ANNUAL REPORT

2006-2007

Central Ground Water Board
Ministry of Water Resources
Govt. of India
Faridabad

ANNUAL REPORT
2006 - 2007

CONTENTS

EXECUTIVE SUMMARY

Ground water plays a key role in meeting the water needs of various user-sectors in India. With growing awareness , the dependability on ground water as a sustainable resource in nation building reasserts the need for an organization like Central Ground Water Board which is vested with the responsibilities of assessing and managing the ground water resources of the country through ground water management studies, exploration, evaluation and monitoring of ground water regime.

The Central Ground Water Board was constituted as a National apex organization in 1972 by the merger of the Ground Water Wing of Geological Survey of India with the erstwhile Exploratory Tube wells Organization (ETO). The main activities of the Board include macro level Hydrogeological investigations, deep exploratory drilling coupled with remote sensing studies, geophysical studies and pumping tests to study the subsurface Hydrogeological features and nation-wide monitoring of the behaviour of water table and water quality through a network of ground water observation wells. The data generated from these investigations provide the scientific base for preparation of ground water development schemes by the State Governments. Besides advising the States on planning, financing and administration of ground water development schemes, the Board undertakes research & development schemes, water balance studies, conjunctive use studies and artificial recharge studies. The Board also organizes training of personnel of different disciplines of Central and State Government Organisations in ground water related activities.

OBJECTIVES

Under the mandate given based on principles of economic, ecological efficiency and equity, the major activities of Central Ground Water Board are to :

- Periodically assess the country's ground water resources.
- Monitor and guide ground water development to promote its sustainable management.
- Develop, refine and disseminate basin specific technologies for sustainable ground water development and management.
- Plan augmentation, conservation and regulation of ground water resources.
- Establish a National Information System to collect, store, process and disseminate ground water data.
- Promote the economic and efficient use of manpower, energy and equipment employed in ground water sector.
- Support and co-ordinate the efforts of State Government for planned development of ground water.
- Foster International co-operation to promote scientific exchanges, acquisition of useful technology.

- Promote environmental awareness and water quality consciousness, impart training and promote applied research.

ORGANISATIONAL SETUP

The Central Ground Water Board is headed by the Chairman and has four main wings namely 1) Exploratory Drilling & Material Management 2) Sustainable Management & Liaison 3) Survey, Assessment & Monitoring and 4) Training and Technology Transfer. Each wing is headed by a Member . The administrative & financial matters of the Board are being dealt with by the Director (Administration) and Finance & Accounts Officer (FAO) respectively.

The Exploratory Drilling & Materials Management wing is responsible for the drilling and construction of Exploratory and other type of boreholes required for ground water exploration including monitoring of stores, consumption and inventory for efficient and economic machine utilization, purchase action in respect of drilling equipment, vehicles, instruments etc.

The Sustainable Management and Liaison wing looks after sustainable management of ground water related policies, issues etc., work related to monitoring of ground water regime and development, conjunctive use of surface and ground water, urban ground water management, drought management, data collection, storage and retrieval etc.

The Survey, Assessment & Monitoring Wing of Central Ground Water Board is vested with the responsibilities for undertaking Ground Water Management Studies, Aquifer mapping and assessment of aquifer characteristics based on exploration and surveys, Hydro- chemical analyses and studies, pollution studies, short term water supply investigations, special studies, preparation of various Hydrogeological maps, Atlases, Master plans, State reports, District reports, etc.

The Training and Technology Transfer Wing is vested with the responsibility of imparting training at different levels to entrepreneurs, professionals and administrators concerned with ground water development and management. The wing is also responsible for formulation of overall training policy, assessment of training needs, conceptualization of the training modules and the programme implementation strategy etc for the organization.

For undertaking the activities in field, 18 Regional Offices, each headed by a Regional Director, have been established in the country. 11 State Unit Offices have also been established in those states having large geographical area for better management of field activities. 17 Divisional offices handle the exploratory drilling and related activities, each headed by an Executive Engineer. Both the State Unit offices and Divisional Offices work under the overall administrative control of the respective Regional offices. The details of Regional office wise field formations and their jurisdiction are given in Annexure- 1. The Board has about 500 Scientists, 200 Engineers; and about 3500 technical & administrative/ministerial supporting staff. The Board has a fleet of 86 drilling rigs (32 Direct Rotary, 41 Down the Hole and 13 Percussion Combination types) for taking up drilling operations.

ACTIVITIES & ACHIEVEMENTS

Various activities of the Board are being pursued on a continuing basis as per National Water Policy (1987) & (2002) and in accordance with the overall development strategy for the X plan. The following activities were undertaken during the period 2006 -2007

- Ground Water Management Studies.
- Ground Water Exploration Aided by Drilling.
- Monitoring of Ground Water Observation Wells.
- Short Term Water Supply Investigations.
- Periodic Assessment of Ground Water Resources.
- Technical Documentation and Publication of Hydrogeological Atlases, Maps & Reports.
- Publication of Quarterly Journal, `Bhujal-News'**:**
- Construction of Deposit Wells.
- Organizing Exhibitions, Seminars, Work Shops etc.
- Hydrochemical Analysis.
- Geophysical studies.
- Hydrological and Hydrometeorological studies.
- Mathematical Modeling studies.
- Data Storage and Retrieval.
- Artificial Recharge studies.
- Organizing Training of Central and State Government personnel.
- Monitoring of Ground Water Development.
- R & D Studies
- Special studies / Basic Research in Hydrogeology.

Ground Water Management Studies

Ground Water Management Studies are carried out in different districts to assess the impact of ground water development within a period of 5 years. The survey has components of key hydrograph monitoring; pumping tests; collection of statistical data pertaining to irrigation structure cropping pattern, Land use and hydrometeorological data. The entire data generated during survey is analyzed & accordingly the future scenario for development of ground water is visualized to further plan ground water development & management in the area. During the year 2006-2007, an area of 1,90,783 Sq.km. have been covered by the Board under Ground Water Management studies (Reappraisal Hydrogeological Surveys) as against target of 1,85,004 Sq km. The Board gave a special emphasis to this study in tribal and drought prone areas and 47015 & 40430 sq km area respectively were covered to assess the status of ground water development in the area**.**

Ground Water Exploration

Exploratory drilling is carried out for establishing the sub-surface aquifer geometry, followed by pumping test to evaluate the aquifer parameters & collection of water

samples from different zones. The entire exercise is aimed at quantitative & qualitative evaluation of ground water in aquifers of the area. These studies help in identifying areas worthy of further development and in guiding the States to adopt follow up action with regard to ground water development on a scientific footing.
During 2006-07 the Board carried out the ground water exploration work with a fleet of 86 rigs (Rotary-32, DTH-41, Percussion-13) and a total of 783 (478 EW, 165 OW, 137 PZ, 1 SH and 2 DW) bore holes were constructed departmentally against the target of 811 (497 Exploratory Wells, 201 Observation Wells, 113 Peizometers) boreholes. It is heartening to report that out of 783 wells, 567 bore holes , 188 bore holes and 178 bore holes were constricted in hard rock, alluvium and bouldary formation respectively. 184 wells and 254 wells were constructed for exploration in tribal and drought prone areas respectively. The Board has so far drilled a total of 26756 bore holes to identify areas worthy ground water development in the country till March, 2007.

Monitoring of Ground Water Observation Wells

The Board closely monitors the ground water regime in the Country through ~ 15500 Ground Water Observation Wells. It monitors changes in water level through these stations 4 times a year (Jan/may/Aug/Nov) and collects water samples once a year in May for water quality analysis. During the year the water level data so generated by these network stations were analyzed to ascertain seasonal and long-term water level changes. Depth to water and water level fluctuation maps were prepared to study the ground water regime for the whole country.

Geophysical Studies

To support and supplement ground water management studies, ground water exploration and water supply investigations, the Board conducts geophysical investigations through its regional offices. Under surface geophysical studies a total of 1894 Vertical Electrical Sounding (VES) were conducted and resistivity profiling of about 74.65 line km was covered. A total of 135 boreholes were logged while the meterage logged was about 26573 m. The Central Geophysical Cell is located at Headquarter office, Faridabad and is responsible for the planning and programming of geophysical activities of the entire Board.

Hydrochemical Analysis

Water samples collected during the course of ground water management studies , ground water exploration, monitoring of Ground Water Observation Wells, Water supply investigations etc., are analysed at 16 well-equipped chemical laboratories located at its regional directorates. During the year, a total of 15794 samples were analysed for basic / specific analysis, 2990 samples for heavy metal determinations and 114 samples for organic, for evaluating the ground water quality and its suitability for various uses.

Artificial Recharge Studies

The Board is carrying out demonstrative artificial recharge studies in high water demand areas with over-exploited / critical stage of ground water development.

Artificial Recharge studies have been completed in most of the Regions and impact assessment of ongoing & completed Schemes, monitoring & report submission are in progress. During 2006-07, A demonstrative scheme on "Rain Water Harvesting and Artificial Recharge to Ground Water" has been taken up in the (1)Lingala, Pulivendula Vemula and Vemalli blocks in Kadapa district, Andhra Pradesh (2)Gangavalli block in Salem district, Tamil Nadu (3)Mallur block in Kolar district, Karnataka (4)Bel watershed, Amla & Multai blocks in Betul District, Madhya Pradesh.(5) Upper reaches of Choti Kali Sindh river in parts of Sonkatch & Bagli blocks in Dewas district, Madhya Pradesh. 38 artificial recharge structures have been completed during the year against the project target of 200 structures.

R&D Studies

Central Ground Water Board, is assisting Ministry of Water Resources in carrying out R&D studies as a member of a sub-committee of Indian National Committee on Hydrology (INCOH), with a view to accelerate the research & development programme in ground water sector. This Committee examines the project proposals received by INCOH in the field of ground water for their suitability for funding by MOWR and also monitors the research schemes funded by INCOH. During the year, 9 New R&D proposals received are under scrutiny where as, three proposals have been recommended to INCOH Secretariat for further approval . Proposals have also been cleared for funding, which will be monitored for their progress.

Reports and Maps

Results of investigations carried out by Central Ground Water Board are suitably documented in the form of reports and maps which are categorized under four main heads viz. Ground Water Management study reports, district reports, state reports, basic data reports and maps. 23 Ground Water Year Books, 36 District Ground Water Resources Development & Management Reports , 36 Hydrogeological Maps, 2 State Reports have been completed during 2006-2007 .

'Bhujal News' is a quarterly journal published by Central Ground Water Board highlighting the latest advances in ground water research. Besides scientific papers, the journal also contains technical notes, news items and regular columns. The journal has more than 1500 readers from all over the country amongst the Central Govt, State Govt, academic institutions and others. During the year 2006-2007, the Vol. No 20 (1 & 2) issues were finalized and sent to the Government Press for publication, Vol. No. 20 (3 & 4) "Special issue on Rajasthan" has been completed and is under final stage for sending to the Govt. Press for printing.

Water Supply Investigations

The Board carries out short-term water supply investigations for Government Agencies and helps them in augmenting their water supply. Normally minimum financial implications are charged from all other departments except Defence. The Board has carried out a total of 232 investigations during this year .

Dissemination and Sharing of Technical Know-how

Central Ground Water Board, organized / participated in various Seminars/symposia/workshop/conference with a view to share its expertise in

Ground Water field and also for getting exposure to new ideas / technological developments in Ground Water science with others. The officers of the Board also participated in various meetings /committees etc. to render advice on ground water development in specific area.

Re- Assessment of Dynamic Ground Water Resource

The Dynamic Ground Water Resource of the country has been jointly estimated by State Ground Water Departments and Central Ground Water Board, based on the methodology recommended by Ground Water Estimation Committee-1997 (GEC-97). The Ground Resource was estimated as on March, 2004. The National level report on "Dynamic Ground Water Resources of India" was finalized and approved by the R&D Advisory Committee in its seventh meeting held at New Delhi on 19th August, 2005. As per the report, the Annual Replenishable Ground Water Resource for the entire country is 433 billion cubic metre (bcm), Net Annual Ground Water Availability is estimated as 399 billion cubic metre where as the Annual ground water draft for irrigation, Domestic & Industrial was 231 billion cubic metre and their Stage of Ground Water Development for the Country as a whole is 58%.

Technical Examination of Major / Medium Irrigation Project proposals

As per directives of the steering committee on Irrigation projects constituted by Planning Commission, the major and medium irrigation project reports and proposals sent by State Governments through Central Water Commission (CWC)/Command area Development (CAD) Authority were scrutinized and cleared by CGWB from Ground Water Development and impact assessment point of view. Suggestions were made for modification / addition of ground water development in these schemes. During the year 2006-2007, Sixteen major irrigation projects of Central Water Commission and Seven irrigation projects related to Command Area Development and Water Management were examined and area specific recommendations were made.

Human Resources Development

It has been the earnest endeavor of the Board to keep its technical personnel abreast with the latest developments in all aspects related to ground water development & management. Trainees from State Departments and candidates from abroad are included in the training programme being organized by the Board.

Publicity and Public Awareness

With a view to generate awareness among the masses, "Water Resources Day" is celebrated every year since 1986. The Board has played a very active role in organizing Water Resources Day functions jointly with CWC and other State Govt. Organisations. On these occasions, emphasis was laid on educating the rural population on various aspects of water resources in the country. Important technical achievements of the Board were brought to the knowledge of the public through radio talks, television interviews, telecast of a short film on ground water pollution, Newspaper reports, release of district reports and Atlases at various public functions.

Central Ground Water Authority

Central Ground Water Authority has organized Mass Awareness programmes and Training's on Rain Water Harvesting including Roof Top Rain Water Harvesting at different locations of the Country, with the aim of educating the common people about judicious and optimum utilization of ground water. 54 Mass awareness programs were organized during the year for ground water conservation, artificial recharge and ground water protection and 52 Ground water management training programs were also organized in different parts of the country for designing rain water harvesting structures for augmenting the water in which ~ 1250 people have been trained.

During the period, CGWA has notified 23 more overexploited areas for regulation of groundwater development in the states Haryana, Madhya Pradesh, Punjab and Rajasthan. In addition to the above regulation of ground water development is already being done in 20 areas notified earlier. In order to put more areas under regulation, 37 new over exploited areas have been identified and notified for registration of ground water structures. The registration work in theses notified areas is to be undertaken by the respective states governments. A total of 1065 Blocks/Mandals are notified with the directives to Chief Secretary for taking suitable measures for artificial recharge to ground water / Rainwater harvesting to augment ground water resources and save it from further depletion in the states. During the period seventy (70) industries have been given no objection certificates for ground water extractions. 27 Drilling agencies have registered with CGWA during the year.

Right to Information Act 2005

The Govt. of India resolved that in order to ensure greater and more effective access to information, the Freedom of Information Act, 2002 must be made more progressive, participatory and meaningful. The National Advisory Council deliberated on the issue and suggested certain important changes to be incorporated in the existing Act. The government examined the suggestions and decided to make a number of changes in the law. In view of significant changes proposed in the existing law, the Government decided to repeal the Freedom of Information Act, 2002 and the, Right to Information Bill, 2005 was introduced. Right to Information Bill, 2005 was passed by Lok Sabha on 11th May, 2005, by Rajya Sabha on 12th May,2005 and received the assent of the President on 15th June, 2005. It came on the Status Book as THE RIGHT TO IINFORMATION ACT, 2005 (22 OF 2005). Central Ground Water Board as a public authority has implemented the act as per various provisions during 2006-07 and supplied information to the requires efficiently.

Budget

Expenditure of 6313.88 lakhs and 7074.41 lakhs of rupees were incurred by the Board during the year under various Plan and Non-plan sub-heads respectively to carry out various activities mentioned above.

1. INTRODUCTION

1.1 HISTORY OF CGWB

The Central Ground Water Board, as the National apex organization under the Ministry of Water Resources, Govt. of India is vested with the responsibilities to carry out ground water management studies, exploration, monitoring of development, management and regulation of country's vast ground water resources. A brief history of the organization follows;

An Exploratory Tubewells Organisation (ETO) was created in 1954 as a subordinate office under the then Ministry of Food, Agriculture, Community Development and Cooperation (Deptt of Agriculture) to carry out ground water exploration in the alluvial areas of the country to delineate the regional aquifer systems and evaluate their yield potential. On 3rd October 1970 the ETO was renamed as Central Ground Water Board. At that time, it was felt that there was need to have a national unified organization for all works related to ground water surveys, exploration, assessment and management in the country. On the recommendations of the Committee on Science and Technology, the Standing Group of Ministers on Science and Technology chaired by Prime Minister Smt. Indira Gandhi, in its meeting on Sept 9, 1971 approved the merger of Ground Water Wing of the Geological Survey of India (GSI) with the Central Ground Water Board. The merger was effected on August 1, 1972 which gave all the administrative and financial powers and flexibility of operation necessary for CGWB's effective functioning. With this, Central Ground Water Board was constituted as an apex organization at the national level with a full time Chairman and two full time Members namely the Chief Hydrogeologist and the Chief Engineer.

In order to streamline staffing pattern, SIU carried out detailed study (1980) and gave its report on staffing pattern of Headquarters, Regional, Divisional and District Unit Office.

A High Level Multi-disciplinary Committee (HLMC) was set up in 1989 to review the role, functions and responsibilities of CGWB in terms of achievements and developments over the past three decades. The HLMC report (1990) highlighted the importance of ground water development and indicated the measures to be taken for achievement of tasks and mandate assigned to CGWB. The Committee reviewed the functions and gave the revised mandate.

In order to provide scientific and technical support to the mandate, Central Ground Water Board conduct training programmes for various levels of ground water professionals/ sub-professionals from CGWB, States, Universities and NGOs. The courses include induction level courses for newly recruited scientists, engineers and drilling professionals; refresher courses for scientists on advanced techniques of ground water investigation, development and management; and training of trainers. The Board had established Rajiv Gandhi National Ground Water Training & Research

Institute in 1997 at Raipur. Infrastructure facilities were created by redeploying officers and staff from Central Ground Water Board. The building of the Institute has since been taken over by the Chhattisgarh State to house Legislative Assembly in 2000. It is proposed to relaunch the institute at Raipur in the newly allotted land by the Government of Chhattisgarh, SFC Memorandum in this regard is under submission. Presently the training courses are being conducted at Central Headquarters and various Regional Offices of the Board.

Central Ground Water Authority has been constituted under Section 3 (3) of the Environment (Protection) Act, 1986 to regulate and control development and management of ground water resources in the country.

The Authority has been conferred with the following powers: (i) Exercise of powers under section 5 of the Environment (Protection) Act, 1986 for issuing directions and taking such measures in respect of all the matters referred to in sub-section (2) of section 3 of the said Act.(ii) To resort to penal provisions contained in sections 15 to 21 of the said Act.(iii) To regulate and control, management and development of ground water in the country and to issue necessary regulatory directions for the purpose. (iv) Exercise of powers under section 4 of the Environment (Protection) Act, 1986 for the appointment of officers.

1.2 MANDATE AND OBJECTIVES

The future of our national food security system as well as the quality of life and livelihood of millions of our people will, to a large extent depend on our ability to conserve and utilize ground water resources in an environment friendly, economically efficient and socially equitable manner. On the basis of the principles of ecology, efficiency, economics and equity, mandate of the Board has been postulated below:

"Develop and disseminate technologies, monitor and implement national policies for the scientific and sustainable development and management of India's ground water resources including their exploration, assessment, conservation, augmentation, protection from pollution and distribution based on principles of economic and ecological efficiency and equity".

Commensurate with the above mandate, the objectives laid down for the Central Ground Water Board are:-

1.2.1 Periodically assess the country's ground water resources and publish, once in 3 years, a report on the status of India's ground water resources.

1.2.2 Formulate perspective plans, basin or sub-basin wise, for harnessing ground water resources in a phased or need based manner and resolve regional imbalances.

1.2.3 Monitor ground water development in the country and promote its sustainable management on principles of ecology, economics, efficiency and equity.

1.2.4 Develop, refine and disseminate, on its own as well as in coordination with other agencies, basin-specific technologies for sustainable ground water

development and management involving priority areas such as major command areas for conjunctive use of ground water and surface water, monitoring, prevention and remedy of pollution and saline ingress and the location, design, operation and maintenance devices, recycling and reuse of waste water, and solutions to other problems of urban areas.

1.2.5 Plan augmentation, conservation, protection and regulation of ground water resources keeping in view the existing and future ground water demand scenario.

1.2.6 Establish a National Information System in collaboration with State Governments and other agencies to collect, store, process and disseminate ground water data as part of an overall water resources data bank.

1.2.7 Forecast the manpower, equipment, energy and financial requirements for the ground water sector, in the context of demand projections.

1.2.8 Promote the economic and efficient use of manpower, energy and equipment employed in the ground water sector through various measures including setting up performance appraisal and management information systems, training, development of technical and managerial skills, and personal development.

1.2.9 Support and coordinate the efforts of State Ground Water Organizations for the planned development of their ground water resources on the above lines, specially where inter-state issues arise.

1.2.10 Foster international cooperation to promote scientific exchanges, acquisition of useful technologies including the use of renewable sources of energy for pumping ground water and assistance in other developing countries.

1.2.11 Establish benchmarks and methodologies for ground water studies in coordination with the State Governments.

1.2.12 Promote environmental awareness and water quality consciousness.

1.2.13 Establish a National Institute for Ground Water Research, Training & Management and organize All India Coordinated Research Projects involving appropriate institutions and universities, in order to foster the growth of a national grid of R&D institutions, covering different aspects of ground water conservation and utilization.

1.3 ORGANIZATIONAL SET UP

The Central Ground Water Board is headed by the Chairman and has four full time Members namely, Member (Exploratory Drilling & Material Management), Member (Sustainable Management & Liaison), Member (Survey Assessment & Monitoring) and Member (Training & Technology Transfer). The other Members of the Board are all ex-officio being the nominees of institutions in related fields of expertise. The ex-officio members are:

1. The Joint Secretary (A), Ministry of Water Resources.

2. The Joint Secretary & Financial Adviser, Ministry of Water Resources

3. The Joint Secretary, Ministry of Environment & Forests, Paryavaran Bhawan, New Delhi.

4. The Chief Engineer, IMO (WP & P), CWC, Sewa Bhawan, New Delhi.
5. The General Manager, ONGC, Ministry of Petroleum & Natural Gas, Dehradun.

Central Ground Water Board has four main wings. Each wing is headed by a member post.

The Exploratory Drilling & Materials Management Wing broadly looks after the drilling and construction of Exploratory Tubewells and other types of bore holes required for assessment of aquifer parameters during ground water exploration. Other activities of this wing include monitoring of Stores, consumption and inventory for efficient and economic machine utilization, Procurement of drilling equipment, vehicles, instruments etc. This wing also looks for the need of improvement in drilling technology, design of abstraction structures, improvement of efficiency of pumps and other water lifting devices, maintenance and up keeping of drilling machinery and related equipment in the Board.

The Sustainable Management and Liaison Wing looks after sustainable management of ground water related policies & issues, works related to monitoring of ground water regime and development and conjunctive use of surface and ground water for the entire country. It also undertakes studies related to recycling and reuse of ground water, urban ground water management, Drought management, Regulation of ground water development and model legislation, National Information System for ground water data collection, storage and retrieval, Planning and Programme formulation for ground water development including techno-economic studies, analysis and associated aspects of ground water development and technical examination of major, medium and minor Irrigation Projects.

The Survey, Assessment & Monitoring Wing has the responsibility of monitoring the works being done in ground water management studies, aquifer mapping and assessment of aquifer characteristics based on exploration and surveys, hydrochemical analysis and studies, pollution studies, short term water supply investigations, special ground water studies, preparation of hydrogeological maps, Atlases, Master plans, State reports, District reports, etc. The other activities of this wing include ground water balance studies, periodic assessment of ground water resources and potential, augmentation of ground water resources including artificial recharge and monitoring of artificial recharge studies, ground water zoning for guiding economic activity areas, rationalization of water rates, forecasting manpower, energy and financial requirements for ground water sector, site selection for Rajiv Gandhi National Drinking Water Mission, dissemination of data & information to various user agencies and publication of quarterly magazine "Bhujal News" by the Board.

The Training and Technology Transfer Wing of the Board is vested with the responsibility for laying the overall training policy, assessment of training needs, conceptualization of the training modules and the programme implementation strategy, identification of thrust area needing technology import from advanced

sources, maintenance of effective liaison and interaction with voluntary agencies and Non Governmental Organisations and the other renowned national and international bodies for training and research purposes. The Member heading this wing also functions as the Principal of Rajiv Gandhi National Ground Water Training and Research Institute of the Board.

The administrative & financial matters of the Board are being dealt with by the Director (Administration) and Finance & Accounts Officer (FAO) respectively.

In order to achieve better results in the Water Resources Sector and have better coordination with the State Government departments, Central Ground Water Board had undertaken various studies in the above mentioned fields being monitored by four wings of the Board through 18 Regional Directorates, supported by 17 engineering divisions, 11 State Unit Offices for carrying out different investigations. The Board had a fleet of 85 rigs for taking up drilling operations during 2006-2007.

1.4 ACTIVITIES OF THE BOARD DURING 2006-2007

The following activities had been undertaken during the period 2006-2007.

1.4.1 Ground Water Management Studies

1.4.2 Ground Water Exploration aided by Drilling.

1.4.3 Monitoring of Ground Water Observation Wells.

1.4.4 Short Term Water Supply Investigations.

1.4.5 Periodic Assessment of Ground Water Resources.

1.4.6 Technical Documentation and Publication of Maps & Reports.

1.4.7 Publication of Quarterly Journal "Bhujal-News".

1.4.8 Taking over of Wells by State Govt.

1.4.9 Organizing Exhibitions, Seminars, Workshops etc.

1.4.10 Hydrochemical Analysis.

1.4.11 Geophysical Studies.

1.4.12 Hydrological and Hydro meteorological Studies.

1.4.13 Mathematical Modeling Studies.

1.4.14 Artificial Recharge studies.

1.4.15 Organizing training of Central and State Government personnel.

1.4.16 R & D Studies.

1.4.17 Basic Research in Hydrogeology/ Special studies

1.5 ANNUAL ACTION PLAN 2006-2007

The activities of the Board are being pursued on a continuing basis as per National Water Policy (2002) and in accordance with the overall development strategy for the X Plan.

Ground Water Management studies were carried in more utility oriented way and in areas facing ground water problems like decline in water levels, water logging, salinity ingress and quality deterioration, and other problems were accorded priority.

In ground water exploration, emphasis was given to carry ground water exploration activities on long-term planning and schemes were prepared for different geologic formations and areas. As far as possible, contiguous and composite areas hitherto unexplored, were selected keeping in view scientific requirements and priorities of State Governments were also taken into consideration. Thrust was given to explore areas having artesian flow, bouldary and hard rock formations. Ground Water Exploration in alluvial areas was done to delineate geometry of aquifer systems by constructing slim holes. During the year, special emphasis was given on tribal, drought and desert areas in exploratory program of the Board. Special studies for computation of specific yield of phreatic aquifers in different parts of the country was also the part of exploratory program.
The Central Ground Water Board is implementing the Central Sector Scheme "Studies on Recharge of Ground Water". Under the scheme, recharge structures are constructed by State Government departments, local NGOs, VOs or other beneficiaries under the technical guidance of the Board. Under the scheme, funds were provided by the Board for pilot recharge projects and the implementing agencies were encouraged to replicate similar types of structures in other areas with their own funds.

Conjunctive use studies were taken up with the objectives to ascertain the Hydrogeological conditions in command areas, to identify areas affected by water logging and salinity, to assess the availability of ground water. The studies provided insight of the problem and helped to formulate action plan for coordinated use of surface and ground water to ensure development on optimal level.

Water logging is a common phenomenon in canal command areas, which causes serious social and economic problems. Micro level mapping of a few water logged areas were taken up to understand and mitigate the problem. Feasibility studies were also carried out to suggest anti water logging measures for reclaiming the affected areas.

Remote sensing and application of GIS as supplementary tool has been considerably utilized to map geomorphological feature, change in land use, fracture zones, vulnerable areas of pollution etc which helped in locating promising areas for ground water exploration and development. These studies provided additional

update scientific information in synoptic manner about land use pattern and its temporal changes to ground water exploratory programme, reappraisal surveys, ground water pollution studies, water logging condition, erosion problem and artificial recharge studies taken by the Board during the year.

2. GROUND WATER MANAGEMENT STUDIES

Ground Water Management Studies are being carried by the Board at district level to evaluate the changes in quantity & quality in the ground water regime owing to development and also to identify related issues for future management strategies. A major part of replenishment of ground water is through infiltration from rainfall. Return flow from irrigation and seepage from surface channels and reservoirs also contribute substantially to the ground water recharge. The effect of ground water withdrawals and out-flows are directly measurable through water table. Since all these inputs and outputs frequently change with time, the ground water situation is being periodically reappraised. As the development of resource leads to changes in its regime and water quality therefore planning for further development of the resource is to be done on the basis of findings of the studies, which provide valuable information for reorienting ground water development programme keeping in view the emerging scenarios. During the year 2006-2007, an area of 1,90,783 Sq.km. have been covered by the Board under Ground Water Management studies as against target of 1,85,004 Sq km. Regions/State/District wise target vis-a-vis achievements during the year 2006-2007 is shown in Table 2.1 and fig. 2.1.

Table : 2.1 REGION/STATE/DISTRICT WISE TARGET AND AC OF GROUND WATER MANAGEMENT STUDIES DURING 2006-2007

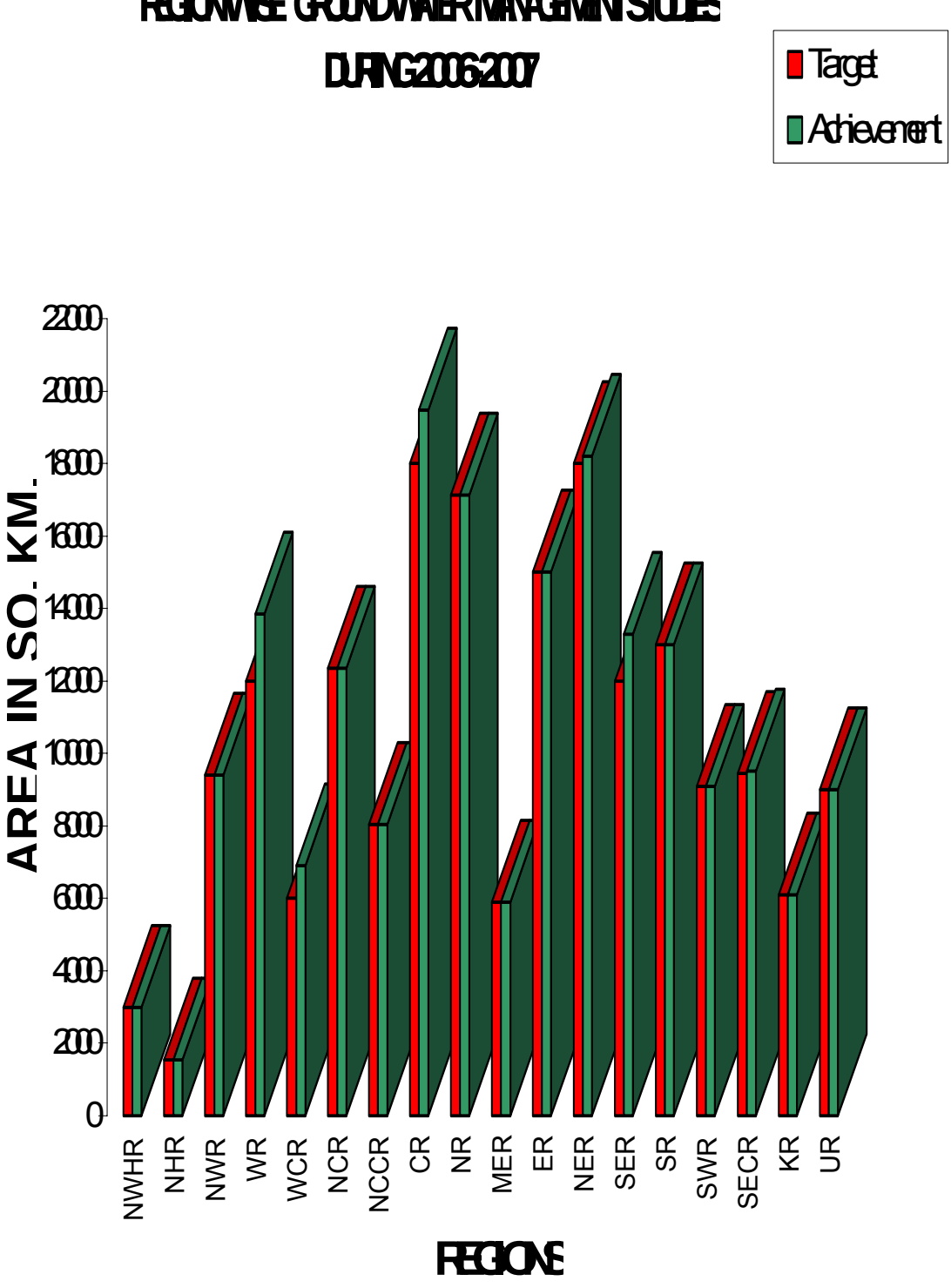
Sl. No.	Regions	States	Districts	Target (Sq. km.)	Achievement (Sq. km.)
1	North Western Himalayan Region	Jammu & Kashmir	Kargil	2500	2500
			Srinagar	500	500
2	North Himalayan Region	Himachal Pradesh	Una	1542	1542
3	North Western Region	Punjab	Kaputhala	1469	1469
			Faridkot	1632	1632
		Haryana	Kurukshetra	1530	1530
			Bhiwani	4778	4778
4	Western Region	Rajasthan	Banswara & Dungarpur	4000	4340
			Udaipur & Sirohi	4000	5500
			Bikaner, Hanumangarh & Ganganagar	4000	4000
5	West Central Region	Gujarat	Banaskantha	3000	3300
			Sabarkantha	3000	3600
6	North Central Region	Madhya Pradesh	Dewas	2390	2390
			Betul	3334	3334
			Dhar	2973	2973
			Neemuch	3647	3647
7	North Central	Chhattisgarh	Durg	8030	8030

Sl. No.	Regions	States	Districts	Target (Sq. km.)	Achievement (Sq. km.)
	Chattisgarh Region				
8	Central Region	Maharashtra	Buldhana	9000	9627
			Amravati	3000	3460
			Ratnagiri	3000	3175
			Ahmadnagar	3000	3218
9	Northern Region	Uttar Pradesh	Baghpath	1321	1321
			G.B. Nagar	1442	1442
			Lalitpur	5039	5039
			Mathura	3340	3340
			Mahamayanagar	1840	1840
			Fatehpur	4152	4152
10	Uttaranchal Region	Uttarakhand	Chamoli	6000	6000
			Pithoragarh	3000	3000
11	Mid Eastern Region	Bihar Jharkhand	Bihar	2852	2852
			Shahibganj & pakur	3050	3050
12	Eastern Region	West Bengal	Murshidabad	3000	3000
			Purba Midnipur	3000	3000
			Purba&Paschim Midnipur	3000	3000
			Murshidabad , Nadia & N 24 Parganas	3000	3000
			A&Nicobar	3000	3000
13	North Eastern Region	Assam	Darrang	3000	3000
		Mizoram	Aizwal	3000	3200
		Nagaland	Wokha & Mokakchang	3000	3000
		Arunachal Pradesh	Papumpare & Lower subansiri	3000	3000
		Meghalaya	Raibhoi & West Khasi Hills	3000	3000
		Tripura	Dhalai & West tripura	3000	3000
14	South Eastern Region	Orissa	Bhadrak & balasore	3000	3043
			Puri	3000	3479
			Sundargarh	6000	6770
15	Southern Region	A.P.	Kadappa	1600	1600
			Anantpur	4900	4900
			Vijianagaram	3200	3200
			West Godavari	3300	3300
16	South Western Region	Karnataka	Chamrajnagar	2797	2797
			Raichur	3332	3332
			Raichur & koppal	2964	2964
17	South East Coastal Region	Tamil Nadu	Tiruvannamalai	3000	3000

Sl. No.	Regions	States	Districts	Target (Sq. km.)	Achievement (Sq. km.)
			Cuddalore	3000	3450
			Nagapattinam	2700	2717
			Salem	750	350
18	Kerala Region	Kerala	Trisur	3030	3030
			Palghat	3070	3070

Fig.21

REGION WISE GROUNDWATER MANAGEMENT STUDIES DURING 2006-2007



2.1 NORTH WESTERN HIMALAYAN REGION (Jammu & Kashmir)

Ground Water Management Studies were carried out in two areas namely in Kargil district (with special emphasis on snow water harvesting) and Srinagar district. A total area of 3000 sq.km (Kargil-2500 & Srinagar-500 sqkm) was covered during the survey in order to evaluate hydrogeological conditions of various geological formation.

2.1.1 Snow Water Harvesting in and around Kargil town, District Kargil: - The study area of about 2500 Sq. km was selected, based on the drought prone conditions and low precipitation, in & around Kargil town, District Kargil. In this area, precipitation occurs in the form of snow, from November to March, which melts during April to mid-August. The surface runoff occurs from April to June, allowing virtually no substantial runoff during irrigation season. To overcome this situation, snow harvesting is the best recommended solution, as snow is major form of precipitation.

Hydrogeology :

In the study area 33 springs which occurs along the fractures / joints or as in the scree materials were studied. Discharge of water from these springs ranges between the least of 0.06 lps in Chhutumel village and highest of 27.2 lps in Kargil. Physical parameters of water samples were measured in the field itself and were collected for further chemical analysis.Shallow aquifers in the study area are capable of yielding meagre discharge.

Geology:

Geologically this area falls under extension of Indus suture zone with granitoid on northern side and sediments of Kargil formation thrusted by volcano-clastic of Drass over the southern margin. Kargil formation shows N 295° to 345° / 25° SW dip at various places, with current, graded bedding structure. Southern margin of study area shows intense deformation in the form of folding and thrusting over low-grade metamorphic rocks.

The proposed sites for snow harvesting

Based on the Geology, Hydrogeology, as well as insulation, wind direction, wind velocity and relative humidity, the below mentioned sites were selected, as northern slope is favourable to conserve the snow. The proposed sites are described below :-

1) South of Air-Force Station: This site is situated around 8 kms from Kargil on Kargil - Cheskar road. Arenacious rocks showing N30° to 35° E strike and 25° dip towards south-east constitutes the country rock, at South of Air-force run-way . The catchment area of 57750 m^2 for main nallah with 25° mean slope for second order nala were considered. Average snow fall is 150 mm, Volume of snow is 8662.5 m^3, 10% of total volume of snow is to be converted as water i.e 866.25 m^3 of water.80% of converted water is only available after deducting evaporation loss etc, i.e 693 m^3 say 93,000 ltrs.

2) Munjigund: This village is located about 12 km from Kargil on Kargil - Trizpon road. A perennial nala is source of surface water in this village, which is sufficient for domestic purpose. Whereas, for irrigation there is scarcity of water. In order to enhance irrigation potential, a second order nala flowing in north eastern direction with catchment area of 27550 m^2 can be tapped. Low grade

metamorphic rocks of Drass volcanics forms the country rock. These volcanic rocks are also utilized as construction material. Average snowfall is 150 mm,Volume of snow is 4132.5 m^3 water, 10% of total volume is converted into water i.e 413.25 m^3 of water, 80% of water is only available after deducting evaporation loss etc. i.e 330.60 m^3 say 330600 lts of water.

3) Another site at around 3 kms east of Cheskar Village: The nala covers an area of about 42,600 m^2 and is a perennial one, feeding water to Cheskar. To enhance water potential, snow-harvesting structure can be constructed. This nala is flowing in north-western direction, over the basaltic terrain of Drass Volcanic, sloping at an angel of 16.44°. Catchment area is 42,600 m^2 ,Average snow fall is 150 mm,Volume of snow is 6,390 m^3 .10% of total volume of snow is converted into water i.e 6,39,000 lts. of water, 80% of water is only available after evaporation loss etc i.e 5,11,200 ltrs.

4) Lalu-Lungpa: Lalung Village is situated at a distance of 20 km from Kargil on Kargil-Batalik road and proposed site is around 3 km from main road towards south. A second order nala, west of Barla-la flowing towards north is a favourable site for snow harvesting. In this village, irrigation activity is restricted to only once, due to scarcity of surface water. This nala is cutting across the Kargil formation opposite to dip direction. As the dip of strata is in upstream direction, construction of sub-surface dyke cum check dam is favourable in this area due to the presence of weathered mantle. Catchment area is 43,600 m^2. Average snow fall is 150 mm, Volume of snow is 6540 m^3
10% of total volume of snow is converted into water = 6,54,000 ltrs.
80% of water is only available after evaporation loss etc.= 5,23,200 ltrs.

2.1.2 Srinagar: Srinagar is the summer capital of Jammu and Kashmir state, situated on the bank of River Jhelum. According to latest master plan of Srinagar city, the area of greater Srinagar is 416 Sq. km. The population of city is 8,94,940 persons, with population density of 2151 persons / Sq. Km (2001 census).

The entire Srinagar is occupied by alluvium underlain by formations of Karewas super group. The thickness of the alluvial cover ranges up to 357 m as revealed by the exploratory drilling at Karan Nagar. Ground water occurs under water table to semi-confined conditions. Shallow aquifers up to 50 m depth are main ground water abstraction source with an yield of 5 to10 lps. Deeper aquifers were also tapped in the exploratory wells drilled by Central Ground Water Board. These aquifers have yielded discharge ranging from 25 to 30 lps. Ground water monitoring was regularly done through National Hydrograph Network Stations (NHNS) up to the year 1989. The post-monsoon water level observed in May 1988 ranges between 1.45 m bgl at Salura to 5.92 m bgl at Betapur. The seasonal water level fluctuation as monitored from NHNS falling within Srinagar city varies from 0.43 m bgl to 0.97 m bgl (year 1988)

To have an idea of suitability of ground water for drinking purposes, water samples were collected from springs, hand pumps and tubewells. The range of various parameters of samples collected from various sources is given in Table 2.2

Table 2.2 : Water quality in Srinagar Town

Source	p.H.	EC µ/cm at 25^0C	Cl mg/l	NO3 mg/l	Ca mg/l	Mg mg/l	F mg/l	Na mg/l
Spring	6.85-7.25	160-530	7.1-18.0	1.9-14.0	22-80	4.9-19.0	0.05-0.50	4.7-9.8
Tube -well	7.00-7.32	202-1140	7.1-106	0.8-70.0	34-92	4.9-44.0	0.12-0.48	1.5-120.0
Hand Pump	7.00-7.66	346-1410	7.1-96.0	2.9-170	44-112	9.7-68.0	0.10-0.42	11-100

2.2 NORTH HIMALAYAN REGION (Himachal Pradesh)

The District Ground Water Management studies were carried out in Una district of Himachal Pradesh .

2.2.1 :**Una district :-** Una district covers in area of about 1542 sq.km. It exhibits rugged mountainous topography. Valley fill deposit exists between the Lesser Himalayan ranges and the outermost Siwalik foothills and this valley is known as Una valley. Soan, an important tributary of Satluj river flows in southeast direction through the valley. Una valley forms a part of the 'Dun' extending from near Daulatpur ($31^0$47'-$75^0$59') in Himachal Pradesh to Pinjaur ($30^0$48'-$76^0$55') in the Haryana state. This intermontane valley covers approximately an area of 650 sq km. Except the Una valley, which has ground water potential the rest of the terrain is underlain by semi consolidated and unconsolidated formations.

During the Ground Water Management studies the whole district was covered during the pre-monsoon period and inventoried 70 dugwells, 16 springs and 18 handpumps. Depth to water level was ranging from 0.45 mbgl (Shivpur) to 48.55 mbgl (Oel) and discharge of springs ranging from seepages to 0.25 lps (Mairi). During the post monsoon period apart from the wells and springs selected during pre- monsoon period, 23 dugwells, 5 springs and 8 deep borewells were inventoried. Water level fluctuates from 0.20 m to 7.00 m and spring discharge from 0.025 lps to 0.50 lps. Conducted three open well pumping tests in Una valley at Santokhgarh, Jhikla Bhera and drawdown ranging from 7.00 m to 9.00 m and recovered within an hour.

It has been observed that the water level is very shallow along the terraces on the left bank of Soan river and some of the wells are in artesian condition. In these areas the depth to water level is within 3.00 mbgl and water logged conditions exists to the extent that ground water cops out at some places. In the terraces on the left bank of river Soan and in the sub- montane tracts of Siwalik hills, the depth to water level deep and ranges from 20-80 m bgl. In the piedmont areas i.e. Beat area the water level ranges from 120- 150 mbgl. The quality of ground water in this area is observed to be good and potable.

Main findings are as follows:-

1. Valley fill deposits and terraces are to be fully explored by constructing test wells for studying the precise distribution of ground water horizons and scope for development.
2. In hard rock area all the weak zones, like faults, fractured, lineaments, and contact of different formation are to be studied in detail for demarcating the aerial extent and vertical distribution of ground water potential zones by hydrogeological/

geophysical studies followed by exploratory drilling based on which suitable ground water structures can be constructed for the development of ground water resources.
3. Deep borewells for a depth of about 200 m may be feasible in Beat area. Infiltration galleries and percolation wells are also feasible in shallow water table zones along the Soan river.
4. Shallow borewells of 50 m may be feasible in Bhangana area for tapping the shallow aquifers.
5. Springs are also to be studied for optimization of their discharges. The discharges can be enhanced by fracturing land horizontal drilling. The interconnection of fractures may be developed by using a hydro fracture unit in hard rock area. In alluvial/weathered zones springs are to be developed by constructing infiltration galleries.
6. The possibilities for the water conservation practices of both rainfall and surface runoff are to be studies so as to mitigate the water supply problems in the hilly regions.
7. Since the district receives high average annual rainfall of 943 mm, it is recommended that rooftop rainwater harvesting may be adopted in the government buildings in the town area like Bhangana, Amb and Una to generate additional fresh water during monsoon period.

2.3 NORTH WESTERN REGION (Punjab, Haryana & Chandigarh)

During 2006-2007, the target for District Ground Water Management Studies was 9409 Sq.Km covering Kapurthala, Faridkot, districts of Punjab State & Kurukshetra and Bhiwani districts of Haryana State. The District wise highlights of the study are as follows:-

2.3.1 Kapurthala district:- Kapurthala District covering 1632 Sq. Km is situated in the Bist Doab and comprises of two non-contiguous parts, separated by approximately 32 kilometers. Topographically Kapurthala district is more or less flat and forms part of Indo-Gangetic alluvial plain. The district can be divided into two distinct regions namely Kapurthala-Sulthanpur Lodhi tract and the Phagwara region. The area is underlain by the Indo-Gangetic alluvium of Quaternary age. The alluvium is of fluvial origin, and consists of alternating beds of sand and clay. The exploratory boreholes were drilled down to the depth of 300m. Irrigation tube wells in Kapurthala district are in depth range of 60 to 90 mbgl.

During Pre-monsoon period, 25 key wells were monitored and 86 water samples were collected. The water levels ranged from 4.19 m. to 22.93 m. bgl. Deeper water levels have been observed in the eastern part of the district and shallow water levels in north and western parts of district along Beas River. During Post monsoon, water levels ranges from 3.78 m bgl to 24.04 m bgl with deeper water levels in Eastern part of the district and shallower being in the North and Western part of the district. Groundwater draft sample survey was also carried out by collecting data for 78 locations through out the Kapurthala district.

Main findings are as follows:-
a. The areas in the north and northwestern part of the district i.e. Dhilwan, Nadala, Bholath have shallow water levels and less fluctuation in water levels. The areas in southern and eastern part i.e. Dalla, Sulthanpur Lodhi, Kalasangia, Sunranwali

and Phagwara have deeper water levels and show high rate of decline in water levels.

b. Seasonal fluctuation (May-06 and Nov-06) show maximum rise of 1.88 m at Tibba and a maximum fall 0f 1.67 m at Sunranwali. The water level decline is observed in the eastern and central part of the district.
c. The tubewells in Kapurthala district are in depth range of 60 to 90 mbgl. The water bearing zones in northern part of district range between 9.0 mbgl to 20.00 mbgl, whereas in south and eastern parts of the district, the water bearing zones range between 45 mbgl to 90 mbgl.
d. The Unit Ground Water draft has been computed to be 3.93 Ham and 1.65 Ham for Kharif and Rabi crops respectively.
e. Ground water quality is fresh and potable in Kapurthala district. Two water samples in Phagwara block have EC more than 2000 micromhos/cm at 25^{o}C.

2.3.2 Faridkot district :- Faridkot is located in the south western part of Punjab state covering an area of 1468 sq,km. The district forms a part of vast Indo-Gangetic alluvial plain. The area represents almost flat alluvial plain interspersed with sand dunes with maximum height of 5.5 m above general land surface. No river flows through the district but there is vast network of canals emanating from Sirhind canal system and Sirhind feeder. Lithological logs reveal the occurrence of clay mixed with sand constituting the topmost layer in the area, underlain by 20 to 40 m thick fine to medium grained sand layer which is further underlain by 5 to 10 m thick plastic clay layer. The ground water in shallow aquifers occurs under phreatic conditions and under semi- confined to confined conditions in deeper aquifers.

During pre-monsoon (May, 2006) depth to water level ranges between 2.80 mbgl (Deep Singh wala) to 14.60 mbgl (Chand Baja). During post-monsoon (Nov, 2006) water level in the district varies in the range of 2.39 mbgl (Deep Singh wala) and 14.40mbgl (Chand Baja). The water levels are deeper in central and northwestern parts of the district and shallower in western parts. The seasonal water level fluctuation shows a rise in water level in whole district.

The quality of ground water is fresh to saline in the district. The electrical conductivity in the district varies from 859 to 7320 micromhos/cm at 25^{o}C. The fluoride concentration in ground water varies from 0.53 to 6.16mg/l. High values of Sulphate concentrations ranging between 38 to 1700 mg/l. have been reported from most of the water samples. There are 26521 shallow irrigation tube wells in the district out of which, 14811 tubewells are in Faridkot block.

2.3.3 Bhiwani district:- The Bhiwani district is situated in the southwestern part of the Haryana State covering an area of 4870.22 sq km. The area forms a part of Indo-Gangetic Alluvial Plain, interspersed by isolated hills and rocky ridges of Aravalli group of rocks, Malani Suite of volcanics and Alwar quartzites of Delhi System and clusters of sand dunes. There is no natural drainage in the area. The district has good canal network and mainly forms a part of Western Yamuna Canal System. The area is drained by artificial drains.

183 observation wells and 20 piezometers were monitored in the district. The depth to water level in the area varies from 1.57 m bgl at Badesra (block-Bhiwani) to 67.69 m bgl at Manphool (block-Loharu). The water logging conditions occur in parts of

Dadri-I, Bhiwani and Bhiwani Khera blocks. Parts of Dadri-II and Tosham blocks have prone to water logging conditions. The deeper water levels are observed all along the southern boundary of the district mainly in parts of Bhadra and Loharu blocks. The seasonal fluctuations (June - Nov 2006) reveals a rise in water table in the area as high as 3.93 m. Decline in water levels are observed at few places in Dadri-II, Badhra and Loharu blocks upto 5.72 m.

127 water samples were collected from shallow and deeper aquifer to assess qualitative change as a result of ground water development, in addition to 16 water samples for heavy metal ions concentration. The results of chemical Analysis of the water samples reveal that the water from shallow aquifer is alkaline in nature. pH value ranges from 7.13 to 8.10. The specific conductance value varies from 440 to 10300 micromhos/cm at 25^0C. The fluoride concentration ranges from 0.02 to 15.8 mg/l and even higher upto 29.8 mg/l. About 44 % of the water samples have fluoride exceeding the permissible limit. In 31 % of the water samples nitrate content exceeds to the permissible limit of 100 mg/l and ranges between 0.36 and 1755 mg/l. Review of trace element analysis indicates that the ground water is rich in heavy metals like Iron and nickel. Iron concentration varies from 0.05 to 3.49 mg/l and in 37% of the water samples it exceeds the permissible limit.

Central Ground Water Board has drilled 18 exploratory boreholes and 12 piezometers down to a maximum depth of 256 m. Only 2 EW have yielded fresh water (Budhera & Jhojhu Kalan), constructed in the depth range of 136 to 152 m. Bedrock comprising mica schists and quartzites has been encountered in 2 boreholes (Dadri and Mandola) in Dadri-II block. The bed rock has also been encountered in some piezometers The maximum thickness of alluvium recorded in the borehole at Bhiwani (block Bhiwani) is 256.15 m and minimum thickness of 111.56 m at Hasanpur (block Loharu).

The drinking water supply schemes are canal water and ground water based. Out of a total of 220 Rural Water Schemes, 172 are canal water based and 48 are based on tubewells. The 493 inhabitant villages and Dhanies are covered under RWS schemes. The water supplies to the town are canal based except Loharu, where it is based on ground water.

2.3.4 Kurukshetra district: The district covers an area of 1530 km ^{2}, located in the northern part of Haryana state. The district forms a part of vast Indo-Gangetic alluvial plain without any conspicuous topographical features. The northern & western part of the district is drained by Markanda River. The Indo-Gangetic alluvium, consisting of newer and older alluvium ranging in age from Upper Pleistocene to recent and are conformable with each other. These Quaternary unconsolidated sediments are underlain by Siwalik formation.

The pre-monsoon (May, 2006) water level in the area varies in the ranges of 15.66 mbgl (Hatira) to 31.35mbgl (Kalsani). The water level is deeper in central and northern parts (Shahabad, Thanesar and Babain blocks) and shallower in southwestern parts and eastern parts (Pehowa and Ladwa blocks) of the district. The post-monsoon water level (Nov, 2006) in the district varies from 17.1 mbgl (Hatira) to 34.72 mbgl (Kalsani). The seasonal water decline has been observed in Shahabad, Thanesar, Babain and Ladwa blocks, where water level has fallen by 3 to 4.6m. The maximum decline of 4.6m has been observed at Rurki in Babain block.

The quality of ground water is generally fresh. Electrical conductivity of ground water varies from 400 to 1750 micromhos/cm at 25^{o}C. The fluoride concentration in ground water varies from 0.11mg/l to 2.06mg/l and Nitrate concentration from nil to 105 mg/l. There are 32989 no. of shallow irrigation tube wells in the district out of which, 10148 are in Thanesar block.

2.4 WESTERN REGION (Rajasthan)

District ground water management studies were carried out in parts of Banswara, Dungarpur, Sirohi and Udaipur districts of Rajasthan during the Annual Action Plan 2006-2007 covering a total of 9840 Sq. Km area.

2.4.1 Banswara and Dungarpur districts: Ground Water Management studies were carried out in Aspur, Sagwara & Simalwara blocks of Dungarpur district and Garhi, Ghatol & Anandpuri blocks of Banswara district, covering 4,340 Sq. Km.

The area is drained by perennial Mahi river and its tributaries namely Som, Anas, Chap, Moran and local nalas. The area is characterized by uneven topography with hills of Aravalli's comprising of quartzite along with intrusives and low lying areas maily comprising of phyllites, schists etc. Average annual rainfall in the area is 760mm. Black soil and red soils are the predominated soil types. Principle source of irrigation are wells,tanks and canal. During 2002-03 a total of 38859 Hectares of areas was irrigated which rose to 78582 hectares during 2005-06. The main irrigation structures constructed include Som-Kanthri-Amba dam, Ladeshwar minor, Amarpura Left canal & Right canal etc.

In general groundwater occurs under unconfined conditions in weathered and structurally weaker zones like bedding planes, joints, fractures etc. Yield of wells ranges from 10 to 80m^3 / day. Depth of wells ranges from 5 to 25m. Alluvial deposits comprising of pebbles of phyllites, schists, quartzites & Kankars occur along major river courses. Thickness of alluvial cover is generally less than 7m. These alluvial deposits have low to moderate permeability depending upon entrapped clay contents and degree of compaction. Depth of wells in alluvial aquifers varies from 2 to 7m and yield varies from 35 to 230 m^3 / day.

Depth to water level in general ranges from 1.35m to 20.30m during premonsoon period. Pre-post water level fluctuation varies from 00m to 15.40m. There is no decline in water levels during this period. Rise in water level in postmonsoon 2006 in comparison to postmonsoon 2005 was higher due to above normal rains in 2006 and addition recharge to groundwater by rainwater harvesting structures. Most of the rainwater harvesting structures has been constructed after March 2006 under National Rural Employment Guarantee Programme (NREGP) and Tribal Area Development.

31 borewells have been drilled under Exploratory Drilling Programme in Hardrock areas ranging in depth from 68.50m to 163m. Depth of weathered zone in the area was observed of the tune of 8 to 25m. Discharge of these wells varies from negligible to as high as 528 lpm with drawdown of 0.33 to 60m. Transmissivity values ranges from 2 to 305m^2 per day.

In major parts of the district, groundwater quality of shallow zones is fresh and is alkaline in nature. Specific conductivity varies from 420 to 4400 micro-mhos/cm while chloride values from 1 to 643 ppm. In deeper aquifers, quality of groundwater is also generally fresh. Fluoride content in groundwater is higher than permissible limit in northern parts of the area and in isolated pockets. Nitrate pollution also prevails locally in the northern parts of the areas. 81% of the samples collected have nitrate concentration below 50 ppm.

2.4.2 Sirohi -Udaipur districts : The study area is situated in south- western part of Rajasthan encompassing 5,500 sq. km of geographical area covering entire Sirohi (4076 sq.km) district and parts of Kotra block (1424 sq.km) of Udaipur District. The district area experiences semi-arid to subhumid type of climate. The average annual rainfall is 579.7 mm (1901-2003) and average annual rainfall during year 2006 was 1529.6mm.

A large part of the district is a vast semi-desertic plain marked by isolated hills and chains of hillocks forming the eastern fringes of the Thar desert. It is bounded by north-east and south-west trending Aravalli ranges on the east. Abu-Sirohi range divides the district into two parts. The area is mainly drained by ephemeral Jawai river and Sabarmati which eventually joins Luni river and Rann of Kachh. Two Medium irrigation projects namely West Banas and Sukli -selwara Project and 25 minor project are in existing in the area.

Quaternary alluvium occurring in the northern and extreme south-western part of the district and weathered and fractured rocks viz. granite, gneisses and meta sediments belonging to Delhi Super Group and Post Delhi form the principal aquifers in the area. The ground water survey in the area reveals that the Quaternary alluvium (covering 981.33 sq. km area) is constituted of clay, silt, sand, calcareous concretion etc. and it has limited thickness down to a maximum of 35 depth. It forms the potential aquifer. Ground water in general occurs under phreatic conditions in Quaternary alluvium and weathered mantle and fractures of hard rocks. Pre-monsoon and Post-monsoon fluctuation of water level showing tremendously rise which is as high as +22.34m in Jawal village of Sheogang block of Sirohi district and decline of –2.80m in village Pulav of Kotra block of Udaipur distt. About 100% of wells of Sirohi district indicated rise in postmonsoon period.

The quality of ground water in general is suitable for drinking and irrigation purposes. 70% of wells have electrical conductivity (EC) less than 2000 micromhos/cm at 25^0 C, 13% having 2000-3000 micromhos/cm and rest is having (EC) more than 3000 micromhos/cm. In the north western part of study area observed high fluoride which is as high as 5.15mg/l in Nawara village of Sheoganj block of Sirohi District whereas entire area having little more then permissible limit of fluoride scattered over the district. At places nitrate is marginally high especially at the southern fringe of area.

Under National Rural Employment Guarantee Scheme many groundwater recharging structures have been constructed. These are mainly anicuts of small type or low cost. In the west Banas river basin the drainage is well developed and gradient is steep. It is essential to retard the velocity of the runoff by putting big boulder with wire-meshes in the stream belts of 1^{st} and 2^{nd} order streams at regular interval.

Because of thick weathered mantle covers subsurface barrier and check dam can be proposed in Basantgarh, Jhadoli, Pesua villge of Pindwara block of Sirohi Distt

2.5 WESTERN CENTRAL REGION(Gujarat)

Ground Water Management studies were taken up in Parts of Banaskantha and Sabarkantha districts, covering an area of about 6900 Sq. Km.

2.5.1 Banaskantha District: Ground Water Management studies were taken up in parts of Banaskantha district(approx. 3300 Sq.km) comprising five taluka namely Palanpur, Vadgam, Danta, Amirgarh and Dantiwada.

The north-eastern part of the area under study is characterized by hilly terrain with highly undulating topography where as the rest of the area is gently sloping plain characterized by alluvial formation. Banas & Saraswati are the prominent rivers draining the district. Sipu, Balaram, Umardasi & Arjuni are the prominent tributaries. The district experiences an average annual rainfall of 575 mm.

A total of 164 keywells were established and 164 ground water samples were collected for complete chemical analysis including fluoride. In addition to this 17 ground water samples were collected for trace element analysis. Seven pumping test were conducted on large diameter wells.

2.5.1.1 Ground water in hard rock area:

The meta-sediments constitute the hard rock aquifer in the area. They occupy most of the parts of Danta taluka and also parts of Amirgarh and Dantiwada taluka. Ground water occurs under water table to semi-confined conditions in weathered and fractured part. The depth of weathering varies from a few meters to 20 mbgl. The depth of dug wells ranges from 20m bgl to more than 40 mbgl and depth to water level varies between 5 to 30m bgl. The yield of the well tapping these meta-sediments varies between 20m^3/day to 60m^3/day. The quality of water is good and the EC varies between 500 to 900µs/cm.

Granites generally form aquifer of limited extent in north-eastern part particularly in Danta taluka. Ground water in Granite occurs under phreatic and semi confined condition in weathered and fractured zone. The weathering is more intense and deep in coarse grained, porphyritic granite and varies in thickness from few meters to more than 20 mbgl. The depth of well tapping granite varies from 10m bgl to 30m bgl and depth to water level range from 6 to 18m bgl. The yield varies from 40m^3/day to 130m^3/day. The quality in general is potable with EC varying between 800 to 1500µs/cm.

2.5.1.2 Ground water in alluvium:

Major part of the area is underlain by alluvium, which mainly consists of fine to coarse-grained sand, gravel, silt, and clay. Most of the dug wells tapping phreatic aquifer have gone dry over a period of time. Ground water occurs in semi-confined to confined conditions in deeper aquifers. The piedmont plain in eastern and north-eastern part forms the principal recharge zone for deeper aquifers.

Ground water is extensively developed by dug-cum-bore wells and tube wells in areas underlain by alluvium. The depth of tube wells varies from 45m bgl to 200m

bgl and the water level varies between 30m bgl to 100m bgl. The yield varies between 130m^3/day to 260m^3/day. Elevation of water table gradually reduces from recharge area in NE towards discharge area in west and south. The ground water level reflects and follows the general topographic slope. The flow direction is from NE to SW.

2.5.1.3 Detailed study area:

Vadgam taluka was selected for detailed study with aerial extent of approximately 560 sq.km. The taluka has witnessed rapid growth since last two decades, the use of high capacity submersible pumps for intensive irrigation has led to great demand of freshwater which in-turn has added more stress on the fresh water resources and thus resulting in fast decline in the ground water level consistently over a period of time. The stage of ground water development is 167% (GEC 2004). High fluoride content is also reported in many villages of the taluka. Taking into consideration these aspects Vadgam taluka was selected for detailed study.

The study area comprises of alluvium consisting of sand, silt and gravel beds from few tens of meters to hundreds of meters. The thickness of alluvium increases towards south and west. Most of the dug wells with depth range of 30-40m bgl have gone dry since last few years. Generally the depth of tube wells range from 45 to 80m bgl in eastern part. However in southern and southeastern part of the taluka, the depth ranges upto 110m bgl. Towards west the depth of the tube well varies between 80 to 200m bgl. The water level ranges from between 45 to 100m bgl. The quality in general is potable, the EC varying between 800 to 1500µs/cm. However high fluoride content is reported in many villages of Vadgam taluka.

Mukteswar irrigation scheme and Dharoi dam project are main source of surface water supply for drinking purposes, which also meet the irrigation water demand in the taluka. About 483 check dams have been constructed in the taluka (till March'07), which has benefited about 2415 Ha area under irrigation. In villages namely Nizampura, Tajpura, Sherpura, Panchda, Salemkot, Bhadarpura, Mepada, Nagana etc. substantial rise in water level has been witnessed during current year. The rise in water level is attributed to good rainfall since last two years and due to conservation of water by recharge structures.

2.5.2 Sabarkantha District: The Studies were taken up inparts of Sabarkanta district of area 3600 sq.km covering the talukas of Talod, Prantij, Himatnagar, Idar, Vadali and Khedbhrama. The study area in general has a moderately undulating topography with dissected Hilly terrain in its Northern part and the rest of the area is gently sloping plain. The rivers draining the area are Sabarmati, Hathmathi and Ghuvai Nadi of which River Sabarmati are prominent. The average annual rainfall in the area is about 733 mm.

Geologically, 85% of the area and parts of Talod talukas is covered by Granites, Calc Gneiss and Basalts. The remaining 15% of the area (parts of Himatnagar, Prantij and Talod talukas) is occupied by alluvial formation. Himatnagar sandstones exist in the talukas of Himatnagar and Prantij.

The groundwater occurs in unconfined as well as in semi-confined conditions. In hard rock area, the groundwater development is mainly by dugwells, in many cases horizontal bores ranging between 10 to 50 m in length existed. Granites, Himatnagar sandstones and alluvial sandy deposits form the potential aquifer within the area. The water level in calc gneiss ranged between 5 and 25 m bgl while in case of Granites and Basalts, the depth to water level ranged between 10 to as deep as 48

m bgl. In alluvial areas most of the dugwells that existed have become dry and are now replaced by tubewells tapping aquifers ranging between 30 and 160 m bgl. The depth to water level in these aquifers ranged between 25 and 90 m bgl. Intensive irrigated agriculture occurs in Prantij, Talod and Himatnagar talukas. Heavy and continuous groundwater pumping has led to groundwater troughs at few pockets particularly in area around Prantij and Himatnagar. The groundwater qualities of the study area were found to be good and potable with the EC ranging between 600 and 2800 µS/cm. However, in some regions of Himatnagar talukas, groundwater in deeper depths are brackish. The yield of the dugwells in calc gneiss varied between 10 and 20 m^3/day while in granites it varies between15 – 50 m3/day and in alluvial it is 20 to 100 m3/day.

The groundwater fluctuations ranged between 3 and 15 m and are more pronounced in granites and basalts. The dugwells within the calc gneiss registered remarkable recharge by rainfall, but with short residence time (2 to 3 months) indicating the less storage capacity. However, dugwells located within the weathered granites had groundwater with longer residence time (> 3 months). Several check dams were constructed by the state government in the hard rock area, these structures had remarkable impact on groundwater recharge particularly in weathered granites. The dugwells sustained for atleast two more months than normal period, which in turn led to increase in agricultural production.

2.5.2.1 Detailed Study Area:

The detailed study covering parts of Idar taluka were carried out as this area experiences fast depletion in groundwater level. More number of dugwells was established for monthly monitoring of water level. The dugwells in this region ranged between 10 m to as deep as 50 m bgl. The area is generally plain with presence of few hillocks at places. The thickness of the alluvial is about 300 m and tapers near the contact with basalt. The groundwater level ranged between 20 and 50 m bgl while EC ranged between 600 and 3000 µS/cm. The groundwater decline is quite rapid which on field enquiry revealed about 0.5 to 1.25 m/year.

Granites, mainly porphyritic granites, occupy the entire taluka. At many places, the granites are highly weathered and forms good potable potential aquifer system. Groundwater development is mainly by dugwells. Due to intensive pumping for agricultural activity, groundwater troughs exist in the villages of Rewas, Choriwad, Goral, Lakshmipura, Ankala and Kukkadiya indicating that the aquifer is under high hydrologic stress. Hence, there arises a need to safe guard this fast declining aquifer system.

2.6 NORTH CENTRAL REGION (Madhya Pradesh)

District Ground Water Management studies were taken up in Betul, Devas, Dhar & Neemuch district covering 12344 Sqkm.

2.6.1 Betul District:-The studies were carried out in Amla, Multai & Prabhat Pattan blocks of Betul district covering an area of 3334 sq.km. The area is covered by Archaean (Granites) and Deccan Trap lava flow (Basalt). Depth to water level in granite ranges from 11.60 m bgl to 26.85 m bgl in Amla block. In Multai and Prabhat Pattan blocks, water level ranges from 6.80 m bgl to 19.60 m bgl in vesicular basalt and jointed and fractured massive basalt. Ground water in Granite formation in tube

wells encountered in deeper fractured zone. At Khedli Bazar exploratory bore hole site, ground water encountered at a depth of 219.00 to 226.00 m bgl and discharge of 12 lps. Special studies were carried out in Bel river watershed in parts of Amla & Multai blocks of Betul district.

2.6.2 Neemuch District:-The studies were carried out in Neemuch, Manasa & Javad Blocks of Neemuch district covering an area of 2643 sq.km. About 78 dug wells/ observation key wells were selected for pre and post monsoon levels and about 41 water samples from representative wells were collected for the ground water quality analysis as salinity problem was reported in the study area. The area is covered by Delhi system (Jiran sand stone), Lower Vindhyan (consisting of sandstone, shales), Upper Vindhayans (consisting of Kymore sandstone/shale, Rewa sandstone, limestone, shale, Bhander shale, limestone and sandstone). Southern most part of the area is covered by Deccan trap basaltic flows with ferruginous capping at places. The yield of the wells is ranging from 1-2 lps and 1 to 5 lps in the study area. The depth to water ranges from 3.52 m to 24.70 mbgl during pre-monsoon period and 1.58 m to 11.38 m bgl during post monsoon period.

2.6.2.1 Special Studies : Carried out special studies pertaining to chemical quality of ground water with more emphasis on salinity problem particularly in "Harkiyakhal basin" of the study area. Collected 10 samples separately from different aquifer (deeper & shallow) from different places of Harkiyakhal basin for the study of salinity problem and suggested artificial recharge structures to be constructed to prevent contamination of ground water in the study area.

2.6.2.2 Artificial Recharge Sites : Selection of 8 suitable sites for the construction of artificial recharge structure to prevent the depleting water levels and augmentation of ground water in the different places of the study area as Neemuch district comes under over exploited category in the state.

2.6.3 Dhar district: The studies were carried out in parts of Dhar district M.P. covering an area of 2973 Sq. Kms. comprising blocks of Dhar, Badnawar, Tirla & Nalchha. The special emphasis was given on the artificial recharge of ground water. The main river flowing in the area are Chambal & Man. The area is underlain by Basaltic lava flows, Laterite and Recent Alluvium. The ground water under unconfined to semi confined condition. 46 Nos Key observation wells were inventoried which included 19 dug wells, 20 borewells and 7 NHS & Pzs. The pre monsoon water levels ranges from 3.78 mbgl to 48.15 mbgl (data includes Borewells). The post monsoon water level ranges from 0.77 mbgl to 17.10 mbgl.The Ground Water Development of Badanwar block was 170%, Dhar 157%, Tirla 111% and Nalchha 123%. About 30 Nos sites were identified for the artificial recharge of Ground Water in the study area. The quality of Ground Water is in general potable except higher fluoride values recorded in Delmi and Nalchha while higher EC values recorded in Sadalpur and Banla.

2.6.4 Dewas district: The ground water development and management studies were carried out in parts of Dewas district M.P. covering an area of 2390 Sq. Kms. compising blocks of Dewas, Sonkutch, & Tonkkhurd. The studies were undertaken to assess the change in ground water scenario in the area, the development potential and management for future planning. The study area is mainly underlain by rocks of Deccan Trap (Basalts) and alluvium along the course of rivers and nallahs. In Deccan

Traps, the dug wells have depth ranging from 4 – 22 meters with a diameter of 2 to 11 meters. The discharge varies from 13-29 cubic meters with a draw down of less than 1.7 m. The specific capacity varies from 26-170 lpm/meter of draw down. Tube wells generally give a discharge of 5 lps, in some cases the discharge is as high as 10-12 lps. CGWB, under Accelerated Exploration Programme had drilled bore wells of 200 m depth, the discharge of which ranges between 2-5 lps with a 5 HP motor.

The premonsoon depth to water level in over 90% of the area is more than 8 mbgl. Shallower water levels of 4-8 mbgl are seen in north eastern and extreme north western parts of the area. Deeper water levels of > 16 mbgl are seen in scattered patches. Dug wells are fast drying up due to higher ground water development in the area.

In the post monsoon season, the general depth to water level is between 0-6 mbgl. Deeper water levels of >9 mbgl is seen in central part of the study area. Water levels ranging between 6-9 mbgl is seen in extreme North Eastern , and central part near Sonkutch and Tonkhurd. A maximum part of the study area shows arise of more than 6 meters while a decline is observed in a patch between Sonkutch and Nevri.

2.7 NORTH CENTRAL CHATTISGARH REGION (Chattisgarh)

During AAP 2006-07, the Durg district covering 8030 sq.km has taken up under the Ground Water Management Studies. Earlier Systematic Hydrogeological Studies (SHS) and first Ground Water Development & Management Studies were conducted in the year 1990 and 1997 respectively in the district. Based on these studies exploration programme has been taken up during 1995-2002.

2.7.1 Durg district: The Durg district ,covers an area of about 8030 sq. km. The southern part of the district is mostly habitated by tribes The study area falls under Seonath sub basin of Mahanadi basin and is situated within Proterozoic Chhattisgarh basin. The area comprising sedimentary rocks age, mainly Shale, Limestone, Sandstone with isolated patches of Quaternary Alluvium and Laterites and the southern parts covered with crystalline rocks of the Achaean age.

An area of 1463 sq.km in Gypsiferous Shale of Saja, Bemetara and Nawagarh blocks is taken up for detailed hydrogeological investigations with the objective to delineate the brackish water aquifer and find out the potable water patches within the brackish water area. The permanent hardness created by dissolution of Gypsum ($CaSO_4$) in ground water has effected not only the drinking water supply programmes but also produced adverse effects on irrigation due to very high rate of corrosion. The gastrointestinal disorder is the common health hazards in this area apart from other problems. Adverse effect of high SO_4 can be seen in horticultural activity. The fruit producing species like Mango, Black Barry are not sustainable under these conditions. Land subsidence is adversely effecting the civil construction like plinth, floor and hand pumps, water wells. From the study it has been established that the lower part of Maniyari Formation toward its contact with Hirri is having much more continuous Gypsum contaminated then that of upper part, which is sporadic in nature.

The second area selected for the detailed survey consist of 964 sq.km in Charmuria Limestone covering of Balod,Gunderdehi, Gurur and Lohara blocks . The objective is

to delineate the cavernous aquifer and demarcation of the alluvium patch for artificial recharge. An area occupied by Ranidhar member of Charmuria Formation (about 500 sq. km) is characterized by high solution action and formed potential aquifer . Cavernous zones developed between 40 to 80 feet below ground level and at few places zones below 25 feet are suitable for ground water recharge through dug-cum- bore wells. Mapable alluvial patch in Gurur block along banks Kharun river is a good repository aquifer system in the area. To minimizing declining water level in these areas, artificial recharge is required. Decline trends of water level have effected not only the drinking water supply programmes but also produced adverse effects on irrigation .It has been established that the areas covered by alluvium are more potential with regard to ground water availability.

To meet out the crisis, people have to be motivated to adopt Rooftop rainwater harvesting in concealed chamber and use it as source of drinking water after proper filtration. Apart from these exercises were carried out to know the unit draft of borewells and specific yield of Maniyari Formation. Relationship of Gypsum Karst bad land topography and joint/ fracture pattern of bed rock, demarcation of auto flowing areas, ground water flow and water quality in brackish water area are also carried out.

2.8 CENTRAL REGION (Maharashtra)

Under Ground Water Management Studies, an area of 19480 sqkm has been covered in Buldhana, parts of Amravati district, parts of Ratnagiri district and parts of Ahmednagar district (under NREGS also)in Maharasthra state.

2.8.1 Buldhana District (W & NW Parts): An area of 3154 sq.kms encompassing parts of Sangrampur, Jalgaon (Jamod), Nandura, Malkapur and Motala talukas of Buldhana district was covered. The area is underlain by Deccan Traps and alluvium occurs along the river courses. A total of 58 key wells were established in the above area. The pre-monsoon depth to water level ranges from 2.40 to 25.60 m.bgl. while the DTW during post-monsoon period ranges from 1.67 to 24.0 m.bgl. The seasonal water level fluctuation varies from –2.56 to 13.25 m. Seven pumping tests were conducted to evaluate the aquifer parameters. A total of 55 water samples were collected from both shallow aquifers and deeper aquifers including the problematic area and towns.

2.8.2 Buldhana District (E & NE Parts): An area of 3173 sq.kms in east and north-eastern parts of Buldhana district was covered in six talukas namely Khamgaon, Shegaon, Mekhar, Chikli, Buldhana and Nandura. Out of 19 watersheds, three watersheds covering an area of about 3012 sq.kms fall under the Purna basin

The general elevation of the area ranges from 272 to 653 m.amsl. Both depositional and erosional physiographic features like alluvial patches, meander scars (near Dollerkhed in PTGB-1 watershed) River Terraces are present along the Purna River courses. The northern part of the area is covered by Purna alluvium. The thickness of the alluvium is reported to be more than 100 m. The thickness of the alluvium decreases towards south. The central and southern part is occupied by basaltic lava flows known as Deccan Traps. The flows range in thickness between 15 and 40 m.

Ground water occurs under semi-confined to unconfined conditions in alluvium and also in weathered/fractured, vesicular and massive basalts. The pre-monsoon depth to water level ranges from 3.30 to 22.00 m.bgl, while the post-monsoon DTW ranges from 0.30 to 22.40 m.bgl. The pre- and post-monsoon water level fluctuation varies from 0.21 to 14.18 m.

For assessing the chemical quality of ground water, 90 water samples were collected. The on-the-spot electrical conductivity in these samples ranged from 300 to 4000 mmhos/cm.

Two watersheds namely PTGB-1 and PTG-5 covering an area of 405 sq.kms were selected for detailed study, in which 33 key wells were established. Depth to water level ranges from 6.64 to 21.1 m.bgl and 1.06 to 18.7 m.bgl during pre- and post-monsoon seasons respectively. Nine pumping tests were conducted to determine the aquifer parameters.

In order to know the impact of urbanization on quality and quantity of ground water, urban hydrogeological studies were carried out in Buldhana town. In this area, 20 key wells were established in 10.88 sq.kms area and water levels were measured. To assess the ground water quality, 20 water samples from dug wells representing shallow aquifers and 20 samples from borewells/hand pumps representing deeper aquifers were collected.

2.8.3 Buldhana District (Southern Parts): Ground Water Management Studies were carried out in southern parts of Buldhana district over an area of 3300 sq. kms. The area forms parts of Buldhana, Chikli, Mehkar, Deolgaon Raja, Sindkhed Raja and Lonar talukas of Buldhana district of Maharashtra. The area is underlain by Deccan Traps. Ground water occurs under unconfined to semi-confined conditions. A total of 98 key wells were established. The pre- monsoon depth to water level ranged from 2.70 m.bgl to 18.00 m.bgl while the post-monsoon depth to water level ranged from 1.10 m.bgl to 13.50 m.bgl. The seasonal fluctuation varies from 0.85 m to 10.40 m.

2.8.4 Amravati District (NW Parts, Melghat Hills): The studies were carried out over an area of about 3460 sq.kms in hilly areas of Melghat in north-western parts of Amravati district covering Chikhaldara and Dharni tahsils. The Melghat terrain is highly uneven with steep high hills, and steep valleys, terraces, plateaus and gently and steeply sloping grounds.

Deccan Traps are the main geological formation. The principal water bearing formations is Deccan Traps. Ground water occurs under unconfined to semi-confined conditions. In order to study the detailed hydrogeological conditions of the area 70 Key wells were established during pre-monsoon season. The pre-monsoon depth to water level ranges from 1.05 m bgl to 18.5 m bgl while the post-monsoon depth to water level ranges from 0.5 m bgl to 12.2 m bgl. The seasonal fluctuation varies from 0.08 to 10.66 m.

The pumping tests results show that the Specific Capacity of these wells varies between 205 m^3/day /m at Chikhli and 925 at Chikhaldara. The permeability of the aquifer (W) ranges from 0.30 m/day at Chikhli to 4.32.m/day at Chikhaldara both taping fractured basalt. The maximum inflow capacity of the wells (Q_{max}) varies

between 0.84m^3/day at Chikhli and 36.83m^3/day at Chikhaldara and the time taken for 99% recuperation ($t_{r(max)}$) varies between 2.97 hrs at Chikhaldara and 103.59 hrs at Chikhli.

2.8.5 Ratnagiri District (W & NW Part): An area of 3175 sq. kms. was covered in western and north-western parts of Ratnagiri district including parts of Ratnagiri, Chiplun, Guhagar, Dapoli, Khed and Mandangarh talukas.The entire Ratnagiri district receives rainfall in excess of 3000 mm per annum. The isohyet almost runs parallel to coast trending north to east. The Ratnagiri and Guhagar taluka on the western coast records the lowest rainfall whereas highest in Mandangad and Devrukh (Sangameswar Taluka). The rainfall gradually increases from seacoast towards hills of Western Ghats.

