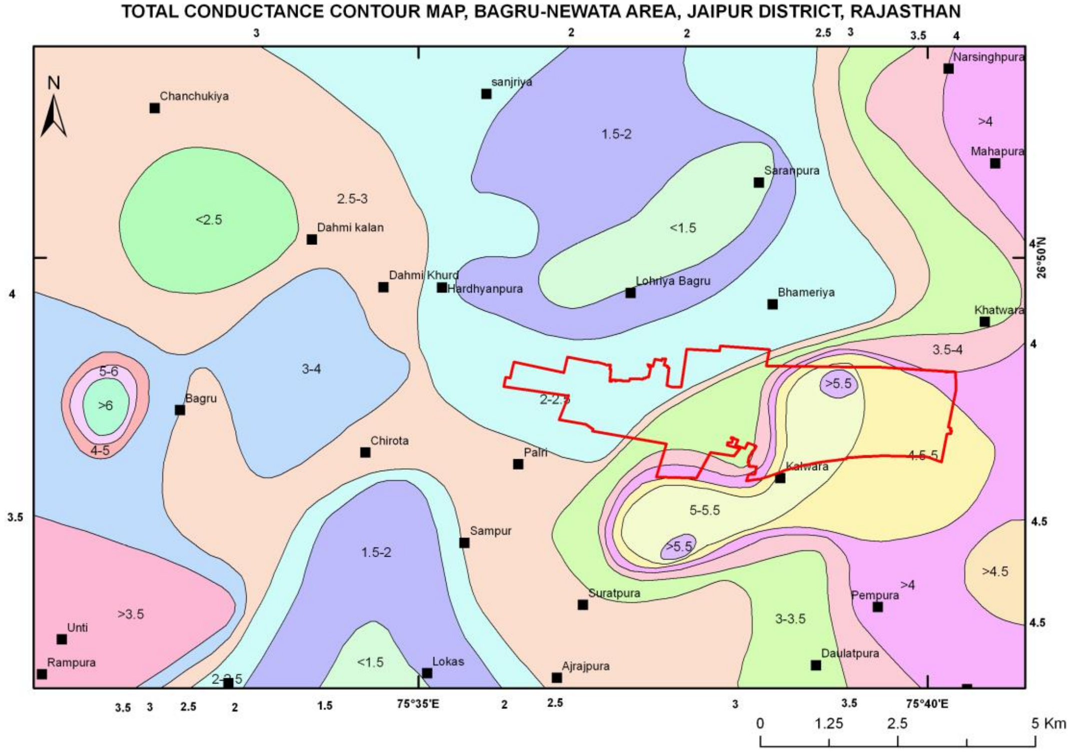
Rainwater Harvesting and Artificial Recharge in Multi Product Special Economic Zone of Mahindra World City (Jaipur) Limited.

Fig. 8

TOTAL CONDUCTANCE CONTOUR MAP, BAGRU-NEWATA AREA, JAIPUR DISTRICT, RAJASTHAN



Submitted to

Mahindra World City (Jaipur) Limited

by

Centre For Environment & Development Studies, Jaipur

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CHAPTER I
INTRODUCTION

1.1 Background

Tourism, Trade and commerce and local handicraft industries are a few well established economic activities within the Jaipur region. The Jaipur Urban area is the major economic core but at the same time, it is crucial to actually realize the contribution of the region towards the state economy. The Rajasthan State Industrial Development and Investment Corporation Limited (RIICO) has developed 49 industrial areas in the Jaipur District covering nearly 2412.13 acres of developed industrial land.

Jaipur a unique region and is the fastest growing region. The city has grown at very fast pace during the last two decades to emerge as a Metro and strengthen its economic base. The city has one of the best road, rail and air connections among cities in Rajasthan State. It has the best economic base for growth of industries and new economy as well (Software, Export Promotion Zone (EPZ) and Special Economic Zones (SEZ)). The SEZ is spread over 2,500 acres and is located close to the proposed Ring Road, at Bhankrota on Jaipur - Ajmer road. The SEZ is a dedicated zone for IT/ ITEs, manufacturing, warehousing, logistics and special zone for auto and auto components and institutions to cater the demand arising out of the processing zone and inland container depot. The SEZ is expected to generate Rs10,000 crorer of investment and create one lakh jobs..

Urban development is a sign of improved life style and socio-economic up gradation too, but if not planned well, brings adverse impact to the environment. Jaipur city is no exception, in the name of development and progress the planners are overlooking the basic problems, which has resulted in unplanned growth of the city and now needs urgent attention of Scientists, Engineers, Planners and Administrators.

Storm water drainage has become the first casualty of intensive urbanization in most cities including Jaipur. Jaipur city is surrounded by small Aravalli hillocks. A number of small rivulets and channels emerge from these hills sloping towards the town and use to larger drain called Dravya Wati River. In most part of the city these natural drainage systems have been leveled, flattened, chocked or blocked by the fast growth of urbanization and industrialization resulting in total collapse of the natural flow of the city. The major drain, which carries the storm water of the area has been squeezed and blocked at many places due to encroachments. Consequently, whenever there are heavy rains or even normal rains the storm water cannot find natural drainage and flow through the roads in the developed areas, flooding houses or creating traffic jam, affecting other urban structures and disrupting the life of city population. It is mainly because of less attention given by the planners to this aspect during urban planning or execution. Also the planning is much behind the pace of growth of urban areas. There is a strong need to channelize and remodel the old drains or plao-channel to take care of storm water because it is going to affect the investments made in the Special Economic Zones- Mahindra World City (Jaipur) Limited (MWCJ).

The SEZ will provide not only competitive infrastructure for prosperous business environment and healthy living but also a sense of responsibility towards the local ecology and environment as a whole. As MWCJ has commitment for refreshing environmental surrounding developments by providing water bodies and gardens. The study addresses all these issues at length.

1.2 The Present Study

Rainwater Harvesting is a process to capture and store rainfall to prevent its runoff, evaporation and seepage for its efficient utilization and conservation. Rainwater harvesting can become an effective tool to augment and utilize a large amount of high quality water, which otherwise flow down the drain. The methods and techniques of harvesting rainwater depend on the run-off, hydro-geological environment and location of land for the purpose.

Mahindra World City (Jaipur) Limited is developing a “Multi Product Special Economic Zone” as an integrated business city in an area of 3000 acres at Jaipur. It is located off Ajmer Road (NH# 8) about 25 km from the Jaipur city. MWCJ intends to prepare a scheme for development of Rainwater Harvesting and Artificial Recharge at different location in MWCJ, particularly in case of industries with large sheds. The harvested rainwater can either be used for recharging groundwater or impounding on the surface by creating structures at suitable sites or both. The choice will be evident only after a study of hydro-geological status in the project area. If it is found that the existing ground water is brackish of higher degree, surface water impounding plans shall be developed.

The rainwater harvesting and artificial recharge (RWH & AR) system are to be adopted in industrial complexes to support the ground water regime effectively. Also it is proposed that the RWH & AR will be adopted only for large rooftop areas in the premises of industries. It is assumed that the RWH & AR system at scattered location will give better recharging of rainwater in less time and will save a huge amount in conveyance system.

The government has made it mandatory to develop Piezometer system for ground water monitoring. The location of this system at the upstream and downstream of the industry/zone will be identified in respect to ground water flow. This study will also attempt to provide the base for installation of the measurable Ground Water Recharge system within the SEZ area of development.

1.3 Aim of the Study

The study was undertaken to suggest measures for rainwater harvesting and artificial recharge in Mahindra World City, Jaipur by using the state-of-the-art technologies of Remote Sensing, Geographical Information Systems (GIS), Global Positioning Systems (GPS), geological and Geomorphological techniques to generate maps, levels, contours, proper alignment and other data to aid in the canalization and remodeling of the drains in the SEZ area. As the surface and groundwater availability, floods and natural disasters are always seen in the regional context a detailed regional study covering all the geographical features were studied rather than only the SEZ development area to propose a best suitable plan.

1.3.1 Objectives of the Study

The specific objectives of the study are as follows:

- To develop a Water Harvesting system /Artificial Recharge System design for effective Storm Water Management in the MWCJ development area.

- To advise on systems for monitoring Ground Water Level-Measurable System for Gr. Water Recharge.
- To suggest the best suitable cost effective sites of Rain Water Harvesting & Artificial Recharge structure within proposed development area in accordance to Rajasthan Government Guidelines.
- To suggest modification in the existing RWH system, if any.

- To suggest the location of Piezo-meter to be installed for ground water monitoring.

- Prepare Bill of material & Cost Estimates for adoption of Rainwater Harvesting & Artificial Recharge system

1.4 Survey work for Mahindra SEZ Jaipur

To achieve the above listed objectives following procedural methods were adopted. Satellite Imagery data, topo sheet base map and rainfall data were procured to prepare different thematic maps. Digital Elevation Model (DEM) was prepared by using World View Image for the SEZ area and by using CARTOSAT Image for the surrounding area. Comprehensive studies in the Jaipur district area were carried out to understand regional geological, geo-morphological, geo-environmental and tectonic set up of the area. Traverses were taken in the surrounding area of SEZ to evolve Quaternary Geological set up with help on available geophysical, borehole drilling and petting data to suggest sustainable water harvesting system. Examination of the physical condition of the existing Water Harvesting Structures (WHS) was also carried out to assess the functionality and to propose modifications or repairs wherever required.

On the bases of the above studies feasible and sustainable locations were identified for Rain Water Harvesting (RWH) and Artificial Recharge (AR) structures by taking in to consideration of the existing drainage and structures for Storm Water Management. Ground water studies were also carried out with help of available data on Ground water quality for the SEZ area to suggest a sustainable Water Harvesting System / Artificial Recharge System design for SEZ area and to propose water level monitoring through Piezometers at respective locations and periodical quality monitoring of the groundwater regime.

The maps of Mahindra SEZ prepared by using the latest instrument like DGPS and satellite imageries. Firstly, survey work was started at the working site of Mahindra SEZ on 14.1.2011 and completed on 16.1.2011, 3 DGPS instrument of Trimble R3 were used for the complete area.

In the centre of whole area, a point P18 was established as a main reference point. The continuous observations of 9 hours were made on P18 for getting the best possible co-ordinates of the point in WGS 84 system. The other two instruments were taken as rover to the different locations as per the requirement for the processing of satellite imageries, the observation was made on Static Mode and the time of observation was kept from 30 minutes to 2 hours depend on the length of base line between reference point and rover point.

The planning for Rover points was made in such a way that every point should form a triangle with Reference Point and one other point, this gives the opportunity to know the error in triangle and its misclosure.

All the necessary precautions were kept in the mind at the time of selection of points for DGPS observation, like the sky over the point should be clear and no any obstruction should be available above 15*, the point should be sharp and clear visible on satellite imageries. No any point should be near to water body and near to High Tension Power Lines.

All the 24 rover points were identified with the help of satellite imageries, Google print outs and concern topo sheets. All points were selected as a sharp point, like the corners of boundary walls, edge of road divider and sharp bend of roads / tracks, maximum points were selected on very sharp corner of boundary walls. Eight points were observed on first day with respect to the point P 18.

Later the next two days PP 11, which was established on first day, near the office of Mahindra SEZ, has been taken as reference point for the observation of other points.

After acquiring the data in field, P18 main reference point was converted into Leica format through RINEX to process under SPP (single point position) to get the better co-ordinate of reference point. All 24 rover points were processed from the reference point P18 and P 11, all the base line were processed with all precaution to get the fixed solution, wherever any base line was having any problem for fixed solution, by disabling the particular satellite and by other methods these base lines were brought to the fix solution.

Total 24 points were established, out of that 4 points were established in side of the main area of Mahindra SEZ.

All the spherical co-ordinates of WGS 84 were converted into UTM co-ordinates through UTM Zone No. 43, the ellipsoidal heights were also converted into ortho heights through EGM96 programme. The accuracy of all the base line were found very high, the standard deviations of all points were within 0.005 M., the best accuracy of triangle of project was >1: 30000000 whereas the least accuracy of triangle was >1:250,000

Finally the whole network were adjusted and the spherical co-ordinates in WGS84 and UTM grid co-ordinates in Grid Zone 43 were obtained for final processing of the satellite imageries, to prepare the map.

1.5 About CEDSJ

The Centre for Environment and Development Studies, Jaipur (CEDSJ) was registered as a centre for research training and action to help poor and marginalized section of the society in the year 2008. Its academic staff has a long experience of work on a wide range of development issues. Our mission is **“Promotion of better relationship between humans and the nature”.** The objective of our research is to inform development policy makers and practitioner at all levels, ultimately contributing to sustainable economic growth and the alleviation of poverty. Our priority areas of research are, environment development with sustainable use of natural resources, poverty, food security and water security, particularly affecting the population living in the semi arid and arid area,

The Centre is a multi-disciplinary research organization. It takes cognizance of the macro environment, planning processes and strategies including their socio-economic dimensions and attempts to make timely interventions through research and dialogues. Particular attention is given to the study of processes, the impact of trickle down effects of growth, direct public interventions such as poverty reduction and employment generation programs, and the participatory efforts of voluntary organizations with respect to the marginalized sections of the society. The Centre is specifically concerned with regional issues relating to Rajasthan. A distinguishing feature of the centre is to help design interventions for grassroots' organizations that are concentratedly attempting to cope with the problems of deprivation in a specific area.

CHAPTER II

GENERAL PHYSICAL CHARACTRICTICS OF THE REGION

2.1 Regional Setting of the Jaipur District

The Jaipur district having an area of 11117.8 sq. km in the Survey of India toposheet Nos. J & M, 45 N and 54 A & B and is bounded by N latitudes 26° 42' and 27º 52' and E longitudes 74º 58' & 76º 15'. It is located in the eastern - northeastern part of Rajasthan with the bordering district Dausa in the east, Alwar in the north and northeast, Tonk in the south and Ajmer in the north- west. The NE-SW trending Aravalli hill ranges run in the west of the district.

Jaipur is well connected with the rest of the country through a close network of roads, railways and airways. It falls on the Delhi-Ahmedabad broad gauge of the western railways and is directly linked with major cities of the country. Two national highways, NH-8 and NH-11, pass through the city leading to Mumbai. National highway-12, originating from Jaipur, leads to Jabalpur in MP. Besides, the city which is a major tourist centre in the northern India is well connected with other major tourist places like Agra, Ajmer, Udaipur, Chandigarh and national capital New Delhi through all weather roads. The Jaipur airport, located to the south of the city at Sanganer, serves as the only air route in the city.

2.2 Physiographic Set-Up and Drainage

The area of the Jaipur district is confined on the eastern slope of the NE - SW trending Aravalli hill ranges which forms a low alluvial flat under an undulating apron of Aeolian sediments. Eastern and northern parts of the district are covered by NNE - SSW trending denudational and discontinuous hill ranges. The height of the hills varies from 786 m to 520 m above the msl. The rest of the area is covered by sand dunes, sand sheet and flood plain deposits. The area is drained by Sabi River in the north, Banganga in the east and Bandi and Mashi in the south west and Mendha, Kantli, rivers in the central part. Mendha River debouches into the Sambhar Lake while Bandi and Mashi find outlet to the Bay of Bengal through Chambal -Yamuna system. Banganga has been impounded near Jamwa-Ramgarh by the Ramgarh dam. Chhaparwara talav and Hingoniya Sagar are the major irrigation reservoirs located towards SW of the JDA region while Kalakh Sagar is situated west of it.

