ENVIRONMENTAL SETTING

2.1 Introduction
Water is ‘life’. It is one of the fundamental needs on the globe. Water is probably the only natural resource to touch all aspects of human civilization from agricultural and industrial development to cultural and religious values embedded in society. Ground water is the principal source of drinking water in our country and indispensable source of our life.

The problems of water quality have become more important than the quantity, as the environmental problems are getting more serious in different parts of the world. A number of factors like geology, soil, effluents, sewage disposal and other environmental conditions in which the water happens to stay or move and interact with ground and biological characteristics. This influences greatly on the groundwater quality of an area. The growth of the area, Geology, Geomorphology, and Hydrogeology tells much about of the environmental conditions of a particular area. In this view the present chapter is devoted to the environmental setting of Aurangabad.

2.2 Growth of Area
Aurangabad has a glorious historic background. It is located almost in the central part of the State of Maharashtra. After the disintegration of the Bahamani Kingdom in 1490 A.D., the town of Khidki became the capital of the Ahmednagar Kingdom under the Prime Minister, Malik Amber. He redesigned the town and laid the foundations for a new town, by creating numerous amenities. Most important among these were the underground water supply system, which is still in existence in some parts of the old city. After Malik Amber, Aurangzeb arrived in the Deccan as the Subedar (Governor) of the Mughal Emperor, Shahjehan, in 1682, and stayed here till his death in 1707 AD. Aurangzeb re-laid the town of Khidki and renamed it as Aurangabad after himself. Aurangzeb is also credited with facilitating the establishment of the embassies of the Portuguese, Armenians and the French in Aurangabad. After the death of Aurangzeb, his minister Nizam-ul-Muluk Asaf Jah declared independence. He added to the beauty of the city and constructed many palaces, mosques, canals and gardens. In the later period the
capital of the Nizam Shahi Kingdom was shifted to Hyderabad and hence, the city of Aurangabad lost its importance as capital city. After independence in 1947, the Nizam’s territories were merged with India in September 1948. Aurangabad became a part of the Bilingual Bombay State in 1956, while it became part of the State of Maharashtra since 1st May 1960 (Gazetteer of Aurangabad District, 1977).

**Recent Development**

The importance of the Aurangabad increased with passage of time. Aurangabad became an educational centre for backward Marathwada region after establishment of Marathwada University in 1958, which later renamed as Dr. Babasaheb Ambedkar University. During 1971-81 decade High Court was established in Aurangabad. Thereafter Aurangabad has commanded more and more area under its influence. Large efforts were taken by state to promote industrialization from 1961. As a result of which MIDC Estate of Chikalthana was established in 1961-1971. Aurangabad City has two industrial estates within Municipal Corporation area and third large industrial estate Waluj MIDC Area, 7 Km away from City in Aurangabad Urban Agglomeration (Fig 2b). Another Industrial Estate is up coming at Shendra MIDC Area, few Km away from Aurangabad and these industrial areas played an important role in development of the Aurangabad. Beside these industries, tourism is a major economic activity of the Aurangabad as places of significant historical importance like great fort of Daulatabad, Grave of Aurangzeb; caves of Ajanata and Ellora are located within few Km from the Aurangabad. Monuments like Bibi Ka Maqbara, replica of Taj Mahal of Agra, Panchakki and Sonehri Mahal are situated inside the Aurangabad. So Aurangabad is also developing as a tourist centre. Aurangabad is well connected with Mumbai, the state capital, Delhi, the national capital and other important places by air, rail and road. Aurangabad was Asia’s one of the fastest growing city during the decade of 80s and 90s due to development of industrial area. The population of Aurangabad as per the 2001 census is 8,73,311 persons the same for the year, 1991 was 4,87,025 persons, thus there was a growth of 3,86,286 persons. The table 2.1 below shows that the population of the city has grown rapidly from 1961 to 1981. The growth rate was highest in 1981 at 89 % (Fig.2a). This could be due to the industrial development at Chikalthana and Waluj which attract
lot of people for employment. The growth rate decreased from 1981 to 1991 and has again increased in the last decade.

Table 2.1 Population Growth of Aurangabad

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Increase/Decrease</th>
<th>Decadal Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1931</td>
<td>29288</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1941</td>
<td>41644</td>
<td>12356</td>
<td>42.19</td>
</tr>
<tr>
<td>1951</td>
<td>57949</td>
<td>16305</td>
<td>39.15</td>
</tr>
<tr>
<td>1961</td>
<td>87579</td>
<td>29630</td>
<td>51.13</td>
</tr>
<tr>
<td>1971</td>
<td>150483</td>
<td>62904</td>
<td>71.83</td>
</tr>
<tr>
<td>1981</td>
<td>284807</td>
<td>134324</td>
<td>89.26</td>
</tr>
<tr>
<td>1991</td>
<td>487025</td>
<td>202218</td>
<td>71.00</td>
</tr>
<tr>
<td>2001</td>
<td>873311</td>
<td>386286</td>
<td>79.32</td>
</tr>
</tbody>
</table>

(After census of India, 2001 and CDP Report, Aurangabad)

Fig. 2 Population Growth of Aurangabad (After CDP, Aurangabad, 2006)

The Aurangabad Municipal Council was formed in 1936 when the geographical area of the town was 54.40 sq. km. In 1982 the council was converted into a Municipal
Corporation and 18 nearby villages were included in the city. The area of the Municipal Corporation at present is 138.5 sq. km. The density of the city as per the 2001 census population is 6300 persons/sq.km.