A total of 74 key wells were established in 10 watersheds covering all the hydrogeological units. To assess the impact of sea water on ground water along the coast, the 150 km long coast line is covered with key wells fixed parallel to it along two rows separated by few hundred meters. The depth of dug wells varies from 1.60 m bgl to 25.45 m bgl while the diameter varies from 1.60 m to 6.0 m bgl.The pre-monsoon depth to water level ranges from 1.60 m bgl to 25.4 m bgl and 18 out of the 76 key wells were dry during pre monsoon. The post-monsoon depth to water level ranges from 0.17 m bgl (Omli) to 25.0 m bgl (Pochri) with no dry wells. The seasonal fluctuation ranges from 0.25m to 8.45m . The EC of the ground water in the key wells measured during pre-monsoon ranges from 0 to 3000 micromhos/cm.

The detailed hydrogeological survey was carried in watershed WF-66. The total area of watershed is 253 sq. kms.. A total of 16 dug wells (key wells) were established in this watershed. The depth of dug wells varies from 2.33 m to 19.05 m . The pre-monsoon depth to water level ranges from 1.80 m bgl to 16.58 m bgl while the post-monsoon depth to water level ranges from 0.7 m bgl to 17.15 . The seasonal fluctuation varies from 0.25m at Bhandarpule to 12.18m at Kalvadevi.

Hydrogeological study in Ratnagiri Town was carried out to assess the impact of urbanization over the ground water regime. The ground water monitoring and sample collection was carried out in 19 dug wells, 2 bore wells and 1 hand pump.

In order to study the ground water quality, 35 from shallow aquifer water samples and 10 from deeper aquifer water samples were collected in addition to 25 water samples collected from Ratnagiri City. Apart from these a pollution study is carried out in the area. Two major industrial areas fall in the study area namely Lote Parshuram MIDC area on Chiplun-Khed section of Bombay-Goa highway and MIDC Mirjole adjacent to Ratnagiri city. Thus 16 (2x8) water samples from Lote Parshuram area and 20 (2x10) samples were collected from Mirjole MIDC area.

2.8.6 Ahmednagar District (W & NW Parts): Ground water management studies were carried out over an area of 3218 sq. kms in western and north-western parts of Ahmednagar district covering parts of Akole, Sangamner, Kopargaon, Rahata and Shrirampur talukas.

The area is drained by the Godavari River and its tributary namely Pravara. The Bhandardara dam is the major irrigation project lying adjacent to the study area on the western side and this project irrigates one third of the study area through canals. The area is mainly underlain by the Deccan traps with alluvium occurring along the river courses. The thickness of alluvium ranges from 10-30 m. A total 115 key observation wells were established. The depth of dug wells ranges from 4.3 to 30.00 m.bgl. The pre-monsoon DTW ranges from 4.10 m.bgl to 25.0 m.bgl while the post-monsoon DTW ranges from 0.4 to 23.0 m bgl. The current annual fluctuation was between 0.80-13.50 m. The yield of dug wells tapping basalts ranges from 5 to 100 m^3/day while the yield of dug wells tapping alluvial formation ranges from 100 to 300 m^3/day. About 90 water samples were collected for chemical analysis. In general, the quality of water is good to brackish. Five sugar factories are located in the study area.

2.9 NORTHERN REGION(Uttar Pradesh)

Ground Water Management Studies were undertaken in an area of 17134 sqkm in Bagpat, Gautam Budh Nagar, Mathura, Fatehpur, Mahamaya Nagar & Lalitpur districts of U.P

2.9.1 Baghpat District:-The studies were carried out in Baghpat district covering an area of 1321 sq.km, occupies part of interfluvial belt of Ganga-Yamuna doab in the extreme western part of the State. The area is underlain by a thick pile of alluvial sediments of Quaternary age and largely constitute sands of various grade, clay and kankar (calcareous nodules). The sandy horizons at depth form the main source of ground water. Major drainage system in the area is covered by Yamuna and Hindon rivers.

The depth to water level varies from 6.06 mbgl to 26.23 mbgl during pre-monsoon period and from 6.06 mbgl to 26.23 mbgl during post-monsoon period with an average seasonal fluctuation of 0.26 m. However, long terms water level trend indicates a continuous declining of water table in large part of the area in the district.

The results of exploratory drilling carried out down to maximum 456.00 mbgl in the area reveal that three tier aquifer system exists in the area in the depth ranges G.L. to 125.0 mbgl (I Aquifer), 130.00 to 260.00 mbgl (II Aquifer) and 275 to 425 mbgl (III Aquifer). Ground water in shallow aquifer down to depth of 50 mbgl occurs under unconfined stage while in deeper reaches in semi-confined to confined stage of disposition. The exploratory tubewell constructed by CGWB tapping II Aquifer yielded 2210 lpm at 6.30 m drawdown while that tapping III Aquifer yielded 2800 lpm at 7.52 m drawdonw. The exploratory tubewells tapping I & II aquifer yielded between 1987 lpm and 3220 lpm at drawdowns ranging from 14.44 to 6.15 m. The yield in a piezometer tapping the deepest aquifer between 627 and 674 was assessed to be 1130 lpm at 19.60 m drawdown and temperature was measured to be 52°C.

To assess the chemical quality of ground water 25 no. of water samples have been collected from entire area from different depth zones. In shallow or first aquifer the quality of groundwater is good whereas in second & third aquifer at deeper zones, it is deteriorated all along the Yamuna river

The ground water development for irrigation and domestic purpose takes place in the district through shallow and moderately deep tubewells. The present, stage of ground water development is 82%. Binauli Block falls under 'Over exploited' category showing intensive ground water development.
The Binauli block with an area of 254.0 Sq.km, was selected for detailed study. On the basis of continuous declining trend of ground water due to over exploitation and increasing demand of irrigation, area falls under 'Over exploitated' category. Detailed surveys including establishing additional Key Wells and collection of water samples were carried out in order to know actual problems and for suggesting remedial measures.

2.9.2 Gautam Budh Nagar District:-The studies were carried out in Gautam Budh Nagar district, covering an area of 1442 Sq. Km. The district occupies central parts of Ganga -Yamuna Doab in Western Uttar Pradesh, underlying a vast sequence of Quaternary alluvial sediments . Based on their topographic positions and geo-morphological characteristics sediments are grouped into Younger and Older alluvium.

The shallow phreatic aquifer is unconfined in nature whereas the relatively deeper aquifers are semiconfined to confined in nature. The depth to water level in phreatic aquifer ranges from 3.35 to 14.40 m bgl during pre-monsoon period whereas it ranges from 2.00m to 13.95m bgl during post-monsoon period. Seasonal water level fluctuation ranges from (-) 2.76 to 3.69m. Post monsoon depletion of depth to water level recorded in large areas mainly in urban NOIDA area and at few places in rural areas as well.

The exploratory drilling in parts of Gautam Budh Nagar district reveals that single-tier aquifer system exists down to the depth of 150m bgl in the area. The thickness of the aquifer decreases towards west and south west directions. The granular mass comprising sands of different grades and gravel forms aquifer system.

Arsenic content in all the six samples collected from phreatic zone has been found within permissible limit(0.001 to 0.007 ppm).In general the quality of ground water in the district is good except at places where it is deteriorated with EC more then 1000 microsiemens/cm at 25°C and Fluoride slightly more than permissible limit.

NOIDA Urban area (Area: 203 Sq.km) has been covered for detailed study to assess the impact of urbanization on ground water resources. Ground water levels were monitored at 13 locations in NOIDA urban area including 8 piezometers. In addition 12 water samples were collected from different zones for detailed and trace element analysis so as to understand the ground water quality and pollution. The development of ground water is being done on large scale in urban and rural areas for irrigation and domestic purposes which may be continued with caution for salinity hazards.

2.9.3 Mathura District: The studies were carried out in Mathura District covering an area of 3340 sq.km, lies in the Yamuna sub basin. The area is almost a flat country with some undulations. The general slope is towards NW to SE and gradient as 30 cm per km. The area is underlain by fluvial sediments of Quaternary period. These sediments are of variable thickness and overlie formations of Vindhyan System.

The depth to water level varies from 1.76 mbgl to 16.02 mbgl during pre-monsoon period and from 1.24 mbgl to 16.08 mbgl during post-monsoon period. The seasonal fluctuation thus recorded has indicated rise of water level maximum upto 2.17 m to a fall of 1.73 m at few places.

The results of exploratory drilling carried out in the depth range of 85 and 278.90 mbgl reveals that mainly two-tier aquifer system exists in the district. The thickness of alluvium increases towards north while towards south it decreases. The ground water occurs under unconfined and semi-confined to confined conditions. The exploratory tubewells tapping first aquifer in the depth range of 28.6–92.9 m and 28–40 yielded 764 lpm at drawdown of 6.43 m and 810 lpm at drawdown of 17.07 m respectively. Exploratory tubewell tapping second aquifer in the depth range of 137-189m yielded 764lpm at 6.43m drawdown. The exploratory data indicates that deeper aquifers contain generally saline groundwater. At favourable locations fresh ground water has been struck but yield is moderate.

The quality of ground water in major part of the district is brackish. The total hardness ranges between 250 to 1500 mg/l. The area is being irrigated by Upper Ganga Canal network system, and private tubewells. The ground water development for irrigation and domestic purposes takes place in the district through shallow and moderately deep tubewells. The ground water is being over exploited resulting in decline of water level which is obvious through long term ground water monitoring data.

Mathura Block with an area of 412 Sq.km, has been selected for detailed study purposes, because of quality problem. The results of water samples collected for chemical analyses show higher range of E.C. from 2487 to 8365 microsiemens /cm and in lower range from 962 to 1193 microsiemens/cm. To study the hydrogeological conditions in detail 50 villages were visited and water levels of dug wells and borewells in the depth range of 4.18-15.90 mbgl monitored.

2.9.4 Fatehpur District:-The studies were carried out in Fatehpur district covering an area of 4152 sq.km. The area is underlain by unconsolidated sediments of Quaternary to Recent periods . The depth of basement varies from 300 to 400 mbgl along Ganga river 100 to 200 mbgl along southern boundary. In general, district may be divided in the two physiographic units, i.e. lowland and upland regions.

The pre-monsoon water level varies from 2.19 mbgl to 22.40 mbgl. The post-monsoon water level varies 2.15 to 17.50 mbgl. Maximum fluctuation ranges from 4.0 to 6.0 m in the district.

Exploratory drilling down to maximum depth to 335.17 mbgl in the area at Araiya Mushayak reveals occurrence of mainly two-tier aquifer system in the district. The ground water occurs under unconfined to semi-confined and confined conditions in the area.The yield of exploratory tubewells construsted in the depth range 100-190 varied between 1000 and 1800 lpm at moderate drawdowns while that tapping granular zone in the depth range 59-107m yielded 2467lpm at 4.11m drawdown The exploratory well tapping second aquifer yielded 2255lpm at 7.17m drawdown.

To assess the chemical quality of ground water water samples were collected from entire area, during pre & post-monsoon. During the studies in the Village Bhaisawadi and Keshalni, it was noticed that the teeth of villagers are affected by excessive flouride in the ground water.
Irrigation in part of the area is being done by Lower Ganga Canal network system. Ground water development in the district takes place through shallow and moderately deep tubewells to meet out the domestic and irrigation requirements.

Detailed studies were carried out in Deomai block of the district due to reportedly excessive fluoride in ground water.

2.9.5 Mahamaya Nagar (Hathras) District:-The studies were carried out in the district covering an area of 1840 Sq.km, underlain by fluvial sediments of Quaternary period and lies in the inter-fluvial tract of the rivers Yamuna & Ganga. The major drainage system in the area is controlled by Kali & Sengar rivers.

The water level varies from 4.25 mbgl to 21.51 mbgl during pre-monsoon and from 4.12 to 23.36 mbgl during post-monsoon period. Exploratory drilling carried out maximum down to the depth of 368.00 mbgl reveal that three-tier aquifer system exists in the area. The ground water occurs under unconfined to semi-confined and confined conditions. The exploratory tubewell Chandappa in the depth range of 59-65mbgl yielded 1130 lpm at 13.14 m drawdown.

The perusal of chemical quality of ground water through 35 water samples reveals that the ground water of the district is mildly alkaline in nature and slightly hard.

The area is being partly irrigated by Upper Ganga Canal network system. The ground water development for irrigation and domestic purposes takes place in the district through shallow and moderately deep tubewells. The stage of ground water development in the district is around 68%. Hathras block falls under 'Critical' category whereas Sadabad, Sahpau and Sasni blocks fall under 'Over-exploited' category.

Block Sasni with an area of 268 Sq.km, falling under 'Over-exploited' category was selected for detailed study. The area also experiences ground water quality problem and requires remedial measures to mitigate the problems. The depth to water level in the block ranges from 12.8 to 21.5 mbgl and additional water samples were collected to assess ground water quality in the block.

2.9.6 Lalitpur District :-The Ground Water Management Studies were carried out in Lalitput district covering an area of 5039 Sq.Km. The major drainage system is covered by river Betwa, Dhasan, Jamni & Narain rivers. The Betwa river flows along the western boundary and the Dhasan river flows along a part of the eastern boundary. The terrain between the two rivers is drained by the Sajnam, the Shahzad and the Jamni rivers. The existing major & medium irrigation projects are covered by the Betwa canal. The district is underlain by Bundelkhand Gneiss / granites, schists, quartz reefs and mafic rocks, which are overlain by limestones, shales and quartzites of the Bijawar Series. The Vindhyan sandstones rest over both the Bundelkhand Gneiss and Bijawar Series. Ground water occurs under water table and semi-confined conditions in the weathered zone and in joints and fractures in fresh rock below the

zone of weathering.There appears to be no hydraulic continuity of aquifer in the district.

The depth to water levels varies from 3.50 mbgl to 11.40 mbgl during pre-monsoon period and it ranged from 1.40 to 10.95 mbgl in the postmonsoon period. The water lever fluctuation shows declining trend throughout the area which ranges between 1.35 m to 3.95 m.

The aquifer system is of heterogeneous nature and the ground water availability is restricted only in the sub-surface fractured/weathered and jointed zones. The shallow tubewells may be constructed at favourable sites selected after intensive hydrogeological and geophysical investigations.The quality of ground water in general is good for drinking as well as irrigation purposes. Quite a good number of exploratory wells have been drilled by CGWB in the depth range of 21.15-178.30 mbgl.The yield of these wells constructed at favourable sites varies from 10 to 700 lpm.

Ground water development has taken place in the district through open wells, dug-cum-bore wells located at favourable sites to meet out domestic/ irrigation requirements. The quality of ground water in the study area is suitable for domestic and irrigation purposes.

Madawara (731.70 Sq.Km) and Bar (659.10 Sq.Km.) blocks were selected for detailed study purposes. The Madawara block is mainly occupied by Bundelkhand Gneisses, schists and granites. In southern part of the block, Vindhyan sandstone and siliceous limestone are also exposed. The siliceous limestone is observed only in this block of Lalitpur district. The recharge to ground water is mainly by rainfall and seepage from tanks/canal etc. The water levels in the compact sandstones having low potentiality are relatively deeper. Bar block is mainly occupied by the granite gneissic complex of Archeam and geomorphologically by the pedeplain unit having poor to moderate ground water prospects.

2.10 UTTARANCHAL REGION (Uttarakhand State)

District Ground Water Development and Management Studies were carried by covering 9000 sqkm of Chamoli & Pithoragarh Districts of the State.

2.10.1 Chamoli District:- Groundwater Management Studies were carried out in Chamoli district covering 7520 sq. km. The district is represented by highly undulating topography, which includes high hills, deep valleys, spurs and steep slopes. The northernmost part is perennially under the snow cover. The district is mainly drained by Alaknanda River. The annual rainfall for the year 2006 is 1258 mm.

The major part of the district is occupied represented by the rocks of Lesser Himalaya. The Lesser Himalayan Zone consists of Garhwal Group of rocks.consisting mainly of quartzites, schists, granites and gneisses (Joshimath Formation) and quartzites, phyllites, calc-silicates and meta-volcanics (Chamoli Formation). The nothern areas are inaccessible and under snow cover throughout the year.

In southern part of the district, hydrogeological studies have been carried in Karnaprayag, Gairsain, Tharali, Narayanbagar, Ghat and Dewal blocks. A total of 51

hand pumps and 26 springs were identified and measured in pre-monsoon and post-monsoon.

Hand Pumps: The hand pumps drilled by Uttarakhand Jal Sansthan are located all along the roads and river terraces. The pre-monsoon water levels of selected hand pumps range from 1.02 to 53.70 m bgl and during the post-monsoon period the water levels range from free flowing to 57.10 m bgl. The present study reveals that 24.39% of the hand pumps show decline in water level ranging from 0.52 to 10.44 m whereas rise in water level ranges from free flowing to 9.10 m.

Springs: Springs are the main source of drinking/domestic water supply in hilly areas of Chamoli district. Spring discharge during pre-monsoon ranges from 2 to 55 lpm having temperature between 15-22ºC and during post-monsoon the discharge ranges from 1 to 86 lpm. Among the 26 springs identified and measured, about 19.23% show decrease in discharge ranging from 1 to 8 lpm. The increase in spring discharge ranges from 0.5 to 34 lpm. As per the pre and post monsoon data of hand pumps and springs the district shows overall rise in water level and increase in spring discharge. There is no ground water pollution reported in the district.

In the northern part of the district, groundwater is developed through hand pumps and the area has not been explored for tube wells. During the course of investigations 51 hand pumps were established and water levels were obtained in both pre and post monsoon, which ranges from 0.42 (Bangthat-I) to 45.12 m bgl (Kotialsain) in the pre-monsoon period and free flowing to 49.74 m bgl (Sharmola) during the post-monsoon survey. Apart from this, 27 springs were were observed during the study. The discharge of springs ranges from 2 lpm (Rini) to 80 lpm (Vinayakchatti) in the pre-monsoon period and 5 lpm (Rini) to 124 lpm (Vinayakchatti) during the post-monsoon period. Three thermal springs were also established in the area and the temperature ranges from 55ºC (Badrinath) to 84ºC (Tapovan). A total of 37 representative water samples were collected from all the structures for chemical analysis.

Ground Water Development: During the course of hydrogeological investigation four (4) areas have been delineated in the southern part of the district for future ground water development in the valley portion. These areas are located near Karnaprayag, Simli, Gauchar and Gairsain. Near Karnaprayag and Simli areas, the industrial activities are about to start in near future. Four valley portions were identified in the northern part of the district and recommended for for future groundwater development and exploration.

2.10.2 Pithoragarh District:- Ground Water Management Studies in Pithoragarh district was carried out in part of the district (covering an area of 3000 km^2) that includes six Developmental Blocks viz. Bin, Munakot, Didihat, Berinag, Gangolihat and Kanalichhina and in parts of two blocks viz. Dharchula and Munsyari. The study area shows a complex geotectonic set up with the rock units suffering multiple phases of structural deformation and metamorphism. The rock types of Central Crystallines (Joshimath Formation) comprise gneiss, schist, migmatite, quartzite, amphibolite and granitoids. The Lesser Himalayan Zone consists of low grade to medium grade metasedimentary and metamorphic rocks with associated basic volcanics.

During the course of hydrogeological investigations, a total of forty eight springs were inventoried. Apart from this, water samples from the rivers Saryu, Ramganga, Gauriganga and from lakes of Thamri Kund and Maser Kund were collected for chemical analysis. Some Hand Pumps were also inventoried for water level measurement both during pre-monsoon and post-monsoon periods.

Springs: The springs are the most important source of drinking water in hilly terrain where motorable roads do not exist. Besides, seepage areas (naolas) having very low discharge occur in and around the valleys, road side slopes . The discharge of nalas during pre-monsoon period is generally negligible (<0.001 lps) and beyond conventional discharge measurement techniques. Discharge during pre-monsoon varies from 0.009 lps to 0.67 lps whereas during post-monsoon it varies from $2.16x10^{-3}$ lps (in a nala showing negligible discharge in pre-monsoon) to a maximum of 1.0 lps. The analysis of data on spring discharge reveals that out of 26 springs and nalas, a majority (18 or 69.23%) have shown an increase in discharge during the post-monsoon period whereas only 4 (15.39%) of them have shown identical discharge both during the pre-monsoon and post-monsoon measurements. The decrease in discharge during the post-monsoon period was observed in another 4 (15.39%) springs/nalas during the study.

Hand Pumps: The water levels during both pre-monsoon and post-monsoon periods could be measured in thirty seven Hand Pumps, out of which 12 were located in the Bin block. The pre-monsoon water level in the Hand Pumps ranges from 2.14 m bgl to 50.35 m bgl During the post-monsoon period, the depth to water level varies from 1.94 m bgl to 49.35 m bgl. The analysis of water level data for 37 Hand Pumps reveals that a majority of them (34 or 91.89%) have shown a rise in water level during the post-monsoon period. The maximum rise was 11.03 m in Govt girls inter college,Pithoragarh(HP-PTH2-06) and the minimum rise of 0.01 m near the PWD IB, Pithoragarh (HP-PTH3-06). The fall in water level during post-monsoon period was observed in three Hand Pumps (8.11%) between 0.05-0.72 m.

Hydrochemistry: A total of forty three water samples were collected during the pre-monsoon survey from springs,Naolas, hand pumps, rivers and lakes. 41 samples were also collected during the post-monsoon period tapping same or other sources.

Ground Water Development: Ground water development in the district is feasible in valley areas along the courses of major rivers. The detailed study area was selected in Bin block (169 km^2 area) keeping in mind the problem of water scarcity, wide valleys near the confluence of Saryu and Ramganga rivers and around Pithoragarh township. A large floating population in Pithoragarh town has resulted in increasing demand for drinking water in the area. Tube wells having low to moderate discharge (300 to 500 lpm) may be feasible in valley portions in Bin block. Pithoragarh township also shows a good potential for roof top rainwater harvesting. Shilang Gad, a tributary of Saryu River, has been selected for carrying out pollution studies as solid and liquid waste disposal along the course of this Gad has become evident during the present investigation.

2.11 MID EASTERN REGION(Bihar and Jharkhand states)

Ground water management studies were undertaken in 5902 Sq. Km. area in parts of Rohtas district(Bihar), Pakur & Sahebganj districts (Jharkhand).

2.11.1:Rohtas district, Bihar:-Ground water management study has been carried out in parts of Rohtas district, Bihar covering an area of 2852 Km^2. The major part of the study area consists of alluvial deposit of Quaternary Age. An area of nearly 732 km^2 consists of limestone, shales and quartzites of Vindhyan Super Group in parts of Rohtas and Chenary blocks. The alluvial area is covered by a network of canals of Sone Canal System. The surface water irrigation system is very efficient in the district, resulting in low utilization of ground water. A perusal of depth to water level in phreatic aquifer indicates that, in alluvial formation it varies from 2.2 to 14.88 mbgl and in hard rock formation it varies from 4.05 to 12.49 mbgl during pre-monsoon period. In the post-monsoon period depth to water level in phreatic aquifer varies in alluvial formation from 0.70 mbgl to 8.55 mbgl and in hard rock formation from 1.6 mbgl to 9.9 mbgl . In Sasaram urban area, depth to ground water level was found to be 2.94 m bgl in pre-monsoon period and 2.85 mbgl in post-monsoon period. Due to seepage from Sone canals, the ground water level in nearby areas close to canals are very shallow throughout the year. This feature is very small in aerial extent. The chemical quality of ground water is suitable for all the uses. The utilization of ground water is low and stage of ground water development is 30%.

2.11.2 Sahebganj and parts of Pakur districts, Jharkhand.:-The ground water management study has been carried out in an area of 3050 km^2 in Sahebganj and parts of Pakur districts, Jharkhand. Geologically the study area is underlain by Quaternary Alluvium, Laterites, Gondwana Super Group, and Rajmahal Trap. Depth to water level in alluvial area, varies from 3.5 to 7.6 m bgl during pre-monsoon and 1.2 to 5.0 m bgl during post-monsoon. In Gondwana Super Group the depth to ground water level has been found to vary, in pre- monsoon period, from 6.97 to 7.38 m bgl and in post-monsoon period, from 3.08 m bgl to 3.52m bgl. In Rajmahal Trap. It varies from 3.06 to 14.86 m bgl in pre-monsoon period, and from 0.3 to 7.67 mbgl in post-monsoon period. The ground water level fluctuation, in alluvial formation and Gondwana formation is within 4.0 m, whereas, the ground water level fluctuation has been observed to be varying between 1.14 m and 7.26 m in Rajmahal Trap.

An attempt has been made to carry out ground water balance study by inventorying an additional 12 dug wells in Pakuria block. The depth to ground water level has been found to vary between 2.8 to 7.6 m bgl in the month of Feb.'07. Thirty two ground water samples have been collected for chemical analysis from this block. In order to study the impact of urbanization, hydrogeological study has been carried out in the urban area of Pakur district headquarters. A total 48 ground water samples have been collected from both dug wells and bore wells to assess the ground water quality. The depth to ground water level has been found to vary in between 2.47 to 10.1 m bgl in the month March'07.

2.12 EASTERN REGION (West Bengal & Sikkim)

Ground water management studies were undertaken in 15000 Sq. Km. area in parts of Murshidabad, Medinipur, Nadia & N 24 Parganas districts

2.12.1 Murshidabad district:- Groundwater Development and Management Studies was carried out in parts of Murshidabad (N & T) districts to study the impact of large scale ground water development on ground water regime with special reference to the 'Semi-critical' blocks, the extension of the deeper potable aquifers in

arsenic infested areas & to study the feasibility of rainwater harvesting for artificial recharge to ground water as well as for large scale conservation. An area of 3000 sq. km. Including 900 sq. km in detailed study area falling mainly in parts of Murshidabad district was covered.

2.12.1.1 Findings:

i. In the area occupied by older Alluvium west of Bhagirathi river groundwater occur under both confined and unconfined condition and in the eastern part of the Bhagirathi, groundwater generally occur under water table condition.

ii. The hydrogeological formation of the area consists of Older alluvium in western part of Bhagirathi river and Recent alluvium in the eastern part. Depth to water level, during pre-monsoon period in Older alluvium ranges from 3.7 to 10.86 mbgl and during post-monsoon period 0.56 to 7.65 mbgl. Fluctuation of water level, in general, varies from 1.4 to 7.44 m. In the tube wells, depth to water level, during pre-monsoon period varies from 4.66 to16.57 mbgl & during post-monsoon period it varies from 2.0 to 12.30 mbgl & fluctuation of water level, in general, varies from 1.4 to 5.63 m.

iii. Depth to water level, during pre-monsoon period in the dug wells in Recent alluvium ranges from 1.13 to 7.88 mbgl and during post-monsoon period 1.1 to 6.60 mbgl. Fluctuation of water level, in general, varies from 0.87 to 5.51 m. In the tube wells, depth to water level, during pre-monsoon period varies from 3.57 to 8.77 mbgl & during post-monsoon period it varies from 0.35 to 7.20 mbgl & fluctuation of water level, in general, varies from 0.87 to 5.51 m. It has been observed in course of investigation that in the western part of the Bhagirathi the potential granular zones occur between 30 to 90 mbgl.and the deep tubewells are capable of yielding 100m3/ hr. and in the eastern part the deep tubewells are capable of yielding 150 m3/ hr. and the shallow tubewells are capable of yielding 30 m^3/ hr and the drawdown is mostly limited to 4 m.

2.12.1.2 Detailed Study Area

An area of 903 sq. km was covered where special study in Baharampur, Mur – Jiaganj, Raninagar–I, and Domkal blocks were carried out. Water samples from the existing irrigation tube wells tapping the granular zones in between 60-100 mbgl were tested for arsenic and the result shows that 50% ground water structures in Mur – Jiaganj block, 58% in Baharampur, 50% in Domkal and 56% in Raninagar – I blocks show less than 0.05 mg/l arsenic concentration. The feasibility study for artificial recharge was also taken through examination of lithologs & water level of existing ground water structures.

2.12.2 Medinipur district: Groundwater Development and Management Studies in Parts of Purba (N) & Paschim (N & T) Medinipur to study the ground water potentiality of Lateritic & Older Alluvium & effect of industrial effluence on ground water around Kharagpur area & feasibility study for rainwater harvesting.An area of 3000 sq. km, including 700 sq. km in detailed study area falling mainly in parts of Purba (N) & Paschim (N & T) Medinipur district was covered.

2.12.2.1 Findings:

i. The study area partly covered by the platform, sedimentary, laterite in the upland area & by the Recent sedimentary in the plain land area. It was

observed that the leteritic upland area & the marginal area underlain by older alluvium are less potential. In the northern part of the Medinipur block & Patrapur- Salua, Kalaikunda Area during the lean period most of the dug wells in lateritic area get dry.

ii. Free flowing zones were noticed in the north of Kasai River along Gurguripal-Dherua section. These wells are essentially tapping the Tertiary aquifers between 60-120 meter below ground level, yielding 1-2 lps. A palaeochannel course, north of Borgai village in Kharagpur I block was noticed in the form of oxbow lake/ cut-off channels. Across the oxbow lake there was a marked difference in potentiality of the aquifers. Barkhola village, at north of the lake, rests over the palaeochannel.

Detailed Study Area: Detailed study area of about 700 sq.km. in parts of Medinipur Sadar and Kharagpur I blocks had been carried out in in Paschim Medinipur district. Due to leaching of industrial effluents in the dug wells in Dhuliapata area in the vicinity of Supergas industry, ground water in the shallow aquifer results a pungent smell & high EC (800 μs/cm), in comparison of a tubewell of 40 m deep where water is clear with EC 80 μs/cm.The disposition of the autoflow wells at Boilasole, illaboni, Chaiphur etc. are parallel to the trend of the minor lineaments in the area.

2.12.3 Murshidabad, Nadia & N-24 Pargana: Groundwater Development and Management Studies in Parts of, Murshidabad, Nadia & N 24 Parganas district bordering Bangladesh to assess the water balance & ground water flow pattern the status of spatial distribution of As concentration in ground water & also change in concentration with time and to study the effect of withdrawal of water from deeper aquifers through unscientifically constructed tube wells

An area of 3000 sq. km including 638 sq. km in detailed study area falling mainly in the blocks of Raninagar II, Jalangi in Murshidabad diatrict, Karimpur I & II, Tehatta I, Chapra, Krishnaganj, Hanskhali, Ranaghat II, Nadia district & Bagdah, Bangaon, Gaighata, Swarupnagar, Baduria, Basirhat I, Part of Deganga in North 24 Parganas district.

2.12.3.1 Findings:

A positive correlation has been observed between the high concentration of arsenic in ground water and some shallow aquifers which are actually parts of palaeo-channels, cut of meander etc. Presence of high arsenic in such geomorphic features may be scientifically explained by the concept of fluvial deposit containing arsenic due to lowering of river flow rate or stagnancy & consequence release of arsenic in reducing condition prevailing in the marshy land.

2.12.3.2 Detailed Study Area: Detailed study area of about 638 sq.km. in Baduria, Gaighata, Swarupnagar and parts of Deganga blocks had been carried out in the Padma – Jamuna - Ichamati interfluves area.

2.12.3.3 Recommendations

i. In Karimpur II block, Nadia district ground water in the tubewells tapping the granular zones in the depth span of 12-140 mbgl is affected by high arsenic concentration. Arsenic free deeper aquifer below 140 mbgl is yet to be explored. Hence surface water source for drinking purpose may be utilized.

ii. In Baduria block where ground water within 15-150 mbgl is arsenic affected in N 24 Parganas district Sate owned tubewells of 300 m depth are used for drinking water but they are very less in numbers in comparison to the dense population of the area. Hence deep tube wells or surface water source may be used to cater the demand.

2.12.4 Purba Medinipur district:- Groundwater Development and Management Studies in parts of Purba Medinipur district (3000 sqkm in 22 blocks) was undertaken to study the extension of saline aquifers & effect of high tidal waves on phreatic aquifers & to study the impact of large scale ground water development on ground water regime including saline water ingression.

2.12.4.1 Findings

Water level in sand dunes varies from 7 to 10 mbgl during pre monsoon period and 4-7 mbgl in post monsoon period., below the dune sand clay bed occur down the depth of 70 mbgl .Alteration of sand and clay bed occur down to a depth of 450 mbgl. Generally brakish water found in all the aquifers below sand dunes up to the depth of 450 mbgl over a small area around Contai . Fresh water aquifer occur within 120 to 300 mbgl towards SE of contai in Mukund pur , Baijapur Sophiabad.

2.12.4.2 Recommendations

i. Fresh water is absent in some places in the detailed study area of Contai I, II & III blocks where the tubewell is not feasible due to high salinity content
ii. Desiltation of existing ponds in Contai area is suggested
iii. Excavation of new ponds in the waste land area
iv. Haldia Industrial Complex in Purba Medinipur district has been notified, consequently indiscriminate withdrawal of ground water has been restricted. Haldia Development Authority has arranged to supply the surface water to meet the water demand. Hence, roof top rain water harvesting structures should be adopted for conservation of rain water in industrial sector for non-drinking purposes.

2.12.5 Andaman District & Nicobar islands(Andaman & Nicobar Islands) : Groundwater Development and Management Studies in Andaman District & Nicobar Islands were undertaken to assess the impact of Tsunami & earth quake on hydrogeological set up, qualitative & quantitative assessment of ground water resources & to evolve development & management strategy in post Tsunami. An area of 3000 sq.km. in South & Middle Andaman (about 1000 sq.km.), Little Andaman (700 sq.km.) and Car Nicobar, Teressa, Kamorta, Nancowrie, Katchal & Great Nicobar islands in Nicobar islands (1300 sq.km.) were covered under the programme of Ground Water Management Studies

2.12.5.1 Findings

South & Middle Andaman: Area under study was from Nimbudera in Baratang island under Port Blair Sub-division to Nimbutala in Middle Andaman islands under Rangat Sub-division. The area is underlain by finer clastic sedimentaries of Mithakhari group along with volcanic and ultramafic intrusions. In general, the formation is having poor yielding capacity and dug well of 5-6 m deep is the only abstraction structures yielding to the tune of 5000-6000 lpd. Yield of the well is relatively high in intermontane valley fills. Transmissivity of the aquifer ranges upto a maximum of 132 m^2/day. Ground water in the area,

in general, is potable. At places, like Baludera in Baratang island, Saberi & Dasarathpur near Rangat, the dug wells and pond water became saline after Tsunami due to saline water ingress. However, quality of water has been subsequently improved due to rainfall and construction of saline reclamation bund. The water level in the entire tract varies from 1.17 to 3.21 mbgl during pre-monsoon and 0.74 to 2.99 mbgl during post-monsoon. A number of spring sources have been studied, which are mainly perennial in nature and are highly potential. The discharges of the springs are as high as 60 lps in ultramafics at Panch wati in Middle Island and 12 lps in sandstone at Adazig in Baratang island. The quality of spring water is very good. The springs water is used for pipe water supply in the islands.

Little Andaman island (including Dugong Creek area): The island is underlain by organic limestone. Several high discharging springs were available in the islands. After Tsunami, the spring sources were affected and discharges were significantly reduced. At the same time some new springs are also generated. However, after two years there has been slight improvement in the discharges of the major springs. In the coastal area of the island, the wells and ponds in the low-lying areas became contaminated with saline water of the sea. After the prolonged rainfall, the salinity condition has been improved and has been observed to the tune of 530-11840 µs/cm. At some places, due to earthquake, water levels were declined to a great extent. Depth to water level in the island varies from 2.97-23.16 mbgl during pre-monsoon and 5.60-18.0 mbgl during post-monsoon.

Nicobar district: The area under study is underlain by coralline limestone. Some of the area is highly undulating, while the coastal areas are gently sloping and flat. The entire coastal areas were devasted during earthquake and the tidal waves had inundated and contaminated ground water as well as the surface water. During the survey, it is observed that the salinity has been reduced, but there is a continuity of salinity/ brackishness in many parts of the coastal area due to sub-surface salinity ingress. Depth to water level in various islands varies from 3.39-9.50 mbgl during pre-monsoon period and 2.10-6.90 mbgl during post-monsoon period. The salinity in the coastal tract ranges from 630->20000 µs/cm.

2.12.5.3 Recommendations

i) Large diameter open wells, where feasible, may be constructed for water supply. Depth of the dug well should not be deepened haphazardly, which may facilitate sea water ingression landward particularly in coastal tract.

ii) Drainage cum regulatory channels are imminent at suitable sites across the tidal creeks, which may improve the quality of ground water apart from checking salinity ingress.

iii) Area specific artificial recharge structures like percolation tank, check dam, sub-surface dyke etc., requires to be constructed to augment and to restore the quality of ground water.

iv) A number of unexploited potential springs are encountered in the area of study.

These are to be harnessed in necessity.

2.13 NORTH EASTERN REGION (Assam, Arunachal Pradesh, Meghalaya , Mizoram & Tripura)

Under Ground Water Management Studies an area of 18000 sq km was covered in districts of Darrang(Assam),Aizwal(Mizoram), Wokha & Mokakchang(Nagaland), Papumpare &Lower Subansiri(Arunachal Pradesh), Ri-Bhoi & West Khasi Hills(Megahlaya), Dhalai & West Tripura(Tripura).

2.13.1 Darrang District, Assam: An area of 3481 sq km was covered under Ground Water Management Studies in Darrang district of Assam. The study area is mainly covered by unconsolidated sediments of quaternary age and an area of about 5 sq.km by hard rock in the form of inselberg, comprising of granite and gniess. During the study, 40 dug wells, and 25 shallow tube wells were monitored. Ground water occurs under water table condition in shallow aquifer and under semi- confined to confine condition in deeper aquifer. The depth to water level rests between 2 to 6 m in major parts of the study area. Deeper water level is recorded in the extreme northern part of the area covering under Bhabar Zone.

The exploratory tube wells constructed by C.G.W.B. shows the existance of promising aquifers down to the depth of 300m bgl. The piezometric level varies from 0.98 to 7.65 m bgl. The discharge varies from 50 to 250 m^3/hr.

Present ground water development is at low key. There is no change in ground water scenario of the district over last 10 years, which may be due to poor draft, high rainfall and presence of potential aquifer.

2.13.2 Wakha & Mokokchung district (Nagaland) : An area of 3481 sq.km was covered under Ground Water Management Studies in Wokha & Mokokchung districts of Nagaland. The study area is occupied by high denudational and structural hills with rugged topography and narrow linear valleys. The general trend of the hills are NE-SW direction with moderate to steep slope. The drainage of the area under investigation is mainly controlled by two prominent rivers i.e Dayung/Tapu flowing NE-SW and Dikhu, which follows N-S direction.

The study area is underlain by formations ranging from Cretaceous to Recent and represents northern extension of Arakan Yoma range of Myanmar and is characterized by rugged topography. Surface water and springs are the only source to meet the water requirement. The semi - consolidated formation mainly comprises clay, shale, siltstone, ferruginous compact sandstone and pebble/boulder bed. The rocks show increasing degree of compaction from the younger to the older age. The area is highly disturbed due to tectonic activities. The rocks are highly fractured and jointed. The area occupied by semi consolidated formations shows predominently run off character and ground water occurrence is attributed to development of secondary porosity like presence of joints and cracks.

2.13.3 Papumpare and parts of Lower Subansiri district (Arunachal Pradesh): An area of 3000 sq km was covered under Ground Water Management Studies in Papumpare and parts of lower Subansiri districts. The area is underlain mostly by Siwalik group of rocks, Quaternary alluvium and terrace deposits. The drainage pattern of the area is dendritic to sub parallel. During the course of study depth to water level from 41 key wells and discharges from 27 springs were monitored.

Hydrogeologically, the area can be divided into three distinct categories viz;

Consolidated formation: Northern parts of Papumpare district is occupied by consolidated formation of Precambrian to Upper Paleozoic ages. The rocks of the unit are intensely folded, fractured and jointed. The movement and storage of ground water is restricted to the limited areas.

Semi consolidated formation: The southern and central foothill zones are covered by sedimentary rocks and are generally semi- consolidated in nature. The depth to water level in this unit is shallow and mostly in the range of 1-5 m bgl as observed in the dug wells. Large diametre dug wells of 5-8 m depth may yield around 15m^3/day.

Unconsolidated formation: It comprises alluvial sediments of the foothill belt (Bhabar) and the intermontane valleys. In general, the alluvial cover in this valley, surrounded by consolidated to semi consolidated rocks, is thin. Ground water prospect in Dikrong river valley and foothills areas are as follows:

Dikrong river valley: The depth to water level in general varies from 2-4 m bgl during pre-monsoon and 2-5 m bgl during post- monsoon periods. Seasonal fluctuation of water level in shallow aquifers as observed in dug wells is within 2 metre. Yield test suggests the feasibility of 6-7 m depth dug wells in the valley yielding 42-63 m^3/day. Tube wells constructed by C.G.W.B in this valley down to a depth of 70 mbgl have yielded 15-35 m^3/ hr for a drawdown of 6-18m

Foot hill zones: This zone has Brahmaputra alluvial plain in the South and the Siwalik hills of Arunachal Pradesh in the North. It comprises of sand and gravel of alluvium formation overlain by recent alluvial deposits.

2.13.4 Ribhoi District and Mairang block, West Khasi Hills(Meghalaya): The study area covers Ribhoi district and Mairang block of West Khasi hill in Meghalaya covering an area of 3654 Sq. km. Geomorphologically, the area under study consists of hilly terrain. The drainage system is controlled by topography. The soil type of the area are classified into three gropes viz; Red loamy, laterite and alluvial soils. Geologically, the area under study consists of Archaean-Proterozoic Gniess complex intruded by acid and basic intrusive and Shillong group of rocks. During the course of study 25 dug wells, 48 springs and 12 bore wells were monitored. In the pre monsoon period it is observed that 36% of the wells shows water level of the range of 0-1 m bgl whereas during post monsoon 40% wells falls within the depth range of 1m bgl Springs plays a vital rule for providing water for the people.

Moirang watershed, which covers an area of 152 Sq. km was studied in detail. It is observed that in shallow aquifer 61% of the wells shows water level from the range of 0-1 m in the month of February against 50% in March. It is also noticed that discharge of springs decreased marginally in the month of March. The depth of water level in the deep tubewells in Mawrong village was 5.46 mbgl during pre monsoon and 4.55 m bgl during post monsoon respectively.

2.13.5 West Tripura District (Tripura) : An area of 3000 Sq. km was covered under Ground Water Management Studies in West Tripura District. Recent alluvium occurs along the course of streams and the flood plains of major rivers. Physiographically, the area can be divided into two parts: 1) Anticlinal Hill ranges and 2) Synclinal Flat bottomed valleys. The drainage pattern in the study area is sub parallel to parallel and dendritic. Pre monsoon depth to water level (phreatic aquifers) varies from 1.34 to 10.83 m bgl and the piezometric head varies

from 1 to 14.70 m bgl. Where as during post monsoon depth to water level (phreatic aquifers) varies from 1.07 to 7.43 m bgl and piezometric head varies from 0.50 to 12.10 m bgl. Artesian zones have been demarcated in Khowai, Kalyanpur,Jironia, Bishalgarh, Dukil, Mohanpur, Melaghar and Baxanagar blocks. The discharge of the wells varies upto 1lps and piezometric head varies upto 1.24 m agl.

2.13.6 Aizwal District(Mizoram) : An area of 3000 sq km was covered under Ground Water Development & Management Studies in Aizwal district, Mizoram. The area under study constitutes a mountainous terrain with rugged topography represented by high longitudinal, parrallel to sub parralel, trending N-S hills with moderate to steep slopes and narrow valleys. The study area experiences tropical humid climate with cool summer and cold winters. The geology of the study area is the repetition of succession of argillaceous and arenaceous sediments. The drainage system of the area is controlled by lineaments. The tectonic lineaments play an important role in creating seepage conduits along cracks/fracture zones, which are the sources of springs. A few open wells were observed around Aizwal town and surrounding area during field investigation. A 10 m dug well, constructed 9m deep at Chitelui near Aizwal gave a discharge of 120 m^3/day. In the north western part i.e. around Kanhmun and Borai village in Lakhicherra block open wells tapping Tipam Sandstone have depth to water level between 2.1 to 6.30 m bgl. and the depth ranges from 4 to 7.5 m bgl.

In the major part of the study area, the ground water manifests in the form of springs. The existing water supply for drinking purposes is mainly from these springs tapped through gravity drainage A total of 30 springs were monitored and water samples were collected for chemical analysis. All the springs are fractured and joints oriented and their flow depends upon local relief, depth to weathered mantle etc.

For drinking water supply springs and rain water harvesting would remain the main sources in the hilly areas.Dug wells, bored wells and tube wells can be constructed to meet the domestic water requirement in the valley.

2.14 SOUTH EASTERN REGION (Orissa State)

Under Ground Water Management Studies an area of 13,292 sqkm was covered in districts of Bhadrak & parts of Balasore, Puri & Sundargarh.

2.14.1 Bhadrak & Parts Of Balasore District : The study area covers around 3000 sq. km. and is thickly populated with agriculture being the main profession. The area is characterized by a flat topography with a gentle eastward slope. The maximum elevation varies from 52 mamsl in the western part at Kupari to 3 – 4 mamsl in the vast patch of coastal tract on the eastern and southern part.

The irrigated from Salandi irrigation canals of the Hadagarh project, and Akhuapada Barrage on Baitarani river. Part of the coastal blocks like Dhamnagar, Chandbali and Basudevpur are irrigated from the Creek Irrigation projects through which fresh river water is collected during high tides in small creeks by means of sluices and is being used for agricultural purpose.

The study area is a part of the Mahanadi Delta, formed by the alluvium brought by the rivers and deposited in a marine environment. The sediments deposited in a

wedge shaped basin. The sand and gravel of the terrestrial phase serves as good aquifer system in the area.

Fresh ground water occurs under phreatic condition in most part of the study area except for the eastern part of the Mandari – Padmapur – Tihidi – Dhusuri sector, where it is saline. This zone is commonly tapped by the shallow dug wells. In the western part, the older alluvium are generally lateritized at the top and the depth to water level is deeper than that in the eastern part. However, presence of good granular zones within 25-50 metres of depth facilitated to the construction of innumerable number of shallow tube wells, which have been used extensively for summer paddy cultivation. The quality of the phreatic and the shallow confined and semi-confined aquifers is very good with the EC ranging from 160 – 800 μS/cm at 25°C. The EC increases from west to east and with the increase in the depth of the tube well.

In most part of the Chandbali and Tihidi blocks and the eastern part of Basudevpur block, fresh water is overlain by saline ground water at variable depths. Freshwater aquifer occurs below a depth of around 90 m at Dhusuri, Sathibati and Arua on the western margin of the saline zone, while at Bijaynagar and Panchatukuri near to the coast, fresh ground water is only available below 280 m. The quality of the ground water is good to moderate with EC varying from 600 – 1100 μS/cm at 25°C with a general increase in EC towards the coast. This deeper aquifer is the only source of water in this area and is commonly used for drinking water purpose. However, a few deep tube wells constructed by Orissa Lift Irrigation Corporation with proper cement sealing are used satisfactorily for irrigation purpose.

The aquifer generally gets replenished by good monsoonal recharge. The depth to water level in the pre-monsoon occurs within 3 – 4 m below ground level in most parts of the study area. The additional recharge due to canal irrigation also supports the heavy withdrawal of ground water for paddy cultivation during the summer months. However, in the northern part of the Basudevpur block, the water level has gone down below mean sea level during summer with deterioration of the ground water quality. In some parts of the saline belt (around Dhusuri – Kothar area) the piezometric surface of the confined aquifer is below msl. Even then the quality of the aquifer is good with no appreciable impact of heavy ground water withdrawal from this aquifer for irrigation purpose. However constant monitoring of ground water is essential in these area for safe and optimal utilization and in areas affected with appreciable deterioration of ground water quality, alternate source through surface water may be created

2.14.2 Puri District : The study area covers a total geographical area of 3,479 sq. km and includes 11 blocks namely - Krushnaprasad, Brahmagiri, Puri, Kakatpur, Astaranga, Pipli, Nimapara, Delang, Kanas, Satyabadi, Sadar and Gop.

Physiographically the district can be divided into three natural divisions : littoral tract or coastal sand dunes, alluvial or deltaic plains and undulating hard rock areas with lateritic cappingsand isolated hillocks. The coastal sand dunes occur as a linear strip, running parallel to the shore line, which maintain higher altitude than the immediate interior part. The width of this tract varies from few hundred metres to 7 kms. Swamps and tidal flats are also common in this tract.

The deltaic plains may be divided into three parts: lower, middle and upper. The lower deltaic plains occur adjacent to the coast , having a width of 5 to 10 km. Extensive flood plains, meandering stream curves, swamps, minor ridges etc. characterize this geomorphic unit. The Sar and Samang lake near Puri were important features in this terrain which have been silted up at present. The middle deltaic plains have characteristic parallel to sub parallel drainage pattern and splitting distributaries. The upper deltaic plains occur along the course of the Daya river with an width of 2 to 3 km. The alluvial plain is characteristically flat. The altitude of the deltaic plain varies from 1 to 10m. above mean sea level.

Puri district falls in the Mahanadi river basin and the main drainage is formed by the rivers Daya, Devi, Kushabhadra, Bhargabi, and Prachi .Another important water body is Chilika, which is a lagoon separated long back from Bay of Bengal.

The Tertiary and Quaternary formations occurs over major parts of the district while the Archeans occupy the hilly areas under higher altitudes in the west. The younger alluvium, which covers nearly 90% of the area, occurs as flood plain deposits along the course of major rivers and streams. Discontinuous ridges of sand dunes occur along the coast and are formed due to wind action.

Phreatic aquifer *:* The sand and gravel layers form the main repository of ground water in this area. The groundwater in near surface shallow aquifers occurs under phreatic conditions, even down to a depth of even 135 mbgl. The deeper aquifers occur under semi-confined to confined conditions. The aquifers are extensive, interconnected and have prolific yield potentials(upto 65 lps). The thickness of individual aquifers varies from 6 to 7m, while the cumulative thickness of aquifer materials down to a depth of 250m. varies from 10 to 79m.

Deeper depth to water level is recorded both in Pre and Post – monsoon in the sand dunes and is the only source of fresh water adjacent to coast where there is salinity hazard. Electrical conductivity varies from 245 to 960 μs/cm. Ground water is fresh in the sand dunes and the sandy alluvium.

Deeper aquifer : Depth to water level varies from 1.58 to 5.92 mbgl and electrical conductivity varies from 196 to 6110 μs/cm. In Brhamagiri- Kanas- Krishnaprasad block autoflow wells are present which is saline in nature and electrical conductivity is of the order of 3000μs/cm and temperature is $35\ ^{0}$C near Brahmagiri.

Over exploitation of Shallow aquifers in Puri Town *:* In Puri town area the unconfined aquifer upto 39 mbgl comprising of sand is fresh in nature and this zone is exploited for different purposes. The shallow aquifer extends from Balidokan in North of Konark upto Giral south of Puri town on Brahmagiri road. So there is depletion of ground water level in Puri town due to overexploitation. As there is no confining layer there are chances of contamination of the shallow aquifer from municipal waste and sewerage etc.

Occurrence of high Iron and fluoride : Except the Pipli block high Iron occurs throughout the district in both shallow and deeper aquifer. In tubewells the Fe value reaches as high as 6mg/l but the average value is between 2-4 mg /l. In dugwells the Fe concentration reaches as high as 8.63 mg/l.High fluoride above 1.5 mg/l(maximum value 4.55mg/l) is reported from different places such as Budhiabar,

Rebana Nuagaon, Gop, Marad, Pratapramchandrapur, Moradpada, Algum, Nuasamsarpur etc.

Salinity hazard in different blocks : In Brahmagiri–Kanas-Delanga-Krishnaprasad blocks adjacent to Chilika lake both shallow and deeper aquifer suffer from salinity problem.

Occurrence of hot water autoflow wells : In Krushnarasad, Brahmagiri block the deeper aquifer from 130 -210 is autoflow in nature. The temperature varies from 30 to 35.5 ^{0}C.

Delineation Of Freshwater Water Zones In Krushnaprasad Block Adjoining Chilika Lake in Puri District, Orissa.

Krushnaprasad block having an area of 328.73 sq. km. is surrounded by Chilika lake. It is bordered by Bay of Bengal on the east. A number of islands are present in Krushnaprasad block. As the block is surrounded by sea and Chilika Lake salinity hazard is very common. For this reason the Krushnaprasad block was taken for special study to delineate the fresh water zones.

Hydrogeology

The ground water is fresh in sand dunes, paleo – beach ridge river alluvium etc. In the mud flat the ground water is saline in nature. The sand dunes upto a depth of 20m. form very good fresh water aquifer.In northeastern part of the block the deeper aquifer is autoflow in nature and yields brackish water. The depth to water level in phreatic aquifer varies from 2.7-4.19mbgl.The depth two water level in shallow tube wells varies from 3 to 5 mbgl. The electrical conductivity of fresh water aquifer varies from 413-980 μs/cm and pH varies from 6.1 to 8.3. Mahasa – Berhampur is the only inhabited island in the Krushnaprasad block. The dug wells in the island are fresh to brackish. Where there is sand zone the shallow tube wells form very good aquifer. In the southern part near Bajrakot sand dunes are well developed. There water is supplied to the adjacent villages from 4 shallow borewells having depth of less than 20m. High iron is reported throughout different areas of the block.

2.14.3 Sundargarh District : Ground Water Management Studies in Sundargarh district was taken up in two parts– the western part and the eastern part..

Western part of the district: The western part of the district covering an area of 3142 sq. km. spans through the blocks of Sundargarh, Tangarpalli, Hemgiri, Lephripada, Subdega and Balisankara. It falls under Ib sub-basin of Mahanadi Basin. The normal / average annual rainfall is 1750 mm, most of which is received from the south-west monsoon. The average elevation is around 300 mamsl and the general slope is towards south. Ib river and its tributaries form the major drainage system in the area. Drainage pattern is mainly dendritic. Rocks belonging to the Gangpur Series(Phyllites / Schists etc.), Sundargarh Granite and Kamthi (Hemgir) Sandstone and shales etc. covers the study area.

80 observation wells were established in the study area, excluding the NHS wells. The depth of these dug wells ranges from 2.9 to 14.2 metres below ground level with the average being around 7 – 8 metres below ground level. The pre-monsoon

Rainwater harvesting schemes implemented by Private institutions (Ahliya Hospital) in Palghat district(during RHS – Palghat)

Degenerated Pond within a Island inside Chilka

depth to water level varies from 2.1 to 13.4 metres below ground level, the most common being in the depth range of 4 -7 metres below ground level. The post-monsoon depth to water level varies from 0.9 to 12.4 metres below ground level with the majority being in the depth range of 3 – 6 metres below ground level. 25% of the wells show depth to water level of more than 6 metres below ground level and 20% of the wells shows depth to water level of less than 3 metres below ground level.The seasonal fluctuation of water level varies from 0.1 to 3.75 m with the majority being in the range of 0.5 – 2.5m. 33 representative water samples were collected from the dug wells for detailed chemical analysis.

A small basin(Saraswati Nala water shed area) in Tangarpalli block was taken up for special studies – for studying the specific yield of the micro basin and assessment and management of ground water resources in the lean period and possible recommendation for improvement of the micro basin from ground water conservation and optimal utilization point of view.

Eastern part of the district: In the eastern part of the district, ground water management study was taken up covering a geographical area of 3628 sq. km. and spanning across 7 blocks of bargain, Kutra, Kuarmunda, Rajgangpur, Nuagaon, Bisra, Lathikata. The topography is highly rugged and dissected by a number of streams. The general elevation varied from 228 to 762 m amsl with the general slope being southerly. The 5 – 15 Km wide esst-west trending valley of the easterly flowing Sankh river and the westerly flowing Koel rivers forms the main drainage system of the area. The study area is characterized by a long stretch of table land dotted with isolated hills of considerable height. The south west monsoon is the principal source of rainfall with the annual average being around 1228.4 mm.

Ground water is stored mainly in the secondary porosities resulting from weathering and fracturing of rocks. The pre-monsoon water level varies from 2.5 – 8 metres below ground level with an average of around 5.2 metres below ground level. However at places deeper water levels of more than 10 metres below ground level are encountered (Lakhmiposh, Kutra Block : 13.38 metres below ground level; Bishalbari, Bargaon block: 10.22 metres below ground level). The post – monsoon depth to water level varies from 1 – 4 metres below ground level with an average of around 3 metres below ground level. Deeper water levels are encountered at Bisra(8.94 metres below ground level) and Lakhiposh(11.65 metres below ground level).

Water quality is generally excellent having electrical conductivity ranging between 150–300 μS/cm at 25°C. Higher electrical conductivity is observed at Lakhmiposh(806 μS/cm), Baghiajor(800 μS/cm) and Deogaon(1220 μS/cm). Ground water is generally alkaline in nature having pH ranging between 6.7 – 7.2.

Rourkela being the steel city, special study was initiated to assess the ground water scenario. The area mostly comprises of schists, phyllites, which at places is lateritised. The depth to water level is moderately deep(2.5 – 5.5 metres below ground level) with the exception at jharpani where the water level is 11.51 metres below ground level. Ground water quality is excellent to very good having electrical conductivity ranging from 250 – 450 μS/cm. However the dependence on ground water is less because the urban water supply is mainly met from the Koel and

Brahmani river. The ground water is exploited from few dug wells and shallow hand pumps. Since the area is geologically disturbed and is infested by dykes, there is very good scope for future ground water development.

2.15 SOUTHERN REGION (Andhra Pradesh)

Total 13415 sq. km. area was covered in parts of Kadapa, and Anantpur, Viziangram & West Godavari districts of Andhra Pradesh during 2006-07. Districtwise summary follows:

2.15.1 Kadapa District: Ground Water Management studies were taken up in Western part of Kadapa district covering an area of 1600 sq.km, including mandals of Vempalli, Vemula, Lingala, Pulivendula, Simhadripuram, Tonduru, V.N. Palli. The area is mostly undulating with the general slope towards east. The area is drained by Mogameru which is the tributary of Papaghni river. The principal crops grown in the area are groundnut, sunflower, citrus, banana etc. The annual average annual rainfall of the area is 600 mm . During the last five years the rainfall was less than normal. The area is underlain by Tadipatri Shales (75%) , Pulivendala Quartzites (5%) and Vempalli Limestones and Dolomites (20%) belonging to Kadapa SuperGroup.

In all, 182 irrigation wells and 55 domestic dug wells were inventoried during the survey and key wells are monitored during pre and post monsoon period. The thickness of weathering ranges from 5 to 30 m. The depth of dug well ranges from 6 to 20 mbgl where as depth of bore wells ranges from 30 to 300 mbgl. However depth of borewells as deep as 250 m in Shales and 350m. in Limestone areas are observed. The depth to water level in bore wells is 6 to 20 mbgl however in some localities particularly in limestone areas the depth to water levels are as deep as 94 mbgl. The yields of bore wells vary from 1 to 6 lps. In all, 80 water samples were collected. Generally, the quality of the water is good.

The survey indicated that depth of weathering is as deep as 30 m in shales, limestones and upto 10 m in quartzite areas. Dug wells are generally drying up in all the formations. Negative fluctuations were observed ranging from –0.24 to 6.7 m in South Western part of the study area covering Lingala, Pulivendula, Vemula Mandals due to the heavy withdrawal of ground water for banana and citrus crops from the limestone aquifer.

2.15.2 Anantapur District: An area of 4,900 sq.km was covered under ground water management studies in 19 mandals (Gudibanda, Amarapuram, Rolla,Aagali, Madakasira, Parigi, Hindupur, C.K. Palli, Penukonda, Sonadipally, Bukkapatnam, Kothacheruvu, Puttaparthi, Vodicheruvu, Nallamada and Gorantla) in southern part of Anantapur district falling in Chitravathi sub-basin.

The area is highly undulating. The soils are clay loamy to sandy loamy type. The principle crops in the area are groundnut, sunflower. The area is underlain by granites and gneisses of Peninsular Gneissic Complex of Archaean age.

In all 288 wells were inventoried during the survey and the key wells were monitored during pre and post monsoon periods. The depth of weathering ranges from 5 to 15 mbgl. Generally the ground water is being developed through dug wells and bore

well ranging in depth from 8 to 15 m and 40 to 180 m.bgl respectively. The yield of dug wells range from 12 to 18 cu.m/hr where as bore well yields ranges from 2 to 6 lps. The wells are capable of irrigating I.D. crops to an extent of 1 to 2 ha. In about 10% of the surveyed area micro irrigation methods are being practiced. In all 130 ground water samples were collected and the general quality is good for irrigation and drinking purposes.

The survey indicated that depth of weathering is up to 15 mbgl and the bore wells are being drilled to a depth of 180 mbgl and the depths to water levels are ranging from 8 to 20 mbgl. The deepest water levels were observed in Madakasira and Rolla Mandals where the ground water management and artificial recharge is necessary.

2.15.3 Vizianagaram District: An area of 3200 sq.km was covered under ground water management studies in Vizianagram district covering the mandals of Pachipenta, Rajam, Merakanupalem, Mantada, Gajapathinagaram, Garividi, Chipurupalli, Bondapalli, Burla, Mellimetla, Gantyada, S. Kota, Jhami, Vizianagaram, Denkada, Pusapatirega, Bhogapuram, L.Kota, Repana, Kothavalasa.

The area is mostly underlain by Archaean group of rocks consisting Migmatites, Charnockites, Khondalites (89%) and Gondwana Sandstones consisting of Rajahmundry Sandstones and Tirupathi Sandstones (4%) and Recent Coastal and River Alluvium in Southern Part of Vizianagaram District.The area is covered in a low ground water development area, which is covered by forest and hills. In all, 84 wells were inventoried and monitored during pre-monsoon and post-monsoon period. 82 water samples were collected to assess the ground water condition and quality of ground water in the area. Generally, the ground water development is through dug wells. The depth of the dug wells ranges from 3.51 to 10.27 m. However, the depth of wells in shallow bore wells ranges in Gondwanas and Alluvial formations from 6.25 5o 7.68 m bgl. Generally, the yield of the wells range from a minimum of 50 to 100 cu.m/day having relatively the yields more in granite gneisses than in Khondalite and Charnockite formations.

The Gondwana formations overlie the Archeans as thin lenses ranging in depth from 5 to 15m. Due to the restricted thickness, ground water potential is limited and is developed through dug wells. Alluvium is restricted to the rivers and along the coast. Ground water is developed through dug wells having depth of 6 to 8 m. However, the coastal alluvium is having thickness of 20 to 30 m bgl and ground water is generally saline.

Since the ground water development is low, there is a plenty of scope for further development. However, in Chipurupalli, Pusapatirega and Bhogapuram mandal being semi-critical mandals care has to be exercised in ground water development.

2.15.4 West Godavari District: Ground Water Development and Management Studies were carried out in West Godavari District, covering an area of 3300 sq.km in mandals of Kovvur, Chagallu, Nidadavolu,Tadepalligudem, Unguturu,Bhimadolu, Nidamanuru, Ganapavaram, Attili, Iragavaram, Peravali, Undi, Akividu, Palakoderu,Penumantra,Podili,Penugonda,Achanta,Kalla,Bhimavaram, Veeravasaram, Elamanchili, Mogaltur, Narsapur.

The area is drained by Godavari River, which also forms the eastern boundary and is covered by black cotton soils and alluvial soils. The principal crops grown in the District is paddy and the other important crops are sugarcane, mango and cashew nuts. Geologically, the area is underlain by Recent Alluvium (98%) except in parts of two mandals viz., Tadepalligudem and Ungutur, where Rajahmundry Sandstones (2%) where it is underlain by Tertiary Formations.

Hydrogeologically, ground water development in alluvium is insignificant except in few mandals, where it is exploited by shallow filter point wells. About 120 wells were inventoried and 104 water samples were collected to know the quality of ground water. The depth range of dug wells varies from 6 to 10 m and in tube wells, 80-100 m, the depth of weathering varies from 2-11m in Territory Formations. The depth to water level ranges from 2.5-3.54 m and the yield ranges from 5.5-9.0 lps in dug wells and 5-12 lps in tube wells. In general, fresh and saline water interface in the area passes East-Westerly direction stretching from Elurupadu to Gummaturu. The thickness of the alluvium ranges from 50 to 60 m in northern part over the Tertiary Formations. Towards Coast, the thickness of alluvium increases. Fresh water occurs to a depth of 20 m in paleo channels below which the ground water is generally saline. Paleo channels exist stretching north to south between Koppam, Sitarampuram and Jettipalem, Penupalem. Ilapakuru, Enuguvaripalem villages. In general, the northern part of the study area is having fresh and potable quality of ground water with EC less than 3000 micro siemens/cm except in Kovvuru, Nidamarru and Ganapavaram mandals whereas in the Southern part of the study area, the quality of ground water is brackish to saline with EC upto 19400 micro siemns/cm.

2.16 SOUTH WESTERN REGION (Karnataka)

During an area of 9093 Sq.Km in parts of three districts of Karnataka (Chamarajanagar, Raichur & Koppal **)** was covered under Ground Water Management Studies.

2.16.1 Kollegal taluk, Chamarajanagar district: An area of 2797 sq.km in Kollegal taluk of Chamarajanagar district was covered under Ground Water Management Studies. Physiographically the taluk is divided into mountainous and flat terrain. Genral elevation of the study area is 656.58 amsl.The area is drained by Cauvery river and its tributaries namely Suvarnavathi, Gundal. Drainage pattern is dendritic and drainage density varies from 1.38 to 3.58km/km^2. The area received an average rainfall of 966mm, and average annual normal rain fall for last forty five years is 818.92mm. Standard deviation is 314.20 and coefficient of variation is 38.36.
Geologically, major portion of the area which is occupied by Charnockites followed by Granitic gneiss and they are intruded by basic and ultra basic intrusives. Sandy alluvial deposits occur as valley fill along the river course. Ground water occurs under phreatic to semi-confined conditions in weathered, fractured, jointed formations of crystallines.

The development of ground water is through dug wells, dug cum bore wells and bore wells. Depth to water table during premonsoon varies from 0.32 to 18.11 mbgl and during post monsoon water level varies from 0.30 to 18.76 mbgl . Water level fluctuation varies from 0.01 to 6.64mbgl. The depth to water level when compared

to previous systematic surveys (1987-88) showed an average rise in water level of 6.24 m and average fall of 2.79 m during pre-monsoon and average rise of 1.98m & average fall of 2.89 m during post monsoon. The long-term water level trend also revealed the rise in water level over the years.

Ground water development in the area is mainly through dug wells and bore wells.The total area irrigated through ground water is 12735 ha.during 2005-06 nad water supply is mainly through ground water. Western part of Kollegal receives benefit from Kabini major irrigation project where as part of eastern and south eastern area is benefited from medium irrigation projects like Guntal & Uduthore Halla projects. Total area benefited through surface water irrigation is 7727 ha. during 2005-06

Chemical analysis of water samples from key observation wells showed higher range of nitrate concentration i.e., 50-136 ppm. It was revealed that excess nitrate may be due to use of fertilisers or it may be due to in proper sewage system causing ground water quality deterioration at some place.

Micro level surveys were carried out in two OE watersheds. As per the studies in watershed 4B3A6 having an area of 23 sq.km covers 6 villages in Kabini command area. Water levels are shallow in the range of 1.63 to 8.86 m, both in BW and DW and the area gets water for irrigation through Kabini distributaries for a period not less than 6 months for paddy& sugarcane, hence it is suggested for re-assessment of Ground water development categorisation. Other watershed No 4B3A3 having an area of 565 sq.km is mainly under forest and hilly terrain. The valley portions are having good density of dug wells. Due to the forest/Hilly terrain Ground water development is negligible and dug wells are not used for irrigation. Hence it is suggested that both the watersheds may be considered for re-assessment of Ground water development categorisation.

2.16.2 Raichur And Manvi Taluks, Raichur district: The Study has been carried out over an area of 3332 sq.km in Raichur and Manvi taluks of Raichur district. Topographically, the study area is moderately plain country having shallow trough and mounds with scattered hills at places. Geologically, Granites and Gneisses are predominately exposed in the area and show moderate weathering. Dolerite dyke at places are predominately exposed and intrude the country rocks.

The normal rainfall for Raichur and Manvi is 688 mm and 640 mm respectively. Majority of the area forms a part of Krishna basin. Major River Krishna flows in easterly direction and forms the northern boundary. Parts of Raichur taluk are irrigated under the Narayanapur right bank canal and Tungabhatra left bank canal .

Ninety key observation wells were established in the area and depth to water level varied between 1.3-13.6 mbgl in pre-monsoon and 0.5-13.9 during post-monsoon. Water samples were also collected for chemical analysis from these wells.

As a part of special study, fluoride contamination in an area of about 750 sq.kms has been taken up. During the surveys, 110 wells were inventoried in the area and the data collected. The Yield of the wells ranges from 10.50 to 21.60 m^3/hr, Duration of pumping ranges from 56 to 120 minutes and draw down ranges from 0.28 to 2.88 m. Falling trend vis- a -vis last surveys in the ground water levels have been

noticed, while it is rising in the command area. Depth to water levels less than 2.0 m have been observed in the command area. The depth to water level ranges from 1.25 m bgl to 13.60 m bgl during pre-monsoon period, while the post-monsoon values range from 0.50 m bgl to 13.90 m bgl. There is a general rise of water level during post-monsoon period. In general ground water in the study area is potable, except at places with high inland salinity.

Special studies have been carried out over an area 750 sq.kms covering 69 villages for fluoride content. Water sample have been collected in the above area both from dug wells and bore wells and sent for chemical analysis. Depth range of the dugwells was between 3.95-11.65 mbgl and borewell was between 55-70mbgl. Water level ranges between 1.65-11.20 mbgl during pre-monsoon and 1.35-7.8 in post-monsoon. Flucation of water level is 0.05-4.95m.

2.16.3 Kushtagi Taluk Of Koppal District And Sindhanur Taluk Of Raichur District : Ground Water Management studies were carried out in 2964 sq.km. in Kushtagi taluk of Koppal district and Sindhanur taluk of Raichur district of Karnataka).

The area is drained by streams of Ghatprabha and Tungabhadra rivers. The drainage pattern is dendritic and the drainage density varies from 1.32 to 1.90 km/km$^{2.}$ The area is covered with black soils of varied thickness. The results of infiltration tests show that the constant rate of infiltration in these soils varies from 0.86 to 2.84 cms\hr .The population of Kushtigi taluk is 2.39 lakhs and 2.97 of Sindhnur taluk as per 2001 census.

The area experiences semi-arid climate with mild to hot summer and mild winter and receives a normal rainfall of 571 mm in Kustigi taluk. However 386.5 mm of rainfall was received in year 2006.

Area under forests is 4110 ha and there is no change since last surveys(1995-96) in Kustigi taluk. The net area sown decreased from 1,39,946 to 91327 ha and covers 67% of the total geographical area of Kustigi taluk. Area under tank irrigation is 200 ha. The area under wells decreased from 3300 to 2475 ha. The area under groundwater irrigation increased from 3300 ha to 17802. Bore well irrigation, which was negligible during mid 90's, has increased to 15327 ha. Groundwater accounts for 98% of total irrigation. In Sindhanur taluk after 94-95,the area under groundwater irrigation increased from 300 ha to 2058. Bore well irrigation, which was negligible during mid 90's, has increased to 1950 ha.

The area is underlain by peninsular Gneisses and Schists . Alluvial deposits of sand and gravel are observed along the palaeo river courses. Depth of weathering range from 5.0 to 20.0 m. The major aquifer system in the area are Schists and Gneisses. Groundwater occurs under phreatic to semi-confined conditions in weathered, fractured, jointed Gneisses and Schists. 197 ground water abstraction structures which includes- dug wells and bore wells were inventoried during the field surveys.

The depth to water level during pre-monsoon period varies from 4.5 to 18.00 mbgl in dug wells and 11.00 to 32.00 m bgl in bore wells. During post-monsoon period it varies from 2.0 to 15.50 m bgl in dug wells and 7.50 to 20.20 m bgl in bore wells. Water level fluctuation is in the range from 2.50 to 4.50 m in dug wells and 3.50 to

11.8 0 m in bore wells. During pre-monsoon period about 42% of the area falls in the water level depth range of 10-15 mbgl while it is 30% during post-monsoon period. In about 65% of the area, water level fluctuation ranges between 2 and 4 m.

Out of 8 hydrographs of National Hydrograph Network Stations in Sindhanur taluk 4 show a falling trend in non command area in the range from 0.5 to 3.60 m and 3 show raising trend in command area in the range from 2.0 to 6.8 m. In Kustigi taluk 4 out of 6 hydrographic show falling trend in the range from 0.30 to 16.50 m. The stations showing falling trend are Kustigi, Kyadikoppa, Anantasagar, Mudanur due to deficit rainfall and increase of groundwater draft during the last decade.

The development of groundwater is through dug wells, dug-cum-bore wells and bore wells. Sizeable amount of groundwater is being extracted through these structures. The yields of dug wells vary from 20 to 250 m^3\day and can sustain pumping for 2 to 8 hrs. Irrigation bore wells sustain pumping for 2 to 12 hrs for a discharge of less than 1 lps to 5 lps. Pumping tests conducted on dug wells during the previous surveys show the Unit Area Specific capacities of dug wells tested ranged from 0.61 to 12.8 x 10^{-2} lpm/m/m^2. The specific capacities of wells varied from 5 to 127 lpm\mDD. Transmissivity 'T' varied from 0.24 to 542 m^2/day, Yield of the wells ranges from 20 to 250 m^3/ day for the Draw down ranges from 1.00 to 2.5 m in duration of pumping ranging from 90 to 180 minutes.

The Public Health Engineering Department, Raichur, has drilled 1088 bore wells in Kustigi and 1561 bore wells drilled in Sindhanur taluk to meet drinking water supply of rural population in 118 villages out of which presently. About 80% of bore wells yielding less than 2 lps are in the depth range of 60 –120 m depth range. High yielding bore wells are located along the lineaments, cross-joints, and in fracture zones.

Under exploratory programme, the fractures were encountered between the depths of 40 and 65 m. The discharges recorded were from 0.60 to 6.0 lps for the draw down of 2.278 to 29.162 m and the Transmissivity 'T' varied from 0.40 to 256 m^2\day.

Special studies: - Micro level studies were carried out in 574 sq.km area in Kustigi taluk, where the ground water level were 8.5-19.0 mbgl in dugwell and 11.0-32.0 mbgl in borewell during pre-monsoon. Seasonal fluctauion ranged between 2.5-3.5 m in dugwell & 2.7-10.7 m in borewells.

In general the groundwater quality is good for domestic and irrigation purposes except in few villages, Belaganur, Benniganur, Hulganchi, Turvihal, Hosahalli, Kalmangi, Virupanur, Jawalgere, Budhihal, Katalhalli, Hanchinal, Salgundi, Marenamuda, and at Jakkalgudda, where the EC exceeds 3000 micro-mhos\cm at 25^0C. The nitrate concentration vary from 22 to 300 mg/l. Higher values of Nitrate are observed at Muddapur, Turvihal, Merlladagudda, Aralahalli, Belliganur, Jawalgeri, Mukheda, Chemnahalli, Yeragudda and at Upplu. Higher concentration of fluoride observed at Madisirwar, Somlapur, Hanchinal, Katalhalli, Parapnur, Turvihal and at Kannur.

2.17 SOUTH EASTERN COASTAL REGION (Tamil Nadu)

Ground Water Mangemnet studies were undertaken in Tirunamallai, Cuddalore, Nagapatnam & Salem covering 9817 sqkm of area.

2.17.1 Tiruvannamalai district : Ground Water Management Studies was undertaken in 3000 sqkm area in OE/Dark Assessment Units of Tiruvannamalai district. Archaean metamorphic rocks underlie the study area. Groundwater occurs under phreatic conditions in the weathered residuum in crystalline rocks. The analysis of water level data of observation wells indicates considerable spatial variations. The water levels are shallow (2-4 m bgl) along the major drainage courses such as Ponnaiyar and Cheyyar rivers. Deeper water levels (4 -14 m bgl) are observed along the surface water divides. The study indicates that long-term ground water levels are showing a rising trend in the major part of the study area. The data indicate that post monsoon ground water levels in all the observation wells are showing a rising trend, ranging from 0.08 to 3.4m. The falling trend is confined mostly in localized patches during pre-monsoon period and can be attributed to localized overdraft for irrigation. The quality of formation water is good and potable, in general. The electrical conductivity of the formation water ranges from 390 – 5890 µ/cm at 25^{o} C. Twenty percent of the total samples collected shows that the nitrate concentration in ground water is more than permissible limit and it is attributed due to the excess usage of fertilizers in the agricultural fields and municipal sewage in the urban areas. Urban sewage pollution has been identified in and around Tiruvannamalai urban agglomeration. Groundwater development is feasible along the river courses wherever alluvial deposits are available and areas having depth to water levels less than 5 m bgl. Shallow dug wells with extension bores/ lateral bores will be ideal for sustainable yield of wells. Status of groundwater development is the study area indicates that there is a need for augmentation of ground water through scientifically planned artificial recharge of ground water.

2. 17.2 Micro level hydrogeological studies in Tiruvannamalai district : The micro level studies were taken up in 300 sqkm area of Tiruvannamalai district. Chengam Block in Tiruvannamalai district was notified by CGWA for registration of existing ground water abstraction structures. To study the 60 village-wise ground water availability, key wells established throughout the Chengam block representing most of villages. Water levels and water samples collected from the key wells and analyzed. The water level details are given in the table below.

Water Levels	May06	Jan/Mar07	Rise	Fall
Minimum	3.12	2.06	0.11	-0.05
Maximum	19.00	15.92	8.10	-2.00
Average	8.31	6.26	2.68	-0.90

The Artificial Recharge Structures constructed by different agencies collected for arriving at comprehensive schemes to recharge the ground water and improve the condition of the Block as a whole. Sample Draft Survey was carried out in 5 villages namely, Kayambattu, Pudupattu, Alaputhur, Neepathurai and Chinna Kolapadi. The data is being analysed for arriving at a unit draft figure for the similar type of villages. It is found that the tube well and deep well are not preferred by the agriculture sector. Hence, the phreatic aquifer is the major source for irrigation and

the fluctuation there off is the true representation of the ground condition. Statistical details of Artificial Recharge structures were collected with location.

State Ground and Surface Water Data Resource Centre identified agency for registration of ground water abstraction structures is in the process of formation of State Ground Water Authority.

2.17.3 Coastal Aquifer Management studies in Cuddalore district: Coastal Aquifer Management studies in Cuddalore district were undertaken in 3000 sqkm area. Altogether 131 no. of Key wells were established during the studies. The depth to Water (m bgl) during Pre monsoon & Post monsoon were (1.9- 4.1) &(1.9-to2.1) respectively, Depth to piezometric surface (m bgl)-during Pre monsoon & Post monsoon were 87.2 - 87.6,:86.1-86.9 respectively.

The study area is underlain by rock formations ranging from Achaean to recent. Major part of the study area is covered by sedimentary formations of Mesozoic to Tertiary consisting of sandstone, limestone, shale and clays. Groundwater extraction for irrigation to sugarcane is relatively more in Paruti and Annagramam blocks. The quality of groundwater is god and potable, in general. The study reveals that the ground water level is declining at the rate of 0.33 m per year and there is quality deterioration in deeper aquifers in certain pockets of the study area. In coastal areas west of Chidambaram, the quality of groundwater turned to brackish which was fresh till 2006. It is need of hours to contemplate artificial recharge and conjunctive use of surface water and ground water. Identified sites for construction of check dam and gully plugs in Panickankuppam. Seven more locations viz. 1. Onakuppam, 2. Arangamangalam, 3. M.K. Thottam, 4. Vakkaramurai, 5. Meyathur, 6. Shengal Medu, 7. Temur, were also identified for construction of artificial recharge structures. During rainy days in the areas around Perumal tank both the pumped out from NLC mines and runoff water is wasted and causing Flood in coastal area. In this area Conjunctive use of both surface water and ground water can be adopted.

2.17.4. Natural Disaster Management Studies in Nagapattinam district : Natural Disaster Management Studies in Nagapattinam district was undertaken in 2717 Sq. Km. 81 No. of Key wells were established. The Depth to Water (m bgl) during Pre monsoon & Post monsoon were 2.11- 4.98 & 0.9- 3.7 respectively

The geology of the area is sedimentary formation mostly of marine, fluvio-marine, and fluvial origin of age from Late Pleistocene to Recent. The geomorphological units are mostly pediplain and coastal plain covering the area. In deeper aquifers piezometric head ranges from 7.00 to 18.00 mbgl. In Kollidam block, the irrigation tube wells are showing deeper piezometric head in the range of 15.00 to 18.00 mbgl due to heavy pumping in last decade.

Totally 6 blocks are in saline category among 11 blocks. The EC ranges from 337 µS/cm at 25^0 C (Vadakkupoiyur – Nagapattinam block) to 10,620 µS/cm at 25^0 C (Umbalacheri-Talainayar block).The scope for Ground water development is less in saline area. The freshwater is extracted from sand dunes which acted as fresh water pockets in Coastal area. The area is deltaic region and groundwater gradient is low. The blocks of Talainayar, Keelaiyur and Vedaranyam is affected by saline by the factors of backwater, aquaculture and in-situ salinity.