The Jaipur urban area is bounded by the NNE-SSW trending Jhalana - Kilangarh - Amagarh hill ranges in the east and north and Harmada - Nahargarh - Amber hill ranges in the north and northwest. The area is covered by a thick sequence of fluvio-aeolian sediments forming sand dunes, interdunal valleys, and sandy flats and in filled channels etc. giving rise to an undulatory topography. The altitude of the highest peak, situated in NW of Jaigarh fort, in the Jaipur urban area is 648 m. above MSL. Amanisha river in the area flows, through the structurally controlled stretches, from north-east to south-west, north to south, NNW to SSE and finally towards southwest. The alluvial terrain, with an obstacle dune cover, abruptly ends eastward against the north-south trending Amber -Nahargarh hills. The area between the Amanisha River and the hills shows intensive gullying effect.

Jhalana nadi emerges from the Jhalana hills and flows towards Jagatpura in a southerly direction but abruptly changes its flow direction towards east. Finally, it meets Dhund River near Bhurtal. Ganda nalla, originally known as Dharbawati, flows southwards through the heart of the city to join Amanisha River. Corresponding to it, there is a northerly flowing stream which carries the city effluents in the artificially impounded Jalmahal Lake.

2.3 Climate and Meteorological Data

Jaipur district falls in the semi-arid eastern plain of the agro-climatic zone of Rajasthan. The rainfall varies from 520 mm isohyets towards west to 650 mm isohyets towards east with an average 32 to 40 rainy days. Mean annual rainfall of Jaipur district is 562.2 mm while normal rainfall is 526.9 mm. The climate of the district is hot and extreme with day temperature reaching 45 degree centigrade during summer and 5 degree Celsius in winter. The district falls between 7 degree Celsius to 9 degree Celsius isotherms. During the month of January the mean of maximum temperature recorded is 40.6 degree centigrade, while the minimum temperature recorded is 8.3 degree Celsius. Mean annual potential evapotranspiration of Jaipur district is 174.52 cm against the highest value of 203.32 cm for Jaisalmer district in the western Rajasthan and the lowest value of 138.12 cm for Udaipur district in southern Rajasthan. Maximum frequency of rainfall in Jaipur is in the order of 501 to 600 mm. Ninety percent of the annual rainfall occurs in the monsoon season, whereas, in winters, precipitation takes place through cyclonic depressions only. Winds are generally light to moderate, but in summers, the early south west monsoon winds may be strong on some days. Westerly to southwesterly winds prevail during the south west monsoon season. In the post-monsoon and winter months, winds blow from directions between east and north while in the summer season, they blow from directions between SW and NW.

2.4 Vegetation

Jaipur was once under a thick cover of vegetation where presence of wild life within the municipal limits was reported up to Jhalana hills, as late as 1940. The present degraded condition of the natural forest is due to the onslaught of urban growth. The Hill slopes facing the city have been extensively quarried resulting in to deforestation / dwindling of natural vegetation.

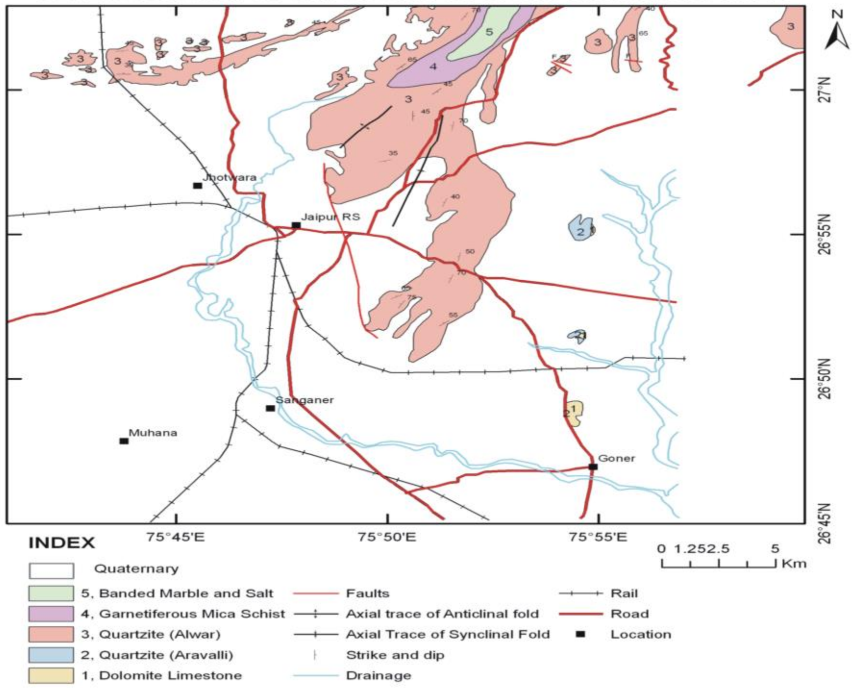
Natural vegetation in the plains consists chiefly of thorny bushes, shrubs etc. These are Matina emeginata. Acacia Senegal, Acacia arabica (Babool), Anogeissus pendula, Sacchra munjha etc. Metina eerginata and Acacia Senegal grow on the consolidated sand dunes. Khejri grows on river terraces and is hardly found on saline lands. Sacchra munjha requires very little amount of water and generally grows on the recent unconsolidated sand bodies. Metina emerginata. Acacia Senegal (Kakera) Boswellis serratia etc. grow in plenty on elevated Lands including hill slopes. Other plant varieties around Jaipur include those bearing edible fruits. Grewia tenax (Gangeran), Aegle marmebs (Leelpatra), and Rhusmy sures (Dansra).

2.5 Geology

Several workers from geological survey of India have carried out geological studies in the above discussed area {Hacket, C. A. (1980), Heron, A. M. (1938), Gupta, S N., Arora Y. K et al., (1983) and Pathak, B. D. (1964)}. The major part of Jaipur district is covered by Quaternary sediments of aeolian and fluvial origin. Western part of the district is covered by the Bhilwara Super group of rocks, rocks while the Delhi Super group is exposed in its eastern and northern parts. The Bhilwara Supergroup rocks are exposed in the form of denudational hills, inselbergs and granitic tors towards southeast, north -north-west and west -south-west of Jaipur city. Isolated outcrops of kyanite - staurolite schist and quartzites of Bhilwara Supergroup occur near Hathroi within Jaipur city. These rocks comprise biotite-quartz gneiss grading into porphyroblaslic granitic gneiss. Quartzite, quartz-mica schist along with intrusive of ultramafics, granites and pegmatites etc., and scattered isolated outcrops of Bhilwara Supergroup of rocks also occur in the southern and western parts of the area (Fig.1)

Fig. 1

GEOLOGICAL MAP OF JAIPUR URBAN AND ITS HINTERLAND AREA



The Delhi Super group is represented by rocks of Alwar and Ajabgarh Groups. The Alwar Group of rocks is exposed towards the east, north and northeast of Jhalana - Kilangarh and Harmada hill range. The northward extension of the Delhi Super group beyond Amer and west of Kukas, exposes micaceous and chloritic schists, minor marble bands, amphibole quartzite and quartzite and phyllites of the younger Ajabgarh Group. The Alwar Group of rocks is exposed on the eastern side of the river Dhund, mostly, in the form of inselbergs and denudational hills. The contact between the Alwar and Ajabgarh Groups is a conformable one.

A generalised stratigraphic succession in Jaipur district, as per the district resource map of Jaipur district 1997, published by GSI is given below:

Quaternary	Alluvium and windblown sand

Post - Delhi intrusive	Granite, pegmatite, amphibolite and metadiorite
	Gritty quartzite, quartzite with interlayered phyllite, carbonaceous phyllite and schist
Ajabgarh Group	Phyllite, schist and minor marble
	Breciated quartzite
	Impure marble, amphibole Quartzite
	(a) massive quartzite, locally feldspathic ,gritty
	(b) schist
	Disconformity
Alwar Group	Schist, phyllite, flaggy quartzite and minor marble
	(a) conglomerate and gritty quartzite with basic flows at places
	(b)quartzite
	(c) quartzite
	(d) feldspathic quartzite with imerbedded basic flows
	Unconformity
Raialo Group	Quartzite with thin bands of conglomerate
	(a) feldspathic quartzite and conglomerate
	(b) dolomitic marble
	Unconformity
Bhilwara Supergroup (=BGC)	Granite and gneiss
	Quartzite with interlayered schist and phyllite

The basement rocks are unconformable overlain by Quaternary formations of varying thickness .The Quaternary sediments are primarily of aeolian, fluvial and lacustrine/ playa environments and considered to have evolved episodically during the Quaternary period in response to wide ranging climatic fluctuations. Raghav, et.al (1986) and Raghav (I987, 1988,1989, 1991, 1995 and 1996 have carried out Quaternary Geological, Geomorphological, Geo-environmental and suggested land use studies around the Jaipur district and in part of the Thar desert. The detail Quaternary Geological sequence developed for the above area is discussed below.

2.6 Seismicity and Neotectonism

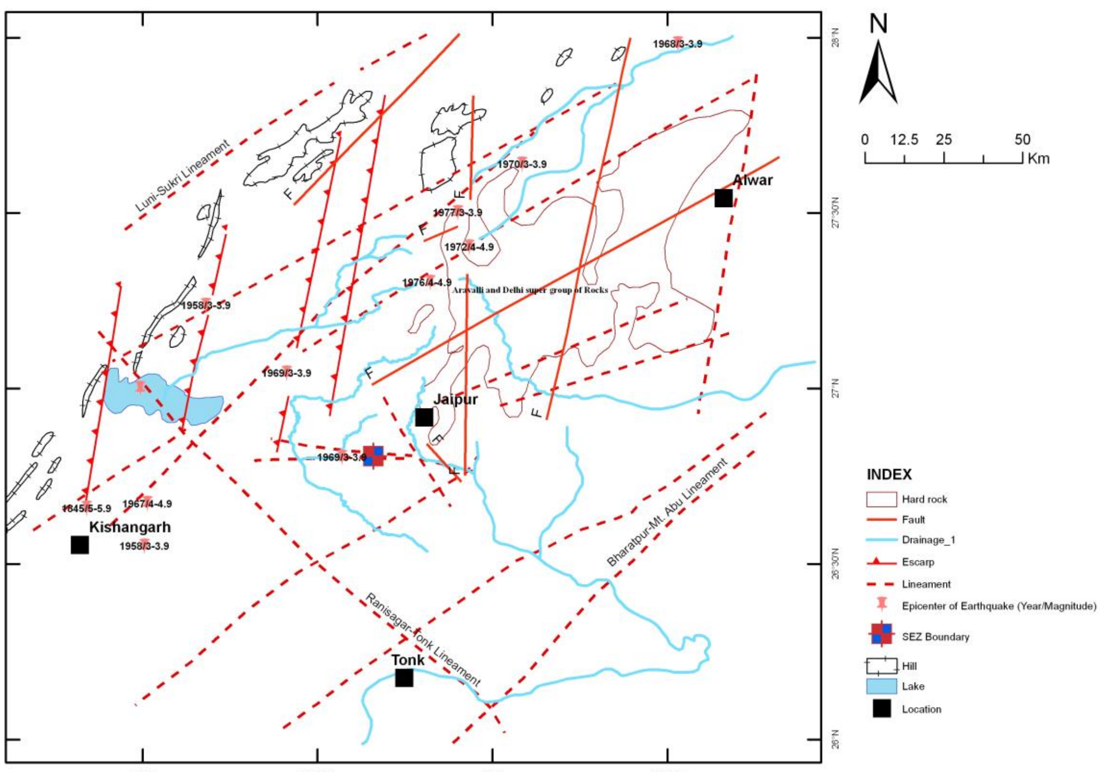
Seismo-tectonic studies carried out around the Jaipur district have revealed Neo-tectonic movements in Jaipur district. These movements are manifested in various dynamic landforms many of which have led to environmental hazards. These movements are documented by faceted fault scarps, relict raised/elevated river terraces, drainage reversals and superposition on a very large scale, geomorphic truncations, and formation of horst and graven structures along river courses.

The eastern flanks of the Alwar quartzite ridges are observed to be affected by fault generated scarps. These scarps at places are found to affect the scree deposit and other Quaternary horizons also. In addition, the relict plantation surface is found to occur warped along the tops of some widely separated and isolated hillocks and series of ridges. These surfaces are often bordered by fault scarps and accompanied with hanging valleys at their faulted margins. Besides, the Quaternary depositional surfaces also record some features like, uplifted and paired older terraces along certain segments of the Banganga and its tributaries (Raghav, 1991) (Fig.3).

The tracts in Jaipur upland where prominent basement faults were recorded by various workers of GSI include the followings:

2.6.1 Maurija - Samod - Gana Ka Sar - Matori Kalan Tract; showing NNE-SSW to NE - SW trending en-echelon strike - slip fault traversed by NE -SW trending minor cross faults. These are observed to have affected the Quaternary sediments to a large extent, forming graven and horsts at few places. This has affected the earlier drainage pattern also (Fig. 3).

MORPHOTECTONIC MAP OF JAIPUR AND ADJOINING AREAS



2.6.2 Rarawas - Manoharpur Tract; showing ENE -WSW or E -W trending strike -Slip faults.

2.6.3 Markhi - Bishangarh Fault; it extends about 2 km or more to the east of Bishangarh. It shows a similar trend as that described above (in No. 2) and these two in combination have uplifted the blocks in between through strike-slip movements, and

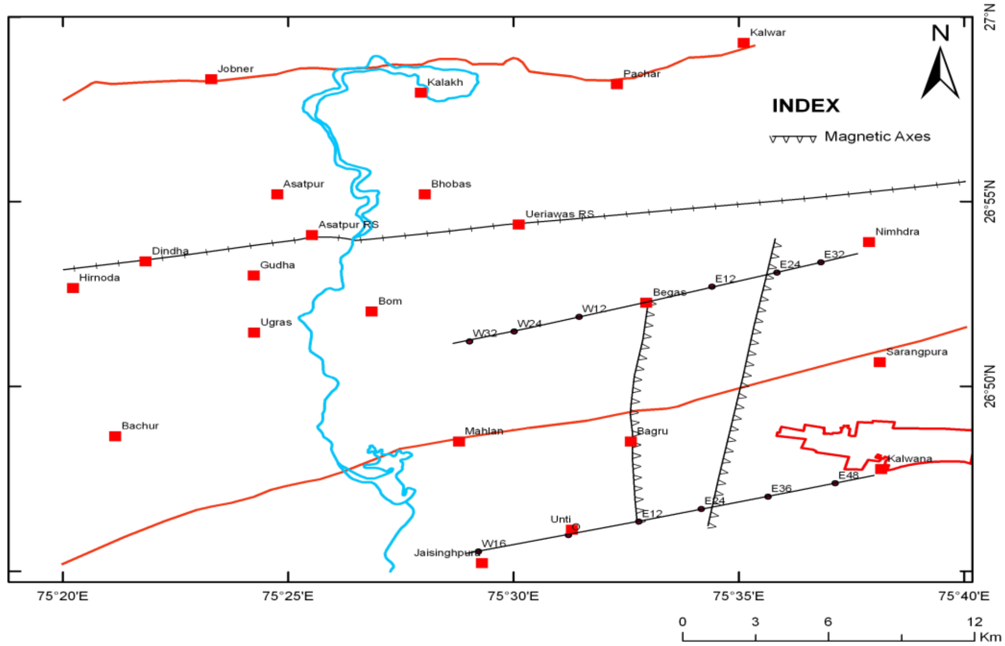
2.6.4 Ajitgarh - Shahpura - Triveni Fault; the trends NW - SE. It is a prominent fault of this sector showing convincing evidences of recent activation.

