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भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

BALRAMPUR DISTRICT, CHHATTISGARH

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

भारत सरकार
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जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
Department of Water Resources, River Development & Ganga Rejuvenation
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Aquifer Maps and Ground Water Management Plan of Balrampur District, Chhattisgarh

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FOREWORD

Groundwater resources are being developed over years in order to meet domestic, irrigation and industrial requirements. The spatial distribution of availability of ground water resources however, is uneven and is being indiscriminately exploited by various users thereby creating relentless pressure. On the other hand, rapid urbanization, industrialization and land use changes has resulted decline of water levels in many parts of the country.

There is an urgent need for scientific approach for proper management of the available ground water resources for sustainability of this precious natural resource for present and future generation.

Central Ground Water Board has been in the forefront of activities for occurrence, development, and management of this resource through various scientific studies and techniques. Over the last four decades CGWB, NCCR, Raipur has gathered a huge amount of data regarding ground water resources of Chhattisgarh. Based on this experience aquifer mapping of Raigarh district was prepared with the vast amount of data generated and available with North Central Chhattisgarh Region. The report embodies all the features of ground water and related aspects of the study area including physiography, meteorological conditions, hydrology, drainage, geomorphology, geology, hydrogeology, ground water resources, hydrochemistry, geophysics, ground water problems etc.

The report titled "A REPORT ON AQUIFER MAPS AND GROUNDWATER MANAGEMENT PLAN OF BALRAMPUR DISTRICT, CHHATTISGARH" is prepared by Sh G. Sreenath, Scientist-B under supervision of Sh. A.K.Patre, Scientist-D. I appreciate the concerted efforts put by the author to make it possible to bring the report in its present shape. I hope this report will no doubt be useful and worthy for the benefit of Balrampur district and would be a useful document for academicians, administrators, planners and all the stakeholders in ground water.

Though utmost care has been taken to minimize the errors, some errors may have inadvertently crept in. It is expected that these mistakes will be taken in the proper spirit.

A.K. Biswal
(REGIONAL DIRECTOR (I/C))

Executive summary

Aquifer mapping is a multidisciplinary scientific process wherein a combination of geological, hydrogeological, geophysical, hydrological and quality data is integrated to characterize the quantity, quality and movement of ground water in aquifers. However, due to paradigm shift in focus from development to management of ground water in last one decade, the need for more reliable and comprehensive aquifer maps on larger scale has been felt for equitable and sustainable management of the ground water resources at local scale. Volumetric assessment of ground water and strategies for future development and management are the primary objectives of aquifer mapping.

Under the aquifer mapping programme, all the development blocks of Balrampur District namely Rajpur, Shakergarh, Wadraf Nagar, Balrampur, Kusumi, and Ramchandrapur were taken up covering an area of 7139.20 sq. km. It falls in the Survey of India's Degree Sheet No. 64 I, and M and it is situated between 23° 60' 67" N Latitude and 83° 62' 03" E Longitude. The Balrampur district occupies the north part of Chhattisgarh state. The district is bound on north and northeast of its parent district, i.e. Surguja district. Most part of the district consists of hills. The district is rich in forest and is famous for its rich wildlife as it has very thick cover of forest.

The total population of the study area as per 2011 Census is 730491 out of which rural population is 695808& the urban population is only 34683. The study area experiences sub-tropical climate. The average annual rainfall for the study area is around 1166.80 mm (1975-2011). Geomorphologically the study area displays Structural Plains, Pediment/Pediplain, Denudational Hills and Valleys with an elevation ranging from 440 to 1116 m amsl.

The net sown area is 166000 hectares, while double-cropped area is 76780 hectares. Rice is sown in nearly 65% of the net sown area. The net irrigated area in the study area is 19560 hectares where ground water contribution is 5560 Ha only. Percentage of Area Irrigated by ground water with respect to net irrigated area is 14 %. About 90% area with respect to net sown area is dependent on rain only.

Based on the exploratory drilling data generated for the blocks, the existing aquifer systems in the area may be divided into phreatic and semiconfined aquifer. The major aquifers present in the study area are (1) Granite/ Gneiss (2) Sandstone (3) Laterites. In Granite/Gneiss, Discharge varies from 0- 4 lps having Av. Drawdown of 18 m and higher yields are obtained where thick weathered zones are associated with bedrock fracturing. In Sandstone (Gondwana), Discharge varies from 0- 10.65 lps having Av. Drawdown of 16 m. Sandstones having felsdpathic composition and medium to coarse grained, it is then porous and permeable and forms good aquifers.

As per 2017 ground water resource calculation stage of ground water development in the study area is only 40.06%. So, there is scope of utilizing more ground water for future irrigation purpose and other purposes. Additional number of Ground water

abstraction structure may be developed for the effective utilization of ground water resources.

Groundwater has proved the most reliable resource for meeting rural water demand in Balrampur district. There are four main hydrogeological environments in the district. 1. Crystalline basement occupies 50% of the land area of Balrampur; 4.5 lakh people live in rural areas underlain by crystalline basement rocks. Groundwater is found where the rocks have been significantly weathered or in underlying fracture zones. Borehole and well yields are generally low, but can be sufficient for rural demand. 2. Laterite aquifers occupy 6% of the land area of Balrampur, and sustain a rural population of about 20000, many of whom live in the drought stricken areas. Groundwater is found within palaeosoils and fractures between lava flows in basalt rocks. Yields can be high, and springs are important in highland areas. 3. Consolidated sedimentary rocks occupy 42% of the land area of Balrampur and sustain a rural population of approximately 2 lakh. Significant groundwater is found within sandstones and shale, which can be exploited for rural supply. Mudstones however, (which account for about 65% of all sedimentary rocks) contain little groundwater, and careful study is required to develop water for community supply. 4. Unconsolidated sediments occupy 2% of the land area of Balrampur and sustain a rural population of about 60000. They are present in river valleys. Groundwater is found within sands and gravels. Groundwater has excellent natural microbiological quality and generally adequate chemical quality for most uses. However problems can arise from the chemistry of groundwater in some circumstances, for example: high sulphate in some parts of the weathered basement and mudstones; hardness in shale aquifers or sandstones cemented with carbonate material. Minor and trace constituents which make up about 1% of the solute content of natural waters can also sometimes lead to health problems or make the water unacceptable for human and animal consumption. For example: high fluoride in some volcanic aquifers; elevated iron and manganese where conditions are anoxic; Geophysical techniques in particular have proved useful in many environments for siting wells and boreholes. Some issues that demand more attention are: • recharge and sustainability of groundwater supplies in basement areas, particularly during drought; • the existence of groundwater in poorly weathered crystalline basement and shale areas; • sustainability of groundwater supplies from upland weathered (laterite) aquifers; • overexploitation of groundwater in sandstone aquifers; • variations in natural quality and contamination of groundwater.

The major ground water issues identified during the survey in the study area are as follows: (i) The aquifers are low yielding ones in terms of groundwater. (ii) During summer, dug wells in some villages becomes dry at many locations. Several handpumps also stop yielding water. (iii) It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. (iv) Poor stage of groundwater development. (v) In some areas the water level remains below 3 m during the post-monsoon period in the study area which needs to be attended for intervention.

In study area because of complex hydrogeological conditions ground availability is scattered. In area where ground water availability is limited surface water may be conserved and utilized. High value of Fluoride and Iron has been reported from several locations. In granitic aquifer system at many places ground water is contaminated with Fluoride because of geogenic reasons. The problem of fluoride contamination in drinking water may be tackled by setting up of small defluorination units in affected villages or alternate source may be identified. Similarly, Iron filter may be used for the villages having high Iron concentration. Regular ground water quality monitoring is also required.

So far as Management strategies are concerned for ground water availability, Artificial Recharge structures may be constructed in suitable locations especially in the areas where the water level remains deeper than 3m in the post-monsoon period. In order to achieve 70% stage of ground water withdrawal in these blocks, ground water development may be taken up by construction of suitable abstraction structures. De-siltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also, Rain water harvesting structures may be constructed in villages to reduce stress on groundwater. Massive awareness campaigns are essential to aware people about the effective utilization of ground water resources and importance of community participation in saving water.

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN BALRAMPUR DISTRICT, CHHATTISGARH

CONTENTS

CHAPTER	Page No
1. Introduction	1-23
1.1 Objective	1
1.2 Scope of study	1-2
1.3 Approach and Methodology	2
1.4 Area Details	2-4
1.5 Data Availability,Data Adequacy, Data Gap Analysis and Data Generation	5
1.6 Rainfall-spatial,temporal and secular distribution	5-6
1.7 Physiography/Geomorphology	6-7
1.8 Landuse	7-8
1.9 Soil	9-10
1.10 Hydrology and Drainage	11-12
1.11 Geology &Hydrogeology	13-21
1.12 Agriculture,Irrigation, Cropping pattern	22
2.Data collection and Generation	23-30
2.1Hydrogeological Data	23-28
2.2 Hydrochemical Data	28
2.3 Geophysical Data	28
2.4 Exploratory Data	28-30
3. Data interpretation, Integration and Aquifer mapping	31-43
4. Ground Water Resources	44
5. Ground Water Related Issues	45
6. Ground Water Management Plan	46-48
7. Conclusion	49
8. Annexure l: Probable sites for Artificial Recharge **Annexure ll: Chemical analysis data of Balrampur district**	50-72 73-77

ABBREVIATIONS

a msl	above mean sea level
BDR	Basic Data Report
BW	Borewell
CGWB	Central Ground Water Board
Dia	Diameter
DTW	Depth To Water
DW	Dugwell
EC	Electrical Conductivity
EW	Exploratory Wells
GS	Gabion structures
GW/ gw	Ground Water
ham	Hectare meter
HP	Handpump (Shallow)
lpcd	litres per capita per day
lpm	litres per minute
lps	liters per second
m	meter
m bgl	meter below ground level
m2/day	Square meter/ day
m3/day	cubic meter/day
MCM/mcm	Million Cubic Meter
NCCR	North Central Chhattisgarh Region
NHNS/ NHS	National Hydrograph Network Stations
OW	Observation Well
PZ	Piezometre
STP	Sewage Treatment Plan
T	Transmissivity
TW	Tubewell

1. Introduction

1.1 Objective

The groundwater is the most valuable resource for the country. However, due to rapid and uneven development, this resource has come under stress in several parts of the country. Central Ground Water Board (CGWB) is, therefore, involved in hydrogeological investigations for Re-appraisal of ground water regime. CGWB has also carried out ground water exploration in different phases with prime objective of demarcating and identifying the potential aquifers in different terrains for evaluating the aquifer parameters and also for developing them in future. The reports and maps generated from the studies are mostly based on administrative units such as districts and blocks and depict the subsurface disposition of aquifer on regional scale. However, due to paradigm shift in focus from development to management of ground water in last one decade, the need for more reliable and comprehensive aquifer maps on larger scale has been felt for equitable and sustainable management of the ground water resources at local scale.

1.2 Scope of study

The demand for ground water for various types of use is increasing day by day; consequently, indiscriminate development of ground water has taken place and the ground water resource has come under stress in several parts of the country. On the other hand, there are also areas where adequate development of ground water resources has not taken place. These facts underscore the need for micro- level study of the aquifer systems of the country. The water resource managers and planners to develop and implement effective long term as well as short term aquifer management strategies, a host of scientific questions must be answered. These questions can be best answered through a comprehensive process that integrates the available scientific data. Aquifer mapping study thus is a multidisciplinary scientific process wherein a combination of geological, hydrogeological, geophysical, hydrological and quality data is integrated to characterize the quantity, quality and movement of ground water in aquifers. It primarily depends on the existing data that are assembled, analyzed and interpreted from available sources. The data gap analysis carried out helped to generate data from data newly collected through activities such as exploratory drilling, groundwater level monitoring on a regular basis for a considerable period and groundwater quality analysis. These existing as well as generated data were analyzed in ordered to prepare regional hydrogeological, thematic, water quality maps, cross-sections, 2 –D and 3-D aquifer disposition maps. The aquifer maps are the maps depicting aquifer disposition, giving lateral and vertical extension. The maps will also provide information on the quantity and quality. It explains the components of the Aquifer Classification System, outlines the assumptions underlying the map information presented and summarizes the content of an aquifer classification map. The goal is to help the map users understand the strengths and limitations of the information contained on the aquifer classification maps so that they can apply that information appropriately to their particular water and land management needs. The system and maps are designed to be used together and in conjunction with other available information as a screening tool for setting groundwater management priorities. These provide a way of comparing aquifers within a consistent hydrogeological context and prioritizing future actions at various planning levels. The maps may provide some background information for site-specific projects. However, the maps are not to be used for making site-specific decisions. The classification of an aquifer reflects the aquifer as a whole and at a specific time. Groundwater

conditions, such as the degree of vulnerability and water quality, may vary locally and over time respectively. This variability in the data sometimes requires subjective decision-making and generalizing of information for an entire aquifer.

1.3 Approach and Methodology

The activities under the aquifer project can be summarized as follows:
i) **Data Compilation & Data Gap Analysis:** One of the important aspects of the aquifer mapping programme was the synthesis of the large volume of data already collected during specific studies carried out by the Central Ground Water Board and various other government organizations with a new set of data generated that broadly describe an aquifer system. The data were compiled, analyzed, synthesized and interpreted from available sources. These sources were predominantly non-computerized data that were converted into computer-based GIS data sets. On the basis of these available data, Data Gaps were identified.
ii) **Data Generation:** It was evident from the data gap that additional data should be generated to fill the data gaps in order to achieve the objective of the aquifer mapping programme. This was done by multiple activities like exploratory drilling, hydrochemical analysis, use of geophysical techniques as well as detail hydrogeological surveys.
iii) **Aquifer map Preparation:** On the basis of integration of data generated through various hydrogeological and geophysical studies, aquifers have been delineated and characterized in terms of quality and potential. Various maps have been prepared bringing out the Characterization of Aquifers. These maps may be termed as Aquifer Maps depicting spatial (lateral and vertical) variation of the aquifers existing within the study area, quality, water level and vulnerability (quality and quantity).
iv) **Aquifer Management Plan:** Based on the integration of these generated, compiled, analysed and interpreted data, the management plan has been prepared for sustainable development of the aquifer existing in the area.

1.4 Area Details

The Balrampur district is a newly formed district on 1st January 2012. Balrampur was earlier a part of the Surguja district and is bounded on South and South-west by its parent district, Surguja. It covers an area of 3806.08 sq. km. The district is located in the extreme northern part of the Chhattisgarh state. It falls in the Survey of India's Degree Sheet Nos. 64I, 64M, 64P & 73 A in parts(1:250000 Scale) between latitudes 23°08'49'to 24°06'22''N and longitudes 82°41'48''to 84°04'38''E. The district is bounded by Jharkhand State in the north-east, Uttar Pradesh State in the north, Madhya Pradesh State in the north- west, Surajpur district in the west and Surguja & Jashpur district in the south. Though the district is well connected by road to adjoining districts such as Surguja and Raipur within the state, the railway connectivity is poor and the nearest railway station is in Ambikapur (Chhattisgarh) and Garhwa (Jharkhand). The nearest airport within the state is the capital of Raipur which is around 400 km from Raipur.

In all, a total of 640 no. of villages are existing in the district. For administrative convenience, the district is divided into 6 blocks, 340 gram panchayats and 5 Nagar panchayats. The block headquarters are located at Rajpur, Shankargarh, Balrampur, Ramanujganj, Kusmi and Wadrafnagar.Under the aquifer mapping programme, all the 06 development blocks of Balrampur district was covered and aquifer map and management plan prepared for all the

blocks. Most part of the district consists of hills. The district is rich in forest and is famous for its rich wildlife as it has very thick cover of forest. It covers an area of 7139.20 Sq Km. Nearly 40 % of the total geographical area of the District is covered by forest. Balrampur district is a predominantly agricultural district. The soil is fertile. This district is mostly populated with tribal people. Maize, Paddy and Wheat are the main agricultural crops raised by farmers in the district. Major problem in the district is lower irrigation facility which is only 8%. The total population of district as per 2011 Census is 730491 out of which male population is 370256 while the female population is 360235 and having population density of 102 per sq km. In the district rural population is 695808 while the urban population is 34683.

