory measures for registration of ground water abstraction structures for industries and their monitoring has to be taken up for sustainable development of the ground water resource. To augment available resources, roof top rainwater harvesting or suitable artificial recharge measures (percolation ponds with recharge shafts) should be made mandatory for the non polluting industries.

Restoration of all the existing tanks should be taken up with the view of accommodating the available surface run off and thus augmentation of the ground water resources by artificial recharge. Periodical maintenance of these tanks is to be ensured.

Disposal of industrial effluents, solid waste and urban sewerage sites has to be identified, so that the phreatic aquifer does not get adversely polluted.

Creating awareness (Mass Awareness Campaign for public and farmers, slideshows, display boards on water conservation, Water Management Training Programme for personnel related with water sector, painting/elocution competition for school students etc.) regarding water conservation through judicious use of water.