Besides, several other faults of smaller scale and of neotectonic origin have been recorded in some localities of this area. The neotectonic movements have led to anomalous variations in depth of oxidation of sulphide bodies in contiguous blocks in the north Aravalli range (Das Sharma, 1986). In the alluvial valleys, these movements are responsible for differential accumulation of Quaternary sediments in contiguous blocks in Jaipur upland (Fig. 9, 10 & 11).

Bed-rock contour maps were prepared by Geological Survey of India on the basis of geophysical survey carried out in the area of Bagru and Newata. The bed-rock contour map (givens R. L.) of the area is shown in (Fig. 9). From this map, it is quite evident that there are three troughs in this area. The largest Trough I, extend towards north and south of Kalwara village and its limits are defined by 260 m contour. Trough II, lies between Bagru, Unti and Lakshminarayanapura villages. This is defined by 240 m contour. Trough III, is located near the Mahapura and Khatwara villages (Fig.9, 10 & 11).

An earthquake that occurred on the 20th August, 1969 at 12.08 hours in the Jaipur and adjacent areas in Rajasthan was of an intensity of 'V' on Modified Mercalli scale. The epicenter was reported to be at about 350 kms southwest of Delhi (Fig.4).

LOCATION MAP SHOWING GEOPHYSICAL TRAVERSES AND MAGNEIC AXES



Geological Survey of India carried out a Geophysical investigation along Jaipur-Ajmer road roughly in the east-west direction between Dausa and Mehlan (26°49'; 75°29') with a view to assist in studying the causes of the tremors. To study the strike wise continuation of the magnetic anomalies between Jaipur and Mehlan, two cross-country traverses with a bearing of 75° were run through villages Begas (26°53' ;75°33') in the north and unit (26°43';75°31') in the south (Fig.4).. The northern traverse was designated as traverse N-1 and the southern as traverse S-1 and the magnetic measurements were made at intervals of 210 meters.

West of Jaipur, the magnetic values (Fig.14).show a gradual upward trend up to Mehlan. In this regional trend two localized highs are Indicated, one at Bagru (26°49'; 75°33') near milestone 18/7 and the other near milestone 16 on the Jaipur-Ajmer road. From the magnetic anomaly profile, the probable depth to the causative body has been computed to be roughly 375 meters near Bagru and 400 meters near milestone 16. On the two traverses N-1 and S-1 (Fig.14).magnetic highs corresponding to the high at milestone 16 were recorded. The three magnetic highs fall roughly on a straight line (Fig. 4 &14) and may be indicative of some geological contact or a buried ridge of appreciable magnetic susceptibility at depth. In case, the magnetic anomaly near Bagru corresponds to a geological contact, displacement of rock formations along the Contact plane might be associated with the earthquake (Prem Chandra and D. S. Shukla, 1971**)** (Fig.4 & 14).

2.7 Quaternary geology

Quaternary studies carried out by Geological Survey of India around the Bagaru area suggest occurrence of E-W trending palaeochannel of F2 cycles from Muhana in the east to Mahala in the west. These palaeochannel deposits are covered by the younger cycles of Aeolian and fluvial deposits leading to the disorganization of the existing drainage (Raghav, 1991). The tributaries of the channel are oriented in the NNE-SSW direction and meeting with the E-W oriented master channel in the south. The relationship of the alignment of the palaeochannels of the F1, F2 and F3 cycles suggest development of fault along the alignment of the F2 and F3 cycles deposits with the upliftment of the southern block (Fig.3).

A.K. Dasgupta, D.C. Dassarma and seven others (1983), B. Sural (1989) and K. S. Raghav (1986,1991), Natani, J.V. and Pal, N.K. (2001) and Natani , J.V. (1993) have carried out Quaternary Geological, Geomorphological, Geoenvironmental and land use studies of the Jaipur district area. K. S. Raghav (2000, 2003) has established a lithostratigraphic sequence on the basis of Quaternary Geological studies carried out in other parts of Rajasthan.

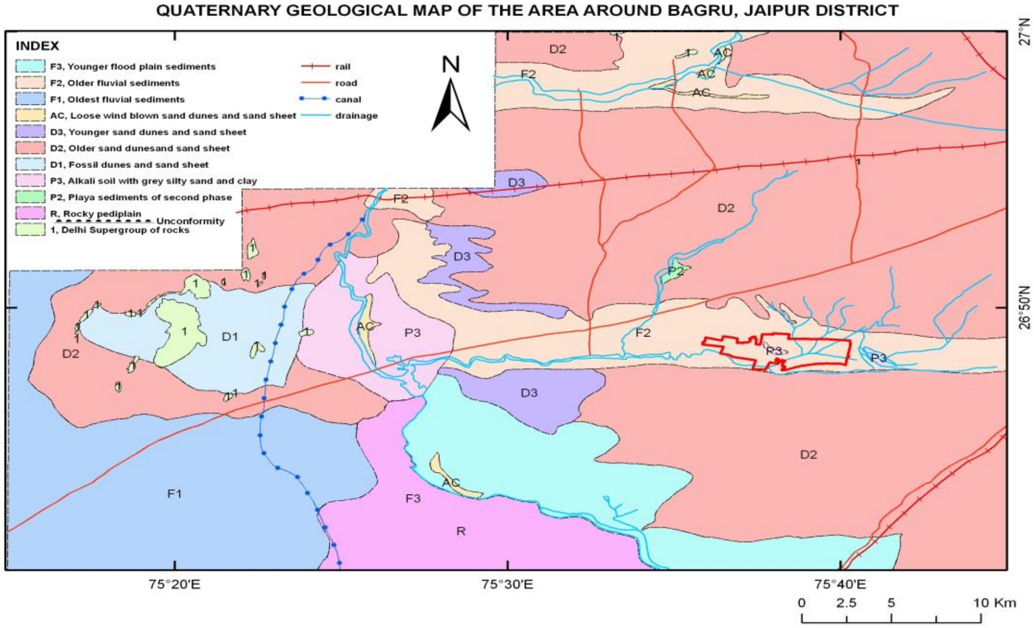
A vast area around Jaipur upland and eastern part of the Thar desert is covered by Quaternary lithological units which are product of fluvial, aeolian, lacustrine and playa environments (Raghav, 1992 b). The following three cycles of sedimentation have been identified from the sections studied in Jaipur upland around Jaipur on the basis of lithological , pedological character and archeological and TL dating and their mutual relationship and XRD mineral analysis) (Fig.2).

2.6.1 First Sedimentation Cycle

The sedimentation in Quaternary period begins with a fluvial cycle (F1) represented by a gravel bed (colluvium/hillwash/fan material) and occurring mostly at the foot hill slope. It is overlain by polymictic conglomerate and fine to coarse sand with calcareous cement. The clasts and sand grains are angular to sub rounded. The sand layers contain fresh water gastropods. The sections where such deposits are exposed/lie in the upper reaches of river (Fig.2).

Fig. 2

QUATERNARY GEOLOGICAL MAP OF THE AREA AROUND BAGRU, JAIPUR DISTRICT



Raghav (1992 b) reported occurrence of loess deposits from the upper reaches of Mendha and Bandi river basins. The loess deposits overlie the earlier fluvial deposits and pre-Quaternary rocks. It occurs along the river sections. Such deposits are exposed approximately 1 km south of Amarsar village on the west bank of Banganga River near Mithal Khawali Dhani.

The loess deposits comprise 6 m thick sequence of massive calcareous silty sand with occurrence of very fine sand, clay admixture associated with gastropod shells. The occurrence of deep dark brown palaeosol was also noticed toward the base of these deposits occurring along the right bank of the river. Loess deposits are covered by Aeolian sand of dark brown colour which is oxidized (D1). These Aeolian deposits (sand) occur as obstacle dunes near the hills and their thickness over the loess deposits varies from 1-5 m to 37 m .At places, loess is also covered by playa sediments (PI) which are hard, compact kankar

Bed with fresh water gastropods overlain by 2 to 10 m thick deposits of calcareous silt and clay bed alternation is found. The thickness of calcrete zone bed varies from 50 cm to 1.5 m

The sediments of Dl arid phase comprise reddish brown oxidized, non-calcareous rounded sand. The oxidized layer is underlain by light yellowish to gray calcareous sand with 1 to 15 cm thick calcareous concretions at depth.

2.6.2 Second Sedimentation Cycle

The paleodrainage of this phase in the Mendha river basin is largely aligned in E-W direction. The fluvial F2 phase sediments rest over the pedogenised Fl, PI and Al surfaces. They are exposed as flood plain deposits south of the Sambhar Lake, along the banks of the Kantli River and in the upper reaches of the Band! River and consist of alternating of light grey, coarse to fine grained sand, silty sand and clay. Well developed calcareous soil profiles are seen in these deposits (Fig.2).

The above sediments at places are covered by abandoned playas sediments. The surfaces of these abandoned playas represent playa stage of second sedimentary cycle (P2). These comprise light gray, white silty sand and clay with formation of disseminated kankar bed, calcareous nodules and gastropods test. The P2 phase sediments consist of fossiliferous, calcareous silty sand and clay alternation with 1 to 1.5 m thick hard kankar horizon in the Mendha river basin. These have an interchanging relationship with D2 phase sediments. The fossils in P2 phase sediments include gastropods, pelecypods, ostracod and a few doubtful vertebrates.

The A2 phase deposits, showing inter fingering with the P2 phase sediments in the basal part, consist of moderately oxidized, light brown, non-calcareous rounded' sand underlain by pale yellow sand with sporadic 0.8 to 4.0 cm thick calcareous concretions at depth. The surfaces of these dunes/sand sheets are generally covered by black and red pottery. A 10 m thick sequence is exposed to the west of Sanjariya in the upper reaches of the Bandi River (Fig.2).

2.6.3 Third Sedimentation Cycle

This pertains to the present day drainage which is broadly dendritic and partly controlled by the structure. These fluvial F3 phase sediments consist of light coloured calcareous to non-calcareous, coarse to fine silty sand and clay along with common transported calcareous concretion not indicated in the sections. This sequence is gradually followed upward by alternating silty sand and clay with Aeolian sand along the flood plains. New units like sand dunes, interdunal plains and sandy plains have formed over pediments and alluvial plains (Fig.2).

The P3 sediments are made up of thinly laminated silt, sand and black clay with sporadic salt, gypsum and fine sand. These are coeval with F3 and D3 deposits and show inter fingering relationship with both at several places. In some places, evidences of old habitation have been found in the playa deposits suggesting flooding of these areas in recent times (Fig.2).

Table 1: ***Quatenary Ltthostratigbaphic Units***

No.	**Sand dune area** (Thickness in meters)	**Valley filled area** (Thickness in meters)	**Playa area** (Thickness in meters)
1	Loose reactivated, light yellow, aeolian sand (40cm-5m) (Ac)	Loose fine to coarse grained sand, silty sand and clay.(50 cm to 2.5 m),	Alternative sequence of light gray silty sand and clay.
2.	Unoxidised, pale yellow to light brown, calcareous aeolian	Coarse to fine grained calcareous silty sand and clay (1.5 m to 2.5 m). (F3)	Light-gray silty sand and black (P3)

	sand (1.5 m to 8 m). (D3)		
3.	Moderately oxidised aeolian sand (2.0 m to 5 m) (D2)		Fossiliferous silty sand and clay with cal. nodules. (1.00 to 1.5 m) (P.2)
4		Light gray, coarse to Fine grained sand, and silty sand and clay impregnated with calc. concretion (2.C to, 12 m). (F.2)	Alternative sequence of light gray silty sand and black clay with salt intrusion along the parting of the clay (2.m to 8 m)
5.	Deep dark brown oxidised aeolian sand (2 to 12 m),(D1)	Fossiliferous silty with hard calc. nodules (1.5 to 2.5 m) (Pl.1)	Arid
6.	Red mottled to light gray calcareous, coarse to very coarse grained' ' sand, silty sand with Fresh water gastropod (1.5 to 3 m). (F1)	Alternative sequence of light gray silty .sand and black clay with salt intrusion along the parting of the clay (2.m to 8 m), (Pl.1)	Semi arid
7.		Light brown calcareous conglomerate with fresh water gastropods (1m to 2m) (F1)	Humid/tropic al

8.	Cobble and Debrie size rock fragment (Colluvial sediments)	Humid/tropical

CHAPTER III

GEOMORPHOLOGY

Geomorphological units are classified on the bases of their nature of occurrence and process of their formation in fluvial, Aeolian and lakes and playa cycles. These are further classified as oldest, older and younger on the bases of soil characteristic and their order of superimposition as discussed below.

3.1 Oldest Fluvial Units (F_1)

They occur at the top of Delhi Super group of rocks as valley fills and as buried Palaeochannel in the valley filled area. The evidences of buried Palaeochannel of this phase were also observed along the north western part of the Harmara hill range in the dug wells. The palaeochannels of this period in the present proposed SEZ area are aligned in the N-S direction as revealed from the geophysical studies (Fig.2, 10 & 11).

3.2 Older Fluvial Sediments (F_2)

This unit is represented by unconsolidated coarse to fine grained sand followed by calcareous silty sand and clay with calcareous nodules, which occur in low lying older valley planes. The surfaces of this unit are mainly along and around the Bandi River and its tributaries. The palaeochannels of this phase are buried under older sand sheet of second phase Aeolian deposits. The present alignment of the E-W trending depressions around the Muhana–Newata-Bagaru is the product of this period of the drainages (Fig.2, 10 & 11).

3.3 Younger Alluvium, Floodplain and Channel Deposits

These are occurring as the flood plain along the present drainage and low lying areas around the lakes and playas areas. It is youngest fluvial unit in the area and is coeval with recent playa/lacustrine and windblown sand aunes/sand sheet deposits. The present Bandi river and its tributaries have wide flattened flood plains. They hardly cut through their valley fill deposits. However, in the central part of the area few vertical cutting have been observed on meander side in the older fluvial, playas and Aeolian sediments and point bar deposits on the other, side as observed upper reaches of the Sanjaryia River tributary of the Bandi river in the north of NH8 (Fig.2,10 & 11).