1.4.1 Administrative Division

Balrampur district has 645villages and for administrative convenience these villages are grouped into 6 no. of development blocks. Balrampur is the districts headquarter. The block headquarters are at Balrampurr, Rajpur, Shankergarh, Kusmi, Wadrafnagar, and Ramchandrapur. The administrative map for the Balrampur district is given in **Fig 1.**

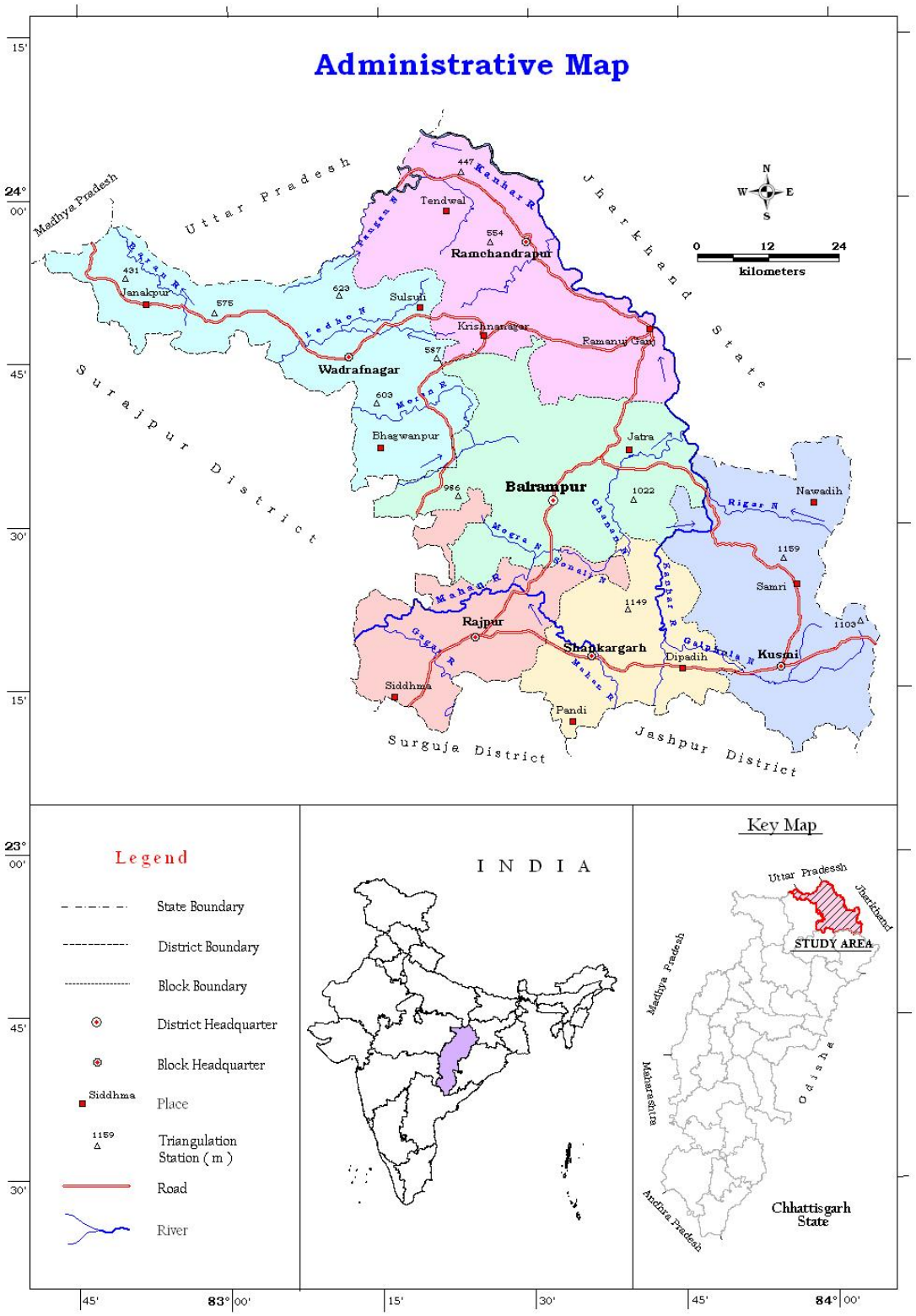

Figure 1 Administrative Map of Balrampur District

Data Availability, Data Adequacy and Data gap Analysis

The hydrogeological data already available including number of key wells, VES, exploratory wells, chemical parameters have been collected and analysed which shows that in the Balrampur district the required number of ground water monitoring stations is 100 for unconfined aquifer against which only 25 stations are available leading to the data gap of 75 and for semiconfined aquifer monitoring stations is 05 against 55. Similarly, the required number of ground water exploratory wells is 55 against which only 24 stations are available leading to the data gap of 26. Likewise, the required number of ground water quality monitoring stations is 140 against which only 25 stations are available leading to the data gap of 115. For geophysical data, the required number of VES is 100 against which 30 are available leading to the data gap of 70.

1.5.1 Data Gap Analysis

On the basis of the NHS data, VES data and chemical data available in the study area, the data gap analysis has been prepared to ascertain the data gap in the Balrampur district which is presented in summary in Table 1.

Table 1 Data gap analysis in Balrampur district

Activity	Required	Available	Gap
Exploration EW/OW	55	15	40
GW Monitoring (Unconfined aquifer)	100	25	75
GW Monitoring (Semiconfined aquifer)	55	5	50
Quality monitoring	140	25	115
VES	100	08	96

1.6 Rainfall-spatial, temporal and secular distribution

The district experiences sub-tropical climate and is characterized by extreme summer and winter seasons. The summer months are from March to May and the months of April and May are the hottest. The mean daily maximum temperature in summer season goes up to 46°C. The rainy season extends from the month of June to September with well distributed rainfall through southwest monsoon. Monsoon generally breaks in the third week of June and is maximum in the months of July and August and is generally pleasant. Winter season is marked by dry and cold weather with intermittent showers during the months of December and January. January is the coldest month with mean daily maximum temperature at 30°C and the minimum is around 10°C.
The evaporation is maximum in the month of May and minimum during the months of December and January.
The atmospheric humidity is usually low during summer months around 25%. However humidity slowly starts building up from third weak of May and it reaches maximum around 85% during monsoon period. The humidity again decreases in winter season and it varies between 30 to 40% during winter season.
The wind flows easterly or westerly during the southwest monsoon period. During post-monsoon and winter seasons the wind directions are between north and east and sometimes westerly. The wind speed of more than 10 km/hr is recorded during the monsoon months (from June to September). In the post-monsoon and winter months (from October to February), the wind speed

is less than 5 km/hr and in the summer months (March to May) the wind speed is more than 7 km/hr.
The Balrampur district receives rainfall mainly from south-west monsoon. It sets in third/fourth week of June and continues till mid August/September with heaviest showers in the months of July and August. The average annual rainfall for the district is around 1166.80 mm (1975-2011).

The Balrampur district receives rainfall mainly from south-west monsoon. About 87% of the annual rainfall is received during June to September, July and August are the months of maximum precipitation, some rainfall is received in June, mostly in the form of thunder showers and during the cold season in association with passing western disturbances. There are on an average 73 rainy days in a year in the District. The average annual rainfall for the Balrampur district is around 960.60 (Average of the last ten years i.e. 2009 to 2018) which is presented below in **Table 2**.

Table 2 Annual Rainfall (mm) in Balrampur district for the years (2009 to 2018)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Surguja	880.1	614.1	989.9	1160.9	838.9	947.9	614.1	771.0	1536.0	1247.7

Source: District Statistical Handbook 2018

1.7 Physiography/Geomorphology

This district is a part of large central water divider of India. General slop of the district is towards north. Therefore, most of the rivers flow in this direction and join Son River which falls in the river Ganges. Rihand River flows from central plateau and crosses the northern mountain ranges. This river provides drainage to the most part of the district. Rihand River originates from Matunga Mountains (1088 m) near south- east border and generally flows to north in Balrampur. It flows on north-east in Sidhi in Madhya Pradesh and Sonbhadra in Uttar Pradesh, where it falls in Son River. Mahan and Moran rivers are its tributaries which meet on the right bank in Balrampur. The second longest river of the district is Kanhar. This originates from Gigha-Dhodhi of Kheria. **Fig 3** shows the Geomorphology in the study area.

The general slope of the district comes under Lower Ganges river slope and is towards the north and north-west and locally in some places towards east. The Lower Ganges basin covers almost total area of the district. Sendur River, Kanhar River and Rehand river tributaries i.e. Mahan and Moran rivers draining the district. All of them flow in north and northwestern direction. The high drainage density in the northern part of the basin reflects the imperviousness of the bedrock as well as the high slope of the area resulting in high runoff. The drainage in the district is mainly of dendritic pattern and is young in nature**.**

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Geomorphologically the district displays Denudational Hills & Valleys, Pediment/Pediplain, and Structural plain, Structural Hills & Valleys, Plateau and Denudational Plateau. The Denudational Hills & Valleys on Proterozoic rocks are formed in southern & northern part. This unit is developed over Granite & Meta-morphic rocks. This unit has extensive cris-crossed fractures/ joints and lineaments. They are formed due to differential erosion and weathering, so that a more resistant formation or intrusion stand as mountains/ hills.

The central, eastern and northern part of the district is represented by Pediment/Pediplain in patches. This unit is developed over Granite & Meta-morphic rocks. This unit has fractures & joints. They are having gently sloping, smooth surface of erosional bed rock between hill & plain with veneer of detritus.

Structural plain on Proterozoic rocks are formed in north-west part of the district. It is developed over rocks of Purana Sedimentaries basins of Chhattisgarh with extensive criss-crossed fractures and Joints. The broad gently sloping erosional surface is covered with detritus of rock and thin to moderatecover of soil. Structural Hills & Valleys are formed in the western part of the district. They are associated with folding /faulting etc. They are having high relief steep sided linear to arcuate hills showing definite trend lines covered with thin soil and forest.

The region of Plateau is developed in central & east part of the district. This unit is developed over Granite & Meta-morphic rocks. This unit has extensive cris-crossed fractures/ joints. It is having flat top and steep slope relief controlled by structure. Denudational Plateau is developed in southern part of the district. This unit is developed over Granite & Meta-morphic rocks. This unit has extensive cris-crossed fractures/ joints and lineaments. It is formed by extensive flat top and steep slopes, relief controlled by structure.

Overall the topography in the district varies between 300 m to 1200 m amsl. The area has general slope towards north & north-west direction with average elevation of 800 m amsl.

1.8 Land use

There is 144015.3 ha is forest area in the district. Area not available for cultivation is 43663 ha. Details are presented in Table 3. Th land use map of the district is given in Fig.2

Table 3: District Land Use Pattern (Ha)

Total geographical area	Forest Area	Khariff Sown area	Rabi sown area	Fruit crop area	Net sown area	Single crop area	Gross cropped area
713920	221026	165750	76780	14160	166000	89220	255220

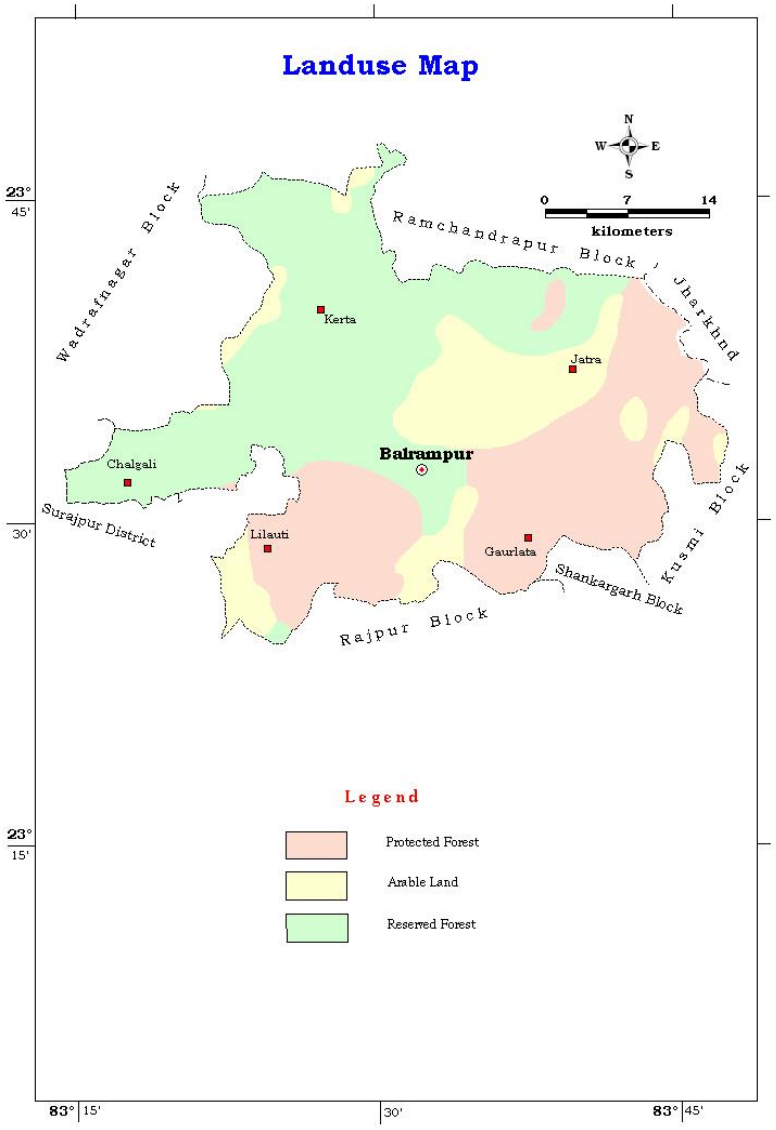


Figure 2. Land use map of Balrampur district

1.9 Soil

Four types of soils occur in the district viz. Alfisols, Vertisols, Ultisols and Inceptisols.

Alfisols- There is only one type of Indian equivalent of this soil is found in Balrampur district namely Red & Sandy soil. They are exposed in major part of the district. This is a fertile leached soil found in humid areas that is alkaline or basic and contains a clay-rich layer. They are less extensively leached of metal ions and develop in cooler climates than the Ultisols, a clay-rich soil of warmer regions. These soils formed where annually dropping leaves form a thick humus layer with the time, under which by decomposition processes the characteristic loam layer are formed, which usually refers to a high age of the soil. They are considered as very fertile soils and are accordingly frequently agriculturally used. Alfisols typically exhibit well-developed, contrasting soil horizons (layers) depleted in calcium carbonate but enriched in aluminum and iron-bearing minerals. Below the surface horizon lies a region with significant accumulation of translocated (migrated) layer silicate clay. This region, called the argillic horizon, is characterized by a relatively high content of available calcium, magnesium, potassium, and sodium ions.

Vertisols-There is one type of Indian equivalent of this soil is found in Balrampur district namely Medium black soil. It is exposed in western & north-western part of the district. Vertisol is a soil in which the content of clay size particles is 30% or more by mass in all horizons of the upper half-metre of the soil profile. They are are characterized by a high content of expanding and shrinking clay known as montmorillonite. Vertisols are especially suitable for rice because they are almost impermeable when saturated. Rainfaid farming is very difficult because vetisols can be worked only under a very narrow range of moisture conditions as they become very hard when dry and become very sticky when wet.

Ultisols-The Indian equivalent of this soil found in Balrampur district is Lateritic and Red & Yellow soil. They are exposed in eastern, northern & south-western part in patches. They are characterized by a humus-rich surface horizon and by a layer of clay that has migrated below the surface horizon. This soil has variety of clay minerals but in many cases the dominant mineral is

Kaolinite- This clay has good bearing capacity and no shrink-swell property. They are red to yellow in color and are quite acidic having pH less than 5. The red and yellow color results from the accumulation of iron oxide which is highly insoluble in water.

Inceptisols- There is one type of Indian equivalent of this soil is found in Balrampur district namely Shallow black soil. These are also called as young soils. Inceptisols are soils of relatively new origin and are characterized by having only the weakest appearance of horizons, or layers, produced by soil-forming factors. The soil profiles give some indications of clay minerals, metal oxides, or humus accumulating in layers, but such accumulation is not sufficient to classify the soil into an order defined by characteristic surface or subsurface horizons. They commonly are found either with underlying weathering-resistant parent material (for example, quartzite or siliceous sandstone) or in topographic settings conducive to soil erosion or water logging. They generally occupy river deltas and hill slopes.

The soils in the district are having wide variations. About 53% of the district area, is covered by **Alfisols**- red sandy soil, covering mainly Rajpur block, southern part of Wadraf nagar block and western part of shankergarh and kusmi block. About 33% area of the district covering part of Balrampur, Ramchandrapur, and Wadraf nagar blocks covered by Ultisols- red and yellow soils. About 16 % of district area i.e. Balrampur block and adjoining area of Ramchandrapur block have the Ultisols in the form of laterites. The remaining part of the district is represented by light grey and shallow black inceptisols, Fig 4 shows the soil map of the area.