2.17.5. Urban GW Management Studies, Salem city, district Salem: GW Management Studies were undertaken in parts of district Salem , covering 350 sqkm area with special reference to Salem city. The geographical area of Salem city is 91.4 sq. km. is the third largest urban agglomeration in Tamil Nadu after Coimbatore and Madurai. The urban agglomeration had a population of 5,83,350 as per 2001 census. About 80% of total area of the city is utilized for residential use. Agricultural activities are being taken up in about 19% of the area. The area receives an average of about 995.2 mm rainfall. More than 80% of the rainfall is received during northeast monsoon. The study area is underlain by crystalline rocks of Archaean age consisting of gneisses and charnockite group of rocks. Thickness of weathered mantle ranges down to 20 m. Weathered mantle, fissured and fractured rocks constitute the major aquifer system in the study area. Groundwater occurs under phreatic conditions in weathered mantle.

The decadal average (1997 - 2006) depth to water in phreatic zone ranged from 7.76 to 16.1 m bgl during May and from 4.45 to 10.15 during January. Decadal average depth to piezometric surface ranged from 5.92 – 15.87 m bgl during May and ranged from 3.22 to 6.8 during January. The quality of groundwater in the study area is good and potable, in general. However, the untreated effluents of industries and urban sewage are let into the Tirumanimuttar, which leads to deterioration of quality of surface water as well as groundwater. In view of limited groundwater availability there is an urgent need for protection, conservation and augmentation of groundwater resources.

2.17.6. Gangavalli block, Salem district for Artificial Recharge and Rain Water Harvesting: Ground Water management studies were underkaen in 410 sqkm area of Gangavalli block, Salem district with the theme of plan of Artificial Recharge and Rain Water Harvesting. During the studies 41 No. of Key wells were established. The depth to Water (m bgl) during Pre monsoon & Post monsoon are 4.00- 35.10, & 1.22- 21.90 respectively.

Gangavalli Block, Salem District has highest groundwater development in the State of Tamil Nadu. In consequent to this, it was decided to take up artificial recharge to groundwater in this block under the scheme "Demonstrative Project in Artificial Recharge to Groundwater & Rainwater Harvesting".

In order to improve the over all groundwater situation in the block, it is suggested to have a two pronged approach, viz., improve the drinking water supply and irrigation water supply.

2.18 KERALA REGION(Kerala State)

Ground Water Mangemnet studies were undertaken in Thrissur& Palghat district covering 6100 sqkm of area of Kerala.

2.18.1 Thrissur District: Groundwater management studies were carried out in Thrissur district covering an area of 3030 sq.km. Physiographically the district can be divided into three well defined marks, the coastal plains in the west, the 'kole land', which is below mean sea level & the midland region in the center.

A check dam constructed along the slope atop of a hill at Kachitodu near Pongamodu, Kerala

Auto flow dug well Located in middle of Paddy field near Pulakod, Pazhayanur Block,Kerala

A dug well section showing vertical lining of roof tiles at bottom near Trichur,Kerala

A photograph showing Kole land with paddy cultivation which is water logged expect during summer near Pazhani, Kerala

The average annual rainfall of the study area is 2937 mm. The amount of potential evaporation in this district is 1744.5 mm. The district comprises of three river basins such as parts of Ponnanai basin, Kole lands (Keecheri and Karuvannar) and parts of Chaklakudi basin.

Major part of the study area is underlain by the crystalline rocks of Archaean age and mainly comprises of Charnockites and peninsular gneissic complex. In up land region these rocks are extensively weathered and overlain by laterites. The coastal sedimentary formation of Miocene to Recent age overlies the crystalline formations. The Kole land regions, piedmont type of valley fills are seen and their thickness ranges from 10 to 15m. Patches of riverine alluvium are also seen along the river courses.

Groundwater occurs under water table condition in the alluvium and weathered crystalline formation and occurs under semi confined to semi-confined condition in the deeper fractured aquifer. The depth to water level varies from 0.70 to 13.50 during Pre monsoon and the post monsoon depth to water level ranges from 0.40 to 10.60. Groundwater exploration carried out by CGWB indicates that the potential fracture zone encountered between 18 to 137 mbgl and the potential zone located along NE-SW E-W lineaments. The yields of dug wells range from 0.5 to 24.5 lps.
The major ground water abstraction structures of the area are open dug wells, bore wells and shallow filter points wells, which are numerous along the coast. The dug-cum bore wells are success in eastern parts of the study area where crystalline rocks are dominant. In general the quality of groundwater is good and can be used for drinking, domestic irrigation and industrial purposes.
Springs: There are two springs in Vellikulangara area with good discharge and meagre discharge even in summer months. The water is suitable for drinking and domestic purposes.

Detailed Study Area: Kodungallur, Mathilakam, Mala and Vellangallur blocks have been assigned for detailed study and the target area is 371 sq.km. Physiographically the area shows undulating topography in the eastern part and the western fringes are covered by coastal and riverine alluvium.

Groundwater occurs under water table condition in alluvium and weathered crystalline rocks. The shallow aquifer is mainly up to a depth of sands and clay, laterite, highly weathered formation and riverine alluvium and yielding appreciable amount of water. The pre monsoon water level varies from 11.50 to 0.70 mbgl and varies from 7.95 to 0.20 mbgl during post monsoon.

Findings:.

i) Kodungallur block falls under over exploited block as per Dynamic Ground Water Resources of Kerala (2004). Though the part of the block is very close to coast and number of filter point wells are constructed in recent days which leads to create the number of environmental problems including declining of ground water level and in future it may lead to ingress saltwater from sea. Earlier days most of the houses are having the small pond for their domestic purposes, which boost groundwater

recharge and balancing aquifer system from the stress. Due to demand for land the ponds are filled and converted into buildings.

ii) Mathilakam block is categorized as semi critical block. Due to over pumping along the coastal area through filter point wells the groundwater level is declining very fast during the summer period. The saline water ingresses also observed during the summer wherever the confluences are located near the sea except the settlements are located in the elevated sand ridges.

iii) One Auto flow dug well has inventoried during post monsoon survey, which is located middle of the paddy field surrounded by hillocks near Pulakod in Pazhayannur Block of Thalapally Taluk.

iv) Pangarapally which is located crystalline terrain of Pazhayannur block having potential ground water resources .The bore wells constructed in this area yielding very high discharge and lasting decades together. The best example, the bore wells constructed by CGWB Board presently yielding water supply to Kerala water Authority (27 HP) and Jalanidhi (10HP).

v) Most of the dug wells in Thalapally taluk become dry during summer because of demand for ground water in both domestic and agricultural purposes. The number of bore wells are also constructed in recent days is one of the reason dug wells are dry. But the deep potential aquifers are compensating the demand during the summer.

vi) In general shallow and deep bore wells are success in most of the hard rock area in the district.

vii) Since numbers of Irrigation scheme are constructed in the district and most of the areas are falling in canal command area which recharges near by dug wells and bore wells in through out year.

In general the quality of surface and groundwater is good except some pockets near coast.

2.18.2 Palghat District : Groundwater management studies were carried out in Palghat District Excluding Mannarkkad, Sreekrishnapuram & Attapady Blocks, covering an area of 3070 sq.km.

Palakkad (Palghat) is the land of Palmyrahs and Paddy fields. Palakkad is a major Paddy growing area of the State. It is often called as the "Gateway of Kerala". There is considerable change in the land use and cropping pattern in the district for the last five years. Due to low income from paddy and coconut, farmers are changing the cropping pattern to cash crops like sugarcane, vegetables and flower cultivation. Over dependence on groundwater for domestic, irrigation and industrial purposes in the district has led to the lowering of water table and water scarcity especially along the eastern parts.

The district is drained mainly by two rivers, viz Bharathapuzha and Bhavani rivers. The district receives on an average 2348 mm of rainfall annually. The western part of the district around Mannarghat receives the maximum rainfall (2849 mm) whereas in the rain shadow area of Chittur in the eastern part receives the minimum rainfall (1758 mm).

Rock water harvesting implemented in Wadakarapathay Panchayath, Palghat district(photograph taken during RHS- Palghat district)

Rainwater harvesting schemes implemented by Private institutions in Palghat (photograph taken during RHS – Palghat)

Groundwater occurs in all the geological formation from Archaean crystalline (hard rock) to Recent alluvium (soft rock). Groundwater occurs in phreatic condition in the laterite, alluvium and weathered crystallines. It is in semi confined to confined condition in the deep fractured rocks.

The entire district can be divided into three units based on hydrogeological information.1)Valley fills/Alluvium 2) Laterite terrain 3) Crystallines.

Valley fills are noticed along the valley portion and along the river terraces/banks (near Ottapalam, Pattambi area) and are shown in the hydrogeological map. These are mainly seen in Mannarghat, Ottapalam and Pattambi, Trithala blocks. The water level ranges from 2- 12 m bgl (premonsoon) and 1- 6 m bgl (post monsoon). The fluctuation is generally high upto 5 m. The yield of dug well ranges from 5 to 20 m^3/ day.

The laterite province is limited in extent, noticed in Trithala ,Ottapalam and Pattambi blocks. The water level ranges from 4 to 11.0 mbgl during pre monsoon and post monsoon water level ranges from 3 to 8 m bgl . The fluctuation between pre and post monsoon varies between 2 to 6 m. The yield ranges from 5 to 30 m^3/ day. In these areas the extraction is less. The specific capacity ranges from 10- 125 l/min/mdd.

The hard rock province covers 80 % of the area. This province can be divided into further zones based on weathering characteristics. The blocks covered by crystallines are Chittur, Kollenkodu, Nenmara, Palghat, , Alathur, Kuzhalmannam

The pre to post monsoon (April – Nov 2006) fluctuation in the district varies from place to place. The fluctuation varies from 2 to 6 m bgl and the maximum fluctuation is noticed in the eastern part of the district. In the central and western part the fluctuation ranges from 2- 4 m. In the eastern side of the district around Chittor, Gopalapuram, Kozhinjampara area (Chittur block), the water levels are declining at the rate 0.4 m per year. Rest of the areas, the water level decline is less and is in the range of 0.2 to 0.3m per year. Rising trend is reported in the central western part of the district.

Based on the chemical analyses it is inferred that the quality of the groundwater in shallow aquifer is in general good .However certain pockets are showing some quality deterioration especially eastern part of Palghat district where fluoride content is slightly high .The dug wells are showing fluoride in the range of 1 - 5.75 ppm. The higher values recorded from Kopanur (5 .75 ppm). The bore wells are showing high concentration of fluoride, ranges from 0.3 to 3.12 ppm. The highest concentration is reported from Chinnamoolathara (EW of CGWB). Inland salinity is noticed from Kadumthuruthi (Yakkara) and Kuduvayoor area. About 1 sq km area is affected in both the areas. The dug wells in the Kadumthuruthi colony (about 40 numbers) area showing high EC values in the range of 2000 - 6700 microseimens/cm at 25^0 C. In the Kuduvayoor area about 25 dug wells are showing high EC values of 756 - 7200 micro seimens/cm at 25^0 C.

Findings

i)The stage of groundwater development in the district during 2004 is 43.67 % leaving scope for future development. But care should be taken since there is a spurt

in the development over the last 5 years ie the development was 39 % during 1999 presently increased to 43.67 %.

ii)As number of abstraction structures including private bore wells are on the increasing trend without proper dissemination, proper census of the abstraction structures is necessary for recommending new structures for future development.

iii)Inland salinity area of Koduvayoor and Kadumthuruthi, are demarcated.

iv)In Thachampara panchayath, there are plenty of springs (locally known as Cholas) especially at Vakottu mala and Irumbumutty mala area. These have not been developed so far effectively. These are the perennial sources for drinking water schemes. Attention may be given to these cholas. Meenvallam and Alta waterfalls can also be used effectively for the drinking water supply schemes.

v)Bore well recharge is very essential in the Chittur and Kollengode blocks as dry fractures encountered in many private bore wells.

vi)The potential fractures are encountered limited within 200m.

vii)There are lot of scope for artificial recharge in the district. The common structures are Sub-Surface dykes, Rock water harvesting and Borewell recharge. The subsurface dykes constructed by CGWB in the district are successful structures and performing well.

viii)Private institutions like Ahlia Hospitals has implemented AR Schemes which helped the institution to become water surplus from scarcity.

ix)Immediate attention is required in the fluoride affected area of the district, especially eastern part.

x)Overdependence of groundwater for industrial purposes should be restricted especially in the eastern parts.

3. GROUND WATER EXPLORATION

Ground water exploration aided by drilling is one of the major activities of the Board. It is aimed at delineation of aquifers in different hydrogeological conditions and determination of their hydraulic parameters. The exploratory drilling operations have enabled demarcation of aquifers both in lateral and vertical extensions and evaluation of various aquifer parameters, designing of suitable structures and assessment of their yield capabilities in various hydrogeological settings. These studies have helped in identifying areas worthy for further ground water development. Ground Water Exploration contributes to a large extent in guiding the States to implement ground water development schemes.

During the year the Board carried out the exploration work with a fleet of 86 rigs (Rotary-32, DTH-41, Percussion-13) and a total of 783 (478 EW, 165 OW, 137 PZ, 1 SH and 2 DW) boreholes were constructed departmentally. Out of 783 wells, 567, 188, 17 boreholes were constructed in hardrock, alluvium and bouldary formations respectively 184 and 254 wells were constructed for exploration in tribal and drought prone areas respectively. The Board has so far drilled a total of 26756 bore holes to identify areas worthy for ground water development in the country till March 31st , 2007.

The statement showing State-wise distribution of boreholes drilled / completed during 2006-2007 in the country is presented in Table 3.1 & Table-3.2. Region wise & Division wise status of bore holes drilled during 2006-2007 is shown as graph in fig. 3.1, 3.2 & 3.3 .

Table 3.1 : STATE-WISE WELLS CONSTRUCTED BY CENTRAL GROUND WATER BOARD DURING THE YEAR 2006-2007

Sl No.	State/UTs	EW	OW	PZ	SH	DW	Total
1.	Andhra Pradesh	34	11	30			75
2.	Arunachal Pradesh	2					2
3.	Assam	12	5				17
4.	Bihar	10	9	9			28
5.	Chhattishgarh	29	9	7			45
6	Gujarat	22	11	19	1		53
7.	Haryana	1		1		2	4
8.	Himachal Pradesh	13	2				15
9.	Jammu & Kashmir	9					9
10.	Jharkhand	7	2	6			15
11.	Karnataka	36	10				46
12.	Kerala	14	5	20			39
13.	Madhya Pradesh	46	19	2			67
14.	Maharashtra	49	13				62
15	Meghalaya	3	1				4
16.	Orissa	73	11				84
17.	Punjab	1					1
18.	Rajasthan	23	4	16			43
19.	Tamilnadu	32	16	6			54

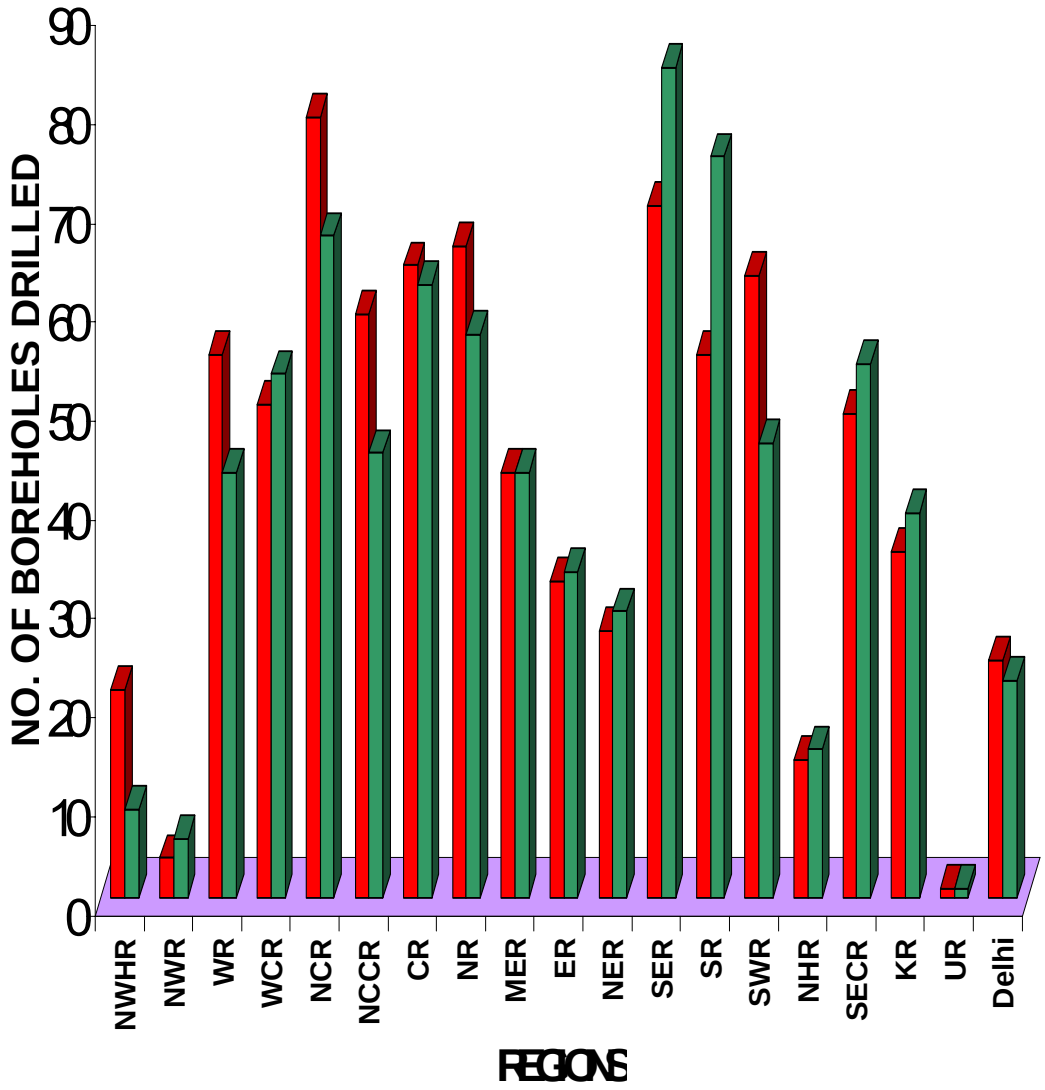
Sl No.	State/UTs	EW	OW	PZ	SH	DW	Total
20.	Tripura	4	2				6
21.	Uttaranchal	1					1
22.	Uttar Pradesh	26	22	9			57
23.	West Bengal	26	7				33
TOTAL(A)		**473**	**159**	**125**	**1**	**2**	**760**
UNION TERRITORIES							
1.	Chandigarh			1			1
2	Delhi	5	6	11			22
TOTAL(B)							
GRAND TOTAL(A+B)		**478**	**165**	**137**	**1**	**2**	**783**

EW - **Exploratory Well**
OW - **Observation Well**
PZ - **Piezometers**
SH - **Slim Holes**
DW - **Deposit Well**

Table 3.2 : DIVISION WISE WELLS CONSTRUCTED BY CENTRAL GROUND WATER BOARD DURING THE YEAR 2006-2007

Sl No.	DIVISION	EW	OW	PZ	SH	DW	Total
1.	I- AHMEDABAD	22	11	19	1	0	53
2.	II- AMBALA	7	6	13	0	2	28
3.	III- VARANASI	23	13	0	0	0	36
4	IV- CHENNAI	46	21	6	0	0	73
5	V- RANCHI	17	11	15	0	0	43
6.	VI-NAGPUR	49	13	0	0	0	62
7.	VII-GUWAHATI	21	8	0	0	0	29
8.	VIII- JAMMU	9	0	0	0	0	9
9.	IX-HYDERABAD	34	11	30	0	0	75
10.	X- BHUWANESWAR	73	11	0	0	0	84
11	XI- JODHPUR	23	4	16	0	0	43
12.	XII BHOPAL	46	19	2	0	0	67
13	XIII- RAIPUR	29	9	7	0	0	45
14.	XIV- BANGALORE	36	10	20	0	0	66
15.	XV- KOLKATTA	26	7	0	0	0	33
16	XVI- BAREILLY	4	9	9	0	0	22
17	XVII- DHARAMSALA	13	2	0	0	0	15
TOTAL		**478**	**165**	**137**	**1**	**2**	**783**

REGION WISE STATUS OF GROUNDWATER EXPLORATION (DURING 2006-2007)



3.1 NORTH WESTERN HIMALAYAN REGION (Jammu & Kashmir)

Groundwater exploration were undertaken during the AAP 2006-07 in Jammu & Kashmir and total 9 exploratory wells were constructed under normal exploration programme, however one well was constructed through outsourcing. The Ground Water Exploration was started in the Kashmir Valley after a gap of 18 years.

3.1.1 Ground Water Exploration(Departmental)

The details of ground water exploration in Jammu & Kashmir is given in table 3.3

Table3.3 : Summarized details of groundwater exploration in J&K

Sl No	Locations/ District	Depth Drille (mbgl	Depth of Casing (mbgl	Zones Encountered	SWL (mbgl
1.	Chamera-I, Udhampur	-	27	2-8,18-24	--
2.	Chamera-II, Udhampur	-	66	42-48,53-59,61-63	-
3.	Jakhole, Kathua	-	42	2-15,33-36	-
4.	Saunthal, Kathua	120	110	93.5-104	-
5.	Iqbal Park, Srinagar	201	197	104-109,119-124,129-133,134-138,188-193	0.12 magl
6.	Najin B, Baramula	-	157	-	-
7.	Dassu, Pulwama	135	135	24-27,30-37,70-76, 108-114,129-131	28.27
8.	Gangu Chak, Jammu	58	50	-	-
9.	Ashram Colony, Jammu	59	59	44-49,51-57	-

3.1.2 Ground Water Exploration (Through Outsourcing)

The target of drilling 39 exploratory tube wells through outsourcing in Kashmir valley was fixed. Of these 39 exploratory tube wells only one well was constructed at Trigam Shadipora, district Baramulla down to the depth of 250m, which was found to be in artesian condition with SWL 1.04 magl.

3.2 NORTH WESTERN REGION (Haryana, Punjab & Chandigarh)

Ground Water Exploratory drilling was undertaken and constructed 6 wells in Gurdaspur(Punjab),Panchkula and Karnal (Haryana) & Chandigarh as per the following details given in table 3.4.

Fig 3.2

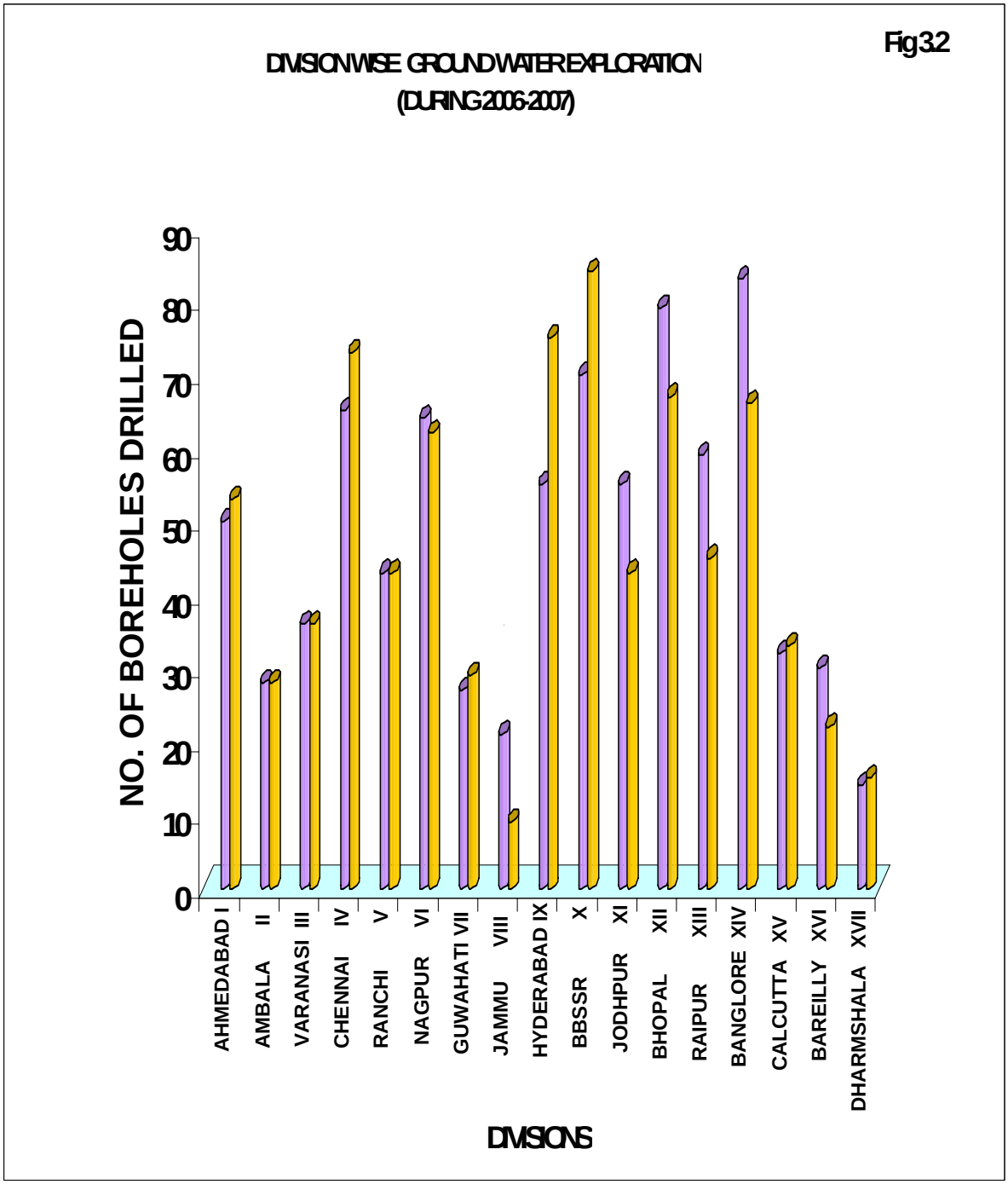

DIVISION WISE GROUND WATER EXPLORATION
(DURING 2006-2007)
NO. OF BOREHOLES DRILLED
0
10
20
30
40
50
60
70
80
90
AHMEDABAD I
AMBALA II
VARANASI III
CHENNAI IV
RANCHI V
NAGPUR VI
GUWAHATI VII
JAMMU VIII
HYDERABAD IX
BBSSR X
JODHPUR XI
BHOPAL XII
RAIPUR XIII
BANGLORE XIV
CALCUTTA XV
BAREILLY XVI
DHARMSHALA XVII
DIVISIONS

Table3.4: Details of Exploration in Punjab, Haryana & Chandigarh

Sl.No /Type of well	Location / Block / District	Depth Drilled / Constructed (mbgl)	Granular zones Depth range (mbgl) encountered (between)	SWL (mbgl)	Formation
1	2	3	4	5	9
PZ	Govt Primary School, Sector52/ Chandigarh	162/95	20.0-153.0	21.3	Alluvium
PZ	Sugarcane Breeding Farm/Karnal (Haryana)	161/105	27.00-154.0	-	Alluvium
EW	Kalka/ Pinjore/ Panchkula	210/205	109-202.0	-	Bouldary
EW	Manwal/ Pathankot/ Gurudaspur	107/104.0	34.0-105.0	15	Bouldary

3.2.1 State wise highlights of exploration is as follows:-

Punjab: - One exploratory well was drilled at village Manwal in Gurdaspur district (Punjab). The exploratory well was drilled down to 107.0 m bgl. The sub-surface Lithology comprise of boulders, pebbles, gravels, sands and clays. Granular zones were encountered in the depth range of 34.0-47.0, 52.0-58.0, 61.0-73.0, 88.0-90.0 and 100.0-105.0m bgl. Well assembly of 104.0m depth was designed and lowered. Discharge of well is 632m^3 for drawdown of 3.51m. Ground water in the area is fresh and potable.

Haryana:-One Piezometer and two deposit wells were drilled in Karnal district (Haryana). The borehole for piezometer was drilled down to 161.0m bgl. Sub surface Lithology consists of sand, clay and kankar. Aquifers in depth range if 74.0-77.0m bgl and 99.0-102.0m bgl were tapped to monitor ground water regime in the area. Depth to water level in the area is 19.0m bgl. One exploratory well was constructed at Kalka in Pinjore block of Panchkula district. The borehole was drilled down to 210.0m bgl. Sub surface Lithology consists of boulders, pebbles, gravels, sands and clays. Well was constructed to a depth of 205.0m. Granular zones in the depth range of 109.0-113.0, 145.0-149.0, 190.0-193.0, and 198.0-202.0 m bgl were encountered.

Chandigarh : One piezometer was constructed in sector 52. Borehole was drilled down to the depth of 162.0m bgl. Sub-surface geological formations consist of fine to coarse sand, gravels and clay beds. Depth to water level in the area is 21.3 m bgl. Aquifers in the range of 53.0-56.0, 71.0-74.0 and 88.0-91.0m bgl were tapped to monitor the ground water regime in the area.

3.3 WESTERN REGION (Rajasthan)

A total of 21 exploratory wells, 03 observation wells and 19 piezometers have been constructed during Annual Action Plan 2006-07.

3.3.1 District wise summarized details of groundwater exploration :-District wise summarized details of groundwater exploration in the State based on departmental drilling (in range) given in table 3.5.

Table3.5 : District wise details of groundwater exploration

Sl. No	District	Depth Drilled (mbgl)	Zones Tapped	SWL (mbgl)	Discharge (m^3/hr)	Formation
1	Alwar	105.20	Naked hole	-	1.50	Quartzite & schist
2	Churu	48-84	41-78	28-41	6.0-16.70	Alluvium
3	Dausa	74-200	Naked hole	20-23	16.80-24.00	Slate/ Phyllite, W.Quartzite
4	Hanumangarh	185-190	39-178	9.5-13.3	49.50-66.0	Alluvium
5	Jaipur	30 - 92	29 - 90	14.5-52.4	3.0-24.0	Alluvium
6	Jaisalmer	146-201	120-198	90-102	1.80-24.00	Alluvium
7	Jhunjhunu	80 - 93	71 - 84	45 - 62.5	7.2- 18.0	Alluvium
8	Rajsamand	111-200	Naked hole	1.7 – 15.0	0.3 – 60.0	Gneisses, Schist, Granite
9	Sikar	94 -102	58 - 84	35.0 –50.0	18.0- 41.0	Alluvium

Highlights of Exploration:

Alwar district:- A total of 1 exploratory wells and 1 piezometer were constructed in Alwar district in consolidated quartzite formation. Depth of the piezometer is 105.2 m. Discharge of well is 25 lpm. Chemical quality of groundwater is fresh having electrical conductivity of 1130 micro. Mhos/cm at 25^0c. Fluoride content is within the permissible limit. Exploratory well constructed at Jajore was abandoned.

Churu district :-A total of 5 piezometers were constructed in Churu district in unconsolidated alluvial formation. Depth of the bore holes drilled varies from minimum of 48.50 to 84.0 m. Static water level in the wells constructed ranges from 28.33m to 40.80m b.gl. and discharge varied from 100 Lpm. to 278 lpm. Chemical quality of groundwater is generally fresh having electrical conductivity 1760 to 15,970 micro. Mhos/cm at 25^0c. Fluoride content in the area is more than permissible limit and varies from 1.18 to 5.02 mg/l.

Dausa district:- In Dausa district a total of 4 EW & 1 observation well were constructed in consolidated quartzite and phyllite formations. Depth of the bore wells drilled varies from 74.20 m to 200m. Static water level ranges from 19.96 to 23m b.gl. and discharge varied from 280 lpm. to 400 lpm. Chemical quality of groundwater is generally fresh having electrical conductivity from 515 to 900 micro. Mhos/cm at 25^0c.

Hanumangarh district:- A total of 2 exploratory wells and 1 piezometer were constructed in Hanumangarh district in unconsolidated alluvial formation. Depth of the bore holes drilled varies from 185.80 m to 190.10m Static water level ranges from 09.50 to 13.32m b.gl. and discharge varied from 825 lpm. to 1100 lpm. Chemical quality of groundwater is fresh to saline, having electrical conductivity variation from 745 to 2800 micro. Mhos/cm at 25^0c. Fluoride content in general is with in the permissible limit of 1.50 mg/ lit.

Jaipur district:- Drilling operations were taken up in Jaipur district and a total of 8 piezometers were constructed in unconsolidated alluvial formation. Depth of the bore holes drilled varies from 30.50 m to 92.65m. Static water level ranges from 14.50 to 52.44m b.g.l. and discharge varies from 06 lpm. to 400 lpm. Chemical quality of groundwater is fresh to brackish having electrical conductivity variation from 570 to 6610 micro. Mhos/cm at 25^0c. Fluoride content in the area varies from 0.75 to 3.49 mg/l.

Jaisalmer District:- Three exploratory wells have been constructed at Sajiti, Laxmansar and Sanwata villages and one PZ at Sirwa.Ground water exploration work carried out in Lathi formation and Tertiary formation. Depth of exploratory drilling ranges from 146.00m to 201m. bgl. Depth to water level in the exploration area varies from 90.35-102m bgl. Discharge of the wells varies from 30 lpm to 400 lpm. Chemical quality of groundwater is brakish to saline having electrical conductivity 2190 to 10850 micro. Mhos/cm at 25^0c. Fluoride content in groundwater is beyond permissible limit at Laxmangarh (2.3 ppm) and at Sanwatapar (2.05 ppm).

Jhunjhunu district:- A total of 2 piezometers were constructed in Jhunjhunu district in unconsolidated alluvial formation at Shivpura and Lalpura. Depth of the bore holes drilled varies from minimum of 80.7m to 93.0 m. Static water level ranges from 45.11 to 62.50m b.gl. and discharge varied from 120 Lpm. to 300 Lpm. Chemical quality of groundwater is generally fresh having electrical conductivity 1425 to 1620 micro.mhos/cm at 25^0c. Fluoride content in general is with in the permissible limit and is higher (2.13) mg/ lit at Lalpura.

Rajsamand districts:- During exploration drilling work in hard rock formation 8 EW, 1 OW & 1 Pz were constructed in Rajsamand District in gneiss, phyllite & granite formations. Maximum drilling done at Asan, Jaitgarh & Gosundi sites up to 200m. Where as minimum drilling was carried out at Dhola Ka Od up to 111.40. Water level observed in the area ranges from 01.70m to 15m. Quality of groundwater is potable. Discharge of the well varies from 05 lpm to 1000 lpm.

Sikar district:- Exploratory drilling operations were taken up in Sikar district and a total of 3 exploratory wells and 1 observation well were constructed in unconsolidated alluvial formation. Depth of the bore holes drilled varies from 94.0 m

to 101.8m Static water level ranges from 34.74 to 49.60m b.g.l. and discharge varied from 300 lpm. to 680 lpm. Chemical quality of groundwater is fresh to brackish having electrical conductivity variation from 1500 to 4280 micro. Mhos/cm at 25^0c. Fluoride content in the area is more than permissible limit and varies from 1.51 to 5.16 mg/l.

The List Of High Yielding Wells Constructed in Rajasthan is given in table 3.6.

Table 3.6: List Of High Yielding Wells Constructed in Rajasthan

Sl. No.	District	Location / Site	Depth (m)	Discharge (lpm)	Formation
1	Hanumangarh	Naiwala	164	825	Alluvium
2	Hanumangarh	Saharni	174	1100	Alluvium
3.	Hanumangarh	Basheer	178	880	Alluvium
4	Rajsamand	Bheru Ghati	156	1000	Gneiss
5	Sikar	Shekhisar	86	680	Alluvium

3.4 WEST CENTRAL REGION (Ahmedabad)

Ground water exploration was carried out in the districts of Vadodara, Bharuch, Narmada, Amreli, Rajkot, Surendranagar and Jamnagar. Piezometer Construction was taken up in the North Gujarat Region manly in the districts of Banaskantha, Mehsana, Patan and Sabarkantha. In all 53 (22-EW, 11-OW, 19-Pz and 1-SH) wells have been constructed during the AAP 2006-07 against the target of 50 wells.The details are given in table 3.7.

Table 3.7: District wise Summarised Details of Ground Water Exploration in Gujarat

Sl. No	District	Depth drilled (m bgl)	Zones tapped / Fractures encountered (m)	SWL (m bgl)	Discharge (lpm)	Draw down / Residual Drawdown (m)	Formation
Ground Water Exploration (Departmental)							
1	Amreli	450.20 - 453.20	11.80-169.60	13.87 – 16.97	18-240	51.4- 75.8	Basalt
2	Bharuch	105.10 – 202.60	4.7 –178.30	3.12 – 22.22	30-1500	4.43 - >100	Basalt
3	Jamnagar	200.00	10.0 – 50.00	8.17-20.02	60	4.35 - 5.4	Limestone/ Sandstone
4	Narmada	45.1 – 202.70	8.8 – 153.9	7.62 – 28.83	18-1052	0.16 – 66.61	Basalt
5	Rajkot	80.40	33.0- 62.0	18.05	84	4.91	Alluvium/ Sandstone
6	Surendranagar	176.20 - 450.20	4.9 – 170.0	5.34 – 53.44	21.6 - 702	3.93 - > 130.0	Alluvium/ Sandstone/ Basalt
7	Vadodara	200.60	22.60 – 28.70	9.96 – 11.90	570-588	1.94 – 8.45	Granite Gneiss

Piezometers							
1	Banaskantha	92-195	73-192	47.62 – 140.87	61.80-132	0.17 – 7.25	Alluvium/ Sandstone
2	Gandhinagar	174 - 450.43	158 – 236	97.95 – 166.10	36.00 –72.0	0.75 – 44.60	Alluvium
3	Mehsana	37.40 – 373.0	23.0 – 370.0	21.6 – 105.55	5.4 -105	0.24 – 17.08	Alluvium/ Sandstone
4	Patan	82.0 – 285.0	40.0 – 282.0	45.12 – 167.74	9.6 – 128.57	0.45 - 18.55	Alluvium
5	Sabarkantha	141.00	90.0 – 138.0	54.14	120	6.46	Alluvium

3.4.1 District Wise Salient Features Of Ground Water Exploration (Hard Rock Areas)

Amreli : Geologically the area is underlain by the Deccan trap. Hydrogeologically the ground water occurs in the weathered, jointed and fractured parts of the formation. Deep Exploration was carried out with an aim to explore the possibility of occurrence of deep seated aquifers/ fractures having potable quality of ground water. Three Exploratory wells were constructed in the district varying from 450.20 to 453.20 m depth. The discharge of the wells varied between 42 to 240 LPM. The quality varied from 478 µS /cm (Jira EW) to 12600 µS (Amritvel EW). No zone with sustainable yield could be encountered in the wells drilled.

Bharuch : Geologically the area explored is underlain by the Deccan trap. In Bharuch district ten borewells were constructed, of which six were exploratory wells and four were observation wells. The depth of the borewells varies from 138.60 m (Kochbar OW II) to 202.60 m (Chiklota EW). The discharge of the wells varies between 30 LPM (Chiklota EW) & 1500 LPM (Kochbar EW). The quality of water in all the wells is good (EC ranges from 435 to 1370 µS /cm at 25^{o} C).

Narmada : Geologically the area explored is underlain by the Deccan trap. In Narmada district nine borewells were constructed, of which six were exploratory wells and three were observation wells. The depth of the borewells varies from 45.10 m (Sunderpura EW) to 202.70 m (Moti Singloti EW). The discharge of the wells varies between 18 LPM (Moti Singloti EW) & 1200 LPM (Wali OW). The quality of water in all the wells is good (EC ranges from 395 to 1200 µS/cm at 25^{o} C).

Surendranagar : The area explored is underlain by the Deccan traps and Infratrappean Sandstone of Dhrangadhra & Wadhawan Formation. The ground water occurs in the weathered, jointed and fractured parts of the Basalt. The Dhrangadhta sandstone forms prolific aquifer in parts of the district. The quality of ground water in Dhangadhra sandstone is variable whereas in Wadhwan sandstone in general the quality is poor. Deep Exploration was carried out with an aim to explore possibility of occurrence of deep seated aquifers/ Fractures having potable quality and sustainable yield of groundwater in Deccan Trap & Infratrappean Sandstone.

Two Exploratory wells and Two Observation wells were constructed in Sayla & Chuda Taluka of the district with depth range of 264.20 & 450.20 m . The discharge of the wells varied between 21.60 LPM (Bhanejda OW) to 702 LPM (Vastadi EW). The quality varied from 1690 µS /cm (Vastadi EW) to 2780 µS (Bhanejda EW). Intratrappean Sandstone contact is encountered at 383 m bgl at Vastadi OW. However No appreciable discharge is observed in it.

Vadodara :Geologically the area explored is underlain by Pre-Cambrian meta-sediments consisting mainly of granite gneiss. Hydrogeologically the ground water occurs in the weathered, jointed and fractured parts of the formation.

Two borewells (One EW & One OW) were drilled in Suryaghoda village in Sankheda Taluka. The depth explored is 200.60 m and the discharge is 570 LPM. The EC of the GW is 1960 µS /cm but Fluoride is more than the permissible limit (3.2 mg/l).

3.4.2 District Wise Salient Features Of Ground Water Exploration (Soft Rock Areas)

The ground water exploration was envisaged in the coastal areas of the Surendranagar, Rajkot and Jamnagar districts underlain by soft rocks. The coastal areas are facing ground water quality problem, the fresh water resources are limited and the fresh water floats over saline water. Exploration was carried out to explore the possibility of fresh water aquifers at depth.

Jamnagar :Coastal area near Dwarka is underlain by rocks of Mio-Pliocene age consisting of Dwarka formation followed by Gaj Formation. The main rocks are Miliolite limestone, Marl, Sandy foraminifera limestone and variegated Clay. Ground water is exploited mainly through Dugwells. The quality is variable depending upon the distance from coast and fresh water saline water interface.

In Okhamandal Taluka of Jamnagar district, two exploratory wells were constructed during the year. The depth explored is 200.00 mbgl. The depth of the constructed tube wells varies from 53.00 m (Vasai EW) to 29.00 m (Goriali EW). The compressor discharge of the wells is 60 LPM. The quality of water in the wells is saline (Field TDS ranges from 5470 to saline).

Rajkot : The northern part of the district is occupied by alluvium of recent period which is underlain by semi-consolidated formation of Tertiary age. The ground water occurs under Unconfined and Semi-confined conditions. Ground water quality is variable in both Alluvium and Tertiary formations. The Quaternary and Tertiary formations are underlain by Deccan Traps. The Drangadhra / Wadhwan sandstone of Mesozoic period underlies the alluvium/ Tertiaries at some places in adjoining Surendranagar district. The Drangadhra sandstone forms prolific aquifer with good ground water quality.

One Exploratory well was drilled at Jetpar, taluka Morbi. The Deccan Trap was encountered at 68.00 mbgl. The compressor discharge was 84 lpm, the ground water quality was moderate (EC 2790), however the Fluoride concentration was more than permissible limits (2.50 ppm).

3.4.3 .Piezometer Construction

Surendranagar: The coastal area of the district is generally covered by Alluvium of Recent period which is underlain by semiconsolidated formation of Tertiary age. At places the Quaternary and Tertiary formations are underlain by Deccan Traps, and Wadhwan &

Dhrangadhra sandstones of Mesozoic age. The ground water occurs in Unconsolidated and Semi-consolidated formations. Ground water quality is variable in Alluvium and Tertiary formations. In Alluvium the fresh water floats over the saline water. Ground water quality is relatively fresh in Dhrangadhra formations.

Two wells (1 EW & 1 OW) were drilled in the soft rock areas in the district. The depth explored was 200mbgl. At Pratapgadh EW alluvium and sandstone were encountered in the depth explored and the quality of ground water is saline. Compressor discharge of 60 LPM was recorded. At Navaghanshaymgadh OW potable quality of groundwater was found.

During the AAP 2006-07, in all 19 Piezometers and 1 Slim hole were constructed tapping different Aquifers down to the depth of 450 mbgl.

Banaskantha, Gandhinagar, Mahesana, Patan and Sabarkantha districts form parts of the North Gujarat region and the future of ground water resources in this region is considered to be bleak due to recurrence of drought and excessive dependency on ground water. For the sake of rapid economic growth ground water resources are being exploited and ultimately cause decline in water levels at an alarming rate in this part of Gujarat. In this perspective improvement of good monitoring network is an ultimate necessity and to achieve this, construction of piezometers at close interval is indeed necessary for Ground Water Regime Monitoring purpose. During the field season 2006-07, 19 Piezometers and 1 SH were constructed in North Gujarat.

Two major aquifer units have been identified in the area. The upper unit is mostly unconfined and designated as aquifer 'A'. The lower unit, comprising a few hundred metres of alternating sandy and argillaceous beds, form confined aquifer system and the aquifers has been designated as 'B', 'C', 'D' and 'E' within post Miocene sediments, 'F' and 'G' in the Miocene sediments and aquifer 'H' in the Himmatnagar sandstone (Mesozoic). Aquifer 'A' shows the most favorable hydraulic parameters and contains the best quality of ground water in the vicinity of the recharge zone in the northeast. It deteriorates towards southwest. The same trends noticed in the confined aquifers also.

3.5 NORTH CENTRAL REGION (Madhya Pradesh)

Ground Water Exploration has been undertaken by constructing 46 EW, 19 OW, 2 PZ(Total-67 wells) in Betul, Satna, Dindori, Mandla, Bhopal &Hoshangabad districts given in table 3.8.

Table 3.8: District wise Details of Ground Water Exploration M.P.(in range)

Sl. No.	District	Depth Drilled (m.bgl)	SWL (m.bgl)	Discharge (lps.)	Formation
1.	Betul	49.80-305.10	2.01-34.5	0.4-16	Deccan Trap,Gondwana sandstone, Granitic gneisses, schists
2.	Mandla	66-202.5		0.63-1.13	Basalts, granites
3.	Dindori	43.90-203.10	4.93-19.5	1.5-12	Basalt
4.	Satna	38.4-205	4.3-17.5	2.7-12	Fractured sandstone & Shale & Siliceous Lime Stone

Betul district: Ground Water exploration was carried in Shahpur and Multai blocks of Betul district. Geologically, the area around Shahpura block is underlain by Gondwana formation (sandstone and shale) and the area around Multai block is covered by Deccan Trap formation (Basalt) and Archaens (Amla Granite). In Shahpura block, 3 number of exploratory wells and 1 no of Observation well have been drilled with depth ranging from 86.34 m bgl (Handipani) to 304.51 mbgl (Shahpura). The discharge of well at Shahpura is about 5 lps. Ground water quality at Shahpura is good for drinking and irrigation purpose.Ground water exploration was carried out in Multai block also. 6 exploratory wells and 2 observation wells have been drilled. The drilled depth ranges from 46.00 m bgl (Umaria) to 307.50 m bgl at Multai town. Ground water encountered at a depth of 219.00 m bgl, in granite with aquifer having a thickness of 9.00 m. at Khedli Bazar. The discharge was 12 lps. Depth to water level ranges from 16.22 m bgl to 56.60 m bgl. The ground water quality in Multai block is good for drinking and irrigation purpose.

3.6 NORTH CENTRAL CHHATTISGARH REGION (Chhattisgarh)

Under exploration drilling programme, 45 wells (29EW, 9 OW & 7 PZ)were drilled in Bilaspur, Janjgir-Champa, Durg, Rajnandgaon & Raigarh district of Chhattisgarh state.District wise Summarized details of ground water exploration given in table 3.9.

Table 3.9: District wise Summarized details of ground water exploration

Sl. No.	District	Depth drilled (mbgl)	Zones tapped/ Fractured encountered	SWL (mbgl)	Discharge (lps)	Draw down (m)	Formation
1	Bilaspur	77-204	22-25, 35-40, 50-58, 78-80& 96-98	4-28	1.8-90	2.4-9	Limestone &Shale
2	Janjgir-Champa	24 -200	16-22, 33-36, 40-45, 57-60, 78-80, 91-92	4-8	1.8-53.2	4-30	Limestone &Shale
3	Durg & Rajnandgaon	19.5-70	17-20, 35-40	3-5	0.5-6.0	upto 30 m	Limestone &Shale
4	Raigarh	33-196	30-40, 50-70,	7-32	1.8-10	25	Sandstone & Shale

3.6.1 District wise Salient features:-District wise Salient features of wells drilled are as follows

Bilaspur :- Most of the area in Bilaspur district is covered by the Chhattisgarh Super Group mainly consists of Limestone, Shale and Sandstone. Weathered zone was encountered down to 44.00 mbgl. Yield of the formation is moderately good. Transmissivity was worked out as 5-2198 m2/day. In Bilaspur District, 16 wells were drilled in hard rock area The sites were selected in consultation with PHED and forest department as per the exploration requirement.

Janjgir- Champa District :-The District is covered by Shale, Limestone, Dolomite, Sandstone and Granites. Ground water occurs under unconfined conditions in weathered mantle and semi-confined to confined conditions in fractured zones. Transmissivity was worked out as 5-604 m2/day.In Janjgir- Champa District 19 wells were drilled using departmental rig. sites were selected in consultation with PHED as per the exploration requirement.

Durg and Rajnandgaon Districts: The area is covered by Shale, Limestone, Dolomite, Sandstone, Rhyolite and Granites. Ground water occurs under unconfined conditions in weathered mantle and semi-confined to confined condition in fractured zones. Potential zone were encountered in the depth range of 17-20and 35-40 .Chandi Limestone forms potential aquifer in the area and the yield varies from 0.5 – 6.0 lps with a draw down of 30 m. Two wells were drilled in Durg District and one well in Rajnandgaon District ,using departmental rig.

Raigarh District:

In the Barakar formation of Raigarh district seven piezometers were drilled to study the behaviour of phreatic and shallow and confined aquifers in mining area The piezometers were drilled using departmental rig. The formations encountered and tapped during drilling is Sandstone of Barakar Formation.

The List of High Yielding wells are given in table 3.10.

Table 3.10: List of High Yielding wells in Chhattisgarh

Sl. No.	District	Location	Drilled depth (m)	Discharge (LPM)	Formation
1	Bilaspur	Chatauna	88.2	840	Hirri Dolomite
2	Bilaspur	Belmundi	171.4	1080	Hirri Dolomite
3	Bilaspur	Shivnagar	100.1	273	Barakar Sandstone
4	Bilaspur	Masturi	77.5	1500	Chandi Limestone
5	Bilaspur	Koni	81.7	1560	Pandaria Limestone
8	Bilaspur	Smritivatika	134.4	425	Hirri Dolomite
9	Janjgir-Champa	Chauranga	24	390	Limestone & shale
10	Janjgir-Champa	Bamnidih	105	222	Limestone & shale
11	Janjgir-Champa	Darrabhata	66.8	732	Dolomite
12	Janjgir-Champa	Bhothia	93.3	402	Dolomite
13	Janjgir-Champa		134.5	306	Limestone & shale
14.	Janjgir-Champa		153	300	Limestone & shale
15.	Durg		19.5	300	Limestone & shale

3.7 CENTRAL REGION (Maharashtra)

Ground Water Exploration has been undertaken in Maharasthra, constructing 62 wells in the districts of Akola, Sangli, Aurangabad & Raigarh.

3.7.1 Summarized Results Of Ground Water Exploration

The district-wise salient features of the exploratory boreholes drilled in hard rocks are given in table 3.11.

Table 3.11 : Summary of Results of Exploration in Hard Rocks Formations

Sl. No.	Salient Features	Nagpur	Akola	Aurangabad	Sangli	Raigarh
1	No. of Exploratory Wells drilled	2	6	21	13	7
2	Depth range (m.bgl)	103.70-305.10	183.30-304.00	110.20 – 200.0	136.0 - 200	145.0-200.0
3	Depth of casing (m.bgl)	9.50-38.00	4.65-88.10	5.25 –16.40	5.80-15.50	4.00-17.50
4	Number of zones encountered	1	1 –3	1-3	1-3	1-3
5	Thickness of individual zone (m)	0.50-5.00	1.00-9.00	0.60-17.10	0.50-3.00	1-3
6	SWL range (m.bgl)	8.51-27.00	0.95->100.00	0.80 – >100.0	3.10 – 57.40	0.98-10.30
7	Yield range (lps)	0.14-0.78	0.14-2.15	0.02 – 25.05	0.43 – 33.63	0.05 to 12.18
8	No. of EW's with yield more than 3 lps	-	-	4	2	3
9	Formation	Alluvium/ Granitic Gneiss	Deccan Traps	Deccan Traps	Deccan Traps	Deccan Traps

Out of 49 exploratory bore wells drilled, 9 EW's have yielded more than 3 lps, which is 18 % of total wells constructed. The details of high yielding wells in Maharasthra is given table 3.12.

Table 3.12: Details of High Yielding wells in Maharasthra

Sl. No.	District	Location	Drilling Depth (m.bgl)	Discharge (lpm)	Formation
1	Aurangabad	Fardapur	110.20	1503	Weathered fractured massive basalt
2	-- do --	Mehegaon	200.00	730	Weathered fractured vesicular basalt
3	-- do --	Ajanta	200.0	190	-- do --
4	-- do --	Shoygaon	200.00	190	Fractured Massive basalt
5	Sangli	Ghatnandre	98.90	2017	Highly fractured vesicular basalt
6	-- do --	Chinchani (Wangi)	200.00	265	-- do --
7	Raigad	Poladpur	170.00	730	Vesicular basalt
8	-- do --	Karanjadi	145.00	336	-- do --
9	-- do --	Wadghar	200.00	226	-- do --

3.8 NORTHERN REGION (Uttar Pradesh)

Ground Water Exploration in U.P has been undertaken in Lakhimpur Kheri, Balrampur ,Ballia, Meerut, Gonda, Noida,Lalitpur, Sant Ravidas Nagar, Chandaluli, Banda, Mahoba & Jhansi and constructed 26 EW, 22 OW, 9 PZ(Total –57 wells)

The Summarized details of Ground Water Exploration in the State are given in table 3.13.

Table 3.13: Summarized details of Ground Water Exploration in the State

Sl. No.	District	Maximum Depth Drilled	Zones tapped/ Fracture encountered (m)	Max SWL (mbgl)	Discharge (lpm)	Formation
	Exploratory wells in Alluvium					
1.	Ballia	358.00	164-341	5.20	378-624	Alluvium
2.	Chandauli (N/D)	137.00	74-128	7.98	1000-3000	Alluvium
3.	Lakhimpur Kheri	361.00	320-352	3.80	-	Alluvium
4.	Meerut	602.25	490-526	9.74	-	Alluvium
5.	Sant Ravidas Nagar (N)	200.00	110-164	8.74	-	Alluvium
	Exploratory wells in Hard Rock formation					
1.	Banda (D)	166.15	Fr 28-99	23.80	660	Granite
2.	Jhansi (D)	174.80	Fr. 57-160	7.00	200	Granite
3.	Lalitpur(D)	173.80	Fr. 8.10-138.00	13.35	700	Granite
4.	Mahoba (D)	166.40	13.65-84.00	10.00	360	Granite

(in range)

Piezometrs construction

1.	Ghaziabad (N)	54.25	33-39, 42-45	-	166	Gangetic Alluvium
2.	Noida	151.75	22-49	11.50	162	Gangetic Alluvium
3.	Meerut	52.00	42-48	6.11	-	Gangetic Alluvium

3.8.2 Highlights of Ground Water Exploration

Ballia : To mitigate the problems arising due to Arsenic contamination in ground water at sporadic spots in the villages located mostly in Recent flood plain of Ganga and Ghaghra rivers, two departmental rigs (350 m drilling capacity) were deployed for delineation of aquifers with arsenic free formation water for safe drinking water supply. Exploratory drilling was taken up at two sites viz. Gaighat and Haldi Rampur

were explored. At Gaighat site three tube wells (about 111.00 m, 149 m & 234 m depth), tapping granular zones of shallow, middle and deeper aquifers separately, were constructed to find out arsenic concentration at different depths. The collapsing nature of the sediments of shallow aquifer group was the big constraint in construction of deep tubewells. Due to predominance of finer sediments in deeper aquifer group, slotted pipe with 0.75 mm slot opening were found most suitable for this area. The tubewells are yet to be finally tested for hydrological parameters and to ascertain arsenic concentration during the various stages of pumping and other chemical constituents. It appears that the ground water occurring below the depth of 100 mbgl is almost arsenic free, as tested at few sites through field kits. The discharge of deep tube wells through air compressor varies from 378 to 624 lpm.

Chandauli : The district lies in the south eastern most corner of the state. The major geological formations are Quarternary alluvium as soft rock in the northern part whereas Vindhyan sandstone as a hardrock formation in the southern part of the district. The dugwells/hand pumps drilled manually or by hand boring set between depth 20-36m yield 50-100lpm. The shallow tubewells drilled by Rotary Rigs (Direct/Reverse) between depth 50-100m yield 1000-1500 lpm whereas deep tubewells drilled by Rotary (Direct) rigs between depth 100-150m (basement encountered) yield 2000-3000 lpm. The results of ground water exploration carried out through drilling of explorlatory well at village Muzaffarpur in Chakia block.reveals that the fractures encountered in Vindhyan sandstone are quite potential having high discharge.Since the area is drought prone and shortage of drinking water is felt one exploratory well was drilled down to 137mbgl at Bhurkura site. The static water level rests at 7.98mbgl.

Lakhimpur Kheri : Geologically the area is underlain by Quaternary alluvium consisting of clay, kankar, sands of various grades & gravels in different proportions. The results of exploratory drilling carried out down to the depth of about 450 mbgl indicate the existence of mainly three tier aquifer system in the district. The ground water occurs under water table condition in shallow aquifer and in deeper aquifer it occurs in confined condition.

One EW tapping IIIrd aquifer, one OW tapping Ist aquifer and one OW tapping IInd aquifer were constructed at Rampurwa site. One OW was constructed at Trilokpur site. The exploratory well is yet to be tested to compute hydrological parameters and to ascertain arsenic concentration during the various stages of pumping and other chemical constituents.

Meerut : The deep drilling rig was deployed in the district falling under northern half part of Ganga-Yamuna Doab with the objective to delineate aquifer systems, assessment of potentiality and sustainability of underutilized deeper aquifer(s) since first aquifer being under much stress/ overdeveloped.

The pilot hole was drilled down to 602.25 mbgl at Timkia Kothi and the same waselectrically logged down to 510 mbgl. Based on the interpretation, it is observed that four-tier aquifer system exists at the depth of 0-100, 140-315,330-470 & 485-600mbgl .Keeping the objective in view a well field consisting of 01 EW tapping IVth aquifer (490-526 mbgl), 01 EW tapping IInd aquifer, 02 OW tapping IInd aquifer at

different distance and 01 Pz tapping Ist aquifer, has been developed at Timkia Kothi site in the district during the year.

It is proposed to conduct long duration pumping test on exploratory tubewell tapping IInd aquifer to ascertain its potentiality and sustainability. The effect of pumping will be observed on the observation wells constructed at different distances tapping identical aquifer and piezometer tapping Ist aquifer.

Sant Ravidas Nagar : The area is underlain by marginal quaternary alluvium. During the year exploratory drilling was carried out down to 200 mbgl at two different sites (Suriyanwan and Kariaon). At these sites exploratory tubewells tapping the granular zones in the depth range of 110-164 and 130-160 respectively were constructed. The wells are yet to be developed for conducting pumping test.

Banda : The district is one of the drought-prone districts of U.P. The northern part of the district is covered by Quarternary alluvium. The alluvial thickness gradually decreases to the south and in the southern half of the district hard rocks (Bundelkhand Granites/ Gneisses) are exposed. Alluvium in the northern part forms potential aquifer. In hard rock area, ground water occurs mainly in the weathered mantle and the rocks having fractures and joints.

The exploratory drilling was confined to the hard rock area of the district. 04 exploratory wells were drilled in the depth range of 99.05 to 166.15 mbgl. The yield of exploratory wells ranged from 180 to 660 lpm.

Jhansi : The district is one of the drought-prone districts of U.P. Major part of the district is underlain by Bundelkhand Gneissic Complex (BGC) of Archaean age. The northern part of the district is covered by Quaternary alluvium overlying the BGC. In the area covered by hard rocks ground water occurs under water table and semi-confined conditions in the weathered zone and in joints and fractures in fresh rocks below the zone of weathering, with no hydraulic continuity. However, in the northern part of the district, alluvium forms potential aquifer.
The exploratory drilling was confined to the hard rock area of the district. During the year only one exploratory well was drilled at Tanako Dram down to 174.80 mbgl which yielded 200 lpm

Lalitpur : The district is one of the drought-prone districts of U.P. and is underlain by Bundelkhand Gneiss / granites, schists, quartz reefs and mafic rocks, which are overlain by limestones, shales and quartzites of the Bijawar Series. The Vindhyan sandstones rest over both the Bundelkhand Gneiss and Bijawar Series. Ground water occurs under water table and semi-confined conditions in the weathered zone and in joints and fractures in fresh rock below the zone of weathering.There appears to be no hydraulic continuity of aquifer in the district.

A total of 09 EW in the depth range 125.00-173.80 mbgl and 02 OW were drilled in the granitic terrain of the district. The yield of 07(eight) exploratory wells ranged between 50 and 400 lpm. The exploratory well drilled at Mirchwara site yielded 1350 lpm during the drilling. However, exploratory well drilled at Nanaura yielded only 08 lpm. The static water level ranges from 1.60 to 13.35 mbgl.

Mahoba : It is one of the drought-prone districts of Uttar Pradesh. The area is mostly covered by Bundelkhand granites and basic intrusives of Pre-cambrian age with a small patch of Alluvium in the north eastern part of the district. Ground water development in the district takes place through open wells dug-cum-bore wells and shallow tubewells constructed at favourable sites.The yield of dug wells/ hand pumps drilled down to the depth between 10-20m by Manual/Blasting/DTH rig varies fro 50 to 60 lpm. Bore wells drilled down to the depth between 30-100m yield between 60 and 500 lpm

During the year total 04 EW have been drilled in depth range of 154-166.4 mbgl. At three sites 1-5 fractures have been encountered at variable depths but within 84 mbgl in the granite. The static water level varies from 4.10 to 10.00 mbgl. The yield of the wells during drilling varied from 30 to 360 lpm is given in table 3.14.

Table 3.14: List of High Yielding wells

S.No.	District	Location / site	Drilled depth (m)	Discharge (LPM)	Formation
1.	Lalitpur	Mirchwara	125	700	Granite
2.	Gudhakala	Banda	99.05	660	-

3.9 UTTARANCHAL REGION(Uttarakhand)

During 2006-2007, one exploratory well was constructed at Jamankhata, Sahaspur block, Dehradun district. Drilling was carried out down to a depth of 158.0 m bgl using percussion drilling technology The well assembly was recommended after carrying out Geophysical Logging up to a depth of 146.0 m bgl. The logging indicated presence of ten potential zones with thickness of each zone varying from 3.0 m to 7.0 m in Doon gravels The resistivity of drilling mud was 20 ohm.m at 25ºC. Finally, the well assembly was recommended down to a depth of 112.0 m bgl and four distinct zones i.e 60-64,72-84,87-99,105-109 m were identified having thickness varying from 4 to 12 m. The discharge during the compressor development was measured to be 1075 lpm and the static water level was measured as 27.27 m bgl. The well is high yielding

3.10 MID EASTERN REGION(Bihar & Jharkhand)

Under ground water exploration 43 wells (17 EW, 11 OW, & 15 PZ) has been constructed in Patna, Samastipur, Buxar, Jamui, Lakhiserai, Munger, Bhojpur(Bihar) & Gumla & Ranchi(Jharkhand). Six PZs have been drilled in the Ranchi Urban area, Jharkhand.

3.10.1 Highlights of exploration

In alluvial formations two rotary rigs were deployed in **Samastipur, Buxar and Patna** districts which drilled 09 peizometers and 03 exploratory wells. The peizometers has been drilled for assessing arsenic concentration in ground water of aquifers disposed at various depths. It has been observed that the aquifers are affected with arsenic down to a depth of 60 m (considering max. permissible limit as

50 ppb).The exploratory wells have been drilled up to depth of 307 m bgl with an objective to tap sufficient thickness of arsenic free aquifers for drinking water supply in the Arsenic affected localities. The aquifers are potential and very high yielding. The transmissivity is observed to be about 7000-8000 m^2/day. The Storativity value is 2.72 $x10^{-5.}$ The aquifers tapped in the exploratory wells are confined in nature.

In fluoride affected areas of **Jamui, Munger and Lakhisarai** districts, wells have been drilled in hard rock formations (mainly Pre-cambrian granite gneiss) up to a depth of 120 m through deployment of one DTH rig. A total of 7 EWs and 7 OWs have been drilled with an objective to tap fluoride free fractures so that the wells are used for drinking water supply to the affected localities. High discharge wells (>5lps) have been drilled at Havelikharagpur, Bhalua koul and Ramankabad.

The other DTH Rig has been deployed for Ground water exploration in the unexplored tribal areas of Jharkhand. A total 7 EWs and 2 OWs have been drilled in tribal area of **Jharkhand in Gumla** districts. A discharge of 13.32 m^3/hr has been obtained from the well located at Toto. Transmissivity is observed to be 15 m^2/day and storativity is 5.84 $x10^{-6}$.

In **Ranchi** urban area 06 piezometers have been drilled to study the temporal variation in piezometric level of fractures located at various depths. The objective is to study the impact of urbanisation upon existing ground water regime.

Table 3.15: Aquifer parameters of exploratory wells tested during 2006-07

Sl. No.	Locations	District	SWL (m bgl)	Discharge (m^3/hr)	Draw down (m)	T (m^2/day)	S
1.	Karnamepur	Bhojpur, Bihar	6.55	194.58	9.91	5720	$6.35x10^{-4}$
2.	Bharauli	Bhojpur, Bihar	4.16	182.79	8.48	8920	$2.72x10^{-5}$
3.	Gayaspur	Patna, Bihar	9.18	194.61	2.69	19425	-
4.	Barh	Patna, Bihar	9.19	191.25	4.40	9333	$1.79x10^{-2}$
5.	Nabinagar-II	Jamui, Bihar	6.16	380.16	22.35	12	$4.89x10^{-4}$
6.	Nabinagar-III	Jamui, Bihar	6.35	7.68	17.0	6	-
7.	Toto	Gumla, Jharkhand	5.64	13.32	29.40	15	$5.84x10^{-6}$
8.	Kumardungi	W.Singhbhum, Jharkhand	8.04	11.3	2.58	75	$5.6x10^{-1}$
9.	Bharno	Gumla, Jharkhand	2.63	5.4	20.16	6	$3.9x10^{-5}$

3.10.2 List of High Yielding Tube wells

The details of high yielding tube wells drilled in Bihar are given in table 3.16.

Table 3.16: High yielding tube wells drilled in Bihar2006-07 (>5 lps discharge)

Sl No.	District	Location/Site	Drilling Depth (m)	Discharge (m^3/hr)	Formation
1	Patna	Barh	278.60	191.25	Quaternary Alluvium.
2	Samastipur	Madudabad	302.00	180.00	-do-
3	Buxar	Brahmpur	250.42	180.00	-do-
4	Jamui	Tajpur	92.40	24.12	Consolidated formation
5		Barhat	50.45	24.12	-do-
6	Munger	Havely Kharagpur	56.50	24.12	-do-
7		Bhalua Kaul	50.60	21.60	-do-
8		Ramankabad-II	49.50	24.12	-do-

3.11 EASTERN REGION (West Bengal)

Ground Water exploration was taken up in 6 districts of West Bengal and 33 wells(26 EW & 7 OW) were drilled. The details of wells constructed and Details of Ground Water Exploration in West Bengal are given in table 3.17 & 3.18.

Table-3.17: Details of wells constructed in West Bengal

Sl. No.	District	No of wells constructed				
		EW	OW	SH	PZ	Total
1	Darjeeling	2	-	-	-	2
2	Uttar & Dakshin Dinajpur	6	2			8
3	Barddhaman	6	-	-	-	6
4	Malda	3	1	-	-	4
5	Haora	4	2			6
6	N-24 Pargana	5	2	-	-	7
Total		**26**	**7**			**33**

Table-3.18 District-wise Summarized Details of Ground Water Exploration in West Bengal (in range)

District	Depth drilled (mbgl)	Zones tapped / fracture encountered (m bgl)	SWL (m bgl)	Discharge in m^3/hr	Drawdown (m)	Aquifer Parameters (T & S)	Forma-tion
Darjeeling	Upto 146	60-131	8.1	61.92	3.08	T-385.65m2/day	Bouldary
Uttar Dinajpur	250	86-245	3.88-6.3	31.8-43.63	2.59-11.62	T- 495-1300 m2/day	Alluvium

Dakshin Dinajpur	250	168-195	3.21	38.17	6.97	T- 2095 m2/day	Alluvium
Barddhaman	100-350	36-218	4.85-8	14.76-47.7	2.68-10.84	-	Alluvium
Malda	160-250	36-241	5.44	30-167	-	-	Alluvium
Haora	250	206-242	9.05-11.20	-	-	-	Alluvium
N-24 Pargana	50-250	22-246	3.24-4.08	47-54	1.15-3.10	T-1733 to 4555 m2/day S-1.38-3.32X10-1	Alluvium

3.12 NORTH EASTERN REGION (Assam, Arunachal Pradesh, Meghalaya & Tripura)

A total of 21 Exploratory wells and 8 observation wells were constructed during 2006-07 which are given in table 3.19 & 3.20.

Table 3.19: District wise achievements under different heads

Sl No.	State	district	Achievement		
			EW	OW	Total
1	Assam	Southern parts of Sibsagar	3	2	5
2		Parts of Bongaigaon & Barpeta	3	2	5
3		Fringe area of South Kamrup & Goalpara	6	1	7
4	Arunachal Pradesh	Tirap District	2	--	2
5	Meghalaya	East Garo Hill & Ribhoi	3	1	4
6	Tripura	Greater Agartala, West Tripura	3	2	5
		Total	**21**	**8**	**29**

3.20: District wise Summarized details of Ground Water Exploration in the State (in range)

District	**Depth drilled (mbgl)**	**Zones tapped/ fractures encountered**	**S.W.L (m bgl)**	**Dicharge m^3/hr.**	**Drawdown (m)**	**Aquifer parameters (T&S)**	**Formation**
Southern parts of Sibsagar District, Assam	110-200	47-138	4.3-15.1	17-42	-	-	Alluvium
Barpeta district, Assam	117-203	67-175	2.29-4.14	46.55	1.27-1.87	--	Alluvium
Parts of Bongaigoan district, Assam	81.25	33-54, 62-92.	3.03	46.54	1.46	T=4758 m^2/day K=176 m/day	-- Do --

Goalpara district, Assam	184-201	46-171	2.32-10.0	7-30	-	-	Granite Gniess
Kamrup district, Assam	90-202	34-232	0.55 agl-6.24mbgl	3-46	25.04	T= 3.47 m²/day (Krishnanagar)	Granite Gniess
West Tripura.	108-200	69-194	20-27	6.07-37.24	3.32-4.46	T= 186.67-1225.31 m^2/day	Tertiary
Ri-Bhoi District, Meghalaya	174.5-201.8	41-195	7-41	-	4.49-10.17	T=23.87m²/day(Mawhati)	Granite
East Garo Hills, Meghalaya	214.70	--	-	-	-	--	Granite Gniess Abandoned
Tirap District, Arunachal Pradesh	91.50	78-87	-	-	-	-	-
Lohit district, Arunachal Pradesh	64.00	34-40, 43-52	-	-	-	-	-

3.12.3 Highlights of Ground Water Exploration

Parts of Sibsagar District(Assam): A total of 3 Exploratory and 2 observation wells were constructed in parts of Sibsagar district of Assam. Exploration was carried out down to depth of 200.7m in alluvial deposit and confined to southern part of the district. Aquifers are mainly fine to medium and coarse grain sand and becoming finer towards deeper depth. About 4 aquifers seem to be continuous in the area. The discharges of the aquifer zones were found to vary from 283 to 708 lpm with draw down within 4 m.

Barpeta District(Assam): Exploration activities were carried out in the flood plains of Brahmaputra in the southern part of the district down to 203.25 m in alluvial deposits reveals promising potential aquifers within drilled depth. Granular zones consist of fine to coarse grain sand, gravel and are homogeneous in nature. A total of 3 exploratory and 2 observation wells were constructed. Discharge potential records around 750 lpm for a draw down less than 2m. Specific capacity values are above 300 lpm/m. Entire southern part of the district seems to hold high ground water potential.

Bongaigaon District(Assam) : Parts of Bongaigaon district occupied with older alluvium was covered under exploration down to a depth of 81.25m beyond this depth drilling could not be carried out due to encountering of boulders. A total of 3 exploratory and 2 observation wells were constructed. The granular zones encountered during drilling are mainly medium to coarse grain sand and gravel. Drilling with Direct Rotary rig faces lot of problems of caving while drilling in bouldery formation and as such further drilling is not possible. The discharges of aquifers are found to be on higher side. The draw down for less than 2 m is observed for discharge of above 700 lpm. Hydraulic parameters like T&K are found to be more than 4500m²/day and 176m/day respectively.

Goalpara district(Assam) : In Goalpara district 3 exploratory wells were drilled and wells were constructed down to the depth range of 184.04 --201.70 m bgl. One at Goalpara civil hospital and the other one at Darranggiri of Rongjuli block. In Goalpara, hard rock is encountered at a depth range of 25 to 30 mbgl whereas in Darranggir hard rock encountered at a depth of 69 mbgl. The formation encountered during drilling is mainly Granite gniess. Fractures encountered in these rocks are found productive with a discharge varies from 117 to 500 lpm.

The analysis of water samples collected during air compressor development of Daranggiri bore well reveals the presence of high content of Fluoride (5 to 6ppm). Hence the water of Daranggiri bore well is not recommended for drinking purposes.

Kamrup District(Assam): Ground water exploration activities are taken up in the south eastern part of Kamrup district where a row of hillocks of Archean Granite gniessic complex are seen. The thickness of the unconsolidated sediments varies from place to place because of the uneven bed rock configuration over which the sediments were deposited. 03 exploratory and 01observation wells were constructed in the hard rock areas of Kamrup district. The formation encountered during drilling consists of granite gniessic of Precambrian age. Depth of drilling varies from 90–251.30m. Static water level ranges from AGL to 6.24m bgl. High potential fractures are encountered at Hahim and Krishnanagar Exploratory bore hole. Discharge of the wells varies from 31 to 766 lpm. The well constructed at Krishnanagar is an auto flow well.

West Tripura District(Tripura): In West Tripura district 3 EW and 2 OW were drilled down to 200.45m each in and around Agartala . Fine grained sandstone of Tipam Group has been encountered during drilling. The discharge of the exploratory wells varies from 100 to 600lpm for a draw down varying from 3- 5 m. Static Water Level varies from 10.69 to 27.83 m bgl. Chemical analysis of water samples reflects presence of higher percentage of Fe.

East Garo Hill District(Meghalaya): Only one exploratory well is drilled down to 214.70 m bgl . The formation encountered during drilling consists of pink Quartzofeldspethic Granite Gniess. No fracture zones has been encountered during entire course of drilling.

Ribhoi District(Meghalaya): : A total of 02 EW and 01 OW were constructed in Ribhoi district of Meghalaya. Drilling depth varies from 174.5 to 201.80 m bgl. The formation encountered during drilling consists of Quartzite and Granite Gniess. Only the fractures encountered in Mawhati well has potential. The discharge varies from 44lpm to 284 lpm. Static water level varies from 7.00 to 41 m bgl. Results of pump test carried out at Mawhati tube well reveals that the Transmissivity is 23.87m² /day and the draw down is 10.17m

Lohit District(Arunachal Pradesh) : One exploratory well was drilled at Namliang Village in Lohit district down to 64 m bgl and well was constructed down to 55m bgl. The formation encountered during drilling consists of recent deposit like clay, silt, sand, pebbles and gravels.

Tirap District(Arunachal Pradesh): One exploratory well was drilled at Surjipathar Village in Tirap district down to 91.50 m bgl. Assembly was recommended down to 90m bgl by tapping granular zones from 78 to 87m bgl.

The list of High yielding wells in Assam is given in table 3.21

Table 3.21: List of High yielding wells in Assam

Sl No	District	Location / Site	Drilling Depth (m)	Discharge (LPM)	Formation
1	Kamrup	Hahim	90	766.6	Hard rock formation (Granite Gniess) in all
	Kamrup	Krishnanagar	202.25	Auto flow	
	Goalpara	Darnaggiri	194.30	500	

3.13 SOUTH EASTERN REGION (Orissa)

Ground water exploration was undertaken in 5 districts in the hard rock areas of Angul, Dhenkanal, Balasore, Mayurbhanj, Ganjam, Kalahandi and Sundargarh districts and in the alluvial tracts of Balasore district. District wise achievements are given in table 3.22 & table 3.23.

Table 3.22: District-wise achievements under following heads (Tribal, Drought, Normal)

Sl No	District	Achievement		
		EW	OW	TOTAL
1	Kalahandi	10	2	12
2	Balasore &Mayurbhanj	10	2	12
3	Dhenkanal & Anugul	11	2	13
4	Sundargarh / Jharsuduga	25	2	27
5	Ganjam district/ Gajapati	11	2	13
6	Balasore	6	1	7
Total		**73**	**11**	**84**

Table 3.23: District wise Summarized details of Ground Water Exploration

Sl No	District	Depth Drilled mbgl	Zones tapped / Fractures Encountered mbgl	SWL mbgl	Discharge m^3/hr	Draw down m	(T) m^2/day	Formation/ Aquifer
1	**Angul**	68.45 - 202.70	10 - 20, 45 - 65, 80 - 100	3.57 - 6.95	Negl - 43.3	15.74 - 24	2.99	Granite Gneiss, Gondwana Sandstone
2	**Dhenkanal**	56.25 - 166.05	10 - 20, 40 - 60, 90 - 100, 120 – 125	2.5-7.5	10.1 – 19.8	20	38.78	Granite Gneiss
3	**Balasore-(Hard**	32.00 - 185.00	15 - 25, 35 - 45, 60 - 80	2.2 - 20.1	1.8 – 72	4.55 - 12.45	10.55 -	Granite, Granite

	Rock)						178.3	Gneiss, Gabbro
4	**Balasore-(Alluvium)**	50.00 - 103.09	20 - 30, 35 - 65, 70 - 80	4.6 - 12.4	14.4 – 45	8.81 - 11.3	142 - 299	Recent Alluvium
5	**Ganjam**	63.00 - 175.80	15 - 35, 45 - 60, 110 - 120	1.2 - 8.8	Negl – 37.8	13.12 - 29.84	7.61	Granite Gneiss, Granodiorite, Basic Rock
6	**Kalahandi**	86.87 - 167	15 - 30, 45 - 60, 70-90, 110 - 120	1 - 5.3	1.8 – 54	3.37 - 17.38	2.23 - 64.13	Granite Gneiss
7	**Sundargarh**	51.00 - 166.30	20 - 40, 60 - 75, 90 - 105	3.5 - 25.0	0.7 - 36	3.36 - 20.97	2.66 - 58.6	Mica Schist, Granite, Sandstone

3.13.3 Highlights of Ground Water exploration is given below

Angul / Dhenkanal District : In the Angul district, 8 exploratory wells and 1 observation well was constructed during 2006 - 07. The major formation encountered are granite, granite gneiss and sandstones. The depth of drilling varies from 68.45 metres below ground level in Nuapada to 202.70 metres below ground level at Tentulihata with the overburden depth ranging from 6 metres below ground level at Kukudang to 22.8 metres below ground level at Talchir. On an average two to three sets of potential fractures were encountered within 100 m depth except for Gondwana sandstone aquifers which yielded water all throughout the formation. The cumulative discharge varies from negligible at Chainpal to 12.03 lps at Nuapada. The static water level varies from 3.47 metres below ground level at Gaudasai to 6.95 metres below ground level at Tentulihata. The average transmissivity value is around 2.99 m^2 /day.

In the Dhenkanal district, 3 exploratory wells and 1 observation well have been drilled. Granite gneiss is the predominant formation encountered. The depth of drilling varies from 56.25 metres below ground level at Narendrapur–Gopalpur to 166.05 metres below ground level at Meramandali with overburden depth ranging from 6 metres below ground level at Narendrapur-Gopalpur to 16 metres below ground level at Kharagaprasad. Generally three potential fractures on an average are encountered within 100 metres below ground level depth but rarely potential fracture beyond 100 metres below ground level is encountered. The cumulative discharge varied from 2.8 lps at Meramandali to 5.5 lps at Narendrapur Gopalpur. The static water level varies from 2.50 metres below ground level at Meramandali EW to 7.50 metres below ground level at Kharagaprasad EW. The average transmissivity values in the wells tested were found to be around 38.78 m^2 /day.

Balasore District : In the hard rock terrain of Balasore district, 10 exploratory wells and 2 observation wells have been drilled. The depth of drilling varies from 32 metres below ground level at Telipal-Ashram School to 185 metres below ground level at Rigidi The formations encountered are in general granite and granite gneisses and gabbro. The depth of overburden varies from 3.10 metres below ground level at Berhampur-Mandir Sahi to 23.30 metres below ground level at

Kuarnpur Mahal-Tailasahi. Mostly 2 – 3 sets of saturated fracture zones have been encountered mostly within a depth of 50 metres below ground level. Cumulative discharge of wells varies from 0.5 lps at Berhampur and Rigidi to 20 lps at Telipal. The static water level varies from 2.20 metres below ground level at Raipal to 20.10 metres below ground level at Kuarnpur Mahal. The residual drawdown varies from 4.45 metres at Raipal to 12.45 metres at Telipal.