3.4 Aeolian Aggradational Units

The oldest fluvial units of F2 and F! Period is overlain by the subsequent Aeolian sediments at most of the places. These sediments, depending upon their physiographic characteristic and field relationship are subdivided into following litho units (Fig.2, 10 & 11).

FIG. 10

E-W CROSS SECTION OF FIG. 15

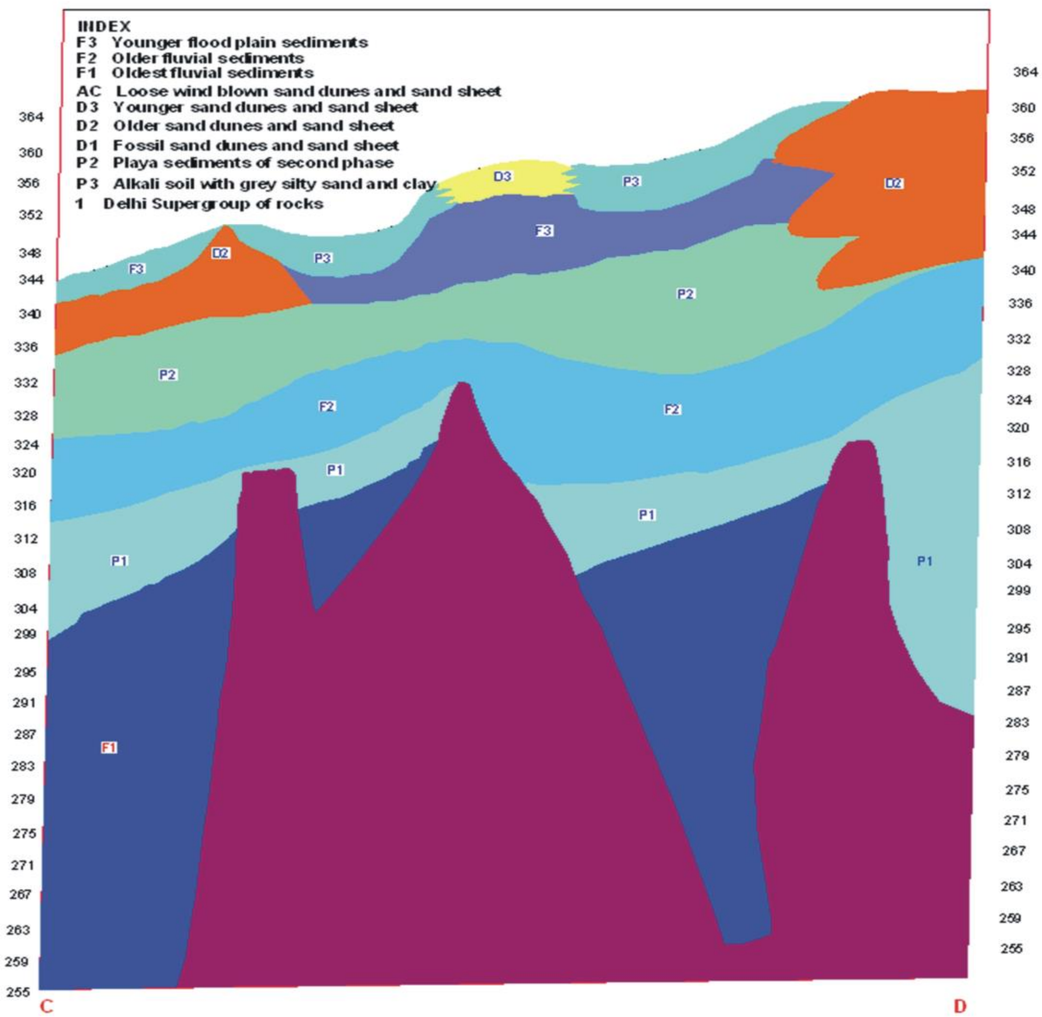
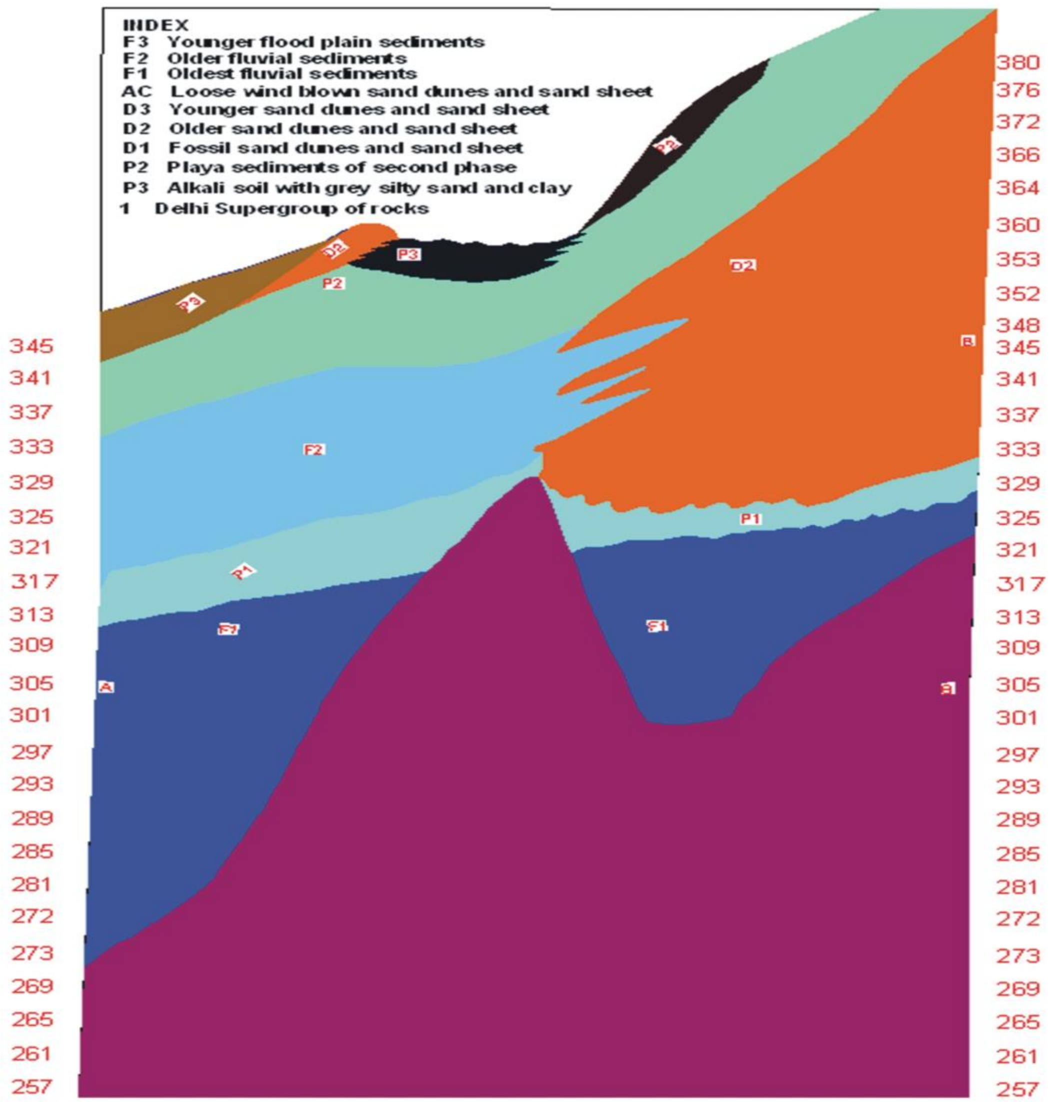


FIG. 11

N-S CROSS SECTION OF FIG. 15



3.5 Oldest Sand Dunes/-Sand Sheet (D_1)

The Aeolian deposits of Dl arid phase have been largely modified by later geomorphological processes. Locally, such deposits can be identified as obstacle dunes occurring around the hills, longitudinal and transverse sand-ridges around the depressions (e.g. playa and lakes) and flat sand sheet in areas away from the hills. The deflated top surfaces of the dunes and sand sheet occasionally contain Mesolithic stone implements. These deposits usually occur in the form of sand sheets in the dune field areas. Some fossil dunes were also observed on the western side of Bichun and Harmara hill range at places) in the form of obstacle dunes. The northern and southern part of the SEZ area is covered by the modified and obliterated dunes of this phase (Fig.2).

3.6 Older Dunes/Sand Sheet of Second Phase (D_2)

The D2 phase Aeolian deposits of the second cycle occur as stabilized longitudinal, transverse, parabolic and obstacle dunes and sand sheets. These dunes are overlying the earlier topography and have been modified, at places, by later biotic, Aeolian and fluvial actions. Most of the topographic factures of the terrain are mainly controlled by the Aeolian sediments of this phase. Longitudinal and parabolic dunes are the most dominating forms of this phase which are present in the northern and southern part of the SEZ area. Wide spread sand sheet deposits of this phase is present toward the western part of the SEZ area. Orientation of these dunes varies from N70 "E to E-W. They also occurred as obstacle dunes in the western side of Jaipur hills (Fig.2).

3.7 Dunes/Sand Sheet of Third Phase (D_3)

These dunes are further classified on the bases of their stability and nature of formation of the soil as discussed below.

i*) Younger stabilized sand dunes/sand sheet:* These are younger stabilized dune forms which are product of reactivation of older dunes. They occur in the zone of sand accretion/reactivation in the form of linear dune shapes of younger time in the northern part of the area and south of the Bagaru (Fig.2).

ii) Active dunes and sand sheet: These are the dunes and send sheet deposits which are being formed due to recycling of sand by wind of aggraded rivers and older established duns areas. Beside the linear and transverse local forms, the other most common dune shape formed by the sediments of this cycle is Barchans. The formation of minor obstacle dunes is also seen in the critical zone of sand accretion and site of reactivated old dunes around habitation, hills and vegetation in many places. The formations of star shapes of dunes were also observed along flood plain area of Bandi River of the Mehala. All these dune shapes forms a complex dune pattern in the area.

3.8 Playa Deposits

These surfaces are also further classified as oldest, older and younger on the bases of soil characteristic and nature of occurrence. The oldest P1 playa surfaces are not exposed in the area. The occurrences of these playa surfaces are given below.

3.8.1 Abandoned Playa Deposits of Second Phase (P2)

These playas are regionally aligned along the palaeochannels of the F2 system, generally forming broad flats or gentle centripetal depressions of sub-rounded or oval shapes, the latter being elongated in E-W direction. At places, the present day river drains through these depressions .These playa deposits overlie the aggraded Palaeochannel deposits of second phase and are overlain by the older Aeolian sediments of second phase. Some section of these deposits was also observed along the bank of Bandi River (Fig.2).

3.8.2 Younger Playa\Local Depression, Deposits (P3)

The playas deposits of the P3 stage are located along the channels of the present day aggrading rivers. Several shallow depressions such Muhana-Newata depressions represent this stage of playa deposits .The top surfaces of these units are covered by encrustation of alkali soil. These playa deposits forms almost broad flat topography. They remain dry throughout the year. Occasional heavy shower results in water accumulation in these areas due to the presence of impervious layer of clay at depth and absence of any out-let for the surface flow. The condition of deposition of playa sediments were also observed in the upstream of Hingonia dam along the bank of Bandi River.

CHAPTER IV
GROUND WATER

4.1 Groundwater in Jaipur Area

Ground water in Jaipur district occurs in Quaternary alluvium and weathered and fractured zone in hard rock aquifers of Delhi and Bhilwara Super group. Depth to water in Jaipur district varies from less than 5 m SE of Jamwa Ramgarh to 45 m SE of Govindgarh in the north western part of the district. In general depth to water varies from I5 m - 30 m below ground level. Yield of wells range from 50 m^3/day to 1200 m^3/1/day in Quaternary aquifers. Average yield in quaternary aquifers is in the range of 50 m^3-100^3/day while yield of wells in hard rock aquifer range from 0.5 m^3/day to 200 m^3/day (Jethra, M S. (1989). Ground water is brackish to saline towards western part of the district especially in Sambhar - Naraina - Dudu - Chhaparwara area and in area south of Sangener, Phagi and Chaksu. High incidence of fluoride and Nitrate in Ground water is common towards north, east, south and west of Jaipur urban area.

Ground water development in the district has reached to an alarming stage. The district falls in dark zone. Ground water supply position is deteriorating very fast in Jaipur Urban and JDA region. Water level in 70% wells of JDA region, monitored by GSI during the period 1980-1992 indicated a significant decline in the wells. In some of the cases the decline was more than 12 m during the period viz. Jaisinghpur (12.20 m), Hathod (13.00 m), Lalpura (14.80 m), Saipura (15.05 m) and Udak (15.10 m). More than 30% wells monitored during 1980 were dry in 1992.

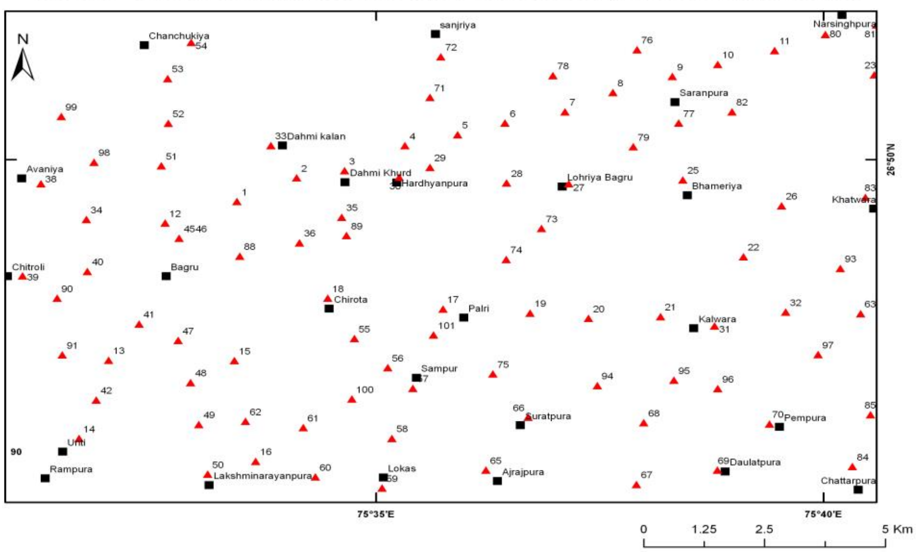
Chemical quality of ground water in general is potable except in southern and western part of the district. Natani 1993 reported high incidence of fluoride in southern and western parts of the district. High NO_3 values were observed in areas without sewage system. High SiO_2 values were reported in wells around Sanganer dyeing industries indicating contamination of ground water from dyeing units.