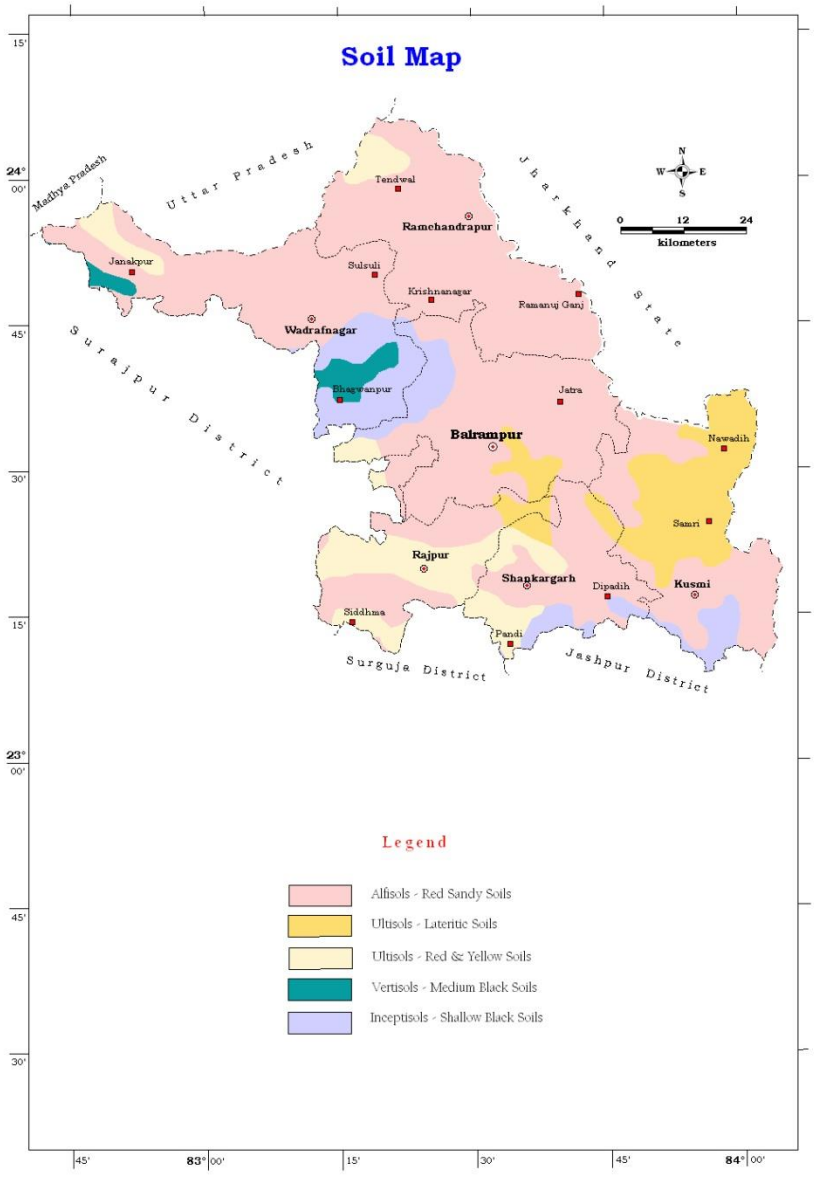


Figure 3 Soil Map of Study Area

1.10 Hydrology and Drainage

This district is a part of large central water divider of India. General slop of the district is north. Therefore, most of the rivers flow in this direction and join Son River which falls in the river Ganges. Rihand River flows from central plateau and crosses the northern mountain ranges. This river provides drainage to the most part of the district. Rihand River originates from Matunga Mountains (1088 m) near south- east border and generally flows to north in Balrampur. It flows on north-east in Sidhi in Madhya Pradesh and Sonbhadra in Uttar Pradesh, where it falls in Son River. Mahan and Moran rivers are its tributaries which meet on the right bank in Balrampur. The second longest river of the district is Kanhar. This originates from Gigha-Dhodhi of Kheria

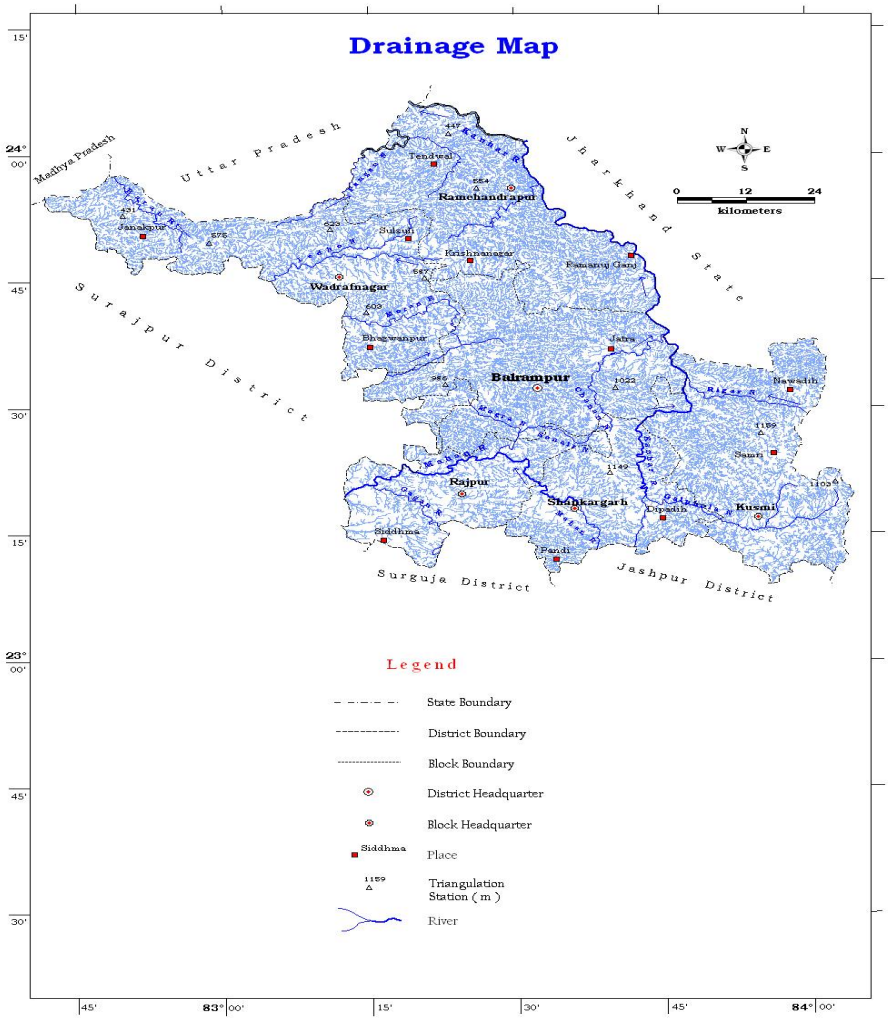


Figure 4 Drainage Map of Study Area

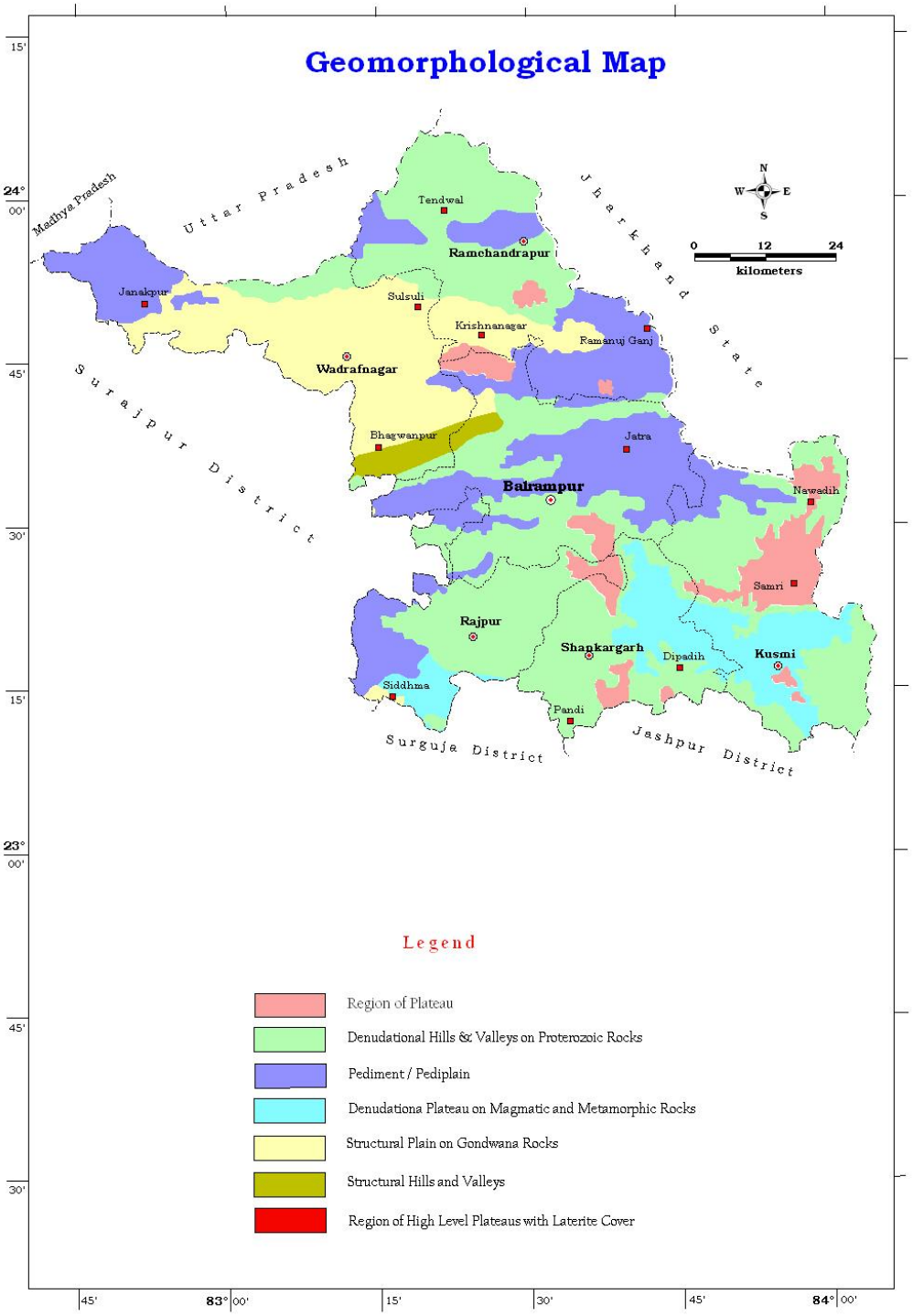


Figure 5 Geomorphological Map of Study Area

1.11 Geology and Hydrogeology

The district is underlain mainly by three distinct geological formations ranging in age from Achaean to recent. The crystalline basement, occupy eastern parts of the district, comprising of granite and granitic gneiss rocks belonging to Chhota Nagpur group, severally intruded by the quartz veins and basic dykes. Central part of the district mainly Wadraf Nagar block and part of Balrampur block of the district is occupied by the rocks of Gondwana Super Group and represented by the sandstone, shale and coal seam. In Mainpat area there is exposure of Deccan trap. The Generalized geological successions in Balrampur district are given in Table 4.

Geologically, the district comprises of rocks of Unclassified metamorphic of Bilaspur-Raigarh-Surguja formation and Chhota Nagpur Gneissic Complex of Archaen- Paleao Proterozoic age, Gondwana Supergroup of rocks especially Talchir formation, Barakar formation, Raniganj formation, Panchet formation, Jabalpur-Parsora-Tikki formation of Paleozoic-Mesozoic age, Deccan Trap & Lameta beds of Cenozoic age and Laterites of Quaternary age.

Unclassified metamorphic of Bilaspur-Raigarh-Surguja formation: The Archean rocks mainly comprising of gneisses, granite, schist and quartzite occupying the northern & western portion of the district. The porphyritic gneiss is pink in coloured and contains phenocrysts in the area. The gneisses exhibit banded structure. The granite of the area comprises of quartz, felspar and biotite. The weathering of these rocks shows biotite altering to chlorite. It is observed that the weathering in these rocks extended down to a depth range of 30 mbgl with the average depth ranging from12 to 15 mbgl.

Chhotanagpur gneissic complex: A large part (i.e. southern, north-western & northern) of the district is covered by Chhotanagpur gneissic complex. These rocks are younger than Bastar gneisses. These rocks have proposed geological sequence for the prominent Central Surguja Shear Zone extending for over 100 km from river Mahan in the west to Binda Nagar in the east in ENE-WSW direction. The CGC comprises of group of meta-sedimentary and gneissic rocks. This rock unit consists of granite gneiss, quartz-mica schist, chlorite- biotite schist, quartzite, calc-silicates and quartz-feldpathic cataclasites. The assemblages of these litho-units occur as isolated patches within the biotite gneiss. Two types of gray and pink colored granites occur as intrusive along with pegmatites, aplites and quartz veins.

The CGC is highly metamorphosed and highly disturbed and dominated by ENE-WSN trending lineaments. The CGC was thrown into isoclinal tight folds as a result of coming together of peninsular and Bundelkhand block during Satpura Orogeny. The crystallines of these areas suffered three phases of deformation and folding. During first phase of deformation, resulting due to N-S compressive stresses, tight isoclinal folds (F1) having ENE-WSW trending axial plane foliation was produced. The phase was culminated by granite activity. The open to tight up right folds (F2) with their axes aligned in the same direction of F1 were superimposed during the second phase of deformation. F2 folds depict variable low angle plunge towards East or West or both with axial plane shearing. The second phase was marked by emplacement of pink granite and pagmatites. The third phase of folding (F3) is conspicuous shown by the closure of the

outcrops along the strike, with their axes running perpendicular to F1 axes. As a result of East-

West compressive stresses, cross folds formed during the third phase with simultaneous generation of several cross faults and associated fractures. Intrusion of pegmatite, applites and dolerite dykes marked the culmination of this phase. Due to poly phase deformation mylonites, cataclasites and phyllonites can be recognised in Surguja area and they host uranium mineralization in this shear zone.

The ground water mainly occurs in phreatic conditions and at places under semi-confined conditions. Average weathered thickness is 20m. The weathered and fractured formation constitutes the aquifers. Invariably the fractures are limited to a depth of 17 to 145m.

Gondwana Supergroup:

The Gondwana Supergroup of rocks are semi consolidated sedimentary rocks of carboniferous to Triassic age occupy the district mostly in north-western part. These rocks form a linear (nearly 200 km long and 50-150 km wide) strip deposited in rift basin characterized by horst and graben, open folds and are intruded by dolerites. These rudaceous- arenaceous -carbono- argillaceous sediments rest directly on Archean granites and gneisses.

i) Talchir Formation

The rocks of Gondwana Supergroup started depositing with the formation of conglomerates over the undulating basement crystallines, known as Tillite, composed of clasts of granite, gneisses, BHQ/BHJ breccia and pinkish quartzite, sandstone – khaki green, fine to medium grained sandstone with lenses of pebbles and clasts of shale. The conglomerate followed by shale and/or sandstone. The outcrop of this formation can be seen in detached pockets/patches. The niddle shape weathering pattern of the shales are typical in nature for this formation. The thickness of the Talchir Formation is generally few tens of meters but occasionally vary up to 100 meters and is exposed in south-western part of the district.

ii) Barakar Formation

The Talchir Formation is overlained by coal bearing argillarenaceous formation known as Barakar Formation and is exposed in north & western part of the district. The Barakars have fine to course-grained, sub rounded to rounded, subarkosic semi consolidated sandstones. They are white, grey or pink to brown in colour, intercalated with shales and coal. Shales are many times bituminous in nature. The intercalation of sandstone & shale in various ratios produces sandstone, shale sandy shale, shaly sand etc. The total thickness of Barakar Formation varies from 100 to 800 m in the area.

iii) Raniganj and Panchet Formation

Small area of Balrampur district is covered by these formations as E-W linear patches of sandstone- shale with thin coal seams in faulted contact with Barakar Formation. They are exposed in northern part of the district. This formation is not a good aquifer. The andstone/shale ratio is very low. Boreholes drilled into this formation are usually dry. Boreholes close to dykes

or cut through dykes, which are weathered and more permeable, have a mean yield of 1.16 l/s and a mean specific capacity of 1.12 l/s/m. This aquifer is semi-confined.

iv) Supra Panchet or Undifferentiated Tiki, Parsora and Jabalpur Formation

These formations are exposed in western part of the district. The rocks are forming hills and traversed by dolerite intrusives. The sandstones are whitish and medium to course grained intercalated with micaceous siltstone. The aquifer is associated with shallow weathering, but has low groundwater development potential. Boreholes are typically 30 – 100 m deep, with water levels about 10 – 15 m and greater than 20 m depth respectively. Yields are relatively low (0.1 - 0.6 l/s); successful boreholes are usually sited in the vicinity of rivers. This is a minor aquifer due to fine grain size and correspondingly low porosity, which averages 2.5%. Groundwater discharge occurs via many seasonal springs at the base of the cliffs, derived from groundwater flows through fractures in the Formation that emerge at the junction with the shales and even lower permeability sandstones of the underlying Panchet Formation. Boreholes drilled in this formation, if not dry, have low yields of ~0.1 l/s (CGWB Database). The Formation is unconfined in some areas, but elsewhere it can be said to be semi-confined

Intratrappeans:

Lametas: Unconformably overlying gondwanas are the sedimentary rocks of Lameta formation which include medium grained sandstone, ferruginous- shale and cherts. These rocks are exposed in southern part of the district in very small patch and occur on the fringes of Deccan Traps.