In the alluvial tract of the district, 6 exploratory wells and 1 observation well have been constructed through the rotary rig, deployed in the area. Formation encountered are alternate layers of sands and clays with occasional presence of thin semi consolidated arenaceous and calcareous materials. Sand and gravels are very fine to coarse in texture, angular to sub-angular and sub-rounded in shape with moderate sorting. These are mostly quartzo-feldspathic in composition with ferruginous concretion at shallow depths. On an average three to four sets of granular zones are encountered in the depth range of 20 – 80 metres below ground level with average thickness of 10 metres. The yield of these wells varies from 4 lps at Matiali to 12.5 lps at Arad Bazar. Drawdown ranges from of 8.81 metres at Arad Bazar to 11.3 metres at Darjipokhari. The transmissivity varies from 142 m^2/day at Darjipokhari to 299 m^2/day at Bankakhejuri. The static water level varies from 4.59 metres below ground level at Matiali to 12.38 metres below ground level at Arad Bazar.

Ganjam District : In Ganjam district, 11 exploratory wells and 2 observation wells have been drilled during 2006 – 07. The depth of drilling varies from 63 metres below ground level at B. Turuburi to 166.7 metres below ground level at Pratapgiri. Formation encountered are mainly granite, granite gneiss, granodiorite and basic rocks. The depth of overburden varies from 8 metres below ground level at Chudangapur to 23.50 metres below ground level at Erandra. The yield of the wells varies from negligible at Dharmamayapur and Pratapgiri to 10.5 lps at Adapada. Two to three sets of saturated fractures zones exists within a depth of 120 metres below ground level. The static water level varies from 1.21 metres below ground level at Khemundi College to 8.81 metres below ground level at Pratapgiri. The drawdown varies from 13.12 metres at B. Turuburi to 29.84 metres at Khemundi College. The transmissivity values averages around 7.61 m^2/day.

Kalahandi District : In Kalahandi District, 10 Exploratory wells and 2 observation wells have been drilled during 2006–07. The depth of drilling varies from 86.87 metres below ground level at Gudialipadar to 167 metres below ground level at Rishigaon. Formations encountered are granite, granite gneiss and its variants. The depth of overburden varies from 7.50 metres below ground level at Badili and Singhjharani to 20.52 metres below ground level at Dungargarh. The yield of wells varies from 0.5 lps at Jamunabahal to 15 lps at Badili. Three to four sets of saturated fracture zones are mostly encountered in the range of 15 – 100 metres below ground level. The static water level varies from 1 metres below ground level at Jamunabahal to 5.3 metres below ground level at Bhikapada. The drawdown varies from 3.37 metres at Singhjharani to 17.38 metres at Jaring. The transmissivity value varies from 2.23 m^2/ day at Dungargarh to 64.13 m^2/ day at Badili.

Sundargarh District : In Sundargarh District, 25 Exploratory wells and 2 observation wells have been drilled during the year 2006–07. The depth of drilling varies from 51 metres below ground level at Chhamunda to 166.30 metres below

ground level at Bhedabahal and Bargaon. Formation encountered are mica schist, granite and sandstone. The depth to overburden varies from 6.75 metres below ground level at Kamlaga to 29.30 at Lefripara. The yield of the well varies from 0.2 lps at Bindujharia to 10 lps at Grinkela. Mica schists have poor yields. Granite and granite gneiss have poor to moderate yields and yield is higher where granites are intruded by pegmatite veins. In general two saturated fracture zones within 100 metres below ground level are of most common occurrence. The exploratory well at Chammunda was abandoned due to the occurrence to weathered shaly formation resulting in well collapse. The static water level varies from 3.50 metres below ground level at Bandhapalli and mangaspur to 25 metres below ground level at Gandapara. The drawdown values varies from 3.36 metres at Grinkela to 20.90 metres at Kamlaga. The transmissivity values vary from 2.66 m^2/day at Rangyamunda to 58.6 m^2/day at Grinkela.

List of high yielding wells of Orissa is given in table 3.24

3.24 List of high yielding wells of Orissa

Sl No	District	Location	Drilling Depth(m)	Discharge (LPM)*	Formation
Hard Rock Terrain					
1	Angul	Motanga - EW	80.7	720	Fractured Granite Gneiss
2	Angul	Nuapada-CESU - OW	68.45	721.8	Fractured Granite Gneiss
3	Balasore	Chekamara - EW	62.5	960	Gabbro
4	Balasore	Chekamara - OW	62.5	702	Gabbro
5	Balasore	Kuarpur Mahal(Tailasahi) - EW	78.8	300	Granite
6	Balasore	Raipal - EW	56.4	660	Granite Gneiss
7	Balasore	Raipal - OW	54.9	900	Granite Gneiss
8	Balasore	Telipal - Ashram School - EW	32	1200	Basic Rock(Gabbro)
9	Dhenkanal	Kharagaprasad - EW	129.45	332.28	Fractured Granite Gneiss
10	Dhenkanal	Narendrapur Gopalpur - EW	56.25	330	Fractured Granite Gneiss
11	Ganjam	Adapada - EW	121	630	Fractured Gneiss
12	Kalahandi	Badili - OW	129.57	900	Granite Gneiss
13	Kalahandi	Gudialipadar - OW	86.87	300	Granite Gneiss
14	Sundargarh	Kamlaga - EW	62.6	360	Shale, Siltstone and Sandstone
15	Sundargarh	Kamlaga - OW	62.6	360	Shale, Siltstone and Sandstone
16	Sundargarh	Grinkela - EW	70	600	Siliceous Limestone
17	Sundargarh	Rangyamunda - EW	95	510	Granite intruded by Pegmatite
18	Sundargarh	Rangyamunda - OW	95	510	Granite intruded by Pegmatite
Alluvial Terrain					
1	Balasore	Arad Bazar - EW	103.09/70	750	Alluvium
2	Balasore	Darjipokhari - EW	102.91/64	660	Alluvium
3	Balasore	Mardrajpur - EW	89.12/61	720	Alluvium
4	Balasore	Makhapada - EW	107/43	600	Alluvium

Autoflow well at Poradiha, Bhadrak District, Orissa

Auto Flow Well(Brakish) – Brahmagiri Block, Puri District

3.14 SOUTH WESTERN REGION(Karnataka)

Ground water Exploration in Karnataka has been undertaken by constructing 42 wells(32EW & 10 OW). District wise target and achievement in Ground Water Exploration is given in table 3.25 and District wise summarized details of ground water exploration is given in table 3.26

Table 3.25: District wise target and achievement in Ground Water Exploration.

Sl.NO	District	Target			Achievement		
1	Davanagere/Chitradurga	EW	OW	Total	EW	OW	Total
		10	04	14	13	04	17
2	Mandya	10	04	14	05	02	07
3	Uttara Kannada	10	04	14	08	02	10
4	Kolar-Deep drilling	05	02	07	05	02	07
5	Bidar	10	04	14	01	-	01
	Total	**45**	**16**	**63**	**32**	**10**	**42**

Table 3.26: District wise summarized details of ground water exploration:

District	Taluks	No. Of wells	Depth range in mbgl	Discharge range in lps	Geology
Davanagere	Jagalur H.P.Halli Harihara	04 06 02	120.82-200.19	0.07-4.39	Schist/Granite gneiss
Chitraurga	Hosadurga	05	154-200	1.5-10.12	Schist/Granite gneiss
Mandya	Maddur Mandya	03 04	123-200	0.014 -7.0	Granite gneiss
U.Kannada	Ankola Kumta Honnavar Karwar	04 01 01 04	65.0-180	0.07- 5.4	Granite gneiss. Chloride schist, meta basalt &Granite
Kolar	Kolar Bangarpet	05 02	86.90 -384.0	1-15.0	Schist &Granite gneiss

3.14.3 Highlights of Ground Water Exploration

Davanagere District/ Chitradurga district: 10 exploratory wells and 02 observation wells were drilled in Jagalur, H.P.Halli and Harihara tauks in Davanegere district. Granite gneiss and schist are main geological formation exposed in the area. Seven exploratory borewells were drilled in the schist formation and the yield ranged from 0.07 to 4.36 lps. The remaining three wells drilled in Granitic gneiss formation and the yield ranged from Neg to 1.83 lps. The high discharge is encountered in the schist formation. The depth of wells ranged from 120.82 to 200.19 mbgl. Static water level ranged from 3.32 to 22.92 mbgl. Specific capacity ranged from 0.612 to 11.0 lpm/m.d.d. The quality of ground water analysed for the exploratory wells are good and potable in nature.

In Chitradurga district 03 exploratory wells and 02 observation wells were drilled in Hosadurga taluk. Granite and Schist are the major formations. Where 4 wells were drilled in schist and one exploratory well was drilled in Schist formation. Depth of the

wells drilled in these formation ranged from 154 to 200 mbgl. Discharge range is 1.5 to 0.12 lps. Static water level ranged from 9.18 to 29.8 mbgl. Specific capacity ranged from 0.14 to 0.96 lpm/m.d.d.

Mandya:In total 05 exploratory wells and 2 observation wells were drilled in Maddur and Mandya taluk. The depth of exploratory wells ranged from 161.94-200 m.bgl and that of observation wells ranged from 123.24 to 145.46mbgl. The area where the exploration programme was taken up is mainly underlain by granite and gneissic formations of Archaean age. Major aquifer is the fractured peninsular gneissic complex. Ground water occur under semi confined to confined conditions. Depth of weathering ranges from 11mbgl to 55mbgl. The deep-seated fractures at the depth of 140- 190mbgl encountered with high discharge. Yield of the wells ranged from 0.014 lps at Halgur to 7.0 lps at Purigali. Range of static water level is from 4.92 to 18.0mbgl. Specific capacity ranged from 21.95 to 113.21 lpm/m.d.d.

Uttara Kannada district: Ground water exploration in granite and granitic gneiss & Schistose formations was carried out in the Kumta, Karwar, Honnavar and Ankola taluks of Uttar Kannada district. Range of depth drilled varied from 65 to 180.95m. Depth of weathering varies between 5.8 and 16.4m. Only at Ramanguli site promising aquifer zone was encountered at 71.15 – 74.2 m bgl and recorded discharge of 5.30 lps for a 20.92 m draw down. At Sakkalben-Averse, saline aquifers were encountered between 75.2 and 111m with meager discharge and the exploratory well was retained for observation purposes to study the lateral extension of saline water intrusion if any in the shallow fresh water phreatic aquifer and to take prevention measures in case the situation warrants.

Ground water exploration in chlorite schist and meta basalt of Dharwar was carried out at 2 sites in Karwar taluk of depth ranging from 150.45 to 152.5 m recorded depth of weathering between 20-27 m and vertical extension of fracture zones up to 135.2m. However potential fractures zones lies between 35.6 and 65 m and recorded discharge between 3.28 and 11.76 lps during drilling operations. Preliminary yield test carried out recorded discharge of 5.40 lps for a draw down of 5.185 m at Ulga site. Except at Sakkalben-Averse the quality of ground water is good and suitable for domestic and irrigation purposes.

Bidar district: Ground water exploration studies at Ujjini in Aurad Taluk of Bidar district up to the depth 204m have revealed the thickness of Deccan traps 0-67m, intra- trappean bed from 67-72m and the granite of Archaean from 73m onwards. The potential aquifer zone in granite was encountered 201-204m bgl with discharge of 5.41lps for draw down of 20.96m.

Kolar district (Deep drilling Programme to a depth of 500m):

In total 7 wells (5 EW and 2 OW) were drilled in Bangarpet and Kolar taluk. In Bangarpet taluk 2 EW were drilled located in BGML, KGF which solved the water scarcity in the area. In Kolar taluk 3 EW and 2 OW were drilled. The well drilled at Kone pura tapped highly fractured granite gneisses at deeper depth yielding 15 lps. Exploratory well drilled at Janaghatta yielded 13 lps encountered between 193-28mbgl. The depth of the bore wells drilled in the taluk ranging from 86.9-384 m bgl.

3.14.4 :List of high yielding wells encountered in Karnataka

Sl. No.	Location with Co-ordinates	District	Depth (m)	Discharge (lps)	Formation
1.	Kunchur 14° 42′ 00″ : 75° 40′30″	Davanagere	200.05	4.39	Schist
2.	Kunchur	Davanagere	120.8	3.34	Schist
3.	Shantinagar tanda 14° 38′45″ : 75° 50′ 36″	Davanagere	200.1	4.36	Schist
4.	Shantinagar tanda	Davanagere	151.25	3.34	Schist
5	Belgaur 13°42′ 15″:76° 17′30″	Chitradurga	154.35	4.0	Schist
6.	Belgaur 14°16′54″:74° 51′09″	Chitradurga	181.8	3.34	Schist
7	Mallappanahalli 13°46′ 10″:76° 07′47″	Chitradurga		10.12	Granite
8	Mallappanahalli	Chitradurga			Granite
9	Maddur 12° 35′10″ : 77° 02′ 20″	Mandya	123.24	4.05	Granite gneiss
10.	Kokkarebellur 12° 30′ 40″ :77° 05′ 30″	Mandya	161.94	4.88	G.Gneiss.
11	Kokkarebellur	Mandya	145.46	4.93	G.Gneiss.
12	Purigali 12° 15′ 30″: 77°00′50″	Mandya	200.00	7.0	G.Gneiss.
13	Ooragaum 12° 58′40″ :78° 15′05″	Kolar	384.00	3.75	Schist/Quartz Vein
14	Konepura 13° 4′45″:78°05′20″	Kolar	187.90	15.0	G.Gneiss.
	Konepura	Kolar	256.7	11.0	G.Gneiss.
15	Janaghatta 13°12′50″:78°07′50″	Kolar	308.5	13.8	G.Gneiss.
16	Ujjini 18°10′30″:77° 32′52″	Bidar	204.0	5.41	Basalt & Granite
17.	Ramanguli 14°47′41″ 74° 35′01″	Uttar Kannada	141.30	5.30	Granite gniess.
18.	Ulga-EW 14°52′45″ 74° 14′37″	Uttar Kannada	65.05	5.40	Chlorite schist
19.	Ulga	Uttar Kannada	132..50	3.58	Chlorite schist
20	Gopishitta 14°54′53″:74° 12′20″	Uttar Kannada	150.45	4.30	Meta basalt

3.15 SOUTHERN REGION (Andhra Pradesh)

Ground Water Exploration in A.P has been undertaken in Medak,, Nizamabad,Guntur, Warangal, Visakhapatnam& Karimnagar district and constructed 34 EW, 11 OW, 30 PZ(Total 75 wells)

3.15.1 Summarised details of Ground Water Exploration in A.P

District wise Summarised details of Ground Water Exploration is given in table 3.27

Table 3.27: District wise Summarised details of Ground Water Exploration

Sl. No	District	Depth drilled (m bgl)	Zones tapped/ Fracture encoun-tered (m bgl)	SWL (mbgl)	Dis-charge (lps)	Draw down (m)	Aquifer parameter (Transmi-ssivity) (m^2/day)	Formation
1	Medak	70-200	16-191	3.01-41.8	Meagre-6.9	11.93-50.95	0.083-89.8	Basalts Granites
2	Nizamabad	60-200	16-166	3.81-4.64	1.5	3.36-14.83	22.6-30.9	Basalts Granites
3	Warangal	70.0	22-57	2.15-15.42	0.13 - 1.21	-	<1.0 to 17	Granite gneisses
4	Karimnagar	70.0	22-39	0.24-13.7	0.21-1.2	0.71-1.46	6.0-17.0	Granite gneisses
5	Guntur	32-230	12.2-157	0.41-11.40	0.44–9.0	2.64-24.65	2.34 – 181.9	Granite gneisses and shales
6	Visakhapatnam	74-200	18-198	1.16-11.9	Meagre-10.1	1.51-21.76	1.0-772	Granites and Khondalites

3.15.2 Highlights of Ground Water Exploration

Medak district: During the year, 10 Exploratory Wells, 3 Observation wells and 14 Piezometer wells were drilled in Northern and Western part of Medak district, exploring an area of 3400 sq.km. Out of 10 Exploratory Wells, 8 EW and 3 OW were drilled in Archaean granites and gneisses, 2 Exploratory Wells and 1 observation well in basaltic terrain. The depth of the EWs varies from 77-200 m bgl. The potential zones were encountered between 20 and 150 m bgl. The static water level was found to be between 3.01-41.86 and 41.86 m bgl. Deepest fracture was encountered at 190 m at Bibipet village with the drilling discharge of 3.34 lps. The drawdown varies from 11.97 to 50.95 m. Transmissivity of the wells ranged from 1 to 89.8 sq.m/day with the general range of 0.5 to 20 sq.m/day.

Besides Exploratory Wells, 14 Piezometers were drilled in Medak district in order to increase the network of ground water monitoring well. All the 14 Piezometers were drilled upto a depth of 70 m bgl in granite gneisses and basalts. The zones were encountered between 20 and 60 m and drilling discharge varied from a minimum of 0.22 lps to a maximum of 2.5 lps. Static Water Level ranged from 6.82 to 11.85 m bgl and transmissivity varied from 1.0 to 17.48 sq.m/day.
The ground water exploration revealed that the quality of ground water is good except fluoride at three places viz., Vasar, Ramireddipet and Annasagar, where it is found to be beyond permissible limit of 1.5 mg/l. The exploration also revealed that the contact between basalt and granite was encountered between 25 and 100 m depth. Generally, no potential fracture zones were encountered in granite gneisses overlain by basalt formation. Two old piezometers were revitalized one each at Rayakodu and Lingampally, by flushing out the collapsed material, for the monitoring purpose.

Nizamabad District: In Nizamabad district, 2 EW and 1 OW well were drilled in South Western part of the district at Jukkal and Annasagar villages down to a depth of 200 m bgl. The zones were encountered even up to 170 m bgl. The drilling discharge in both the wells was 1.5 lps. Static Water Level ranged from 3.81-4.64 m bgl. The drawdown was between 3.36 to 13.88 and transmissivity varied from 22.6

to 31.9 sq.m/day. The storage coefficient was observed to be 3.7 x 10^{-2} at Annasagar well.

Warangal & Karimnagar Districts: Under ground water exploration, 16 piezometer wells were drilled (13 PZs in Warangal and 3 PZs Karimnagar District) out of which 1 Piezometer well was abandoned due to collapsing nature of formation at Enugal. Piezometer wells were drilled in order to increase the network of observation wells for monitoring purpose. 13 piezometers were drilled in southern part of Warangal district and 3 piezometers in South Eastern part of Karimnagar district in the area underlain by granites and gneisses. All the wells were drilled upto a depth of 70 m bgl. The fracture zones were encountered between 22 and 67 m bgl. The static water level ranged from a minimum of 0.24 m to a maximum 15.24 m bgl with general water levels of 10 to 15 m. The drilling discharges ranged from meagre to 1.2 lps with general range of 0.1 to 0.5 lps. Transmissivity values range from less than 1 to 17.0 sq.m/day. However, most of the wells have the transmissivity values between 1 and 5 sq.m/day.Piezometer wells drilled in Warangal district indicated that the phreatic aquifer is almost de-saturated and water levels are deep ranging between 10 and 15 m.

Guntur district: The ground water exploration was carried out in Central part of Guntur district extending from Tallacheruvu in the North to Nujendla in the South. In all, 10 Exploratory Wells and 3 Observation Wells were drilled with the depth ranging from 32-230 m bgl. The explored area was underlain by granite gneisses and Charnockites of Archean SuperGroup and Shales of Kurnool Group. The aquifer zones were encountered from a minimum of 12 to a maximum of 173 m bgl (Mukkellapadu). However, most of the potential zones were encountered between 15 and 30 m depth only. The discharges of the wells ranged from 0.441 to 9.0 lps. The water levels ranged from 0.41 to 11.40 m bgl. The granite gneisses are more potential than migmatite gneisses. In shales, the aquifer zones are extended upto a depth of 75 m with discharges between 1 and 4 lps and depth to water level upto 16m. Transmissivity of the aquifer ranged from 2.35 to 181.89 sq.m/day with a general range of 5 to 75 sq.m/day. The storage co-efficient varied from 1.3 x 10^{-4} to 2.8 x $10^{-6.}$

Visakhapatnam District: Ground Water Exploration was taken up in Western and Central Part of the Visakhapatnam district by drilling 12 EW and 4 OW in Granite and Khondalite formations. The depth of the Exploratory Wells range from 33 to 202 m bgl. The water bearing zones were encountered between 15 and 198 m bgl. However, in general, potential zones were encountered between 20 and 60 m bgl. Deepest zone was encountered at the depth of 198 m at Kammapalem village. The drilling discharge ranged from a minimum of 0.22 lps to a maximum of 10.1 lps with general range of 0.5 to 4.0 lps. The transmissiivty values varied from 1 to 772 sq.m/day with general range of 1 to 20 sq.m/day for a drawdown of 1.5 to 21.76 m bgl.

The exploratory well drilled in Visakahpatnam district revealed that the yields are relatively higher in Granites and Gneisses than in Khondalites. The yields in Khondalites vary from a meagre to 2.0 lps, whereas in Granites and Gneisses, it varied from 0.22 to 10.1 lps. Out of 12 wells drilled, high yields were encountered at 3 locations viz., Koppaka, Mediwada, Ravikantham with the drilling discharges of 8.4 lps, 10.10 lps and 9.7 lps, respectively.

List of High yielding wells encountered in Andhra Pradesh is given in table 3.28

Table3.28: List of High yielding wells encountered in Andhra Pradesh

Sl. No.	Site/District	Drilling Depth (m)	Discharge (LPS)	Formations
1	Bibipet/ Medak	160.0	6.91	Fractured granite pink
2	Ramireddipet/ Medak	149.2	3.85	Fractured granite grey
3	Tallacheruvu /Guntur	137.0	9.0	Shale
4	Bollapally /Guntur	190.6	4.36	Shale
5	Mediwada/ Visakhapatnam	110.8	10.1	Fractured Granite gneiss
6	Koppaka /Visakhapatnam	153.5	8.4	Weathered & Fissured Granite gneiss

3.16 SOUTH EASTERN COASTAL REGION (Tamil Nadu)

Ground Water Exploration in Tamil Nadu has been undertaken in Dharampuri, Krishnagiri, Karur, Nagapatnam, Villupuram, Cuddlaore & Perambalur district and constructed 32 EW, 16 OW, 6 PZ(Total 54 wells)

3.16.1 District wise Summarized Details of Ground Water Exploration

Sl No	District	Depth Drilled (m bgl)	Zones tapped/ Fracture encountered (m bgl)	SWL (mbgl)	Discharge M^3/hr	Drawdown (m)	Formation
1	Nagapattinam	70 - 452	39 - 378	1 – 10.5	2.63 – 43.2	0.2 - 16	Sandstone
2	Villupuram	363	124 - 194			1.22	
3	Cuddalore	109 - 300	60-275	6.6 - 34.57	7.2 - 43.2	1.4 – 1.8	
4	Perambalur	300	47 - 201	40	30.2	2	
5	Dharmapuri 1	82 - 275	8.5 - 270	3 - 11	Meager - 25	7 – 30	Gr. Gn.
6	Krishnagiri	110 – 275.2	12 - 267	4 - 18	Meager - 34	5 - 32	
7	Karur	130 - 200	10 – 189	1 – 21.3	0.4 – 33.3	2 - 29	

3.16.2. Highlights of Ground Water Exploration

Dharmapuri district: The exploration carried out in Dharmapuri district reveals that the depth of phreatic aquifer (weathered mantle) extended down to 20mbgl. The exploration established the presence of potential aquifer even up to a depth of 270 m bgl. The number of fractures encountered within 100 m bgl ranges up to 3, the yield in these fractures ranges from meager to 5 lps. The number of fractures encountered between 100 –200 m bgl ranges up to 5, the yield in these fractures ranges from meager to 3.5 lps. The number of fractures encountered between 200 –275 m bgl ranges up to 2, the yield in these fractures were loss than 1 lps.

Krishnagiri District: The exploration carried out in Krishnagiri district reveals that the depth of phreatic aquifer (weathered mantle) extended down to 24 mbgl. The

exploration established the presence of potential aquifer even up to a depth of 287 m bgl. The number of fractures encountered within 100 m bgl ranges from 0 to 5, the yield in these fractures ranges from meager to 6 lps. The number of fractures encountered between 100 –200 m bgl ranges from 0 to 3, the yield in these fractures ranges from meager to 11 lps. The number of fractures encountered between 200 –275 m bgl ranges from 0 to 3, the yield in these fractures ranges from meager to 8 lps.

Karur District: The exploration carried out in Karur district reveals that the depth of phreatic aquifer (weathered mantle) extended down to 21mbgl. The exploration established the presence of potential aquifer even up to a depth of 188 m bgl. The number of fractures encountered within 100 m bgl ranges from 0 to 6, the yield in these fractures ranges from meager to 7 lps. The number of fractures encountered between 100 –200 m bgl ranges from 0 to 4, the yield in these fractures ranges from meager to 9 lps.

List of High Yielding Wells Constructed in Tamil Nadu is given in table 3.29

3.29: LIST OF HIGH YIELDING WELLS CONSTRUCTED IN TAMIL NADU

Sl. No.	Site / District	Drilling Depth (m)	Discharge (LPM)	Formation
1	Paramasivapuram PZ-I/ Nagapattinam	451.8	390	Sandstone
2	Paramasivapuram PZ-II/ Nagapattinam	300	720	
3	Paramasivapuram PZ-III/ Nagapattinam	70	504	
4	Koonimedu PZ-I/ Villupuram	363	1200	
5	Theerthanagiri /Cuddalore	300	720	
6	Melur/ Perambalur	300	504	
7	Kottapatti /Dharmapuri	192	415	Gr. Gn.
8	Mullukallapalli /Krishnagiri	176.14	390	
9	Varattanapalli/ Krishnagiri	124	617	
10	Alapatti/ Krishnagiri	222	203	
11	Nedumaruthi/ Krishnagiri	137	321	
13	Lalapet/ Karur	130	458	
14	Puliyur/ Karur	200	504	
15	Valayapatti/ Karur	200	228	
16	Kodaiyur/ Karur	200	295.2	Gr. Gn+ Bio. Gn
17	Valvarmangalam/ Karur	180	198	Bio. Gn.
18	Parali/ Karur	165	660	
19	Sankaranmalaipatti/ Karur	171	554	Gn.

3.17 KERALA REGION(Kerala)

Ground Water Exploration in Kerala has been undertaken and constructed 13 EW & 5 OW in Trivendram district and 20 PZ in Palghat district. Summarised details of Ground Water Exploration is given in table 3.30.

Table 3.30: Summarised details of Ground Water Exploration

Sl. No	District	Depth Drilled m	Zones tapped/ Fracture encountered	SWL mbgl	Discharge m3/hr	Draw down	Aquifer parameter	Formation
1.	Trivendram	48-200	16-192	1.40-17.75	1.8-36.0	8-28	T- 1.46-28.25 m2/day S-7.1X10-5 to 1.15x10-3	Khondalite, Charnockite
2.	Palakkhad	70-104	10-103	4-24.8	0.1-4.75	3.75-22.45		Hornblende-Biotite Gneiss

3.17.2 Highlights of Groundwater exploration

Trivandrum district: Groundwater exploration was carried out in central and northern part of Trivandrum district. The area comprises of Archean crystalline rocks consists of Khondalite group, charnockite group and migmatite group. Khondalite group is the major rock type composed of garnetiferous biotite-sillimanite gneiss with occasional bands of calc granulite and quartzites. Veins of pegmatite and quartz are common in the rock. The EW was drilled to a depth varying from 48.00m to 200.00 mbgl. The EW at Nanniyode could not be drilled beyond 48 m for want of hard rock. At two sites, the well could not be drilled to the target depth of 200m because of high discharge and at 2 sites because of drilling problems. The yield of EW ranges from 0.2 lps (0.72 m^3/hr) to 10.0 lps (36 m^3/hr). The DTW ranges from 1.16 to 17.75 mbgl. The fracture zones encountered are generally within 80 mbgl, but most of high yielding zones encountered beyond 150 metres depth viz 125 m at Tholikuzhy, 144m and 178 m at Melethumuzhi, 190 m at Mamam etc. Some of the fracture zones are found to be unsaturated even at shallow depth (Bharathannur) because of the thick clay formation as overburden. The quality of groundwater us generally good All the water samples shown the EC less than 500 µs/cm at 25^0C and fluoride less than 0.5 mg/l.

Piezometer constructed in Palghat District: The various types of aquifers encountered during piezometer construction are fractured hornblende biotite gneiss, granitic gneiss and charnockite. The depth ranges of piezometers ar between 70 and 104 mbgl. The discharge ranges from0.10 to 16.00 lps.The yield is up to 960 lpm. The depth to water level in piezometers ranges between 2.90 and 27.80 mbgl. The drawdown ranges between 3.25 and 26.65 for 60 minute during Preliminary Yield test (PYT) done using compressor. The transmissivity value based on PYT ranged between 4 and 185 m^2/day. The exploration of palghat revels that the high yield wells with the fracture depth of 35 to 94 bmgl in particular 45 to 55 mbgl.

List of High Yielding Wells encountered in Kerala is given in table 3.31

Table 3.31: List of High Yielding Wells encountered in Kerala

Sl. No.	District	Location / Site	Depth drilled m	Discharge LPM	Formation
1.	TRIVANDRUM	Melattumuzhi	144.50	600	Charnockite/Gabbro
2.		Tholikuzhy	125.00	600	Khondalite
3.		Nagarur	141.50	420	Khondalite
4.		Mamam	200.00	420	Khondalite
5.		Nanniyode	48.00	204	Pegmatite/Khondalite
6.		Anad	200.00	180	Leptynite
7.	PLAKKAD	Karadiyampara	100	180	Hornblende Biotite Gneiss
8.		Pazhambalakod	100	420	Hornblende Biotite Gneiss
9.		Kadambur	90	420	Hornblende Biotite Gneiss
1		Padur	86	600	Hornblende Biotite Gneiss
1		Ottapalam	100	900	Hornblende Biotite Gneiss
1		Peringottukurissy	99	960	Hornblende Biotite Gneiss
1		Vallapuzha	70	960	Hornblende Biotite Gneiss

3.18 NORH HIMALAYAN REGION (Himachal Pradesh)

Ground Water Exploration has been undertaken and constructed 13 EW & 2 OW in Una, Kangra, Mandi, Bilaspur, Kulu, Bilaspur ditricts of Himachal Pradesh. District wise summarized details of Ground Water Exploration is given in table 3.32

Table3.32: District wise summarized details of Ground Water Exploration (in range)

Sl. No	District	Depth Drilled (m)	Zones tapped (m)	SWL (mbgl)	Discharge m3/hr	Drawdown (m)	Aquifer parameter (T) in m2/day
1.	Kangra	23.50-45.50	33.0-42.0	23.29	6.3		
2.	Mandi	102.35-104.69	71.0-81.0 85.0-89.0 91.0-97.0	2.85- 49.88	0.648- 10.80	1.72- 20.05	59.33
3.	Una	80.0 – 83.0	37.0-40.0 42.0-55.0 60.0-65.0 67.0-69.0 71.0-78.0	-	--	--	--
4.	Kulu	19.18 –100.70	10.0-18.0 26.0-35.0 46.0-58.0 61.0-76.0 82.0-94.0	2.0 to 7.28	17.93 to 64.8	15.31	270
5.	Bilaspur	88.0 – 115.0	20.0-26.0 42.0-45.0 50.0-53.0 56.0-59.0 61.0-64.0 69.0-70.0 86.0-89.0 98.0-104.0 105.0-108	36.55	49.98	6.11	147

Geological formations encountered in all the above wells were valley fills.

3.19 State Unit Office(Delhi)

Ground Water exploration in Delhi has been undertaken in North, North-west ,South & South-West District and constructed 5 EW, 7 OW, 10 PZ (Total 22 wells). Summarized details of ground water Exploration Details is given in table3.33

Table3.33: Summarized details of ground water Exploration Details

Sl. No.	Location/District/	Type of well	Depth drilled/ Constructed depth(m)	Zones tapped (m)	SWL, mbgl	Formation
1.	Chatrashal Stadium North Distt	EW& OW	119/32	214 to 30	4.05	Alluvium
2.	Delhi Univ. Near Stadium gate	EW& OW	32/32	24 to 30	5.80	Alluvium Up to Bed rock
3.	AshokVihar Ph-4 within park &near Gate	EW& OW	53/40	26 to 30 34 to 38	9.90	Alluvium Up to Bed rock
4.	Rohini ,Sect-11,DDA Park	EW& OW	103/26	12 to 16 20 to 24	5.40	Alluvium

5.	Pochanpur(Dwarka Sect-23,near Smasan)	Pz	100 /46	28 to 30 42 to 44	7.98	Alluvium
6.	Chawala (DJB ompound & near NajafgarhDrain)	Pz	75/62	50 to 54 56 to 60	17.90	Alluvium
7.	Shikarpur Vill.(deep) S-W Distt	Pz	75/72	62 to 69	16.22	Alluvium
8.	Shikarpur Vill.(Shallow) S-W Distt	Pz	50/40	32 - 38	15.99	Alluvium
9.	Ishapur Vill. S-W Distt	Pz	100/60	43 to 47 56 to 58		Alluvium
10	Mandhela Khurd S-W Distt	Pz	99/42	34 to 40		
11	Dariyapur S-W Distt	Pz	93/38	30 to 36		
12	Sultanpur,IMS South Distt	EW & OW	75/73	49 to 52 56 to 60 69 to 71		Alluvium Up to Bed rock
13	Najaf garha Town STP	Pz	100/37	29-35		

4. DEVELOPMENTS AND TESTING OF WELLS

A tube well, is developed during its construction to increase its specific capacity to prevent sand rushing into the well and to obtain maximum well life. Thereafter, pumping tests are conducted for evaluating aquifer characteristics i.e. transmitivity, storage co-efficient and well characteristics viz. specific capacity and well efficiency, with a view to evolve efficient design for tube wells, assessment of yield capabilities and spacing criteria for tube wells. The Board has got the capacity of conducting 175 to 200 pumping tests per annum with the existing infrastructure facilities. With the increasing drilling activities, the Board is constructing, on an average, about 400 pumping wells every year, which have resulted in backlog of pumping tests. Procurement action has been initiated in the Board to equip each rig unit with adequate pumping test units. However, in spite of constraints faced by the Board in this aspect, a total of 245 wells were developed and tested during the year 2006-2007. Region wise achievement has been presented in Table 4.1

Table 4.1: REGIONWISE/STATEWISE PUMPING TESTS CONDUCTED IN THE YEAR 2006 – 2007

Sr. No.	Regions	State / Union Territories	No of wells tested during 2006-07 Upto March,2007		
			No. of E. wells constructed during 2006-07 and tested	No. of E. wells constructed in earlier Year and tested	Total No. of wells tested
1	NWHR, Jammu	Jammu & Kashmir	1	4	5
2	NWR,Chandigarh	Haryana	(DW-2)	-	(DW-2)
		Punjab	1	1	2
		Delhi	1	4	5
3	WR, Jaipur	Rajasthan	4	15	19
4	WCR, Ahmedabad	Gujrat	3	11	14
5	NCR, Bhopal	Madhya Pradesh	11	4	15
6	NCCR, Raipur	Chhattisgarh	4	-	4
7	CR, Nagpur	Maharashtra	1	36	37*
8	NR, Lucknow	Uttar Pradesh	2	8	10
9	MER, Patna	Bihar	1	5	6
		Jharkhand	1	2	3
10	ER,Kolkata	West Bengal	8	8	16
11	NER, Guwahati	Assam	4	6	10
		Meghalaya	1	8	9
		Tripura	-	2	2
12	SER ,Bhubneswar	Orissa	6	13	19
13	SR, Hyderabad	Andhra Pradesh	12	-	12
14	SWR, Bangalore	Karnataka	6	2	8
15	SECR, Chennai	Tamilnadu	4	14	18
16	KR, Kerala	Kerala	5	-	5
17	NHR, Dharamshala	Himachal Pradesh	-	7	7
18	UR, Dehradun	Uttarakhand	-	1	1
TOTAL			**78**	**151**	**229**

* 33 Exploratory Wells tested on the basis of Compressor Test.

5. TAKING OVER OF WELLS BY STATES

5.1 Exploratory Wells

The exploratory drilling sites are selected in consultation with the State Government Departments considering that, successful exploratory wells would be converted into production wells once taken over by States. Till March 2007, a total of 12059 wells have been drilled, out of which 9309 successful exploratory wells have been constructed and only 5511 wells have so far been accepted /taken over by State Governments while 3116 successful wells are yet to be accepted/ taken over by them and only 682 successful wells to be offered. The status of handing over of exploratory wells drilled by Central Ground Water Board to the State Government as on 31-3-2007 is presented in table 5.1

Table 5.1: HANDING OVER OF WELLS DRILLED BY CGWB (As on 31.03.2007)

Sl. No.	State / Union Territories	Total wells drilled	Total successful Wells	No. of wells accepted	No. of wells offered but yet to be accepted	No. of wells to be offered
	States					
1	Andhra Pradesh	1147	813	728	37	48
2	Arunachal Pradesh	30	27	14	2	11
3	Assam	288	239	120	61	58
4	Bihar	246	199	61	118	20
5	Chhattishgarh	487	442	139	288	15
6	Goa	58	49	0	49	0
7	Gujarat	860	544	431	36	77
8	Haryana	362	193	145	47	1
9	Himachal Pradesh	157	143	74	43	26
10	Jammu& Kashmir	267	216	158	35	23
11	Jharkhand	268	220	75	131	14
12	Karnataka	1070	909	471	430	8
13	Kerala	352	250	212	29	9
14	Madhya Pradesh	766	474	428	6	40
15	Maharashtra	976	830	743	60	27
16	Manipur	25	15	14	0	1
17	Meghalaya	76	65	13	1	51
18	Mizoram	3	3	3	0	0
19	Nagaland	11	7	5	1	1
20	Orissa	1102	1018	402	591	25
21	Panjab	155	131	77	49	5
22	Rajasthan	1028	731	249	456	26
23	Sikkim	31	10	6	0	4
24	Tamilnadu	874	642	494	123	25
25	Tripura	60	54	36	8	10

Sl. No.	State / Union Territories	Total wells drilled	Total successful Wells	No. of wells accepted	No. of wells offered but yet to be accepted	No. of wells to be offered
26	Uttaranchal	51	41	23	10	8
27	Uttar Pradesh	730	587	185	321	81
28	West Bangal	355	306	120	151	35
TOTAL		**11835**	**9158**	**5426**	**3083**	**649**
Union Territories						
	Andaman & Nicobar	46	12	-	10	2
2	Chandigarh	7	7	6	-	1
3	Dadara & Nagar Haveli	12	8	8	-	-
4	Delhi	129	111	58	23	30
5	Pondicherry	30	13	13	-	-
TOTAL		**224**	**151**	**85**	**33**	**33**
GRAND TOTAL		**12059**	**9309**	**5511**	**3116**	**682**

5.2 Deposit Wells

In addition to its exploratory drilling programme, the Board also undertakes construction of production wells on specific requests for Defence and other Govt. agencies to meet their immediate water supply requirements. During 2006-2007, 2 deposit wells was constructed by the Board in Kamal district of Haryana State given in table 5.2.

Table 5.2: CONSTRUCTION OF DEPOSIT WELL DURING 2006-2007

Sl. No.	State	District	No. of Deposit Wells Constructed
1	Haryana	Kamal	2
Total			**2**

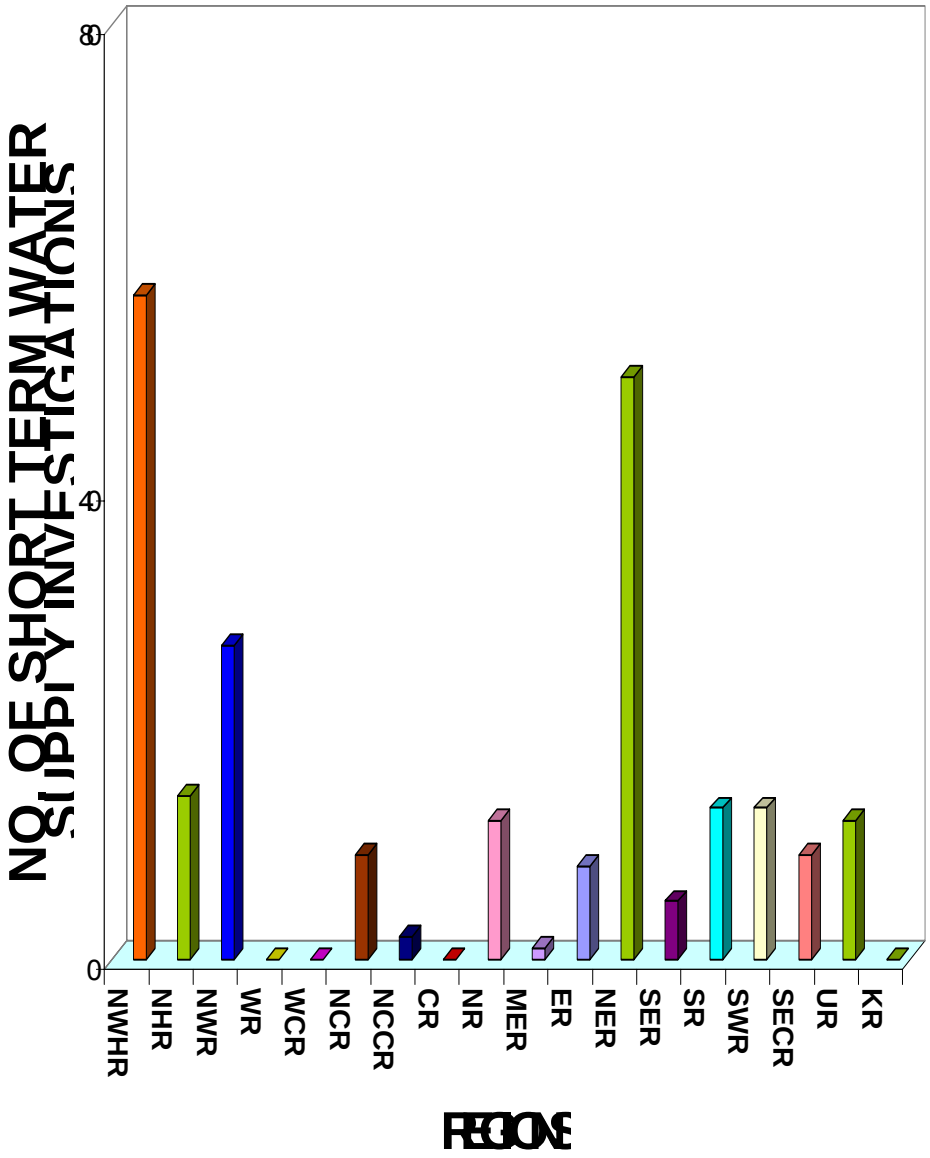
6. WATER SUPPLY INVESTIGATIONS

The Board provides assistance to various urban, defence and public sector establishments to solve their immediate water supply problems by selecting suitable sites for construction of ground water abstraction structures. During 2006-07, 232 Water Supply Investigations were carried out and region wise/state wise status is given in table 6.1 and fig. 6.1

Table 6.1 : REGION/STATEWISE WATER SUPPLY INVESTIGATIONS TAKEN UP DURING 2006-2007

Sl. No.	Regions	States	Number of Water Supply Investigations
1	NORTHERN WESTERN HIMALAYAN REGION	Jammu & Kashmir	57
2	NORTHERN HIMALAYAN REGION	Himachal Pradesh	14
3	NORTH WESTERN REGION	Punjab	11
		Haryana	04
		Delhi	12
4	WESTERN REGION	Rajasthan	0
5	WEST CENTRAL REGION	Gujarat	0
6	CENTRAL REGION	Maharashtra	0
7	NORTHERN REGION	Uttar Pradesh	12
8	UTTARANCHAL REGION	Uttaranchal	12
9	EASTERN REGION	West Bengal	8
10	NORTH CENTRAL REGION	Madhya Pradesh	9
11	NORTH CENTRAL CHATTISGARH REGION	Chhattisgarh	2
12	MID EASTERN REGION	Bihar & Jharkhand	1
13	NORTH EASTERN REGION	Assam,Meghalaya,Tripura	50
14	SOUTH EASTERN REGION	Orissa	5
15	SOUTERN REGION	Andhra Pradesh	13
16	SOUTH WESTERN REGION	Karnataka	13
17	SOUTH EASTERN COASTAL REGION	Chennai	9
18	KERALA REGION	Kerala	0
Total			**232**

REGION WISE STATUS OF SHORT TERM WATER SUPPLY INVESTIGATIONS (DURING 2006-2007)



7. HYDROLOGICAL AND HYDROMETEROLOGICAL STUDIES

Hydrological and Hydrometeorological studies play an important role in the assessment and management of ground water resources of an area. Hydrological and hydrometeorological data collected during the course of various hydrologeological surveys & investigation, exploration, hydrograph network monitoring etc are being entered into the computer and analysed following standard techniques. The results are incorporated suitably in different reports.

7.1 Hydrological Studies : Hydrological studies are carried out as a part of ground water management studies, artificial recharge studies as well as conjunctive use studies.

1. During the year 2006-07, detailed hydrological studies have been carried out as a part of artificial recharge studies in the following watersheds

   i. Koilmalai watershed of Palar basin in Tamil Nadu.
   ii. Kallaparai watershed of Palar basin in Tamil Nadu.

   The hydrological studies carried out in the watershed areas included.

   a. Preparation of Drainage map and morphometer analysis for determination of catchment characteristics.
   b. Rain gauge data has been collected from various aquifers and analysed for estimation of surface water availability.
   c. Infiltration test has been carried out at selected places in the irrigation command to establish the parameter related for infiltration factor.

2. Hydrological Study as aid in ground water management study: Various hydrological data related to basin characteristics and rain gauge data has been collected, computerized and analyzed used in overall planning and management of ground water. The data has been suitably interpreted in ground water management study report/ state report/ district report/brochure etc.
3. Detailed hydrological study carried out as aid in Artificial Recharge Studies for estimating the runoff from the catchment and availability of water for artificial recharge to ground water.

7.1.1 Hydrological studies with findings/conclusion

1. Hydrological study of Koilmalai watershed of Palar basin in Tamil Nadu

Area: Koilmalai water shed
Extent: 200.83 Sq. km
North latitudes 12.56° and 12.75°
East longitudes 78.79° and 78.95°.

Data generated during "Hydrological study of Koilmalai watershed of Palar basin in Tamil Nadu" in AAP 2005 - 06 were analyzed and findings are given below:

About 70% of the watershed area is covered by hills & reserved forests and remaining area has a plain to undulating topography. A stream called "Koilmalai Ar" drains the entire watershed. The stream is a 5^{th} order one and ephemeral in nature and traverse for a distance of 28.33 km within the watershed. The total no of stream segments of all order within the watershed is about 865 nos, of which 669 first order streams, 148 second order streams, 38 third order streams and 9 forth order streams. The soils of Koilmalai watershed can be broadly classified as clayey and loamy types. Sandy soil / gravely soil have shown higher rate of infiltration, which are classified under "Rapid Infiltration". The infiltration rate of loamy clay and silty clay are in the range of 1.2 – 3.1 mm/hr and are classified under "moderate Infiltration".

The shape of the watershed is strongly elongated in nature and having very high relief and steep slopes. Moderately high drainage density and less value of length of overland flow indicative that the terrain characteristics of weak or impermeable sub surface materials, sparse vegetation and mountainous relief and hence it has poor groundwater recharge potential.

Based on the statistical analysis of 100-years annual rainfall data, the annual normal rainfall of watershed is worked out as 900.97 mm, of which 768.87 mm received during monsoon periods. The estimated surface runoff of Koilmalai watershed is about 18.07 MCM, of which the committed storage of watershed for the existing 16 nos. of tanks and ponds were worked out as 1.112 MCM. The net ground water available within the watershed for all uses is 6.411 MCM. The non-committed surface water resource available in the Koilmalai watershed is of the order of 16.958 MCM.

The presence of high relief morphology of watershed favors good generation of surface runoff even for small shower but presence of clayey and loamy soils did not allow for good ground water recharge. In spite of the sufficient surface flow available in the watershed, so far no irrigation project has been done to meet the domestic/ irrigation demands. Hence, almost the entire demands are met through ground water only. The non-committed surface water resource of 16.958 MCM can be utilized scientifically and an integrated manner. All the tanks in the watershed must be revitalized and their bunds and allied structure are to be strengthened to augment the surface storage and the remaining flow can be utilized for ground water recharge. The detailed study on integrated surface and groundwater management could be done to effectively utilized surplus runoff for creating additional irrigation potential in the plains of the watershed as well as for augmentation of ground water resources through scientifically designed artificial recharge structures constructed at suitable locations.

2. Hydrological study of Kallaparai watershed of Palar basin in Tamil Nadu

Area: Kallaparai water shed
Extent: 142.9 Sq. km
District: Vellore

Data generated during "Hydrological study of Kallaparai watershed of Palar basin in Tamil Nadu" in AAP 2005-06 were analyzed and findings are given below:

The Kallaparai stream originates in the Alangayam reserved forest area and the place is called Karuthamalai murugan temple at an elevation of 722 m above mean sea level. It is draining through vast dense forest area and reaching the plain near the village "Kallparai", from here the stream is called Kallparai Ar. The Kallparai Ar drains on its own path of 25.02KM from its origin and joins the main river of Palar.

a. The forest area is about 11520 ha, which is 80.61% of the total study area.
b. The cultural area is about 1722 ha in the year 2003, which is 12% of the total study area.
c. The net area sown is about 2858 ha in the year 2003, which is 20% of the total study area.
d. The net area sown is about 2858 ha in the year 2003, which is 20% of the total study area.
e. The 50% and 75% dependable yields of the Kallaparai minor basin up to the study area is estimated to be 10 Mm^3 and 8 Mm^3 respectively.
f. The gross ground water potential is assessed to be 14.35 Mm^3.
g. The rate of infiltration varies to be from 0.9 cm/hr to 15 cm/hr.

7.2 Hydrometeorological Studies: Hydrometeorological Studies forms a part of ground water management study, conjunctive use study as well as Artificial Recharge studies. It provides the various climatological data which helps in estimation of ground water resources as well as planning the development and management of ground water. The data being generated various studies through out the country entered into the database and analysed using standard techniques. The various hydrometeorological studies carried out during the year in different Regional Offices is summarized below

7.2.1 KERALA REGION (Kerala)

a. The weekly rainfall data have been collected and analysed for the fourteen districts of Kerala.
b. Monthly rainfall distribution, normal rainfall for various periods such as south-west monsoon, north-east monsoon, winter and summer periods were determined.
c. Departure of the seasonal rainfall for preceding year, seasonal rainfall contribution to the total rainfall is also attempted.
d The climatological data collected during the reappraisal survey in Palakkad and Thrissur Districts by the respective officers will be analysed for their reports.

7.2.2 NORTH CENTRAL CHHATTISGARH REGION (Chhattisgarh)

a. Rainfall data from IMD and historical Rainfall data of different rain gauge stations of Chhattisgarh State were collected from water resources department and stored in GWDES.
b. The data was analysed and used for preparation of Ground Water Year book and Chhattisgarh Hydrogeological Report.

7.2.3 NORTH CENTRAL REGION (Madhya Pradesh)

Collected monthly rainfall data for about 225 stations from land record office for the year 2004 & 2005. Monsoon rainfall also collected for all 48 district of M.P. An isohyetal map and a departure map for monsoon rainfall 2005 from normal rainfall prepared. The normal meteorological parameter such as maximum & minimum temperature, wind velocity and relative humidity were compiled for Pendra road(for Shahdol district), Dhar, Mandla and Shahdol. The data was analysed and used for preparation of district reports for the above-mentioned district.

7.2.4 NORTH REGION (Uttar Pradesh)

a. The interpretation of rainfall data and analysis were completed for Auraiya, Balrampur, Moradabad and Budaun districts.

b. The compilation work was also done of long term monthly rainfall data for 10 years upto 2002 & compiled the climatic factors and represented them in form of graphics.

7.2.5 NORTH WESTERN REGION (Punjab and Haryana)

a. The weekly rainfall data has been compiled for 17 districts of Punjab and 19 districts of Haryana for the year 2005-06 and the same has been computerized and analysed to district wise to estimate the mean monthly rainfall, seasonal and annually rainfall.
b. The percent deviation of rainfall has been compared with the quarterly monitoring especially for the month of May, August, November 2006 and January 2007. The analysis and results have been incorporated in the quarterly ground water monitoring report.
c.The results of the analysis of rainfall data along with the graphical presentation for the entire water year forms a part of the Ground Water Year 2006-07.
d.Hydrometeorological studies involving collection and compilation of various climatological data has provided important input in preparation of various reports given as
   i. Punjab State Report

   ii. Karnal, Kurukshetra, Bathinda, Kapurthala district reports.

7.2.6 SOUTH EASTERN COASTAL REGION (Tamil Nadu)

Like several states in India, the state of Tamil Nadu comes under the grip of drought conditions frequently, which hit a crippling blow to the economy of the state as well as that of the country. Study of the variability of rainfall over was taken up in

i. Tamil Nadu and Puducherry and Karaikal Regions of U.T. of Puducherry
ii. Sivaganga
iii. Villupuram and
iv. Tirumanimuttar Watershed

Under this, it was undertaken to analyse long-term rainfall data (1901-2000 and beyond) with a view to study the variability of annual rainfall and seasonal rainfall (SW monsoon and NE monsoon), incidence, intensity and periodicity of droughts over Tamil Nadu state and U.T. of Puducherry and Sivaganga and Villupuram districts. For this purpose, annual/seasonal rainfall data for available rain gauge stations spread over the respective districts have been statistically analysed and the results are presented in the form of various maps and tables. For each station, the 100-year normal annual/seasonal rainfall has been computed and the probability of occurrence of normal rainfall has been studied. The departure of each year's annual/seasonal rainfall from the normal has been computed. Based on this departure, the category of drought, if any, has been determined and "drought areas" have been demarcated. The frequency of occurrence of drought at each station has also been estimated in terms of number of years per drought. The trend of annual rainfall at each rain gauge station over the study period has been determined. The variation in long-term normals of rainfall (50 years Vs 100 years) at each station has also been studied.

7.2.7 SOUTH EASTERN REGION (Orissa)

Block wise monthly rainfall data for all the 30 districts were collected and compiled upto 2004. The existing database is updated and strengthened for use by various users. Also rainfall data of IMD stations from IMD office, Bhubaneswar were collected.

7.2.8 SOUTHERN REGION (Andhra Pradesh)

a. Collected and compiled the daily rainfall data from state agency and updated the data base in GEMS pertaining to 1127 revenue rainguage stations (upto Dec. 2005) and 32 IMD stations(upto Dec. 2006).

b. Compilation and analysis of rainfall data in support of Ground Water Regime studies during the months of May 2006, Aug 2006, November 2006 and January 2007.

c. Estimated mean monthly, seasonal and annual rainfall of the state using station normals compiled from Daily Weather Reports.

d. In support of ground water yearbook 2005-06 the hydrometeorological data was analysed and prepared.

e. Analysis of rainfall data was carried out in support of District Ground Water Management Studies in Nalgonda district, Anantapur district and Parts of Kurnool district.

f. Compilation of rainfall and analysis in support of 16 HOTSPOT districts (9 in Telangana, 4 in Rayalaseema and 3 in Coastal Andhra).

g. Rainfall analysis for special studies of the following areas:

i. Vempally mandal of Kadapa district.
ii. Dharmavaram mandal of Anantapur district
iii. Veldurthy mandal of Kurnool district
iv. Oravakal mandal of Kurnool district

7.2.9 SOUTH WESTERN REGION (Karnataka)

Planning and execution of hydrological and hydrometeorological work is basically undertaken. The work involved collection, compilation, analysis and interpretation of all relevant data. During this year rainfall, data pertaining to the year 2006 was collected from various central and state departments. The same is compiled and computerised with a view to efficient management and retrieval. Presently rainfall data is available from 1901 to 2006.

Draft Guidelines on Hydrometeorology were finalised and the same are being scrutinised by the Commissioner (GW). In addition data analysis and interpretation was carried out for periodic NHS reports, Hydrogeological survey reports and resources estimation reports.

7.2.10 WESTERN REGION (Rajasthan)

a. Analysis of hydrometeorological data of Hanumangarh district is completed.
b. Analysis of hydrometeorological data of Ganganagar district is completed.
c. Analysis of hydrometeorological data of Bhilwara district is in progress.
d. Analysis of hydrometeorological data of Bhilwara district is completed.
e. Analysis of hydrometeorological data of Bikaner district is in progress.
f. Analysis of hydrometeorological data of Dungarpur district & Banswara district is in progress. Computed rainfall average (June – May) for a period of 10 years (1995-96 to 2004-05) for all the districts of Rajasthan.
g. Analysed rainfall data of Barmer & Jaisalmer districts and prepared notes on the current flood situation in the respective disticts . Computed rainfall average (August – July) for a period of 10 years (1995-96 to 2004-05) for all the districts of Rajasthan to correlate with the fluctuations in NHS.
h. Compilation of rainfall data of all the R.G.Stations of the state for the Year-Book (2005-06) is in progress.
i. Analysed annual rainfall data of Sri Madhopur rain-gauge station of Sikar district for the period 1975-2002 for inclusion in climatological chapter.
j. Computed average monthly rainfall (June-August) for the period 1996-2005 & June to May for the period 1994-95 to 2004-2005 of all the districts of Rajasthan.
k. Compilation of rainfall data of all the R.G.Stations of the state for the Year-Book (2005-06) is in progress.
l. Analysed annual rainfall data of Khetri Rain-Gauge station of Jhunjhunu district for the period 1975-2002 for inclusion in climatological chapter.
m. Compilation of rainfall data of all the R.G.Stations of the state for the Year-Book (2005-06) is in progress.
n. Analysed annual rainfall data of Phagi, Phulera & Dudu blocks of Jaipur district for inclusion in climatological chapter of re-appraisal survey report of parts of Jaipur district.
o. Updated monthly rainfall data of all the stations for the months of April & May 2006.
p. Analysed monthly and annual rainfall data of Jhunjhunu,Chirawa,Khetri & Udaipur-wati blocks of Jhunjhunu district. for the period 1978 -2006.

q. Updated annual rainfall data of all the stations of the state for the year 2006.

r. Analysed monthly and annual rainfall data of Dungarpur district for the period 1971 to 2006. Prepared Bar-Diagrams of normal rainfall and annual rainfall (2004,2005&2006). Iso-hyetal maps of the district displaying normal annual rainfall and annual rainfall of 2006 were drawn.

s. Analysed monthly and annual rainfall data of Sanchore block. for the period 1976 -2005.Compiled a note on the hydrometeorological conditions prevailing in the block.

t. Analysed monthly and annual rainfall data of Barmer district for the period 1977 to 2006. Prepared Bar-Diagrams of annual rainfall (1977-2006) along with departure curves. Iso-hyetal map of the district displaying mean annual rainfall has been drawn. Completed hydrometeorological chapter of Barmer district for incorporation in the district report of Barmer.

u. Analysed monthly and annual rainfall data of Osian block , Jodhpur district, parts of Udaipur , Sirohi and Banswara districts for the period 1976 - 2005.Compiled a note on the hydrometeorological conditions prevailing in these reappraisal areas for incorporation in the respective reports.

8. GROUND WATER LEVEL SCENARIO

8.1 INTRODUCTION:

Monitoring of ground water regime is an effort to obtain information on ground water levels and chemical quality through representative sampling. The primary objective of establishing the ground water monitoring network stations is to record the response of ground regime to the natural and anthropogenic stresses of recharge and discharge parameters with reference to geology, climate, physiography, land use pattern and hydrologic characteristics. The natural conditions affecting the regime involve climatic parameters like rainfall, evapotranspiration etc., whereas anthropogenic influences include pumpage from the aquifer, recharge due to irrigation systems and other practices like waste disposal etc.

Ground water levels are being measured four times a year during January, April/ May, August and November. The regime monitoring started in the year 1969 by Central Ground Water Board . At present a network of 15640 observation wells located all over the country is being monitored. Ground water samples are collected from these observation wells once a year during the month of April/ May to obtain background information of ground water quality changes on regional scale. The database thus generated forms the basis for planning the ground water development and management programme. The ground water level and quality monitoring is of particular importance in coastal as well inland saline environment to assess the changes in salt water/fresh water interface as also the gradual quality changes in the fresh ground water regime. This data is used for assessment of ground water resources and changes in the regime consequent to various development and management activities.

The State-wise distribution of the ground water observation wells is given in table 8.1 and graph is given in fig. 8.1 & 8.2.

TABLE 8.1 : STATEWISE DISTRIBUTION OF OBSERVATION WELLS

Sl No.	Name of the State	Total No. of Observation Wells (as on 31.03.2007)
	States	
1	Andhra Pradesh	981
2	Arunachal Pradesh	19
3	Assam	381
4	Bihar	373
5	Chhatishgarh	516
6	Delhi	87
7	Goa	53
8	Gujarat	966
9	Haryana	426
10	Himachal Pradesh	85
11	Jammu & Kashmir	206
12	Jharkhand	208

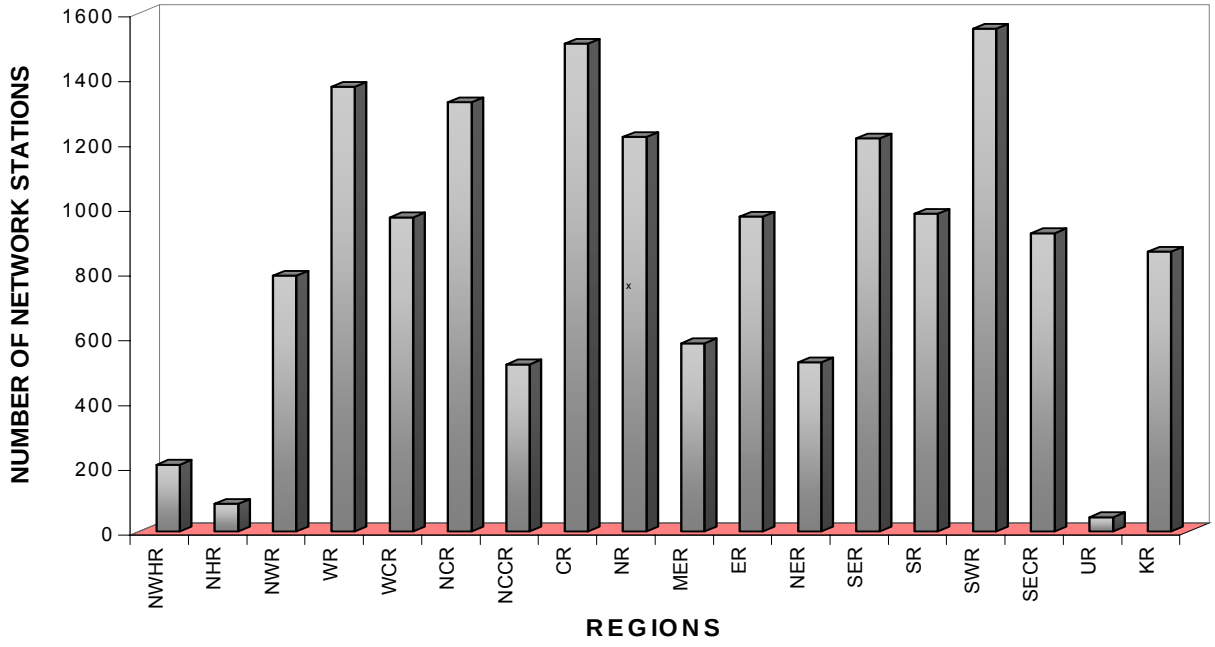
Sl No.	Name of the State	Total No. of Observation Wells (as on 31.03.2007)
13	Karnataka	1499
14	Kerala	864
15	Madhya Pradesh	1325
16	Maharashtra	1496
17	Manipur	25
18	Meghalaya	38
19	Nagaland	17
20	Orissa	1214
21	Punjab	261
22	Rajasthan	1373
23	Tamil Nadu	906
24	Tripura	42
25	Uttar Pradesh	1218
26	Uttaranchal	44
27	West Bengal	909
	UTs	
1	Andaman & Nicober	63
2	Chandigarh	16
3	Dadra & nagar Haveli	10
4	Daman & Diu	4
5	Pondicherry	15
	Total	**15,640**

8.2 GROUND WATER LEVEL SCENARIO - PRE-MONSOON, 2006

A perusal of depth to water level map of India for Pre-Monsoon (May 2006) (Plate I) reveals that in sub-Himalayan area, north of river Ganges, the depth to water level, in general, ranges from 2-10 meter below ground level (mbgl). In Brahmaputra valley, in the eastern part of the country, water level is generally in the range of 2-5 mbgl, except in isolated pockets where depth to water level is less than 2 mbgl. However, in upper Assam, isolated pockets of deeper water level, 5-10 mbgl have been observed. In major parts of Indus basin, depth to water level generally ranges from 10-20 m.bgl. In the western part of the country, covering states of Gujarat and Rajasthan deeper water levels are in the range of 10-20 m.bgl.were recorded. Depth to water level, more than 40m has also been observed in Jodhpur, Churu, Jalore, Nagaur, Jhunjhunu and Jaipur districts of Rajasthan. In the west coast, water level generally ranges from 5-10 m. Western part of Maharastra recorded water level less than 5m. In the east coast i,e coastal Andhra Pradesh and Orissa, generally the water level ranges between 2-5m. However, isolated pockets having water level less than 2m have also been recorded. Eastern most part of west Bengal recorded water level in the range of 5-10 mbgl. In central India, water level generally varies between 5-20 mbgl., except in isolated pockets where water level is more than 20 mbgl. The peninsular part of country generally has water level between 2-10 mbgl, except in pockets where it is more than 10m bgl. Isolated patches of deeper water levels in the range of 20-40m and more than 40m have also been recorded in various parts of the country.

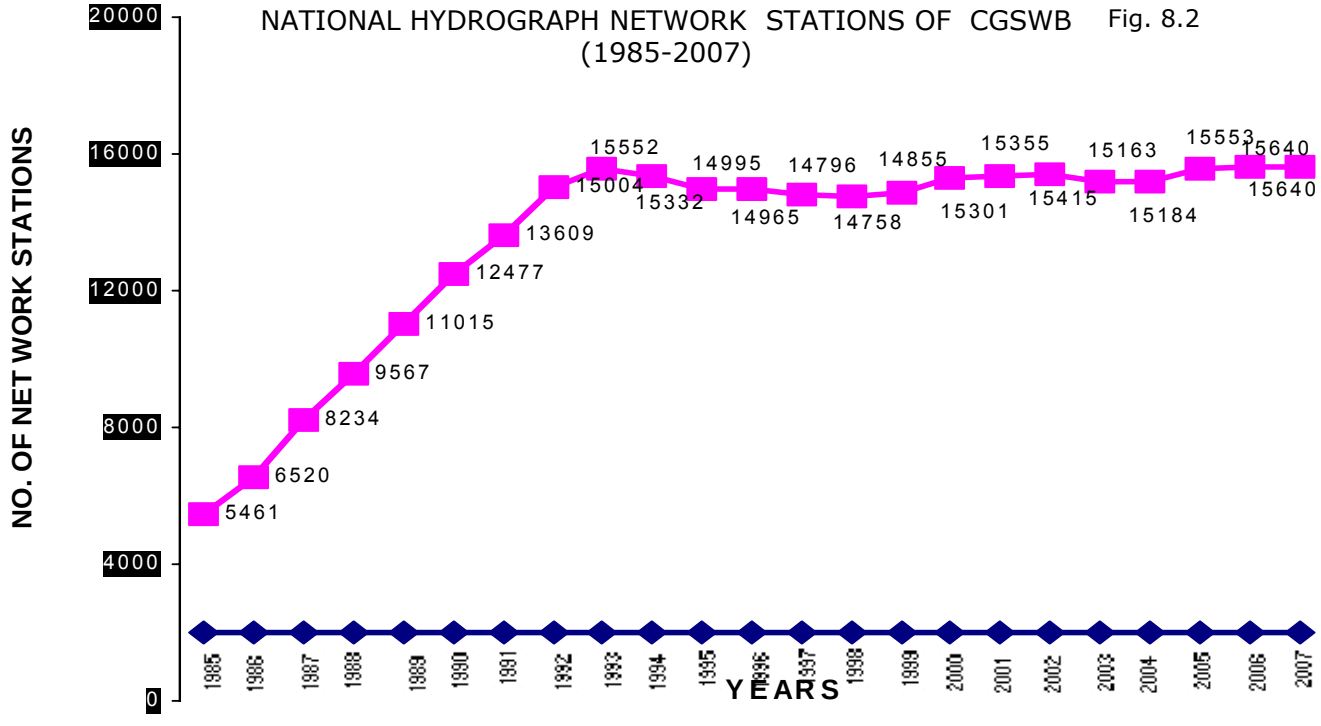
REGIONWISE NATIONAL HYDROGRAPH NETWORK STATIONS MONITORED DURING 2006-2007

Fig. 8.1



NATIONAL HYDROGRAPH NETWORK STATIONS OF CGSWB (1985-2007)

Fig. 8.2



A comparison of depth to water level during Pre-Monsoon (May 2006) with decadal mean (1996-2005) (Plate –II) reveals that there is general rise in water level in the range of 0-4m in peninsular India, coastal Andhra Pradesh and Orissa. However, in isolated pockets, fall of water level has also been recorded. In Northern India there is general fall in water level in the range of 0-2m. However, there is rise in water level in the northern part of Bihar and Uttar Pradesh. In Central India, there is mixed trend of Rise and fall in water level. In addition, isolated patches of rise or fall of water level in the range of 0-2m have been observed through out the country.

8.3 GROUND WATER LEVEL SCENARIO - POST-MONSOON, 2006

A perusal of depth to water level map of India for Post-Monsoon period (Nov 2006) (Plate III) reveals that in sub-Himalayan area, north of river Ganges, generally the depth to water level ranges from 2-5m bgl. Isolated pockets of shallow water level less than 2m has also been observed. In the eastern parts of the country in the Brahmaputra valley water level generally ranges from 2-5 m.bgl , except in isolated pockets where depth to water level is less than 2m bgl. However in upper Assam, isolated pocket of deeper water level, 5-10 m.bgl is observed. In major parts of Northwestern states- Indus basin, depth to water level generally ranges from 10-20m. bgl. In the western parts of the country covering states of Gujarat, Rajasthan deeper water level is recorded in the range of 10-20m. bgl. In the state of Rajasthan, the depth to water level more than 60m has been noticed in the districts of Jaisalmer and Barmer. Isolated pockets of such deep water levels were also observed in Jodhpur, Churu, Jalore, Nagaur, Jhunjhunu and jaipur district. In the west coast water level is generally less than 10m and in western parts of Maharastra State isolated pockets of water level less than 2m has also been observed. In the east coast i,e coastal Andhra Pradesh and Orissa, shallow water level of less than 2m have been recorded. In eastern states- of water level in general ranges from 2-5m bgl. However eastern most part of west Bengal recorded water level in the range of 5-10m bgl. In central India water level generally varies between 2-10m bgl., except in isolated pockets where deeper water level more than 10m.bgl.has been observed. Similarly pockets of shallow water level of less than 2m is also observed. The peninsular part of country generally recorded a water level in the range 5-10m bgl. In some patches water level ranges from 10-20m bgl. Isolated patches of water level of 10-20 and 20-40 have been observed as well.

Water level of November 2006 when compared with decadal mean (1996-2005) (Plate IV), shows that in the states of Uttar Pradesh, Rajasthan, Karnataka, Madhya Pradesh, Chandigarh, Punjab and Haryana show a decline in water level of more than 2m. In Uttar Pradesh in some parts of Aligarh, Bahraich, Balrampur, Bijnor, Chandoli, Banda, Kanpur, Mathura, Pratapgarh, Moradabad and Varanasi districts falls in this category. In Rajasthan districts of Bikaner, Jaisalmer, Barmer, Jodhpur, Churu, Jalore, Nagaur, Jhunjhunu and Jaipur fall in this category. In Uttar Pradesh fall more than 2m is observed in Agra, Allahabad, Banda, Hamirpur, Kanpur, Mathura and Pratapgarh districts. In Karnataka water level fall is observed in Bellari, Bijapur, Shimoga and Mangalore districts. In Madhya Pradesh the districts of Morena, Bhind, Gwalior, Datia, Sheopur and Central part of Guna shows a fall in water level. In Punjab ground water level falls in Amritsar, Bhatinda, Hoshiarpur and Rupnagar districts. In Haryana, Ambala, Faridabad, Jind, Fatehbad, Mahendragarh and Rewari shows a falling ground water level. Majority of the well in the states of Tamil Nadu

and Bihar shows a rise in water level when compared with Decadal mean. In Tamil Nadu, Coimbatore, Dindigul, Erode, Kanyakumari, Karur, Madurai, Nilgiri, Perambatore districts shows rise in water level. In Bihar rise in water level is observed in Kishanganj, Lakhisarai, Madhopur, Nalanda and Purnia districts. In addition isolated patches of rise or fall of water level in the range of 0-2m have been observed through out the country.

8.4 GROUND WATER LEVEL SCENARIO- JANUARY, 2007

A perusal of depth to water level map of India for January 2007 (Plate V) reveals that in sub-Himalayan area, north of river Ganges, generally the depth to water level ranges from 2-5 meter below ground level (mbgl). Isolated pockets of shallow water level less than 2m have also been observed. In the eastern part of the country in the Brahmaputra valley water level generally ranges from 2-5 mbgl, except in isolated pockets where depth to water level is less than 2 mbgl. However, in upper Assam, isolated pocket of deeper water level, 5-10 mbgl has been observed. In major parts of Indus basin, depth to water level generally ranges from 10-20 m.bgl. In the western part of the country covering states of Gujarat and Rajasthan deeper water level is recorded in the range of 10-20 m.bgl. Depth to water level more than 40m has also been observed in Jodhpur, Churu, Jalore, Nagaur, Jhunjhunu and jaipur district of Rajasthan In the west coast, water level generally ranges from 5-10 m . Western part of Maharastra recorded water level of less than 5m. In the east coast i,e coastal Andhra Pradesh and Orissa, generally the water level ranges between 2-5m. However, isolated pockets of water level less than 2m have also been recorded. In eastern part of Ganga basin water level in general ranges from 2-5 mbgl. Eastern most part of west Bengal recorded water level in the range of 5-10 mbgl. In central India water level generally varies between 2-10 mbgl., except in isolated pockets where water level is more than 10 mbgl. The peninsular part of country generally water level ranges between 2-10 mbgl except in pockets where water level ranges from 10-20m bgl. Isolated patches of water level of in the range of 20-40m and more than 40m have also been observed in pockets.

Water level fluctuation between January 2007 and average water level (1997-2006) as shown in Plate –VI indicates that more than 20% of the monitoring wells in the state of Punjab, Haryana, Chandigarh, Bihar, West Bengal, Eastern parts of Madhya Pradesh and eastern Rajasthan show a decline in water level of more than 2m. In hilly terrain of west Bengal, Assam, parts of Meghalaya, Tripura and Jharkhand there is rise in water level more than 2m. In Karnataka ,fall has been observed in major part. In Andhra Pradesh rise of water level more than 4m is noticed in Adilabad, Karimnagar, Medak, Nalgonda, and Mehbubnagar districts and in small isolated areas in West Godavari, Cuddapah and Chitoor districts. In the state of U.P rise in water level up to 2m is observed in parts of Aligarh, Bahraich, Balrampur, Bijnour, Chandoli, Jhansi, Mharajganj districts. Fall of more than 4m is observed in Agra, Allahabad, Banda, Jhansi, Kanpur, Mathura, Pratapgarh, Moradabad and Varanasi districts.