Aurangabad, as mentioned earlier was originally a small town called Khidki, later on the walled city came up which was 5.35 Ha. in area. Then the cantonment area was established towards the end of 19th century, which was developed on the western bank of the south-west walled city. Till the beginning of this century the development of the city was limited within the walled city, Begampura and Cantonment. As population started growing area outside the walled city started developing. The development was not possible on the northern part of the city due to the hilly land, which acts as a major physical constraint. Hence city started developing towards south and areas like Osmanpura, Padmpura, Kranti Chowk etc started developing. CIDCO was established during 1972 as a special planning authority and New Aurangabad Township was developed towards east side of the city during 1971-81. Eastern and north-eastern areas like Chikalthanana and Harsool near city started developing due to establishment of CIDCO. The MIDC, industrial area just on the east of the Municipal limits have given a great inputs for development along Jalana Road, the proximity of the area to the northern Delhi Gate with the Himayat Bagh, the Government Office Complex, the Shahaganj area (city centre). Areas like Jyotinagar, Jawahar Colony and Garkheda etc. started developing in 1980s with large no of apartments and are still developing today. On the south-west, city started developing towards Paithan road in the areas like Kanchanwadi, Nakshtrawadi etc. City is developing in three main directions, which are

- South of Railway Station
- Along the Jalna Road towards the east
- Towards north along Jalgaon Road and northwest side beyond Dr. Babasaheb Ambedkar Marathwada University.

Now city is developing beyond Garkheda towards Satara near Beed bypass road on the Southern side. This area is outside the Aurangabad Municipal corporation limit. Also due to establishment of new Five Star Industrial Estate at Shendra towards east, city is expected to grow in that direction.
2.3 Geology of Aurangabad District

The district is monotonously covered by the basaltic lava flows called Deccan Trap. The lava flows are called trap because of the step like or terraced appearance of their outcrops. The lava flows are indicative of a great volcanic activity. The close of cretaceous period in the Indian Sub-continent was marked by an outburst of great volcanic activity through a series of gigantic fissures. The eruptions were not continuous but occurred at intervals separated by long or short periods of sequence. The Deccan Trap flows are spread over an area of about 5,00,000 square kilometers covering parts of the States of Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh. Deccan traps are a thick pile of basaltic flows, horizontally disposed and apparently more or less uniform in composition. Each individual flow is a typical section, which varies from porous weathered base to a
massive middle unit, becoming increasingly vesicular towards the top. These flows have been divided into the following three divisions.

Table 2.2 Classification of Deccan Traps

<table>
<thead>
<tr>
<th>Divisions</th>
<th>Distributions</th>
<th>Characters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Traps (450m)</td>
<td>NW Peninsula</td>
<td>Lavaflows with ash beds and intertrappeans.</td>
</tr>
<tr>
<td>Middle Traps (1200)</td>
<td>Maharashtra and Madhya Pradesh</td>
<td>Lavaflows with ash beds. Intertrappeans are rare.</td>
</tr>
<tr>
<td>Lower Traps (150m)</td>
<td>Madhya Pradesh and Eastern areas</td>
<td>Lavaflows with many Intertrappeans. Ash beds are rare.</td>
</tr>
</tbody>
</table>

The basaltic lava flows belonging to the Deccan Trap is the only major geological formation occurring in the district the lava flows are horizontal and each flow has distinct two units. The upper layers consist of vesicular and amygdule zeolitic basalt whiles the bottom layer consists of massive basalt. The Aurangabad district is occupied by the middle traps. The middle traps of two broad divisions. The geological sequence in the district is as follows:

Alluvium .......... Recent to Sub-recent.

Deccan Trap … Upper Cretaceous to Lower Eocene.

**Deccan Trap**

The lava flows consist of massive and vesicular flows. These two can be further divided into the following:

Massive Trap - Porphyritic or non-Porphyritic.

Vesicular Trap - Hard, with or without amygdales, Porphyritic or non-Porphyritic, soft, with or without amygdales, Porphyritic or Non-Porphyritic.

The Porphyritic texture of a flow is exhibited by the presence of phenocrysts commonly of feldspar and rarely of pyroxenes, set in a dense groundmass. The basalts of the middle trap flows are essentially composed of plagioclase feldspar, augite and interstitial glass, with minor amounts of magnetite and limonite. Both augite and plagioclase occur as phenocrysts. Andesine is seen in the groundmass while labradorite occurs as phenocrysts. When the phenocrysts cluster together they give rise to the
glomeroporphyritic texture. Some secondary minerals such as zeolites, calcite and silica are often developed as infillings in the amygdule cavities or as products of alteration and replacement. Columnar jointing and spheroidal weathering are two characteristic features of Deccan trap. The columnar structure results from the development of prismatic joints that break the rock into polygonal columns. The spheroidal structure results from uniform contraction during cooling of the lava, giving rise to a series of spheroidal cracks about compact nuclei. The cracks are accentuated by weathering, producing thin concentric shells or layers which become soft and fall off gradually.