Deccan Traps:

The Deccan Traps are younger than lametas (infratrappeans) and at places directly overliethe Archaean granite gneisses. These comprise layered basaltic lava flows, which are known as Deccan Trap, due to their step like structure. These basalts are melanocratic, dense hard, medium grained composed of feldspar augite hornblned, quartz, etc. These rocks are also exposed in southern part of the district in very small patch. Basic intrusives or dykes of dolerite, etc are seen exposed at a number of places in Gondwana formation. The lower parts of the flows are sandstones form prominent hill ranges generally massive, hard and compact in nature. The upper part of each flow is vesicular and comprises rounded to oval shaped vesicles, which are generally filled with zeolities, calcites or quartz.

Laterites:
Insitu and rolled Laterite occurs at many places in isolated patch in the southern part of the district. These are blanket deposits and few centimeters to few meter in thickness developed on a variety of rock type. The Deccan traps invariably have the lateritic or bauxite cover. Prominent laterite capping is also observed on various types ferruginous shale and sandstones and granite. Well-developed profile of laterite can be seen at many a place starting from lithomergic clay to vermicular or pisolitic grains.

Ground water in the district occurs under phreatic, semi confined and confined conditions. It is controlled by the local topography, drainage, lithology and disposition of structural features like

fractures and joints. Similarly medium to coarse-grained sandstone forms good aquifers in which movement of ground water is controlled by inter-granular porosity. Basic dykes, and sills traversing the basement crystalline and gondwana formations also play significant role in sub-surface movement of groundwater. As such the aquifer system in the district constitutes two type aquifers. The hydrogeological properties of the different lithological formations in the district are described as follows.

Hydrogeology

Chhota Nagpur Gneissic Complex & Unclassified Metamorphics of Bilaspur-Raigarh-Surguja belt forms the the basement aquifers. The primary intergranular permeability of the basement rocks in the block is generally low. However, they form aquifers where secondary permeability is increased: where there is a significant weathered or regolith zone, and in highly fractured zones. The characteristics of the aquifers are very variable as a result of the varying intensity of weathering and the anisotropic nature of fractures. The most productive zone of these aquifers is usually the lower part of the regolith and upper part of the bedrock, otherwise known as the sapprock. Ground water generally occurs under phreatic conditions in the weathered, jointed and fractured zones, ranging thickness from 10-40 meters in Archeans. These formations exposed in large parts of the district are hard and compact and poorly permeable rocks. Gneisses, granites and quartzites are susceptible to weathering and have weathered, jointed and fractured zones extending about 15 to 25 mbgl. The schists and phyllites are moderately permeable and the occurrence of groundwater in them is dependent on the intensity of fractures and development of weathered zone. Impervious bands of siliceous phyllites with vertical foliation at places acts as sub-surface barrier for ground water movements. Sites having such disposition are suitable for ground water development on its upstream side.

Yields from the basement aquifers are highly variable. Reported yields are from <0.1 to 10 l/s. Measured transmissivity varies between 0.2 and 119 m²/day. The basement aquifers are generally confined and vary in thickness from 2-20 m, depending on the thickness of the weathered zone. Borehole depths vary between 40-200 m, depending on the type of aquifer

Gondwans Supergroup of rocks: Gondwanas comprise thick beds of sandstone, shales, clays and coal seams. Sandstones having felsdpathic composition and medium to coarse grained, it is then porous and permeable and forms good aquifers. Sandstone having siliceous matrix behave like impervious hard rocks. These sandstones are medium to coarse-grained felsdpathic and highly porous and permeable. The inter granular pore spaces, joints and fractures control ground water movement in them. Shale beds behave as confining layers and help to form different aquifer systems. The ground water occurs under phreatic, semi confined and confined conditionsShales are fine grained, compact and though porous lack in permeability and so do not form good aquifers. The Barakar, Raniganj and Panchet formations are the aquifers in the group. Sandstone layers within these formations are the key aquifers. These sandstone layers vary in grain size, shape, packing and degree of cementation and, therefore, vary in their permeability. The primary porosity, storage and transmissivity of groundwater in the sedimentary rock aquifers is generally relatively low. Secondary porosity (fracturing) created by igneous intrusions has improved permeability a little. Among Gondwana formation the Barakar sandstones are the most

important water bearing formations in the district. It is found at depth and the aquifer is always confined. Boreholes are usually 100 – 150 m deep Baraker Sandstones. Yields range from 1.2 to 5.8 l/s. This formation is regarded as the best aquifer in the district.

Talchir sandstone which is very fine- grained and compact yield comparatively less ground water. Ground water is extracted by dug wells and tube wells for domestic and irrigation purposes. Shallow dug wells in the depth range 5-20 mbgl tapping Barakar sandstones can give a yield range of 25 to 15 m^3/day. The depth to water level in these wells ranges from 4 to 16 mbgl.

The Barakar, Raniganj and Panchet formations are the aquifers in the group. Sandstone layers within these formations are the key aquifers. These sandstone layers vary in grain size, shape, packing and degree of cementation and, therefore, vary in their permeability. The primary porosity, storage and transmissivity of groundwater in the sedimentary rock aquifers is generally relatively low. Secondary porosity (fracturing) created by igneous intrusions has improved permeability a little.

Lameta Formation: The infratrappeans, which uncoformably overlie Gondwanas and Archaeans, are represented by medium grained sandstone and limestone. The formation occurs over small area in widely separated patches. The rocks have low arenaceous and more calcareous in nature. Sandstones are hard and compact and well jointed and fractured and hence act as good aquifers with solution cavities in limestone. Groundwater generally occurs under water table condition and dug wells tapping lametas in areas of lower elevations yield upto 5 m^3/ hr discharge.

Deccan Traps: Deccan trap basalts occur in patches in southern parts of the district. Ground water occurs in weathered zone, joints and fracture and vesicular zones under both phreatic and semi-confined conditions. Semi confined conditions are observed in interflow zones at shallow depths, whereas confined conditions are observed in the interflow zones at deeper depth. The bottom of each flow is massive, hard and compact in nature and the overlying vesicular basalt comprise rounded to oval shaped vesicles which are filled in by secondary minerals like quartz, calcite and zeolites. Thickness of vesicular horizon is limited. It is observed that ground water in Deccan Traps occur in Weathered loose morrum like material in upper weathered zone, Weathered ambygadaliodal basalts in each flow, Exfoliated weathered zones covered by flows with columnar joints, Fractured massive basalt, dykes etc.

The shallow aquifers are tapped by open wells of depth range of 8 to 25 mbgl in which depth to water level range from1.5 to 21.0 mbgl. The yield of shallow dug wells ranges from 20 to 100 m3/day, while those wells located in topographic lows near the confluences of streams or at intersection of fractures often yields from 50 to 150 m3/day. The yield of shallow/ deep boreholes depends on the thickness of vesicular and jointed horizons and it's interconnection with the overlying recharge zone.

Laterites: Laterites capping on the top of Deccan trap and basement crystalline are seen in plateau areas. The capping are porous, permeable and thickness ranges from 1-5 meters. Laterite forms good and high yielding aquifers in low-lying areas. The depth of dug wells range from 5 to 21 mbgl. The yield of shallow dug wells in laterite varies from 40 to 60-m^3/ day.

Well Design

Since the district is covered by semi-consolidated & consolidated/hard rocks, DTH drilling & Rotary drilling are recommended and is being used. In such areas the weathered portion is usually cased to prevent formation collapse and remaining hard portion is kept necked as per the desired depth. With the help of high capacity DTH rigs, 150 m deep wells can be constructed within 6-10 hrs in such areas. The drilling time for borehole depends on the nature of formation and capacity of the drilling rigs. Constraints come whenever there are collapsible fractured zone, or crushed breccia struck below massive rock. Drilling through clay filled zone or zone of very high discharge also produce hindrance to drilling process. Due to filling of sticky clay in the well during drilling which sometimes needs casing to complete the drilling operation successfully.

The soft rock areas are drilled through Direct Rotary rigs using Bentonite mud as drilling fluid. In Rotary drilling, the pilot hole drilling commences with a suitable size RR bit of a smaller diameter. After the pilot hole is penetrated through the soil and the weathered zone the borehole is reamed to a suitable larger diameter to facilitate the lowering of service pipe with a 'T' joint. The service pipe is used to prevent the collapse of weathered top soil. The 'T' pipe brings out the drill cuttings from borehole through mud flow and let the cutting settle into the sample catcher, thus helping in collection of proper representative sample. The drilling operations are continued till the targeted depth is reached or the basement is touched. Sample of drill cuttings are collected at regular intervals, say every three meters or whenever there is a change in formation. From the study of drill cuttings, penetration rate of the drilling bit, change in the viscosity of the drilling fluid and interpretation of the electrical log the final lithological log of the bore hole is prepared. From the study of the electrical log the granular zones which constitute the aquifers are delineated. From the results of the sieve analysis the slot size of the screens to be used for well construction and the size of the gravel to be shrouded is finalized. Accordingly, the well design is framed by recommending the slotted section against the water bearing formation and blank pipes against the unproductive zones like shale and clay. The pilot hole is then reamed to a large diameter to a desired depth so that at least three inches space should be available surrounding the well assembly for gravel shrouding. After erecting the well assembly (Preferably 8″ dia or 8″/6″dia) into the reamed borehole the annular space between the borehole wall and assembly pipe may be filled with well rounded well sorted quartz gravel of suitable size down to bottom. The gravel shrouding is done simultaneously with the circulation of clear water from mud pump so as to avoid any bridging of gravel surrounding the well assembly The well thus constructed is then developed by various methods like surging, jetting, back washing etc. using an air compressor. The purpose of developing the well means to break and remove the bentonite mud cake & to free from mud and sand particles.

Aquifer Parameters

The rocks of Unclassified metamorphic of Bilaspur-Raigarh-Surguja formation and Chhota Nagpur Gneissic Complex are not very good aquifers in the district as they are massive, hard and compact. In these rocks, the yield/discharge varies between less than 1 to 7 lps in the district. The storativity is in general poor to moderate and ranges up to 30. The rocks of Gondwana Supergroup form the best aquifer of the Balrampur district. In these rocks, the yield/discharge varies between less than 1 to 7.88 lps. These aquifers show wide range of transmissivity from 10.65 to 46.2 m^2/day indicating their heterogeneous behavior. Along the conduit and fracture the

transmissivity is high as they also yield good water. The massive or weathered parts have poor transmissivity.

Small, low productivity local aquifers are formed in fractured zones and/or weathered basins. The combined thickness of laterite and weathered basement is usually between 8 and 20 m (. Below this there are deeper fractured aquifer, which usually has low permeability. The depth to groundwater level in the aquifers is typically 5 to 20 m.

Yields are generally low. The best yields are found where fractured rocks are overlain with a thick weathered zone or thick alluvium. Borehole yields are usually 1 to 3 m^3/hour. The aquifers are generally unconfined, and receive recharge mainly by direct rainfall infiltration. Where the basement aquifers are overlain by permeable Quaternary alluvium, groundwater in both aquifers may be in hydraulic continuity, and the basement aquifer may receive additional recharge from enhanced storage in the overlying alluvium.

The Gondwana Supergroup forms a stratified aquifer which can be moderately productive. More permeable layers (dominantly sandstone) are separated by layers with low permeability. A large proportion of groundwater storage and flow, particularly in Lower Gondwana Group sandstones, is via fractures in the aquifer layers. The more loosely consolidated Sandstones show more dominant intergranular flow. Semi-vertical fault zones and fractures form hydraulic connections between aquifer layers. The highest potential aquifers within the Gondwana Supergroup are fractured sandstones with high transmissivity and storage capacity, particularly the Barakar Sandstone.

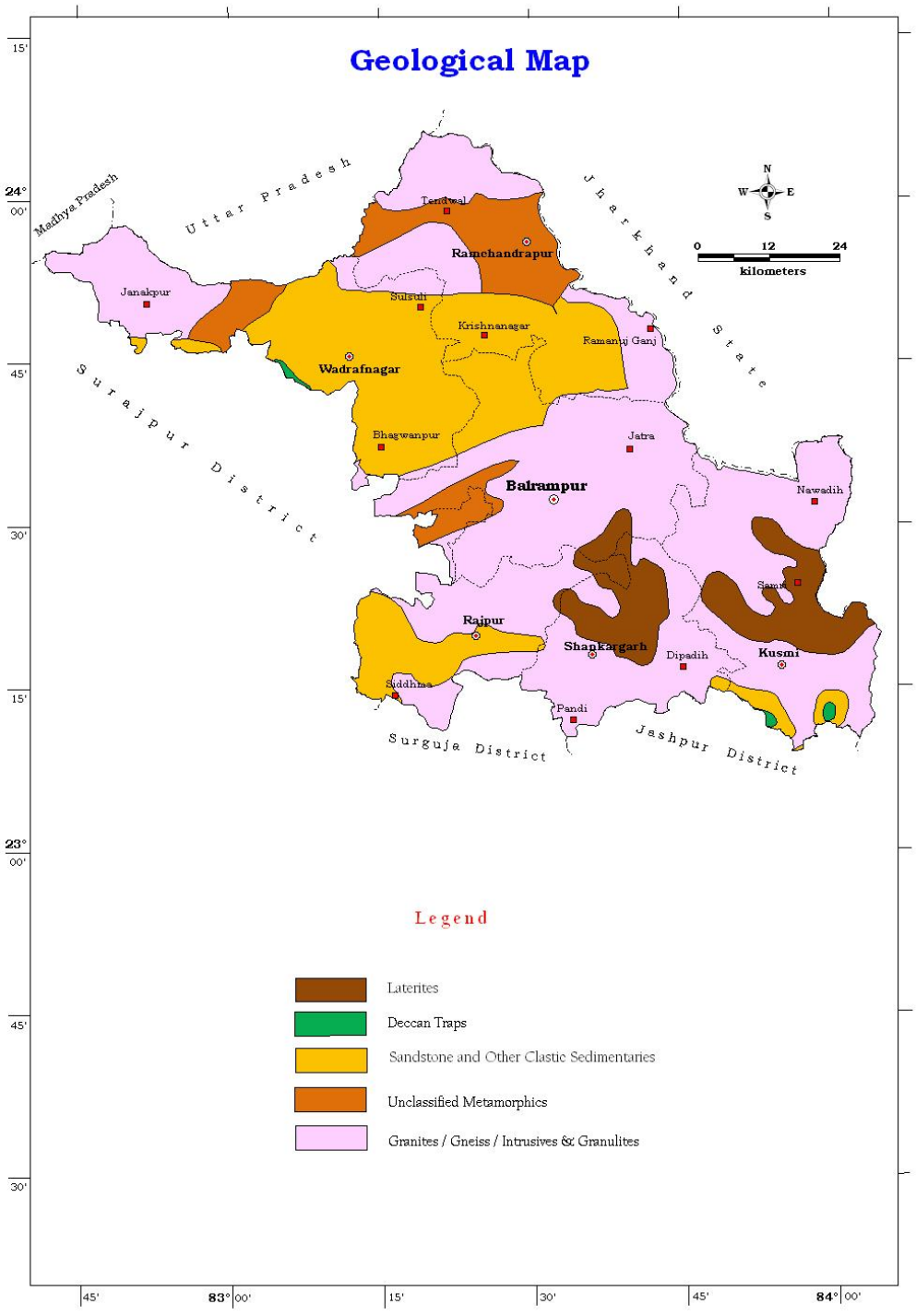


Figure 6 Geological Map of Study Area

Table 4 Generalized geological successions in Balrampur district

Lithology	Stratigraphic status		Age	Nature and Characteristics
Alluvium	Calc-tuff, alluvial sands		Quaternary	Sand, Silt, Clay & Pebble
Laterite				**Red, dark brown, pisolitic, massive, cavernous, hard, compact, ferrugenous**
Deccan Trap	**Basaltic flows**		Cenozoic	**The trap basalts are dark brownish black to grayish black, fine to medium grained, hard and compact rocks.**
Lameta Group	**Infratrappean beds**			**Limestones are greenish, fine grained, silicified and sandy. Arkosic sandstones are greenish white, medium grained, motteled rock, fine grained with chert fragments, poorly sorted, calcareous and conglomeratic in nature, clay bands are red, variegated in nature.**
	Mahadevas	**Gondwana Supergroup**	Paleozoic to Mesozoic	
Sandstone, shale	**Panchet**			**Sandstones are whitish and medium to course grained intercalated with micaceous siltstone.**
	Kamthi			
Sand stone and shale thin coal seams	**Raniganj**			**Greyish to brown in colour, intercalated with shales and coal. Shales are many times bituminous in nature.**
	Supra Barakars			
Grits, sandstones with shale and coal	**Barakars**			**White, grey or pink to brown in colour, intercalated with shales and coal. Shales are many times bituminous in nature.**
	Karharbaris			
Boulder bed, sandstone , shale and tillite	**Talchirs**			**Clasts of granite, gneisses, BHQ/BHJ breccia and pinkish quartzite, sandstone – khaki green, fine to medium grained sandstone with lenses of pebbles and clasts of shale.**
Chhattisgarh Supergroup				
Granite gneiss, Quartz-mica schist, Chlorite- biotite schist, Quartzite, Calc-silicates and Quartz-feldpathic cataclasites	**Chhota Nagpur Gneissic Complex**		**Palaeo Proterozoic**	**Gray and pink in colored granites occur as intrusive along with pegmatites, aplites and quartz veins.**
Gneisses, Granite, Schist and Quartzite.	**Unclassified Metamorphics of Bilaspur-Raigarh-Surguja belt**		**Paleao Proterozoic to Archaean**	**Porphyritic gneiss is pink in coloured with phenocrysts. The gneisses exhibit banded structure. The granite of the area comprise of quartz, felspar and biotite.**
Archeans				

1.12 Agriculture, Irrigation, Cropping Pattern

Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season, it is done through ground water as well as partly through surface water like canals and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops are paddy, wheat, maize, oil seeds, vegetables and pulses.