Plate - I

Depth to Water Level
Pre-Monsoon 2006

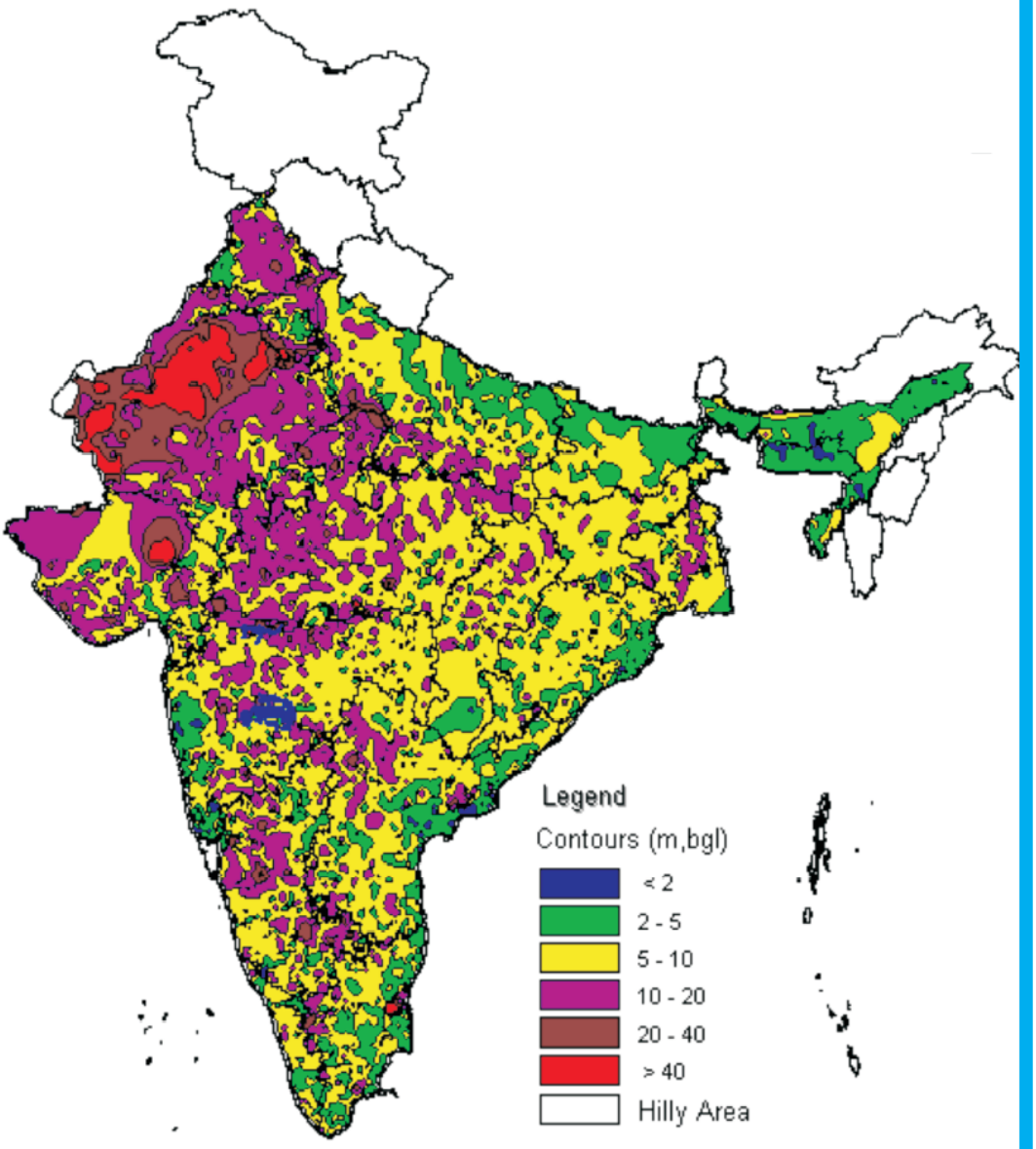


Plate - II

Water Level Fluctuation - Pre-Monsoon 2006 Vs Decadal Mean (1996-2005)

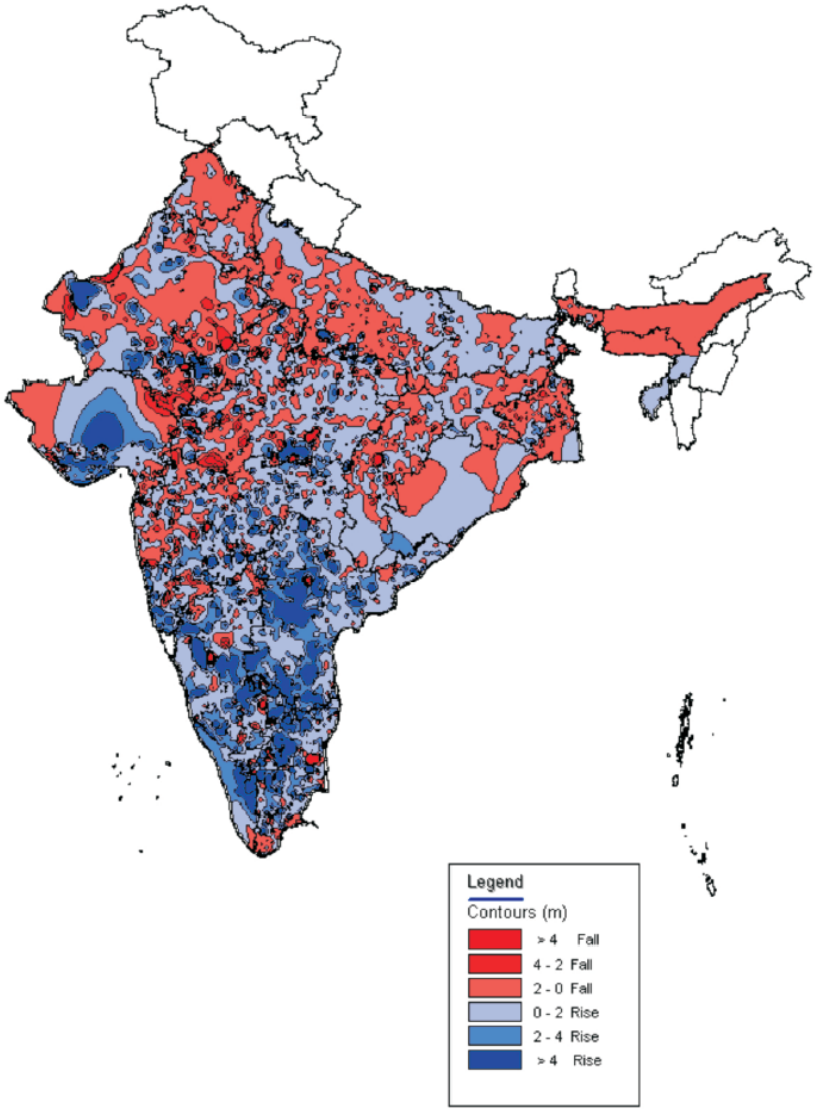


Plate - III

Depth to Water Level
Post-Monsoon 2006

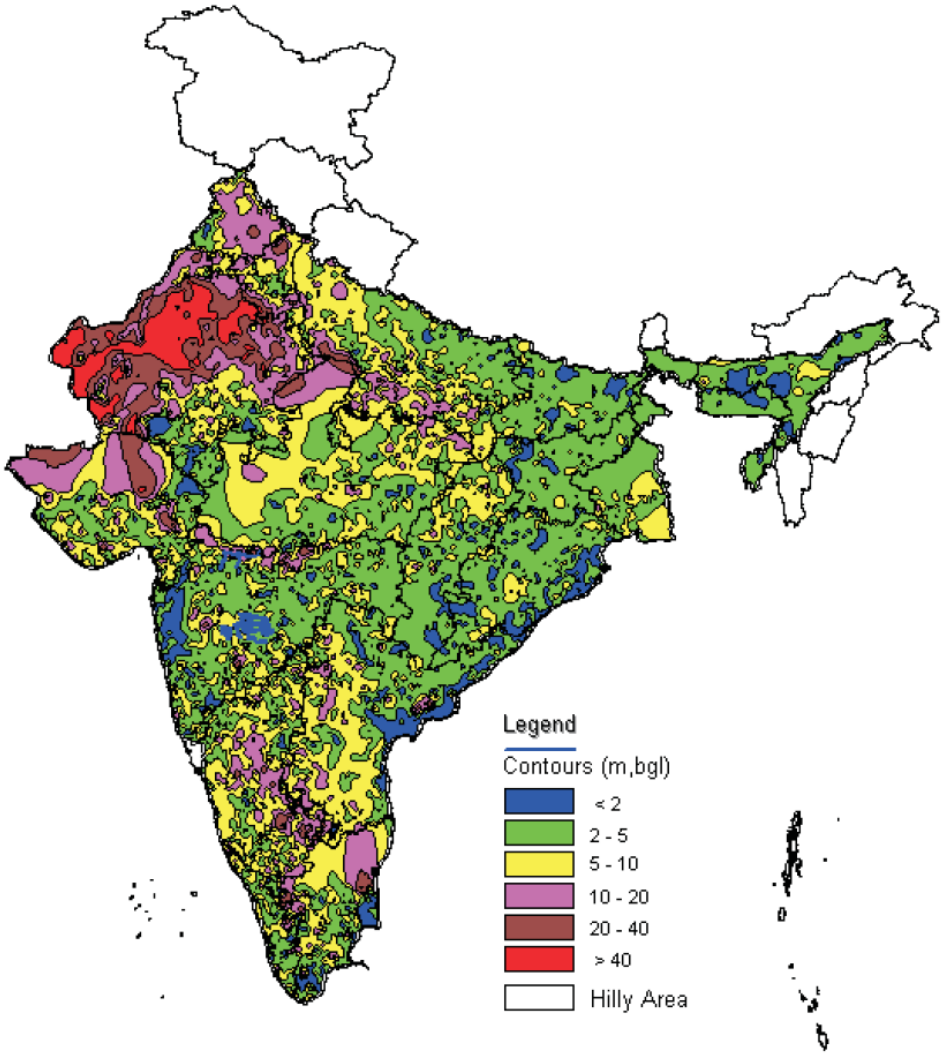


Plate -IV

Water Level Fluctuation - Post-Monsoon 2006 Vs Decadal Mean(1996-2005)

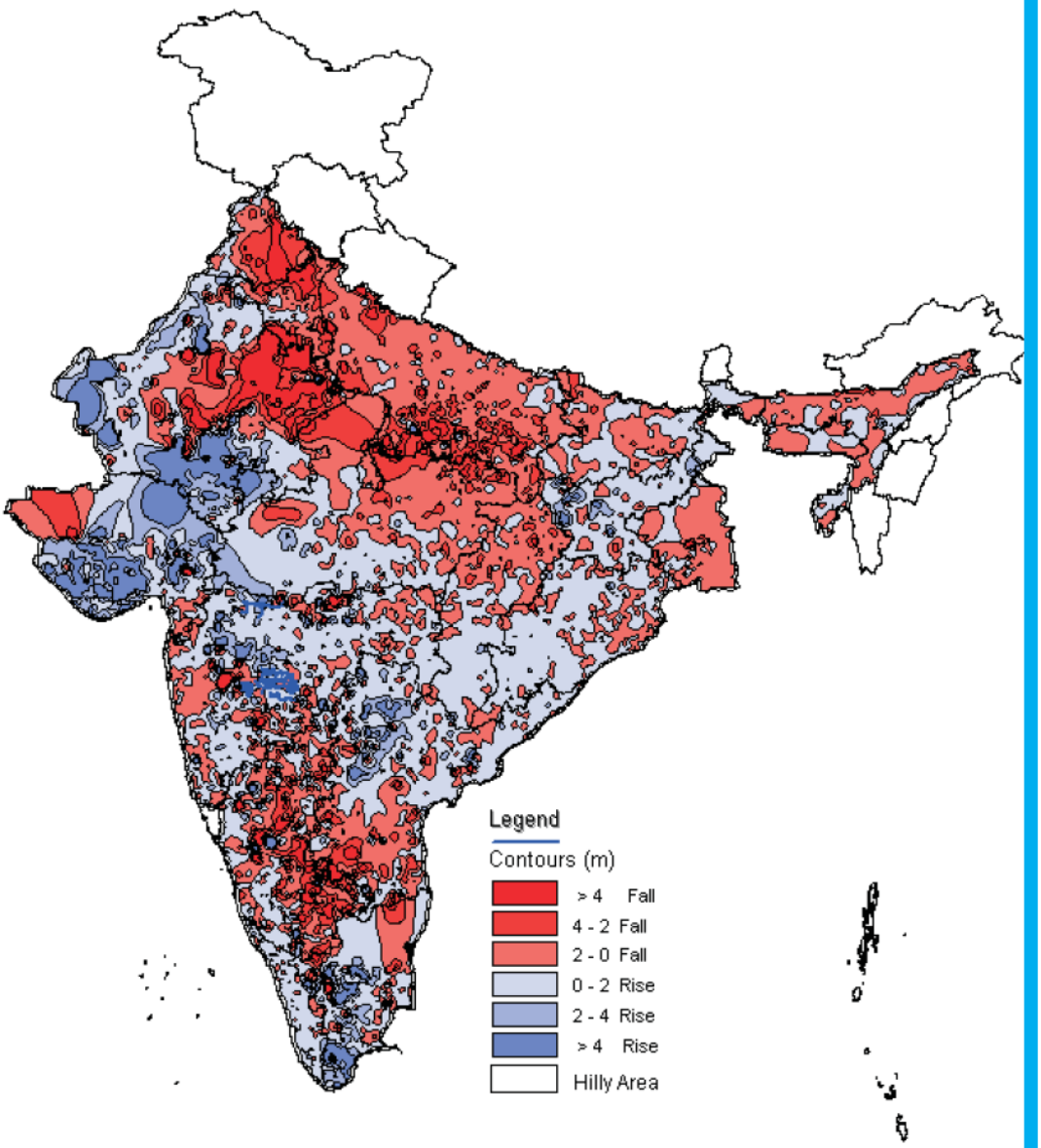


Plate - V

Depth to Water Level
January 2007

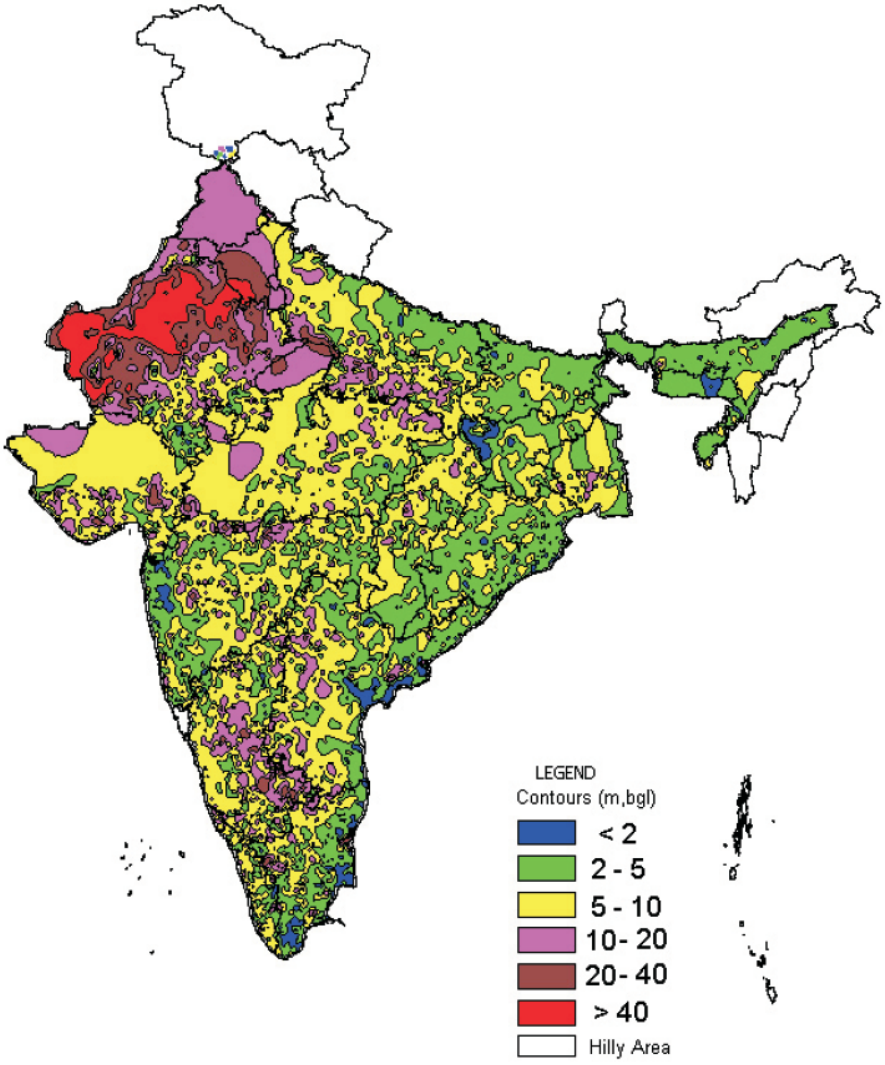
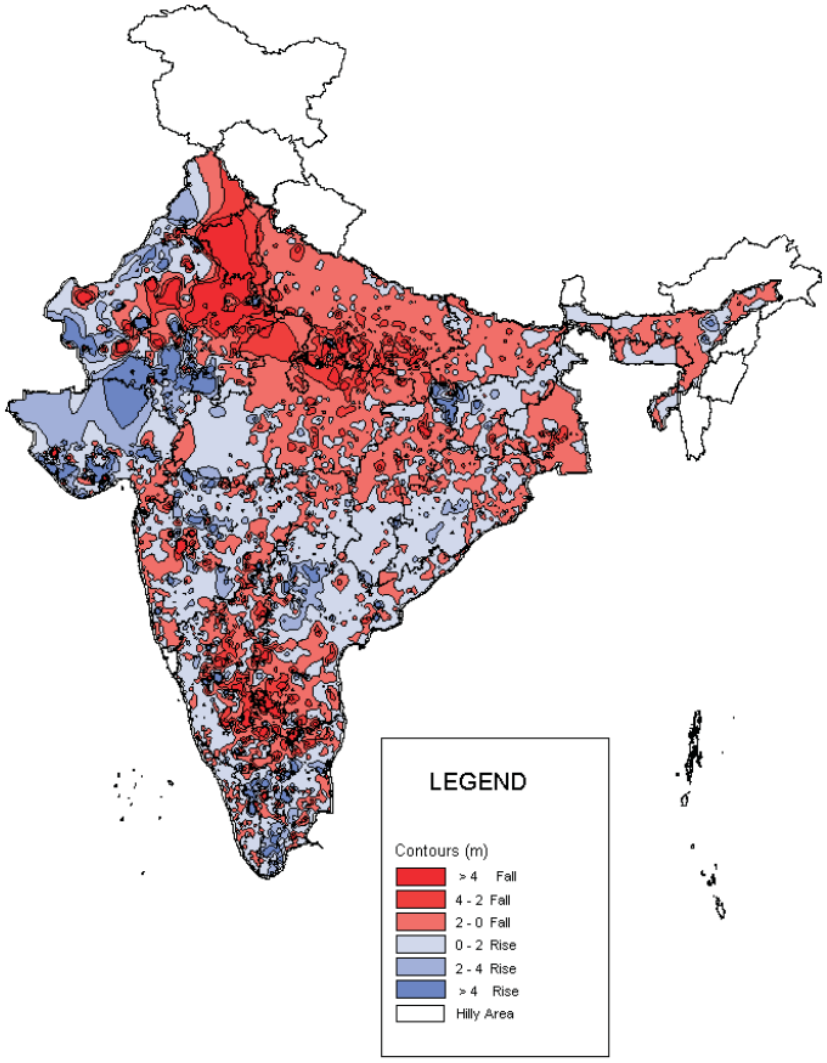
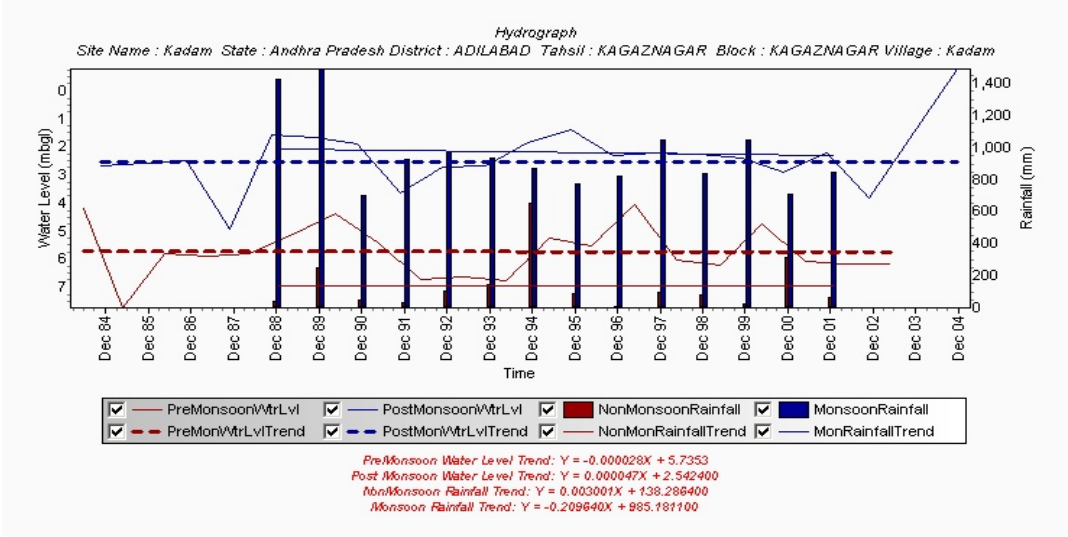
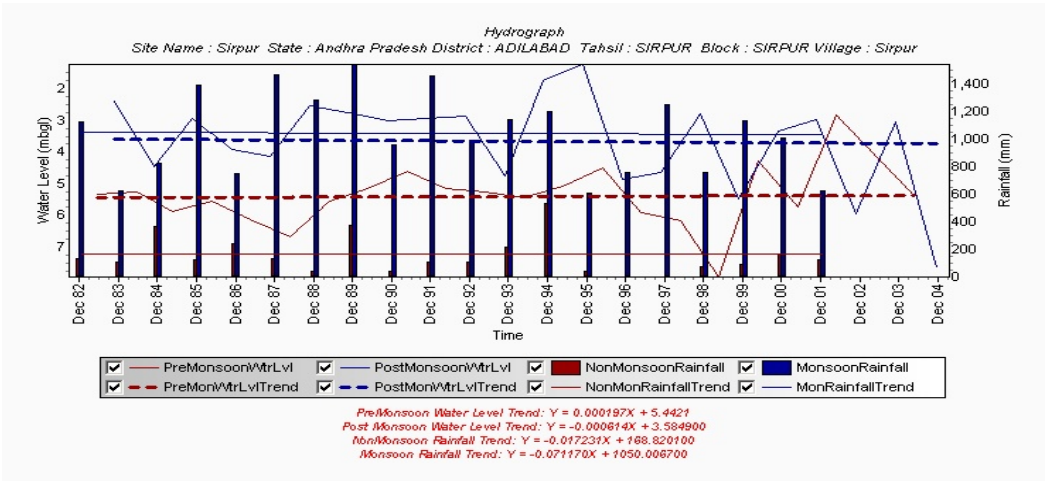


Plate - VI

Water Level Fluctuation - January 2007 Vs Decadal Mean(1997-2006)







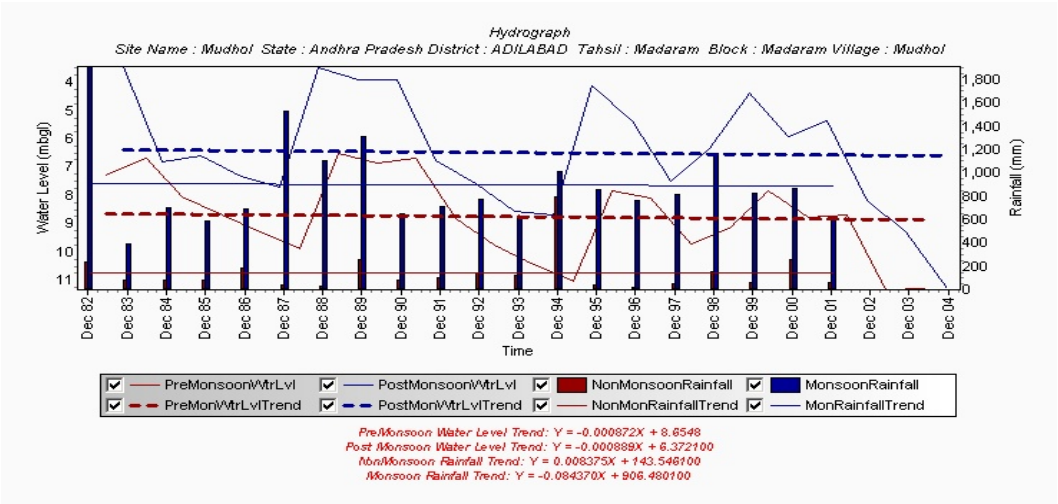


Figure shows hydrographs of selected monitoring observation wells

9. GEOPHYSICAL STUDIES

The Board undertakes geophysical investigations to support and supplement hydrogeological surveys, ground water exploration and short-term water supply investigations as an integral part of its activities. Besides these studies, geophysical techniques were also undertaken to demarcate saline -fresh water interface, thickness of overburden, favorable sites for artificial recharge studies and bedrock configuration.

9.1 Central Geophysical Cell

Central Geophysical cell is entrusted with planning and programming of geophysical activities in the Board, acquisition, maintenance and repair of geophysical equipment, organizing geophysical training programmes and guidance in special geophysical field surveys etc. The Central Geophysical Cell undertook the following works during year 2006-2007.

- Planning & Programming of Geophysical surveys in CGWB, Finalization of AAP of different Regions for Geophysical investigation and monitoring of progress of geophysical work.
- Acquisition of geophysical equipments, drawing of Specifications and organizing performance testing of Geophysical equipments.
- Co ordination of Geophysical Surveys and related Activities of the Regions.
- Preparation of inventory of equipments in different Regional and Assessment of present capability of Board as regards instrumentation.
- Co-ordination of Training Activities for personnel in geophysical Survey and related items.

9.2 GEOPHYSICAL SURVEYS AT A GLANCE

Details of Geophysical surveys & geophysical bore hole logging carried out in the regional offices are given in table 9.1 and 9.2

Table 9.1: SURFACE GEOPHYSICAL STUDIES DURING 2006-2007

REGION	NO. OF VES	RESISTIVITY PROFILES (line Km)
NWHR, Jammu	23	0.785
NWR, Chandigarh	71	-
WR, Jaipur	107	-
WCR, Ahmedabad	33	17.16
NCR, Bhopal	131	4.11
NCCR, Raipur	69	1.10
CR, Nagpur	100	-
NR, Lucknow	39	0.57
MER, Patna	157	4.0-
ER, Kolkata	131	-
NER, Guwahati	18	-
SER, Bhubaneswar	100	-
SR, Hyderabad	398	20.95
SWR, Bangalore	255	-
SECR, Chennai	153	20.0
KR, Trivendrum	101	15.43
NHR, Dharamshala	-	-
UR, Uttaranchal	26	-
TOTAL	**1912**	**84.105**

Table – 9.2: BOREHOLE LOGGING DURING 2006-07

REGION	No. of Boreholes logged	Total meterage logged (m)
NWHR, Jammu	4	750.00
NWR, Chandigarh	23	2537.00
WR, Jaipur	15	2022.0
WCR, Ahmedabad	15	3252.00
NCR, Bhopal	12	2046.65
NCCR, Raipur	-	-
CR, Nagpur	2	188.00
NR, Lucknow	15	5354.00
MER, Patna	9	1452
ER, Kolkata	11	2826.57
NER, Guwahati	-	-
SER, Bhubneswar	6	544
SR, Hyderabad	21	3207
SWR, Bangalore	1	181
SECR, Chennai	6	1926
KR, Trivendrum	-	-
NHR, Dharamshala	1	71
UR, Utteranchal	-	-
TOTAL	**135**	**26356.57**

9.3 Region wise highlights during the year 2006-2007 are as follows;

9.3.1 North Western Himalayan Region, Jammu

Surface geophysical surveys were mostly carried out with an objective of pinpointing the sites for ground water exploration. The main objective of the surface resistivity survey was to delineate the depth of potential water bearing zones. The interpreted results of the VES carried out at the exploratory well sites and litholog prepared were correlated to establish the resistivity ranges for different formations. The field VES data was entered in MS Excel format in computer for easy analysis, retrieval and dissemination. The field VES data along with the interpreted results were also entered in GEMS. Boreholes drilled in Jammu & Kashmir were electrically logged for recommending the well assembly and deciphering the depth of water bearing zones.

9.3.1.1 SURFACE GEOPHYSICAL STUDIES:

Resistivity Surveys:

A total of **30 Geo-electrical surveys** comprising of 23 Vertical Electrical Sounding (VES) and 07 Wenner Resistivity Profiles covering a traverse of 785 line-m, have been carried out. The district-wise details of resistivity surveys conducted is given in Table 9.3.

VES around Konark area - Puri District, Orissa

Degenerated Pond within a Island inside Chilka, Orissa

TABLE 9.3: STATE & DISTRICT-WISE DETAILS OF VES CONDUCTED

State	District	Locations	Total No. of VES	No. of Profiles / line-m
Jammu & Kashmir	Jammu	Sumbli	13	07 / 785 line-m
		Channi Rama	03	--
		Sanik Colony, Sector 'C'	03	--
		Channi Himmat	04	--
		Total	**23**	**07 Nos. / 785 line-m**

9.3.1.2 BOREHOLE LOGGING:

A total of 750 meterage of logging has been carried out by conducting geophysical logging in **four** boreholes drilled in parts of Jammu & Kashmir. The district wise number of boreholes with total meterage logged is given in Table 9.4.

Table 9.4 : DISTRICT-WISE BOREHOLES LOGGED IN JAMMU & KASHMIR

Sl. No.	Location / Tehsil/District	Depth Drilled (m)	Depth Logged (m)	Logging Parameters Recorded	No. of Logging	Meterage of Logging
1.	Iqbal Park / Srinagar.	201.00	200.00	SP, N16" & N64"	**04**	**750**
2.	Sanik Colony, Sector C / Jammu	176.40	174.00			
3.	Najin 'B' / Sumbal/Baramulla	174.80	172.00			
4.	Dussu / Pampore/Pulwama	205.80	204.00			

All the electrical logs were interpreted and suitable recommendations were prepared for lowering the assembly.

9.3.1.3. COMPILATION OF GEOPHYSICAL REPORT / DATA:

A total of three reports were submitted, during this period. The detail is given below

- Resistivity Surveys for Water Supply Investigation at Satarwan (Ghaink), Tehsil: Akhnoor,DistrictJammu(J&K). by K. P. Singh, AGP & Birendra Pratap, STA(GP).
- Compilation of old Electrical log of Kashmir Valley byK.P.Singh, AGP
- Resistivity Surveys for Ground Water Exploration at Sumbli, Tehsil: Samba, District: Jammu (J&K) by K. P. Singh, AGP & Birendra Pratap, STA(GP).

- 22 field VES and 7 Wenner Resistivity Profiles data was entered in computer for updating the Geophysical database in MS Excel format.
- A total of 47 VES and 14 Wenner Resistivity Profiles data were entered in GEMS.
- A total of 14 old electrical logs were manually digitized.
- The manually digitized data points of 13 old electrical logs were entered in computer, in MS Excel format.
- A total of **180** old Electrical Logs of boreholes drilled in Budgam, Baramulla, Pulwama, Srinagar, Anantnag & Kupwara districts were repaired, scanned, stitched for top & bottom scanned parts, as prerequisite for digitization and compilation.
- A total of **49** Electrical Logs of boreholes drilled in Kathua, Udhampur & Jammu districts were repaired, scanned, stitched for top & bottom scanned parts for prerequisite of digitization.
- All the "Data in Log Header Form" of **421** Electrical Logs of boreholes drilled in Jammu & Kashmir State were entered in Geophysical Logging Database made in MS Access.

9.3.2 North Western Region, Chandigarh

SURFACE GEOPHYSICAL STUDIES:

Resistivity Surveys were conducted in Bist Doab area of Punjab, parts of Punjab and other areas viz. Pinjore, Kalka and Narnaul in Haryana. In total 71, Vertical Electrical Soundings (VES) were conducted, out of which 42 VES were conducted in Bist Doab areas of Punjab and remaining 29 VES in other areas deploying ABEM Terrameter.

9.3.2.1 RESISTIVITY SURVEYS:

(i) Resistivity Surveys In Bist Doab Areas of Punjab

Under the assignment of Resistivity Survey depth soundings to delineate thickness of clays and aquifers, a total of 42 deep Vertical Electrical Soundings (VES) were conducted in the Bist Doan area comprising Nawanshahar, Jalandhar, Hoshiarpur and Kapurthala districts in Punjab. The interpretation of Resistivity data is in progress.

(ii) RESISTIVITY SURVEYS IN OTHER AREAS

Resistivity surveys were carried out to select sites of exploratory drilling, district Ground water Management studies, to assess the ground water quality, to delineate sub-surface geology to plan the design of Roof Top Rain water Harvesting Structure for artificial recharge of ground water and short term water supply investigation.

Thus, a total of 71 deep and shallow VES were conducted under the above assignments achieving the target. The item-wise details are tabulated as given in table 9.5.

Table 9.5 : DISTRICT WISE RESISTIVITY SURVEYS

STATE	DISTRICT	No. of VES	Area covered (sq.Km)
Punjab	1.Bist Doab areas of Punjab 2. Parts of Taran Taran And Patiala district	42 17	500
Haryana	1.Judicial complex, Narnaul, Mahendragarh 2. Pinjore & Kalka, Distt. Panchkula	4 8	1 15
	Total	71	516

9.3.2.2 BOREHOLE LOGGING:

A total of 23 exploratory/piezometers boreholes were geophysically logged, out of which, three boreholes in Haryana, two boreholes in Punjab, Sixteen boreholes in Delhi and one each boreholes in Uttaranchal and H.P. respectively. The total metrege of logging conducted is 2537m. The instrument used for logging was UPTRON Multichannel logger. Spot recommendations in respect of granular zones and quality of ground water were made after each logging for designing of well assemblies. District wise details are given in table 9.6.

Table 9.6: DISTRICT WISE DETAILS OF BOREHOLE LOGGING

District	No. of Boreholes Logged	Total meterege of borehole Logged
Jalandhar, Gurdaspur, Punjab	1 1	458
Panchkula Karnal Haryana	1 2	472
Delhi	16	1391
Dehradun, Uttarakhand	1	148
Una, Himachal Pradesh	1	70
Total	**23**	**2539**

9.3.3 Western Region, Jaipur

SURFACE GEOPHYSICAL STUDIES:

Integrated approach of Ground water sciences like remote sensing and geophysical studies basically seismic, electromagnetic, and electrical methods and borehole logging are used for pre estimation of aquifers geometry, water quality and quantity. It reduces the effective cost of drilling and accurate well assembly design.

Central Ground Water Board, Western Region is equipped with one analog multi-channel (Uptron make) and another OYO digital logger for study of borehole

geophysics and able to measure self potential, single point resistance, normal & 6' - lateral resistivity, natural gamma, caliper, temperature and fluid – conductivity parameters. Minitronics and DDR – IV resistivity meters are available for study of lateral and vertical variation of rocks properties. The following geophysical studies have been carried out.

9.3.3.1 SURFACE RESISTIVITY SURVEYS

Resistive survey is the electrical geophysical method that infers sub – surface features like fractures, type of hydrogeological formations, lineaments etc. Cost of resistivity survey instruments and maintenance are lower than other geophysical technique instruments and survey is also comfortable, required less manpower.

A total of 107 Vertical Electrical Sounding (VES) under the resistivity survey was conducted during the A.A.P. 2006 - 07, details are given in table 9.7.

Table 9.7: District wise surface Resistivity surveys in Rajasthan

District	No. of VES	Area covered in Km^2	Studies
Alwar	52	50	North- south trending ridges and isolated hillocks of Delhi super group occur along the eastern margin of Tizara block in Alwar district. Streams originated in this elevated area drain toward west forming a series of watersheds. Piedmont area of this ridge is characterized by talus and scree valley fills. Recent to Quaternary sediments like sand, silt, clay gravel and pebble deposits forms aquifers in well-defined water shades Maler Jatwali and Tizara RF of this block. Depth of base rock is highly undulating varying approximate from a few meter to 100 m. Occurrences of ground water is controlled by valley fill deposits and alluvium under the semi-confined to unconfined conditions. A total of 52 Vertical Electrical Sounding is conducted in these two water shades with the objective to identify aquifer geometry for selecting the suitable site for constructing the rainwater harvesting and groundwater recharge structures. Interpretation of data is under progress.
Hanumangarh	40	40	Recent to Quaternary alluvium comprises of alternate sand and clay layers conceal the entire area of Hanumangarh and Ganganagar districts as a Ghaghar flood plain. Thickness of this alluvium varying from 100 m to 400 m. Base – rocks of this area is Palana and Nagaur group of formations. Brackish to saline quality of ground water exists in this alluvium. Ingression of fresh water by Indira Gandhi Canals is occurred in canal command area at shallow depth up to 60 m approximately and also at places deeper depth which was inferred by geophysical logging data. Ghaghar river is also contributing to ground water recharge during floods. Total 55 Vertical Electrical Sounding is conducted in this area with the objective to delineate lenses of fresh water pockets, which were formed by ingression of canal water. Interpretation of data is under progress.
Ganganagar	15	15	
Total	**107**	**105**	

9.3.3.2 BOREHOLE GEOPHYSICAL LOGGING

During 2006-07, fifteen boreholes were geophysically logged recording Self potential, single point resistance, Resistivity (Short and long normal), 6"- Lateral resistivity and gamma logging parameters measuring cumulative depth of 2022 meters were logged at different parts of Rajasthan. Logs parameters thus recorded and identify the granular zones and well assembly were recommended. The District wise break – up of Geophysical logging in Rajasthan is given in table 9.8.

Table 9.8*:* District wise Geophysical logging in Rajasthan

District	No of boreholes logged	Total depth of borehole logged
Churu	2	161
Hanumangarh	2	374
Jaipur	4	270
Jaisalmer	3	552
Jhunjhunu	1	89
Nagaur	1	393
Sikar	2	183
Total	**15**	**2022**

9.3.3.3 COMPILATION OF GEOPHYSICAL REPORTS / DATA

Compilation of 90 VES data, 18 borehole logging data and three reports were done.

9.3.4 West Central Region Ahmedabad

GEOPHYSICAL STUDIES

During the AAP 2006-07, a total of 33 VES were conducted along the coastal belt of Porbandar and Junagadh districts and geophysical borehole logging were carried out in 15 boreholes drilled in alluvial area, out of these, two wells were logged by State Government logger on payment basis.

9.3.4.1 Resistivity Surveys

A total 33 VES were carried out against the target of 100 VES covering an area of about 900 sq. km. The VES were conducted in the coastal belts of Porbandar and Junagadh districts. The purpose of the investigation is to decipher fresh/ saline water interface (sea ingress salinity demarcation) and stratigraphic variations along the

coastal track of about 30.00 km width starting from Bhavnagar to Porbandar districts.

9.3.4.2 District-wise details of VES in Gujarat

Total of 33 VES and 17.16 Line Km. of Resistivity profiling were conducted covering an area of 900 Sq.Km in Junagadh and Porbandar districts of Gujarat.

9.3.4.3 Borehole logging

During the field season 2006-07 a total of 15 wells were electrically logged. Electrical Logging in 13 wells were done by the Departmental logger and two wells in Surendranagar and Jamnagar districts were logged through outsourcing from GWRDC Ltd, Govt. of Gujarat. District wise bore hole logged is given in table 9.9.

Table 9.9: District wise details of boreholes logged in Gujarat

District	Nos. of Boreholes logged	Total depth of bore holes logged (m)	Aquifer
Banaskantha	2	335	Alluvium
Gandhinagar	2	720	Alluvium
Jamnagar	1	200	Alluvium
Mahesana	3	576	Alluvium
Patan	3	845	Alluvium
Rajkot	1	70	Alluvium
Sabarkantha	1	106	Alluvium
Surendranagar	1	200	Sandstone
Jamnagar	1	200	Limestone/sandsto
Total	**15**	**3252**	

At one site logging was done two times.

9.3.5 North Central Region, Bhopal

GEOPHYSICAL STUDIES:

9.3.5.1 Surface Geophysical Surveys:

Resistivity Surveys

Surface resistivity surveys have been conducted to unravel the subsurface hydrogeological condition in parts of Gwalior, Betul, Bhopal Satna, Mandla, Dindori, Hosangabad and Ratlam district to support the groundwater exploration programme, augmentation of water supply and suggesting structure for Artificial recharge to various government agencies. For conducting the resistivity investigation DDR-4 and SSR-MP1 resistivity meter have been used. To achieve the target 131 Vertical Electrical Sounding (VES) and 4.11 line-km Gradient Resistivity Profiling (GRP) have been conducted. Most of the VES curves have been interpreted through conventional curve matching techniques and modeled with computer software like SCHLUM and

IPI2WIN. The GRP data have been interpreted qualitatively in terms of resistivity `low' with respect to the background resistivity. The Microsoft EXCEL software has also been used for plotting VES and GRP data. The District wise detail is given in table 9.10

Table 9.10: . District Wise Geophysical Surveys in Madhya Pradesh

District	No. of VES	Profiling line / km	Studies
Gwalior	**02**	**0.08**	Delineation of the thickness of alluvium formation
Betul	**42**	**1.63**	Groundwater exploration programme/ structures for artificial recharge to groundwater in Bel Watershed
Bhopal	**11**	**1.04**	Augmentation of water supply
Satna	**13**	**0.16**	Groundwater Exploration
Mandla	**04**	**0.32**	Groundwater Exploration
Dindori	**02**	**0.16**	Groundwater Exploration
Hosangabad	**08**	**0.72**	Short-term water supply/ rainwater harvesting structures
Ratlam	**49**	**-**	"Characterization of aquifer and litho units through surface resistivity surveys.
	131	**4.11**	

9.3.5.2. Geophysical Logging:

The District wise detail is given in table 9.11

Table 9.11: District wise details of boreholes logged in Madhya Pradesh

District	Nos. of boreholes logged	Total depth of boreholes logged in meter
Betul	**10**	**1892.65**
Mandla	**02**	**154.0**
Total	**12**	**2046.65**

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9.3.5.3 Compilation of Geophysical Reports / data:

A total of Six no of Short term Investigation reports for the augmentation of water supply to 1. NCC (OTA), Gawaliar, 2. National Archives, Bhopal, 3.Ordinance Factory, Itarsi, district 4. Hosangabad, Sultania Infantry, Bhopal, 5. G. C. F., Jabalpur and 6.Airport Authority of India, Bhopal were prepared.

9.3.5.4 Salient Features on the basis of resistivity Surveys:

A special studies programme titled "Characterization of aquifer and litho units through surface resistivity in Jaora block, Ratlam district was taken up. In total 49 VES with varying maximum current electrode separation of 200 m to 1000 m were conducted in an area of about 16 sq.km in Sarwani Watershed of Jaora block in Ratlam district. During the field session, to observe the resistivity variation with time (due to saturation and de-saturation of aquifer), at some predetermined locations the repeated VES were conducted in the month of May, October and March. The base maps etc have been prepared. The VES data have also been interpreted and being synthesized for final report writing.

9.3.6 North Central Chhattisgarh Region, Raipur

SURFACE GEOPHYSICAL STUDIES

During the year 2006-07, geophysical studies were carried out in four tribal districts of Chhattisgarh to know the subsurface condition in order to locate the sites for the construction of bore wells/ tube wells for exploration drillings, urban hydrology and short term investigations. A total 69 nos. Vertical Electrical Sounding (VES) and 1.10 line km Gradient Resistivity Profiling (GRP) were carried out.

9.3.6.1 Resistivity Survey

A total 69 nos. Vertical Electrical Sounding (VES) and 1.10 line kms Gradient Resistivity Profiling (GRP) is carried out during the year 2006-2007

Resistivity survey was carried out in hard rock terrain by deploying D.C. Resistivity Meter as well as Aqua meter (CRM 500) to know the subsurface variation, overburden thickness, weathered/fractured zone and depth to basement, which in turn infer favorable place for tapping ground water. Vertical Electrical Soundings (VES) were carried out using Schlumberger configuration and where ever lack of space Pole-Dipole configuration was used. The Gradient Resistivity Profiling (GRP) technique was also applied to delineate the weak zones in the subsurface in order to conducting electrical soundings at that particular point. The sounding data is plotted on a log-log graph paper and interpreted by partial curve matching techniques with the help of two/three layer master curves. SCHLUM and AIMREV software are also used to check the interpreted results \

A total 69 nos. Vertical Electrical Sounding (VES) and 8 nos. (1.10 line kms) of Gradient Resistivity Profiling (GRP) are carried out during the year 2006-2007, which is given in the Table9.12

Table 9.12. Resistivity Surveys carried out with objectives and achievements

S. No.	Districts	Nos. of VES	Gradient Resistivity profiling (Line km.)	Studies/*Findings*
1	Bilaspur	**23**	**-**	Delineation of fractures in Lime stones**,** At Masturi exploratory well site the fractured limestone is at a depth of 80m.
2	Durg	**20**	**0.60**	Exploratory Programme, The contact of Maniyari Shale and Hirri Dolomite is observed at a depth of 90 m at village Junwani Khurd whereas at villages Tuma and Murkuta it is observed at a depth of 45m
3	Janjgir-Champa	**19**	**-**	
4	Raipur	**7**	**0.50**	Exploratory Programme, the contact of Gunderdehi Shale and Charmuria Limstone at a depth of 280m is delineated
	Total	**69**	**1.10**	

9.3.6.2 Compilation of Geophysical Reports / Data

Short -term investigation report of CRPF. Campus at Thanod in Raipur district is submitted.

9.3.7 Central Region, Nagpur

Geophysical Studies	**Target**	**Achievement**
a) Sounding	100	100
b) Profiling	2 LK	Nil
c) Logging	2 LK	2

SURFACE GEOPHYSICAL SURVEYS

Electrical resistivity surveys were carried out to delineate fracture zones/potential water bearing zones in Morshi and Warud taluks, which are the over exploited areas in Amravati district. These surveys were also carried out to estimate the alluvium thickness and to assess the quality of ground water in parts of Akola district.

9.3.7.1 Resistivity Surveys

In total 100 Vertical Electrical Soundings (VES) in 3 districts with Schlumberger configuration were carried against the target of 100 VES. The district wise details are given in Table 9.13.

Table 9.13 District wise Vertical Electrical Soundings in Maharashtra

Amravati	93	NIL	1400
Akola	6	NIL	-
Nagpur	1	NIL	-
Total	**100**	**NIL**	**1400**

9.3.7.2 BOREHOLE LOGGING WITH RESULTS/FINDINGS/CONCLUSION

Two boreholes were logged, one each in Akola and Nagpur districts. These loggings were done using the ABEM-SAS-200 Logging unit attached to the ABEM-SAS-300 Resistivity meter. The district-wise details are given in Table 9.14

Table 9.14.: District-wise details of Boreholes logged in Maharashtra

State/UT	District/Location	No. of boreholes logged	Total depth of bore holes logged (m)
Maharashtra	Akola/Mhaisang	1	87
-Do-	Nagpur/Brahmanwada	1	101
Total		**2**	**188**

9.3.7.3 COMPILATION OF THE GEOPHYSICAL REPORTS/ DATA

Surface geophysical data collected in the field was compiled and interpreted both manually and by using computer aided techniques. Recommendations were given accordingly for drilling boreholes.

9.3.8 Northern Region, Lucknow

SURFACE GEOPHYSICAL STUDIES

9.3.8.1 Resistivity Surveys:

Field geophysical surveys were carried out in the:

NOIDA ,Gautam Buddha Nagar- Reconnoitry surface geo-electrical surveys were conducted to delineate fresh/saline groundwater interface and define the top layer characteristics for the purpose of artificial recharge over an area measuring 71 sq. kms– 21 VES . A close networking of VES is planned on the basis of this work.

Gajokhar , Varanasi – Short term water supply investigations in and around the campus of Jawahar Navodaya Vidyalaya for pin-pointing fresh quality groundwater bearing sites in largely saline groundwater environs – 4 VES.A note on the same was prepared and sent to user agencies.

Barkachha , Mirzapur - Short term water supply investigations in and around the campus of BHU : south extension campus to identify worthy aquifers in area of secondary porosity – 570 line-m Gradient resistivity profiling & 14 VES A note on the same was prepared and sent to user agencies.

9.3.8.2 District-wise details of Geophysical Surveys in Uttar Pradesh

District-wise details of Geophysical Surveys in Uttar Pradesh is given in table 9.15

Table 9.15: District-wise Geophysical Surveys in Uttar Pradesh

District	No. of VES	Line Kms Gradient Resistivity Profiling (GRP)	Area Covered (Sq Km)
Varanasi	04	-	-
Mirzapur	14	0.57 GRP	-
Gautam Buddha Nagar -NOIDA	21	-	71

9.3.8.3 District wise details of boreholes logged.

District wise details of boreholes logged given in Table 9.16

Table 9.16: District wise details of boreholes logged

District	No. of Boreholes logged	Location	Depth *Drilled* (m)	Depth Logged (m)	Total depth of logging (m)
Ballia	04	Gai Ghat Rewati	330.0	300.0 140.0	440
		Gai Ghat Rewati	358.0	300.0	740
		Gai Ghat Rewati	358.0	290.0	1030
		Haldiram pur, Belthara	351.0	346.0 350.0	1726
Bijnor	01	Mota Dhak Kotdwar	159.10	155.0 155.0	2036
Chandauli	01	Batauwan Sahabganj	137.0	136.0 137.0	2309
Gautam Buddh Nagar	5	Beel- Akabar Pur Dadri	151.0	148.0 148.0	2605
		Kasna	150.0	145.0 148.0	2898
		G Block Park Sector- 63	151.0	148.0	3046

		B-24 Park Sector- 81	150.0	148.0	3194
		Reserve Forest Area Sector- 92	150.0	150.0 135.0	3479
Lakhim -pur Kheri	02	Trilokpur Palia	360.0	355.0	3834
		Rampurwa	361.0	360.0	4194
Meerut	02	Timkia Kothi EW-1	602.0	510.0	4704
		Timkia Kothi EW-2	335.0	325.0 325.0	5354

9.3.8.4 Compilation of Geophysical Reports

Reports have been prepared on the following:

i) Surface geophysical surveys for drinking water in Chandraprabha and Orawan Tand area, Naugarh block, Chandauli district, U.P. by M.M. Srivastava and M.K.Bhowmic (Issued)

ii) Groundwater management studies through surface geophysical surveys in Tundla block, Firozabad district,U.P. by B.B.Trivedi.

9.3.9 Mid-Eastern Region, Patna

GEOPHYSICAL STUDIES

9.3.9.1. Resistivity Surveys:

A total of 157 Vertical Electrical Soundings (VES) have been conducted during 2006-07 which is given in table 9.17.

Table 9.17: District wise details of VES conducted

State/UT	District	No. of VES	Lines Kms	Studies/Findings
Bihar	Patna	45	-	Study of depositional environment in Patna (17 VESin Patna –Jahanabad Section), and to know the ground water seepage in the archeological site at Kumhrahar belonging to the Mauryan Period (28 VES). Geophysical data reveals a clear picture of the deposition of sand and clay layer around the site of a tentative direction of ground water seepage.
	Nalanda	04		-
	Munger	05		Ground water exploration, to identify the subsurface fractures. Interpretation of VES data indicates more than one sets of fracture both in shallow (<50.0m) and deeper depths. It also demarcates the thickness of weathered mantle which sometimes extends up to the depth of 40.0 m.

Jharkhand	Ranchi	18	-	Exploratory Drilling/To identify the fracture/fracture zones for the construction of piezometers in Ranchi urban area. Vertical Electrical Sounding (VES) have been conducted to delineate fracture. Soundings' results indicate water bearing fracture zone at a depth of 30-40 m in Ranchi Zila School. Similarly, in Gumla district GRP followed by VES were conducted to pin-point the location of exploratory drilling sites. A systematic geophysical survey was conducted (with GRP & sounding) in the Hazaribagh district to get the surface signature of lineaments inferred from satellite imageries. A total of 48 VES were conducted in the area along the road section. Interpreted results along with the apparent resistivity pseudo-section, prepared on the basis of field data, indicate the spatial distribution of more than one set of fracture system at various depths. A short term investigation (on payment basis) was carried out for proposed Thermal Power Station of DVC in Koderma district, 6 sites have been recommended for drilling down to the depth of 100-150 m.

9.3.9.2 Magnetic Surveys:

Magnetic survey is given in Table 9.18

Table 9.18: Magnetic survey

State/UT	District	No of Profiles	Lines Kms	Objective
Bihar	Nalanda	01	2.5 km	Reconnoitry Survey to study Lateral Variations

9.3.9.3 Borehole logging with results/findings/conclusion:

Location and depth of the bore hole logged in the State are given in table 9.19.

Table 9.19 .Location and depth of the bore hole logged

State/UT	District/Location	No. of bore wells logged	Total depth of bore well logged (m)
Bihar	Patna a. Barh	 03	 270.0
Bihar	Samastipur a. Madudabad b. Madudabad	 01 01	 260 200
Bihar	Buxar a. Brahmpur b. Brahmpur	 01 01	 77 245

	c. Arjunpur	01	150
Uttar Pradesh	Balia a. Balia	 01	 250
Total		**09**	**1452**

9.3.9.4 Compilation of geophysical reports/data:

All the data have been compiled and all the logs digitized for future use.

9.3.10 Eastern Region, Kolkata

GEOPHYSICAL STUDIES

9.3.10.1 Resistivity Survey with district wise details

District wise details of Resistivity Survey is given in table 9.20

Table 9.20: District wise Resistivity Survey

District	Location	No. of VES	Studies & Findings
North 24 Parganas	i) Baduria & sorroundings	23 VES	At the eastern part of river Padma, Jadurati, Maslandapur & Jangalpur area, a sand layer is detected below the clay layer 18-60 mbgl whereas at Bagjola and Chandipur area the sand of different grades are available just below the top soil.
	ii) Pakdah & surroundings	16 VES	In the western part of Padma river medium to coarse sand available just below the top soil of 2-5 m thickness (at Ranidanga, Chowrashi, Kalsur etc.). At both the sides clay is available below 120 mbgl.
	iii) RBI Campus, Salt Lake	1 VES	The interpreted data shows that there are 4-6 nos of subsurface layers. Below the top soil 35-103 mbgl medium sand of resistivity 20-26 Ωm is available at the northern part. Below this medium sand thick 80 m clay is detected. But at the southern part clay slowly pinches out and a coarse grained sand of resistivity 50-75 Ωm is found below medium sand. Below this coarse sand, a clay layer is detected
			5 layers are identified. Below the top soil, a fine grained sand layer (saline) within 2.5-20 mbgl having resistivity 4 Ωm. 2nd layer is fine to medium sand within 20-37 m having 22 Ωm. 3rd layer is clay bed ranging 37-62 mbgl & the 4th layer is medium to coarse sand below 62 m.
Medinipur East	i) In and around Contai and Digha	20 VES	Sand dunes of thickness 15-20 m have been delineated. It exhibits two geo-electrical layers: Thickness(m) Resistivity(Ωm) Lithology a) 1-7.5 100-3500 Partially saturated or dry coarse sand b) 5-32 10-90 Sand saturated with fresh water
Medinipur West	i) In and around Medinipur Sadar	21 VES	Down to the depth of 10 mbgl, the lithology is mainly pebble & coarse sand. Below this down to 70 mbgl coarse sands predominates & this trends continue down below.
	ii) Air Force Station, Salua	8 VES	Down to 0.7 mbgl – Top soil Down to 5.0 mbgl – Fine to medium sand Down to 120 mbgl – Coarse grained sand Below 120 mbgl – Medium grained sand

A & N Islands	i) Macca Pahat,	19 VES	The interpreted data shows that the topsoil is weathered in the NE direction and its depth ranges from 0.39 mbgl to 14.65 mbgl. 2nd layer shows mostly weathered and fractured formation which is the potential ground water bearing zone and ranges from 8.88 mbgl to 55.60 mbgl. One fractured zone has been identified within 10-30 mbgl. The last layer is mainly compact volcanic, ultramafic and sandstone and common fractures are within the depth range from 70-100 mbgl.
	ii) Calicut, Teylerabad & New Bimbleton, Port Blair,	23 VES	
	Total	**131 VES**	

9.3.10.2 Bore hole logging

A total of 11 nos. of borehole have been electrically logged in West Bengal. Electrical logging details and findings are as follows in table 9.21:

Table 9.21: DETAILS OF ELECTRICAL LOGGING IN WEST BENGAL

District	Location	No. of borehole electrically logged	Depth drilled (mbgl)	Depth logged (mbgl)	Zones identified (in mbgl)
Malda	Bhaluka Netaji Chatrabas, Harischandrapur II	1 No	250.9	250	40-135, 175-250
Haora	Belpukur College Campus, Shyampur II	1 No	250	250	48-67,82-115, 157-177, 192-210, 216-221, 224-245
Dakshin Dinajpur	Jahangirpur Higher Secondary School, Gangarampur	1 No	250	250	27-48, 53-68, 76-82, 85-92, 100-107, 119-122, 144-147, 151-165, 168-195, 200-205, 208-213, 217-222, 223-225 & 232-250
Uttar Dinajpur	Goalpara, Raiganj	2 Nos.	248	248	24-29, 35-46, 55-65, 70-80, 85-120, 127-133, 136-154, 158-165, 172-186, 194-198, 203-210 & 213-247
	Technical Training Centre, Kaliaganj		250.13	250	25-37, 77-95, 103-110, 120-130, 153-160, 185-195, 213-222
Barddhaman	Benakar, Purbasthali II	2 Nos	280	277.4	78-92, 111-131 & 136-147
	Purba Sahapur High School, Kalna II		338	335	12-20, 27-44, 65-121, 125-157, 173-179, 181-200, 208-213, 219-232, 235-239, 242-250
North 24 Parganas	Choumaha High School, Barasat II	4 Nos.	265.4	260	26-43, 62-161, 170-191, 202-225 & 241-246
	-Do-		284	216.17	26-43, 60-161, 168-191, 199-223 & 240-246
	Chandalhati		250	250	180-192 & 212-230
	Pakdah Primary School, Barasat II		324.38	240	30-50, 96-215 & 222-229
Total		**11**		**2826.57**	

9.3.10.3 Compilation of Geophysical Reports:

(i) Litho variation studies through geophysical method in and around Calicut-Macca Pahad area, Port Blair Tehsil, South Andaman, Andaman sub-division, Andaman district, A & N Islands and issued.
(ii) Feasibility study for construction of a standby deep tube well as an alternative source of water supply at Reserve Bank of India's Staff Quarter Premises, LB Park, Salt Lake, Kolkata, West Bengal and issued.
(iii) Geophysical investigation report in and around Bishnupur area, Bankura District, West Bengal.
(iv) Geophysical investigation report in and around Habibpur and Manickchak area, Malda District, West Bengal

9.3.11 North Eastern Region, Guwahati

GEOPHYSICAL STUDIES:

Electrical Resistivity method has been employed for carrying out geophysical survey in various parts of Assam, Meghalaya, Nagaland and Arunachal Pradesh. A total of 18 Vertical Electrical Soundings (VES) have been conducted adopting the Schlumberger/Half-Schlumberger electrode configurations to know the vertical extension of different litho-units and to delineate the existing potential fractures in hard rocks. All these 18 VES have been taken up under short term water supply investigation to facilitate the construction of tube wells for augmentation of drinking water.

In soft rock areas, a sequence of sand and clay with varied thickness have been identified where as in hard rock areas, weathered and fracture zones, semi-compact and compact formations have been identified. All the reports have been finalised and the findings/results are discussed in the next item.

In connection with the preparation of status report, compilation of surface geophysical data of Meghalaya State has been made.

9.3.11.1 Surface Geophysical Studies.

Resistivity survey was carried out in different parts of the North Eastern Region which are given in table 9.21.

Table 9.21: Resistivity survey carried out in different parts of North Eastern Region

State	District with Premises with no of VES Conducted / Recommended	No of VES
Assam	A.**Kamrup** – 1- Kendriya Vidyalaya, CRPF Campus Area, 9 Mile, 3 VES/**2VES.** 2 - Indian Institute of Enterpreneurship, Lalmati, Basistha, One VES/**One VES** 3 - Indian Water Transport Terminal, Pandu port, Guwahati, One VES/**One VES**	13

	4 - CRPF Campus, 9 Mile, Two VES/ **Two VES** 5 - GE- Guwahati Office Premises, Bhutnath, Guwahati, 2 VES/ **1VES** 6 - RBI, Residential Complex, Zoo Narengi Road, -One VES/**One VES** 7- Cankareng Building Premises, Canara Bank, Bhangagarh- One VES/ **One VES** 8. Assam Engineering Institute Guest House, One VES/ **One VES** 9. SIB Complex, Barbari, One VES/**One VES.** B.**Goalpara-** Civil Hospital Complex, Two VES/ **One VES**	02
Meghalaya	North Eastern Hill University, Tura District**,** West Garo Hills	03
Total		**18**

9.3.12. South Eastern Region, Bhubaneshwar

9.3.12.1. Surface geophysical studies with results/findings/conclusion.

Resistivity Surveys: Resistivity Surveys comprising of 100 Vertical Electrical Soundings (VES) were conducted with different objectives during AAP 2006-07 given in table 9. 22.

Table9.22: District-wise details in Orissa

District	No. of VES	Area covered under (Km)2
Khurda	6	6
Puri	48	89.2
Ganjam	8	16.5
Sundargarh	38	24.5
TOTAL	**100**	**136.2**

9.3.12.2 Borehole Geophysical Logging

The borehole geophysical loggings were conducted in all the 6 exploratory boreholes drilled with Direct Rotary Rig in coastal alluvial areas of Balasore district to demarcate the saline/fresh and pervious & non-pervious zones. SP, P.R., Short Normal (N16") and Long Normal (N64") resistivity logs were recorded using Uptron Multi-channel Logger. The productive zones and water quality estimations of the different zones with in the bore hole are deciphered based on the logging results for the tube well assembly recommendations. District wise details of boreholes logged in Orissa given in Table 9.23.

Table 9.23: . District wise details of boreholes logged in Orissa

District	No. of boreholes logged	Depth Drilled (m)	Bore Hole Logging Depth (m)	Total depth of bore holes logged (m)
Balasore -	6			

Arad Bazar		103.09	102	
Bankakhejuri		102.99	101	
Darjipokhari		102.91	101	

9.3.12.4 Surface Resistivity Surveys

Resistivity Surveys comprising of 100 Vertical Electrical Soundings (VES) were conducted with different objectives as given in the following paragraphs during 2006-07.

Mardrajpur		89.12	87	
Matiali		50	48	
Makhapada		107	105	

The logging results have deciphered the granular zones and suitable zones were recommended for well assembly on the basis of log interpretations.

9.3.12.3. Compilation of geophysical reports/data

All the four Short-term water supply investigation reports on the Resistivity surveys in Khurda and Sundargarh districts were prepared with recommendations etc.

All the reports on the Geophysical logging of the exploratory bore holes in Balasore district were prepared and submitted for construction of production wells.

A paper in Rajbhasha (Hindi) on "Investigation of Fresh/Saline water using Geophysical methods" was prepared and presented in the National seminar organized by Regional Research Laboratory, Bhubaneswar during 7-8, December2006.

Salient features: The Geophysical Investigations are taken up in two parts - Surface Resistivity Surveys & Borehole Geophysical Loggings

Resistivity Surveys for Ground Water Exploration: A total of 26 VES (Radial) were conducted in parts of Ganjam and Sundargarh districts to delineate the nature and depth of different subsurface formations, occurrence and direction of fractures in the hard formations and feasibility for drilling of production bore wells. Based on the VES results ten sites were recommended for drilling under ground water exploration programme.

Resistivity Surveys for short-term water supply investigations: Total eight VES were conducted in Khurda and Sundargarh districts and 4 sites were recommended for drilling boreholes. The drilling was undertaken at two sites and fractures encountered at depth.

Resistivity Surveys for Fresh/Saline Ground water interface studies: The complex hydrogeological set up in the coastal tract of Orissa poses a serious problem for ground water management. 48 VES were conducted in Gop and Konark blocks of Puri district to delineate fresh/saline ground water interface and to demarcate areas for future drilling for water supply tube wells. The VES data interpreted and fresh/saline ground water zones are mapped in an area of about 150 sq. kms. A fence diagram showing the occurrence and extension of different sub surface layers is prepared based on the VES results.

Resistivity Surveys for Groundwater Management Studies and Watershed Development: A total of 18 VES were conducted in Saraswati Nala basin of Sundargarh district in the area proposed for watershed development Programme for delineation of overburden thickness and fractures at depths along with massive rock geometry.

9.3.13. Southern Region, Hyderabad

Surface geophysical studies with results / findings / conclusion

9.3.13.1. Resistivity surveys

A total of 398 Vertical Electrical Soundings (348 shallow and 48 Deep) and 19.95 Line Km of resitivity, profiling were carried out in parts of Guntur, Medak, Kurnool, Kadapa, West Godavari, Ranga Reddy and Karimnagar districts. These surveys are aimed to locate the shallow/deep fracture zones, litho contacts, associated structural fractures and saline-fresh water studies. The district wise detail is given in Table 9.24.

Table 9.24: District wise details

District	No. of VES	Profiling in Line Kms	Studies / Findings
Guntur	115	-	Exploratory drilling and 68 VES were carried out in Guntur district, covering the parts of 56P and 65D toposheets. The major thrust zone trending in NNE-SSW direction along the eastern margin of the Kadapa basin, running approximately parallel to the Meta sedimentary/migmatites contact was surveyed for ground water potential zones. The interpreted data revealed positive findings with encouraging results. However, the compilation and analysis of data is under progress employing different software.
Kurnool	73 (25 shallow & 48 Deep)	15	To delineate the zones for ground water exploration through deep drilling. From the interpreted data of the VES profiles, the thickness of the shales overlying the limestones has been estimated. The present investigations revealed two conductive zones below 200 m in the massive plinths of quartzites/dolomites. However further studies are required to carryout in this area for finalization of sites; which are still continuing.
Medak	18	2.35	Exploratory drilling
Karimnagar	4	-	Exploratory drilling
West Godavari	29		To study the fresh – salt water interface
Kadapa	125		To delineate the weathered and fractured zones near the artificial recharge sties.
Ranga Reddy	34	1.6	For water supply investigations
Total	**398**	**18.95**	

9.3.13.2 VLF/Magnetic Survey

Dettails of Magnetic survey is given in Table 9.25.

Table 9.25: VLF/Magnetic Survey

District	Type of Survey	Line Km covered
Guntur	VLF	0.4
R.R. District	VLF	0.6
		1.0 Lkm

9.3.13.3 Borehole logging with results/findings/conclusion:

19 exploratory wells in Medak district and 2 exploratory wells in Nizamabad district covering hard rock areas were logged with OYO Portable Logger measuring the parameters of Self Potential, Short/Long Normal Resistivity and Natural Gamma logs to the maximum depth of 200 mbgl. The interpreted log indicated various litho units and shallow fractures with moderate to high yields. District wise details of Boreholes logged in Andhra Pradesh is given in Table 9.26.

Table 9.26: . District wise details of Boreholes logged in Andhra Pradesh.

District	No. of boreholes logged	Total depth of boreholes logged (m)
Medak	19	2959
Nizamabad	2	248
Total	**21**	**3207m**

9.3.13.4 Compilation of Geophysical Reports/Data:

Since the geophysical investigations for delineation of structural features in Guntur and Kurnool districts are continuing, the vast resistivity data is under compilation for taking up further surveys.

Four no of reports were issued

- Report on Geophysical Surveys for Selection of Drilling Sites in Parts of Guntur District, Andhra Pradesh (2006-07)
- A Report on the Geophysical Surveys for Selection Of Exploratory Drilling Sites In Parts Of Nizamabad District, Andhra Pradesh (2000-01)
- Report on geophysical surveys for selection of exploratory drilling sites in the drought affected areas of Mahabubnagar and Medak districts of Andhra Pradesh (2003-04)
- Geophysical surveys for selection of exploratory drilling sites in parts of Visakhapatnam district, Andhra Pradesh (2005-06

9.3.13.5. Salient features:

The resistivity surveys carried out for deep ground water exploration in Kurool district along the Reamalakota Gani lineament indicated 4 to 5 layers geo electrical section. The deep favourable zone was deciphered between 120 and 190 m at

Yambai, Sidhanagattu and Kalva villages. However, at Ramallakota, it is found that beyond 200 m, high resistivity zones were encountered. So, the deep resistivity soundings with AB/2 around 2 kms has indicated that the favourable zones are likely to be encountered within the 200 m only beyond which the formation is found to have high resistivity.

Geophysical surveys consisting of VES profiling was taken up to delineate the thrust zone and litho units traversing along Piduguralla-Rajupalem-Sattenapalli section. Surveys were carried out between 5 and 9 km, 10 and 14 km and 18 and 23 kms, respectively. The pseudo resistivity and geo electrical section indicated that the thickness of the limestones and shales was found to be between 80 and 100 m bgl over basement rock along 5 to 9 km section. The resistivity carried out between 10 and 14 km has indicated the presence of thrust zone between 80 and 100 m bgl whereas between 18-23 km profile, the thrust zone was identified between 20 and 80 m along the eastern margin of Kadapa basin.

Geophysical surveys were carried out to delineate fresh water pockets and presence of paleo channels between Bhimavaram, Palakoderu, Vempa, Sitarampuram, Mogaltur and Penupalem villages upto the coast in saline tracts of West Godavari district. The survey indicated the presence of fresh water pockets at two locations at 10m and 15 m. The presence of fresh water may be due to the presence of paleo channels. The extent and continuity of these fresh water zones as well as paleo channels could be delineated by extending the surveys.

On the advise of the Chairman, Parliamentary Standing Committee on Water Resources, Central Government desired to locate sites for drilling bore wells for drinking water purpose in problematic villages of Guntur district. In this connection, on the basis of hydrogeological conditions, tentatively selected 36 sites at villages of Thullur, Thadikonda, Peddakakani, Guntur Rural, Chebrolu, Yedlapadu and Prathipadu mandals of Guntur district for drilling bore wells on the recommendations of geophysical investigations. Based on the VES results, the sites at Nekkolu, Vadlamanu, Anantavaram, Tadikonda, Nadimpally, Unnova, Sekur to a depth of 40 m and Nambur to a depth of 15m are expected to be promising from the ground water point of view and quality of water is expected to be potable

9.3.14 South Western Region, Bangalore

9.3.14.1. Surface Geophysical Surveys

Type Of Survey	Target	Achievement	Remarks
VES	250	255	**TARGET COMPLETED AND EXCEEDED BY 5 VES**
VLF	Need based	-	

9.3.14.2. District Wise Details of Resistivity Surveys:

For Ground Water Exploration:

Geophysical surveys were carried out in Mandya, Bidar, Chitradurga, Davanagere and Kolar districts. The geophysical surveys mainly comprising of Vertical Electrical Soundings (VES) at the hydro geologically selected sites in order to know the nature of sub-surface such as extent of weathering, fracturing, etc., to know the quality of ground water

and to select comparatively better sites for taking up drilling. VES was conducted by employing Schlumberger electrode configuration.

Sl. No	Taluk / District	No. of VES	No. of sites recommended for drilling	Study / Findings
1.	Mandya Malavalli, Mandya	21	07	To know the nature of sub-surface such as extent of weathering, fracturing, etc., to know the quality of ground water. The exploratory drilling at the recommended sites to a maximum depth of 200m yielded the discharge is in the range of 2.5 – 12lps.
2.	Aurad Bhalki Bidar, Bidar	35	09	The study area is covered by mainly Basaltic formation of Deccan trap with various numbers of flows along with red bole beds. The second and third layer was characterised by the resistivity in the range of 6-800 ohm m which is considered as weathered / semi weathered and massive formation in nature. The thickness in this formation is varying in the range of 2 to 40 m. By considering the interpreted results and existing bore wells data 9 sites were recommended for drilling bore wells.
3.	Hosadurga, Chitradurga	43	08	Geophysical survey carried out at hydrogeologically selected sites in Hosadurga taluk, has given rise to 3-4 layered geoelectrical section in which the last layer is basement. The second and / or third layer resistivity was varying in the range of 11-75 Ohm.m. with thickness in the range of 2-40mts. and is considered as highly weathered to weathered formation. At about 6 sites the drilling was carried out upto a depth of 200mts. At 85% of the sites the drilling discharge was in the range of 1.75-10 lps.
4.	Malur, Kolar	30	04	Based on the VES curves and interpreted results, 4 sites were recommended for deep drilling.
5.	Harihara, Davanagere	06	02	Two sites were recommended for exploratory drilling.

Artificial Recharge Studies:

Resistivity Surveys comprising 81VES and eight no of Profiles were carried out in Malur , Bangarpet and Kolar taluks for the proposed sub surface dams. VES profiling were conducted at two to three proposed alignment for thickness of soil, weathered thickness and depth to hard formations in each of the taluks with a station interval of 10-15m between each VES. At 8 places subsurface conditions were inferred for construction of AR structures. The Taluk wise detail is given below.

Kolar taluk:

VES profiling were carried out at Medihalli gate, Chokkahalli, Juvahalli & Hullumkallu across the stream. A total of 45 VES was carried out in these four profiles.

Location	Resistivity Range in Ohm.m	Thickness in meters	Inferred layer	Depth to Hard rock in meters
Medihalli	6-220	0.8-2.0	Top soil	
	9-150	3.4-11.0	Weathered	
	High	-	Semi weathered to hard	5-11m
Chokkahalli	14-130	0.7-3.0	Top soil	
	22-100	4.2-10.0	Weathered	
	High	-	Semi weathered to hard	5-12 m
Juvahalli	21-300	0.7-1.2	Top soil	
	11-18	8.0-13.0	Weathered	
	High	-	Semi weathered to hard	9-15m

Malur taluk:

Two VES profiling were carried out at Gopasandra & Kugataganahalli across the stream. Totally 19 VES were carried in these two profiles. Results are as below:

Location	Resistivity Range in Ohm.m	Thickness in meters	Inferred layer	Depth to Hard rock in meters
Gopasandra	7.5-148	1.0-2.0	Top soil	
	22-60	1.4-6.0	Weathered	
	High	-	Semi weathered to hard	1-9m
Kugataganahalli	11-535	0.5-2.5	Top soil	
	11-122	1.1-20	Weathered	
	High	-	Semi weathered to hard	2-21.5m

Bangarpet taluk:

Three VES profiling were carried out at Avanur Hosahalli, Ajjappanahalli & Doddavagamadi across the stream. Totally 17 VES were carried in these three profiles. Results are as below

Location	Resistivity Range in Ohm.m	Thickness in meters	Inferred layer	Depth to Hard rock in meters
Avanur Hosahalli	27-80	1.0-4.0	Top soil	
	26-100	4.5-8.0	Weathered	
	High	-	Semi weathered to hard	5.5-10m
Ajjappanahalli	9-150	0.7-1.5	Top soil	
	22-47	3.3-7.5	Weathered	
	High	-	Semi weathered to hard	4-9.0m
Doddavagamadi	11-88	0.8-1.7	Top soil	
	14-38	6.2-8.3	Weathered	
	High	-	Semi weathered to hard	7-10m

Short term water supply investigation: A total of 39 VES were conducted in Bangalore North and South Taluk of Bangalore district for the augmentation of Water Supply. 11sites were recommended for drilling. The detail is given below.

DISTRICT	Location	No. of VES	Recommended Sites for drilling
Bangalore North Taluk	1.BSF, Yelahanka	7	2
	2.BSF, Karehalli	11	1
Bangalore South Taluk	SSTL campus, Kodathi,	13	4
Defence Establishment, Bangalore	Station Workshop, Indian Army	**6**	**2**
Bangalore	Karnataka Housing Board	**2**	Data Under Processing.

9.3.14.3 Bore hole logging:

One well at Kolar in Kolar taluk was logged for SP, N16"&N64" for a depth of 181m to confirm the potential ground water zones.

9.3.14.4. Compilation of geophysical survey data/report

1. Geophysical Geophysical survey Report on Suryanagar, Bangalore
2. survey report of Karnataka and Goa for inclusion in State report
3. Geophysical survey report for ARS in Kolar district
4. Report on geophysical surveys for water supply investigation in BSF firing range, Karehalli, Bangalore
5. Interim report of the survey carried out in Malavalli taluk, Mandya district for GW exploration
6. Final Report of geophysical surveys for drilling exploratory bore wells in Jagalur &Harappanahalli taluks of Davanagere district.
7. Report on geophysical survey carried out in KGF, Gold mine area for water supply in Kolar district
8. Interim report of geophysical survey in Hosadurga Taluk Chitradurga district for ground water exploration
9. Interim report on geophysical investigations for selection of sites for bore wells at STS, BSF, Yelahanka, Bangalore.
10. Interim report on water supply investigations at SSTL,Kodathi.,Bangalore
11. Report on geophysical survey for water supply investigation at Station workshop, EME, Domlur Bangalore.
12. Interim report of geophysical survey carried out in Aurad, Bidar and Bhalki taluks of Bidar district

9.3.15 South East Coastal Region, Chennai

GEOPHYSICAL STUDIES

9.3.15.1 Surface geophysical studies

Surface geophysical surveys comprised electrical resistivity profiling and Vertical Electrical Sounding (VES), conducted in locations selected on the basis of geological / hydrogeological /geomorphologic studies carried out earlier, with the primary scope of quantification of Geoelectrical parameters viz resistivity and thickness of various subsurface geological formations including thickness of weathered layer and depth to bedrock and water quality as and when required for well sitting / special studies. The main objective of such electrical resistivity surveys was to delineate potential ground water zones to recommend most favorable sites for sinking bore wells. Based on the VES results sites were recommended for exploratory drilling, keeping in view the local hydrogeological as well as favorable geoelectric spectrum reflecting, fractured rock layers at depth, which form conduits for ground water flow. Indigenous equipments with gadgets have been deployed and data analysis had been done both manually (graphically) and through computer software packages. .The district wise break up of the Resistivity Surveys carried out in Tamil Nadus shown in the Table. 9.27

Table. 9.27: District wise Resistivity Surveys carried out in Tamil Nadus

Sl. No	District	No. of VES	Line (Km)	Area Covered (Sq. Km)	Studies/Findings
1	Dharmapuri	6	-	3	Based on favorable VES results, duly extrapolated, the site was taken up for drilling. The yield was less than 3 lps probably due to the presence of dry fractures at depth.
2	Krishnagiri	48	9.4	62	Based on the VES results 15 sites were recommended for exploratory drilling. Out of which, 13 sites were taken up for drilling. 4 sites, Viz Kottapatti, Mulakalapalli, Alapatty and Vertanapalli yielded more than 3 lps discharge and remaining 9 sites yielded less than 3 lps discharge, probably due to the presence of dry fractures at depth.
3	Karur	44	2.5	64	6 sites, Viz Parali, Valvanmangalam, Lalapet, Koilpalayam, Valayapatti and Kodaiyur yielded more than 3 lps discharge and remaining 19 sites yielded less than 3 lps discharge probably due to the presence of dry fractures at depth.

4	Villupuram	54	8.1	76	Based on the VES results 10 sites were recommended for exploratory drilling,. The drilling at the recommended sites is yet to be taken up. Apart from these, surveys were conducted, as part of Short-Term investigation, in Kancheepuram district for identifying most feasible sites for production well.
5	Kancheepuram	1	-	1	
Total		**153**	**20**		

9.3.15.2 Borehole logging

Borehole geophysical surveys comprised Electrical logging of pilot boreholes by deployment of indigenous UPTRON logging unit for recording the basic geo-electric parameters of Spontaneous Potential, Point Resistance and Normal / Lateral Resistivity of various sedimentary strata encountered in mud filled boreholes.

Critical analysis of E-logs in conjunction with drilling time and formation sample details, facilitated in identification of subsurface geological formations, delineation of zones comprising granular / finer sediment formations and approximate assessment of quality of interstitial waters at depths. Logging played a vital role in deciding effective well assembly to be sunk for extraction of large amounts of potable quality of groundwater through selective screening / sealing techniques. District wise details of Boreholes logged in Tamil Nadu is given in Table 9.28.

Table 9.28 : District wise details of Boreholes logged in Tamil Nadu

Sl. No.	District	No. of boreholes logged	Total depth of boreholes logged (m)
1	Perambalur	1	290
2	Villupuram	1	310
3	Nagappatinam	3	1025
4	Cuddalore	1	301
Total		**6**	**1926**

9.3.15.3 Compilation of geophysical reports / data

(i) Technical notes on Electrical logging of each borehole had been submitted in time for deciding suitable well assembly and incorporating in related BDRs.

(ii) Reports on surface geophysical surveys conducted in parts of Perambalur and Pudukottai districts as well as surveys conducted in Kancheepuram district as part of Short-Term Investigations have been submitted.

9.3.16 Kerala Region, Trivendrum

9.3.16 .1 Surface Geophysical Studies

Total of 101 VES and 15.43 Line Km. of Resistivity profiling were carried out in Trivendrum district of Kerala during 2006-07

Findings on the basis of Geophysical studies

9.3.16.2 Trivandrum District Exploratory Drilling Studies

Conducted 25 VES and 345 line meters of resistivity profiling covering 5 sites in Manickel Panchayat and 3 sites in Kilimanoor Panchayat , Trivendrum District, Kerala State to pin point sites for exploratory drilling. Out of these eight sites four sites are recommended for exploratory well drilling . In resistivity surveyed area top layer consists of laterite of thickness around 10 meters fallowed by Khondalites. This feature was showed in most of the VES curves. The fractured layer is falling in the depth range of 35 mbgl to 45 mbgl.

(i) The site Minara Mini Stadium, Manickel Panchayat was recommended for drilling. The VES curve analysis revealed that top layer consists of 6.1 meter thick laterite layer, fallowed by 7. 66 meter thick highly weathered khondalites layer of 76 ohm - meters resistivity and then fallowed by bottom layer of highly weathered formation of khondalites of 129 ohm -meters resistivity in that order . Due to highly weathered formation of khondalites, during drilling the well started to caving and finally the well was abandoned after drilling down to a depth of 89 mbgl.

(ii) The site Government Higher Secondary School, Pirappancod, Manickel Panchayat was recommended for drilling . The site was situated on a small hillock and that is why the top soil thickness is low . The VES curve analysis revealed that top layer consists of 2. 53 meter thick layer of laterite of 1232 ohm - meters resistivity, fallowed by 9. 18meter thick weathered khondalites layer of 226 ohm – meters resistivity, followed by 12. 5 meter thick highly weathered khondalites layer of 61 ohm – meters resistivity , followed by bottom layer of compact formation of 1556 ohm – meters resistivity in that order.

(iii) The site Nedugani Masjid, Manickel Panchayat was recommended for drilling. The VES curve analysis revealed that top layer consists of 7. 53 meter thick layer of 320 ohm - meters resistivity , fallowed by 29 meter thick highly weathered khondalites layer of 63 ohm - meters resistivity and then fallowed by the bottom layer of compact formation of 1002 ohm – meters resistivity in that order.

(iv) The site Ponganadu Post Office Ground , Kilimanoor Panchayat was recommended for drilling . The VES curve analysis revealed that top layer consists of one meter thick layer of 565 ohm -

meters resistivity, fallowed by 6. 1 meter thick highly weathered and saturated khondalites layer of 38 ohm - meters resistivity and then fallowed by bottom layer of highly weathered formation of 142 ohm – meters resistivity in that order.

(v) Other sites are not considered for drilling at present , because they come under low priority based on the geological , geophysical and practical condition's information available at present .

Most of the resistivity surveyed sites are falling in densely populated areas and it was difficult to get clear straight line land to spread current electrodes to conduct a VES of larger electrode separations or larger AB/ 2 values. So the applicability of Pole – Dipole VES technique to this lateritic terrain was studied at the site Government Higher Secondary School , Kilimanoor , Kilimanoor Panchayat to conduct VES in smaller areas and with improvements in Pole – Dipole VES technique, easy conducting of VES in smaller areas was made possible. This improved Pole – Dipole VES technique was named as Gradient VES technique.

9.3.16.3 Saline/fresh water interface studies along the coast between Kappil and Chakkai using hydrochemical and geophysical methods

Objective:

(i) To carry out resistivity survey along the coast in order to study/delineate the saline/fresh water interface in terms of geoelectrical parameters

(ii) Groundwater sampling along geophysical sections and analysis of water samples to ascertain the effect of sea water ingression

Geophysical survey was carried out in connection with fresh/saline interface study from Kappil to Chakkai, West coast of Kerala state. 76 VES and 15.085 line km Wenner profiling were carried out along several E-W traverses perpendicular to the coast using ABEM SAS 300C instrument during the summer season.

The following are the salient findings of the study;

(i) Geophysical survey was carried out between Kappil and Chakkai coasts during the summer season and it has enabled to identify the areas which show very low resistivity less than 10 ohm-m at several locations especially pudukurichi and Anjengo coasts. Ground water samples were collected in those areas which also show higher conductivity as far as coastal tracts are concerned in the range between 1010 and 3640 microseimens/cm at 25^0 C.

(ii) During the summer season, sea water enters through the coastal inlet and enters into the backwaters. The mixed up water percolates down affecting the ground water quality of the wells located along the fringes of the backwaters especially Pudukurichi, Matanvila and Anjenko coasts. The resistivity values along the fringes of the backwaters were very low and substantiated by the higher conductivity of ground water samples analysed chemically in the range between 1010 and 3640 microseimens/cm at 25^0 C.

(iii) Groundwater quality is poor in the narrow stretch of land in between the coast and the backwaters especially in Pudukurichi areas. The ground water quality is

affected in the entrapped land because of the contribution of both the sea water and the backwaters. The resistivity survey also show very low resistivity in these areas.

(iv) Resistivity sounding and profiling were carried out along E-W traverses perpendicular to the coast in the premises of Dr.Salil's clinic located in the narrow stretch of land between the backwaters and the coast and at several locations, very low resistivity were observed.