**Boles and Red Beds**

The red or reddish brown horizons occurring between the flows are commonly called Boles. Therefore the red or reddish brown horizons, if occurring between the flows in the district, could be either sedimentary or tufraccous in nature, indicative of a period of diminished or no volcanic activity. The inter-trappean when present acts as specific marker horizons and help to recognize individual flows.

**Alluvium**

The older alluvium consists of gravel, conglomerates and silts. Overlying the older alluvium is the recent alluvium consisting of silts and soils. The black cotton soil called regur which is the ultimate product of weathering of the Deccan Traps is found everywhere and varies in thickness from practically nothing on the hill tops and slopes to several meters in the plains. The black cotton soil is rich in plant nutrients such as lime, magnesia, iron and alkalies.

**Economic Minerals**

Minerals of economic importance are not reported from the district. The semi precious gemstones occurring in the basalts are jasper, agate, chalcedony, and amethyst (Fig.2.1).

**2.4 Geomorphology and Lineaments**

Aurangabad District is located mainly in Godavari basin and its some part towards north west of Tapi river Basin. This district’s general down level is towards south and east and north west part comes in Purna-Godavari river basin. Geomorphologically, the district comprises of varied topographic features and landscape consisting of high hills and plains and low lying hills. Most of the hill ranges are located in the northern part of the district.
The Satmala hills and Ajanta hills extend from east to west. The hills near Verul in Khulabad taluka are part of these ranges which extend to Chawaka ranges and Aurangabad hills. The Satmala range encompasses several hills overlooking the Tapi valley. From west to east they are Antur (826 m amsl), Satonda (552 m amsl), Abasgand (671 m amsl) and Ajantha (578 m amsl). The Satmala hill (493 m amsl) from which name of the range is derived is situated north to Kannad town. A number of lineaments which are fracture zones have been identified on the satellite imagery due to linear pattern, exhibited by darker tone and straight drainage course. These lineaments are favorable for occurrence of groundwater. The major lineament trends in the district are NW-SE, NE-SW and E-W (Fig.2.2).

2.5 Hydrogeology

Water occurs in the weathered vesicular zones, joints and fracture planes. The annual recharge to the groundwater body is by infiltration of rainwater. Therefore, the groundwater reserve is totally dependent upon the occurrence of weathered zones, joints and fractures coupled with intensity and distribution of rainfall which is directly related to percolation. The major part of the district forms the moderately dissected basaltic plateau, which has moderate to good groundwater potential. The northern part forms the highly dissected basaltic plateau; the groundwater potential is expected to be poor. In massive traps, groundwater occurs in soil-cum-weathered mantle, joints, cracks and other weaker zones. The upper portion of the massive traps show persistent spheroidal weathering and exfoliation, which helps in retaining more groundwater in these rocks in comparison to compact massive trap. The storages groundwater in compact massive trap totally depends upon the presence of joints and their nature, distribution and interconnection. Vesicular units comprising weathered zeolitic traps occurring in topographic lows are the main water bearing formation in hard rock terrain of the district. Good potential pockets for groundwater exploitation are expected along the lineaments. The narrow alluvial deposits along the major river also form potential zones for groundwater exploitation. In alluvium the groundwater in isolated alluvial pockets in the Godavari, Shivna, Purna and their tributaries occur under both winter table and semi confined conditions (Fig. 2.3). In the exploration of the shallow alluvial area of Shivna
basin it is observed that the saturated thickness of the alluvial material comprising silty clay, sand and gravel ranges from 1-7 meters. The depth to basements ranges between 16.25m and 26.45 bgl. The aquifer horizons were encountered as coarse sand mixed with clay and silt between 15.00 and 26.00 b.g.l. They constitute the potential aquifer in the area. It is observed that the depth of water table in premonsoon period i.e. April-May vary from 3.37-15.77m bgl while in post monsoon period i.e. in October it is shallower & varies between 1.42-15.85m bgl. However, physiographic location of wells exerts great influence on the depth to water level. The average seasonal fluctuations for last seven years vary from 0.26m- 4.92m. While the average seasonal fluctuation of groundwater level in the district is found to be 3.00m. (Deshpande S.M., 2004)

2.6 Geology of the study area

The entire study area is covered by the Deccan Trap lava flows of Upper Cretaceous to Lower Eocene age. The traps are overlain by thin alluvial deposits along the Sukhana river. The basaltic lava flows belonging to the Deccan Trap is the only major geological formation occurring in the Chikalthana area of Aurangabad. The lava flows are horizontal and each flow has distinct two units. The upper layers consist of vesicular and amygdaloidal zeolitic basalt whiles the bottom layer consists of massive basalt. The basalt litho unit forms an aquifer of moderate to high potential. The soil is mostly formed from igneous rocks and are black, medium black, shallow and calcareous types having different depths and profiles.