In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Balrampur district is given in Table 5, 6 and 7.

Table 5: Cropping pattern (in ha)

Kharif	Rabi	Cereal					Pulses	Tilhan	Fruits and Vegetables	Sugarcane	Mirch Masala
		Wheat	Rice	Jowar & Maize	Rajgira	Others					
151837	29698	23840	86330	34910	0	1420	30310	44120	14160	1680	3460

Table 6: Area irrigated by various sources (in ha)

No. of canal s (private and Govt.)	Irrigated area	No.of bore wells/ Tube wells	Irrigated area	No. Of dug wells	Irrigated area	No. of Talabs	Irrigated area	Irrigated area by other sources	Net Irri-gated area	Gross irrigated area	% of irrigated area wrt. Net sown area
30	2140	1490	2640	6380	2920	805	4830	7030	19560	34560	12

Table 7: Statistics showing Agricultural land Irrigated

Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water wrt. net irrigated area
19560	5560	14%

2.0 Data Collection and Generation

2.1 Hydrogeological Data Keeping in view of the diverse hydrogeology of the Surguja district additional 24 key well has been established in unconfined aquifer and 102 key well in semiconfined/confined aquifer for monitoring of water level and other hydrogeological information. A total of 126 key well (**Table 8**) has been established and monitored in pre monsoon and post monsoon period.

Table 8. Details of monitoring well (Key well)

SL	Location	Block	Latitude	Longitude	Well Type	WL_Premonsoon	WL_PostMon	Fluctuation
1	KARRI-CHALGALI	Rajpur	23.5297690	83.3089360	HP	12.61	8.19	4.42
2	GAURIPUR	Ramchandrapur	23.5451540	83.3163720	HP	11.98	7.69	4.29
3	KODAKI	Shankargarh	23.5508850	83.3183740	HP	12.00	6.58	5.42
4	SARASWATHIPUR	Balrampur	23.5584230	83.3465350	HP	12.67	8.18	4.49
5	RAMPUR	Rajpur	23.5943800	83.3766100	HP	13.48	9.26	4.22
6	CHALGALI KHAS	Ramchandrapur	23.6055800	83.3610440	HP	12.29	8.47	3.82
7	DONGARA	Rajpur	23.6368620	83.3660970	HP	11.39	7.61	3.78
8	BELIYA	Wadrafnagar	23.6366900	83.3497760	HP	15.69	10.38	5.31
9	BADKAGAON	Rajpur	23.6385410	83.3297110	HP	14.39	9.64	4.75
10	KADIYA	Kusmi	23.6644340	83.3851060	HP	6.98	3.19	3.79
11	MURKA	Ramchandrapur	23.6425780	83.4154910	HP	7.96	4.00	3.96
12	BELKUDRI	Wadrafnagar	23.6478740	83.4618710	HP	15.34	10.67	4.67
13	GIRWARGANJ	Rajpur	23.6846300	83.4598110	HP	16.37	9.69	6.68
14	SHANKARPUR	Ramchandrapur	23.6349790	83.5238400	HP	15.39	8.18	7.21
15	SONHARA	Balrampur	23.6267220	83.5662410	HP	13.29	6.19	7.10
16	BHANORA	Rajpur	23.6251470	83.5993720	HP	11.29	4.19	7.10
17	JABRAHI	Ramchandrapur	23.6492580	83.5761250	HP	10.37	4.14	6.23
18	SENDUR	Shankargarh	23.6724810	83.5774990	HP	10.34	4.67	5.67
19	MANIKPUR	Ramchandrapur	23.6644680	83.4957440	HP	15.19	9.47	5.72
20	KOTARKI	Wadrafnagar	23.6718040	83.4614480	HP	17.49	11.29	6.20

SL	Location	Block	Latitude	Longitude	Well Type	WL_Premonsoon	WL_PostMon	Fluctuation
21	CHAINPUR (MURKA)	Rajpur	23.6648770	83.4366180	HP	18.61	13.27	5.34
22	KADIYA	Rajpur	23.6646940	83.3853370	HP	10.29	3.18	7.11
23	PADAULI	Rajpur	23.6633860	83.3627790	HP	13.29	7.19	6.10
24	ALKA	Rajpur	23.6868690	83.3620830	HP	12.67	8.14	4.53
25	KACHCHI	Rajpur	23.6749250	83.3418150	HP	13.67	9.28	4.39
26	ODARI	Rajpur	23.6734670	83.2984040	HP	10.27	5.19	5.08
27	BARTI KHURD	Ramchandrapur	23.6619710	83.2470350	HP	9.37	4.16	5.21
28	BARTI KALAN	Shankargarh	23.6553530	83.2339910	HP	8.42	3.54	4.88
29	AMDIHA	Balrampur	23.6553530	83.2215610	HP	9.19	4.16	5.03
30	JAMAI	Rajpur	23.6722340	83.2227860	HP	8.19	3.27	4.92
31	PARASDIHA	Ramchandrapur	23.6668560	83.2150100	HP	8.00	3.57	4.43
32	REVATI	Rajpur	23.6435170	83.1707390	HP	12.64	8.39	4.25
33	CHACHIDAND	Wadrafnagar	23.6347690	83.2072340	HP	13.67	8.34	5.33
34	SHIWAR	Rajpur	23.6339280	83.2241340	HP	15.67	9.37	6.30
35	SAVITRIPUR	Kusmi	23.6441360	83.2492390	HP	16.37	10.67	5.70
36	INJANI	Ramchandrapur	23.6478380	83.2676670	HP	16.19	9.47	6.72
37	BHAGAWANPUR (KHAS)	Wadrafnagar	23.6122180	83.2575040	HP	17.34	11.27	6.07
38	BHAGAWANPUR (JIRAT)	Rajpur	23.6221480	83.2752600	HP	16.16	10.37	5.79
39	SHARDAPUR	Ramchandrapur	23.6247250	83.3003050	HP	15.37	12.16	3.21
40	RAJKHETA	Balrampur	23.7468780	83.2401230	HP	13.27	10.41	2.86
41	BHAISAMUNDA	Rajpur	23.6904230	83.2193070	HP	14.07	10.18	3.89
42	KAILASHPUR	Ramchandrapur	23.6941960	83.2333391	HP	13.90	10.11	3.79
43	DHODHI	Shankargarh	23.6979010	83.2638210	HP	13.00	10.23	2.77
44	PANSARA	Ramchandrapur	23.6798600	83.2579150	HP	9.27	3.64	5.63
45	BHUTATAND	Wadrafnagar	23.6838330	83.2756080	HP	10.17	4.61	5.56

SL	Location	Block	Latitude	Longitude	Well Type	WL_Premonsoon	WL_PostMon	Fluctuation
46	DODIHA	Rajpur	23.6974620	83.3100010	HP	13.29	9.84	3.45
47	PAHADKARWAN	Rajpur	23.5984810	83.1614160	HP	12.29	7.19	5.10
48	NAWADHAKI	Rajpur	23.5594480	83.1483840	HP	16.39	11.27	5.12
49	GHAT PANDERI	Rajpur	23.5437270	83.1870410	HP	14.39	6.67	7.72
50	PAHIYA	Rajpur	23.5595160	83.1976560	HP	12.26	5.13	7.13
51	DUMARKHOLI	Rajpur	23.5125920	83.2093810	HP	13.27	6.15	7.12
52	MANI	Ramchandrapur	23.5130500	83.2269860	HP	15.30	7.69	7.61
53	RAMGAWAN	Shankargarh	23.5077920	83.2423510	HP	19.67	8.13	11.54
54	BHAIRAPUR	Balrampur	23.5293230	83.2660890	HP	20.14	9.32	10.82
55	LOLKI	Rajpur	23.5240990	83.2682770	HP	18.13	8.16	9.97
56	CHEMEE	Ramchandrapur	23.5254780	83.2782520	HP	16.67	7.19	9.48
57	AMARPUR	Rajpur	23.5274510	83.2849940	HP	15.36	7.68	7.68
58	KHUNSHI	Wadrafnagar	23.5368930	83.2267850	HP	13.26	5.37	7.89
59	SILANTA	Rajpur	23.4868400	83.3062500	HP	12.19	4.67	7.52
60	CHANDRALIL	Kusmi	23.4630020	83.3021430	HP	17.29	9.19	8.10
61	PANDIYA	Ramchandrapur	23.4493020	83.3308820	HP	14.61	6.39	8.22
62	NAWADIH	Wadrafnagar	23.4884750	83.3510790	HP	20.67	11.39	9.28
63	PENDARI	Rajpur	23.4525667	83.3631180	HP	23.37	16.17	7.20
64	KARWAN	Ramchandrapur	23.4044170	83.3948570	HP	15.34	4.62	10.72
65	MUNNUWAN	Balrampur	23.3903780	83.4134440	HP	14.67	4.90	9.77
66	KUNDUKHU	Rajpur	23.3838090	83.4033750	HP	13.40	4.16	9.24
67	BAGADI	Ramchandrapur	23.3603720	83.4085070	HP	15.24	8.19	7.05
68	PATRATU	Shankargarh	23.3671040	83.4295060	HP	16.34	7.16	9.18
69	BAKASPUR	Ramchandrapur	23.3568260	83.4282230	HP	17.21	8.19	9.02
70	THARKI	Wadrafnagar	23.3969950	83.4296050	HP	15.41	6.18	9.23
71	KARRA	Rajpur	23.3828450	83.4481920	HP	19.42	14.20	5.22

SL	Location	Block	Latitude	Longitude	Well Type	WL_Premonsoon	WL_PostMon	Fluctuation
72	LADKUND	Rajpur	23.4175110	83.4935860	HP	16.34	11.26	5.08
73	BASEN	Rajpur	23.4212200	83.5122370	HP	14.68	7.19	7.49
74	JIGDI	Rajpur	23.4123500	83.5059750	HP	15.65	8.37	7.28
75	CHILMAKH	Rajpur	23.4406740	83.5204010	HP	16.16	8.31	7.85
76	ULIYA	Rajpur	23.4440200	83.5262660	HP	18.40	10.00	8.40
77	SEMRA	Ramchandrapur	23.3632570	83.4439000	HP	17.11	9.29	7.82
78	JHINGO	Shankargarh	23.3559120	83.4515510	HP	21.16	13.22	7.94
79	MHUAPARA	Balrampur	23.3438410	83.4404140	HP	18.24	12.11	6.13
80	DANDHKAD	Rajpur	23.3626530	83.4608890	HP	19.44	13.20	6.24
81	KAWDA	Ramchandrapur	23.3733250	83.5120550	HP	11.67	4.32	7.35
82	PENDARI	Rajpur	23.3417310	83.5303400	HP	14.28	7.16	7.12
83	SILPHILI	Wadrafnagar	23.3382820	83.5442450	HP	13.16	5.11	8.05
84	KAMARI	Rajpur	23.3310040	83.5461200	HP	12.16	4.37	7.79
85	SEWARI	Kusmi	23.3351580	83.5032950	HP	14.68	7.34	7.34
86	SIHAR	Ramchandrapur	23.2915470	83.5898690	HP	11.62	4.31	7.31
87	BHADAR	Wadrafnagar	23.3238570	83.5247070	HP	16.34	8.11	8.23
88	MURKA	Rajpur	23.3183660	83.5412540	HP	17.16	7.56	9.60
89	SARGAWAN	Ramchandrapur	23.3173460	83.5758060	HP	11.29	4.60	6.69
90	DOHNA	Balrampur	23.3093000	83.5758060	HP	13.42	5.19	8.23
91	ALKADIHA	Rajpur	23.3842090	83.4685090	HP	16.19	9.14	7.05
92	DIPADHIH KHURD	Ramchandrapur	23.3325940	83.5902470	HP	13.48	6.11	7.37
93	BUDH BAGHICHA	Shankargarh	23.3266890	83.4316350	HP	11.48	5.61	5.87
94	CHATAKPUR	Ramchandrapur	23.3142760	83.4288730	HP	14.62	7.39	7.23
95	NAWAPARA	Wadrafnagar	23.3086200	83.4453810	HP	11.42	5.11	6.31
96	GHARGHODI	Rajpur	23.3249330	83.4693100	HP	12.14	5.27	6.87
97	LAU	Rajpur	23.3084260	83.4969000	HP	11.67	4.29	7.38

SL	Location	Block	Latitude	Longitude	Well Type	WL_Premonsoon	WL_PostMon	Fluctuation
98	DAMODARPUR	Rajpur	23.3037090	83.5332200	HP	11.16	4.67	6.49
99	MANKEPI	Rajpur	23.2895180	83.5453440	HP	11.49	4.60	6.89
100	SARIMA	Rajpur	23.2965090	83.5694050	HP	12.62	4.27	8.35
101	Alakadih	Rajpur	23.3902	83.4603	DW	4.00	2.00	2.00
102	Aragahi	Ramchandrapur	23.7542	83.6833	DW	7.00	3.00	4.00
103	Bachwar	Shankargarh	23.3008	83.5756	DW	6.50	3.42	3.08
104	Balrampur	Balrampur	23.5903	83.6167	DW	10.00	6.00	4.00
105	Bhadar	Rajpur	23.3331	83.5086	DW	5.30	3.20	2.10
106	Dhamni	Ramchandrapur	23.7889	83.4250	DW	8.00	4.02	3.98
107	Ghorghadi	Rajpur	23.3401	83.4606	DW	7.00	4.00	3.00
108	Karamdiha	Wadrafnagar	23.8139	83.2806	DW	6.00	3.81	2.19
109	Karji new	Rajpur	23.3139	83.3520	DW	8.00	4.00	4.00
110	Kusmi	Kusmi	23.2783	83.9078	DW	10.00	4.09	5.91
111	Mahaviganj	Ramchandrapur	23.8149	83.5841	DW	7.00	1.00	6.00
112	Mahewa	Wadrafnagar	23.8139	83.0917	DW	9.00	3.56	5.44
113	Makanpur	Rajpur	23.4133	83.3233	DW	8.50	4.14	4.36
114	Nawadih	Ramchandrapur	23.8167	83.4083	DW	9.00	4.18	4.82
115	Pasta	Balrampur	23.4500	83.5250	DW	5.15	2.38	2.77
116	Rajpur	Rajpur	23.3375	83.4042	DW	11.00	6.50	4.50
117	Ramanujganj	Ramchandrapur	23.7944	83.6833	DW	9.00	4.51	4.49
118	Sargaoa	Shankargarh	23.3071	83.5562	DW	6.00	4.06	1.94
119	Tattapani	Ramchandrapur	23.6889	83.6583	DW	11.51	5.00	6.51
120	Wadrafnagar	Wadrafnagar	23.7667	83.1958	DW	10.00	7.36	2.64
121	Narsingpur	Rajpur	23.3651	83.3096	DW	7.00	4.00	3.00
122	Karji	Rajpur	23.3182	83.3410	DW	5.00	3.00	2.00
123	Chilamkala	Rajpur	23.3474	83.3438	DW	7.00	3.50	3.50
124	Parsagudi	Rajpur	23.3324	83.3728	DW	10.00	8.00	2.00

SL	Location	Block	Latitude	Longitude	Well Type	WL_Premonsoon	WL_PostMon	Fluctuation
125	Bario	Rajpur	23.2441	83.3163	DW	7.20	3.82	3.38

2.2 Hydrochemical Data

The quality of groundwater in the district is suitable for drinking as well as irrigation purposes. From the Chemical analysis of ground water samples, it is observed that the pH value ranges from 8.1 to 8.4, which shows alkaline nature of ground water in the district. The electrical conductivity value varies from 103 µs/cm to 611 µs/cm. All the chemical constituents are well within permissible limit. The water in the district is mixed bicarbonate type and is having low sodium and medium salinity hazard. Water quality in the basement aquifers is fair to good. Groundwater is typically slightly acidic (pH<6.5) with low salinity and total hardness, but slightly higher salinity occurs in some areas. High fluoride (up to 2 mg/l) occurs in some areas in the Upper Regions (Semersot in Balrampur block),

In Gondwana aquifers Water quality is generally good with total dissolved solids (TDS) concentration below 1000 mg/l. There is no recognised fluoride threat, although it may pose a mild encrustation hazard.