Wenner electrical sounding was carried out in front of the dug cum filter well. The resistivity is of Q type, the resistivity below 6 m is 13 ohm-m and probably beyond 6 m depth, the resistivity is expected to be less than 10 ohm-m. Groundwater samples were collected from the dug/open well and the electrical conductivity (EC) of the sample is 1129 microseimens/cm at 25^0 C and the EC of groundwater sample collected in the same dug cum filter well after one and half hours of pumping is 3640 microseimens/cm at 25^0 C. The sample collected from the shallower portion of open well has shown that the quality of water is good as far as coastal tracts are concerned whereas the sample collected from the deeper portion of the filter well, the quality of water is deteriorated. The deterioration in the quality of groundwater is may be due to several reasons. It may be due to (a) over pumping of the limited fresh water resource which led to the reversal of hydraulic gradient and/or in situ formation. Therefore, a sudden conclusion can not be arrived at and periodical monitoring of geophysical survey and chemical analysis of ground water samples should be done to ascertain the reason for the groundwater quality deterioration.

Recommendations

In the present study, pre-monsoon analysis (summer season) analysis of ground water samples and geophysical survey were done. Post-monsoon and every seasonal monitoring of ground water samples and geophysical survey should be done yearly to ascertain the changes with time.

Care should be undertaken in the narrow stretch of land between coast and the backwater to avoid overexploitation of limited fresh water resource and to prevent the quality deterioration of ground water thus protecting the ground water resource.

9.3.17 Uttrakhand Region, Dehradun

9.3.17.1. Resistivity Surveys

A total of twenty-six VES were carried out in parts of Dehradun and Pauri districts of Uttarakhand. Out of the above eight VES were carried out in Kotdwar area of Pauri Garhwal in vicinity of existing exploratory wells drilled by Central Ground Water Board for correlation studies of surface resistivity survey, geophysical logging and lithology of the wells in the area. Two VES were carried out for short term water supply investigation for Uttarakhand Jal Sansthan for pinpointing the site for tube well for domestic water supply and sixteen VES were carried out in the Asan Catchment of Doon Valley for systematic coverage of Doon Valley in grid pattern by resistivity survey. The data was processed and interpreted both manually as well as on computer using Schlum Software. District-wise details Resistivity in Uttarakhand is given in Table 9.29

Table 9.29: District-wise details Resistivity in Uttarakhand

District	No. of VES	Area covered under (km^2)
Dehradun	18	225
Pauri Garhwal	08	81

9.3.17.2. Borehole Logging with Results/Findings/Conclusion

Geophysical logging of one exploratory well at Jamankhata, Dehradun was conducted using Multichannel Uptron Logger by the Geophysicist of NWR, Chandigarh down to depth of 146 mbgl against the depth drilled 148.0 mbgl.for deciphering the granular zones.

9.3.17.3 Compilation of Geophysical Repots/Data:

The data of 26 nos. VES was compiled, processed and interpreted both manually as well as on computer using Schlum Software and recommendation reports were submitted. The data of Geophysical logging of exploratory well at Jamankhata, Dehradun was also compiled, processed and interpreted and recommendation report was submitted.

9.3.17.4 Findings on the Basis of Geophysical Studies:

A good correlation was found in the finding of surface geophysical resistivity data interpretation results with that of the results of Geophysical logging and litholog of the borehole. All the four exploratory wells are tapping the granular zones comprising of boulders, cobbles, pebbles, gravels and sand. The value of true resistivity against these zones interpreted to be in the ranges between **60 to 250 Ohm.m.** These wells are giving very good discharge for reasonable draw down. The site recommended for short-term water supply investigation for Uttarakhand Jal Sansthan is yet to be taken up for drilling. The true resistivity against productive granular zones at this site is inferred in the range between **80 to 325 Ohm.m.** The detailed finding of resistivity survey for systematic coverage is under progress.

9.3.18. North Himalayan Region, Dharamshala

GEOPHYSICAL STUDIES

Borehole logging at boreholes was conducted by the Geophysicist of Central Ground Water Board, North Western Region, Chandigarh in Himachal Pradesh is given in Table 9.30.

Table 9.30: Borehole logging at Himachal Pradesh

District	No. of boreholes logged	Total depth of bore holes logged (m)
Una	1	71 m (at Babehar)
Bilaspur	1	70 m (at Behal) using State logger

10. HYDROCHEMICAL STUDIES

The Central Ground Water Board has 16 well equipped Regional Chemical Laboratories to carry out chemical analysis of major and minor inorganic constituents in water samples. All Chemical Laboratories are also well equipped to carry out Basic analysis, Heavy and toxic elements analysis using sophisticated instruments like Digital and PC based Spectrophotometer, Flame Photometer, pH meter, Conductivity meter, Ion meter, Nephelometer and Atomic Absorption Spectrophotometer (AAS). All Laboratories are provided with Electronic and Top Loading Balances, Deioniser/Double Distillation Plant, Hot Air Oven, Water Bath, Magnetic Stirrers and hot plates. Regional Laboratories at Kolkata, Hyderabad, Lucknow and Raipur are equipped with Gas Chromatograph (GC) to undertake the analysis of organic pollutants (Pesticides) at mg/l level and Chemical Laboratory at Hyderabad is equipped with Inductive Coupled Plasma Spectrometer (ICPS) to undertake sequential analysis of the multiple toxic elements with high accuracy. One laboratory (Kolkata) also has Total Organic Carbon analyzer (TOC). Some laboratories are equipped with equipment to carry out biological and bacteriological analysis. The Chemical Data generated by these laboratories is used for monitoring and evaluating the ground water quality in compliance with National Standards for designated use, to study the impact of anthropogenic activities on ground water quality, to demarcate critical areas where water quality deterioration has been observed and areas vulnerable to quality deterioration and to assess point and non-point sources of ground water pollution for taking necessary action for management of ground water resources.

During 2006-07, about 15515 samples have been analysed for Basic, 279 samples have been analysed for Specific analysis, 2990 samples for Heavy metals such as As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn and 114 samples for organic analysis. North Central Chhattisgarh Regional Chemical Laboratory has analysed 376 samples for determination of Arsenic. Chemists from various Laboratories have participated in mass awareness programme and Trade fairs and have prepared posters, handouts and diagrams on water quality for display. They have demonstrated the testing of various chemical paramerters present in water and their impact on human body. The importance of water quality in rain water harvesting and water quality for drinking, agricultural and industrial purposes is also explained to the visitors and students. The details of water samples analysed by different Chemical Laboratories are given in table 10.1.

Table 10.1: Region wise Water Samples Analysis

Sl. No.	Region	Basic Analysis		Specific Analysis		Heavy Metals		Organic	
		Samples	Constituents	Samples	Constituents	Samples	Constituents	Samples	Constituents
1.	NWHR	407	4961	124	1570	78	780	-	-
2.	NWR	1150	17989	-	-	175	1215	-	-
3.	WCR	878	13170	149	456	192	192	5	5
4.	WR	1300	20185	-	-	-	-	-	-
5.	NCR	1379	18959	-	-	124	-	-	-
6.	NCCR	713	9269	-	-	503	503	-	-
7.	CR	1397	15121	-	-	108	540	-	-
8.	NR	1478	18485	-	-	345	1563	79	1106
9.	MER	583	6498	-	-	-	-	-	-

Sl. No.	Region	Basic Analysis		Specific Analysis		Heavy Metals		Organic	
		Samples	Constituents	Samples	Constituents	Samples	Constituents	Samples	Constituents
10.	ER	1020	15330	-	-	350	-	-	-
11.	NER	356	3916	6	6	746	746	-	-
12.	SER	366	2960	-	-	-	-	-	-
13.	SR	1417	19005	-	-	130	436	30	600
14.	SWR	906	9338	-	-	-	-	-	-
15.	SECR	1174	15262	-	-	239	683	-	-
16.	KR	991	6529	-	-	-	-	-	-
TOTAL		15515	196977	279	2032	2990	6658	114	1711

10.1 Central Region, Nagpur

10.1.1 QUALITY MAPS

Water quality maps for EC, Cl, NO_3, and F (2006) of Maharashtra and Union Territory of Dadra and Nagar Haveli were prepared.

10.1.2 GROUND WATER QUALITY DATA BASE

Compilation, Validation, Computerisation and Manual data entry into ledger of all ground water quality data generated in Chemical Laboratory were carried out. The data entry and checks in GEMS/GWDES software for updating ground water quality data of NHS-2006 were carried out.

10.2 Eastern Region, Kolkata

10.2.1 HYDRO CHEMICAL STUDIES WITH FINDING/CONCLUSIONS

Water samples from the monitoring stations were collected during April- May 2006 and were analysed, the results of analysis of the water samples of shallow and unconfined aquifer reveals that the water in the entire state is slightly alkaline in nature.

In the northern part of the state covering Darjeeling, Jalpaiguri, Kochbehar the mineral content are low, having sp.conductance between 99 to 681 us/ cm. Soluble salts in the western and southern part of the state ranges from 53 to 4700 us/cm. In the coastal tract of East Medinipur, South 24 parganas, North 24 Parganas, Hoogly and Howrah districts lying in the Gangetic delta of west Bengal the concentration of soluble salts was comparatively high as 8600us/cm. It has also been observed from the results of chemical analysis that the fluoride concentration in part of the areas in Raniganj and Kultore in Burdwan district, Illambazar, Rajnagar, khoyrasole block of Birbhum district, Anara, Nadura and Sindhri areas of Puruliya district. The samples were collected mainly from dug wells.

During 2006-07 a total 32 nos exploratory wells were drilled in the districts namely in Darjeeling, Uttar and Dakshin Dinajpur and Malda , North 24 Parganas, Bardhaman, Howrah districtwith the objective to know the

potentiality of the deeper aquifer & to identify the aquifers free from fluoride & arsenic contamination respectively.

Exploratory drilling down to 250 mbgl was done in Uttar & Dakshin Dinajpur district and the tubewells were constructed by tapping granularzones in the depth span of 53-248 mbgl. The water thus obtained from these tubewells analyzed and found fluoride concentration is below permissible limit.
In the arsenic infested areas of N-24 Parganas, Malda, Barddhaman districts exploratory drilling maximum upto 350 mbgl was done and tubewells constructed in different depth ranges i.e 30-250 mbgl. It was found that in shallow aquifers within depth range of 30-60 mbgl arsenic concentration varies from 0.05-0.0.08 mg/l whereas arsenic concentration in deeper aquifers is below detectable limit.

10.3 Kerala Region, Trivendrum

Paper titled "High Fluoride in Ground Water of Palghat District", Kerala by Dr. E. Shaji, Bindu.J. Viju and D.S. Thambi was published in Current Science-Vol. 92, No.2, 25 January 2007.

Smt. V.N. Sreelatha, Scientist 'B' (Chemist) and Smt. Bindu.J. Viju, Assistant Chemist was participated in Thrissurpooram Exhibitation, 2006 of Ministry of Water Resources, New Delhi from 06.05.06 to 11.5.06 and 15.5.06 to 18.5.06.

During the year 2006-07, 663 water samples are analysed for NHNS, 59 water samples for exploration programme, 251 water samples are analysed for Reappraisal Survey and 18 water samples are analysed for local and other area monitoring works. Found that in some piezometer of Palghat district, fluoride concentration is 1 mg/l and above. All these wells are located in eastern part of Palghat district.

10.4 Mid Eastern Region, Patna

10.4.1 BIHAR

Hydrochemical studies with findings / conclusions
(As per HNS sample Analyzed)

i. The groundwater in the state of Bihar is mildly alkaline in nature. Most of the samples contain no carbonate but are characterised by the presence of bi-carbonate.
ii. The value of electrical conductivity indicates wide variation in dissolved constituents in groundwater of Bihar. The maximum conductivity value (1600 micro Siemens/Cm) has been observed at Jagdishpur, Bhagalpur district whereas minimum conductivity value (190 micro Siemens/Cm) has been observed at Bahadurganj, Purnea district.
iii. Generally the quality of groundwater in terms of Total Hardness as $CaCO_3$ has been found to be hard to very hard. The maximum concentration of Ca has been found as 100 mg/l at Baunai, Bhagalpur

district, whereas the minimum concentration of Mg has been observed as 2.4 mg/l at Shahkund, Bhagalpur district.

iv. The concentration of Chloride in majority of the ground water samples has been found to be within the desirable limit for drinking purpose (as per BIS, 1991). The maximum concentration of chloride has been found to be 341 mg/l at Jalalpur, Gopalganj district.

v. The concentration of Na ranged from 2 mg/l at Gopalganj, to 253 mg/l at Jagdispur, Bhagalpur district, and of K ranged from 0.4 mg/l at Jamalpur, Munger district to 86 mg/l at Kajha, Purnea district.

vi. Sodium has important considerations with regard to irrigation water.

vii. The content of alkalinity gives an idea of the nature of the salts present. Bi-carbonate in water samples varies from 55 mg/l at Potigarh, Purnea district to 427 mg/l at Jagdishpur, Bhagalpur district.

viii. In 20% groundwater samples analysed for special study, Iron concentration has been found more than 1.0 mg/l.

ix. Fluoride concentration has been found more than 1.5 mg/l in all the 13 groundwater samples analysed for special study at Bhubnagar, Jhari, Bairbigha and Simri villages of Amas block, Gaya district, Bihar.

x. The average concentration of Fluoride at Amas block has been found to be 3.55 mg/l. The minimum concentration of Ca is 4.0 mg/l and the maximum concentration is 60 mg/l. The average concentration of bi-carbonate has been found to be 342 mg/l.

10.4.2 JHARKHAND

Hydrochemical studies with findings / conclusions (As per the HNS Samples)

i. The groundwater in the state of Jharkhand is mildly alkaline in nature. Most of the samples contain no carbonate but are characterised by the presence of bi-carbonate.

ii. The maximum conductivity value, 2350 micro Siemens/Cm, has been found at Chowparan, Hazaribag district, whereas minimum value of 70 micro Siemens/Cm have been found at Baharagora, Singhbhum district. The value of electrical conductivity indicates wide variation in dissolved contents in groundwater of Jharkhand.

iii. The maximum concentration of bi-carbonate has been found 464 mg/l at Basia, Gumla district, whereas the minimum concentration has been reported 16 mg/l at Baharagora, Singhbhum district.

iv. The concentration of chloride in majority of the groundwater samples has been found to be within the desirable limit for drinking purpose.

v. The concentration of chloride ranged from 6.4 mg/l at Bero, Ranchi district to 547 mg/l at Chowparan, Hazaribag district.

vi. The concentration of Na ranged from 2.3 mg/l at Mandro, Sahebganj district to 350 mg/l at Maheshpur , Godda district.

vii. The concentration of K in groundwater samples varied from 0.3 mg/l at Maheshpur, Sahebganj district to 100 mg/l at Basia, Gumla district.

viii. Generally, the quality of groundwater in terms of Total hardness as $CaCO_3$ has been found to be hard to very hard.

ix. The maximum concentration of Ca has been found 185 mg/l at Kalikapur, Singhbhum district whereas the maximum concentration of Mg has been reported is 62 mg/l at Topchanchi, Dhanbad district.

x. The concentration of nitrate has been observed more than the permissible limit of 45 mg/l (BIS, 1991) in 13% groundwater samples analysed for reappraisal survey in Pakur and Sahebganj district of Jharkhand. The maximum concentration of NO_3 has been found to be 211 mg/l at Kaira Chhatar village, Maheshpur Block of Pakur district.

10.5 North Central Chhattisgarh Region, Raipur

As per facilities available in the Chemical lab 13 parameters namely pH, EC, Carbonate, Bicarbonate, Chloride, Total Hardness, Calcium, Magnesium, Sodium and Potassium have been determined. A total of 1216 no of water samples were analysed during AAP 2006-07 and out of which 376 samples were analysed for determination of Arsenic .

10.6 Northern Region , Lucknow

10.6.1 HYDRO CHEMICAL STUDIES WITH FINDING/ CONCLUSIONS

Ground water due to its continuous contact with minerals and rocks is generally more mineralized than surface water. The quality of shallow ground water in phreartic zone is further affected by anthropogenic sources at the ground surface. Human activities like domestic, agricultural or industrial also affect the quality of ground water.

Shallow ground water in the State of U.P. is by and large fresh with EC below 2000 ms/cm at 25^{o}C. The analysis shows that ground water is fresh in general, except at a few places where concentration of ions has been found above permissible limits.

10.6.2 Hydrogen Ion Concentration (pH):

The pH value of ground water in the State of UP varies from 7.65-820 which is within permissible limits and the water is slightly alkaline in nature.

10.6.3 Electrical Conductivity (EC):

The Electrical Conductivity is a reflection of the concentration of various chemical constituents in ground water and reflects the over all quality for drinking, irrigation and other purposes. The EC is lowest, less than 500 ms/cm at 25^{o}C in the northern and eastern parts of the State, with some patches in the central part. EC upto 1000 ms/cm at 25^{o}C is widespread. EC of 1000-2000 ms/cm at 25^{o}C occurs in the western part with patches in the central part. High EC of 2000-4000 ms/cm at 25^{o}C also occurs in the western part of the State in GB Nagar, Ghaziabad, Agra and Mathura districts and in isolated patches in Jalaun, Banda, Gazipur and Unnao districts. Very high EC, above 6000 ms/cm at 25^{o}C indicating saline water occurs in Mathura district

The highest EC values 7895 and 9786 ms/cm had been recorded at Farah and Saunkh,Mathura distrit.

Chloride:

The concentration of Chloride ranges from as low as 3.5 to 3098 mg/l. A total of 92.8% water samples fall within the desirable limit while 6.6% contain chloride within the permissible limit prescribed by BIS (1991). Only 0.6% samples from Sehta Thapi (Agra district) 1120 mg/l; Garon (Aligarh district) 1404 mg/l; Saunkh 2964 mg/l and Farah 3098 mg/l (Mathura district) have higher level of chloride concentration.

Nitrate:

The concentration of Nitrate has been found varying widely. It is ranging between not detectable to 1162 mg/l with 86% of water samples falling within the desirable limit of 45 mg/l; 6.9% falling within the permissible limit of 100 mg/l. (BIS 19911.7.1% samples have higher level of Nitrate concentration with the highest value 1162 mg/l recoroded at Maudaha (Hamirpur district). High Nitrate is found all over the State and does not follow any pattern of distribution in the state.

Fluoride:

Small quantitites of Fluoride are beneficial in reducing tooth decay, whereas excess concentration (>1.5 mg/l) is harmful causing staining of tooth enamel and fluorosis.

The fluoride concentration is found ranging between not detectable to 3.11 mg/l with 95.6% samples falling within the permissible limit of 1.5 mg/l prescribed by BiS (1991). The highest value of 3.11 mg/l has been recorded at Locha (Etah district). High Fluoride occurs in five contiguous districts. Higher concentration of 2.6, 2.15, 2.21 have been recorder at Sahganj Prithvinath (Agra district), Gonda (Aligarh) and Ferozabad (Ferozabad district) respectively; 2.16 and 2.08 in Biswan and Hathras (Hathras district); 2.33 in Harharpur (Kannauj); 2.96 in Nagla, 2.1 in Chhata and 2.04 in Jachoda (all in Mathura district.

Total Hardness as $CaCO_3$:

The total Hardness of ground water ranges from 50 to 3060 mg/l. In may cases it is exceeding 300 mg/ll (desirable limit) and in some cases it is exceedin g 600 mg/l (suitable limit) fixed by (BIS 1991).The water samples from Sehta Thapi (Agra district) and faroh (Mathura district) have highest value as 1035 and 3060 mg/l respectively.

10.7 North Western Region, Chandigarh

Hydro chemical studies with findings / conclusions

10.7.1 Ground water quality variation in Bawal block, Rewari district, Haryana

Bawal block has total geographical area of 246.73 sq km and falls in the southern tip of Rewari district. Bawal is a part of Indo-Gangetic alluvium of Quaternary age and rests on basement rocks of Delhi system. The alluvium comprises of very fine to coarse sand, gravel, silt and clay with kankar. In order to ascertain the variation in ground water quality in Bawal block, the complete area of 246.73 sq. km was surveyed. 29 No. of ground water samples were collected and analysed. 7 No. samples were also collected along NH-8 from industrial units and analysed as per guidelines in APHA (1998) for major and heavy metal studies. Though there is a considerable variation in ground water quality in the block, it is observed that 65.3% area of the block has E.C. below 2000 micromhos/cm and can be put to domestic use. Nitrate in 82.7% in the area is within the permissible BIS limit of 100mg/l, indicating its suitability for drinking water purposes. Fluoride concentration has been recorded as high as 10.28 mg/l in the block, however, 62% of the ground water samples have Fluoride within permissible limits. Heavy metals are in very low concentrations. proximately 70% of block area has ground water suitable for irrigational use.

10.7.2 Occurrence and distribution of Fluoride, Bhiwani district , Haryana

Bhiwani district lies in southwestern part of Haryana State between 28^0 10′ latitude and 29^0 03′ north and 75^0 30′ and 76^0 27′ east longitudes covering an area of 4870 sq kms. Dohan river is the only ephemeral stream in the area. Bhiwani district has water scarcity on one hand and deteriorating water quality on the other.

The study shows that about 60.3% of the shallow and 33.3% deep ground samples are not suitable for drinking purposes due to fluoride hazards (F >1.5 mg/l). The results show that the high fluoride in ground water, both at shallow and deeper level, are moderately alkaline and moderately to highly mineralized. They are associated with low calcium and high sodium content. Fluoride concentration shows a positive correlation with alkalinity as $CaCO_3$ salt concentration (EC) and sodium but a negative correlation with calcium both at shallow and deeper aquifers. In several cases high Fluoride concentration has been found in shallow dug well & low Fluoride concentration in deep tube wells & vice versa. Ground water, the major source of drinking water supplies, has fairly good distribution of fluoride in considerable part of the district. The environmental factors (semi-arid climatic conditions) may have played a good role in the enhancement of fluoride content as well as other water quality parameters. High fluoride in ground water in the Bhiwani district is a matter of concern and need immediate remedial measures.

10.8 South East Coastal Region, Chennai

In the chemical lab of SECR, Chennai, samples were analyzed for basic and heavy metal involving 15,945 constituents under Ground Water Monitoring, Exploration, Reappraisal, Pollution studies and others for the period of April 2006 to March 2007.

The quality of shallow ground water in Tamil Nadu state has been evaluated by sampling and analysis of water sample collected from Ground water monitoring wells. About 456 ground water monitoring wells (GWMWs) were monitored for water quality during May 2006 representing pre-monsoon water quality. The details are given in the Performa as above.

In general, the ground water quality in the state is fresh in about 13% of the GWMWs as indicated by the EC value less than 750 μs/cm at 25^0C. In about 54% of the GWMWs the EC varies between 751- 2250 and 13% of GWMWs are between 2251-3000 indicating that the ground water is slightly mineralized and about 20% of GWMWs, the EC is more than 3000 μs/cm at 25^0C indicating that the ground water is highly mineralized

The chloride content is less than 250 mg/l in about 54% of the sample analyzed and 39% of the samples are between 251-1000 mg/l and 7% shows more than 1000mg/l, which are from the districts Viz., Chennai, Cuddalore, Pudukottai, Ramanathapuram, Nagapattinam, Thiruvarur, Tuticorin and small patches in districts Viz., Tirunelveli, Dindigul, Namakkal, and Coimbatore.
The Fluoride content is less than 1.5 mg/l in about 91% of the sample analyzed and 9% of the sample shows more than 1.5 mg/l, which are from the districts Viz., Dharmapuri, Salem, Namakkal, Erode, Coimbatore, Pudukottai, Sivagangai, and Virudhunagar,

The Nitrate content is less than 45mg/l in about 63% of the sample analyzed and 10% is within the permissible limit of 46-100mg/l and 27% of sample shows more than 100 mg/l, which are from the districts Viz., Salem, Namakkal, Erode, Kancheepuram Thiruvannamalai,Villupuram, and small patches in the districts Viz., Cuddalore, Kanyakumari and Dindigul.

10.9 South Eastern Region, Bhubaneshwar

The Parameters determined in during the year were - pH, E.C., Carbonate, Bicarbonate, Chloride, Sulphate, Nitrate, Fluoride, Total Hardness, Calcium, Magnesium, Sodium, Potassium, Phosphate and Iron. Samples from National Hydrograph Network Stations were analysed for pH, E.C., Fluoride, Chloride, and Nitrate contents apart from total Iron analysis in all the acidified samples from National Hydrograph Network Stations.

10.10 Southern Region, Hyderabad

CHEMICAL ANALYSIS AND STUDIES

10.10.1 Ground Water Monitoring Wells:

Out of 618 samples collected from Ground Water Monitoring Wells, 33% of the samples are fit for drinking as per BIS drinking standards, 82% samples are very hard, followed by 14% are moderately hard and 3% are slightly hard. The chemical properties are dominated by Ca Mg Cl SO4 (37%) followed by Na K Cl SO4 (27%), Ca Mg HCO3 (24%) and Na K HCO3 (12%). Most of the samples are suitable for drinking and irrigation purposes. Sodium Absorption Ratio (SAR) is in the range of 0.14 to 32.6 with average being 4.

The Fluoride was recorded as high as 6.1 mg/l at Achavalli, Kadapa District. In some locations, Nitrates were found to be beyond permissible limits. Highest Nitrate of 900 mg/l was recorded at Pamudurthy, Anantapur district.

All the ground water samples (618) collected from Ground Water Monitoring Wells were analysed for Boron. The Boron values ranged from Nil to 2.58 mg/l. Out of 618 samples, 98% of samples fall in the excellently suitable category and these waters are suitable for sensitive, semi tolerant and tolerant crops in respect of Boron.

10.10.2 Ground Water Management Study:

As many as 720 samples for basic analysis and 99 samples for heavy metals were collected during Ground Water Management Studies in parts of Anantapur, Kadapa, West Godavari and Guntur districts, covering an area of 13,000 sq.km. Among the samples collected for Ground Water Management Studies, the EC ranged from 245 to 19400 micro siemens/cm. Highest EC value of 19400 was found in West Godavari district in the coastal alluvium. The Nitrates ranged from 1.0 to 900 mg/l, highest being in Annatapur district. The Fluoride values ranged from 0.01 to 6.15 mg/l, highest being in Kadapa District. In general, most of the samples were found to be suitable for drinking as well as irrigation purposes etc. at few locations, due to geogenic and anthropogenic contamination.

10.10.3 Ground Water Exploration:

In all, 113 samples were collected for basic analysis, 31 samples for heavy metal analysis from the exploratory wells drilled during the year. Electrical Conductivity of these samples ranged from 300 to 3000 micro siemens/cm. However, the highest EC of 13,000, 13,200, 9,000, 4,450 and 4280 micro siemens/cm was found at Guntur, Atmakur, Tummalapad, Savalyapur, Chakalipuram Exploratory Wells. Out of 75 wells drilled, 10% of the wells have shown the Fluoride concentration of more than permissible limit, highest being 4.8 mg/l at Manthani, Warangal district. Highest Nitrate values beyond permissible limits were also found at four locations, highest being 1184 mg/l at Tummalapalem of Guntur district.

10.10.4 Pesticide Multi-residue Analysis

Analysis of 10 samples for 20 parameters in Karimnagar district was carried out. Among these samples, Hepatchlor was detected in the range of 0.007 to 0.889 ppb Endrine aldehyde about nil to 3.3 ppb and Endrine ketone from nil to 0.991 ppb. Pesticide multi residue was analysed for 20 parameters pertaining to SECR, Chennai. Delta-BHC was ranged from nil to 0.0394 ppb, Heptachlor from Nil to 0.0029 ppb, alpha endosulfan from Nil to 0.00048 ppb and beta endosulfan from Nil to 0.00024 ppb.

10.10.5 Heavy Metal Analysis

About 76 samples were analysed for Arsenic and Iron pertaining to North Eastern Region, Guwahati. The Arsenic values of these samples ranged from 0.5 ppb to 249 ppb. As per BIS standards, about 53 samples have the Arsenic concentration of more than permissible limit of 10 ppb. For the same 76 samples, Iron analysis was also carried out. Iron concentration was ranging from more than 0.1 to 65 mg/l. About 70% of the samples have the Iron concentration of more than permissible limit i.e., 1.0 mg/l as per BIS standards.

10.11 South Western Region, Bangalore

In the South Western Regional Chemical Laboratory, a total of 1038 ground water samples was received during the AAP. The samples were analyzed for major, minor and trace elements. Out of these 906 water samples were analyzed for 9338 chemical constituents and exceeded the target of 750 samples by 156 samples.

10.12 West Central Region, Ahmedabad

There was a backlog of 548 water samples in the lab to be analysed and during the AAP 2006-07, 1327 samples were received for analysis. Thus the total number of water samples were 1875.

During the AAP 2006-07, 849 samples were subjected to basic analysis comprising of 12735 constituents. The heavy metal and Fe analysis were carried out for 247 samples comprising 399 constituents, five samples were analysed for organic analysis and 123 samples were subjected for specific analysis for 377 constituents. Thus totally 1224 samples were analysed for 13516 constituents in the Regional Chemical Lab of WCR. The details of analysis are given as table-

The pH values range from 7.20 to 8.86, which clearly indicate that the majority of the samples are basic in nature with fresh to saline in terms of conductivity. The TDS values range from 200 to 21239 mg/l. The concentration of various anions vary from negligible to very high values, which mainly depends upon the country rock composition. The chloride value ranges from 14 to 10709 mg/l while sulphate ranges from Nil to 985 mg/l. The carbonate ions are absent in most of the ground water samples whereas

bicarbonate ion ranges from 73 to 1659 mg/l. Majority of the cationic concentration is contributed by the Ca and Mg ions and the rest by Na and K ions. This phenomenon is supported by high hardness values ranging from 100 to 2550 mg/l.

In addition to the major cations and anions, samples were subjected to analysis of fluoride and nitrate, which range from nil to 7.5 mg/l and nil to 840 mg/l respectively. Sodium Adsorption Ratio, which is an important parameter in determining the suitability of ground water for irrigation purposes, was also calculated and the value ranges from 0.2 to 52.5.

Trace element analysis was carried out for some RHS samples of Banaskantha district. Trace metals such as Iron, Manganese, Copper, Lead, Zinc, Cadmium, Chromium and Nickel were identified.

10.13 Western Region, Jaipur

Rajasthan suffers chemical quality problem in ground water due to arid climatic conditions. In order to ascertain the scenario of chemical quality of ground water in the State, water samples from National Hydrograph Network Stations, exploratory wells, Groundwater Management Study areas, polluted areas etc. were collected and analyzed.

11. HIGH YIELDING WELLS DRILLED

Board has explored high yielding aquifers during 2006-07 in the various states of the Country under its scientific exploratory drilling programme, based on hydrogeological studies and utilizing remote sensing and geophysical techniques. High yielding wells with discharge ranging from 150 LPM to 2500 LPM have been constructed in the states of Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajsthan, Tamil Nadu and West Bengal. The study will help in identifying ground water sources and in guiding the states to adopt follow up action with regard to ground water development for drinking water supply and other demands. High Yielding Wells constructed during 2006-07 is given Table 11.1.

Table 11.1 : HIGH YIELDING WELLS CONSTRUCTED DURING 2006- 2007

Sl. No.	Name of States	Description
1.	**Andhra Pradesh**	i. The Observatory well drilled down to a depth of 137 m bgl at Tallacheruvu, Guntur district piercing the granite gneisses has yielded a high discharge of 591 LPM (9.85 lps) for a draw down of 6.31 m and duration of 1000minutes. ii. An exploratory well drilled in piercing granite formation at Ravikamtam, Vishakhapatanam district has yielded drilling discharge of 360 LPM and drilled to a depth of 23.00 mbgl. This bore well can cater to drinking water requirement of a population of about 3600 (@60 lpcd for ten hours of pumping a day) in the area.
2.	**Bihar**	i. A well drilled down to the depth of 62.50 m bgl in fluoride affected village of Ramankabad, Mungher district Bihar has yielded 250 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 2500 (@60 lpcd for ten hours of pumping a day) in the area. ii. An exploratory well drilled down to the depth of 50.40 m bgl in hard rock area of Mungher district has yielded 540 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 5400 (@60 lpcd for ten hours of pumping a day) in the area. iii. An observation well drilled down to the depth of 50.60 m bgl in hard rock area of Mungher district has yielded 360 LPM . This bore well can cater to the drinking water requirement of a population of about 3500 (@60 lpcd for ten hours of pumping a day) in the area.

Sl. No.	Name of States	Description
3.	**Chhattisgarh**	i. A high discharge bore well yielding 720 LPM has been constructed at Darrabhata in Janjgir-champa district. This bore well can cater to the drinking water requirement of a population of about 7200 (@60 lpcd for ten hours of pumping a day) in the area.
4.	**Gujarat**	i. An exploratory well drilled in Jaghadia taluka at Bharuch district has yielded 981 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 9800 (@60 lpcd for ten hours of pumping a day) in the area. ii. An observation well drilled in Jaghadia taluka at Bharuch district has yielded 1200 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 12000 (@60 lpcd for ten hours of pumping a day) in the area. iii. An exploratory well drilled in Nandod taluka at Narmada district has yielded 900 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 9000 (@60 lpcd for ten hours of pumping a day) in the area.
5.	**Himachal Pradesh**	**"**Artesian (Flowing) conditions have been observed in the Exploratory Wells constructed at following sites i. Rampur in Una district with free flow discharge of 300 LPM. The well has been drilled upto 83.0 m with well construction depth of 81.0 m. This bore well can cater to the drinking water requirement of a population of about 3000 (@60 lpcd for ten hours of pumping a day) in the area. ii. Sangri Bag in Kulu district with free flow discharge 900 LPM. The well has been drilled upto 100.70 m with well construction depth of 100 m. This bore well can cater to the drinking water requirement of a population of about 9000 (@60 lpcd for ten hours of pumping a day) in the area.

High yielding well at Goalpara, Raiganj, Uttar Dinajpur district, West Bengal

Drilling under progress with high discharge at Nagarur in Trivandrum, Kerala

Sl. No.	Name of States	Description
6.	**Jammu & Kashmir**	i. An exploratory well drilled at Iqbal Park PHE Complex, Srinagar district down to the depth of 197.00 m bgl has yielded a high discharge of 1200 LPM during drilling. The well was constructed successfully and handed over to the State Govt. This bore well can cater to drinking water requirement of a population of about 12000 (@60 lpcd for ten hours of pumping a day) in the area.
7.	**Karnataka**	i. An exploratory well drilled at Shantinagar Tanda, Davanagere district drilled to a depth of 200.10 m bgl has yielded discharge of 262 LPM. Casing of 17m has been lowered. This bore well can cater to drinking water requirement of a population of about 2500 (@60 lpcd for ten hours of pumping a day) in the are ii. An exploratory well drilled in Mallapura Halli, Hosadurga taluk down to the depth of 150.45 m bgl at Chitradurga district has yielded 607.20 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 6000 (@60 lpcd for ten hours of pumping a day) in the area. iii. An exploratory well drilled in Purugali, Malavalli taluk down to the depth of 200.00 m bgl at Mandhya district has yielded 554.40 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 5500 (@60 lpcd for ten hours of pumping a day) in the area. iv. An exploratory well drilled at Jannnaghatta, Kolar taluk, Kolar district has yielded drilling discharge of 840 LPM and drilled to a depth of 268.50 mbgl. This bore well can cater to the drinking water requirement of a population of about 8400 (@60 lpcd for ten hours of pumping a day) in the area. v. An exploratory well drilled at Ugla, Karwar taluk, Uttar Kanada district down to the depth of 65.05 m bgl has yielded a high discharge of 706 LPM during drilling. and PYT discharge of 324 LPM. This bore well can cater to drinking water requirement of a population of about 7000 (@60 lpcd for ten hours of pumping a day) in the area. vi. Observation Well – II drilled at Konepura, Kolar taluk, Kolar district down to a depth of 256.70 mbgl has yielded discharge of 660 LPM (39600 liters per hour) during drilling.
8.	**Kerala**	i. One Piezometer was drilled at Peringottukurussi, Palakkad district upto a depth of 99 m bgl which yielded a high discharge of 960 LPM.

Sl. No.	Name of States	Description
		ii. One Exploratory drilled in Charnokitic band of khondalite terrain at Melattumuzhi, Trivendrum district gave a high discharge of 600 LPM. iii.An exploratory well drilled in Khondalite down to the depth of 141.50 m bgl at Nagarur , Trivendrum district has yielded 420 LPM during drilling. iv. A Piezometer drilled in Hornblende Biotite Gneiss down to the depth of 7.5 m bgl at Palam, Palakode in Palghat district has yielded 330 LPM during drilling. Drilling is under progress. v. An exploratory well drilling is under progress at Mamom, Trivendrum district which yielded discharge of 240 LPM (14400 liters per hour). vi. The piezometer drilled at Ottappalam down to the depth of 76.00 mbgl has yielded 960 LPM. This well can cater to drinking water requirement of a population of about 9500 (@60 lpcd for ten hours of pumping a day) in the area.
9.	**Madhya Pradesh**	i. An exploratory well drilled in Bahera, Dindori district down to the depth of 42.50 m bgl in fractured and jointed basalt has yielded a high discharge of 720 LPM during drilling. This bore well can cater to drinking water requirement of a population of about 7000 (@60 lpcd for ten hours of pumping a day) in the area. ii. An exploratory well drilled in Khelri Bazar down to the depth of 226.00 m bgl at Betul district has yielded 960 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 9500 (@60 lpcd for ten hours of pumping a day) in the area.
10.	**Maharashtra**	i. An exploratory well drilled down to a depth of 145 m bgl at Karanjadi village in Mahad Taluka of Raigarh district has yielded 356 LPM in Deccan Traps. Three Water bearing zones have been encountered at 13.00 and from 62- 64 and 139-142 m bgl. The SWL is at 10.30 m bgl. The formation is highly fractured vesicular basalt. ii. The observation well was drilled down to a depth of 75.20m bgl has yielded 525 LPM. The observation well has also encountered three zones at 10-11, 47- 49, 58-60. iii. The exploratory well was drilled down to a depth of 200m bgl and gave high yield of about 810 LPM at Ghat Nandre in Sangli district in highly fractured Vesicular Basalt. This bore well can cater to drinking water requirement of a population of about 8000 (@60 lpcd for ten hours of pumping a day) in the area. Water yielding fracture zones were encountered at 22-23,65-67and 94-100m depth.

Sl. No.	Name of States	Description
		iv. The observation well drilled down to a depth of 98.9m bgl gave very high yield of about 2018 LPM and zones encountered were at 22-23, 65-67 and 95-98.9m depth at Ghat Nandre in Sangli district in highly fractured Vesicular Basalt. This bore well can cater to drinking water requirement of a population of about 20000 (@60 lpcd for ten hours of pumping a day) in the area. v. An exploratory well drilled down to a depth of 172.00 mbgl in Poladpur taluka headquarters of Raigarh District has yielded 226 LPM in Deccan Traps. Two water-bearing zones have been encountered at 30.00 and at 59.00 m.bgl . The SWL was at 4.50 m.bgl. The formation is highly fractured vesicular basalt. The maximum draw down created after 100 minutes of test was 24.80 m. This bore well can cater to drinking water requirement of a population of about 2200 (@60 lpcd for ten hours of pumping a day) in the area. vi. The Observation Well -I was drilled down to the depth of 170.00 m.bgl and has yielded 731 LPM. The Observation Well has encountered four water bearing zones between 23.00-24.00 (3.77 lps), 29.00-31.0 (6.81 lps), 80.00-81.00 (9.48 lps) and at 136.00 m.bgl (12.18 lps). The static water level was at 8.00 m.bgl. This well can cater to drinking water requirement of a population of about 7300 (@60 lpcd for ten hours of pumping a day) in the area. vii.The Observation Well -II was also drilled down to a depth of 150 m.bgl. This well has yielded 356 LPM and has encountered two water bearing zones between 22.00-23.00 and 72.00-73.00 m.bgl The SWL was at 9.00 m.bgl. This well can cater to the drinking water requirement of a population of about 3500 (@60 lpcd for ten hours of pumping a day) in the area.
11.	**Orissa**	i. A exploratory well drilled in Granite Gneiss down to the depth of 62.60 m bgl at Kamlaga, Sundergarh district has yielded 360 LPM during drilling. ii. A Observatory well drilled in Granite Gneiss down to the depth of 62.20 m bgl at Kamlaga, Sundergarh district has yielded 348 LPM during drilling. iii. A exploratory well drilled in Granite Gneiss down to the depth of 56.40 m bgl Casing 18.80m at Nilgiri block, Balasore district has yielded 660 LPM during drilling.

Sl. No.	Name of States	Description
		iv. An exploratory well drilled in Granite Gneiss down to the depth of 63 m bgl Casing 12 m at Digapahandi block, Ganjam district has yielded 300 LPM during drilling. v. An exploratory well drilled in Dongargarh, Bhawanipatna down to the depth of 141.77 m bgl at Kalahandi district has yielded 264 LPM during drilling. vi. An exploratory well drilled in Khemundi, Dighapahandi down to the depth of 148.40 m bgl at Ganjam district has yielded 180 LPM during drilling. vii. An observation well drilled in Raipal, Nilgiri down to the depth of 54.90 m bgl at Balasore district has yielded 720 LPM during drilling. viii. An exploratory well drilled in Kulabira, Lehripara down to the depth of 148.00 m bgl at Sundargarh district has yielded 150 LPM (9000 liters per hour) during drilling. ix. An exploratory well drilled in Bhawanipatna block down to the depth of 153.8 m bgl at Kalahandi district has yielded 258 LPM during drilling. x. An exploratory well drilled in Lefripada block down to the depth of 124.00 m bgl at Sundergarh district has yielded 180 LPM during drilling. xi. An exploratory well drilled in Tangapalli block down to the depth of 95.00 m bgl at Sundergarh district has yielded 510 LPM during drilling. This bore well can cater to drinking water requirement of a population of about 5000 (@60 lpcd for ten hours of pumping a day) in the area. xii. An exploratory well drilled in Banarpal block down to the depth of 86.75 m bgl at Angul district has yielded 360 LPM during drilling. This bore well can cater to drinking water requirement of a population of about 3500 (@60 lpcd for ten hours of pumping a day) in the area. xiii. An exploratory well drilled in Bhawanipatna block down to the depth of 150.00 m bgl at Kalahandi district has yielded 240 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 2400 (@60 lpcd for ten hours of pumping a day) in the area. xiv. An exploratory well drilled in Bargaon block down to the depth of 110.00 m bgl at Sundargarh district has yielded 270 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 2700 (@60 lpcd for ten hours of pumping a day) in the area.

Sl. No.	Name of States	Description
		xv. An exploratory well drilled in Nilgiri block down to the depth of 62.00 m bgl in Granite aquifer at Balasore district has yielded 960 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 9500 (@60 lpcd for ten hours of pumping a day) in the area. xvi. An exploratory well drilled in Kutra block down to the depth of 95.00 m bgl in Granite Gneiss and Mica Schist aquifer at Sundargarh district has yielded 300 LPM during drilling. This bore well can cater to the drinking water requirement of a population of about 3000 (@60 lpcd for ten hours of pumping a day) in the area.
12.	**Rajasthan**	i. A high yielding exploratory well was constructed at village Bheru Ghat, Rajsamand district of Rajasthan in otherwise water scarce hard rock area. The well was drilled to a depth of 156m in Gneiss formation Discharge of the well is 1000 LPM.
13.	**Tamil Nau**	i. An Exploratory drilling in hard rock area of karur district has revealed the presence of moderately/ high yielding fractures. A bore well drilled in biotite Geniess down to the depth of 165 m bgl at Parali has yielded 660 LPM during drilling. The high yielding fracture were encountered at various depths in the range of 7 – 159 m bgl. This bore well can cater to / augment drinking water requirement of a population of about 6600 (@ 60 lpcd for ten hours of pumping a day) in the area. ii. An Exploratory drilling in hard rock area of Krishnagiri district has revealed the presence of moderately/ high yielding fractures. A bore well drilled in biotite Geniess down to the depth of 192 m bgl at Kottapatti has yielded 609 LPM during drilling. The high yielding fracture were encountered at various depths in the range of 8 – 192 m bgl. This bore well can cater to / augment drinking water requirement of a population of about 6600 (@ 60 lpcd for ten hours of pumping a day) in the area. iii. An Exploratory drilling in hard rock area of Karur district has revealed the presence of moderately/ high yielding fractures. A bore well drilled in Biotite Gneiss and quartzite down to the depth of 180 m bgl at Vazhvarmangalam has yielded 200 LPM during drilling. The high yielding fractures were encountered at various depths in the range of 10.40 to 145 m bgl. This bore well can cater to / augment drinking water requirement of a population of about 2000 (@60 lpcd for ten hours of pumping a day) in the area.

Sl. No.	Name of States	Description
		iv. An Exploratory drilling in hard rock area of Krishnagiri district has revealed the presence of high yielding fractures. Two bore well drilled in Granite Gneiss down to the depth of 162.50m and 43.5m bgl at Mulukalapalli has yielded 660 LPM during drilling. The high yielding fractures were encountered at various depths in the range of 25-162.50m and 26.50-43.50m bgl. This bore well can cater to drinking water requirement of a population of about 6600 (@60lpcd for ten hours of pumping a day) in the area. v. An Exploratory drilling in hard rock area of Karur district has revealed the presence of high yielding fractures. A bore well, drilled in Gneiss down to the depth of 171.00 m bgl at Sankaranmalaipatty has yielded 504.60 LPM during drilling. The high yielding fracture was encountered at the depth in the range of 170.00 to 171.00 m bgl. This bore well can cater to drinking water requirement of a population of about 5000 (@60 lpcd for ten hours of pumping a day) in the area. vi. An Exploratory drilling in hard rock area of Karur district has revealed the presence of high yielding fractures. A bore well, drilled in Granite Gneiss down to the depth of 130.00 m bgl at Lalapet has yielded 456 LPM during drilling. The high yielding fracture was encountered at the depth in the range of 28.00 to 128.00 m bgl. This bore well can cater to drinking water requirement of a population of about 4500 (@60 lpcd for ten hours of pumping a day) in the area. vii. A bore well, drilled in Granite Gneiss down to the depth of 221.56 m bgl at Alapatti in Krishnagiri district has yielded 504 LPM during drilling. The high yielding fracture was encountered at the depth of 221.36-221.56. This bore well can cater to drinking water requirement of a population of about 5000 (@60 lpcd for ten hours of pumping a day) in the area. viii. A bore well, drilled in Granite Gneiss down to the depth of 200.00 m bgl at Paliyur in Karur district has yielded 554 LPM during drilling. The high yielding fracture was encountered at the depth of 18.00-123.00 mbgl. This bore well can cater to drinking water requirement of a population of about 5500 (@60 lpcd for ten hours of pumping a day) in the area.

Sl. No.	Name of States	Description
14.	**West Bengal**	i. During ground water exploration in Rajganj Municipality area of Uttar Dinajpur district highly potential aquifers in the depth range of 115m bgl has been encountered and an exploratory well of 113 m depth tapping aquifers between 86 & 110m bgl yielded 110.16 m3/hr during development by air compressor. ii. Ground water exploration is taken up in bouldery formation at Bhutabari, Bagdogra, Darjeeling district by deploying Percussion (Sankyo) rig. An exploratory well of 134 m depth tapping cumulative aquifers between 87 & 131 mbgl has yielded a high discharge of 1033 LPM at 4.01 m draw down during pumping test. This bore well can cater to drinking water requirement of a population of about 10000 (@60 lpcd for ten hours of pumping a day) in the area. iii. Ground water exploration is taken up in bouldery formation at Falakata in Jalpaiguri district, by deploying Percussion (Sankyo) rig. An exploratory well of 71 m depth tapping cumulative aquifers between 44 & 68 m bgl has yielded a high discharge of 1276 LPM at 7.40 m draw down during pumping test. This bore well can cater to drinking water requirement of a population of about 12700 (@60 lpcd for ten hours of pumping a day) in the area. iv. During air compressor development of the exploratory well (depth-57 m) tapping granular zones between 33 & 54 mbgl in alluvial formation at Uttar Chirail, Kaliganj block of Uttar Dinajpur district, W.B. the well yielded as high as 2403 LPM. This bore well can cater to drinking water requirement of a population of about 24000 (@60 lpcd for ten hours of pumping a day) in the area. v. During aquifer performance test of the exploratory well (tapping aquifers in the depth span of 180-192, 212-230 mbgl) at Chandalhati, in arsenic affected block of Deganga, North 24 Parganas district (W.B). It is observed that the well can be harnessed at a discharge of 2500 LPM yield arsenic free water for a population of 30000 @ 40 lpcd considering 8 hrs of pumping per day.

12. HYDROLOGY PROJECT PHASE –II

The Hydrology Project - Phase –II (HP-II) is a follow up project of HP-I. Its major thrust is to use Hydrological Information System (HIS) data effectively and efficiently for water resources planning and management.

The Project will further extend and promote the sustained and effective use of the HIS by all potential users concerned with water resources planning and management, both public and private, thereby contributing to improved productivity and cost-effectiveness of water-related investments in the 13 states and eight Central agencies. The project objectives will be achieved by

(a) Strengthening the capacity of hydrology departments to develop and sustain the use of the HIS for hydrological designs and decision tools thus creating enabling environment for improved integrated water resources planning and management;
(b) Improving the capabilities of implementing agencies at state/central level in using HIS for efficient water resource planning and management reducing vulnerability droughts and thereby meeting the country's poverty reduction objectives;
(c)Establishing and enhancing user-friendly, demand responsive and easily accessible HIS to improve shared vision and transparency of HIS between all users; and
(d)Improving access to the HIS by public agencies, civil society organizations and the private sector through awareness building supporting outreach services.

Greater use of an improved HIS is expected to have a broad but definite impact on the planning and design of water resources schemes, from which the rural and urban poor will have secure and sustainable access to water for multi-purpose livelihood uses.

CGWB is participating agency in HP-II and has a budget provision of Rs 27.8 Crores and project has duration of 6 years staring from May 2006 to 2012. The revised provision for the year 2006-07 is Rs 1.7 Crore. H-P-II has two major components i.e Horizontal Expansion in three new States covering Goa, Himachal Pradesh and Punjab and Vertical Extension in the 9HP-I peninsular States. Under Horizontal Expansion, HP-I type of activities and facilities will be extended to new States, however, under Vertical Extension special knowledge enhancement type of activities such as Hydrological Design Aid, Decision support System and Purpose Driven Studies would be taken up. In the first year of the project domain specific training would be imparted, Awareness raising program would be held, tender documents for procurement/upgrading of the equipments would be prepared and construction of the piezometers would be taken up.

13. STUDIES ON ARTIFICIAL RECHARGE OF GROUND WATER

A demonstrative scheme on "Rain Water Harvesting and Artificial Recharge to Ground Water" for 2006-08 has been taken up in the following areas:

i. **Lingala, Pulivendula Vemula and Vemalli blocks** in Kadapa district, Andhra Pradesh
ii. **Gangavalli block** in Salem district, Tamil Nadu
iii. **Mallur block** in Kolar district, Karnataka
iv. **Bel watershed**, Amla & Multai blocks in Betul District, Madhya Pradesh.
v. **Upper reaches** of Choti Kali Sindh river in parts of Sonkatch & Bagli blocks in Dewas district, Madhya Pradesh.

Under the scheme, recharge structures in over-exploited area were approved for implementation by the respective state departments under the overall technical guidance of CGWB with 100% funding by the Government of India. The approved cost of construction of recharge structures in cluster mode is Rs. 5.95 Crores. The norms adopted in implementation of National Rural Employment Guarantee Scheme (NREGS) by the Ministry of Rural Development are being followed in implementation of civil works under the present scheme The details of demonstrative recharge projects on Artificial Recharge to Ground Water and Rain Water Harvesting being implemented in states of Karnataka, Tamil Nadu, Andhra Pradesh and Madhya Pradesh are given in Table 13.1. Impact assessment studies are also incorporated to assess the efficacy of artificial recharge and rain water harvesting structures taken as in cluster mode in the above mentioned sites. Success of demonstrative recharge projects constructed in different hydrogeological conditions would be encourage the states to replicate the same in the similar set ups.

Table 13.1: Details of Demonstrative Projects on Artificial Recharge to Ground Water and Rain Water Harvesting in Karnataka, Tamil Nadu, Andhra Pradesh and Madhya Pradesh States (2006- 07)

Progress of Demonstrative Projects on Artificial Recharge to Ground Water and Rain Water Harvesting (As on 31st March, 2007)							
Sl. No.	**Name of the Scheme/ Projects**	**State (Number of structures)**	**District**	**Blocks (Number of structures)**	**Target (No. of Structures)**	**Achievement (No. of Structures)**	**Remarks**
1	2	3	4	5	6	7	8
	Demonstrative Projects on Artificial Recharge to Ground Water and Rain Water Harvesting	Karnataka	Kolar	Malur (28 Structures)	Check dam -23 Percolation tank-3 Sub Surface Dyke-2	Check dam -2	Work under progress
				Sub Total	**28**	**2**	
		Tamil Nadu	Salem	Gangavalli (41 Structures)	Check dam-23 Desiltation of tanks-2 Percolation tank -16	Check dam-15 Desiltation of tanks-2	Work under progress
				Sub Total	**41**	**17**	
		Andhra Pradesh	Kadapa	Lingala -(9 Structures)	Check dam-5 Mini Percolation Tank -1 Percolation Tank -3	Check dam-3	Work under progress
			Kadapa	Pulivendla -(3 Structures)	Check dam-2 Mini Percolation Tank -1	Check dam-2	
			Kadapa	Vemula -(6 Structures)	Check dam-5 Percolation Tank -1	Check dam-4	
			Kadapa	Vempalli -(5 Structures)	Check dam-3 Mini Percolation Tank -1 Percolation Tank -1	Check dam-1	
				Sub Total	**23**	**10**	
		Madhya Pradesh	Betul	Bel Watershed of Amla and Multai blocks (67 Structures)	RCC Check dam-18 Masonry Check dam-5 Recharge Shaft-3 Percolation Tank -1 PZs-40	Check dam-9	Work under progress
			Dewas	Sonkatch and Bagli blocks -(41 Structures)	Stop dam-11 Gabion-10 SSD-1 Percolation Tank -1 Recharge Shaft-1 RTRWH-2 PZs-15		
				Sub Total	**108**	**9**	
				Grand Total	**200**	**38**	

14. MATHMATICAL MODELLING STUDIES

A model is any device that represents an approximation of a field situation. A ground water model can be defined as a simplified version of a real ground water system. Ground Water simulation models provide a platform to study that problems in broader perspective and resolve solution for the optimal benefit taking into considerations the simplest and complex aspects along with economic, social and environmental aspects.

The Central Ground Water Board has undertaken two studies on ground water modeling during the year. Mathematical modeling have been taken up in irrigation command for arriving at optimal conjunctive use plan in the Western Yamuna Canal as well as in Chennai Metropolitan Area for planning the ground water development. The brief finding of the study are described in the following paragraphs:

14.1 System simulation studies for development of optimal allocation plan for ground and surface water in parts of western Yamuna canal command area in the state of Haryana.

The Western Yamuna Canal (WYC) takes off from the Yamuna River at the Hathnikund barrage and supplies water for irrigation, drinking and industrial use through its network. Its command covers parts of the Upper Yamuna Basin and the inland alluvial basin in the State of Haryana. The area faces problems of declining water level in some parts and rising water level in other parts. Long-term behaviour of water table (May1985 – May 2004) reveals that in central, north and all along river Yamuna, water level has gone down by 10 to 16 m. In the south and south-western part, water level has risen by 5 to 10 m.

In this study, a mathematical model has been developed to simulate the hydrogeological conditions and groundwater flow in part of the Western Yamuna Canal command area. An area of 7508 sq km out of the total 13543 sq km area of Western Yamuna Canal command was selected for modeling. The model area covers 32 blocks of Yamuna Nagar, Karnal, Panipat, Sonipat, Rohtak, Jhajjar, Kurukshetra and Jind districts. The 3-D Modular Finite Difference Groundwater Flow Package MODFLOW with Visual MODFLOW as an interface was used for model development. Conceptualization of the area was done based on the surface hydrology, bore hole lithology, fence diagram and water levels as reported in Upper Yamuna Basin reports of CGWB. The area is modeled as a three layer system with layer 1 representing upper phreatic aquifer; layer 2 representing confining layer and layer 3 representing confined/semi-confined aquifer. The area was discretized into 1km×1km grids. The eastern and south-western side of the model area was represented by river boundary, western side as no flow boundary and north and southern sides as flux boundaries. Major canals and drains were also simulated in the model as rivers to account for their recharge/discharge to groundwater system. The various model inputs like hydrogeological parameters, aerial recharge and groundwater abstraction was assigned to the model based on the data available. A total of 29 observation wells (20 in aquifer I and 9 in aquifer II) were used for model calibration. Very good calibration is achieved for aquifer I (layer 1). But due to very limited data

availability, mainly recharge and discharge, the calibration results achieved for 3rd layer (aquifer II) are not as good as of layer I. The results of the study will be useful to predict the sustainability of the groundwater resources of the study area and to evaluate possible management actions.

14.2 Modelling Studies in Coastal Aquifers of Southern Part of Chennai Metropolitan Area, Tamil Nadu

The phenomenon of seawater ingress in the coastal aquifers in Minjur in north has diverted the entrepreneurs to exploit the coastal aquifers in the southern part of Chennai Metropolitan Area (CMA) and there is lots of apprehension about the fate of the coastal aquifers in the southern part of CMA in the coming years.

In such conditions, a research project was taken up by Central Ground Water Board in collaboration with Bhabha Atomic Research Centre (BARC) & MS Swaminathan Research Foundation (MSSRF) to study the coastal aquifers of southern part of CMA. The work is the extension of the research project work.

The study area comprising coastal aquifer of southern part of Chennai Metropolitan Area is located between longitudes 80°13′30″ and 80°16′30″ and Latitudes 12°48′15″ and 12°59′15″. The area is bounded by Bay of Bengal in the east and Kovalam Creek on the south while in the north Tiruvanmiyur area was taken as boundary and about 1 – 3 km west of Buckingham canal was taken as western boundary

A conceptual model has been developed for the study area, which includes the delineation of the number and nature of aquifers, aquifer extension (lateral & vertical) and source of recharge.

Two-layered aquifer system has been considered for the study area. Modelling studies have been attempted for the study area. Initially, lumped model has been attempted and subsequently distributed modelling has been carried out.

It has been seen that in the study area, in layer 1 during non-monsoon period, there is a change in storage of –3.960998 M.Cu.m, while during monsoon period the change in storage is of the order of 2.554059 M.Cu.m. During the period of Jul 2000 to May 2001, there is a change in storage of –1.40693 M.Cu.m, there by indicating that the discharge components are more than the recharge components.

Similarly in Layer 2 also a change in storage of -0.045686 M.Cu.m during non monsoon period while during monsoon period the change in storage is of the order of 0.015149 M.Cu.m. Thus during the period of Jul 2000 to May 2001, there is a change in storage of –0.03054 M.Cu.m, indicating that discharge components are more than the recharge components. Due to paucity of data the distributed model could not be attempted, however efforts are being made to acquire relevant data.

In both the layers, the change in storage is negative there by indicating that the recharge components do not sufficiently compensate the discharge components. This would result in the further decline of water level over the years unless groundwater

development is regulated and measures for augmentation of groundwater recharge are undertaken.

In the present study, the multi aquifer system geometry has been conceptualized and interconnection between the two-aquifer units has been proved. The source of recharge and source of salinity of groundwater has been ascertained. Further, groundwater budget for the aquifer system has been computed and an attempt on distributed modelling has provided a reasonable estimate on groundwater flow conditions. It requires further fine-tuning to simulate the flow around the boundary. Further research can be taken up from this point with additional data to fine tune the model.

14.3 Ground water modeling in parts of Yamuna flood plain (Palla Well Field) of NCT Delhi.

As a result of collaborative project between Central Ground Water Board and National Institute of Hydrology pertaining to ground water modeling in parts of Yamuna flood plain (Palla Well Field) of NCT Delhi, project report titled " An operative Model for ground water pumping at palla well field , NCT Delhi" was printed at NIH, Roorkee . The model is to be made operational with further field inputs and verifications .

The Optimum pumping schedule for the tube wells operational in palla well field have been proposed keeping into consideration overall environmentally sustainable development of ground water resources .

15. CENTRAL GROUND WATER AUTHORITY (CGWA)

Central Ground Water Authority was constituted by the Ministry of Environment and Forest vide notification no. S.O. 38(E) dated 14.01.97 with the mandate to regulate and control ground water development and management in the country under Environment (Protection) Act, 1986. CGWA had been declared as a permanent body through gazette notification of the Ministry of Environment & Forest dated 6th November, 2000. Activity wise achievements during the period of 1st April 2006 to 31st March 2007 are summarized below.

15.1 Regulation of ground water development

During the period, CGWA had notified additional 23 severely overexploited areas for regulation of groundwater development in the states Haryana, Madhya Pradesh, Punjab and Rajasthan (Table 15.1). In addition to the above regulation of ground water development is already being done in 20 areas notified earlier (Table 15.2).

Table 15.1: List of notified areas for regulation of ground water deveelopment

Sl. No.	Name of the notified area/ block/ mandal	District	State
1	Shahbad	Kurukshetra	Haryana
2	Nangal Chowdhary	Mahendergarh	
3	Narnaul	Mahendergarh	
4	Samalkha	Panipat	
5	Karnal	Karnal	
6	Khol	Rewari	
7	Dhar	Dhar	Madhya Pradesh
8	Manawar	Dhar	
9	Mandsaur	Mandsaur	
10	Sitamau	Mandsaur	
11	Neemuch	Neemuch	
12	Jaora	Ratlam	
13	Indore Municipal Corpn	Indore	
14	Moga –I	Moga	Punjab
15	Moga-II	Moga	
16	Sangrur	Sangrur	
17	Maha Kalan	Sangrur	
18	Ahmedgarh	Sangrur	
19	Behror	Alwar	Rajasthan
20	Bhinmal	Jalor	
21	Surajgarh	Jhunjhunu	
22	Dhod	Sikar	
23	Sri Madhopur	Sikar	

Table 15.2: . List of 20 notified areas for regulation ofground water development

Sl. No.	Name of the notified area / block / mandal	District	State
1	Faridabad and Ballabgarh	Faridabad	Haryana
2	Diu	Diu	UT of Diu
3	Ludhiana	Ludhiana	Punjab
4	Ghaziabad Municipal Corporation	Ghaziabad	Uttar Pradesh
5	Jhotwara Block	Jaipur	Rajasthan
6	Haldia Municipal Area	Mednipur	West Bengal
7	South district of NCT of Delhi	South District of NCT of Delhi	NCT of Delhi
8	South-West district of NCT of Delhi	South-West district of NCT of Delhi	NCT of Delhi
9	Gandhinagar Taluka	Gandhinagar District	Gujarat
10	Yamuna Flood Plain Area	-	NCT of Delhi
11	Gurgaon Block	Gurgaon	Haryana
12	Midjil	Mahboobnagar	Andhra Pradesh
13	Tirupathi (Rural)	Chittoor	
14	Vempalli	Cuddapah	
15	PushkarValley	Ajmer	Rajasthan
16	Jalore	Jalore	
17	Raniwara	Jalor	
18	Buhana	Jhunjhunu	
19	Chirawa	Jhunjhunu	
20	Mundwa	Nagaur	

In the notified areas of Andhra Pradesh, the regulation of ground water development is being undertaken by Andhra Pradesh ground water Authority. In the remaining notified areas, the regulatory measures are being enforced through the concerned District Collector/Deputy Commissioner of concern district.

15.2. Registration of Ground water Structures:

In order to put more areas under regulation, 37 new over exploited areas have been identified and notified for registration of ground water structures (Table 15.3). The registration work in theses notified areas is to be undertaken by the respective states governments.

Table 15.3: List of 37 notified area for registration of ground water abstraction structures.

Sl. No.	Name of the notified area / block / mandal	District	State
1	Rolla	Ananthapur	Andhra Pradesh
2	Kadiam	East Godavari	
3	Sodam	Chittoor	
4	Medchal	RangaReddy	
5	Chityal	Nalgonda	
6	Tharad	Banaskantha	Gujarat
7	Deodar	Banaskantha	
8	Kankrej	Banaskantha	
9	Patan	Patan	
10	Pataudi	Gurgaon	Haryana
11	Ellanabad	Sirsa	
12	Rania	Sirsa	
13	Mallur	Kolar	Karnataka
14	Bangarapeta	Kolar	
15	Sidlaghhatta	Kolar	
16	ChikBallapur	Kolar	
17	Gauribidanur	Kolar	
18	Athiyannur	Travandrum	Kerala
19	Chittoor	Palghat	
20	Kozhikode	Kozhikode	
21	Badnawar	Dhar	Madhya Pradesh
22	Nalcha	Dhar	
23	Tirla	Dhar	
24	Piploda	Ratlam	
25	Ratlam	Ratlam	
26	Alot	Ratlam	
27	Morshi	Amaravati	Maharashtra
28	Warud	Amaravati	
29	Jalandhar East	Jalandhar	Punjab
30	Jalandhar West	Jalandhar	
31	Nakodar	Jalandhar	
32	Veerapani	Salem	Tamil Nadu
33	Pernampet	Vellore	
34	Gangoh	Saharanpur	Uttar Pradesh
35	Nakur	Saharanpur	
36	Ambiapur	Badaum	

37	Pondicherry	Pondicherry	Union Territory of Pondicherry

The Due date for Registration of Ground water Abstraction structures in 28 areas notified during 2005-06 had been extended up to 17-02-2007.

15.3. Notification for taking suitable measures for Artificial Recharge and Rain Water Harvesting

Total of 1065 Blocks/Mandals are notified with the directives to Chief Secretary for taking suitable measures for artificial recharge to ground water / Rainwater harvesting to augment ground water resources and save it from further depletion in the states as per Table15. 4.

Table 15.4: Details of notified areas for taking suitable measures for Artificial Recharge and Rain Water Harvesting

Sl. No	States/Union territories	Blocks/Mandal/Talukas	
		Critical	Over -exploited
1	Andhra Pradesh	77	219
2	Delhi	0	7
3	Gujarat	12	31
4	Haryana	11	55
5	Karnataka	3	65
6	Kerala	15	5
7	Madhya Pradesh	5	24
8	Maharashtra	1	7
9	Punjab	5	103
10	Rajasthan	50	140
11	Tamil Nadu	33	142
12	Uttar Pradesh	13	37
13	Uttarranchal	0	2
14	West Bengal	1	0
15	Daman &DIU	0	1
16	Pondicherry	0	1
	Total	**226**	**839**

15.4. Regulation of ground water withdrawal by Industries

In order to regulate the ground water development by the industries, a list of over exploited /critical areas have been circulated to statutory organizations like state pollution control Boards, Ministry of Environment and Forest etc., which refers new industries/projects to CGWA for permission prior to setting up of industries/projects. The proposals received are evaluated on case to case basis, based on site specific recommendations of Central Ground Water Board and are accorded ground water clearance on merit. During the period seventy (70) industries have been accorded permissions.

15.5. Registration of drilling agencies:

Registration of water well drilling agencies are being undertaken by CGWA to develop micro level data base on ground water development and to control indiscriminate drilling activity in the country. During the period 27 agencies were registered with CGWA.

15.6. Mass Awareness and Training Program

Details of Mass Awareness and training Programs conducted during the periods are given below:

I 54 Mass awareness programs were organized for ground water conservation, artificial recharge, ground water protection in which around 100 Persons in each program have participated.

II 52 Ground water management training programs were organized in different parts of the country for designing rain water harvesting structures for augmenting the water. During the training around 25 persons in each program were trained.

III **Training course on Ground Water Management (Regulation and Control) was conducted by CGWA at Faridabad from 20th to 25th November 2006 for 16 officers of CGWB from various states.**

Sh. V. Chenthamarakshan, MLA Kollengode inaugurates Function of Mass Awareness Programme on Rainwater Harvesting conducted by CGWB, Kerala Region at Kollengode, Palakkad, Kerala by lighting the lamp. Sh. B M Jha, Member (ED&MM), and RD Sh. D S Thambi

Sh. B.M.Jha, Member (ED&MM), Central Ground Water Board delivering presidential ad
co

Sub Area Commander K, Mazumdar giving memento to the Regional Director, North Western Region during MAP at Ambala Cantt

Deputy Commissioner, Moga releasing District Brochure on Moga during MAP at village Khokhri Kalan

Dr. S.C.Dhiman, MEMBER(SML) addressing the gathering, J&K

Sh. Arun Kumar, Regional Director addressing the gathering, J&K

Water Management Training Programme - Ahmedabad

16. GROUND WATER MANAGEMENT STUDIES IN DROUGHT PRONE AREA

The Central Ground Water Board covered an area of 40430sq. km. categorized as drought prone in Gujarat, Madhya pradesh, Maharashtra, Uttar Pradesh, Orissa, Andhra Pradesh, Karnataka and Kerala States of the country under ground water management studies. In addition to this, 254 bore holes (180 EW, 40 OW, 1 SH & 33 PZ) by departmental rigs were drilled in drought prone areas of Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Rajasthan and Uttar Pradesh.

Details of area covered under ground water management studies and status of exploration in drought prone areas are shown in Table 16.1, 16.2 & Fig 17.1 & 17.2 respectively.

Table 16.1 : AREA COVERED UNDER GROUND WATER MANAGEMENT STUDIES IN DROUGHT PRONE AREAS DURING 2006-2007

Sl. No	Regions/ State	Districts	Achievement Sq.Km.
1.	**WEST CENTRAL REGION**	Banaskantha	3300
	Gujarat	Sabarkantha	3600
		Total	**6900**
2.	**NORTH CENTRAL REGION**	Betul	3334
	Madhya Pradesh	**Total**	**3334**
3.	**CENTRAL REGION**	Ahmednagar	3218
	Maharashtra	**Total**	**3218**
4.	**NORTHERN REGION**	Lalitpur	5039
	Uttar Pradesh	**Total**	**5039**
5.	**SOUTH EASTERN REGION**	Bhadrak & Balasore	3043
	Orissa	**Total**	**3043**
6.	**SOUTHERN REGION**	Anantpur	4900
	Andhra Pradesh	Kadapa	1600
		Total	**6500**
7.	**SOUTH WESTERN REGION**	Raichhur	3332
	Karnataka	Raichur & Koppal	2964

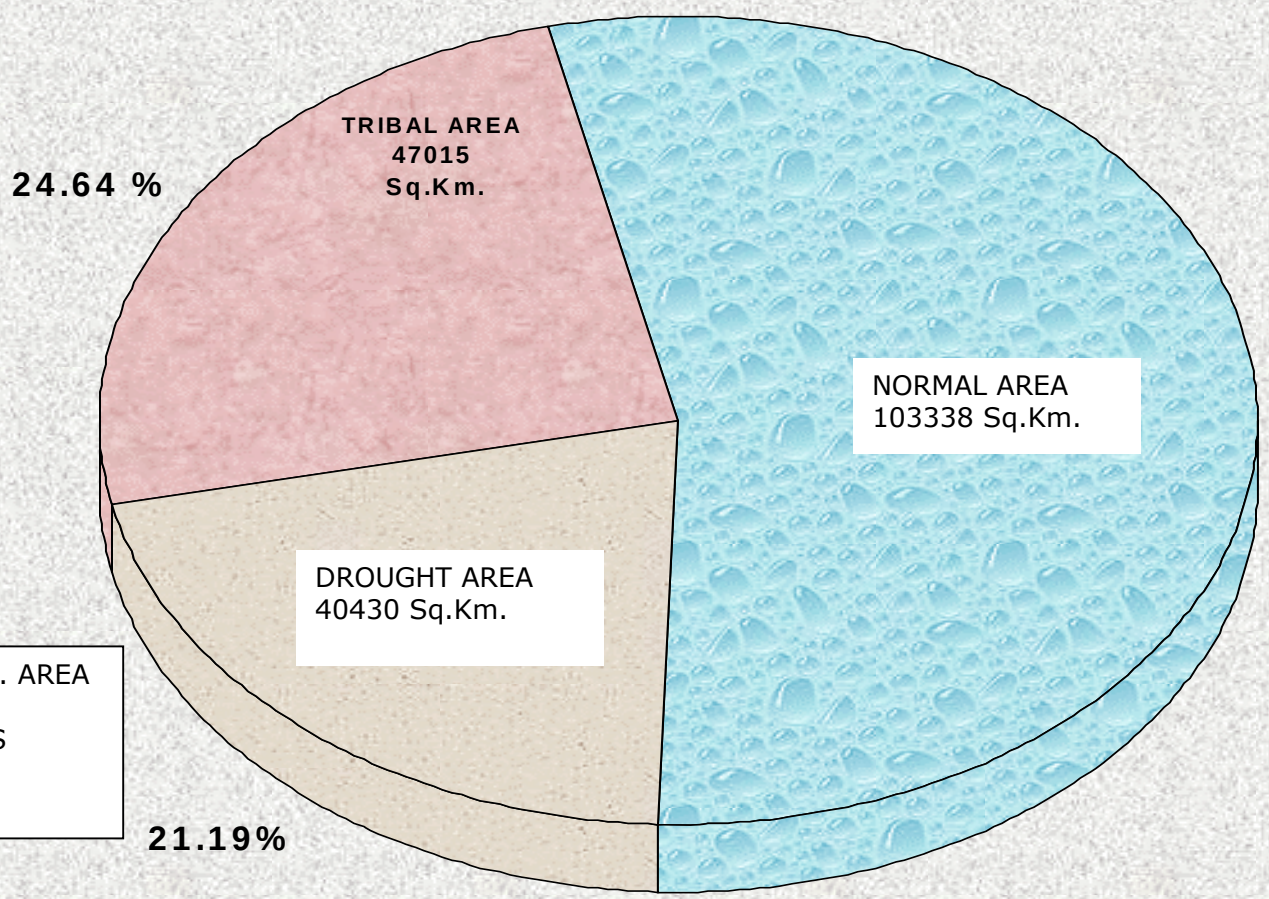
		Total	**6296**
8.	**KERALA REGION** Kerala	Trichur	3030
		Palaghat	3070
		Total	**6100**
GRAND TOTAL			**40430**

Table 16.2 : EXPLORATORY WELLS DRILLED IN "DROUGHT PRONE" AREA DURING 2006-2007
(By Departmental Rigs)

Sl. No	States	Districts	EW	OW	PZ	SH	DW	Total
1	**Gujarat**	Amreli	3	**-**	**-**	**-**	**-**	03
		Banaskantha			2			02
		Gandhinagar		**-**	1	1	**-**	02
		Jamnagarnagar	2	**-**	**-**	**-**	**-**	02
		Mehsana			2			02
		Patan			1			01
		Rajkot	1					01
		Sabarkantha			1			01
		Surendernagar	3	3				06
		Total	**9**	**3**	**7**	**1**	**-**	**20**
2	**Karnataka**	Devanagere	10	2	-	-	-	12
		Kolar	7	2	-	-	-	09
		Bidar	1					01
		Chitraddurga	4	1				05
		Total	**22**	**5**	**-**	**-**	**-**	**27**
3	**Kerala**	Palghat	**-**	**-**	20	**-**	**-**	20
		Trivendrum	14	5	-	-	-	19
		Total	**14**	**5**	**20**	**-**	**-**	**39**
4	**Maharashtra**	Aurangabad	21	5	-	-	-	26
		Sangli	13	4	-	-	-	17
		Total	**34**	**9**	**-**	**-**	**-**	**43**
5	**Orissa**	Angul	11	2	-	-	-	13
		Balasore	16	3	-	-	-	19
		Ganjam	11	2	-	-	-	13
		Kalahandi	10	2	-	-	-	12
		Sundergarh	25	2	-	-	-	27
		Total	**73**	**11**	**-**	**-**	**-**	**84**
6	**RAJASTHAN**	Hanumangarh	2	1		-	-	03
		Churu	2		3			05
		Jaisalmer	3	-	1	-	-	04
		Jhun-jhunu			2	-	-	02

Sl. No	States	Districts	EW	OW	PZ	SH	DW	Total
		Sikar	3	1				04
		Total	**10**	**2**	**6**	**-**	**-**	**18**
7	**Uttar Pradesh**	Banda	4		-	-	-	04
		Jhansi	1	1				02
		Lalitpur	9	2	-	-	-	11
		Mahoba	4	2	-	-	-	06
		Total	**18**	**5**	**-**	**-**	**-**	**23**
GRAND TOTAL			**180**	**40**	**33**	**1**	**-**	**254**

GROUND WATER MANAGEMENT STUDIES IN TRIBAL, DROUGHT AND NORMAL AREAS



TOTAL 190783 Sq.Km. AREA COVERED
UNDER GWM STUDIES
(REAPPRAISAL)
DURING 2006-2007

17. GROUND WATER MANAGEMENT STUDIES IN TRIBAL AREAS

The Central Ground Water Board, in its 2006-2007 Annual Action Plan gave emphasis to Ground Water Management Studies and exploratory drilling programme in districts falling under tribal areas of the country. An area of 47015 sq. km. was covered in Tribal areas of the country and 184 bore holes (EW- 124, OW-52 & PZ-08) were drilled in Tribal areas to explore the possibility of tapping potential aquifers.

The status of coverage under Ground Water Management Studies and exploratory drilling in tribal areas are shown in Tables 17.1 & 17.2. and Fig 17.1 & 17.2 respectively.

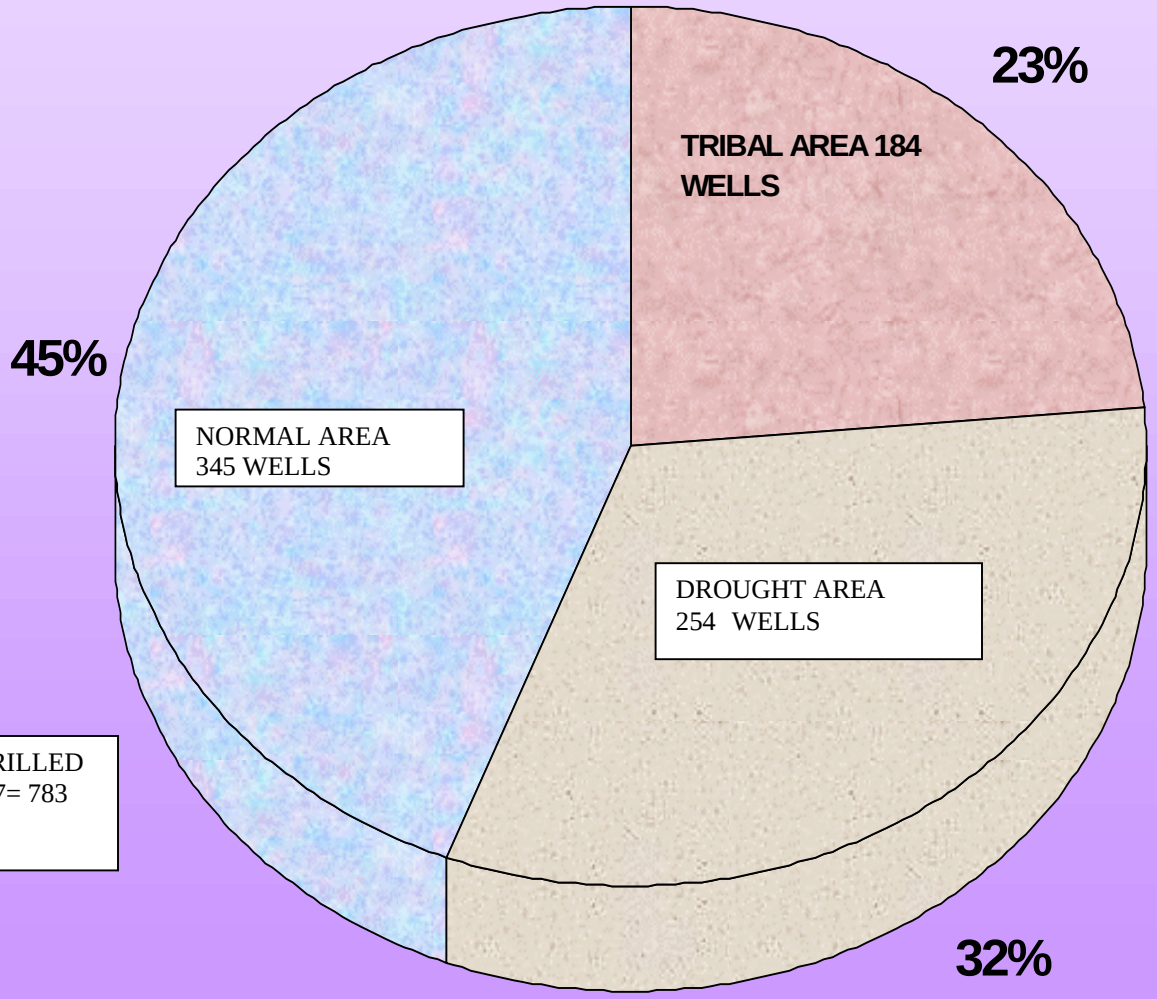
Table 17.1 : AREAS COVERED UNDER GROUND WATER MANAGEMENT STUDIES IN TRIBAL AREAS DURING 2006-2007

Sl. No	Regions/state	District	Achievement (Sq.Km.)
1.	**WESTERN REGION**		
	Rajasthan	Sirohi & Udaipur	5500
		Total	**5500**
2.	**NORTH CENTRAL CHHATTISGARH REGION**	Durg	1366
	Chhattisgarh	Total	**1366**
3.	**EASTERN REGION**	Purb&Paschim Medinipur	1152
	West Bengal	Andaman&Nicobar Island	1800
		Murshidabad	415
		Total	**3367**
4.	**SOUTH EASTERN REGION**	Sundergarh	6770
	Orissa	Total	**6770**
5.	**MID EASTERN REGION**	Sahebganj and parts of Pakur	3050
	Jharkhand	Total	**3050**
6.	**NORTH EASTERN REGION**		
	Mizoram	Aizal	3000
	Nagalan	Wokha&Mokokchang	3000
	Arunachal Pradesh	Papumpare & parts of Lower Subansiri	3000
	Meghalaya	Ribhoi & parts of W. Khasi Hill	3000
	Tripura	Dhalai & parts of West Tripura	3000
		Total	**15000**
7.	**SOUTH WESTERN REGION**	Chamrajnagar	2797
	Karnataka	Total	**2797**
8.	**CENTRAL REGION**	Amravati	3460
	Maharashtra	Total	**3460**
9.	**NORTH CENTRAL REGION**	Dhar	2973
	Madhya Pradesh	Neemuch	2712
		Total	**5685**
GRAND TOTAL			**47015**

Table 17.2 : EXPLORATORY WELLS DRILLED IN "TRIBAL" AREA DURING 2006-2007
(by Departmental Rigs)

Sl. No	States	Districts	EW	OW	PZ	SH	DW	Total
1.	Andhra Pradesh	Vishakhapatanam	12	4	-	-	-	16
		Total	**12**	**4**	**-**	**-**	**-**	**16**
2.	Arunachal Pradesh	Lohit	1	-	-	-	-	01
		Tirap	1	-	-	-	-	01
		Total	**2**	**-**	**-**	**-**	**-**	**02**
3.	Assam	Goalpara	3	-	-	-	-	03
		Kamrup	3	1	-	-	-	04
		Total	**6**	**1**				**07**
4.	Bihar	Jammui	2	4	-	-	-	06
		Munger	4	2	-	-	-	06
		Lakhisarai	1	1	-	-	-	02
		Total	**7**	**7**	**-**	**-**	**-**	**14**
5.	Chattisgarh	Bilaspur	10	5	-	-	-	15
		Champa	14	4		-	--	18
		Durg	2	-	-	-		02
		Raigarh	1	-	7	-	--	08
		Rajnangaon	1	-	-	-	-	01
		Surguja	1	-	-	-	-	01
		Total	**29**	**09**	**07**	**-**	**-**	**45**
6.	Gujarat	Vadodra	1	1	-	-	-	02
		Bharuch	6	3	-	-	-	09
		Narmada	6	4	-	-	-	10
		Total	**13**	**8**	**-**	**-**	**-**	**21**
7.	Jharkhand	Gumla	7	2	-	-	-	09
		Total	**07**	**02**	**-**	**-**	**-**	**09**
8.	Madhya Pradesh	Betul	19	9	-	-	-	28
		Dindori	10	4	-	-	-	14
		Mandla	3	1	1	-	-	05
		Total	**32**	**14**	**1**	**-**	**-**	**47**
9.	Maharashtra	Raigarh	7	4	-	-	-	11
		Total	**7**	**4**	**-**	**-**	**-**	**11**
10.	Meghalaya	Ri-Bhoi	2	1	-	-	-	03
		W.G.Hills	1	-	-	-	-	01
		Total	**3**	**1**	**-**	**-**	**-**	**04**
11.	Tripura	West Tripura	4	2	-	-	-	06
		Total	**4**	**2**	**-**	**-**	**-**	**06**
12.	West Bengal	Darjeeling	2	-	-	-	-	02
		Total	**02**	**-**	**-**	**-**	**-**	**02**
Grand Total			**124**	**52**	**08**	**-**	**--**	**184**

GROUND WATER EXPLORATION IN TRIBAL , DROUGHT AND NORMAL AREA



TOTAL WELLS DRILLED DURING 2006-2007= 783

18. ESTIMATION OF GROUND WATER RESOURCE BASED ON GEC - 1997 METHODOLOGY

As per the National Water Policy 2002, the ground water resource potential need to be re-assessed periodically on scientific basis. Accordingly, the ground water resource of the entire country is being re-assessed jointly by the Central Ground Water Board and the States based on the Ground water resources estimation methodology, (GEC – 97) .