4.2 SEZ Area

S. R. Singh, A. K. Chattopadhyaya (1981) from geological Survey of India carried out geophysical survey in the Bagru-Nevata area falls in the Survey of India toposheet No. 45 N/9. Based on the present surveys, the contour maps for bed-rock, well water sensitivities, total conductance, overburden thickness and water table have been prepared which are discussed below (Figs 5,6,7,8,&9).

Fig. 5

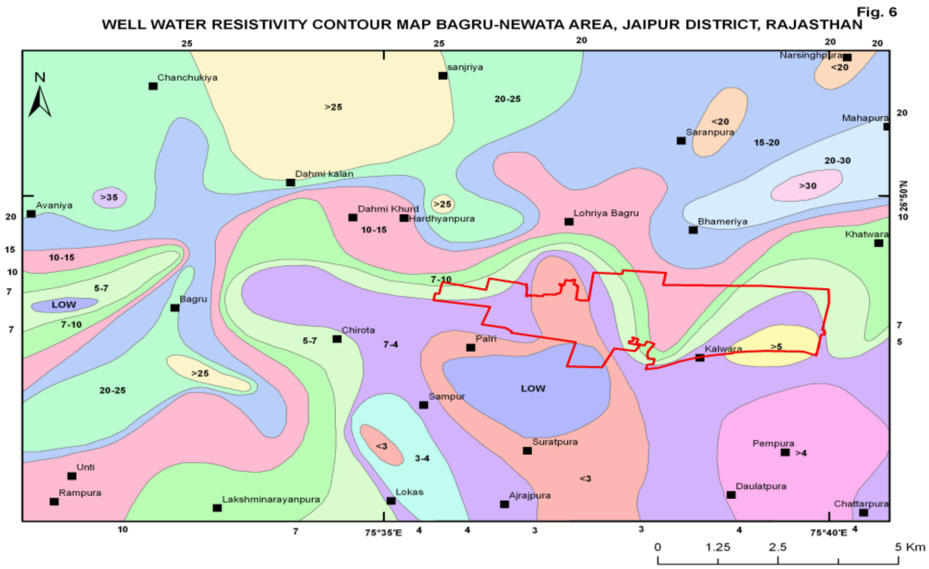
LAY OUT MAP SHOWING RESISTIVITY SOUNDING IN, BAGRU-NEWATA AREA, JAIPUR DISTRICT, RAJASTHAN



4.3 Well water resistively contour map

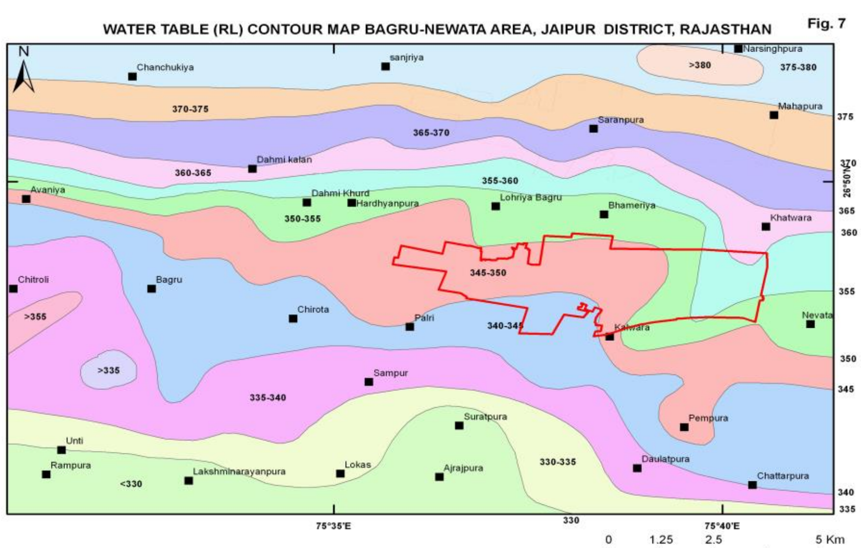
This map is shown in (Fig.6). The well water is saline in the southern part of the area, where it's resistively is less than 5 ohm. m. This area (marked by resistively lows) falls in and around the villages Chirota, Palri, Kalwara, Nevata, Pempura, Daulatpura, Suratpura, Sampura and Lakas. A resistively low also lies to the east of Chitroli village. In general, the quality of water is found to improve in the northern part of the area. Between Dahmi-Khurd and Mahapura (along Ajmer-Jaipur Road) the quality of water is potable in the wells, which is also reflected in the contour values here. The quality of water is found to be potable again in south of Bagru

(Fig.6).



4.4 Water table contour map

The water table contour map of the area suggests a general flow direction from north to south. This is indeed significant as otherwise a flow from south to north would have meant a possible infiltration of saline water into the potable water zone in the northern part of the area (Fig.7).

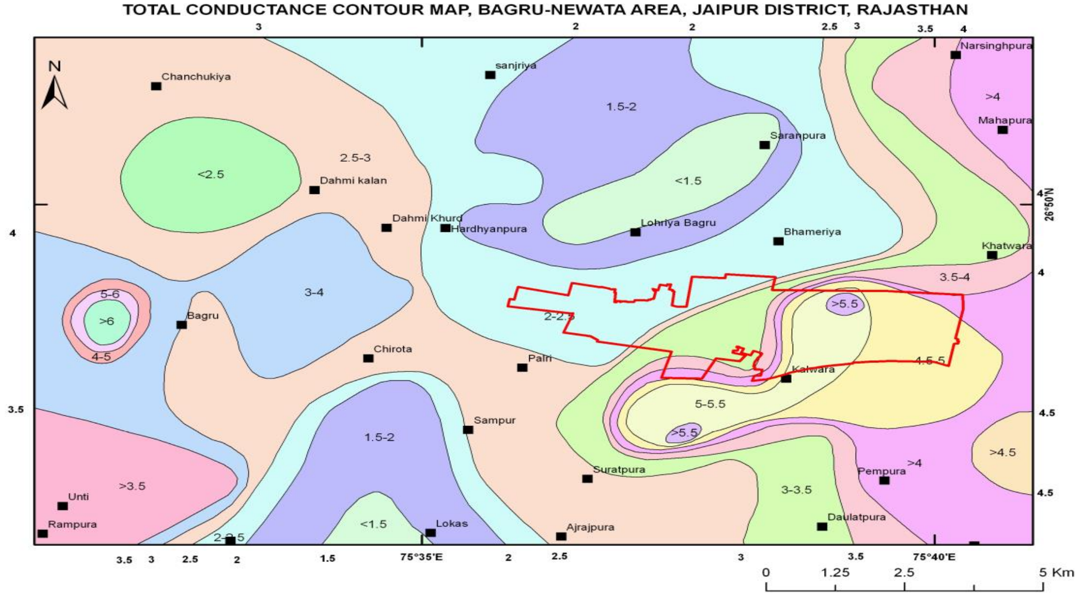


4.5 Total conductance contour map

The total conductance contour map of the area is shown in and the over-burden thickness map. The total conductance (S) is related to the thickness and the resistively of the overburden material by the relation h/q = S. This relation shows that the value of total conductance increases with increase in thickness or decrease in resistively value of the overburden material. In The present case, the S values are abnormally high around Kalwara village. This increase in values can be partly attributed, to the decrease in resistively (saline water zone) and partly to increase in overburden thickness (of the order of about 100 m) as compared to the surrounding area (where overburden thickness is less) (Fig.8&9).

Fig. 8

TOTAL CONDUCTANCE CONTOUR MAP, BAGRU-NEWATA AREA, JAIPUR DISTRICT, RAJASTHAN



In the area between Nariya and Sampura, though the overburden resistively is low (saline water area) the total conductance value is normal. This is possibly because of the smaller overburden thickness compared to Kalwara area. In the area to the north of Hardyanpura, Lohariya-Bagru, Bhamoriya and Khatwara villages the totals of conductance's are quite low suggestive of potable water conditions. The total conductance values increase again towards Mahapura (where the water is potable) indicating an increase in overburden thickness (from west to east) which is also corroborated by the bed-rock contours.

The area around Mahapura appears to be favorable for ground water development considering the quality of water (Pw = 20 ohm m) and the overburden thickness (80-100 m). The area to the south of Bagru should also be favourable as the well water resistively is of the order of 20 ohm m and the overburden thickness is of the order of about 120 m. The favorable hydrological conditions of this zone are further supported by normal values of total conductance's which are of the order of 3 in this zone (Fig.8 & 9).

The groundwater conditions are found to improve to the north of Bagru also. The area between Bagru, Avania and Chanchukia is again favourable in view of the potable quality of water and the large overburden thickness of 120 to 150m (Fig.8 & 9).

An inferred depth session (based on resistively data) along Bagru- Mahapura road is shown in (Figs 5&6). The bed - rock depth is of the order of 60 to 70m. The well water resistively here (14-18 ohm m) and the receptivity of the aquifer (20-50 ohm m) suggest a potable water zone (Fig.6). The bed-rock goes down towards Mahapura where it is at a depth of 120m. As the quality of water is also good, the bed-rock depths at sounding points S1 and S2 are of the order of 120m but the well water resistivity is rather low suggesting brackish conditions (Figs.4, 5 & 9).

CHAPTER V
ENVIRONMENTAL APPRAISAL

5.1 Environmental Appraisal Jaipur City and Its Hinter Land Areas

Environmental problems of Jaipur district owe their origin to unscientific handling of water system, geomorphic landforms and processes, anthropogenic and neotectonic activity. Increasing sand migration, water logging, recurrent flood and salinisation of shallow aquifers in the river regimes have resulted from segmentation, local pounding and disorganisation of rivers due to mismanagement of present drainage courses and underground water, neotectonism and incompatibility of earlier drainage system to cope up with the changing tectonic frame (Raghav 1991). Salinity and high fluoride incidence in the groundwater are in majority cases environmental hazards inherent in the land - water system of the area. Much of the problems have stemmed from the rapid urbanisation and migration of population from the rural areas to urban centers in pursuit of job. Stress on industrial development and undertaking expansion without considering either the natural land capability (actors or long term considerations have complicated the situations. Jaipur district, especially the Jaipur urban area and its hinterland faces severe environmental problems in term of large scale land transformation, pollution, land degradation, ground water depletion, drainage blocking, gully erosion etc. There has been a steady encroachment on river beds, flood plains and spill areas. Comparison of antique map of the Jaipur urban area and its hinterland with the latest top base (1:50,000) indicates significant decrease in the length of tributary streams. Industrial, urban and slum growth along the Amanishah nallah, Nagtalai nallah, and reactivation and remobilization of dune sands have caused blocking and choking of natural drainage system, ultimately giving rise to frequent flash floods and standing body of water on roads and streets. Choking and blocking of natural drainage from the hills /through the dunes leveled up for civil construction, create situation wherein monsoon run off cannot be eased out but accumulates and undercuts the loose, unconsolidated Aeolian sands thereby causing damage to foundations and roads (Natani 1995b).