2.3 Geophysical Data

To delineate the disposition of the existing aquifer system 35 Transient electromagnetic (TEM) method were carried out. Along with 20 VES data and 35 TEM different water zone identified in the district.

2.4 Exploratory Data

A total of 13 exploratory wells exist in the balrampur district before the NAQUIM study. During the year 2019-20 additional 10 exploratory and 01 observation well has been constructed. Table-9 summarizes the status of exploratory wells in the study area.

Table 9. Detail of Exploration in the Balrampur district

Sl NO	location	Well Type	Block	LAT	LONG	Depth	casing	Zone_encountered	SWL (mbgl)	Discharge	Drawdown (mbgl)	T (m2/day)
1	karji (iti)	EW	rajpur	23.300592	83.338563	202	12	NIL		3.4	NIL	
2	kakna ew	OW	rajpur	23.233413	83.30109	202	14.5	22-25;40-43;101-104	7.96	3	4	10.23
3	kakna ow	EW	rajpur	23.233431	83.301123	104.4	11.71	22-25;40-43;101-104	8.1	3	4	
4	jhingo	EW	rajpur	23.353514	83.434988	132	19	NIL			NIL	
5	chanchi	EW	rajpur	23.28242	83.332085	202	12.1	23-25	14.35	12	0.5	
6	parsapani (ghorghadi)	EW	rajpur	23.326892	83.514756	202	20	NIL		4	NIL	
7	pasta	EW	balrampur	23.46186	83.530107	198	16	NIL		6.3	NIL	
8	kaudu	EW	balrampur	23.374011	83.495162	134.9	17.8	31-33;89-92	9.67	5	1	4.56
9	lodhi	EW	shankergarh	23.292643	83.538391	183.7	18.18	89-92	9.69	0.5	0.5	3.34
10	sewari ew	EW	shankergarh	23.339785	83.498486	134.9	24.8	38-91;83-86	8.35	0.5	4	4.76
11	bartikalan	EW	Wadrafnagar	23.6625	83.2181	340		(Abondoned due to lack of granular zone	8	Negligible		
12	karamdiha	EW	Wadrafnagar	23.8106	83.2778	167.63		62-64,70-76,78-90,103-106,116-120,142-148,151-157	4.82	8.7	25.61	
13	karamdiha ow	EW	Wadrafnagar	23.8106	83.2778							
14	keoti	EW	Wadrafnagar	23.8106	83.0931	320.27	153	60-75,81-95,120-132,141-150	16.86	3.5	31.82	10.65

15	pendari	EW	Wadraf nagar	23.7833	83.1333	300.8	188	40-49,83-85,110-112,124-134,147-151,174-179,182-185,	20.98	3.16	26.24	16
16	premnagar(jamai)	EW	Wadraf nagar	23.8333	83.2	300.42	292	70-74,126-132,156-171,178-190,222-234261-269,274-280,282-287	3.83	7.88	27.07	46.2
17	rajkheta	EW	Wadraf nagar	23.7639	83.2333	244.31	120	33-46,75-117	7.78	6.95	13.585	55.31
18	shankargarh	EW	Shankargarh	23.3	83.6039	115.28	21.21	28.3		7		
19	deepadih kalan	EW	Shankargarh	23.2881	83.7206	123.48	16.2	-		1.5		
20	rajpur (budha bagicha)	EW	Rajpur	23.3289	83.4258		14.38	14.5				30
21	jingdi (e.w)	EW	Rajpur	23.4233	83.5192	164.6	27.6	20.2 - 23.8	6.86	0.2	33.8	
22	jigdi (o.w)	EW	Rajpur	23.4233	83.5192	43	00.00 - 21.86 B 21.86-27.92S		6.9	seepage		
23	balrampur(ew)	EW	Balrampur	23.6189	83.6253	202.6	25.5	27.8 -31.40	6.1	1.04	33.7	0.96

3. Data Interpretation, Integration and Aquifer Mapping

Based on the depth to water level periodical monitoring data of the key wells established in the study area, pre-monsoon and post-monsoon depth to water level maps as well as seasonal fluctuation maps have been prepared.

Water Level Behavior:

Ground water is a dynamic system. It always remains under the influence of time dependant recharging and discharging factors. Due to this continuous influence, water level of the aquifer system fluctuates and the range depends on the period of influence. Central Ground Water Board monitors the ground water regime through the National Hydrograph Network Stations. As a part of National Hydrograph Network Observation Stations (NHS), 20 no. of Dug wells and 8 no. of Piezometers are established in the district to monitor water levels four times in a year i.e. in January, May (Pre-monsoon), August and in November (post-monsoon). The depth of the dug well varies from 7.01 to 18.00 m and the diameter varies from 2.14 m to 4.94 m while the depth of the Piezometers varies from 30.52 to 73.86 m and the diameter varies from 0.152m. These monitoring wells are distributed throughout the district covering all the lithological formations.

Depth to Water Level

i) Pre-monsoon

The depth to water level in the district during pre-monsoon period is ranges between 3.80 to 17.32 m bgl. In most of the area the water level lies in the range of 5 to 10 m bgl. The depth to water levels in the range of 10 to 15 m bgl is observed in western & south & eastern part of the district. Water level >15 mbgl is observed in east part in isolated patch. The shallow water levels 0 to 5 m bgl are observed along river course in small patch in western part of the district.

ii) Post-monsoon

The depth to water level in the district during post-monsoon period is ranges between 2.17 to 13.90 m bgl. In most of the area the water level lies in the range of 3 to 5 m bgl. The depth to water levels in the range of 5 to 10 m bgl is observed in western & south & eastern part of the district. Water level >10 mbgl is observed in east part in isolated patch. The shallow water levels 0 to 3 m bgl are observed along river course in small patch in western part of the district.

Water Level Fluctuation

The seasonal water level fluctuation in a year is calculated based on the depth to water level data collected during the month of May'2019 Vs November'2019 in order to see the seasonal water level variation in the district. It is observed that the maximum water level fluctuation of 6.39 m was observed at Rajpur observation station. The minimum fluctuation of the order of 0.9 m was at Karamdiha observation station. It is observed that

in around 98% of the area, the fluctuation is less than 5 m & 2% area shows fluctuation is more than 5 m.

Long term trend of water levels

i) Pre-monsoon

When compared to the decadal mean water level with the water level of May'2019, nearly 55% of the wells are showing fall in the range of -0.08 to -3.13 m in May 2013. The rest 45% of monitored wells are showing a rise in the water level, mostly in the range of 0.03 to 1.49 m.

ii) Pre-monsoon

When compared to the decadal mean water level with the water level of Nov'2019, nearly 75% of the wells are showing fall in the range of -0.21 to -4.40 m. The rest 25% of monitored wells are showing a rise in the water level, mostly in the range of 0.09 to 1.45 m.

Aquifer Geometry and Characterization

Based on the exploratory drilling data generated for the blocks, the existing aquifer systems in the area may be divided into two namely phreatic and deeper fractured aquifer in all the major three aquifer systems.

Granite Aquifer System:

Groundwater occurrence is largely limited to secondary permeability, such as weathered zones, joints, fractures or faults. The potential of weathered zones depends on the degree and depth of weathering and associated fracturing, and the saturated thickness. The aquifers are generally discontinuous, and often confined. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing.

The average thickness of the weathered portion in the area is around 21.60 m. In general, the discharge varies from meagre to 12.71 lps. The average drawdown of the formation is around 26.52 m. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone. Water zone has been encountered up to 158 mbgl in the formation. Transmissivity range observed is upto 43.72 sq meter/day.

Sandstone Aquifer System:

After studying the exploratory well details in Sandstone aquifer system, it has been envisaged that Gondwana rock comprise thick beds of sandstone, shale's, clays and coal seams. Sandstones having felsdpathic composition and medium to course grained, it is then porous and permeable and forms good aquifers. Sandstone having siliceous matrix behave like impervious hard rocks. Shales are fine grained, compact and though porous lack in permeability and so do not form good aquifers. Among Gondwana formation the Barakar and Suprabarakar sandstones are the most important water bearing formations.

These sandstones are medium to coarse-grained felsdpathic and highly porous and permeable. The intergranular pore spaces, joints and fractures control ground water movement in them. Shale beds behave as confining layers and help to form different aquifer systems. The ground water occurs under phreatic, semi confined and confined conditions. Talchir sandstone which is very fine- grained and compact yield comparatively less ground water.
The average thickness of the weathered portion is around 21 m. In general, the discharge varies from meagre to 12.5 lps. The average drawdown of the formation is around 27 m. Well construction is required depending upon the water zone and formation encountered. Water zone has been encountered up to 191 mbgl at Balsedi in Ambikapur. Transmissivity range observed is 3.74 to 159.1 sq. meter/day.

LateriteAquifer System:
These are Laterites of Pleistocene and recent age occur over large areas of this District as capping on formations. They are mostly ferruginous in nature (at places aluminous) and due to concentration of aluminous material deposits of Bauxite are formed at localised places. At places the laterite is 25 to 30 meters thick.

The shallow aquifers are tapped by open wells of depth range of 8 to 25 mbgl. in which depth to water level range from1.5 to 21.0 mbgl The yield of shallow dug wells ranges from 20 to 100 m3/day, while those wells located in topographic lows near the confluences of streams or at intersection of fractures often yields from 50 to 150 m3/day.

Laterites capping on the top of Deccan trap and basement crystalline are seen in plateau areas. The capping are porous, permeable and thickness ranges from 1-5 meters. Laterite forms good and high yielding aquifers in low-lying areas. The depth of dug wells range from 5 to 21 mbgl. The yield of shallow dugwells in laterite varies from 40 to 60-m3/ day. The depth of tube wells ranges from 60 to 100 m and their yield varies from 30 to 70 m3/day.

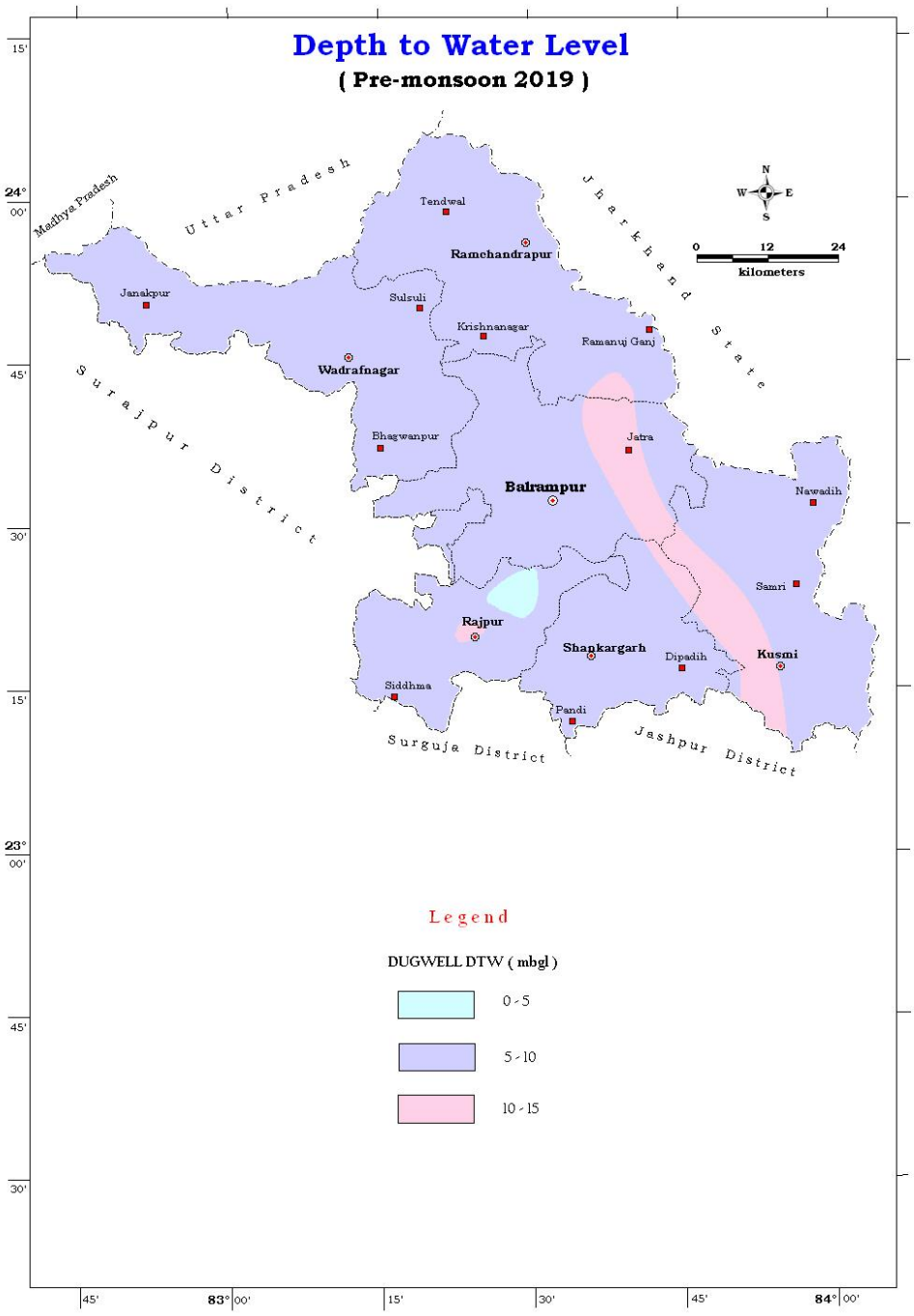


Figure 7 Depth to water level map Phreatic Aquifer (Pre-monsoon)

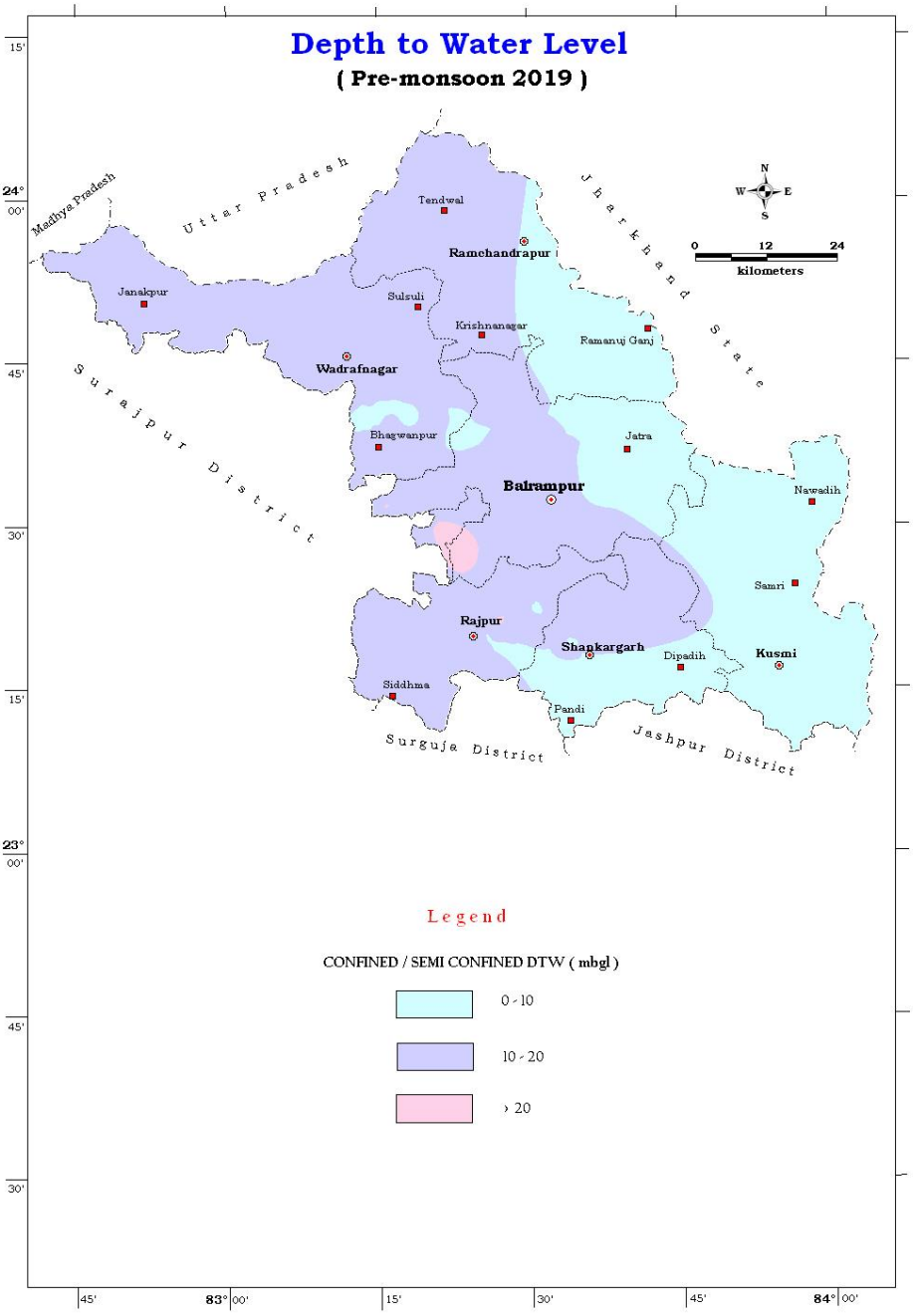


Figure 8 Depth to water level map of confined/semiconfined aquifer (pre-monsoon)