The Total Annual Replenishable Ground Water Resources of the Country have been reassessed as 433 Billion Cubic Metres (bcm) and the Net Annual Ground Water Availability is estimated as 399 bcm. Annual Ground Water Draft as on March, 2004 for all uses is 231 bcm. The Stage of Ground Water Development is 58%. The state – wise availability of ground water resources is given in Table 18.1.

The development of ground water in different areas of the Country has not been uniform. Highly intensive development of ground water in certain areas in the country has resulted in over – exploitation. As per the latest assessment of ground water resources out of 5723 assessment units (Block/Mandals/Talukas) in the country, 839 units in various States have been categorized as ' over-exploited' i.e. the annual ground water draft exceeds the annual Replenishable ground water resources and significant decline in long term ground water level trend has been observed either in pre-monsoon or post-monsoon or both. In addition 226 units are 'Critical' where the stage of ground water development is 100% of annual replenishable ground water resource and significant decline is observed in the long term water level trend in both pre-monsoon and post-monsoon periods. There are 550 semi-critical units, where the stage of ground water development is between 70 - 90% and significant decline in long term water level trend has been recorded in either Pre-monsoon or Post-monsoon. The state – wise status of over – exploited and critical and semi-critical areas is given in Table 18.2.

Table 18.1: STATE-WISE GOUND WATER RESOURCES AVAILABILITY, UTILIZATION AND STAGE OF DEVELOPMENT

Sl. No.	States/ UTs	Annual Replenis-hable Ground Water Resource	Natural Discharge during non-Monsoon season	Net Annual Ground Water Availability	Annual Ground Water Draft			Stage of Ground Water Development (%)
					Irrigation	Domestic and Industrial uses	Total	
1	2	3	4	5	6	7	8	9
	States							
1	Andhra Pradesh	36.50	3.55	32.95	13.88	1.02	14.90	45
2	Arunachal Pradesh	2.56	0.26	2.30	0.0008	0	0.0008	0.04
3	Assam	27.23	2.34	24.89	4.85	0.59	5.44	22
4	Bihar	29.19	1.77	27.42	9.39	1.37	10.77	39
5	Chattisgarh	14.93	1.25	13.68	2.31	0.48	2.80	20
6	Delhi	0.30	0.02	0.28	0.20	0.28	0.48	170
7	Goa	0.28	0.02	0.27	0.04	0.03	0.07	27
8	Gujarat	15.81	0.79	15.02	10.49	0.99	11.49	76
9	Haryana	9.31	0.68	8.63	9.10	0.35	9.45	109
10	Himachal Pradesh	0.43	0.04	0.39	0.09	0.02	0.12	30
11	Jammu & Kashmir	2.70	0.27	2.43	0.10	0.24	0.33	14
12	Jharkhand	5.58	0.33	5.25	0.70	0.38	1.09	21
13	Karnataka	15.93	0.63	15.30	9.75	0.97	10.71	70
14	Kerala	6.84	0.61	6.23	1.82	1.10	2.92	47
15	Madhya Pradesh	37.19	1.86	35.33	16.08	1.04	17.12	48
16	Maharashtra	32.96	1.75	31.21	14.24	0.85	15.09	48
17	Manipur	0.38	0.04	0.34	0.002	0.0005	0.002	0.65
18	Meghalaya	1.15	0.12	1.04	0.00	0.002	0.002	0.18
19	Mizoram	0.04	0.004	0.04	0.00	0.0004	0.0004	0.90
20	Nagaland	0.36	0.04	0.32	0.00	0.009	0.009	3
21	Orissa	23.09	2.08	21.01	3.01	0.84	3.85	18
22	Punjab	23.78	2.33	21.44	30.34	0.83	31.16	145
23	Rajasthan	11.56	1.18	10.38	11.60	1.39	12.99	125
24	Sikkim	0.08	-	0.08	0.00	0.01	0.01	16
25	Tamil Nadu	23.07	2.31	20.76	16.77	0.88	17.65	85
26	Tripura	2.19	0.22	1.97	0.08	0.09	0.17	9
27	Uttar Pradesh	76.35	6.17	70.18	45.36	3.42	48.78	70
28	Uttaranchal	2.27	0.17	2.10	1.34	0.05	1.39	66
29	West Bengal	30.36	2.90	27.46	10.84	081	11.65	42
	Total States	**432.43**	**33.73**	**398.70**	**212.38**	**18.04**	**230.44**	**58**
	Union Territories							
1	Andaman & Nicobar	0.330	0.005	0.320	0.000	0.010	0.010	4
2	Chandigarh	0.023	0.002	0.020	0.000	0.000	0.000	0

Sl. No.	States/ UTs	Annual Replenis-hable Ground Water Resource	Natural Discharge during non-Monsoon season	Net Annual Ground Water Availability	Annual Ground Water Draft			Stage of Ground Water Development (%)
					Irrigation	Domestic and Industrial uses	Total	
1	2	3	4	5	6	7	8	9
3	Dadra & Nagar Haveli	0.063	0.003	0.060	0.001	0.007	0.009	14
4	Daman & Diu	0.009	0.0004	0.008	0.007	0.002	0.009	107
5	Lakshdweep	0.012	0.009	0.004	0.000	0.002	0.002	63
6	Pondicherry	0.160	0.016	0.144	0.121	0.030	0.151	105
	Total Uts	**0.597**	**0.036**	**0.556**	**0.129**	**0.051**	**0.181**	**33**
	Grand Total	**433.02**	**33.77**	**399.25**	**212.51**	**18.09**	**230.62**	**58**

Table 18.2: CATEGORIZATION OF BLOCKS/ MANDALS/ TALUKAS IN INDIA AS ON 31st MARCH, 2004

Sl. No.	States /Union Territories	Total No. of Assessed Units	Semi-Critical		Critical		Over-exploited		Remarks
			Nos.	%	Nos.	%	Nos.	%	Nos.
	States								
1	Andhra Pradesh	1231	175	14	77	6	219	18	-
2	Arunachal Pradesh	13	0	0	0	0	0	0	-
3	Assam	23	0	0	0	0	0	0	-
4	Bihar	515	0	0	0	0	0	0	-
5	Chattisgarh	146	8	5	0	0	0	0	-
6	Delhi	9	0	0	0	0	7	78	-
7	Goa	11	0	0	0	0	0	0	-
8	Gujarat	223	69	31	12	5	31	14	Rest 14 talukas Saline
9	Haryana	113	5	4	11	10	55	49	-
10	Himachal Pradesh	5	0	0	0	0	0	0	-
11	Jammu & Kashmir	8	0	0	0	0	0	0	-
12	Jharkhand	208	0	0	0	0	0	0	-
13	Karnataka	175	14	8	3	2	65	37	-
14	Kerala	151	30	20	15	10	5	3	-
15	Madhya Pradesh	312	19	6	5	2	24	8	-
16	Maharashtra	318	23	7	1	0	7	2	-
17	Manipur	7	0	0	0	0	0	0	-
18	Meghalaya	7	0	0	0	0	0	0	-
19	Mizoram	22	0	0	0	0	0	0	-
20	Nagaland	7	0	0	0	0	0	0	-
21	Orissa	314	0	0	0	0	0	0	Rest 6 blocks Saline
22	Punjab	137	4	3	5	4	103	75	-
23	Rajasthan	237	14	6	50	21	140	59	Rest 1 block Saline
24	Sikkim	1	0	0	0	0	0	0	-
25	Tamil Nadu	385	57	15	33	9	142	37	Rest 8 blocks Saline
26	Tripura	38	0	0	0	0	0	0	-
27	Uttar Pradesh	803	88	11	13	2	37	5	-
28	Uttaranchal	17	3	18	0	0	2	12	-
29	West Bengal	269	37	14	1	0	0	0	-
	Total States	5705	546	10	226	4	837	15	-

	Union Territories								
1	Andaman & Nicobar	1	**0**	**0**	**0**	**0**	**0**	**0**	**-**
2	Chandigarh	1	**0**	**0**	**0**	**0**	**0**	**0**	**-**
3	Dadra & Nagar Haveli	1	**0**	**0**	**0**	**0**	**0**	**0**	**-**
4	Daman & Diu	2	**1**	**50**	**0**	**0**	**1**	**50**	**-**
5	Lakshdweep	9	**3**	**33**	**0**	**0**	**0**	**0**	**-**
6	Pondicherry	4	**0**	**0**	**0**	**0**	**1**	**25**	**Rest 1 Region Saline**
	Total UTs	**18**	**4**	**22**	**0**	**0**	**2**	**11**	**1**
	Grand Total	**5723**	**550**	**10**	**226**	**4**	**839**	**15**	**30**

Blocks- Bihar, Chhattisgarh, Haryana, Jharkhand, Kerala, Madhya Pradesh, Manipur, Mizoram, Orissa, Punjab, Rajasthan, Tamilnadu, Tripura, Uttar Pradesh, Uttaranchal , West Bengal

Mandals (command/ non-command) - Andhra Pradesh

Talukas - Goa, Gujarat, Karnataka, Maharashtra

Districts - Arunachal Pradesh, Assam, Delhi, Meghalaya, Nagaland

Districts (Valley) - Himachal Pradesh, Jammu & Kashmir

State – Sikkim

Islands – Lakshdweep

UT - Andaman & Nicobar, Chandigarh, Dadra & Nagar Haveli,Daman & Diu, Pondicherry.

19. TECHNICAL EXAMINATION OF MAJOR AND MEDIUM IRRIGATION SCHEMES

As per the directives of the Planning Commission, the Board is scrutinizing the major and medium irrigation project reports/proposals sent by the State Governments / Central Water Commission / National Water Development Agency / Command Area Development & Water Management Wing of Ministry of Agriculture from the point of view of their impact on ground water regime and specific recommendations are being made to protect quality and quantity of ground water. During the year 2006-2007, Sixteen major irrigation project of Central Water Commission and Seven irrigation projects of Command Area Development and Water Management were examined and area specific recommendations were made which are given in table 19.1.

Table 19.1: MAJOR AND MEDIUM IRRIGATION SCHEMES

Sl. No.	Name of Projects
Central Water Commission	
1.	Ddadupur – Nalvi Irrigation Schemes, Haryana
2.	Argula Gutpha Lift Irrigation Scheme, Nizamabad, Andhra Pradesh
3.	Alisar Lift Irrigation Scheme, Nizamabad, Andhra Pradesh
4.	Godavari Lift Irrigation Scheme (Devaula) , Andhra Pradesh
5.	Pushkara Lift Irrigation Scheme, Andhra Pradesh
6.	Kelo Irrigation Project, Chhattisgarh.
7.	Jasrana Naveen Nahar Pariyojna, Uttar Pradesh.
8.	Master Plan for Drainage Development in Coastal Belt of Orissa, Orissa
9.	Bembla River Project, Maharashtra.
10.	Madernization of Canal System oF Bhadra Reservoir, Karnataka
11.	Sondur Reservoir Project, Chhattisgarh
12.	Khaakpurna River Project, Maharashtra
13.	Pentakli Project, Maharashtra
14.	Musurumilli Reservoir Scheme, East Godavari, , Andhra Pradesh
15.	Krishna – Koyna Lift Irrigation Scheme, Sangli / Solapur district, Maharashtra
16.	BML-Hansi Branch-Butana Branch Multipurpose Link Canal
Command Area Development and Water Management	
17.	Loktak Irrigation Project, Manipur
18.	Upper Weinganga Irrigation Project, Madhya Pradesh.
19.	Karjan Reservoir Project, Gujarat
20.	Ravi Irrigation Project, Jammu & Kashmir.
21.	Bhabour Sahib Lift Irrigation Project –II, Himachal Pradesh
22.	Impact Evaluation Study of Command Area Development Programme, Mahanadi Delta, Stage – I, Orissa
23.	Upper Ganga Canal, Uttar Pradesh

20. STORES MANAGEMENT

Arrangement of the right material at right time and at the right place is the key to success for efficient drilling activity. Material management and physical distribution of stores therefore play a vital role in drilling activities. The physical distribution and flow of material is mainly taken care of by divisional offices whereas arrangement buffer stock, procurement of centrally controlled vital items, costly scientific and engineering equipment is managed by Material Management Cell at Headquarter. Besides this, lot of demands which are beyond the powers of Divisional / Regional offices are met by Headquarter. The cases are examined at Headquarter and necessary approval / sanction of the competent authority is obtained and conveyed to the concerned Divisional/ Regional Offices.. Inspite of poor infrastructure facility available at Headquarter the stores branch is efficiently taking care of procurement, stock taking, inspection etc. Lot of equipments which become unserviceable every year and reports of which are received at Headquarter are examined and their condemnation / write off sanction is conveyed to the concerned for their ultimate disposal.

Abstract of cases processed and finalized during the year 2006-2007 are given in Table 20.1 and Table 20.2 .

Table 20.1 :STATEMENT SHOWING THE DETAILS OF PROCUREMENT ACTION TAKEN DURING 2006-2007

Sl. No	Action Taken	No of Cases	Amount involved (Rs.in Lakhs)
1.	Expenditure sanction conveyed	25 Nos	39.29
2.	Administrative approval conveyed	36 Nos	
3.	Supply order placed on DGS&D Rate Contract	12 Nos	346.23
4.	Supply order placed outside DGS&D Rate Contract	3 Nos	50.77
	Total		**436.29**

Table 20.2: STATEMENT SHOWING THE CONDEMNATION OF VEHICLES /EQUIPMENT DURING THE YEAR 2006-2007

Sl.No.	Description	Quality
1	Vehicles	8 Nos
2	Computer	1 No
3	Desk Top Projector	1 No
4	Atomic Observation Spectrometer	1 No

Reserve Stock Limits for the year 2006-07 in respect of all the Divisions of the Board have been fixed amounting to Rs. 26,44,17,000.00.
Total amount of condemned stores material in respect of all the offices of the Board have been auctioned during the year 2006-07 amounting to Rs. 34,51,469.00.

20.1 PHYSICAL VERIFICATION OF STORES

No. of offices for which stores Physically verified = 19 Nos.
No. of discrepancies settled = 125 Nos
Physical verification reports settled = 21 Nos.

21. HUMAN RESOURCES DEVELOPMENT

It is the earnest endeavor of Central Ground Water Board to keep its technical personnel apprised with the latest development in all aspects related to ground water and drilling techniques. The Board also includes trainees from State Departments and candidates from abroad for different training programmes.

21.1 TRAINING ON RAINWATER HARVESTING

21.1.1 Andhra Pradesh

1. A Water Management Training Programme on Rain Water Harvesting conducted at Vizianagaram District, Andhra Pradesh on 12th and 13th of December 2006.
2. Two days training programme on Rainwater Harvesting and Artificial Recharge was organized at Kadapa district from 12.02.2007 to 13.02.2007.

21.1.2 Jammu & Kashmir

1. A Training Programme on Roof Top Rainwater Harvesting and Artificial Recharge to Ground Water was organized by Central Ground Water Board and Central Ground Water Authority, NWHR, Jammu on 23.03.2007 at Mansar, district Udhampur (J&K). The technical lectures and presentations on the subject were presented by the officers of CGWB, NWHR. The participants were also shown the working model of Roof Top Rainwater Harvesting. The Regional Director, CGWB, NWHR also explained the process of snow Harvesting and its need in the snowy/hilly parts of Jammu and Kashmir. Dr S.C. Dhiman gave away the certificates to the trainees.
2. A Training Programme Rainwater Harvesting and Artificial Recharge to Ground Water was organized by Central Ground Water Board and Central Ground Water Authority, NWHR, Jammu on 19.03.2007 at PHE Complex, Sitlee (Nagrota), district Jammu. Shri C.P. Srivastava, Supdtg Hg. CGWB, NWHR, Jammu explained about the role of individual to save and conservation water so that depleting of ground water could be controlled. Shri J.N. Bhagat, Scientist B, CGWB, NWHR, Jammu expressed his views on conservation of ground water and also the activities of CGWB. The certificates of training were distributed by the Regional Director among the Engineers of PHE, Irrigation and Flood Control, J&K Govt who participated in the training program.
3. A Training Programme on Roof Top Rainwater Harvesting and Artificial Recharge to Ground Water was organized by Central Ground Water Board and Central Ground Water Authority, NWHR, Jammu on 20.03.2007 at Town Hall, Ramnagar, Udhampur district (J&K). The officers of PHE, Irigation and Flood Control, PWD, Power Development department J&K Govt. participated in the training program. Dr. S.C. Dhiman, Regional Director, CGWB, NWHR, Jammu stressed upon the needs of Roof Top Rainwater Harvesting and Artificial Recharge to Ground Water and also to conserve it also emphasized on traditional practices of rainwater harvesting, conservation and management and to adopt them by using scientific inputs. Shri Vinod

Sharma, AHG expressed his views on conservation of ground water and stressed upon to awaring the public to conserve, manage and recharge of ground water and prevent wastage of water. The certificates of training were distributed by the Regional Director among the Engineers of PHE, Irrigation and Flood Control, J&K Govt . who participated in the training program.

21.1.3 Maharashtra

1. The Central Ground Water Authority and The Central Ground Water Board, Central Region, Nagpur organized two days Water Management Training Programme on "Water Management & Rain Water Harvesting" on 4-5th January 2007 at Wardha district, one of the farmers distress district identified by the PMO. About 25 participants, including Scientists, Engineers, State Government Officials and NGOs attended the programme. The programme was highly successful. Shri G.D.Dhawale, Prof. of Civil Engineering at B.D. Engineering College, Sewagram, Wardha, was the Chief Guest for the inaugural session. The chief guest for the valedictory function was Shri E.Z. Khobragade, Collector, Wardha. The programme included presentations by the officers of CGWB as well as the State Government. A field visit to the nearby Artificial Recharge sites was also made. The programme was highly successful. The participants were very enthusiastic and a lot of interaction was made.
2. The Central Ground Water Authority and The Central Ground Water Board, Central Region, Nagpur has organized a two days WMTP programme on "Ground Water Management and Rainwater Harvesting" between 23-24th January 2007 at Administrative Building, Washim, one of the Farmers' distress districts of Maharashtra. The training was imparted to 40 participants including scientists and engineers from GSDA, Irrigation Dept, Forest Dept., tahsil offices and NGO etc. The deliberations were given by the experts of CGWB and State Govt. with some documentaries. The programme was completed successfully.
3. The Central Ground Water Authority and The Central Ground Water Board, Central Region, Nagpur organized two days Water Management Training Programme on "Water Management & Rain Water Harvesting" on 24-25th March 2007 at Shri Sant Gajanan Maharaj College of Engineering at Shegaon in Buldhana district, one of the farmers distress district identified by the PMO. About 30 participants, including faculty Engineers, State Government Officials and NGOs attended the programme. The programme was highly successful. The inauguration programme was presided over by Shri. P.K. Parchure, Scientist-D, CGWB, Nagpur on 24th March 2007. Shri. Pankajbhau Shitoot, Secretary, Shri Sant Gajanan Maharaj Shikshan Sanstha was the Chief Guest and Dr. D.G. Wakde, Principal, Shri Sant Gajanan Maharaj College of Engineering, Shegaon was the Guest of Honour during the inaugural session. During the inauguration ceremony, a booklet on "Hydrogeology of Buldhana District" was released by the Chief Guest Shri Pankajbhau Shitoot and other dignitaries on the dais. Shri Bhushan Lamsoge, Scientist-B, CGWB conducted the inauguration programme and Shri. Neelakantarama, J. M. STA (HG) proposed vote of thanks. Prof.S.B.Somani, Dept. of Mechanical Engineering, SSGMCE, Shegaon worked as a Nodal Officer of this two-day training

programme. Shri. Dinesh Prakash, Regional Director, CGWB, Nagpur delivered a lecture on "Ground Water Resource Management and Conservation" to the trainees. S/Shri. P.K. Parchure, P. Narendra, V.P. Nawale, Bhushan Lamsoge, and D. Venkateswaran also delivered their lectures. The training sessions were conducted by Shri Anilchand, A.D. Asst. Hydrogeologist, CGWB. During the first day the lectures were followed by field visits at village Nagjhira in Shegaon taluka where the trainees were shown and explained about the existing recharge structures like Nala bunding and K.T. Weirs. During the second day the lectures were followed by evaluation of trainees on Roof top rainwater harvesting. The Valedictory function was held on 25th March 2007. Shri. Chaturbhujji Bhattad, Joint Secretary, Shri Gajanana Shikshan Sanstha, Shegaon was the Chief Guest of the function. Shri. Dinesh Prakash, Regional Director, CGWB presided over the function. Dr. D.G. Wakde, Principal, SSGMCE, Shegaon was the collaborator of the above training and was the Guest of Honour. The valedictory function was conducted by Shri. D. Venkateswaran, Scientist-B, CGWB and Shri. Bhushan Lamsoge, Scientist-B, CGWB proposed vote of thanks.

21.1.4 West Bengal

1. A Water Management Training were held on 13th December 2006 at North 24 Parganas district, West Bengal. In the training programme, 14 nos. of participants were attended from Municipalities, Panchayat Samities, Institutions and PHED, Govt. of West Bengal. The scientists from CGWB, ER, delivered lectures on different topics, viz. groundwater occurrence, its exploitation methodology, geophysical techniques for ground water exploration, quality aspects with special reference to arsenic contamination in groundwater and methods of rainwater harvesting.
2. Water Management Training Programme on "Ground Water Development & Management and Scope for Rain Water Harvesting in Coastal areas of Purba Medinipur district, W.B." at Contsi Municipality Hall, Contai, Purba Medinipur district, WB, was organized by CGWA & CGWB, ER, Kolkata, on 15th March '07. About 21 participants from different departments of Govt. of West Bengal were enrolled. However, ultimately 8 trainees participated due to unavoidable circumstances.
3. One day Water Management Training Programme under Central Ground Water Authority was organized in the Conference hall of Baripada Municipality on 23.03.2007. It was inaugurated by the Collector and District Magistrate, Mayurbhanj District. More than 40 participants from various State Govt. departments and NGOs actively took part in the programme.

21.1.5 Rajasthan

A Training Programme on Rainwater Harvesting for Artificial Recharge to Ground Water was organized at Sikar on 20.12.2006 and 21.12.2006. Smt. Malli Devi Gujar, Jila pramukh, Sikar was the Chief Guest in the inauguration and valedictory session. Shri K.P. Singh, Regional Director, WR, Jaipur presided over the function. Shri Arjun Ram Chaudhary, Additional olletor, Sikar and Shri Suwa Lal, Chief Executive Officer, Jila Parisad, Sikar were the

Guest of Hour in the training programme. The trainees were officers from Public Health Engineering Department, Ground Water Department, Irrigation, Forest, Agriculture, Planning Departments, Panchayat samiti etc. along with Non-Govt Organizations including PRAYTNA, Bhujal Prayatna Samiti and CEECONDECON. S/Shri K.P. Singh, Regional Director, R.P.Mathur, Supdtg.Hg., S.K. Gupta, Sc-D and Dr. L.N.Mathur, Sc-B, CGWB, WR, Jaipur imparted the training. An exercise was also given to trainees on Roof top raiwater harvesting. A fiel5d visit was also arranged to demonstrate rainwater harvesting structure at Malakhera, Deogarh, Sikar district. An exhibition was also organized during the training programme. Wide publicity was given through leading news papers and ETV.

21.1.6 Madhya Pradesh

1. A Training Programme on water management was organized on 9.11.2006 at Narmada Nagar (Indira Sagar Pariyojna), Khandwa district Madhya Pradesh. The target audience were Engineers of Narmada Hydro Development Corporation (NHDC) and villagers.
2. A two days training programme on Artificial Recharge and ground water quality was organized at Bhopal on 1st and 2nd December 2006 in association with Water Aid India (a NGO funded by European Union). The target group was NGOs and about 50 participants from various NGOs of Madhya Pradesh and Chhattisgarh attended the programme.

21.1.7 Karnataka

Water Management Training Programme was conducted at ZP hall, Belgaum on 23rd and 24th of January 2007. Shri Dheemappa Gorabal, President Zilla Panchayat was the Chief Guest and inaugurated the program. Shri Shivalingammurthy KAS, Chief Executive Officer, Beigaum and Dr. Nagaraja Sharma, Deputy Director, DMG, Gov. of Karnataka were the guest of honour. Shri T.M. Hunse, Regional Director, presided over the function and delivered presidential address.

21.1.8 Kerala

A Water Management Training Programme conducted at Sulthan Bathery, Waynad district on 24th and 25th of November 2006. Shri D.S. Thambi, Regional Director (I/C) presided over the function , Smt Sarasamma Teacher, District Panchayath President gave the inaugural address. Shri Joy , Block Panchayat President gave the felicitations.

21.1.9 North Eastern States

1. A one day Training Programme was organized on Ground Water Management with reference to Rain Water Harvesting and Artificial Recharge to Ground Water on 8th December 2006 at Science Hall, Nongpoh, Rai-Bhoi district, Meghalaya. 28 persons were imparted training and Shri B.Dhar, Deputy Commissiner, Rai-Bhoi district was the Chief Guest in the inaugural

programme. A drawing competition was organized among the school students of the Nongpoh area on 9th December 2006.

2. CGWB, NER, organized one day training programme on Ground Water Management with reference to Rain Water Harvesting and Artficial Recharge to Ground Water on 16th Mach, 2007 at Itanagar, Papumpare district, Arunachal Pradesh. 20 persons were imparted training.

21.1.10 Gujarat

1. A 'Water Management Training Programme' was successfully conducted for two days on 14 and 15th November 2006 at Himmatnagar, Sabarkantha district Gujarat. 45 senior officers of State govt. and non govt. agencies have been imparted the training.
2. Water Management Training Programme on Rainwater Harvesting and Artificial Recharge to Ground Water organized in the drought prone district of Banaskantha on 23rd and 24th January, 2007. The Banaskantha district is also covered under NREG scheme of Govt. of India.
3. Water Management Training Programme was conducted successfully on 28th March 2007 at Agricultural University, Junagadh district. The training was imparted to Scientific Officers, Engineers and other technical officers from GOG ,NGO and faculty & students of Junagadh Agricultral University, Junagadh.
4. One day Water Management Training Programme under Central Ground Water Authority was organized in the DRDA Conference hall, Sundergarh on 01.03.2007. It was inaugurated by the Additional District Magistrate, Sundargarh District. More than 40 participants from various State Govt. departments and NGOs actively took part in the programme.

21.1.11 Orissa

A one day Training Programme was organized on Ground Water Management on 7th December 2006 at D.R.D.A. Conference Hall, Jharsuguda district, Orissa.

21.1.12 Bihar

The Central Ground Water Board, Mid Eastern Region, Patna organized one day Water Management Training Programme on 8.03.2007 at Hotel Rajhans, Bhagalpur, Bihar. The training was imparted to 75 participants drawn from different agriculture, Engineering & other college , NGOs, Research Scholars representatives from builders and State Govt representatives.

21.1.13 Himachal Pradesh

A Training Programme was organized on Rain Water Harvesting and Artificial Recharge to Ground Water during December 2006 at Padhar, Mandi district, Himachal Pradesh.

21.1.14 Jharkhand

1. The Central Ground Water Board, Mid Eastern Region, Patna organized one day Water Management Training Programme on 4.02.2007 at Tata College, Chaibasa, Jharkhand. The Chief Guest of training programme was Dr. G.S. Jha, Diector CWC. The training was imparted to 80 participants drawn from Tata College, NGOs, Research Scholars and State Govt representatives.

2. The Central Ground Water Board, Mid Eastern Region, Patna organized one day Water Management Training Programme on 28.02.2007 at Daultanganj, Palamau, Jharkhand. The Chief Guest of training programme was Dr. D.S. Srivastava, Principal of GLA College. The training was imparted to 100 participants drawn from College students, NGOs, Research Scholars and State Govt representatives.

21.1.15 Uttarakhand

One day training programme on Ground Water Management and Rainwater Harvesting under Central Ground Water Board was organized in the Haldwani town, Nainital district on 19.03.2007.

21.1.16 Delhi

Two days training programme on "Design, implementation, operation, Monitoring and Maintenance of Rainwater Harvesting System in Urban areas" has been conducted on 21-22nd December 2006 at Jamnagar House, New Delhi. Forty officials from different agencies like NDMC, DMC, CPWD, NGO, Lecturer from Delhi University Teachers have been participated.

21.2 TRAINING COURSE ORGANIZED FOR UNIVERSITY STUDENTS

21.2.1 Training Course for M.Sc. Geology Students of Solapur University

CGWB, Central Region provided training to three M.Sc. Geology students of Solapur University for a duration of two weeks w.e.f 5th June 2006. The first part of the training was given for duration of one week from 5-10 June 2006 by unit office, Pune in which the topics like field demo at exploratory drilling site at Raigad district, analysis of pumping test data, Reappraisal Hydrogeological Surveys (RHS) and preparation of DTW maps etc. were imparted to the trainees by Hydrogeologist of the Board.

The second part of the training was held at Region office, Nagpur from 12-16 June 2006 in which the students were given training on Chemical analysis of ground water, Geophysical field surveys, VES and Electrical logging and interpretation of VES & Electrical logging data and Lectures on Artificial Recharge to ground water and Roof Top Rain Water Harvesting, CGWA and its

activities, lecture on Ground Water Monitoring - Monitoring of observation wells and analysis of monitored data. These topics were respectively taken up by officers from Central Region. Shri. Dinesh Prakash, Regional Director, CGWB, Nagpur had assessed the trainees and distributed the certificates. In addition to the above, the on-site drilling operation and demonstration of new DTH rig under Commissioning (DTH/REL-06/119) was also shown to the trainees.

21.2.2 Training on Drilling and Exploration for Geology students of Nagpur University

As requested by the Head, PG Department of Geology, Nagpur University, the Central Region, Nagpur has given one day field demonstration of hydrogeology surveys and ground water exploration at drilling site at Mathani, Mauda taluka, Nagpur district on 10th June 2006. The training was attended by 18 PG students of Geology. During the training, Hydrogeologist of the Board explained the hydrogeology in and around Mathani. The operation and maintenance of drilling rigs was explained by S.E., CGWB, Chennai (on inspection tour) along with E.E., CGWB, Division-VI, Nagpur. On-site drilling operation and demonstration of new DTH rig under Commissioning (DTH/REL-06/119) was given to the trainees.

21.3 TRAINING PROGRAMME UNDER RGNGWTRI

During the year 2006-07 seventeen training courses including one special training course were conducted under Rajiv Gandhi National Ground Water Training and Research Institute, Faridabad. All the seventeen training courses were conducted successfully with the co-operation of all the Regional and Divisional offices of CGWB. In these training's a total of 306 officers / officials were trained. Out of the sixteen courses five courses were conducted at other institute like IIT Roorkee, IIRS, Dehradun, TTTI Chennai, IIPA & ISTM New Delhi etc. The following training programme were organized by CGWB under RGNGWTRI.

1. A special training course on Ground water management and modeling was completed under RGNGWTRI for the officers of NWRA , Republic of Yemen on 9.06.2006 at New Delhi. Five officers from Yemen and Sixteen trainees from State Ground Water Organization attended the course.
2. "Induction Level training Course 2006 on hydrogeological Investigations, Development and Management of Ground Water Resources techniques, Equipments and Practices" was completed on 18th October 2006 (7th August – 18th October 2006) under RGNGWTRI at Bhopal. 20 trainees have attended the training course. Two trainees from Naveli Lignight Corporation Ltd. are also participating along with CGWB officers.
3. A training on **Water Well Ddrilling – Techniques, Equipment and Management** was conducted during 10th July 2006 to 2nd September, 2006 under RGNGWTRI at Bhopal. 20 trainees have attended the training course.

4. A training course on Management Principles and Practices was completed on 11th August, 2006 (from 31st July 2006 – 11 August 2006) under RGNGWTRI at Bhopal. 15 trainees from Central Ground Water Board attended the training course.
5. A training course on "Material Management for Officers of Central Ground Water Board" was completed on 22 September, 2006 (from 18th- 22nd September 2006) under RGNGWTRI at Nagpur. 20 trainees from Regions and Division offices of CGWB have attended the training course.
6. A training course on "Artificial Recharge Techniques in different Hydrogeological Conditions " under RGNGWTRI was conducted from 25th to 30th September,2006 at Ansal Bhawan, New Delhi. 20 officers from various Regions and Unit offices attended the training course.
6. Administrative Training Course for staff of CGWB was conducted during 18-22nd September,2006 at Institute of Secretarial Training and Management (ISTM) , New Delhi. 25 trainees from Regional , Division and State Unit Offices of CGWB have attended the training course.
7. A Refresher Course for Chemist on "Analysis of Organic Constituents and trace elements in Ground Water" was completed on 11th November 2006 (30 October – 11th November 2006) under RGNGWTRI at SR, Hyderabad. 20 officers from Central Ground Water Board and other Central / State Govt. organizations have attended the training course.
8. A training course on "Ground Water Management (Regulation & Control)" was completed on 11th November 2006 (6th November – 11th November 2006) under RGNGWTRI at CGWB, Ansal Bhawan, New Delhi. 16 trainees have attended the training course.
9. A six days Refresher Course on "GEMS Software on Statistical and Hydrograph Analysis" was completed on 2nd December 2006 (27th November – 2nd December 2006) under RGNGWTRI at CGWB, NDC Faridabad. 16 officers from various Regional offices of Central Ground Water Board have attended the training course.
10. A 12 days training course on "Application of Geophysical Techniques for Ground Water Exploration and Management**"** was completed on 23rd December 2006 (11th December – 23rd December 2006) under RGNGWTRI at CGWB, MER, Patna. 23 trainees have attended the training course.
11. A 12 days Refresher Course on "**Ground Water Estimation and Management Software**" was completed on 16th December 2006 (4th December – 16th December 2006) under RGNGWTRI at CGWB NDC Faridabad. 18 participants from various Region / CHQ and officers from State Govt. attended the training course.
12. A 12 days Refresher Course on "Surface Resistivity Surveys for Geophysicists / Hydrogeologists" was completed on 2nd December 2006 (20th November – 2nd December 2006) under RGNGWTRI at SR, Hyderabad. 20 participants attended the training course.
13. A two weeks training course on Mathematical Modeling of Ground Water System was completed on 6th January 2007 (26th December 2006 – 6th January 2007) under RGNGWTRI at IIT, Roorkee. 15 trainees have attended this course.
14. A 12 days training course on **Remote Sensing and GIS application in Groundwater Studies** for CGWB officers conducted under **Rajiv**

Gandhi National Ground Water Training and Research Institute at Indian Institute of Remote Sensing, Dehradun during 12th - 23rd March, 2007. Sri A.M. Khan, Regional Director was the Chief Guest for the Valedictory Function of this course on 23rd March, 2007. 18 scientific officers have attended this course.

15. A 5 days course on **Administrative matters for Senior Officers of CGWB** was conducted from 12-16th March 2007 at Indian Institute of Public Administration, New Delhi. 15 Senior officers have attended this course.
16. A training course on Computer aided Drawing, Designing and Digitization for Draft's man was conducted during 15th - 25th January 2007 at NTTT&R, Chennai under RGNGWTRI. 20 trainees attended the course.

21.4 APPRECIATION FROM SOLAPUR UNIVERSITY

The Head of the Dept. Of Geology, Solapur University, Solapur has conveyed his deep appreciation to the Regional Director CGWB, Nagpur for imparting training to their students for duration of two weeks w.e.f. 5th June 2006. It is conveyed that their students are highly benefited with the training in the field hydrogeological surveys demonstrated at Pune and Nagpur, field geophysical surveys and by the lectures delivered at Nagpur/Pune office. The H.O.D. has also conveyed his personal appreciation to the all concerned officers of CGWB, Nagpur and SUO, Pune.

22. TECHNICAL DOCUMENTATION AND PUBLICATION

Results of investigations carried out by The Central Ground Water Board were suitably documented in the form of reports and maps. All the field offices have been provided with report processing sections, which are responsible for the scrutiny and issuance of reports of various assignments carried out by its officers.

22.1 REPORTS

Details of various type of technical reports issued by respective regional offices of the Board were as follows:

22.1.1 State Reports

State Reports containing complete details of ground water surveys, exploration and other ground water related information are compiled and prepared for the status of ground water development in the State. Based upon reports, ground water development perspectives are worked out and future strategies are planned. During 2006-2007, State Reports of Chandigarh and Pondicherry were prepared.

22.1.2 District Reports

The Central Ground Water Board is compiling and issuing district reports of each district from time to time containing all the results of ground water surveys, exploration and other related studies. Further, groundwater development perspectives are also worked out for the benefit of State and other users agencies. The reports have been found very useful for their strategies for future. During 2006-07, 36 district reports were prepared and submitted. Region wise status of preparation of District Reports are presented in Table 22.1

Table 22.1: STATUS OF DISTRICT REPORTS COMPLETED DURING 2006-2007

Sl. No	Regions	Nos.	Name of District Report
1	North Western Himalayan Region	1	Baramulla
2	North Himalayan Region	1	Kulu
3	North Western region	2	Patiala, Mewat
4	Western Region	3	Jalore, Tonk, Bundi
5	West Central Region	2	Suendranagar & Dahod
6	North Central Region	3	Shahdol, Morena & Mandla

Sl. No	Regions	Nos.	Name of District Report
7	North Central Chhatisgarh Region	3	Koriya, Bilaspur & Mahasmund
8	Central Region	1	Beed
9	Northern Region	1	Kaushambi
10	Mid Eastern Region	2	Koderma, Chatra
11	Eastern Region	3	Haora,Jalpaiguri & Bardhaman
12	North Eastern region	2	Jorhat, Cachar
13	South Eastern region	3	Kalahandi, Nawapara & Koraput
14	Southern Region	2	Warangal, West Godavari
15	South Western Region	3	Gadag,Haveri & Bagalkot
16	South Eastern Coastal Region	2	Villupuram, Sivaganga
17.	Kerala Region	2	Palghat, Kozhikode
	Total	**36**	

22.1.3Ground Water Year Book

The Central Ground Water Board is compiling ground water year books to elucidate the changes in ground water levels and water quality. The accurate monitoring of the ground water levels and its quality both in space and time are the main requisite for assessment, scientific development and planning of this vital resource. During 2006-07, 23 reports are prepared . Region wise status of preparation of ground water year book are presented in Table 22.2

Table 22.2: STATUS OF GROUND WATER YEAR BOOKS COMPLETED DURING 2006-07

Sl. No	Region	Ground Water Year book prepared	
		Nos.	State
1	North West Himalayan Region	1	Jammu & Kashmir
2.	North Himalayan Region	1	Himachal Pradesh
3	North Western region	3	Punjab, Haryana & Chandigarh

Sl. No	Region	Ground Water Year book prepared	
		Nos.	State
4	Western Region	1	Rajasthan
5	West Central Region	1	Gujarat
6.	North Central region	1	Madhya Pradesh
7.	North Central Chhatisgarh Region	1	Chhattisgarh
8.	Central Region	1	Maharashtra
9.	Northern Region	1	Uttar Pradesh
10.	Mid Eastern Region	2	Bihar, Jharkhand
11.	Eastern Region	1	West Bengal
12	North Eastern region	1	North Eastern States
13	South Eastern region	1	Orissa
14	Southern Region	1	Andhra Pradesh
15	South Western Region	2	Karnataka, Goa
16	South Eastern Coastal Region	1	Tamilnadu
17	Kerala Region	1	Kerala
18.	Uttaranchal Region	1	Uttarakhand
19.	SUO, Delhi	1	Delhi
	Total	**23**	

22.2 BHUJAL NEWS

Bhujal News, a quarterly journal is published by Central Ground Water Board highlighting the latest advances in ground water research. Besides scientific papers, the journal also contains technical notes, news items , and regular columns. The journal has more than 1500 readers from all over the country amongst the Central Government, State Government, academic institutions and others. During the year 2006-07 , Vol. No. 21 special issue on Uttarakhand state has been prepared.

23. IMPLEMENTATION OF RTI ACT-2005

The Govt. of India resolved that in order to ensure greater and more effective access to information, the Freedom of Information Act, 2002 must be made more progressive, participatory and meaningful. The National Advisory Council deliberated on the issue and suggested certain important changes to be incorporated in the existing Act. The government examined the suggestion and decided to make a number of changes in the law. In view of significant changes proposed in the existing law, the Government decided to repeal the Freedom of Information Act, 2002 and the, Right to Information Bill, 2005 was introduced.

Right to Information Bill, 2005 was passed by Lok Sabha on 11th May, 2005 and by Rajya Sabha on 12th May,2005 and received the assent of the President on 15th June, 2005. It came on the Status Book as THE RIGHT TO IINFORMATION ACT, 2005.

For the smooth implementation of RTI Act**,** 2005 in Central Ground Water Board following steps were taken

1. The Central Ground Water Board prepared and published a booklet entitled as "Information on Central Ground Water Board" containing seventeen chapters as envisaged in chapter II, Para 4 of the Act and placed them on the Website of the Board.

2. Twenty Public Information Officers and Sixteen Asstt. Public Information Officers were appointed in the Board in its different field offices spread over in the entire country.

3. Board also appointed an Appellate Authority and a Nodal Officer as required under the Act.

4. A system has also been developed in the Board to receive and process the request application efficiently.

5. Up to the end of March, 2007, the Board received 72 requests seeking the information under RTI. In all the Board collected a sum of Rs.8512/- (Rupees Eight thousand five hundred twelve only) to supply this information.

6. The Board supplied the requisite material for the year ending March, 2007 as required under section 25 of the Act as given in table 23.1.

Table 23.1: SUPPLIED REQUISITE MATERIAL FOR ENDING MARCH, 2007 AS REQUIRED UNDER SECTION 25 OF THE ACT

A.	Number of requests received by each authority	72
B.	Number of decisions where applications were not entitled to access the documents pursuant to the requests, the provisions of the Act under which these decisions were made and the number of times such provisions were invoked.	2 Nos 8(1)(j)
C.	The number of appeals referred to Central information commission for review, the nature of appeals and the outcome of appeals.	Nil
D.	Details of disciplinary action taken against any officer in respect of administration of this ACT.	Nil
E.	Amount of charges collected by each public authority under this Act.	Rs.8512/-
F.	The details to indicate efforts made by the public authorities to administer and implement the sprit and intention of this Act.	-
G.	Suitable suggestions for reforms, including those required for development, improvement, modernizations, reform for the amendment of the Act or other legislation or common law or any other matter relevant for operationalisation the Right to access the information.	-

24. MEETINGS

24.1 MEETINGS WITH HON'BLE MINISTER/VIP

i. Dr Saleem Romani, Chairman, CGWB attended the briefing meeting on 31-03-2006 regarding visit of Hon'ble Minister (WR) to Jammu on status of Jammu project during 1st week of April, 2006 taken by AS (WR).
ii. Chairman and OIC, Delhi SU attended 3rd meeting of UYRC held under the Chairmanship of Hon'ble Minister (WR) to supervise the functioning of Upper Yamuna River Board (UYRB) on 12.04.06 at Shram Shakti Bhawan, New Delhi.
iii. Chairman attended the meeting to discuss matter related to inclusion of Irrigation Potential Created (IPC) in next MI Census taken by the AS(WR) on 13.04.06 at Shram Shakti Bhavan, New Delhi.
iv. Chairman & Member (ED&MM) attended meeting on out sourcing in Srinagar (J&K) taken by Minister (WR) at Shram Shakti Bhavan, New Delhi
v. Chairman attended XVI meeting of the Inter-Ministerial Sanctioning Committee for inclusion /deletion of the projects under the Centrally Sponsored Command Area Development and Water Management (CADWM) Programme at MOWRT, Shram Shakti Bhavan, New Delhi on 20.04.2006.
vi. Chairman attended 3rd meeting of Expert committee on "Ground Water Ownership of India" under the Chairmanship of Dr. Kirti Parikh, Member (Water & Power) at Planning Commission, Yojna Bhavan, New Delhi.
vii. The Principal Secretary to the Government of Maharashtra, convened a Technical meeting at Mantralaya, Mumbai on 24 April 2006 to discuss the issues related to NREGS to be implemented in Ahmednagar district of Maharashtra. The meeting was attended by Dr. Sunil Kumar Jain, Sc-D, Sh. Sourabh Gupta, SC-D and Sh A.B. Kawade, SC-B of this Region. The Principal Secretary has advised the District Collector, Ahmednagar to provide the list and location of various P.T., Cement Plugs to CGWB, SUO, Pune in the first week of May 2006 for verification and consideration on hydrogeological guidelines.
viii. The Chairman, Central Ground Water Board attended a meeting on 10.05.2006 with Minster (WR) regarding issues relating to J&K.
ix. Chairman, CGWB attended a meeting with a team from World Bank regarding Discussion on Importance of Ground Water Economy to Indian Development Study and Technical Assistance on 23-05-2006.
x. The Chairman, Central Ground Water Board attended Hydrology Project Phase II – Wrap-up meeting of the implementation Review Mission on 13.06.2006 under the Chairmanship of Secretary (WR), MoWR, New Delhi.
xi. The Chairman and Member (SML) of CGWB attended a meeting on 16.06.2006 on GW (Regulation, Development & Management) Rules, 2006 , Draft rules vetted by Ministry of Law – Consideration thereof taken by the Secretary(WR).
xii. Chairman & Member(SML) CGWB attended a meeting on 19-06-2006 on declining of water table taken by Hon'ble Minister (WR) in his office Chamber, Shram Shakti Bhawan, New Delhi.

xiii. Chairman, CGWB attended a 1st meeting of Organising Committee on Artificial Recharge of GW Advisory Council under the Chairmanship of AS(WR), Shram Shakti Bhawan, New Delhi on 23-06-2006.

xiv. Chairman, CGWB attended 2nd meeting of Working Group on Water Resources for the 11th FWP 2007-2012 with Secretary (WR) at Shram Shakti Bhawan, New Delhi on 27.06.2006.

xv. The Chairman, Central Ground Water Board attended a meeting on 3rd August, 2006 taken by Secretary (WR) to discuss the Agenda for National Congress on Ground Water and framing of guidelines for identifying the Best Pani Panchayat Award at Shram Shakti Bhawan, New Delhi .

xvi. The Chairman of CGWB attended meeting on 31.08.2006 with Secretary General, International Association of Hydrological Sciences (IAHS) Fontainebleau, France regarding holding 8th Scientific Assembly during 2009 at Hyderabad.

xvii. The Chairman of CGWB and Regional Director (HP) attended third meeting of the Working Group on Water Resources for the Eleventh Five Year Plan (2007-12) under the Chairmanship of Secretary (WR) in the committee room of Ministry of Labour, Shram Shakti Bhawan, New Delhi on 27.10.2006.

xviii. Chairman CGWB attended the meeting taken by the AS (WR) regarding the National Symposium on Hydrology, Ground Water used by Industries, Pani Panchayat Award and National Congress on Ground Water at Ministry of Water Resources, Shram Shakti Bhawan, New Delhi on 3.11.2006.

xix. Chairman CGWB attended meeting on 8.11.2006 taken by the Hon'ble MOS (WR) on status of work done by the Central Ground Water Board in Bihar.

xx. Chairman and Member (SML) attended meeting on 17.11.2006 on Enactment of legislation on control and development of ground water resources in various States/ UTs taken by Hon'ble Minister (WR) in the office Chamber of Hon'ble Minister(WR) Shram Shakti Bhawan, New Delhi.

xxi. Chairman CGWB and Member (SAM) attended 4th Meeting of the Working Group on 5.12.2006 on Water Resources for the XI Plan (2007-2012) under the Chairmanship of Secretary, Water Resources at Committee Room of Ministry of Labour, Shram Shakti Bhawan, New Delhi .

xxii. Chairman CGWB attended 31st meeting of the Department Council of Ministry of Water Resources on 6.12.2006 under the Chairmanship of Secretary (WR), Committee Room of Ministry of Labour, Shram Shakti Bhawan, New Delhi.

xxiii. Member (SAM) attended a meeting with Sr. Adviser (WR) Planning Commission on 22.12.2006 regarding Outlay for 11th Plan and Annual Plan 2007-2008 for the Ministry of Water Resources.

xxiv. Chairman attended brief meeting on discussion with Member (W&P), Planning Commission on Outlay for 11th Plan and Annual Plan 2007-2008 for the Ministry of Water Resources taken by the Secretary(WR) on 27.12.2006.

xxv. Member (SAM) attended meeting taken by Additional Secretary in connection with Major Programmes / Activities to be undertaken in the Ministry of Water Resources during "Water Year 2007" on 23.01.2007.

xxvi. Chairman CGWB attended Third meeting of Sub Committee for preparing guidelines of institution of an Annual Award for outstanding village community working on Pani Panchayat taken by AS (WR) on 23.02.2007.

xxvii. Chairman, Member (SAM) and Member (SML) attended briefing meting taken by Hon'ble Minister of State (WR) in respect of Rajya Sabha Stared Question in Shram Shakti Bhawan, New Delhi on 10.03.2007.

xxviii. Chairman, Member (SAM) attended meeting on 12.03.2007 regarding organizing of World Water Day on 22.03.2007 taken by Additional Secretary, MoWR, Shram Shakti Bhawan, New Delhi.

xxix. Chairman and Member (ED&MM) attended meeting regarding Dugwell Recharge taken by Secretary (WR) in Committee Room of Ministry of Labour, Shram Shakti Bhawan, New Delhi on 23.03.2007.

xxx. Chairman attended meeting regarding Annual Award of Pani Panchayat taken by Additional Secretary (WR), MoWR, Shram Shakti Bhawan, New Delhi on 23.03.2007.

24.2 PARLIAMENTARY COMMITTEE MEETINGS

i. Member (SML), Member(EDM&M) and Superintending Hydrogeologist attended briefing meeting taken by Secretary (WR) on 1.4.06 at Shram Shakti Bhavan, New Delhi in connection with Parliamentary Standing committee regarding Examination of Demands for Grants 2006-07.

ii. Chairman and Member (SML) attended briefing meeting taken by Secretary (WR) on 3.04.06 at Shram Shakti Bhavan, New Delhi in connection with Parliamentary Standing Committee regarding Examination of Demands for Grants 2006-07.

iii. Chairman and all the Members of the Board attended meeting of Parliamentary Standing Committee regarding Examination of Demands for grants 2006-07 on 4.04.06 at Parliament House Annexe, New Delhi.

iv. Chairman, CGWB attended the briefing meeting on 17-05-2006 and 20.05.2006 to 23.05.2006 with Minister (WR) regarding Parliament Questions in Ministry of Water Resources, Shram Shakti Bhawan, New Delhi.

v. The Chairman and Member (SML) of CGWB attended brief meeting on LS/RS Starred Questions due for reply (LS Q No. 341, 350 and RS Q.No. 365) taken by Hon'ble Minister (WR) at Parliament House & Shram Shakti Bhawan, New Delhi on 17.08.2006, 18.08.2006 and 21.08.2006.

vi. Chairman, CGWB attended meeting of Parliamentary Standing Committee on 22.09.2006 on the Rural Development for oral evidence of the representatives of MOWR on "Drinking Water Scenario in Rural Areas in the Country" in the Committee Room, Parliament House Annexe, New Delhi.

vii. The Chairman of CGWB and Regional Director SWR attended the parliamentary committee meeting and Parliamentary Consultative Committee on Water Resources at Bangalore on 18th October 2006.

viii. Chairman CGWB attended the briefing meeting taken by Hon'ble Minister in respect of Lok Sabha Starred Question in Parliament House, New Delhi on 4.12.2006.

ix. Chairman CGWB and Member (SML) attended the briefing meeting taken by Hon'ble Minister in respect of Rajya Sabha Starred Question in Parliament House, New Delhi on 5.12.2006.

x. Chairman, Member (SAM) and Member (SML) attended briefing meting taken by Hon'ble Minister of State (WR) in respect of Rajya Sabha Stared Question in Shram Shakti Bhawan, New Delhi on 10.03.2007.

xi. Chairman, Member (SAM) and Member (SML) attended briefing meting taken by Hon'ble Minister of State (WR) in respect of Lok Sabha Stared Question in Parliament House Annexe, New Delhi on 12.03.2007.
xii. Member(SAM) and Member(SML) attended briefing meting taken by Hon'ble Minister of State (WR) in respect of Rajya Sabha Stared Question in Parliament House Annexe, New Delhi on 13.03.2007.
xiii. Chairman, Member (ED&MM) and Member (SML) attended briefing meting taken by Hon'ble Minister of State (WR) in respect of Lok Sabha Stared Question in Parliament House Annexe, New Delhi on 19.03.2007.
xiv. Chairman, Member (ED&MM) and Member (SML) attended briefing meting taken by Hon'ble Minister of State (WR) in respect of Rajya Sabha Stared Question in Parliament House Annexe, New Delhi on 20.03.2007.

24.3 REGIONAL DIRECTORS MEETING OF THE CGWB

A Review meeting for Regional Directors was held during 22-23rd February 2007 at CGWB, Bhujal Bhawan, Faridabad under the Chairmanship of Chairman, CGWB**.** Members, Director (Administration), FAO CGWB, Regional Directors and other senior officers attended the meeting . The various items discussed were Progress of work done during AAP 2006-07, Finalization of AAP 2007-08, Administrative & Financial matters.

24.4 REVIEW MEETING ON FARMERS DISTRESS HOT SPOT DISTRICTS

The Review Meeting of Regional Directors of SR/ CR/ SWR/ KR regarding Farmers Distress Hotspot Districts was held on 28-29th August, 2006 at CGWB, Bhujal Bhawan, Faridabad under the Chairmanship of Chairman CGWB to review & discuss the latest progress of work and planning for future development in 31 farmers distress hot spot districts in four states. The meeting was also attended by Member(ED & MM), Member(SAM) and other senior officers of the Board.

24.5 CONSULTATIVE COMMITTEE OF MOWR

i. The Chairman, Member(SML) and Member (ED&MM) of CGWB attended meeting of Consultative Committee regarding Rain Water Harvesting in Parliament House Annexe on 12th July, 2006 held at New Delhi.
ii. The Chairman of CGWB attended meeting of the Consultative Committee of the Ministry of Water Resources on 22.08.2006 during Monsoon Session of Parliament 2006 at Committee Room 62, Parliament House, New Delhi.
iii. Chairman attended Consultative Committee Meeting of Ministry of Water Resources on 18.10.2006.
iv. Chairman CGWB attended meeting of Consultative Committee of Ministry of Water Resources during the Winter Session 2006 of Parliament on "Role & Functions of CWPRS, Pune" at Committee Room No B, Paliament House Annexe, New Delhi on 6.12.2006.

v. Chairman CGWB attended brief meeting taken by Hon'ble Minister (WR) and Secretary (WR) regarding Consultative Committee Meeting held on 17.1.2007.
vi. Chairman CGWB and Member (SML) attended meeting of Consultative Committee at Parliament House Annexe, New Delhi on 17.01.2007.

24.6 STATE LEVEL SCIENTIFIC SOURCE FINDING COMMITTEE MEETING

i. Meeting of the State Level Scientific Source Finding Committee, Technology Mission on Drinking Water and Related Water Management in West Bengal was held under the Chairmanship of the Principal Secretary, PHE Department, Govt. of West Bengal, on 29.08.06. In this meeting Technical clearance and Source clearance were accorded for 12 and 17 PWS Schemes, respectively. The Regional Director, CGWB, ER, is the Member Secretary of this Committee. Schemes related to source clearance were scrutinized by the officers of CGWB, ER, Kolkata.
ii. Chairman and Member (SAM) attended First meeting of National Level Steering Committee (NLSC) on Hydrology Project Phase-II under the Chairmanship of Secretary (WR), Shram Shakti Bhawan, New Delhi on 17.11.2006.
iii. The 53rd meeting of the State Level Scientific Source Finding Committee, Technology Mission on drinking water and related water management in West Bengal was held at Kolkata on 8th December 2006 under the Chairmanship of the Principal Secretary, PHE Department, Govt. of West Bengal. The Regional Director, Eastern Region, is the Member Secretary of the Committee. In this meeting, technical and source clearance were accorded for 29 and 8 PWS schemes respectively. The officers of CGWB, ER, scrutinized the schemes related to source clearance and necessary comments were given.

24.7 ADVISORY COMMITTEES ON GROUND WATER

i. The Chairman, CGWB attended 1st meeting of organizing committee on Artificial Recharge of Ground Water Advisory Council inaugurated by Hon'ble Prime Minister on 22.07.2006 at Vigyan Bhawan, New Delhi.
ii. The Chairman of CGWB attended the 14th meeting of Standing Advisory Committee (SAC) of the Ministry of Water Resources on 23.08.2006 in the office Chamber of Secretary (WR), New Delhi.
iii. A meeting of sub-group on "More crop and income per drop of Water" under the Advisory Council of Artificial Recharge was held on 29.09.2006. Many useful suggestions were made for demand supply side management of ground water resources during the discussions by Dr. S.K. Jain, Scientist – D, CGWB as a member of Sub-group.
iv. A meeting was held under the Chairmanship of Member (SAM) which was attended by Senior Officials of Central Ground Water Board regarding holding of National Congress on Ground Water as a follow-up of the recommendation of the 1st meeting of Advisory Council of Artificial Recharge to Ground Water.
v. Shri K.P.Singh, Regional Director WR Jaipur attended meeting of Advisory Committee in the notified area of Chirawa & Buhana of Jhunjhunu district,

Rajasthan on 16.10.2006. Various problems faced in the notified area including permission for construction/deepening of wells, registration of drilling agencies, status of updating registration of wells/tube wells etc. were discussed. The meeting was held at Jhunjhunu under the Chairmanship of Shri Bhawani Singh Detha, District Collector, Jhunjhunu.

vi. Member (SML) attended 87th meeting of Advisory Committee on Irrigation, Flood Control and Multi purpose Project under the Chairmanship of Secretary (WR) at Conference Room of CWC, Sewa Bhawan, R.K.Puram, New Delhi on 17.11.2006.

vii. Member (SML) and Superintending Hydrogeologist attended the 1st meeting of Advisory Committee on organizing the National Congress on Ground Water at Central Water Commission, New Delhi on 05.02.2007.

24.8 REGIONAL OFFICE LEVEL MEETING

i. Regional Director and Scientist D of CGWB, SER attended meeting on Ongoing collaborative R&D studies jointly under taken by GWS&I, Govt. of Orissa, P.G. Deptt. of Geology, Utkal University and CGWB, SER.

ii. Regional Director CGWB, SWR attended a meeting on 11.08.2006 organized by NABARD regarding WENNEXA, the US aided project on Water Energy Nexus at Doddaballapur for efficiency in water and energy.

iii. Regional Director of CGWB, SWR attended a meeting on 25.08.2006 with Secretary, Water Resources (MI), Govt. of Karnataka for discussed the matters on registration of ground water abstraction structures in the three notified talukas of Bangalore urban district.

iv. Under the Chairmanship of the Principal Secretary, Commerce & Industries Department, Govt. of West Bengal the 34th meeting of State Geological Programming Board, West Bengal was held at Kolkata on 08.09.06. In this meeting CGWB has given proposal of joint study with GSI on fluoride problem in groundwater in West Bengal.

24.9 TCC MEETINGS

i. Shri N. Varadaraj, Regional Director, S. Suresh, Scientist-D and Dr. A. Asokan, Scientist-B, CGWB, SECR attended State Level Technical Co-ordination Committee meeting on Artificial Recharge to ground water on 18.10.2006 and participated in the deliberations.

ii. Scientists of CGWB, NCR, Bhopal attended First Local Level Technical Coordination Committee meeting on 4th October 2006 at Ujjain and on 26th October 2006 at Mandsaur on Reclamation of Ravines by construction of Artificial Recharge Structures in Idar and Chamla watersheds, Mandsaur and Ujjain districts.

iii. Member (SAM) and Scientist of CGWB attended the 2nd meeting of Technical Committee on "Procurement of Technical Assistance (Implementation Support) and Management Consultancy" for Project Coordination Sectt. MOWR under World Bank aided HP Phase-II at Lok Nayak Bhawan, New Delhi on 1.11.2006.

iv. The Chairman, Member (SAM) and Member (SML) of CGWB attended 1st meeting of TCC (CHQ) for approval of Demonstrative Schemes on

Artificial Recharge Studies and Rain Water Harvesting on 6th July, 2006 held at CGWA, New Delhi.

24.10 OTHER IMPORTANT MEETINGS

i. 8th meeting of Central Ground Water Board was held on 24.05.2006 under the Chairmanship of Chairman CGWB which was attended by Member (ED & MM), Member(SML), Member(SAM), Commissioner(GW) and Director (WP&P) CWC and other senior officers of the Board.
ii. 21st meeting of CGWA was taken by the Chairman on 24.05.2006 which was attended by the Members of the Board, Director (WP&P) CWC, representative from MOEF and other senior officers of the Board and Authority.
iii. Member (ED & MM), Central Ground Water Board took a meeting on 1.05.2006 with the Regional Director, NWHR ,Jammu for Finalization of NIT For construction of tube well in Kashmir Valley.
iv. A meeting was held on 03.05.06 in MOWR Govt. of India, regarding installation and commissioning of desalination plants (RO) supplied to APWD in connection with the relief for Tsunami. The meeting was attended by the Member (SAM), the Director (GW), MOWR, the Regional Director, ER, & other officers from CGWB and the representatives from M/s. Fontus Water Ltd. During the discussion, CGWB was requested to get in touch with APWD to get confirmation about availability of all inventory items as supplied to them by the firm at different sites and after receipt of such confirmation and verification, as considered necessary by CGWB, the firm will be approached to depute their engineers for installation and commissioning of the desalination plants.
v. The Chairman,CGWB and other Sr. officers of the Board, Western Region, Jaipur attended a meeting on 17.06.2006 on control and regulatory measures for ground water development in Rajasthan State with special reference to Jhotwara block of Jaipur held in the conference hall of CGWB, WR, Jaipur.
vi. Chairman, CGWB attended the 1st meeting of the Sectoral Committee on Water Resources & Technology for formulation of 11th Five Year Plan under the Chairmanship of Dr. Satish Satye at CSIR Science Centre, New Delhi on 20.06.2006.
vii. Member (SML) CGWB attended meeting on 23.06.2006 regarding the Monitoring Committee constituted by the Hon'ble Apex Court in connection with Judgment of Hon'ble Supreme Court of India dated 13th April, 2006 in I.A. No. 1785 in I.A. No. 22 in Write Petition (Civil) No. 4677 of 1985 in the matter of M.C. Mehta Vs. Union of India and Ors. And visited mines in Sirohi and Khori villages, Jamalpur, Faridabad district.
viii. Chairman, CGWB attended meeting on 28.06.2006 with Hon'ble Minister(WR) regarding Special General Meeting of NWDA Society to consider modification of the objectives of NWDA.
ix. The Chairman and Member (SML) of CGWB attended 1st meeting with Executive Council of AICGWBOA on 6th July, 2006 held at CGWA, New Delhi.

x. The Chairman, CGWB attended meeting in Planning Commission of Technical Committee for 12th National Symposium on Hydrology on 18.07.2006 at Planning Commission, New Delhi.
xi. Member (SAM) CGWB and Superintending Chemist attended the 5th Meeting of Water Quality Assessment Authority (WQAA) under the Chairmanship of Dr. Prodipto Ghosh, Secretary, Ministry of Environment and Forest at CGO Complex, Paryawaran Bhawan, New Delhi on 3.08.2006.
xii. Member (ED & MM) of CGWB attended Inter-Ministerial meeting of Pre-Island Development Authority under the Chairmanship of Member Secretary, Planning Commission at Yojna Bhawan, New Delhi on 7.08.2006.
xiii. The Chairman of CGWB attended meeting on 10.08.2006 with Regional Chairman ICC, New Delhi in connection with Seminar on "Water Resources Management in Chemical Industry" on 6-7th September, 2006 at CGWB, Jamnagar House, New Delhi.
xiv. Member (SAM) of CGWB and Sr. officers of the Board, Drinking Water Mission and Andaman & Nicobar officers participated in the meeting on 11.08.2006 on Commissioning of 10 Desalination Plants in Andaman & Nicobar Islands under the Chairmanship of Chairman, CGWB at CGWB, Jamnagar House, New Delhi.
xv. Member (SAM) attended Second Meeting of the Task Force for formulating Action Plan for Removal of Arsenic Contamination in West Bengal at Yojana Bhawan, New Delhi on 17.08.2006.
xvi. The Chairman CGWB, Member (SAM) and Member (ED & MM) attended a meeting on 4th September, 2006 in connection with procurement and installation of desalination plants at various Islands in Andaman & Nicobar convened by the Secretary , Ministry of Water Resources at New Delhi .
xvii. Sh. A.R. Bakshi, Member (SAM) and Dr. R.P.Singh, Sc-D of CGWB attended a meeting of the Steering Committee on the Development of Decision Support System (Planning) for Integrated Water Resources Development and Management under the World Bank aided Hydrology Project (Phase II) held at National Institute of Hydrology, Roorkee on 11th September, 2006 .
xvii. The Chairman of CGWB , Member (SML), Member (ED&MM) and Member (SAM) attended the 75th meeting of the Office Council (JCM) under the Chairmanship of Chairman at CGWB, Faridabad on 19.09.2006.
xviii. Member (ED&MM) attended the meeting to review of Annual Plan Schemes and important issues for inclusion in the meeting of Senior Officers with Secretary (WR), Shram Shakti Bhawan, New Delhi on 3-10-2006.
xix. Regional Director (HP) attended meeting on 12.10.2006 for inclusion of Irrigation Potential
xx. Created (IPC) in 4th Census under the Chairmanship of Commissioner (B&B) at New Delhi.
xxi. Chairman CGWB took a meeting with officials from NIH, Member (SML), Member (ED & MM) and Member (SAM) regarding the 12th National Symposium on Hydrology with focal theme for sponsorship on "GW Governance: Ownership of GW and pricing" at Central Ground Water Authority, New Delhi on 17.10.2006.

xxii. Member (SAM) attended meeting on 13.11.2006 regarding Installation of 10 nos. of Desalination Plants in Andaman and Nicobar Islands in the Chamber of Joint Secretary (Admn.), Shram Shakti Bhawan, New Delhi.

xxiii. Chairman CGWB attended 67th meeting of Governing Body National Institute of Hydrology under the Chairmanship of Secretary (WR) on 16.11.2006 at Committee Room 307, CWC, Sewa Bhawan, R.K. Puram, New Delhi.

xxiv. Chairman, Member (SAM) and Regional Director Incharge (HP) attended First meeting of Technical Committee for Procurement of Consultancy on Hydrological Design Aid (GW) under Hydrology Project Phase-II at CGWB, Faridabad on 23.11.2006.

xxv. Shri G.D. Ojha, Regional Director, SR, Hyderabad and B.Jaya Kumar,Supdtg. Hg. attended the meeting pertaining to relief package to the distressed identified distress district in Andhra Pradesh on 3.11.2006 organized by the Principal Secretary, I&CAD, Secretariat, Govt. of A.P., Hyderabad.

xxvi. The second meeting of Monitoring Committee constituted by Ministry of Water Resources, Govt. of India, for monitoring of irrigation projects included in package announced by Honorable Prime Minister of India for Vidarbha Region of Maharashtra was held at Sinchan Seva Bhawan, Nagpur on 19.12.2006. Shri. Dinesh Prakash, Regional Director, Central Region attended the meeting as the committee member. During the meeting the status of different projects under the package was discussed.

24.11 VISIT OF MINISTERS/VIPs

i. Shri Saifuddin Soz, the Hon'ble Union Minister of Water Resources visited Pune on 4-5th September 2006. On 4th September, the Hon'ble Minister held discussions with the officers of concerned Water Resources Departments and this Region was represented by S/Shri. Dinesh Prakash, Regional Director, CGWB, Nagpur and Sourabh Gupta, OIC, CGWB, SUO, Pune. He also visited the Rain Water Harvesting Projects at Panchgani near Mahabaleshwar in Satara district on 5th September 2006.

ii. Smt. Sushma Singh, AS(WR), MoWR, Govt. of India visited Chennai during 17th to 19th June 2006. She visited parts of Kancheepuram district for inspection of Irrigation and Water Supply Tanks being maintained by PWD, Govt. of Tamilnadu. She also had discussions with Secretary, PWD, Govt. of Tamilnadu on various aspects of surface and ground water resources in Tamilnadu. Sh. N. Varadaraj, Regional Director(I/C) accompanied the Addl. Secretary during the field visits and also took part in the deliberations during the meetings with State Govt. authorities.

iii. Shri. S. Manoharan, Additional Secretary, Ministry of Water Resources visited CGWB, SWR, Bangalore office on 19th October 2006 and held meeting with the officers to review the progress of Region and Division. He also inspected the construction activities of the office building at HSR lay out, Bangalore.

iv. Shri C.S. Ramasesha Commissioner (GW), Ministry of Water Resources, Govt. of India visited Bangalore between 23.12.2006 and 26.12.2006. During the period, he inspected CGWB, SWR office and new office building under construction.

v. Shri. B.M. Jha, Member (ED&MM), CGWB, Faridabad visited CGWB, CR, Nagpur on 21-22nd September 2006. On 21st September 2006, he held discussions with the officers of Central Region and also graced the 'Valedictory Function of Rajabhasa Hindi Week', which was celebrated by this office between 11-15th September 2006 as Chief Guest. On 22nd September 2006, he inspected Division VI Workshop and also had meeting with the Chief Engineer, CWC, Nagpur. Afterwards, The Member as the Chief Guest graced the occasion of Valedictory Function of the Training Programme on 'Materials Management' conducted from 18-22nd September 2006 at Indian Institute of Materials Management, Nagpur under the auspices of Rajiv Gandhi National Ground Water Training & Research Institute, CGWB.

vi. Member (ED & MM), visited the NCCR, Chhattisgarh Region on 20th September 2006 to review the progress of Region and Division and inspected the RGNGWTRI land site.

vii. Shri B.M. Jha, Member (ED & MM), Central Ground Water Board made an official visit to SECR, Division IV, Chennai and drilling site during 17 to 19th January 2007. He reviewed the progress of various activities of the Region and Division and suggested timely action for resolving pending issues of technical as well as administrative nature.

25. CONSTRUCTION / ACQUISITION OF OFFICE BUILDINGS

During the IXth Plan, scheme for acquisition of land and construction of various offices of CGWB was approved. Under this scheme, CGWB has completed construction of office buildings at Jaipur, Bhubaneswar, Lucknow and Kolkata. The Board has also acquired ready-built accommodation at Trivendrum, Patna and Bhopal. The construction of office building at Chandigarh, Faridabad, Guwahati has been completed during the Xth Plan.

Under the scheme of "Infrastructure Development" the construction of office building at Hyderabad , Bangalore and Bhopal (Division office) is under progress. The acquisition of land for office building at Ambala, Jodhpur, Ahmedabad, Nagpur, Chennai, Dehradun and Kangra has been taken up during Xth Plan.

The details of following construction work for own office building of Central Ground Water Board have been carried out during the year 2006-2007 is given in Table 25.1

Table 25.1 : CONSTRUCTION OF OFFICE BUILDINGS DURING 2006-2007

Sl. No.	Construction work during 2006-2007	Status
1	Bangalore	The construction work of office building of CGWB in respect of SWR and Division XIV, Bangalore is under progress. The boundary wall on the land of store and workshop of Division XIV Bangalore has been constructed. Building is likely to be completed by the end this year.
2	Hyderabad	The construction work of building of CGWB in respect of SR and Division IX, Hyderabad is under progress. Building is likely to be completed by the end this year.
3	Guwahati	The construction work for two RCC culverts and store building at Guwahati office is to be started after release of required funds.
4.	Bhopal	The construction work of the Bhopal building is likely to start in the next financial year 2007-08. The CPWD has submitted revised plan by reduction of one floor of the building due to height restriction with some minor changes.
5.	Ambala	The land for Division-II office building of Central Ground Water Board has offered by HUDA in Sect-10, Ambala. The administrative approval and expenditure sanction of Rs. 1,65,60,000/- lac as land cost allotted by the Ministry.
6.	Bhubaneswar	Possession of the land for South Eastern Region, Bhubneshwar has already been taken from the Orissa Govt. The balance amount of Rs.15,55,000/- has been sanctioned. The Ministry has suggested for

Sl. No.	Construction work during 2006-2007	Status
		including the proposal in the next Plan commencing from 1.04.2007.

26. DISSEMINATION AND SHARING OF TECHNICAL KNOW-HOW

26.1 Seminar/Symposium/Workshop/Conferences attended or participated

- Chairman, Member (ED&MM) and Member (SAM) attended Project Launch Workshop of Hydrology Project II at India Habitat Centre, Lodhi Road, New Delhi on 19.4.06.
- Chairman attended National workshop on "Technologies for water Quality" organized by Ministry of Rural Development on 4.05.2006.
- Scientists from CGWB, Southern Region participated in a "Brain Storming Session on Water Security" organized by NGRI on 12.04.2006.
- Dr S.K. Jain, Scientist – D, attended the Workshop on "Ground Water Issues in Over-Exploited Watersheds" at Morshi taluka, Amravati district which was organized by GSDA, Pune on 7th April 2006.
- Shri R.P.Mathur, Superintending Hydrogeologist, Central Ground Water Board, Western Region, Jaipur attended workshop on **Disaster Management** on 22nd and 23rd May, 2006 at H.C.Mathur Institute of Public Administration, Jaipur. The workshop was organised by National Institute of Disaster Management, New Delhi under Administrative Reforms Commission. Various aspects of Drought Management were discussed.
- Scientists from Southern Region participated in a workshop on rainwater harvesting and arranged an exhibition on the occasion of 204th birth celebration of Father of Irrigation, General Sir Arthur Thomas Cotton on 15.05.2006 organised by Institute of Engineers of India and Prof. C. Mahadevan Studies and Admirers' Association at Hyderabad.
- Superintending Hydrogeologist of CGWB attended Phase – II Inception Workshop of the Strategic Analysis of the India's National River Linking Project on 2.05.2006 at IWMI, South Asia Regional Office, NASC Complex, New Delhi.
- Scientists from Southern Region participated in Brain Storming session on **"**The Indian Coast Planning & Management" organized by Centre for Studies on Bay of Bengal, Andhra University, Visakhaptnam on 22nd and 23rd May, 2006 at Andhra University, Visakhapatnam. Representatives from Dept. of Science and Technology, and Academicians from several Universities have participated in the Session.
- Regional Director, SWR attended the workshop on **"**Priorities in Watershed management" which was conducted at Bangalore on 22nd and 23rd of May 2006. Watershed department, Govt.of Karnataka, organized the workshop.
- Sri G. Sudarshan, Scientist-D attended the workshop on "Desert and Desertification" on the occasion of World Environment Day on 5th June, 2006, organized by the Institute of Engineers (India), Hyderabad.
- The Regional Director, CGWB, ER, Kolkata attended the National Conference on Indias Energy Security, Coal and Alternative Energy Resources, organized by ISM Alumni Association – Kolkata on 16 – 17th June, 2006 at Hyatt Regency, Kolkata.

The Regional Director, ER, participated in the discussions on the effect of coal mining on ground water regime.

- Sh. K.P.Singh, Regional Director attended a technical seminar organized by FICCI on " Industrial Water Conservation & Management " on 27th & 28th July 2006 at Jaipur. Sh. R.P.Mathur, Suptdg. Hg. gave a presentation on " Ground Water Scenario, Management & Regulatory Measures in Rajasthan ".
- Shri K.P.Singh, Regional Director, Central Ground Water Board, WR, Jaipur attended seminar on "Vikasshil Bharat Mai Parmanu Urja Sansadhan Avam Paryavaran Ki Chunotiya" organised by Atomic Energy Department on 22.09.2006 at Jaipur. Shri K.P.Singh presented a key note lecture on Bhu Jal Paridrashya, Samasyaye avam Prabandhan in Hindi.
- Chairman, CGWB attended the Indo-Canada Workshop on "SPATIAL DATA INFRASTRUCTURES AND DISASTER MANAGEMENT" at India Habitat Center, Max Muller Marg, New Delhi on 18.09.2006.
- Shri R.P.Mathur, Superintending Hydrogeologist, CGWB, WR, Jaipur attended State level workshop on National Water Quality Monitoring Surveillance organised by IHMR, Jaipur on 12.09.2006. Shri R.P.Mathur made Group presentation on Information, Education and Social Mobilisation.
- Professor Saifuddin Soz, Hon'ble Union Cabinet Minister of Water Resources visited Jaipur on 15.11.2006. Scientists from Central Ground Water Board, WR, Jaipur attended International Seminar on Water Management organized by the Rotary International along with the Hon'ble Minister.
- Shri K.P.Singh, Regional Director, Central Ground Water Board, WR, Jaipur attended National Conference on "Save Water- Save Earth'' organized by the Rotary Club at Jaipur on 25.11.2006 and 26.11.2006. Shri R.P.Mathur, Superintending Hydrogeologist was the speaker on "Urban Storm Water Harvesting and Artificial Recharge to Groundwater" during technical session. An exhibition was also organized demonstrating various posters, electronic and live models etc.during the conference.
- Dr S. C. Singh, Scientist `B' attended Regional Workshop on " Forests for Sustainable Water Regime in Central India" organised by Indian Institute of Forest Management (IIFM) and delivered the talk on "Emerging trends in technology for groundwater resources development".
- Sh. R.N.Singh, Regional Director, NCR, Bhopal attended a symposium on "New Frontiers & Future Prospects: Focus on the role of S&T for the growth and prosperity of Madhya Pradesh" organised by MP Council of Science and Technology on 26th October 2006.
- Sh. R.N.Singh, Regional Director , NCR, Bhopal attended the National Convention on "Science and Technology – Communication, Growth and Empowerment" organized by M.P.Council of Science & Technology from 17th to 21st January 2007.
- Shri. Dinesh Prakash, Regional Director, CGWB, Nagpur attended the Awareness Seminar on "Digital Data Disaster Management" on 19th January 2007 at Indian Water Works Association (IWWA) at Nagpur. The Seminar was organized by M/S. Stellar Information Systems Ltd. and Equinox Interactive.
- Shri. Dinesh Prakash, Regional Director, CGWB, Nagpur attended a Seminar on "The Need of Convergence of Information Technology and Farming Technology to Reduce Suicides of Farmers in Maharashtra" on 21st January 2007 at Hotel Sunny International, Nagpur. The Seminar was organized by The Institution of Electronics & Telecommunication Engineers (IETE), Nagpur Centre.