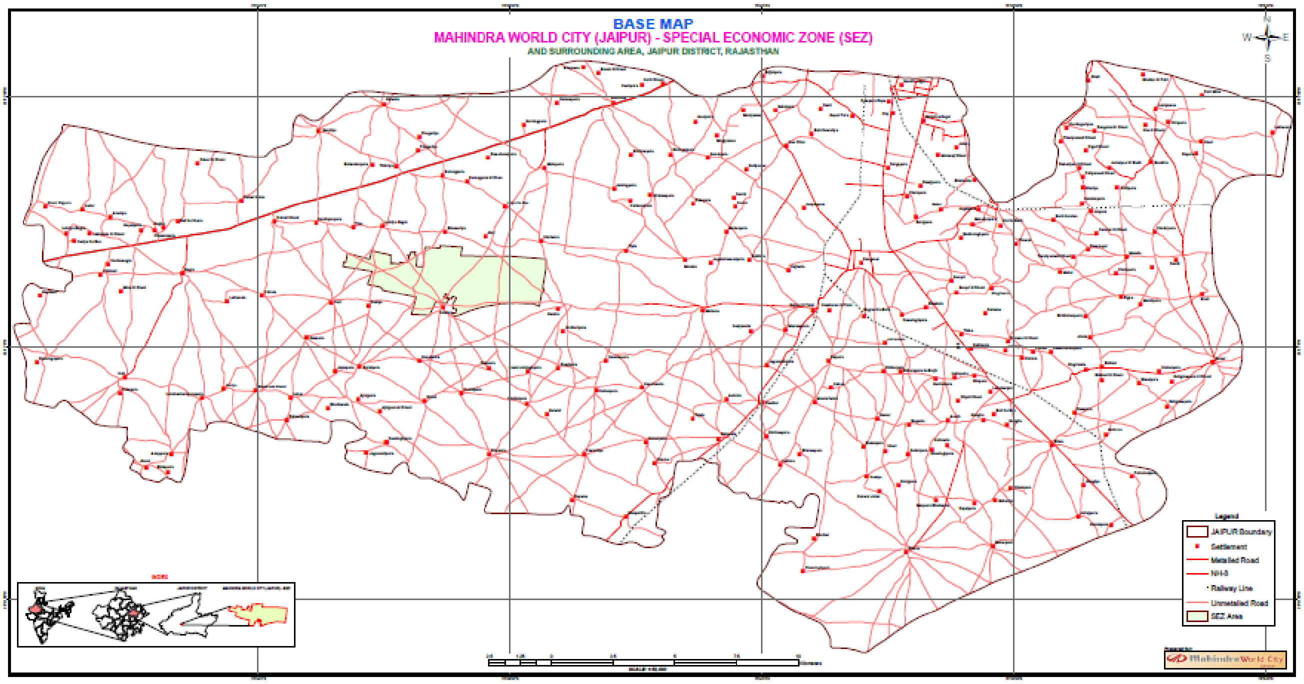
5.2 Environmental Appraisal SEZ Area

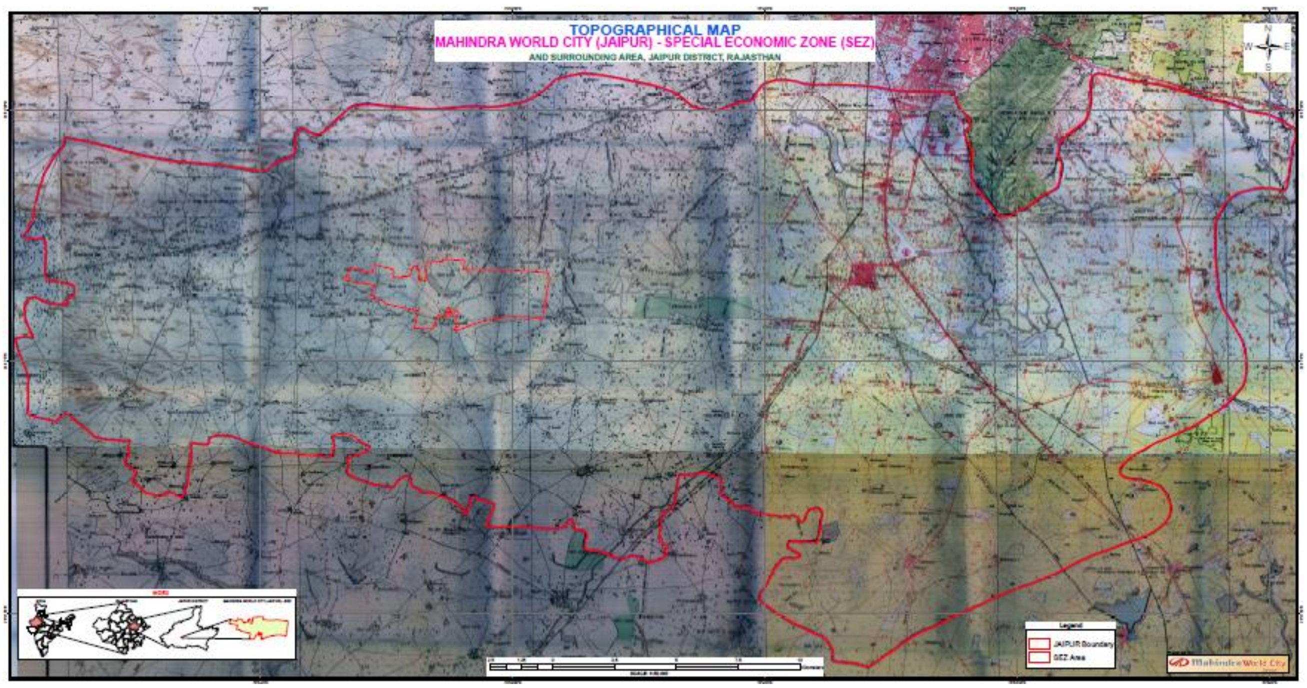
Similar problems are expected in the area proposed for the SEZ. As discussed above all the depressions such as Muhana-Newata and Kalwar- Chirota are aligned in the E-W directions. These areas are drained by the channel of the Bandi River which ultimately meets with the tributary of Chambal River. The western part of the Muhana depression is drained by N-S trending Aminisha nallah which takes turn toward the east in the south of the Sanganer (Fig.3). The general slop of the present land form west of Sanganer is westerly. The area in between the channel bed of Aminisha nallah and Muhana depression is covered by the sediments of the older dunes which are prone to gulling (Fig.13). The obstruction created to the Aminisha nallah due to construction of check dam and urbanization will result in raise of base level of the Aminisha nallah. In such condition the area around the Aminisha nallah may be flooded and Aminisha nallah′ over flow water will start flowing toward the Muhana depression. Therefore, during the storm water condition there is a possibility of rejuvenation of the palaeochannels courses of F2 cycles due to formation of gulling in the Aeolian sediment. If measures are not taken well in advance than creation of above mentioned situation may lead to havoc for the upcoming of the SEZ area and other settlements which are confined on the courses of older palaeochannels F2 (Fig.2).

Dumping solid waste directly on the river beds and in nallahs may aggravate the problem. Practice of dumping municipal solid waste in open lands, thickly populated residential areas, on nallah banks and depressions is common in the Jaipur urban centre. Flash floods in 1981 and 1992 caused loss of life and property worth crores of rupees. Care should, therefore, be taken for disposal of solid waste as it may cause rejuvenation of palaeochannels. High nitrate concentration and increase in the number of confirm organisms in the ground water of Jaipur city; have been attributed to the recharge from soak pits and lack of sewage system (Natani, 1993). Semi consolidated Aeolian sand covers, areas with intense gully erosion, abandoned channels and recently filled up channels are potential areas for creation of geo-environmental hazards leading to flash floods, under seepage in abandoned channels, sand mobilization etc. Slight increase in precipitation and improper land use practices combined with neotectonic / seism tectonic activities in the area may lead to changes in hydrodynamics of the area bringing unforeseen disasters during flash floods (Figs. 2 & 3).

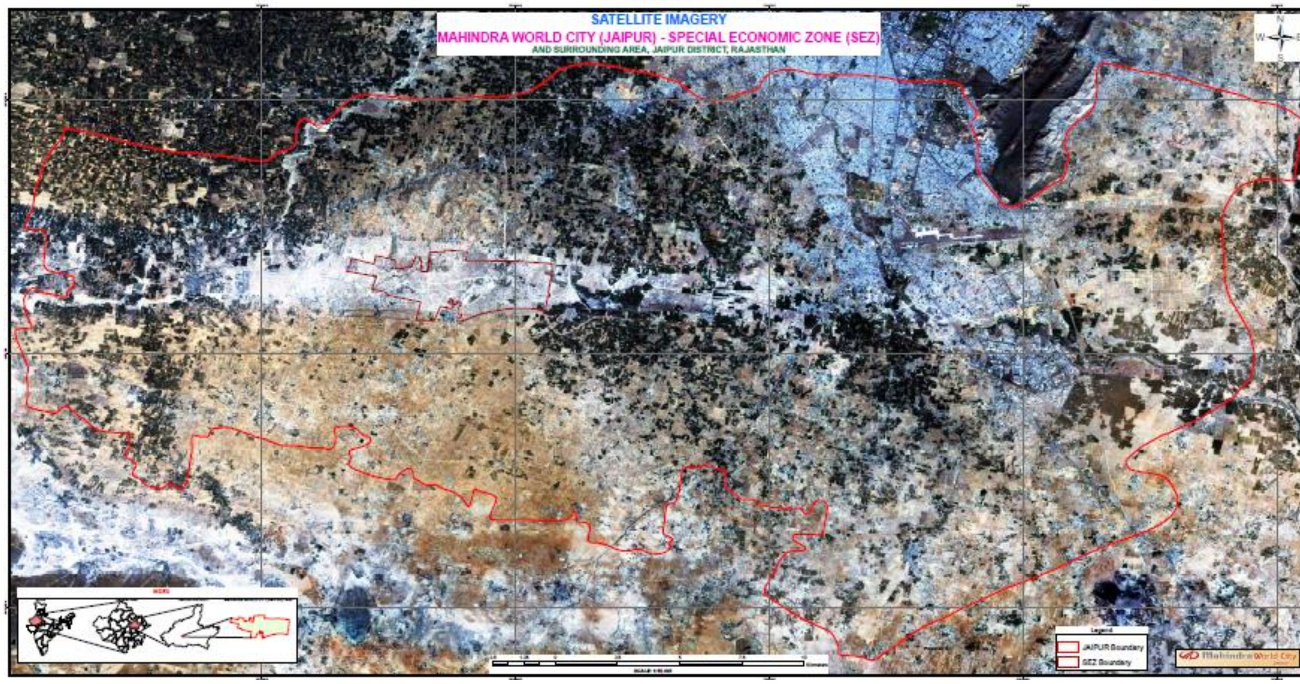
Large scale land transformation from agricultural usage to urban construction, open spaces/ parks etc. to built-up land, bills to quarries and loose sand covered areas/sand dunes to urban industrial use are common site and they have accelerated.

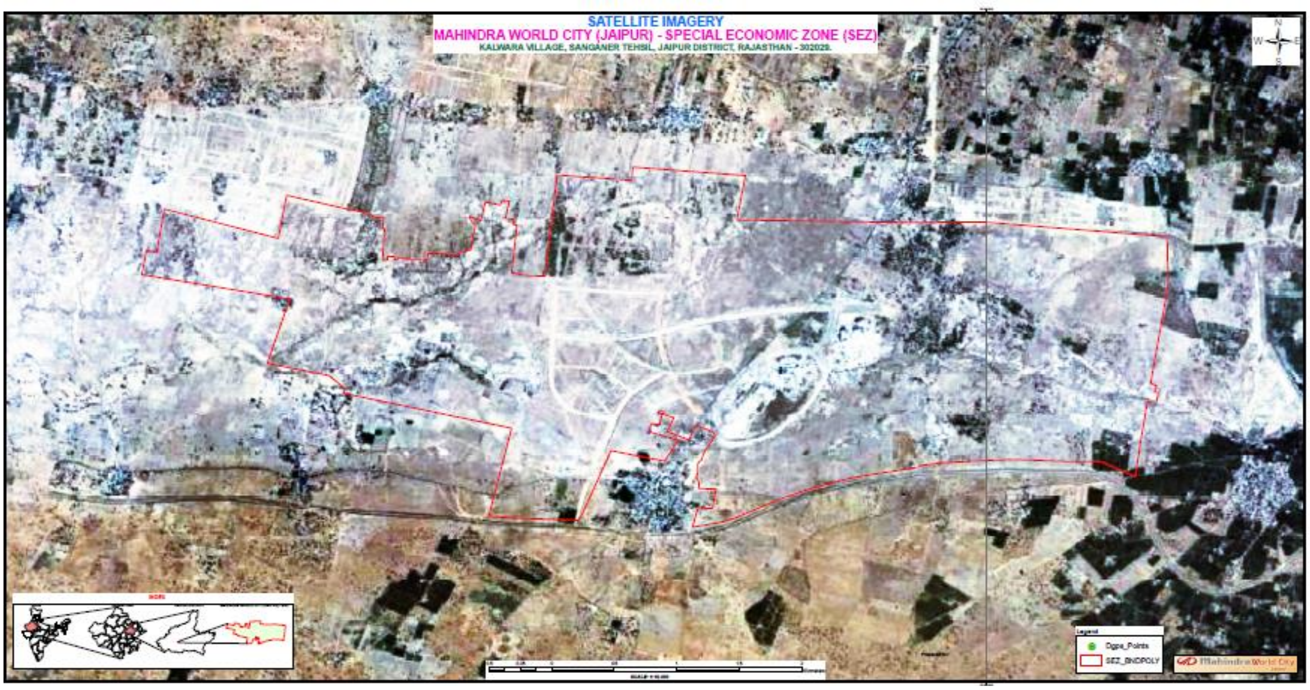
Sand remobilization, soil erosion and land degradation. Increase in soil salinity and fast development of alkali flats (alkalination) are common environmental problems in the irrigated agricultural tracts (Fig.13). This is chiefly due to the faulty irrigation practices in which excess water is allowed to stand in the field which is subject to evaporation. During this process the dissolved salts, reach the surface of soil through capillary movement, and precipitate (Fig.13).

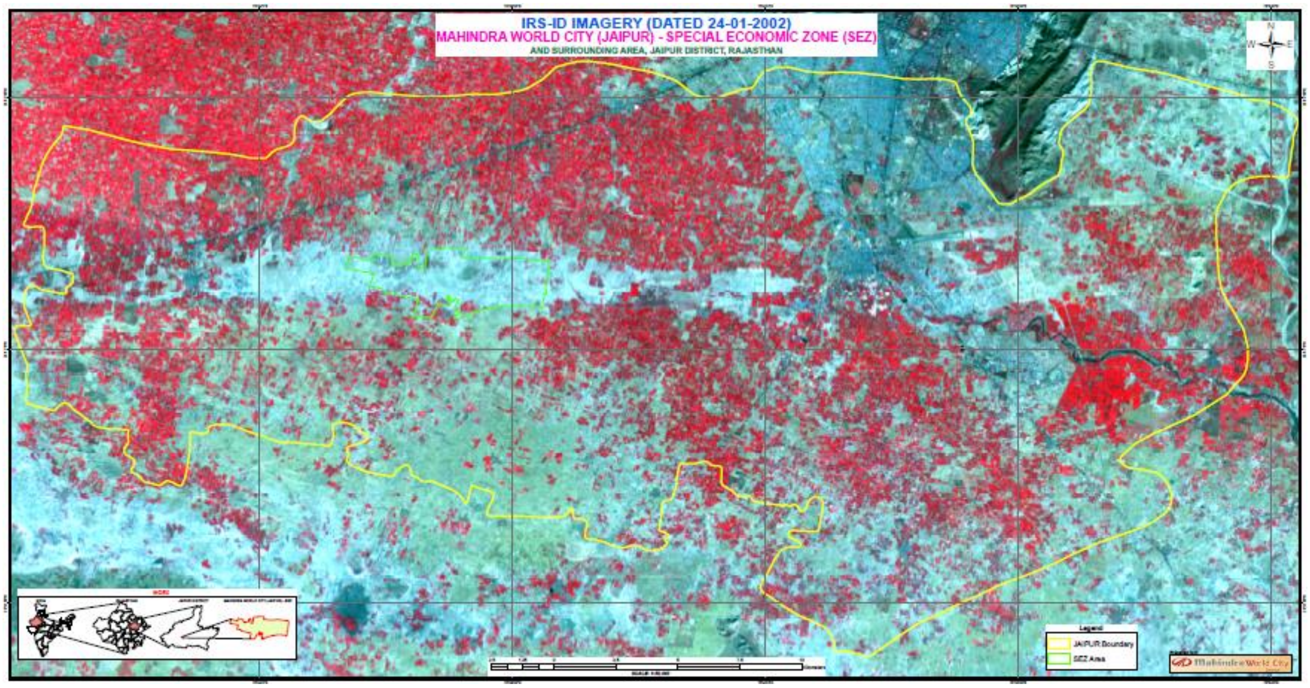

BASE MAP
MAHINDRA WORLD CITY (JAIPUR) - SPECIAL ECONOMIC ZONE (SEZ)
AND SURROUNDING AREA, JAIPUR DISTRICT, RAJASTHAN
N
W
E
S
Legend
JAIPUR Boundary
Settlement
Metalled Road
NH-8
Railway Line
Unmetalled Road
SEZ Area
Mahindra World City

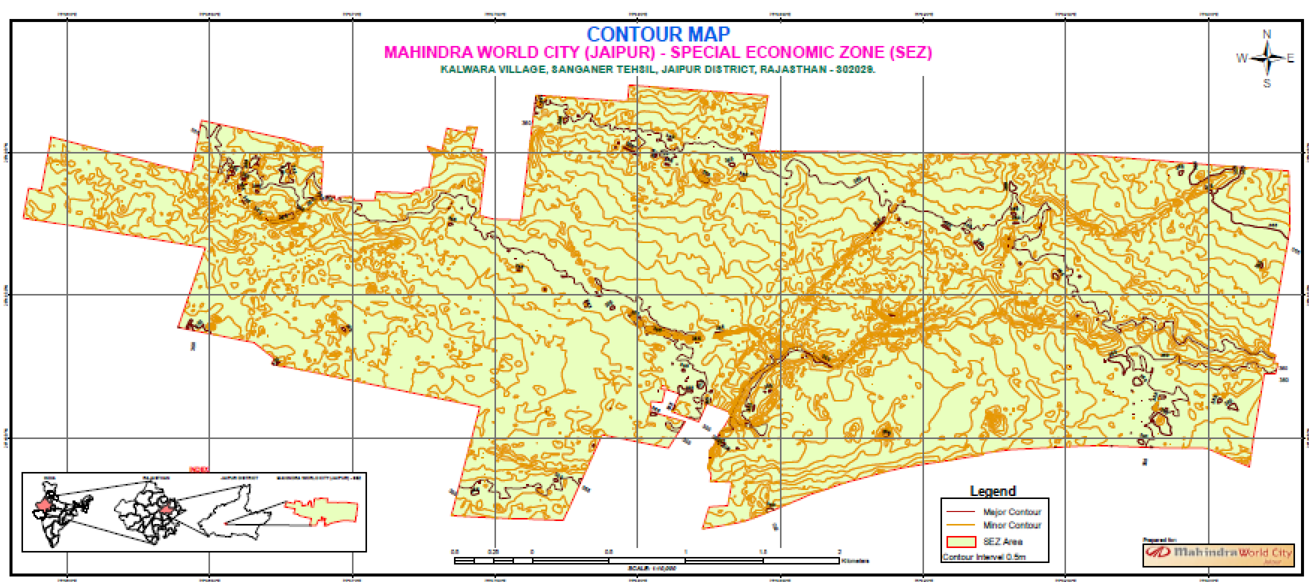

TOPOGRAPHICAL MAP
MAHINDRA WORLD CITY (JAIPUR) - SPECIAL ECONOMIC ZONE (SEZ)
AND SURROUNDING AREA, JAIPUR DISTRICT, RAJASTHAN
Legend
JAIPUR Boundary
SEZ Area