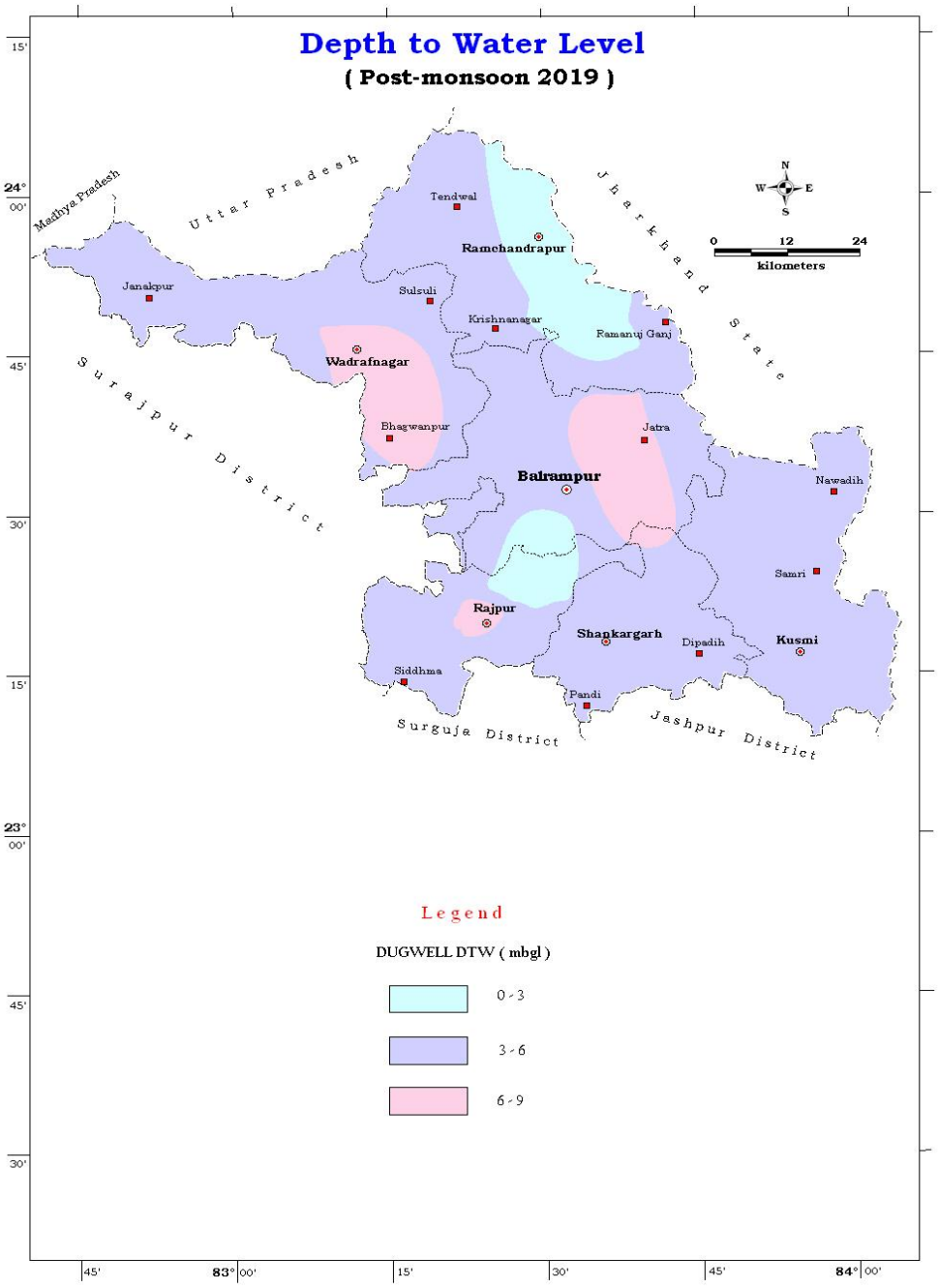


Figure 9 Depth to water level map of Phreatic Aquifer (Post-monsoon)

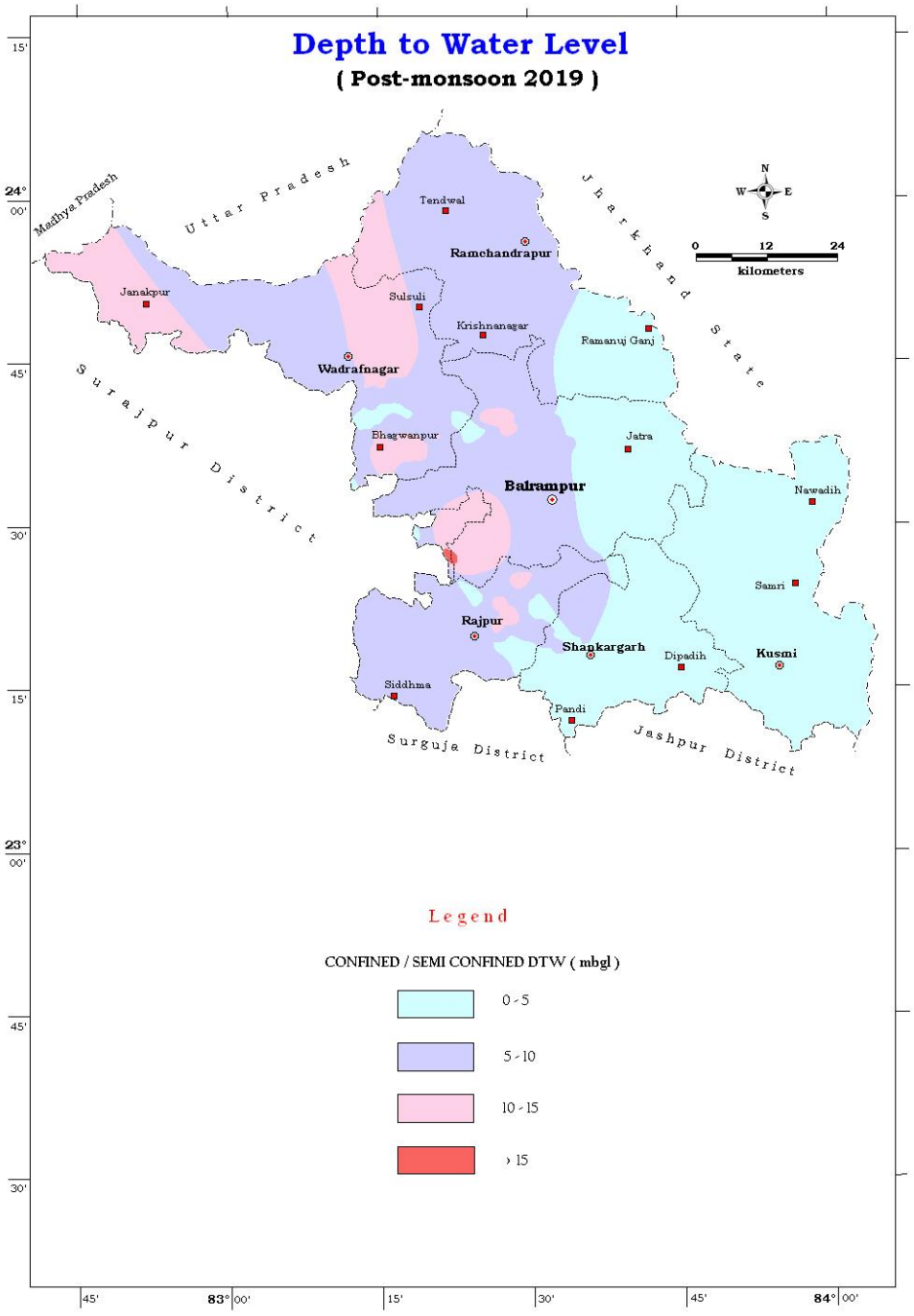


Figure 10 Depth to water level map of Confined/Semi confined Aquifer (Post-monsoon)