- Shri. Dinesh Prakash, Regional Director attended a Workshop on "Integrated Fluorosis Mitigation Challenges and Avenues" to be held at NEERI, Nagpur during 31st January-1st February 2007.
- Shri. P.K. Parchure, Sc-D participated in the 'Interactive Workshop for Prioritization of structure, inputs and outputs of DSS (Planning) held at NIH, Roorkee between 22-24th November 2006.
- Shri. Dinesh Prakash, Regional Director attended the National Seminar on "Rainwater Harvesting and Water Management" (RAINHARVEST 2006) organized by the Institution of Engineers (India), Nagpur Local Centre on 11-12th November 2006 at Nagpur.
- Shri B. M. Jha, Member (ED&MM), Shri C. P. Gawri Regional Director attended a National Seminar on "Water Conservation and Ground Water Recharging for Effective Health Insurance" for Ground Water Studies, Kolkata on 16.02.07.
- Shri. C.P.Gawri, Regional Director attended a National Symposium on Hydrology with focal theme on "Groundwater Governance: Ownership of Groundwater & its Pricing" on 15.11.2006.
- Shri K.R.Sooryanarayana, Sc-D participated the International workshop on Integrated Water Resource Management (IWRM-2007) held at Bangalore. Presented a technical paper titled " Integrated management of water resources through artificial recharge in Jnanabharati campus, Bangalore University."
- Shri K.R.Sooryanarayana, Sc-D participated the workshop on "The impact of Air and Water Pollution on the Quality of life and Solutions Thereof "organised by the State Development Reforms Commission, Govt of Meghalaya. Presented a technical topic on " Ground water pollution " during the workshop.
- Dr.P.N.Rao Sc-D Participated an International Conference on "Hydrology and water shed Management" organised by Jawaharlal Nehru University, Hyderabad. Presented paper titled " Improvement of Water Productivity for Urban area through Roof Top Rain Water Harvesting - A case study in Osmania University, Hyderabad, Andhra Pradesh.
- Sri B. Jaya Kumar, Suptdg. Hydrogeologist attended the Workshop on Decision Support System (DSS) on 20.09.2006 in connection with Hydrology Project Phase-II organized by the Engineer-in-Chief, Hydrology Project, Government of Andhra Pradesh, Hyderabad at Hyderabad.
- Sri B.Jayakumar, Supdt.Hg. attended the workshop on "Prioritization of structure input and output of DSS organized under Hydrology Project – II by NIH at Roorkee from 22-11-2006 to 24-11-2006.
- Shri Abhijit Ray, HOO attended Two days workshop on Consultation of State WATSAN Policy Framework organized by Orissa State Water & Sanitation Management , Govt. of Orissa on 6th July 2006.
- 12th National Symposium on Hydrology with focal theme on **"**Ground Water Governance: Ownership of Ground Water and its Pricing" has been organized jointly by CGWB and NIH during 14-15 November, 2006 at New Delhi. The symposium was inaugurated by Sh. Montek Singh Ahluwalia, Hon'ble Deputy Chairman Planning Commission of India and inaugural function was presided over by Hon'ble Minister of Water Resources Prof. Saif-ud-din Soz. Hon'ble Minister of State for Water Resources Sh Jai Prakash Narayan Yadav was guest of Honour. On this occasion proceedings of the Symposium and Watershed Atlas of India was released by Sh. Montek Singh Ahluwalia, Hon'ble Deputy Chairman Planning Commission of India and Hon,ble Minister of Water Resources Prof. Saif-ud-din Soz in the presence of Secretary, Ministry of Water Resources respectively.

The symposium was attended by the Eminent Scientist, Planners, Administrators, Engineers as delegates from various Central and State Governments departments viz Ground Water, Irrigation, PHED, Water supply Agricultural, Rural Development, Planning Commission, NABARD, REC, IITs, NGRI etc., It was also attented by the representatives from NGOs and experts from the field of ground water.

The recommendations included scientific development of ground water resources and their assessment at macro and micro level; adoption of newer technologies and integrated ground water information system; R&D activities with more integrated, multi-disciplinary approach including ground water management models; emphasis on rain water harvesting and artificial recharge to ground water involving stakeholders participation; strengthening of database for resource planning; clear cut demarcation between ownership, regime of water rights and entitlements; establishing centers of excellence; redrafting of national water policy by including policy for ground water governance; and strengthening of ground water institutions in all the states etc.

- Shri. P. K. Naik, Scientist –'B' attended a National Seminar on Geological and Hydrogeological Evaluation of Sedimentary Basins organized by the P. G. Department of Geology, Utkal University, Bhubaneswar on 25.02.2007.
- Scientists from Eastern Region, Kolkata participated in Asian International Arsenic Workshop organized by MISEREOR (Germany), West Bengal Voluntary Health Association (India) and NGO Forum (Bangladesh), held on 13th-14th Nov'06 at Indian Institute of Training and Development, Kolkata. Sh.T.Talukdar, Sc-'B', gave presentation on "Arsenic contamination in ground water of West Bengal- an approach undertaken by CGWB, ER, Kolkata."
- Regional Director SWR attended one day workshop on reappraisal of mining and environmental issues and presented a paper on " Ground water and Environmental aspects" on 1/09/06.
- Sh. C.P.Gawri, Regional Director, Eastern Region Kolkata participated in the Workshop on Underground Coal Gasification organized by Indo-US Energy Dialogue Working Group on Coal & Asian Pacific Partnership Coal Mining Task Force, held on 12th-14th November 2006 at Hotel Taj Bengal, Kolkata. A paper on "Impact of coal mining activities on ground water regime in parts of Raniganj Coalfield area, Barddhaman district, West Bengal" by S, ER, A.Ray, Suptdg. Hydrogeologist, R.K.Guha, Sc-'B', was presented by Sh. A.Ray, Suptdg. Hydrogeologist, on 13th November 2006.
- Shri A. Subburaj, Scientist-D attended the Workshop on "Participation of farmers in Irrigation Water Management" organized by Agricultural Engineering Department, Government of Tamil Nadu at Chennai on 14.11.2006.
- Sh. A. K. Bhatia, Superintending Hydrogeologist attended 12th National Symposium on Hydrology with Focal Theme on Ground Water Governance in November 2006.
- Sh. A. M. Khan, Regional Director attended National Seminar on "Active and Fossil Suture Zones" held at Wadia Institute of Himalayan Geology, Dehradun in November 2006.
- Sh. A. M. Khan, Regional Director attended National Seminar on "Ground Water Governance – Ownership of Ground Water and it Pricing" held at Hotel Intercontinental, New Delhi during November 2006.

- Shri B.M. Jha, Member (ED & MM) and (SAM) delivered a key note address on policy framework and present scenario of rain water harvesting in India. He also chaired a technical session in National Seminar on " Water Conservation and Ground Water Rercharging for Effective Health Insurance" held on 16th February 2007 at Kolkata. Dr. P.C. Chandra, Regional Director, Dr. Dipankar Saha Supdtg. Hg and Shri G.K. Roy,Scientist – D , Central Ground Water Board, Mid Eastern Region and officers from Eastern Region, Kolkata attended the Seminar.
- Regional Director CGWB, NHR, Dharmsala attended to the Seminar on "Water & Environment": A Modular Awareness Programme for school students and other social groups in mountainous regions of Himachal Pradesh" catalyzed and supported by Rashtriya Vigyan Sanchar Parishad, Department of Science and Technology New Delhi organized on 21st & 22nd March 2007 at CSKKVV Palampur (H.P). The seminar was organized by the Global Hydrogeological Solutions, New Delhi.
- Shri Sushil Gupta, Regional Director, NWR Chandigarh attended National Seminar on "Fresh Water Crisis; A Global Phenomenon" sponsored by UGC, New Delhi at Govt. College, Ambala Cantt. Shri Sushil Gupta, Regional Director was the Guest of Hoour. He delivered a lecture on water crisis in the State of Haryana. Smt. Anita Gupta, Supdtg. Hg. was the Guest of Honour and she stressed upon the need for ground water conservation and its management for sustainable development of the water resources. Shri S. Marwaha delivered key note address on water crisis in urban areas with special reference to Ludhiana City, Shri P. Das AHG and Shri S. Marwaha Scientist – D also presented a paper entitled "Possibilities of Artificial Recharge to Ground Water in BBMB Complex, Jagadhri block, Yamunanagar district, Haryana.

26.2 Technical Papers presented

1. Dr. L.N.Mathur, Scientist-B presented paper on Management strategies for Nitrate Pollution in Ground water in Jaipur Urban Area, Rajasthan, India in a National Conference on Environmental Conservation organized by BITS, Pilani.
2. Dr. L.N.Mathur, Scientist-B presented paper on Urbanization And Environmental Pollution Jaipur Urban Area, Rajasthan in a UGC sponsored National Seminar on Environment organized by Subodh College, Jaipur
3. Dr. P.K.Jain, Sc-D, presented scientific paper entitled "Scope of Rain Water Harvesting in Nagpur city " in 22nd National Covention of Environmental Engineering and National Seminar on Rain Water Harvesting and Water Management (11th-12th November 2006 at Nagpur.
4. Paper titled "Emerging trends in technology for groundwater resources development" by Dr S C Singh presented at Regional Workshop on Forests for Sustainable Water Regime in Central India" organised by Indian Institute of Forest Management (IIFM) and paper is being published in workshop proceedings.
5. Paper titled " Subsurface Geophysical Surveys for Groundwater Investigation in different hydrogeological Terrain of MP" by Dr S C Singh published in Abstract volume of MP Science Congress organised by Rajeev Gandhi College, Bhopal.

6. Paper titled "Understanding subsurface horizons through geophysical methods regarding inter-basin transfer of water' by Dr S C Singh published in Abstract volume of MP Science Congress organised by Rajeev Gandhi College, Bhopal.
7. Paper titled ` Delineation of Subsurface Inland Salinity by Surface Resistivity Measurements in Parts of Bhind District, Madhya Pradesh' by Dr S C Singh and R N Singh published in proceedings of National Seminar Groundwater-2007 organized by AICGWBOA at Bhopal.
8. Paper titled "Surface Resistivity Measurements for Identifying Polluted Zone in Pithampura Industrial Area of Dhar District Madhya Pradesh" by Dr S C Singh and R N Singh published in proceedings of National Seminar Groundwater-2007 organized by AICGWBOA at Bhopal.
9. A paper entitled "Ground Water Scenario in Chhattisgarh State" by Dr.A.Srisailanath, Regional Driector, B.K.Sahoo, Sc'B' D.Tewari, Sc'B' and M.Panneer, AHG was presented by Regional Director on 21st September 2006 and submitted in the National Conference on "Role of Soil and Water Conservation in Rural Employment (RSWCRE- 2006) " held at Indira Gandhi Agricultural University, Raipur on 19-21 September 2006, (organized by Indira Gandhi Agricultural University, Raipur on Soil Conservation Society of India, New Delhi).
10. A paper entitled Emerging Challenges in Ground Water Resource Management bore Newly Created state- with Special reference to Chhattisgarh by Dr.A.Mukherjee, AHG, J.R.Verma, AHG and Dinesh Tewari, Sc'B' was published in the proceedings of the 12th National Symposium on Hydrology "Ground Water Governance-ownership of ground water and its pricing in New Delhi on 14-15 November 2006, organized by CGWB and National Institute of Hydrology.
11. The paper "Spatial analysis of multiple data for mapping of groundwater potential in drought affected Tiptur taluk, Tumkur dist, Karnataka" by Sh. TM Hunse, Dr. K.Md. Najeeb, & K. Rajarajan, presented at the National Seminar on Soil Health and water management for sustainable sericulture on 27.09.06 at Bangalore by Dr. K.Md. Najeeb was selected as the best paper in the session.
12. Following officers presented technical papers in the national convention of Civil Engineers with a focal theme on "Water Resources planning Conservation and management" on 12th and 13th august 2006.
    - Dr.K.Md.Najeeb Sc-D & N.VinayaChandran Sc-B: Water Budgeting and ecological balancing in Atolls – A case study, published in the seminar proceeding, pp 14-24.
    - Sri K.Rajarajan AHG & Dr.K.Md.Najeeb Sc-D: Detection of Fluoride levels in aquifers in hard rock of Bellary and Siruguppa taluks Bellary district, Karnataka, published in the seminar proceeding, pp 70-76.
13. Shri N.Varadaraj, Suptdg. HG & H.O.O. made a presentation on " Rain Water Harvesting by industries – Dos & Don'ts " at the Technical meet on " Industrial Water Conservation & Management " held on 17 – 18.04.06, (organized by Federation of Indian chambers of Commerce and Industry) at Chennai.
14. Chairman, CGWB and Scientist – D presented a paper at Seminar on Water Resource Management in the chemical Industries organized by Indian Chemical Council at Indian Habitat Centre, New Delhi from 6.09.2006 to 7.09.2006.

26.3 Delivered Lectures

1. Shri P.K.Parchure, Sc D delivered a lecture, Ground Water Hydraulics on 06/06/06 in Traininng on "Ground Water Management and Modeling" for the officers of NWRA, Republic of Yamen at Ansal Bhavan, New Delhi.
2. Shri Anoop Nagar, Sc-D, delivered a lecture on "Case Studies of Artificial Recharge to Ground Water in Alluvial Terrain " in a training on Artificial recharge to Ground Water in different Hydrogeological Terrain's on 27th September 2006.
3. Shri Anoop Nagar, Sc-D, delivered a lecture on Hydrogeological Investigations, during Training Program Course on Scientific Source finding on 6/12/2006 at GJTI, Gandhinagar.
4. Dr. D.Gnanasundar, Sc-B, delivered a lecture on "Monitoring & Impact Analysis, during Training Program Course on Scientific Source finding on 8/12/2006 at GJTI, Gandhinagar.
5. Dr. D.Gnanasundar, Sc-B, delivered a lecture on "Water Input/ Impact Analysis, Moulded study on 28/04/2006 at GJTI, Gandhinagar.
6. Dr. D.Gnanasundar, Sc-B, delivered a lecture on " Scope of Geophysical Studies in Coastal Gujarat" during the Training Course on Application of Geophysical Techniques for Ground Water Exploration and Management conducted at CGWB, MER, Patna during 11th to 23rd December 2006.
7. Ms. Anuradha Bhatia Scientist 'B', delivered a talk on "Hydrogeology of Bhopal and Rain Water Harvesting Techniques in Urban Areas" in Workshop on Environmental Awareness and Communication for Water Conservation at Lake Conservation Authority, Bhopal on 6.02.2007.
8. Dr S. C. Singh, Scientist `B' delivered the lecture titled "Use of geophysical methods for groundwater pollution study" in Groundwater Management Training program organised by CGWB, NCR at Bhopal.
9. Dr S. C. Singh, Scientist `B' delivered a lecture titled "Resistivity and geophysical surveys for groundwater survey" at academy of Administration, Bhopal for the officers of PHED, Govt. of MP.
10. Dr S. C. Singh, Scientist `B' delivered lecture titled ` Surface and borehole Geophysics in monitoring groundwater recharge & pollution – Case studies at training programme " Application of Geophysical techniques for Groundwater Exploration and Management" organised by CGWB, MER, Patna.
11. Dr S. C. Singh, Scientist `B' delivered the lecture titled `Computer based interpretation of resistivity data' at training programme " Application of Geophysical techniques for Groundwater Exploration and Management" organised by CGWB, MER, Patna.
12. Dr S. C. Singh, Scientist `B' delivered a talk on "Techniques of Artificial Recharge to groundwater in Rural and Urban area" to the audience NHDC, Onkareshwer.
13. Dr S. C. Singh, Scientist `B' delivered the lecture titled " Geophysical investigation for selection of groundwater artificial recharge sites" in Groundwater Management Training program organised by CGWB, NCR at Betul.
14. Miss Anuradha Bhatia, Sc 'B' delivered a lecture on "Rain Water harvesting & ground water Recharge In Urban Areas" in a Seminar on "Ground Water Conservation & Recharge" organized by 21 Army Corps, Sultania Infantory lines, Bhopal on 25.07.06.

15. Dr. S.C. Singh, Sc 'B' delivered a lecture on "Geophysical Techniques for selection of sites for Ground Water Recharge" in a Seminar on "Ground Water Conservation & Recharge" organized by 21 Army Corps, Sultania Infantry lines, Bhopal on 26.07.06.
16. Shri R.K.Sharma, Asstt. Chemist delivered a lecture on "Water quality Consideration for Rain water harvesting & Recharge to Ground Water" in a Seminar on "Ground Water Conservation & Recharge" organized by 21 Army Corps, Sultania Infantory lines, Bhopal on 26.07.06.
17. Shri B.P.Singh, AHG delivered a lecture on "Rain Water harvesting & ground water Recharge In Rural Areas" in a Seminar on "Ground Water Conservation & Recharge" organized by 21 Army Corps, Sultania Infantory lines, Bhopal on 25.07.06.
18. Shri R.K.Sharma, Asstt. Chemist delivered lecture on "Ground Water Pollution" in a seminar on Rain Water Harvesting Techniques organized by Career College at Bhopal on 23rd Sept 2006.
19. Shri. Sourabh Gupta, Sc-D & OIC, CGWB, SUO, Pune delivered two lectures viz; a) Planning of Artificial Recharge Projects and b) Monitoring Mechanism for Artificial Recharge Projects for the Short Term Training Module on "Rain Water Harvesting and Ground Water Recharging" on 20th July, 2006 at National Water Academy, Khadakwasla, Pune.
20. Shri. Sourabh Gupta, Sc-D has delivered a lecture on "Ground Water Model Bill & Role of CGWA" at GSDA, Pune on 21st February 2007 for Technical Training under Jalswarajya Project.
21. Shri. D. Venkateswaran, Sc-B delivered a lecture on "Manual Computation of data for Resources Assessment" at GSDA, Govt. of Maharashtra, Pune on 12th February 2007 for Technical Training under Jalswarajya Project.
22. Shri. Upendra Dhonde, AHG delivered a lecture on Hydrogeology of Maharashtra at GSDA, Govt. of Maharashtra, Pune for Technical Training under Jalswarajya Project in July 2007.
23. Regional Director delivered a lecture on Rain water Harvesting at NSS rural camp at Somanahlli organized by S.S.M.R.V first grade college, Bangalore on 24. 03.2007.
24. Dr.K.Md Najeed, Superintending Hydrogeologist delivered lecture at Environmental Science Dept of JnanaBharathi campus on 30.03.2007.
25. Seven officers viz., S/Sri S.S.Hegde Sc-B, K.Kumaresan AHG, M.A.Farooqi AHG. H.P.Jayaprakash Asst.Hydrologist, K.Koti Reddy AGP, M.C.Gupta Asst Chemist & Smt Veena R.Achutha AGP delivered lectures on topics related to water conservation and management during the training programme organized by R.V.College of Engineering Bangalore on "Water conservation for rural areas" from 22.03.07 to 27.03.07.
26. Sri K.Kumaresan AHG & M.C.Gupta Asst Chemist delivered lectures on ground water exploration and ground water quality & human health at Department of Mining and Geology, Govt. Of Karnataka on 23.03.2007.

26.4 Water Resources Day

Central Ground Water Board & Central Water Commission jointly celebrated World Water & Water Resources Day on "peoples Participation in Water Conservation & Water quality" at National Teachers Training & research Institute, Shamla Hills, Bhopal on 22.03.2007.

26.5 Raj Bhasha Vaijayanti Prize

Central Ground Water Board awarded third Raj Bhasha Vaijayanti prize for the year 2004-05 on 10.10.2006 from Hon'ble Secretary (WR). Dr. Saleem Romani, Chairman CGWB received the prize in a grand prize distribution ceremony organized in Shram Shakti Bhawan, New Delhi.

26.6 World Water Day 2007

- WORLD WATER DAY 2007 was celebrated on 22nd March 2007 at Bhaikaka Bhavan, Law College Road, Ahmedabad, on the theme "Coping with Water Scarcity" jointly with The Institution of Engineers (India) and Water Management Forum. The fuction was presided over by the Hon'ble Minister of Water Resources and Water Supply, GOG , Sh. Narottambhai T. Patel. The Chief Guest was the Hon'ble Minister of State Water Resources, Govt. of Gujrat, Sh. Ratibhai Sureja. The guests of Honour were Sh. A.K.Sinha, Ex. Member CGWB & Member Secretary, CGWA, and Sh. S.S. Rathore, Principal Secretary (Water Resources), GOG. About 250 Scientific officers, Engineers and othher technical officers from various departments of GOI and GOG participated in the function.

- CGWB, ER, Kolkata, celebrated World Water Day on 22nd March'07 at the auditorium of National Test House, Salt Lake, Kolkata. Dr. D.K.Das, Sr. Dy. Director General, GSI, Govt. of India, and Dr. P. Nag, Director, NATMO, Govt. of India, graced the occasion as Chief Guest and Guest of Honour respectively. The high dignitaries from various Central Govt. Organisations, such as, CWC, WAPCOS, DVC, GSI, NTH, National Bureau of Soil Survey & Land Use, State Govt. Departments like, SWID, WB Pollution Control Board, Bidhannagar Municipality, Wetland Management, Forest Departmentand and also students from colleges and universities participated. About 150 participants were present in World Water Day celebration.

- Central Region, Nagpur has celebrated World Water Day on 22nd March 2007. During this programme, a drawing competition was organised in two groups respectively by drawing 30 Middle and High school students from Bishop Cotton High School, Tidke Vidyalaya and RRBBGG High School. Prizes for the winners and consolation prizes for the participants were given for each group. The programme was organized by Dr. P.K. Naik, Scientist-D, CGWB, Nagpur. He was supported by S/Shri. S.K. Bhatnagar, AHG, V.P. Nawale, ACH, D. Venkateswaran, JHG, Y.B. Chisty, Draftsman etc.

- CGWB, NER celebrated World Water Day with a theme on "Coping with Water Scarcity" at institute of Engineers , Guwahati on 22nd March, 2007. On the eve of this event drawing competition, Quiz and debating competition were conducted in the forenoon among the

school children. Prizes were distributed to the winners. In the after noon meeting was held in which public personalities /Academicians were invited to view their messages. School Children, Teachers, representatives from different State Govt. departments participated in the programme.

- World Water Day was celebrated on 22.03.2007 at 3 places in the Mid East Region. The main program was organised at Conference Hall of CGWB, MER, Patna. Essay and slogan writing competition was held. The other program was organised at Division V office Ranchi and Town Hall Pakur. Painting competition was organized at Ranchi and Quiz and Essay compeiion was organised at Pakur.

- Central Ground Water Board and Central Water Commission jointly celebrated World Water & Water Resources Day on "Peoples Participation in Water Conservation and Water Quality" at National Teachers Training & Research Institute, Shamla Hills, Bhopal on 22.03.2007.

- WORLD WATER DAY with the theme of "Coping with Water Scarcity" was celebrated on 22nd March 2007 at Bhujal Bhavan, Chandigarh. Shri T.L. Bangey, M.D., PSTC was the Chief Guest. Shri K.S. Takshi, Director, Water Resources Punjab and Shri Ishwar Singh, Deputy Conservator of Forests, Chandigarh (U.T.) were the Guest of Honour. Officers from the State Govt. organizations, Central Govt. organizations attended the World Water Day. Shri Sushil Gupta, Regional Director while delivering the presidential address stressed the coping of water scarcity in the States of Punjab and Haryana by recharging atleast 25% of rain fall as well as recycling the waste water bring generated in the States of Punjab and Haryana. Smt. Anita Gupta, Supdtg Hg. Spoke on the causes of water scarcity and its remedial measures. Poems on the importance of water were also recited by the officers/officials of Central Ground Water Board.

- WORLD WATER DAY was observed on 22nd March 2007 by SER, Bhubneswar. A Mass rally was organized by CGWB, SER at MPC High School, Betnoti Block, Mayurbhanj District, Orissa. The rally was flagged off by the Block Development Officer Betnoti Block. More than 500 school children and teachers from all the schools in the area took part. Later on an elocution competition on water conservation was also held among the school students and prizes were distributed.

- Celebrated World Water Day 2007 on 22nd March 2007 by SWR, Bangalore. Shri T.M. Hunse, Regional Director was the guest of honour for World Water Day celebrations at R.V. College of Engineering, Bangalore.

- A World Water Day function was organized by Central Ground Water Authority and Central Ground Water Board, NWHR, Jammu on 22.03.2007 at Ritz Hotel, Pearl Hall, Channi Himmat, Jammu. Shri V.K.

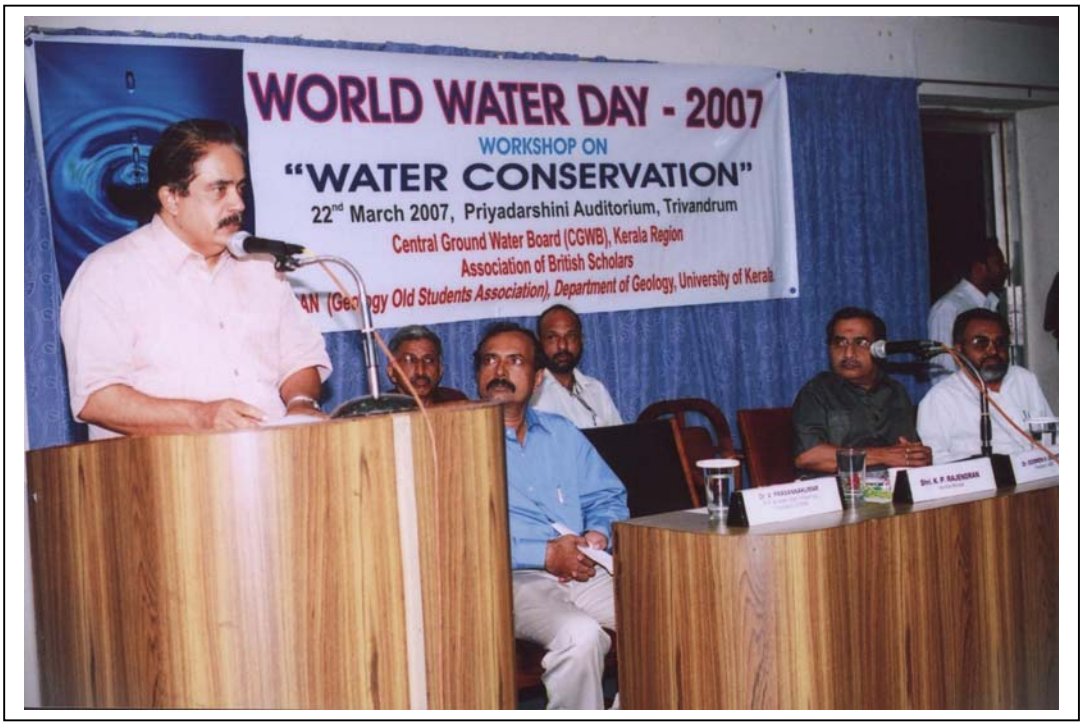
Goswami, Chief Engineer, PHE, Jammu presided over the function. The gathering was addressed by the officers of CGWB and PHE department, J&K Govt. Dr. S.C. Dhiman, Regional Director, NWHR, explained the importance and theme of World Water Day and emphasized on traditional and modern practices of rain water harvesting, conservation and management of ground water. He told that the participation of public is very important in the water conservation and management schemes. This will improve the socio-economic conditions of the villagers and ecosystem. The officers and officials of PHE, Irrigation and Flood Control and Stores Procurement, J&K Govt., participated in the function. Besides this the CGWB, Jammu organized a painting competition on the theme "Roof Top Rain Water Harvesting" in the Heritage School Jammu in the morning. Dr. S.C. Dhiman, Regional Director, NWHR distributed the prizes to the winners of painting competition.

- A World Water Day function was organized by Central Ground Water Authority and Central Ground Water Board, Uttaranchal Region, Dehradun on 22.03.2007 on the theme "Coping with Water Scarcity" at CGWB Regional Office, Uttranchal Region, Dehradun.

26.7 WORLD ENVIRONMENTAL DAY

- The President of India visited CGWB stall in an exclusive exhibition arranged to celebrate World Environmental Day organized jointly by Department of Ecology & Forestry and Govt. of Karnataka. CGWB, SWR erected one stall for Artificial Recharge and Rainwater Harvesting structures models on 5th , 6th and 7th June, 2006 on the occasion of World Environment Day Celebrations on 6th June 2006.
- Sh. G. Sudarshan, Scientist D attended the workshop on "Desert and Desertification" on the occasion of World Environment Day on 5th June, 2006 organized by the Institute of Engineers Chairman, Members, Regional Directors and Executive Engineers of CGWB attended meeting to review the flood situation in Gujarat & Madhya Pradesh taken by Home Secretary on 5.7.2005.

World Water Day organized at Kolkata on 22.3.07



Honourable Minister Shri K. P. Rajendran inaugurating the workshop on Water Conservation on World Water Day **on 22nd March 2007 at Trivendram**

Dr. S.C. Dhiman, Regional Director, NWHR, Jammu delivering speech during World Water Day at Heritage School, Jammu

27. RESEARCH & DEVELOPMENT SCHEMES

The Central Ground Water Board is chairing a sub – committee of Indian National Committee on Hydrology (INCOH) , on R&D in Ground Water with a view to accelerate the development programme in ground water sector and giving due consideration to increased need of taking up research in the field of ground water. This committee examines the project proposals received by INCOH on ground water issues for their suitability for funding and recommendations for sanctioning by the Ministry of Water Resources. During the year, 9 New R&D Proposals received on ground water as given in table 27.1

Three Proposals as given below in Table 27.2 recommended to INCOH Secretariat for further approval. Two Proposals as given below in Table 27.3 have been finally cleared for payment of installments, which will be monitored for their progress.

Table 27.1- List of New R&D Proposals received on ground water and under process

Sl No.	Project Title
1	Bacterial Degradation Of Lignin And Pentachlorophenol From Pulp Paper Effluent And Its Applications For Aquaculture & Ferti-Irrigation-
2.	Evaluation and Modelling of Rain Water Harvesting Filter Systems .
3.	Fluoride Contamination of Ground Water in Nayagarh district, Orissa
4.	Morpho-tectonic study of Jhalawar Urban area & its Hinterland towards Groundwater Recharge Enhancement: A Remote Sensing and GIS based approach, Jhalawar district, Rajasthan.
5.	Evaluation of Heavy Metal Pollution index for groundwater of townships located near different mining areas.
6.	Groundwater Potential assessment and management in the Rangamalai watershed, a hard rock region in Dindigul district, Tamilnadu.
7.	Assessment , Augmentation and Regulation of Water Resources at Banaras Hindu University Main Campus Varanasi and its Rajeev Gandhi South Campus, Barkachha, Mirzapur.
8.	Vulnerability assessment and groundwater management studies in aquifers of Pondicherry and Karaikal Region
9.	Management of Aquifer Recharge for Augmentation of Groundwater Resources

Sl No.	Project Title
	(MAR for AGWR)

Table 27.2- List of Proposals recommended to INCOH Secretariat for further approval

Sl. No.	Project Title
1.	Spatio-temporal Modelling of Ground Water Quality using Artificial Neural Network.
2.	Arsenic Problem in Jharkhand & Bihar and some remedial measure
3.	Developing a Methodology for Evaluating the impact of Rain Water Harvesting in Urban Areas.

Table 27.3- List of Proposals finally sanctioned for payment of Installment

Sl No	Project Title
1.	Identification & Mapping of Palaeo channels in the eastern fringe of Thar Desert for water resources augmentation plan
2.	Development of Models for cleanup of Cromium (VI) contaminated aquifers using Bio-remediation

28. PUBLICITY AND PUBLIC AWARENESS

Water is a precious resource vitally important for development as a whole for every day life. With a view to generate consciousness among the masses ' Water Resources Day" is being celebrated everywhere since 1986. Central Ground Water Board has played very active role by organizing functions jointly with Central Water Commission, other State Govt. Organizations and departments. On the occasion of Water Resources Day, emphasis has been laid to educate the rural population on various aspects of water resources in the country by organizing these functions in rural areas and by giving popular talks and bringing out technical pamphlets in regional languages.

Important technical achievements of the Board have been brought to the knowledge of the public through Radio Talks, Television interviews, telecast of a short film on ground water pollution, News Paper reports, release of district reports, Atlases at the Public functions.

Working Model of Hydrological Cycle, Conjunctive use of Surface and Ground Water, Artificial Recharge Studies carried out in JNU, New Delhi and Rotary Drilling Rig are displayed along with photos of drilling activities, panels showing activities and achievements of CGWB, Translite showing various methods of artificial Recharge, Translite on Roof Top Rain Water Harvesting Techniques, various publications released by Central Ground Water Board and various slogans on ground water are displayed to create awareness on various aspects of ground water. Knowledge on water quality and testing is provided to visitors and facility for 'on the spot analysis of water to check its suitability for drinking and domestic use is provided.

The Central Ground Water Board was successful in attracting the masses and creating awareness among the farmers, school/college students, agriculture Scientists, general public and dignitaries. During the exhibition brochures on activities and achievements of CGWB, Attributes of Ground Water, Roof Top rain Water harvesting Techniques, Ground Water and Health etc were distributed. Various publications of CGWB and Water Testing Kits developed by CGWB were in great demand by the visitors. Some of them have expressed this in the visitor book also.

28.1 EXHIBITIONS/ MELAS/ TRADE FAIRS

During the year 2006-2007 various exhibitions and trade fairs have been organized and the participation of the Board in these events are indicated below.

1. Central Ground Water Board, North Central Region, participated in **Planet Earth Exhibition** at the "National Convention on Science and Technology – Communication, Growth and Empowerment" organized by M.P.Council of

Science & Technology from 17th to 21st January 2007. The stall put up by CGWB was highly appreciated and secured the **Best Stall Display (Central Government Organisation)** at the exhibition.

2. Central Ground Water Board, Eastern Region, Kolkata participated in the exhibition "Indian National Development Festival 2006" at Kalyani, Nadia district from 16th to 25th June, 2006 organized by Gandhi Seva Sangha. Best Pavilion Award has been conferred to CGWB, ER, Kolkata.
3. The President of India visited CGWB stall in an exclusive exhibition arranged to celebrate World Environmental Day organized jointly by Department of Ecology & Forestry and Govt. of Karnataka. CGWB, SWR erected one stall for Artificial Recharge and Rainwater Harvesting structures models on 5th , 6th and 7th June, 2006 on the occasion of World Environment Day Celebrations on 6th June 2006 .
4. Central Ground Water Board, Faridabad participated in **CBSE REGIONAL SCIENCE EXHIBITION 2006** Organized By Eicher School, Faridabad on 11th September, 2006. During this occasion Models of Rain Water Harvesting, Artificial Recharge to Ground Water and Hydrological Cycle, charts, photographs and posters etc. along with relevant literatures were displayed in the pavilion. The senior officers of CBSE and around 1500 school children & their parents from in and around Faridabad district visited the exhibition stall of CGWB. Mrs G. Anupama, IAS, DC, Faridabad also made a visit to the exhibition stall of CGWB and appreciated the exhibition.
5. Central Ground Water Board, SWR, Bangalore participated in **DASHERA EXHIBITION** Organized By Cauvery Neeravari Nigama Ltd., Govt. of Karnataka and exhibited working models and other exhibits on Water Conservation from 9th October to 19th October 2006. During this occasion charts, photographs and posters etc. along with relevant literatures were displayed in the exhibition.
6. Ministry of Water Resources participated in the 27th India International Trade Fair (IITF) -2006 at Pragati Maidan, New Delhi during the period 14th to 27th November,2006. Ministry of Water Resources organized a pavilion in Hall No. 8 of Pragati Maidan depicting Models of Rain Water Harvesting and Artificial Recharge Structures. The structures consist of Rain Water Harvesting in Urban areas, Rain Water Harvesting in rural areas, Gabion Structures across flowingrivers and check dams across flowing rivers. At the center of the pavilion a huge fish in white dazzling colour with coloured crown depicted the queen of water. Skit (one act play) was organized by the Ministry of Water Resources with the help of "Jagran" group depicting the need of conservation and management of water resources.
7. The pavilion was inaugurated on 14th November, 2006 by Hon'ble Minister of Water Resources Professor Saif-uddin Soz and Minister of State for Water Resources Shri Jai Prakash Narayan Yadav accompanied by Smt. Gauri Chatterjee, Secretary, Ministry of Water Resources and Shri S. Manoharan, Additional Secretary, Ministry of Water Resources. On this occasion, Shri A.K. Sinha, Member (SML) and Shri B.M. Jha, Member (ED & MM) and Officers of CGWB were also present. Shri G.C. Saha, Officer-in-Charge, Central Ground Water Board, State Unit Office, New Delhi explained the models to the esteemed delegates, who appreciated and gave excellent comments in the visitors book. Hundreds of visitors from all corners of India including MPs, MLAs of Delhi and Heads of various State and Central

Government rganizations visited our pavilion. The efforts of Ministry of Water Resources for organizing this pavilion was rewarded with **Third Prize i.e. Bronze Shield** and a certificate of appreciation by IITF.

8. Scientists of CGWB, SECR Chennai attended and demonstrated exhibits/ Models depicting various hydrogeological scenarios in the Inter School Science Exhibition organized by Tamil Nadu Science and Technology Center at Chennai from 27.11.2006 to 30.11.2006. The exhibits were highly appreciated by the visitors. Further, the Executive Director, Tamil Nadu Science and Technology Center has sent a letter of appreciation for the association of CGWB with the exhibition.
9. Central Ground Water Board, North Central Region participated in **Planet Earth Exhibition** at the "National Convention on Science and Technology – Communication, Growth and Empowerment" organized by M.P. Council of Science and Technology from 17th to 21st January 2007. The stall put up by CGWB was highly appreciated and secured the Best Stall Display (Central Government Organization) at the exhibition. The certificate for Best Stall Display award was also received by the Central Ground Water Board, Bhopal.
10. Central Ground Water Board, NER, participated in the **14th International Guwahati Trade Fair 2007** organized by IIFAA at Guwahati from 26th February 2007 to 11th March 2007. Maps were displayed and distributed literatures related to Roof Top Rainwater Harvesting for awareness of public. The CGWB pavilion was rewarded 2nd Prize winner in the fare for its attracting display of working models and appreciated demonstrations.

28.2 DISPLAY OF RAINWATER HARVESTING MODEL AT GANAPATHI FESTIVAL

Rain Water Harvesting Model of CGWB Central Region, Nagpur was displayed during Ganapathi Festival by the Rotary Club of Nagpur between 25th August to 6th September 2006. It helped to popularize the concept of Rain Water Harvesting amongst the common man. The overwhelming response was received from around 1.5 lakhs visitors for the model exhibition and organizers have lauded the cooperation of CGWB and placed their appreciation as follows "On the behalf of Rotary Club of Nagpur, Kindly accept my heartiest thanks for providing us live model of Rain Water Harvesting. The model was displayed during Ganesh Utsav Festival for ten days, we have covered about 1,50,000 people and every body appreciated it. Our Water Management Committee has already completed a project of Rain Water Harvesting at Modern School. We would like to co-operate with your department in future also".

28.3 AWARENESS THROUGH PRINT & ELECTRONIC MEDIA

1. Miss Anuradha Bhatia,Sc 'B' participated as a guest speaker in live phone-in programme 'Shubh Sham' of Bhopal Doordarshan on topic "Ground Water Conservation & Recharge" on 13.06.2006.
2. At the request of Principal, St. Ursula Girls High School, Nagpur this office arranged an exhibition and a talk on Rain water Harvesting at the above

school premises on 16th September 2006. Shri. Dinesh Prakash, Regional Director, CGWB, Nagpur introduced the topic of 'Water Conservation through Roof Top Rain Water Harvesting' to the school children. Shri. P.K. Parchure, Scientist-D has given a talk on 'Roof Top Rain Water Harvesting in Rural areas', which followed by a brief talk on 'Water Conservation at Home' by Shri. D. Venkateswaran, Scientist-B. About 70 school children from to class VIII to X Std. participated in the above programme. S/Shri. B.N. Warke, Scientist-B and S.J. Kolte, Photographer of this Region displayed the models on Rain Water Harvesting and explained the students about them.

3. Dr. K.Md. Najeeb, Superintending Hydrogeologist attended the Press meet of Hon'ble Chief Minister, Govt. of Karnataka to release the State Agricultural Policy 2006.
4. During a radio programme "Aaj di Awaj" aired "Live" by All India Radio Jalandhar on 16.07.2007. Shri Sushil Gupta, Regional Director replied the questions put up by persons from all walks of life relating to Artificial Recharge to Groundwater and Rainwater Harvesting and other aspects relating to ground water in respect of Punjab.
5. Shri G.P.Singh, Assistant Hydrogeologist, NWR, Chandigarh participated in live telecast of Punjabi Channel PTC on the topic "Mudda – Pani Bas Khatam Kahani". The duration of the programme was of one hour. During the programme questions regarding depletion of water levels and measures taken for groundwater management were replied.

28.4 MASS AWARENESS AND TRAINING PROGRAMMES

28.4.1 MASS AWARENESS PROGRAMMES

1. A Mass Awareness Programme was organized at the over-exploited area of Ramayampet Mandal, Medak district on 8.09.2006.
2. At the request of the District Magistrate & District Programme Coordinator (NREGA), Murshidabad District, W.B. the officers from CGWB, ER, Kolkata delivered lectures in the training programme on "Groundwater Management and Artificial Recharge to Groundwater" conducted by the District Authorities under the programme of NREGS at Berhampur, Murshidabad District.
3. A mass Awareness programme on Water Management was organized at Samundra Village, Tehshil Amla, Betul district on 12.09.2006 for the students & villagers of the village. This programme was organized during the field trip of the trainees of "Induction Level Training Course 200 on Hydrogeological Investigations, Development and Management of Ground Water Resources Techniques, Equipments and Practices".
4. A Mass Awareness Programme on Water Conservation was organized at Athner, Betul district on 7.10.2006.
5. Mass Awareness Programme on the theme "Groundwater Development and Management in Coastal Areas and Scope for Rain Water Harvesting" and Water Management Training were held on 2nd & 3rd Nov'06 respectively at Diamond Harbour, South 24 Parganas district, West Bengal. Mass Awareness Programme was chaired by the SDO, Diamond Harbour. The scientists from CGWB, ER, delivered lectures on the theme. The participants from different State Govt. departments,

Panchayats, students from three reputed schools actively took part in the discussions on the topic. In the training programme, participants were from Municipalities, Panchayat Samities, Institutions and PHED, Govt. of WB. The scientists from CGWB, ER, delivered lectures on different topics, viz. groundwater occurrence, its exploitation methodology, quality aspects and methods of rainwater harvesting.

6. A Mass Awareness Programme was organized on 10.11.2006 at Omkareshwar, Khandwa district Madhya Pradesh. The target audience were Engineers of Narmada Hydro Development Corporation (NHDC) , NGOs' and villagers.
7. Shri T.M. Hunse, Regional Director participated as Chief guest in the Mass Awareness Programme organised by department of Mines and Geology, Govt. of Karnataka on 8.11.2006. The programme was held at Devanahalli, Bangalore district. Regional Director also presented a lecture on the theme. Dr. K.Md.Najeeb, Supdtg.Hg. also participated in the programme.
8. The Central Ground Water Board, Central Region, Nagpur organized Mass Awareness Programme on "Groundwater Management and Rain Water Harvesting " on 22nd December 2006 at Hinganghat, Wardha district, one of the farmers distress distriict identified by the PMO. Shri Sudhakar Kolmehte, Sub-Divisional Officer (Revenue), Hinganghat was the Chief Guest of the function. Shri Vasantrao Zade, Ex Sub-Divisional Agriculture Officer, Hinganghat and Shri Anil Javade, Secretary, Dr. B.R. Ambedkar Shikshan Sanstha, Hinganghat were the guests of Honour. Shri Dinesh Prakash, Regional Director, CGWB, CR presided over the function. About 300 participants representing the farmers, Gram Panchayat, Govt. and Non-govt. organizations and local people from the Hinganghat town attended the function. The programme was covered well by the media.
9. A Mass Awareness Programme was organized on 14th December 2006 at Bhogapuram, Vizianagaram District , Andhra Pradesh.
10. A Mass Awareness Programme on the theme "Groundwater Development and Management in arsenic infested areas and Scope for Rain Water Harvesting" on 12th December 2006 at Asokenagar, West Bengal. The Programme was chaired by the Sabhapati, Habra Panchayat Samiti II. The scientists from CGWB, ER, delivered lectures on the theme. The participants from different State Govt. Departments, Panchayats, Municipalities, students from three reputed schools actively took part in the discussions on the topic.
11. A Mass Awareness Programme was organized on Ground Water Consevation and Protection on 11th December 2006 at Science Hall, Nongpoh, Rai-Bhoi district, Meghalaya. Shri R.R. Makdoh, Member, District Council, KHADC, graced the occasion as the Chief Guest and emphasized on the need and conservation of the ground water resources. About 200 participants paricipaed in the Mass Awareness Programme. Shri D.B. Saha, Regional Director, CGWB presided over the function.
12. A Mass Awareness Programme was conducted at Palghat town, Palghat district, Kerala.

13. A Mass Awareness Programme was organized on 6th December 2006 at Lakhanpur block office, Jharsuguda district, Orissa.
14. Mass Awareness Programme was held at Kadur, Chikmagalur ditrict on 1.12.2006. Shri K.M. Kemaraju Member, ZP, Kadur was the Chief Guest and inaugurated the program. Shri K.Rajkumar, Lecturer, Govt. Jr. College, Kadur was the Guest of Honors. Shri T.M. Hunse Regional Director, SWR, Bangalore presided over the function and it was followed technical presentation and interaction. Technical session was held as a part of the programme Drawing competition was organized for school children, prizes and certificates were also distributed. An exhibition of models and technical documents was also held. About 350 representatives from State Govt., educational institutions, farmer community, NGOs and Stree Shakti participated in the programme.
15. Mass Awareness Programme has been conducted on 20-22nd December 2006 in Sarvodaya Vidyalaya, Nilothi Village, West District of NCT Delhi. About 1000 students and teachers have attended the programme. There was one week programme of students which was focused on ground water conservation ad protection as a theme of awareness. The students have participated in drawing, slogan writing, recital of poetry and drama. The prize distribution to winner students have been also delivered by Member (SML) CGWB on 20th December 2006.
16. The Central Ground Water Board, Central Region, Nagpur organized one day Mass Awareness Programme on "Ground Water Management & Rain Water Harvesting" on 25th January 2007 at Nagar Palika Hall, Washim, one of the Farmer's distress districts. About 300 participants from Washim, Mangrul Pir and Manora talukas have participated. The programme was completed successfully.
17. A Mass Awareness Programme was conducted at Chikkodi, Belgaum district on 25.01.2007. Smt. Amita Prasad IAS, Regional Commissioner, Belgaum district was the Chief Guest and inaugurated the programme. Shri R. Vishal IAS, Ass. Commissioner, Chikkodi, Belgaum district, Shri Revadihal, Principal, Basappa Kore Arts and Science College, Chikkodi and Shri Nagaraj, Executive Officer, Taluk Panchayat were the Guest of Honors. It was followed technical presentation and interaction. As a part of the programme drawing competition was organized for school children. Priizes and certificates were also distributed. An exhibition of models and technical documents was also held. About 300 representatives from state govt. , educational institutions farmer community, NGOs and Stree Shakti participated in the programme.
18. The Central Ground Water Board, North Himalayan Region, Dharamshala organized Mass Awareness Programme on Rain Water Harvesting and Water Management" was conducted on 11.01.2007 at Sukedi Khalsa, Nalagarh Tehsil , Solan district, Himachal Pradesh under the aegis of CGWA & was attended by large gathering of local farmers & students.
19. The Central Ground Water Board, Mid Eastern Region, Patna organized a Mass Awareness Programme on 14.02.2007 at Mohiddinnagar, Samastipur district, Bihar. It was inaugurated by Dr

N. Sarwan Kumar, DM Samastipur. About 400 school students and villagers participated in the Mass Awareness Programme.

20. Mass Awareness Programme on Ground Water Conservation and Rainwater Harvesting was conducted at Bhagwanpur block, Haridwar district Uttarakhand on 24th February 2007.
21. A Mass Awareness programme was organized at Vemula, Vemula Mandala, Kadapa District Andhra Pradesh on 14.02.2007.
22. Mass Awareness Programme was conducted successfully at Ambuja Cement Foundataion, Kodinar, Junagadh district on 26th March 2007. Mass of about 250 people attended the programme.
23. A Mass Awareness Programme on "Ground Water Development & Management and Scope for Rain Water Harvesting in Coastal areas of Purba Medinipur district, W.B." at Town Hall, Contai, Purba Medinipur district, WB, was organized by CGWA & CGWB, ER, Kolkata, on 14th March '07. About 145 participants from various Govt. Organizations, NGO, Panchayats, Municipality, teachers and students of different schools were present and actively participated in the discussion.
24. CGWB, Eastern Region, Kolkata has organized one day Mass Awareness Programme on "Ground Water Management & Rain Water Harvesting" on 26th March 2007 at Agrasen Bhawan, Akola, one of the Farmers' distress districts. The inauguration programme was presided over by Shri. Dinesh Prakash, Regional Director, CGWB, Nagpur. Other dignitaries present in the dais were Shri. P.K. Parchure, Sc-D, CGWB, Nagpur and Shri. K.H. Randheria, Sr. Geologist, GSDA, Akola. During the inauguration ceremony, a booklet on "Hydrogeology of Akola District" was released by the president of the function Shri Dinesh Prakash and other dignitaries on the dais. About 200 participants from Akola and adjacent talukas have participated. The programme was completed successfully.
25. Mass Awareness Programme on Ground Water Conservation and Rainwater Harvesting was organized on 22.03.07 at Town Hall Pakur, Jharkhand. The programme was inaugurated by Shri Madan Sengupta, DDC, Pakur. Around 150 participants attended the program. The participants were school and college students, NGO's, local peoples and state government representatives.
26. Mass Awareness Programme was organised on 28.03.2007 at Gandhi Pustakalaya Sabhagar (Town Hall), Jamui Bihar. The program was inaugurated by Hon'ble MoS (WR) Shri Jai rakash Narayan Yadav and Shri B.M. Jha, Member (SAM) & Member (ED&MM) CGWB. Around 1000 villagers, NGO's, School students and state government representatives participated in the program.
27. One day Mass Awareness Programme under Central Ground Water Authority was organized in the Panchayat Samiti Conference hall of Betnoti Block, Mayurbhanj District on 24.03.2007. More than 130 persons including block level officials, local citizens, school teachers, local people representatives actively participated in the programme.
28. A Mass Awareness Programme was organized on 19.03.2007 at PHE Complex, Sitlee (Nagrota), district Jammu on the subject "Conservation and Management of Ground Water". The Chief Guest Shri Ashok Gupta, SE, PHE, Jammu stressed upon the needs of ground

water to conserve it. Dr. S.C. Dhiman, Regional Director, CGWB, NWHR, Jammu emphasized on traditional practices of rainwater harvesting, conservation and management and to adopt them by using scientific inputs. This will improve the social economic conditions of the society. The office of CGWB and PHE department also addressed the gathering. There was a large gathering of local people in the program along with the officers and officials of PHE, Irrigation and Flood Control, J&K Govt.

29. A Mass Awareness Programme on "Artificial Recharge to Ground Water" was organized on 20.03.2007 at Town Hall, Ramnagar, Udhampur district (J&K). Shri C.P. Srivastava, Supdtg Hg. CGWB, NWHR, Jammu expressed his views on the role of individual to save and conservation water so that depleting of ground water could be controlled. Shri J.N. Bhagat, Scientist B, CGWB, NWHR, Jammu expressed his views on conservation of ground water and emphasized the importance of Roof Top Rainwater Harvesting and Artificial Recharge conservation of ground water. About 230 people including the officers of PHE, Irigation and Flood Control, PWD, Power Development department the residents of Ramnagar town including women and school students and the officers and staff of the Board made the program successful.

30. A Mass Awareness Programme on "Conservation of Ground Water" was organized on 23.03.2007 at Mansar, district Udhampur (J&K). Lauding the efforts of CGWB in development of water resources the Dr. S.C. Dhiman, Regional Director, CGWB, NWHR, Jammu conveyed the massage that every drop of water is precious and we should not waste it. We should take care of our legacy i.e. lakes and ponds. He said our villages have reached the heights of development but continuously ignoring the path showed by our ancestors . On this occasion the sarpanch of the village Mansar also laid stress on the importance and need of saving each and every drop of fresh water. Including the officers and officials of PHE, villagers and officers and staff of the Board. Around 200 participants attended the program.

28.4.2 Water Management Training Programmes for Public

- A one day training programme on Water Management and Environmental Protection was organized at Betul District on 6.10.2006.
- Shri Sourabh Gupta, Scientist – D , CGWB, SUO Pune has attended 12th Training Programme on "Applications of Geoinformaticsin Water Sector" conducted by National Water Academy,CWC, Pune from 10-20th October 2006.
- A 'Water Management Training Programme' was successfully conducted for two days on 14 and 15th November 2006 at Himmatnagar, Sabarkantha district Gujarat. 45 senior officers of State govt. and non govt. agencies have been imparted the training.
- A Training Programme on water management was organized on 9.11.2006 at Narmada Nagar (Indira Sagar Pariyojna), Khandwa district Madhya Pradesh. The target audience were Engineers of Narmada Hydro Development Corporation (NHDC) and villagers.

- A Water Management Training Programme conducted at Sulthan Bathery, Waynad district on 24th and 25th of November 2006. Shri D.S. Thambi, Regional Director (I/C) presided over the function , Smt Sarasamma Teacher, District Panchayath President gave the inaugural address. Shri Joy , Block Panchayat President gave the felicitations.
- A Water Management Training Programme on Rain Water Harvesting conducted at Vizianagaram District, Andhra Pradesh on 12th and 13th of December 2006.
- A Water Management Training were held on 13th December 2006 at North 24 Parganas district, West Bengal. In the training programme, 14 nos. of participants were attended from Municipalities, Panchayat Samities, Institutions and PHED, Govt. of West Bengal. The scientists from CGWB, ER, delivered lectures on different topics, viz. groundwater occurrence, its exploitation methodology, geophysical techniques for ground water exploration, quality aspects with special reference to arsenic contamination in groundwater and methods of rainwater harvesting.
- A one day Training Programme was organized on Ground Water Management with reference to Rain Water Harvesting and Artificial Recharge to Ground Water on 8th December 2006 at Science Hall, Nongpoh, Rai-Bhoi district, Meghalaya. 28 persons were imparted training and Shri B.Dhar, Deputy Commissiner, Rai-Bhoi district was the Chief Guest in the inaugural programme. A drawing competition was organized among the school students of the Nongpoh area on 9th December 2006.
- A two days training programme on Artificial Recharge and ground water quality was organized at Bhopal on 1st and 2nd December 2006 in association with Water Aid India (a NGO funded by European Union). The target group was NGOs and about 50 participants from various NGOs of Madhya Pradesh and Chhattisgarh attended the programme.
- A Training Programme was organized on Rain Water Harvesting and Artificial Recharge to Ground Water during December 2006 at Padhar, Mandi district, Himachal Pradesh.
- A one day Training Programme was organized on Ground Water Management on 7th December 2006 at D.R.D.A. Conference Hall, Jharsuguda district, Orissa.
- A Training Programme on Rainwater Harvesting for Artificial Recharge to Ground Water was organized at Sikar on 20.12.2006 and 21.12.2006. Smt. Malli Devi Gujar, Jila pramukh, Sikar was the Chief Guest in the inauguration and valedictory session. Shri K.P. Singh, Regional Director, WR, Jaipur presided over the function. Shri Arjun Ram Chaudhary, Additional olletor, Sikar and Shri Suwa Lal, Chief Executive Officer, Jila Parisad, Sikar were the Guest of Hour in the training programme. The trainees were officers from Public Health Engineering Department, Ground Water Department, Irrigation, Forest, Agriculture, Planning Departments, Panchayat samiti etc. along with Non-Govt Organizations including PRAYTNA, Bhujal Prayatna Samiti and CEECONDECON. S/Shri K.P. Singh, Regional Director, R.P.Mathur, Supdtg.Hg., S.K. Gupta, Sc-D and Dr. L.N.Mathur, Sc-B, CGWB, WR, Jaipur imparted the training. An exercise was also given to trainees on Roof top raiwater harvesting. A fiel5d visit was also arranged to demonstrate rainwater harvesting structure at Malakhera, Deogarh, Sikar district. An exhibition was also organized during the training programme. Wide publicity was given through leading news papers and ETV.

- Two days training programme on "Design, implementation, operation, Monitoring and Maintenance of Rainwater Harvesting System in Urban areas" has been conducted on 21-22nd December 2006 at Jamnagar House, New Delhi. Forty officials from different agencies like NDMC, DMC, CPWD, NGO, Lecturer from Delhi University Teachers have been participated.
- Water Management Training and Mass Awareness Programmes were organized respectively at Cuddalore during 18-19th January 2007 and Panickankuppam village in Panruti block of Cuddalore district (18.01.2007). Water Management Training was imparted to 42 officers of various departments of Govts. of Tamilnadu and Pondicherry, mostly those involved in activities related to implementation of NREGS schemes. The Mass Awareness Programme was graced by Member (ED & MM) , CGWB, District Collector, Cuddalore and Member of Tamilnadu Legislative Assembly from Panruti Constituency was attended by more than 600 people. During his address, the District Collector appreciated the training and mass awareness campaign being conducted by CGWB and requested CGWB to adopt Paniickankuppam village and take up more useful water conservation programs under NREGS. He also sanctioned an amount of Rs. 25 lacs for implementation of such schemes in the village for which CGWB will give the action plan and monitor the implementation of the schemes with local participation.
- The Central Ground Water Authority and The Central Ground Water Board, Central Region, Nagpur organized two days Water Management Training Programme on "Water Management & Rain Water Harvesting" on 4-5th January 2007 at Wardha district, one of the farmers distress district identified by the PMO. About 25 participants, including Scientists, Engineers, State Government Officials and NGOs attended the programme. The programme was highly successful. Shri G.D.Dhawale, Prof. of Civil Engineering at B.D. Engineering College, Sewagram, Wardha, was the Chief Guest for the inaugural session. The chief guest for the valedictory function was Shri E.Z. Khobragade, Collector, Wardha. The programme included presentations by the officers of CGWB as well as the State Government. A field visit to the nearby Artificial Recharge sites was also made. The programme was highly successful. The participants were very enthusiastic and a lot of interaction was made.
- The Central Ground Water Authority and The Central Ground Water Board, Central Region, Nagpur has organized a two days WMTP programme on "Ground Water Management and Rainwater Harvesting" between 23-24th January 2007 at Administrative Building, Washim, one of the Farmers' distress districts of Maharashtra. The training was imparted to 40 participants including scientists and engineers from GSDA, Irrigation Dept, Forest Dept., tahsil offices and NGO etc. The deliberations were given by the experts of CGWB and State Govt. with some documentaries. The programme was completed successfully.
- Water Management Training Programme was conducted at ZP hall, Belgaum on 23rd and 24th of January 2007. Shri Dheemappa Gorabal, President Zilla Panchayat was the Chief Guest and inaugurated the program. Shri Shivalingammurthy KAS, Chief Executive Officer, Beigaum and Dr. Nagaraja Sharma, Deputy Director, DMG, Gov. of Karnataka were the guest of honour. Shri T.M. Hunse, Regional Director, presided over the function and delivered presidential address.
- Water Management Training Programme on Rainwater Harvesting and Artificial Recharge to Ground Water organized in the drought prone district of

Banaskantha on 23rd and 24th January, 2007. The Banaskantha district is also covered under NREG scheme of Govt. of India.

- The Central Ground Water Board, Mid Eastern Region, Patna organized one day Water Management Training Programme on 4.02.2007 at Tata College, Chaibasa, Jharkhand. The Chief Guest of training programme was Dr. G.S. Jha, Diector CWC. The training was imparted to 80 participants drawn from Tata College, NGOs, Research Scholars and State Govt representatives.
- The Central Ground Water Board, Mid Eastern Region, Patna organized one day Water Management Training Programme on 28.02.2007 at Daultanganj, Palamau, Jharkhand. The Chief Guest of training programme was Dr. D.S. Srivastava, Principal of GLA College. The training was imparted to 100 participants drawn from College students, NGOs, Research Scholars and State Govt representatives.
- Two days training programme on Rainwater Harvesting and Artificial Recharge was organized at Kadapa district from 12.02.2007 to 13.02.2007.
- Water Management Training Programme was conducted successfully on 28th March 2007 at Agricultural University, Junagadh district. The training was imparted to Scientific Officers, Engineers and other technical officers from GOG ,NGO and faculty & students of Junagadh Agricultral University, Junagadh.
- Water Management Training Programme on "Ground Water Development & Management and Scope for Rain Water Harvesting in Coastal areas of Purba Medinipur district, W.B." at Contsi Municipality Hall, Contai, Purba Medinipur district, WB, was organized by CGWA & CGWB, ER, Kolkata, on 15th March '07. About 21 participants from different departments of Govt. of West Bengal were enrolled. However, ultimately 8 trainees participated due to unavoidable circumstances.
- The Central Ground Water Authority and The Central Ground Water Board, Central Region, Nagpur organized two days Water Management Training Programme on "Water Management & Rain Water Harvesting" on 24-25th March 2007 at Shri Sant Gajanan Maharaj College of Engineering at Shegaon in Buldhana district, one of the farmers distress district identified by the PMO. About 30 participants, including faculty Engineers, State Government Officials and NGOs attended the programme. The programme was highly successful. The inauguration programme was presided over by Shri. P.K. Parchure, Scientist-D, CGWB, Nagpur on 24th March 2007. Shri. Pankajbhau Shitoot, Secretary, Shri Sant Gajanan Maharaj Shikshan Sanstha was the Chief Guest and Dr. D.G. Wakde, Principal, Shri Sant Gajanan Maharaj College of Engineering, Shegaon was the Guest of Honour during the inaugural session. During the inauguration ceremony, a booklet on "Hydrogeology of Buldhana District" was released by the Chief Guest Shri Pankajbhau Shitoot and other dignitaries on the dais. Shri Bhushan Lamsoge, Scientist-B, CGWB conducted the inauguration programme and Shri. Neelakantarama, J. M. STA (HG) proposed vote of thanks. Prof.S.B.Somani, Dept. of Mechanical Engineering, SSGMCE, Shegaon worked as a Nodal Officer of this two-day training programme. Shri. Dinesh Prakash, Regional Director, CGWB, Nagpur delivered a lecture on "Ground Water Resource Management and Conservation" to the trainees. S/Shri. P.K. Parchure, P. Narendra, V.P. Nawale, Bhushan Lamsoge, and D. Venkateswaran also delivered their lectures. The training sessions were conducted by Shri Anilchand, A.D. Asst. Hydrogeologist, CGWB. During the first day the lectures were followed by field visits at village Nagjhira in Shegaon taluka where the

trainees were shown and explained about the existing recharge structures like Nala bunding and K.T. Weirs. During the second day the lectures were followed by evaluation of trainees on Roof top rainwater harvesting. The Valedictory function was held on 25th March 2007. Shri. Chaturbhujji Bhattad, Joint Secretary, Shri Gajanana Shikshan Sanstha, Shegaon was the Chief Guest of the function. Shri. Dinesh Prakash, Regional Director, CGWB presided over the function. Dr. D.G. Wakde, Principal, SSGMCE, Shegaon was the collaborator of the above training and was the Guest of Honour. The valedictory function was conducted by Shri. D. Venkateswaran, Scientist-B, CGWB and Shri. Bhushan Lamsoge, Scientist-B, CGWB proposed vote of thanks.

- CGWB, NER, organized one day training programme on Ground Water Management with reference to Rain Water Harvesting and Artficial Recharge to Ground Water on 16th Mach, 2007 at Itanagar, Papumpare district, Arunachal Pradesh. 20 persons were imparted training.
- The Central Ground Water Board, Mid Eastern Region, Patna organized one day Water Management Training Programme on 28.02.2007 at Town hall , Medininagar, Palamu district, Jharkhand. The training was imparted to 84 participants drawn from different College , NGOs, Research Scholars and State Govt representatives.
- The Central Ground Water Board, Mid Eastern Region, Patna organized one day Water Management Training Programme on 8.03.2007 at Hotel Rajhans, Bhagalpur, Bihar. The training was imparted to 75 participants drawn from different agriculture, Engineering & other college , NGOs, Research Scholars representatives from builders and State Govt representatives.
- One day Water Management Training Programme under Central Ground Water Authority was organized in the DRDA Conference hall, Sundergarh on 01.03.2007. It was inaugurated by the Additional District Magistrate, Sundargarh District. More than 40 participants from various State Govt. departments and NGOs actively took part in the programme.
- One day Water Management Training Programme under Central Ground Water Authority was organized in the Conference hall of Baripada Municipality on 23.03.2007. It was inaugurated by the Collector and District Magistrate, Mayurbhanj District. More than 40 participants from various State Govt. departments and NGOs actively took part in the programme.
- One day training programme on Ground Water Management and Rainwater Harvesting under Central Ground Water Board was organized in the Haldwani town, Nainital district on 19.03.2007.
- A Training Programme Rainwater Harvesting and Artificial Recharge to Ground Water was organized by Central Ground Water Board and Central Ground Water Authority, NWHR, Jammu on 19.03.2007 at PHE Complex, Sitlee (Nagrota), district Jammu. Shri C.P. Srivastava, Supdtg Hg. CGWB, NWHR, Jammu explained about the role of individual to save and conservation water so that depleting of ground water could be controlled. Shri J.N. Bhagat, Scientist B, CGWB, NWHR, Jammu expressed his views on conservation of ground water and also the activities of CGWB. The certificates of training were distributed by the Regional Director among the Engineers of PHE, Irrigation and Flood Control, J&K Govt who participated in the training program.
- A Training Programme on Roof Top Rainwater Harvesting and Artificial Recharge to Ground Water was organized by Central Ground Water Board and Central Ground Water Authority, NWHR, Jammu on 20.03.2007 at Town Hall,

Ramnagar, Udhampur district (J&K). The officers of PHE, Irigation and Flood Control, PWD, Power Development department J&K Govt. participated in the training program. Dr. S.C. Dhiman, Regional Director, CGWB, NWHR, Jammu stressed upon the needs of Roof Top Rainwater Harvesting and Artificial Recharge to Ground Water and also to conserve it also emphasized on traditional practices of rainwater harvesting, conservation and management and to adopt them by using scientific inputs. Shri Vinod Sharma, AHG expressed his views on conservation of ground water and stressed upon to awaring the public to conserve, manage and recharge of ground water and prevent wastage of water. The certificates of training were distributed by the Regional Director among the Engineers of PHE, Irrigation and Flood Control, J&K Govt who participated in the training program.

- A Training Programme on Roof Top Rainwater Harvesting and Artificial Recharge to Ground Water was organized by Central Ground Water Board and Central Ground Water Authority, NWHR, Jammu on 23.03.2007 at Mansar, district Udhampur (J&K). The technical lectures and presentations on the subject were presented by the officers of CGWB, NWHR. The participants were also shown the working model of Roof Top Rainwater Harvesting. The Regional Director, CGWB, NWHR also explained the process of snow Harvesting and its need in the snowy/hilly parts of Jammu and Kashmir. Dr S.C. Dhiman gave away the certificates to the trainees.

29. PROGRESSIVE USE OF HINDI

- The provision relating to Section 3(3) of the Official Language Act, 1963 has been fully complied with and all the letters received in Hindi have been replied in Hindi under Rule 5 of the Act.
- Nine sections of the Board have been instructed to do their 100% work in Hindi.
- The quarterly Hindi progress report is being sent regularly to MOWR, New Delhi / Town Official Language Implementation Committee , Faridabad and Regional Implementation Office, Department of Official Language.
- Quarterly meetings of the Departmental Official Language implementation committee are organized regularly and necessary action is taken as per the decisions taken in the meeting.
- Hindi workshops were organized regularly in each quarter.
- Hindi fortnight was organized from 14.09.2006 to 28.09.2006. A number of competitions were organized during the fortnight. The participation of officers/officials was encouraging.
- Incentive schemes always implemented for original noting and drafting in Hindi.
- Necessary action for notifications under Rule 10(4) of the official language rule is being taken in respect of the offices located in Region "A" and "B".
- The Committee of Parliament on Official Language inspected South Eastern Region, Bhubneshwar and State Unit Office, Vishakhapatanam offices of the Board during the year. The Committee expressed satisfaction on the progress of Hindi in these offices and advised for more efforts in this regard.
- Bimonthly magazine 'Bhujal Newsletter' is being published from July-August 2006. Dr. Saleem Romani, Chairman, CGWB released its first issue on 5th August 2006. The Newsletter includes various activities, achievements, important meetings, appointments and other important information's relating to the Board.
- Instructions are issued from time to time for achieving prescribed targets as per the annual programme of the department of official language.
- The Board is committed towards the progress and implementation of Hindi and determined for its progressive use as per the Annual Programme issued by the official language department.

30. PERSONNEL MANAGEMENT

The sanctioned strength, filled up, vacancy position, category-wise personnel deployed and highlights of the achievements of the administrative wing in the Board is presented in table 30.1, 30.2 and 30.3 respectively.

Table 30.1: PERSONNEL DEPLOYMENT IN CENTRAL GROUND WATER BOARD DURING 2006-07

Name of Group	Particular	Scientific / Technical	Ministerial	Engineering	Total Strength
Group A	Sanctioned	364	6	54	424
	Filled	305	4	45	354
	Vacant	59	2	09	70
Group B (Gazetted)	Sanctioned	225	37	110	372
	Filled	197	26	95	318
	Vacant	28	11	15	54
Group B (N-Gazetted)	Sanctioned	119	58	28	205
	Filled	104	58	23	185
	Vacant	15	0	05	20
Group C	Sanctioned	91	1085	865	2041
	Filled	80	975	781	1836
	Vacant	11	110	84	205
Group D	Sanctioned	79	375	893	1347
	Filled	71	323	826	1220
	Vacant	08	52	67	127
Grand Total	Sanctioned	878	1561	1950	4389
	Filled	757	1386	1770	3913
	Vacant	121	175	180	476

Table 30.2 : CATEGORY - WISE STAFF POSITION

Groups	Category	Scientific	Ministerial	Engineering
Group A	OBC	21	-	6
	SC	42	-	11
	ST	12	-	4
	Handicapped	-	-	-
Group B (Gazitted)	OBC	-	-	4
	SC	03	3	16
	ST	-	2	6
	Handicapped	-	-	-
Group B (Non-Gazitted)	OBC	11	-	2
	SC	18	7	5
	ST	04	4	1
	Handicapped	01	1	-
Group C	OBC	01	81	19
	SC	16	169	146
	ST	04	72	52
	Handicapped	-	08	-
Group D	OBC	02	16	73
	SC	25	86	188
	ST	09	20	42
	Handicapped	-	6	-

Table 30.3 :HIGHLIGHTS OF THE ACHIEVEMENTS OF THE ADMINISTRATIVE WING DURING 2006-2007

Sl. No	ITEMS	Scintific	Ministrial	Engineering
1.	DPCs held	22	11	13
2.	Promotions, Appointments & ACPs	36 20 01	54 26 25	228 26 62
3.	EB cases cleared	-	-	-

4.	Confirmation ordered/Probation	17 Confirmation & 35 Probation	-	25Confirmation & 99 Probation
5.	Deputation	2	1	-

31. VIGILANCE

31.1 Vigilance Activities

During the year 2006-2007, 20 complaint cases were brought forward from the last year and 22 complaints have been received during 1.04.2006 to 31.03.2007. Thus total 42 complaint cases were on the record. Out of these 16 cases of complaint were closed and 5 complaint cases have been taken up as disciplinary proceedings. Therefore, 21 complaint cases have been carried forward w.e.f. 1.04.2007 to next year.

31.2 Disciplinary Proceedings

15 cases of disciplinary proceedings were brought forward from last year and 5 cases of disciplinary proceedings have been received during the year. Thus a total 20 cases of disciplinary proceedings were on the record. Out of these 5 cases of disciplinary proceedings have been finalized and 15 cases have been carried forward to next year.

32. PERSONS WITH DISABILITIES

Persons with Disabilities for the year 2006-2007 are given in table 32.1

Table 32.1 PERSONS WITH DISABILITIES FOR THE YEAR 2006-2007

1.	Schemes/Policies run by the respective Ministry/Department for the benefit of Persons with Disabilities.					Nil
2.	Budget allocated and expenditure incurred under each scheme during the financial year.					Nil
3.	No. of persons benefited					Nil
4.	Per capita expenditure					Nil
5.	Sanctioned strength, the number of vacancies filled since 1996 and the number of persons with disabilities appointed in various posts in Group – A, B, C & D against the 3% vacancies to be reserved for them under Section-33 of the PWD Act.	Group	Sanction Strength	Number of vacancies filled since 1996	Number of persons with disabilities appointed against 3% reservation	Remarks
		A	42 4	85	-	
		B	577	103	-	
		C	2041	167	-	
		D	1347	217	3	Requisition for filling up 2 posts amongst physical handicapped (One for OH and one for HH) has been sent to the SSC.

33. BUDGET AND ACCOUNTING

Statement showing actual expenditure incurred by the Board during 2006-2007 has been shown in Table 33.1, Table 33.2, Table 33.3, Table 33.4, Table 33.5 ,Table 33.6 and Table 33.7.

Table 33.1 : STATEMENT SHOWING ACTUAL EXPENDITURE INCURRED BY THE BOARD DURING 2006-2007

Sub-Head	Plan (Rs. In Lakhs) Final Grant up to March 2006		Non-Plan (Rs. In Lakhs) Final Grant up to March 2006	
	Funds	Expenditure	Funds	Expenditure
Salary	1250.00	1176.05	5126.78	5094.56
Wages	12.00	11.80	1.00	0.44
O.T.A	1.95	1.95	16.00	16.72
T. E	330.00	307.72	290.00	284.44
F.T.E	-	0.59	1.00	0.45
O.E	543.00	515.54	6.00	5.81
P.S	11.25	7.07	-	-
R.R.T	165.00	147.85	4.00	3.66
Publications	40.00	48.99	-	-
Subsidies	0.10	0.04	-	-
Susp. Stock	1075.00	976.58	-	-
W. O.L	3.50	0.27	-	-
M.V.	30.00	29.90	-	-
M & E	580.00	405.89	-	-
Works	1700.00	1517.22	-	-
Medical	50.50	47.99	155.00	140.35
Other Charges	10.00	8.31	-	-
B.C.T.T.	0.39	0.41	-	-
POL	1147.31	1109.71	-	-
Total	**6950.00**	**6313.88**	**5600.00**	**5545.65**

Table 33.2: Rajiv Gandhi National Training & Research Institute for Ground Water

Sub-Head	Fund Allotment	Expenditures
Salaries	11.50	9.48
Wages	-	-
O.T.A	-	-
D.T.E	22.00	15.32
O.E	13.50	12.31

R.R.T	-	-
Publication	-	-
P.S	22.00	21.81
M.V	-	-
M & E	-	-
Medical treeatment	2.00	1.76
Total (RGNTR&I)	**71.00**	**60.67**

Table 33.3: Hydrology Project

Sub-Head	**Fund Allotment**	**Expenditures**
Salaries	52.10	51.87
Wages	-	-
O.T.A	-	-
D.T.E	1.75	1.41
O.E	-	-
R.R.T	-	-
Publication	-	-
P.S	0.05	0.02
M.V	1.00	0.81
M & E	3.60	-
Medical treatment	0.50	0.45
Total (Hydrology Project)	**59.00**	**54.56**

Table 33.4: Central Ground Water Authority

Sub-Head	**Fund Allotment**	**Expenditures**
Salaries	55.20	54.59
Wages	0.05	0.02
O.T.A	0.10	0.10
D.T.E	2.75	2.71
O.E	12.00	11.99
R.R.T	0	0
Publication	0	0
P.S	0.25	0.12
M.V	2.10	2.43
M & E	0	0
Medical Treatment	0.25	0.14
Other Charges	0	0
Advs. & Publicity	97.30	48.20
Total CGWA	**170.00**	**120.30**

Table 33.5 :Research and Development in Water Resources Sector

Grant-in-aid	**50.00**	**Scheme controlled by Commissioner(GW) MOWR**
Total (R&D)	**50.00**	**-**

Table 33.6 : Central Ground Water Board building for offices

Sub-Head	Fund Allotment	Expenditures
Major Works	525.00	525.00
Total	525.00	525.00
Total CGWB	7825.00	7074.41

Table 33.7 : DEDUCT RECOVERIES

Sub-Head	Fund Allotment	Expenditures
Central Ground Water Board		
Issue to works and other credits		
Deduct Recoveries 01.02.70	1100.00	1037.00
Other Suspense Stock	100.00	0.00
Deduct Recoveries 01.03.70	1200.00	1037.00
Total Recoveries	**1200.00**	**1037.00**
NET CGWB	**6625.00**	**6037.41**

Annexure -1

LOCATION AND JURISDICTION OF REGIONAL AND OTHER OFFICES OF CENTRAL GROUND WATER BOARD

REGIONS	HEADQUARTERS	JURISDICTION
NORTH WESTERN HIMALAYAN REGION		
Regional Office	Jammu	J&K
Division Office	Div. VIII, Jammu	J&K
NORTH HIMALAYAN REGION		
Regional Office	Dharamshala	Himachal Pradesh
Division Office	Div. XVII, Dharamshala	Himachal Pradesh
NORTH WESTERN REGION		
Regional Office	Chandigarh	Punjab, Haryana, NCT of Delhi & UT of Chandigarh
State Unit Office	Delhi	NCT of Delhi
Division Office	Div. II, Ambala	Punjab, Haryana, NCT of Delhi & UT of Chandigarh
WESTERN REGION		
Regional Office	Jaipur	Rajasthan
State Unit Office	Jodhpur	Western Rajasthan
Division Office	Div. XI, Jodhpur	Rajasthan
WEST CENTRAL REGION		
Regional Office	Ahmedabad	Gujarat, UT of Daman & Diu
Division Office	Div.I, Ahmedabad	Gujarat, UT of Daman & Diu
NORTH CENTRAL REGION		
Regional Office	Bhopal	Madhya Pradesh
Division Office	Div.XII, Bhopal	Madhya Pradesh
NORTH CENTRAL CHATTISGARH		
Regional Office	Raipur	Chattisgarh
Division Office	Div.XIII, Raipur	Chattisgarh
CENTRAL REGION		
Regional Office	Nagpur	Maharashtra, UT of D & N. Haveli
State Unit Office	Pune	West Maharashtra
Division Office	Div. VI, Nagpur	Maharashtra, UT of D & N. Haveli
NOTHERN REGION		
Regional Office	Lucknow	Uttar Pradesh
State Unit Office	Allahabad	Uttar Pradesh
Division Office	Div.III, Varanasi	Uttar Pradesh
UTTARANCHAL REGION		
Regional Office	Dehradun	Uttaranchal
State Unit Office	Bareilly	Uttaranchal
Division Office	Div.XVI, Bareilly	Uttaranchal
MID EASTERN REGION		
Regional Office	Patna	Bihar, Jharkhand
Division Office	Div. V, Ranchi	Bihar, Jharkhand
EASTERN REGION		
Regional Office	Kolkata	West Bengal, Sikkim, UT of A & Nicobar Islands
Division Office	Div. XV, Kolkata	-do-
NORTH EASTERN REGION		
Regional Office	Guwahati	Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Tripura
State Unit Office	Itanagar	Arunachal Pradesh
	Shillong	Meghalaya
	Agartalla	Mizoram, Tripura
Division Office	Div.VII, Guwahati	Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Tripura
SOUTH EASTERN REGION		
Regional Office	Bhubaneshwar	Orissa
Division Office	Div. x, Bhubaneshwar	Orissa
SOUTHERN REGION		
Regional Office	Hyderabad	Andhra Pradesh
State Unit Office	Vishakhapatanam	Coastal Andhra Pradesh

Division Office	Div. ix, Hyderabad	Andhra Pradesh
SOUTH WESTERN REGION		
Regional Office	Bangalore	Karnataka & Goa
State Unit Office	Belgaum	W. Karnataka & Goa
Division Office	Div. xiv, Bangalore	Karnataka & Goa
SOUTH EASTERN COASTAL REGION		
Regional Office	Chennai	Tamil Nadu, UT of Pondicherry
Division Office	Div. iv, Chennai	Tamil Nadu, UT of Pondicherry
KERALA REGION		
Regional Office	Trivendrum	Kerala & UT of Lakshadweep
Division Office	Div. iv, Chennai	Kerala & UT of Lakshadweep