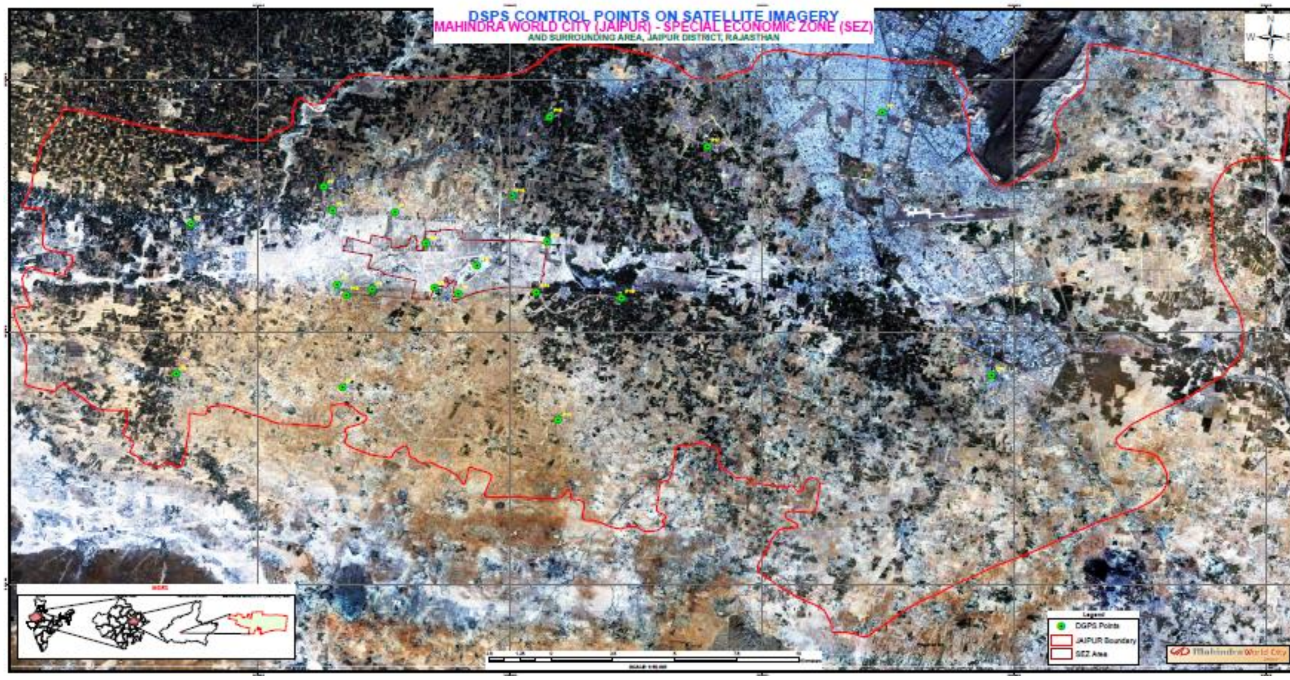

WORLD VIEW IMAGERY
MAHINDRA WORLD CITY (JAIPUR) - SPECIAL ECONOMIC ZONE (SEZ)
KALWARA VILLAGE, SANGANER TEHSIL, JAIPUR DISTRICT, RAJASTHAN - 302029.
Legend
SEZ Boundary


SATELLITE IMAGERY
MAHINDRA WORLD CITY (JAIPUR) - SPECIAL ECONOMIC ZONE (SEZ)
AND SURROUNDING AREA, JAIPUR DISTRICT, RAJASTHAN
JAIPUR Boundary
SEZ Boundary


SATELLITE IMAGERY
MAHINDRA WORLD CITY (JAIPUR) - SPECIAL ECONOMIC ZONE (SEZ)
KALWARA VILLAGE, SANGANER TEHSIL, JAIPUR DISTRICT, RAJASTHAN - 302029.
Dgps_Points
SEZ_BNDPOLY


IRS-ID IMAGERY (DATED 24-01-2002)
MAHINDRA WORLD CITY (JAIPUR) - SPECIAL ECONOMIC ZONE (SEZ)
AND SURROUNDING AREA, JAIPUR DISTRICT, RAJASTHAN
N
W
E
S


CONTOUR MAP
MAHINDRA WORLD CITY (JAIPUR) - SPECIAL ECONOMIC ZONE (SEZ)
KALWARA VILLAGE, SANGANER TEHSIL, JAIPUR DISTRICT, RAJASTHAN - 302029.
N
W
E
S
Legend
Major Contour
Minor Contour
SEZ Area
Contour Interval 0.5m
Prepared for:
Mahindra World City

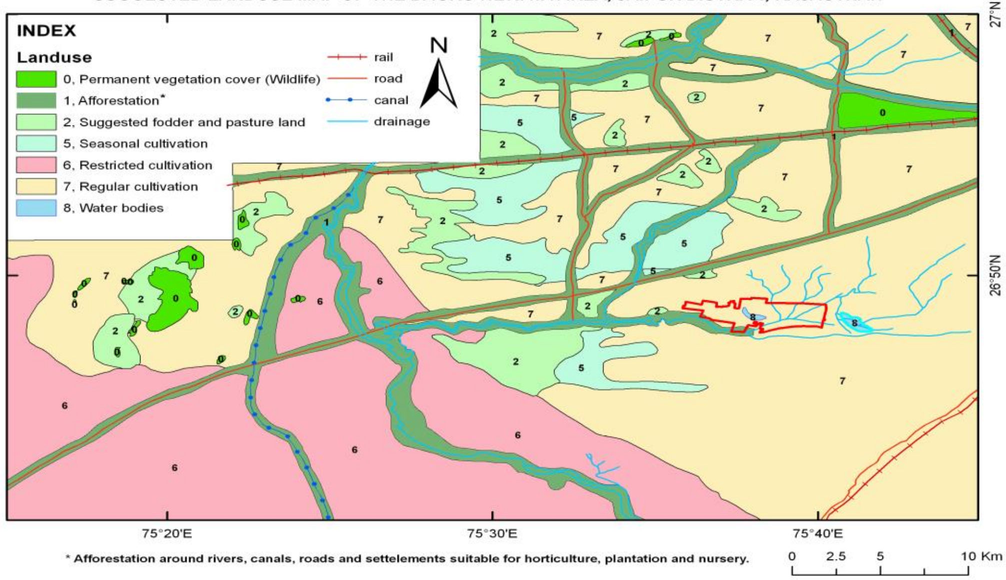

DSPS CONTROL POINTS ON SATELLITE IMAGERY
MAHINDRA WORLD CITY (JAIPUR) - SPECIAL ECONOMIC ZONE (SEZ)
AND SURROUNDING AREA, JAIPUR DISTRICT, RAJASTHAN
Legend
DGPS Points
JAIPUR Boundary
SEZ Area
Mahindra World City

CHAPTER VI
SUGGESTED LAND USE

Major part of the Jaipur district is covered by Quaternary sediments of different Aeolian, fluvial and mixed cycles excepting few areas towards north, north east and south east. These sediments display wide differences in lithology, colour, degree of compaction, extent of oxidation, pedogenic properties etc. Depending upon information regarding groundwater potential, elevation in the terrain, slope, drainage occurrences and etc, land capability and suitability map of land use has been prepared (Fig.12). The existing land use of unit is considered suitable for a forestation, preservation and regeneration of natural vegetation and resource development with suitable measures for land reclamation and restoration. Morphostratigraphic unit of D1 comprising consolidated, locally dissected stable dunes and sandy flat areas is considered suitable for urban expansion due to its good load bearing capacity, low permeability, higher compactness and better surface run off with proper alignment of forestation belt all along the roads, streams, drains and railway lines. The proper flow of the natural streams and nallah should be maintained with the afforestation belt all along their alignment. The surface area of D1 unit and older flood plains, buried and infilled channels and undulating low tracts are suggested for systematic groundwater development, dairy development and regular agricultural use (Fig.12). Quaternary formations of mainly consolidated fluviatile succession of gravel, clay and sandy loam are also suitable for urban development and systematic aforestation. However, industrial use of such land should be discouraged as it may cause pollution through chemical industrial wastes and solid and liquid urban waste and sewage.

Fig. 12

SUGGESTED LANDUSE MAP OF THE BAGRU-NEWATA AREA, JAIPUR DISTRICT, RAJASTHAN



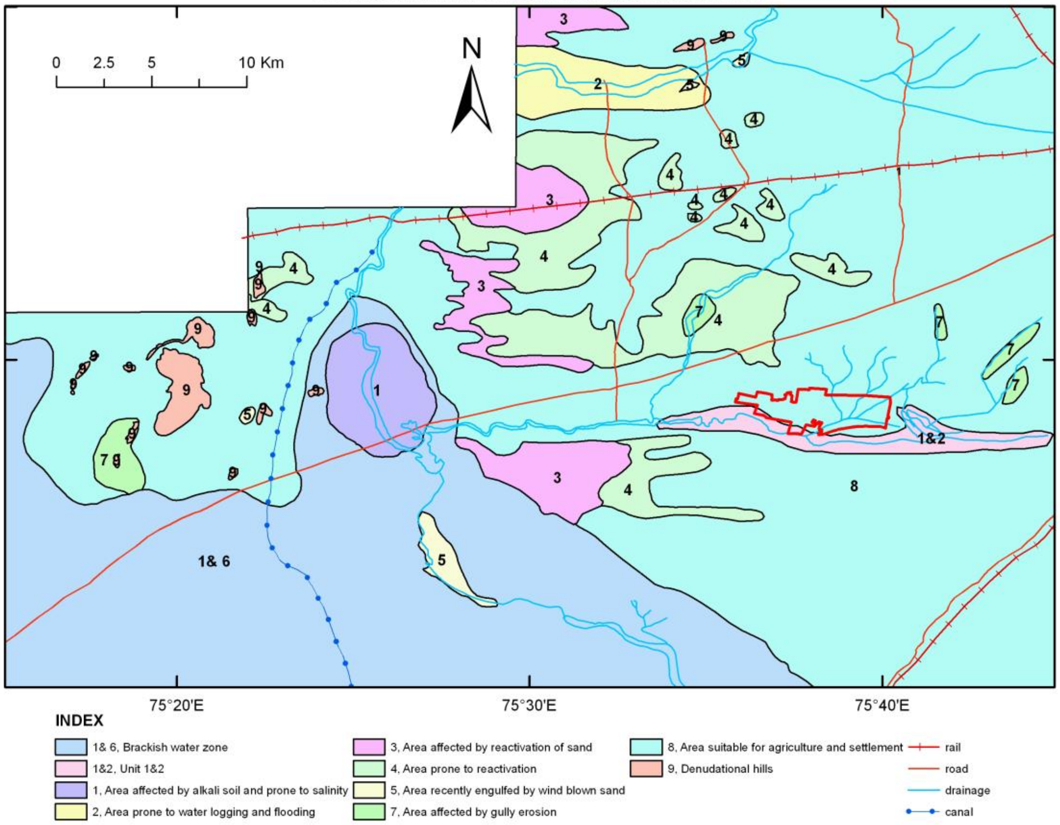
* Afforestation around rivers, canals, roads and settelements suitable for horticulture, plantation and nursery.

The older stabilized sand dunes/sand sheet of D2 cycle can be used for restricted cultivation and settlement by avoiding gullying and wind erosion affected area. Such areas should be declared reserve for forestation (Fig.13).

Younger dunes and sheet and channel sediments deposits areas are in the vicinity of ephemeral streams. These constitute stabilized with formation of calcrete concretion at the surface due to evaporation and loose and unconsolidated deposits which are mostly the reactivation product of older stabilized deposits and aggraded river deposits. This is primarily due to biotic and anthropogenic interferences. These area and area prone to intense gulling should be used for reserve forestation (Fig.13).

Fig. 13

WASTE LAND & ENVIRONMENTAL APPRAISAL MAP OF THE AREA AROUND BAGRU-NEWATA, JAIPUR DISTRICT RAJASTHAN

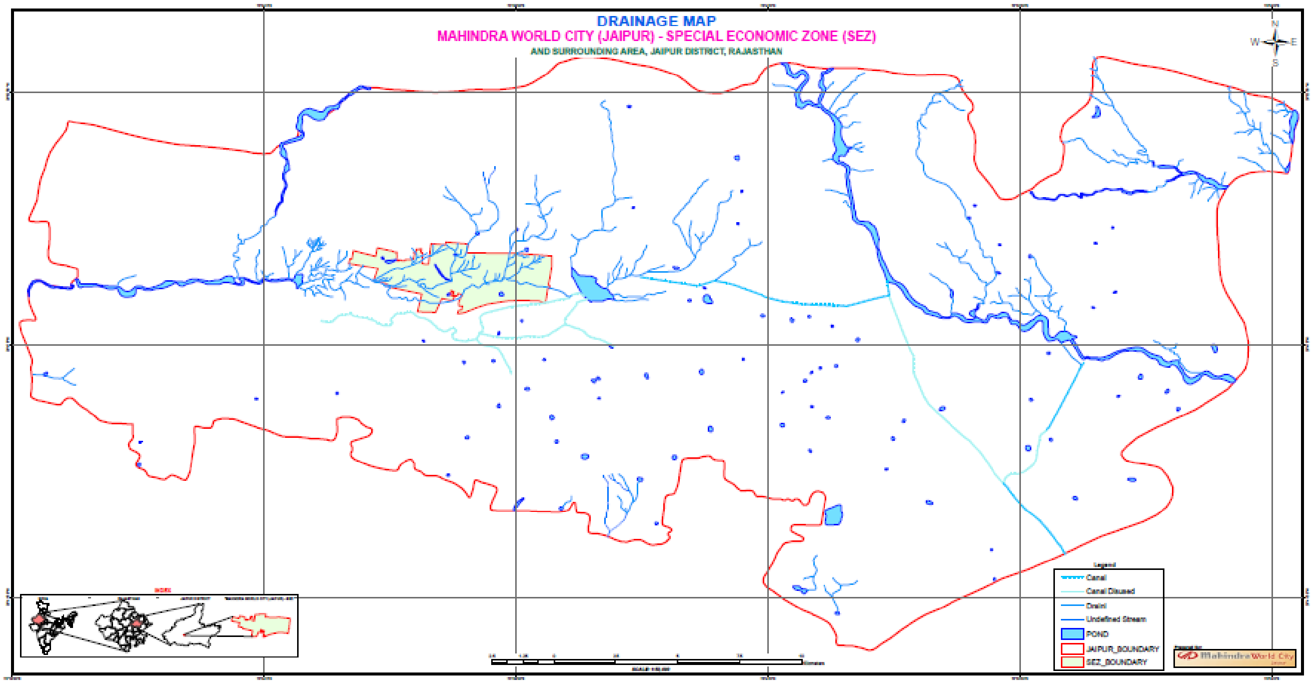


CHAPTER VII

SUGGESTIONS FOR RAIN/STROM WATER HARVESTING AND SURFACE AND GROUND WATER MANAGEMENT

MWCJ have got prepared a report for Start-up of the SEZ development area. Most of the aspect related with the development of the SEZ area has been covered in this report. Storm water drainage system, water supply and distribution system and sewerage system are covered in this chapter based on the detailed geological and hydrogeological studies carried out to understand the exact status of the SEZ area in terms of rainwater harvesting and recharge. Summary of the recommendations made are given below.

7.1 Drainage: MWCJ has got prepared a report for Start-up of the SEZ development area on the water harvesting system. In this report it has been indicated that the proposed collector drain is suggested at the existing depressions in NPA and IT/ITES areas, in order to use the existing draining profile of the terrain at the eastern portion of the Start-up area. This is also to minimise earth fills as well as cost. The earth fills required is then further reduced by lowering of the nallah invert levels. The maximum depths for lowering of existing nallah invert levels shall be limited by the controlled nallah invert level of 345.3m located about 4.26 km downstream from Start-up Area. All calculations, such as Peak Runoff (Q) and Runoff coefficient (P) on the storm water drainage system management for the SEZ area, are done considering the area within the MWCJ-SEZ. The proposed development scheme for storm water drainage system for the Start-up area is abstracted from the overall drainage concept design.



7.2 Rainwater: Rainfall Intensity (I_o) is also calculated for storm water drainage design by considering the area of the proposed development. The sizing of the box drains are designed to the discharge capacity for the peak runoff using Manning's formula. It has been also suggested that sufficient freeboard shall be provided to prevent waves or fluctuation of water surface from overflowing the cope / bank. Drainage Network and detention pond at Start-up Area are proposed for 540 ha area. This has been abstracted from the overall drainage network where surface runoff from the roadside drain is being discharged to the collector drain. Subsequently, it will be discharged into the existing nallah. The drainage sizes in the Start-up Area are proposed based on the peak runoff for the proposed overall development, which means the drains within the Start-up Area are designed to ultimate sizes. Additional drainage reserve will be required at locations where the total widths of the proposed drains exceeds the allocated 2.5m drain reserve as appended in the typical road sections. It has been suggested that the collector drain size can be reduced with the implementation of detention ponds. The entire Start-up Area has been divided into ten (10) sub-catchments areas.

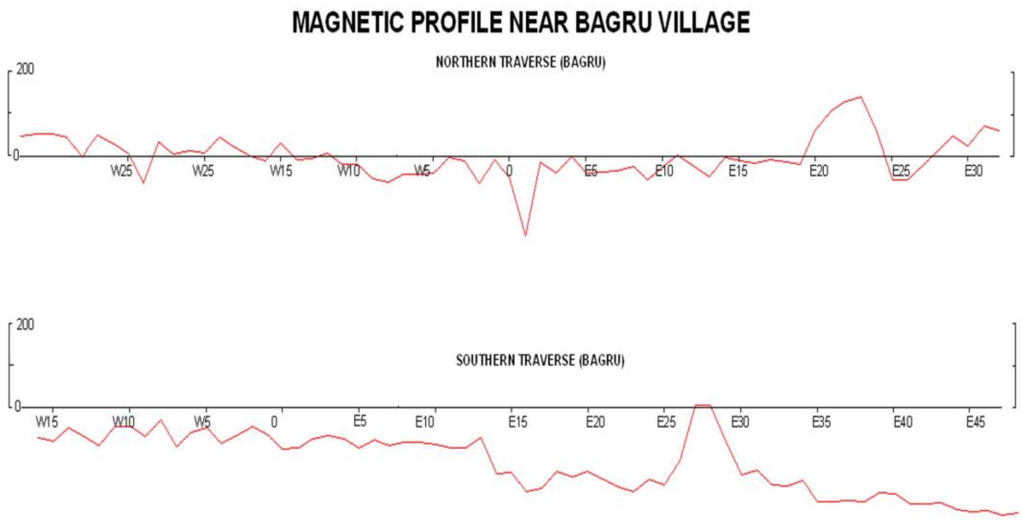
7.3 Sewerage: The sewerage catchments for the Start-up of the MWCJ SEZ development Area are shown in as per the estimated capacity of the two STPs for the two sewerage catchments. To minimise the capital cost outlay, it is recommended that the two STPs/TTPs to be planned in modular units to treat the initial sewage arising from the Start-up Area. The STPs/TTPs can subsequently be expanded to the ultimate capacities as the sewage load picks up and eventually when the development is fully built-up. However, the pipe system within the Start-up Area should be provided to the ultimate capacity.

7.4 Surface and Groundwater Management

On the basis of the above studies following suggestions are made on rainwater harvesting (RWH) and artificial recharge (AR) system in Mahindra world city area of SEZ.

Present study reveals that proposed SEZ area is confined at the top surfaces of the earlier fluvial F1 and F2 cycles deposits with intervening of arid to semi arid cycles deposits. These deposits are aligned in NNE-SSW and EEN-WWS directions respectively. The flow patterns of the present drainages of the area are controlled by NNE to SSW trending stream in the northern part and EEN to WWS in the southern part. Drill hole logging carried out in the SEZ area for a depth of 10 meter also indicated occurrence of alternative sequences of fluvial- and pluvial cycle deposits. It is further evidenced by the presence of silty sand and gravel bed at the base. These deposits are overlain by alternative sequences of silty sand and fine to very fine sand with alternation of clay band. The top surfaces of these deposits are covered by calcareous silty sand and clay. These sequences of the deposits suggest fluctuation in the intensity of the streams flowing through the area. The SEZ area is seismo tectonically active (Figs 3, 4 & 14) and prone to water logging, flooding and environmental hazards such as soil erosion and ground water pollution. However the land forms are suitable for the construction and industrial development provided all the suggested measures are taken care off**.** Therefore, while selecting and implementing rain water harvesting and artificial recharge, sewerage storage and treatment plant for the Start-up area of the MWCJ SEZ area all the above discussed factors and suggestions given below should be seriously considered. In view of the above discussions following recommendations are made for effective water management of the MWCJ SEZ area.

Fig. 14

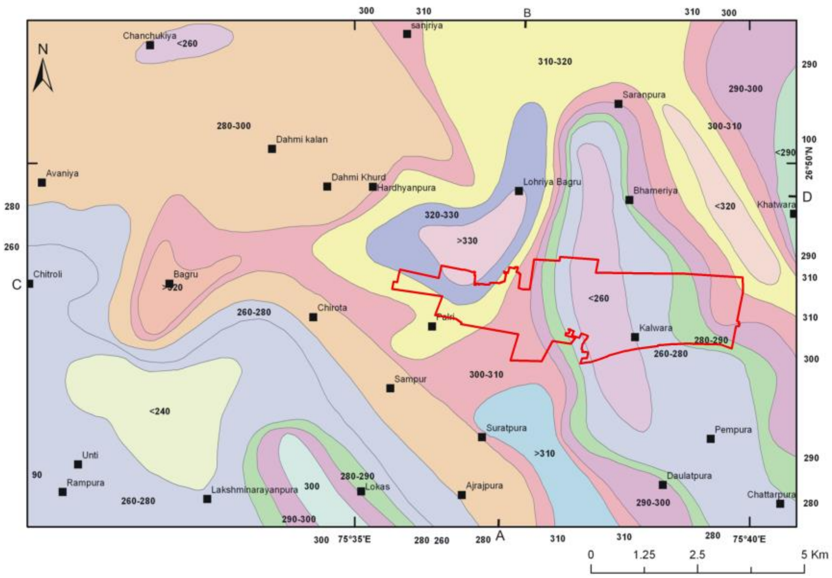


7.4.1 Sewerage Water Management

The surface and ground water flow of the SEZ area is toward the south (Figs 7 & 15). Therefore, any proposal of sewerage storage and treatment in the northern part of the area will lead to contamination of the sweet portable water. The proposed site for construction of sewerage storage and treatment in SEZ area should be avoided and it can be constructed further down in southern part of the SEZ area, where the ground water is brackish. Only in condition that it become mandatory to have sewerage storage and treatment in the SEZ area it should be constructed toward the south western part as suggested in the MWCJ SEZ report. Further, if 100 % leak proof is ensured in construction and provision that in any condition rain water is not allowed to flow toward the sewerage storage and treatment plant.

Fig. 15

SURFACE AND BED ROCK CONTOUR MAP BAGRU-NEWATA AREA, JAIPUR DISTRICT, RAJASTHAN



7.4.2 Potable Water Storage Plant

The potable water storage plant can be confined in the north eastern part of the proposed SEZ area. Since the slope of the proposed area is also higher in the northern part therefore it can be designed as underground storage tank.

7.4.3 Storm Water Management

The existing storm water drainage system management of MWCJ has been calculated for the proposed SEZ area only. However, this study reveals that entire rain water flow from the northern and eastern part of the proposed area has flow towards the SEZ only. Blocking the stream course by developing water ponds without proper measures will lead to sever environmental hazards such as flooding, water logging and soil erosion. Similarly, if flow of the southerly and westerly flowing drainage of outside boundary area of SEZ are blocked/chocked than during the storm rain entire rain water of the upper catchments may start following toward the SEZ through opening in the boundary and with development of internal drainage due to soil susceptibility to erosion. These internal drainages may reappear in the area of SEZ near the meeting points of the present stream course. There is a possibility that entire area of the proposed SEZ will be flooded and water logging condition will developed during the heavy rain. his may lead to havoc in the area.

The another sever problem is expected from the Newata dam, which is confined to the western side of the SEZ area. The Newata dam is having an outlet through a drainage that passes through SEZ area. The water catchment of this dam is very large right from southern and south western part of the Aminisha nallah. During the heavy rains, there is a possibility that Aminisha nallah may be flooded and additional water of over flowing Aminisha nallah may start flowing toward Newata Dam as discussed above in the environmental chapter. In view of the above facts following remedial measures are suggested:

A. A water canal system outside the SEZ area in the northern, western and southern part should be developed to fetch up the storm/rain water with a proper out let to the Bandi river system.

B. Similarly, a water canal system of approximately 5m of width all around the SEZ area boundary within the SEZ area should be developed. The entire surface water flow of the SEZ area should be diverted toward this canal by creating natural slop toward the canal. During the designing of the canal general slope of this canal should be maintained on the basis of msl value of inlet and outlet of the SEZ area in the east and west area respectively. However, the depth (5 to 1o m), width (5 to 10m) and length (50 to 100m) of this canal can be increased at an interval of 100 m of this proposed canal. The over flow water during heavy rain can be drained through the proposed opening at the out let of the canal toward the Bandi river in the west. Within the extended area of the canal some dug well should be opened at a 50 m interval of a depth of 4 to 8m depth .The opening of these well should be covered with a lid. These lids can be opened during the heavy rain and development of flooding and water logging condition in the SEZ area. Since natural Palaeochannel bed is present at a depth of 10 to 15 m in the proposed SEZ area the open dug well will act as artificial ground water recharging well. These well can also be used for monitoring of ground water table and in quantification and quality control.

C. The Canal will be of multiple usages particularly during storm water conditions developed in the SEZ area. It will take care of water logging, flooding and artificial recharging of groundwater.

D. The canal can also be developed as a beautiful swimming pool and water spot for boating. In the area of the road this canal will be under ground and at certain open places this canal should be covered to avoid the evaporation losses.

7.5 Groundwater Monitoring

Deep wells constructed within the area of the canal should be used for ground water table monitoring by installing Piezo-meters. It will help in calculating the ground water recharge of the SEZ area. The regular chemical analyses of the water samples collected from the canal water and wells water will help in maintaining the quality of the potable water and to find out is there any biotic contamination.

7.6 Forestation and Plantation

As suggested in the chapter on land use, the area all along the roads and canal should be developed for plantations and forestations. At the site of extended canal some area should be developed as garden and parks. In this processes MWCJ can make better use of the available land and can save more valuable land for constructions.

7.7 Earth Quack Safety Measures

As discussed in the chapter 2, Section 2.6 on seismicity and Neotectonism, the area is neotectonically active. Therefore earthquake resistibility measures of VI Mercalli scale should be taken while designing the construction in the area.

REFERENCES

Banerjee, B. and Singh, N.P. (1982), “A report on the geophysical studies for Environmental appraisal in Jaipur district, Rajasthan”, Un pub., GSI progress report for 1979-80.

Das Gupta, Sharma, D.C. and et al. (1983), “A report on environmental geo-scientific appraisal of the Jaipur Urban zone and its hinter land, Jaipur district, Rajasthan”. Un pub. GSI progress report for 1977-1982.

Das Gupta and Sharma, D. C. (1986), “Neotecionism in Rajasthan: Its manifestations and effects”, International symposiums of Neotectonics in south Asia, Survey of India. Dehradun, District Resource map (1997), District resource map of Jaipur Compiled by S. S, Jain and Published by Director General GSI, Calcutta.

Gupta, S. N., Arora Y. K. et al.(1981), “Lithostratigraphic map of Aravalli region, south eastern Rajasthan and northern Gujarat”, Geol. Survey of India, Hyderabad.

Jethra, M S. (1989), “Ground water resource and development potential of Jaipur District”, CGWB Unpublished progress report for F. S. 1986-87.

Natani, J. V. (1993) “Geoenvironmental reappraisal of Jaipur urban and its hinterland area”,

-------------- & N.K. Pal, (1995c), “Final report on sustainable developmental of Jaipur district with special emphasis on Jaipur development authority region”, Unpublished report of Geological Survey of India, Western Region Jaipur.

Raghav, K S. (1991 a), “Geology, Geomorphology, Geoenvironmental appraisal and land use mapping in the upper reaches of Mendha and Bandi Rivers”, Jaipur upland, GSI Un published report for the F. S. 1987-90.

Raghav, K. S. (1991b), “Neotectonic activities and quaternary sedimentation in parts of Jaipur upland”, Annals of arid zone, 30 (4), pr 301-308.

Shukla, D. S. (1981), “Electrical resistivity survey for bed rock topography and ground water in Sanganer and Jagatpura area, Jaipur district, Rajasthan”, GSI Un pub. report for the F. S, 1978-79.