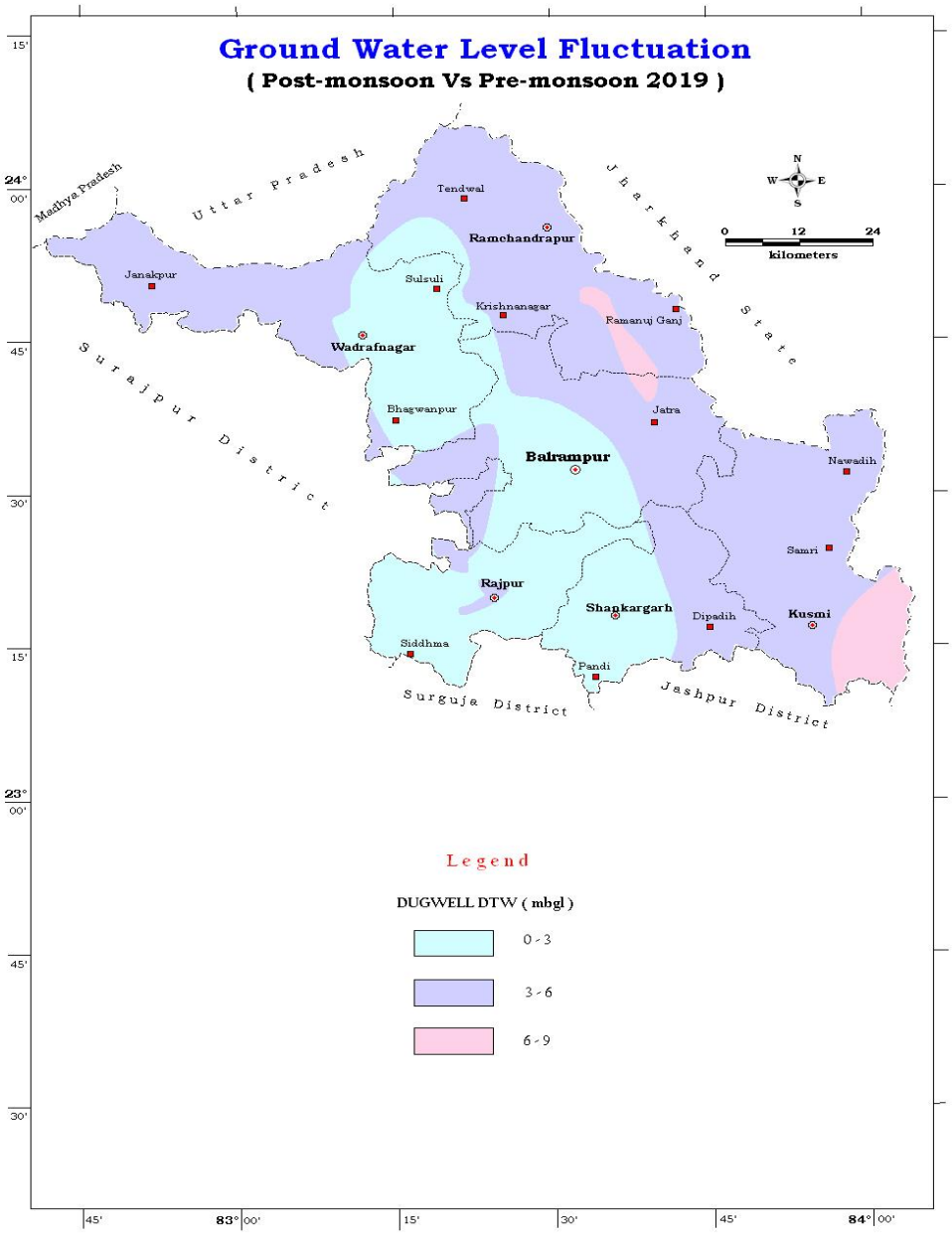


Figure 11 Depth to water level fluctuation map of phreatic Aquifer

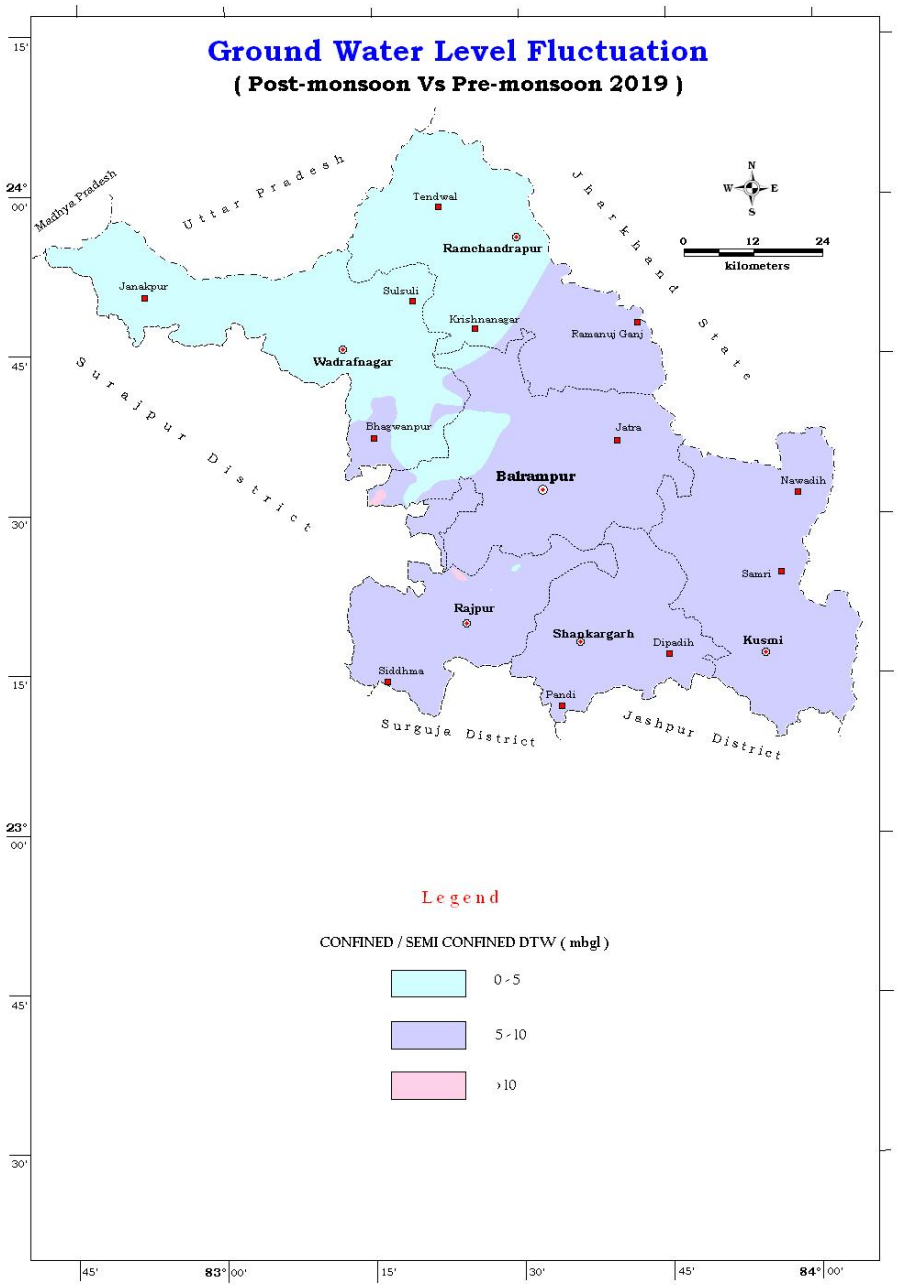


Figure 12 Depth to water level fluctuation map of confined/ Semiconfined Aquifer

Figure 13. 3D disposition of Aquifer in Balrampur Dist

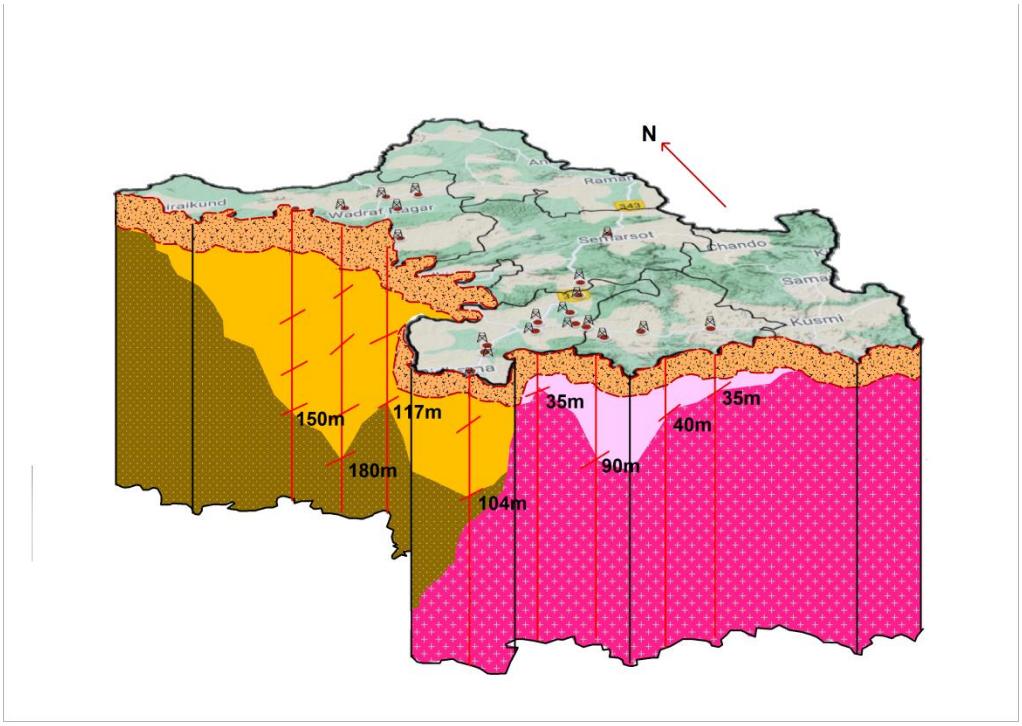
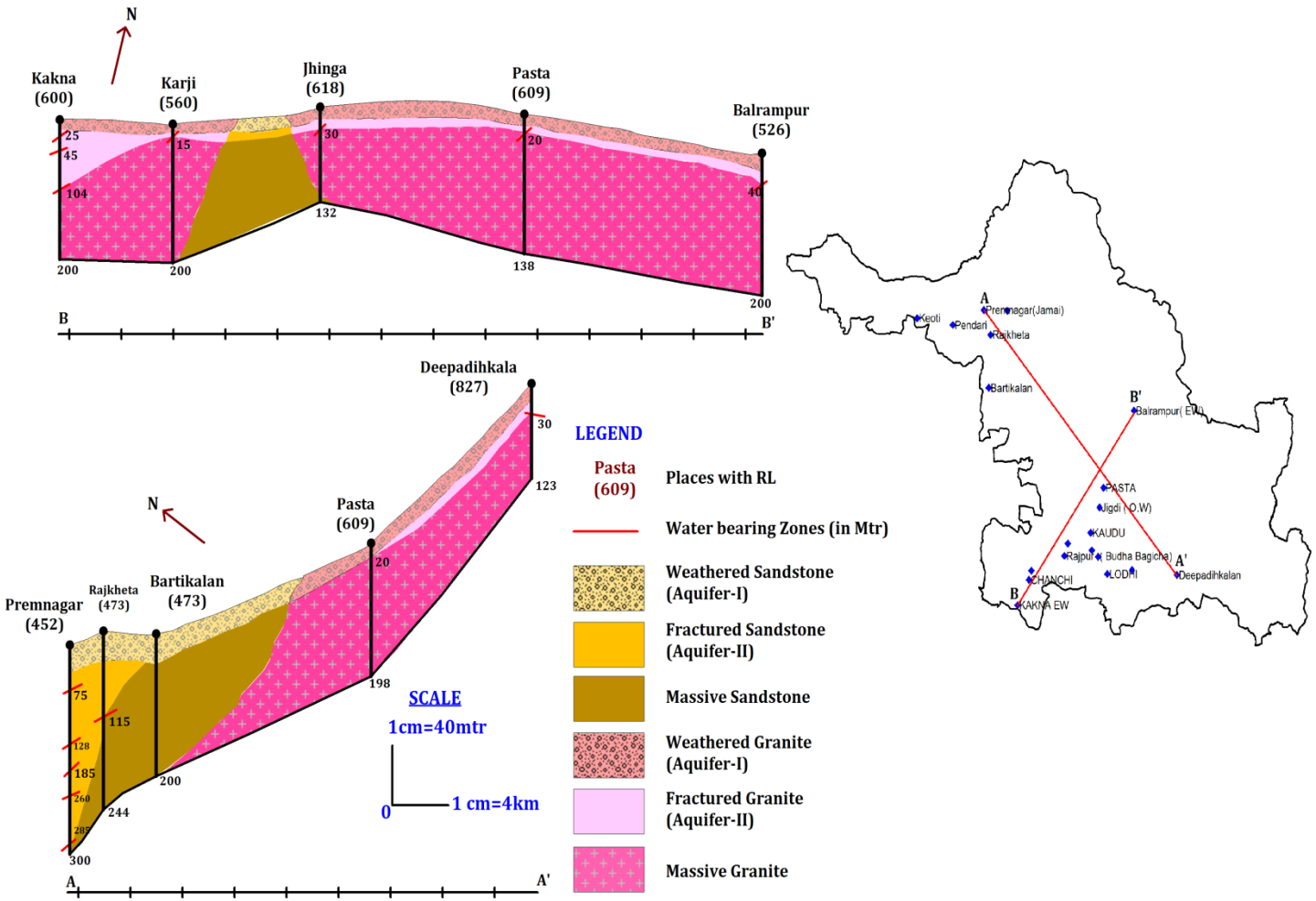


Figure 14. Fence diagram of Aquifer disposition in Balrampur



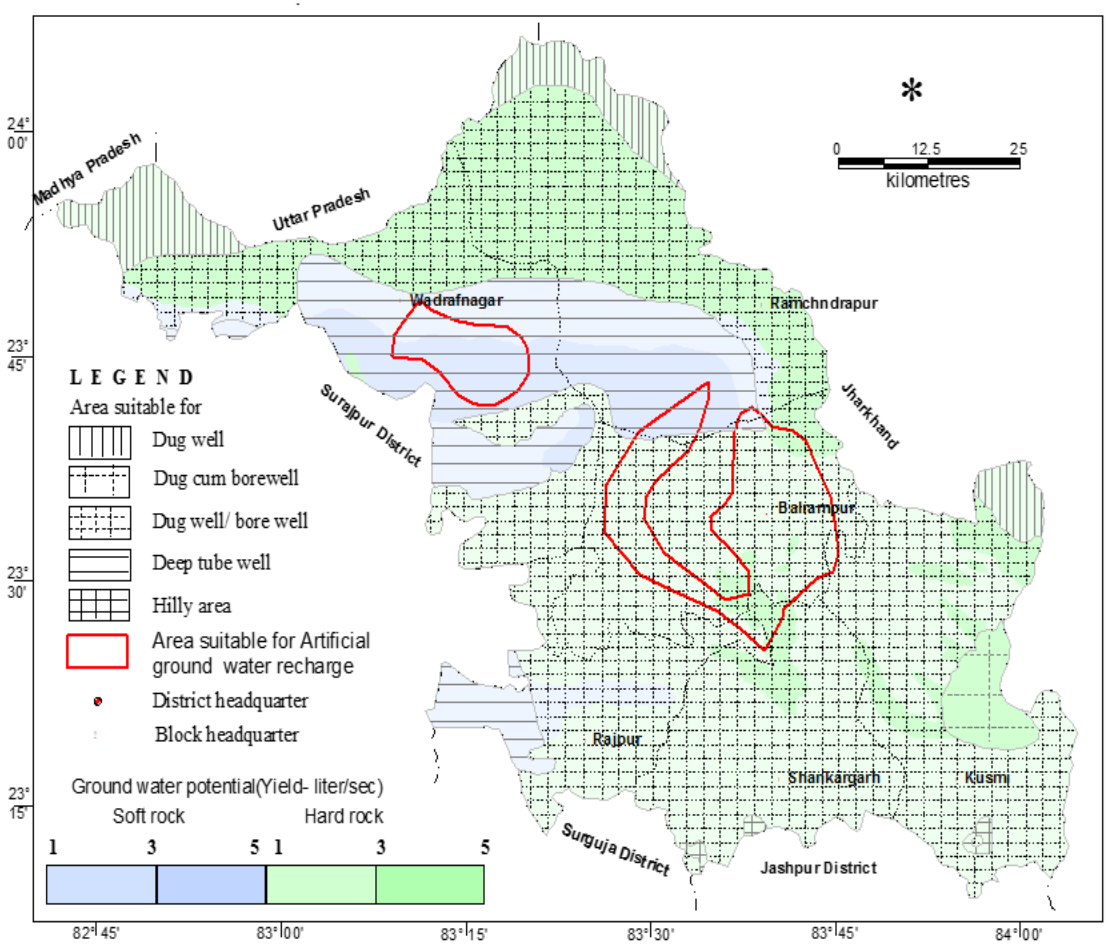


Figure 15 Groundwatet prospect map and locations fesible for artificial recharge structure

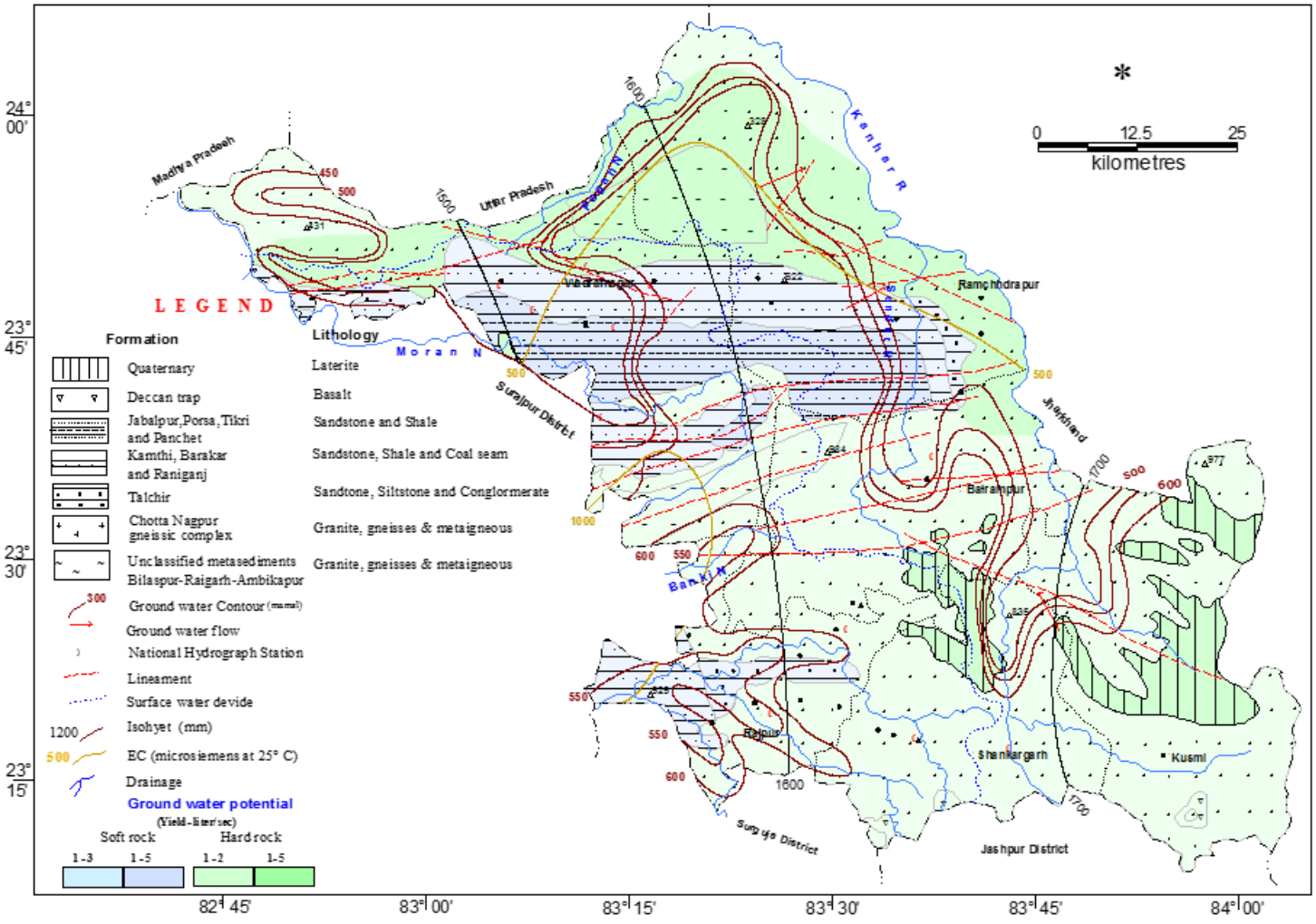


Figure 16 Aquifer Map of Balrampur District

4. GROUND WATER RESOURCES

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in Surguja district upto 200 m depth is given in the table-10.

Table – 10: Ground Water Resources of Surguja district in Ham

Block/District	Dynamic resource Unconfined Aquifer (Ham)	Dynamic Ground Water Resource Confined Aquifer (Ham)	Total Static Resources Unconfined Aquifer (Ham)	Total Resource (Ham)	Stage of Ground Water Extraction (%)	Categorization
Balrampur	5961.79	173.62	20136.10	31256.20	30.50	Safe
Kusmi	9390.26	241.77	28266.67	44877.20	22.07	Safe
Rajpur	8232.51	160.25	18527.21	31569.99	30.43	Safe
Ramchandrapur	9384.4	204.71	23720.69	39281.58	39.75	Safe
Shankargarh	5553.75	144.19	16632.71	26558.97	30.58	Safe
Wadrafnagar	12744.31	218.74	25407.84	44819.16	32.84	Safe
Total	51267.02	1143.31	132691.25	218363.10	40.06	Safe

Existing and Future Water Demand (2025)*:* The existing demand for irrigation in the area is 14188 Ham while for domestic demand is 1825 Ham. To meet the future demand for ground water, a total quantity of 34968 ham of ground water is available for future use.

Table – 11: Ground Water Existing and Future Water Demand (2025) of Surguja district

Block/ District	Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction (Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use
		Irrigation Use	Industrial Use	Domestic Use	Total Extraction		
Balrampur	5961.79	1541.41	0.00	277.49	1818.90	322.91	4097.47
Kusmi	9390.26	1804.84	0.00	268.35	2073.19	301.49	7283.93
Rajpur	8232.51	2232.60	0.00	273.17	2505.77	316.69	5683.22
Ramchandrapur	9384.40	3302.07	0.00	429.14	3731.21	504.79	5577.54
Shankargarh	5553.75	1525.25	0.00	173.47	1698.72	194.28	3834.22
Wadrafnagarr	12744.31	3782.10	0.00	404.33	4186.43	470.46	8491.75
Total	51267.02	14188.27	0.00	1825.95	16014.22	2110.62	34968.13

5. GROUND WATER RELATED ISSUES

(i) During summer, dugwells in some villages becomes dry at many locations. Several handpumps also stop yielding water. The aquifer itself is a low yielding one.

(ii) In Granite aquifer system potential zone for ground water is related with occurrence of fracture, so drilling a high yield well is always a challenge. Proper scientific study coupled with geophysical investigation may minimize the failure of well.

(iii) Problems in Tube well / Bore well construction in Sandstone Aquifer System: In case of filter point wells drilled with hand bores, the depth of penetration is variable and whenever the Shale or any other compact layers are encountered, further drilling becomes difficult. When portable rotary rigs are deployed for drilling, the drilling operations become very slow and the pore spaces in fine grained layers are invaded by drilling fluid as a result the discharges tend to be poor. Proper well development is seldom carried out by private drillers and as a result fine sands get deposited in the bore. Sometimes caving of wells are commonly reported particularly when the top loss sand is cased and the bottom shales are drilled with down the hole hammer rig.

(iv) Problems in ring well construction Sandstone Aquifer System: The common problem is sand filling inside the rings during and after the lowering of rings, thereby practically eliminating the change of deepening of wells to tap more saturated column in summer months. The weep holes provided in the rings allow water with fine sands and gets filled up as and when sand removal is in progress thereby making it difficult for lowering of rings is highly saturated sands.

(v) High value of Fluoride and Iron has been reported from several locations.

6. MANAGEMENT STRATEGY

(i) It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. So, Information, Education and Communication (IEC) activities need to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance of community participation in saving water.

(ii) Desiltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also Rain water harvesting structures may be constructed in villages to reduce stress on groundwater.

(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At locations where water level is declining, we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water storage in the area. The different types of artificial structures feasible in the block are described in table-11. Probable sites are also identified for the construction of Artificial Recharge structure such as percolation tank, Nala bunding/ cement plug/ check dam, Gully Plugs/ gabion structures in district and details of the sites has been provided in Annexure. Abandoned tube well and dug well may be used for the recharge through shaft especially in urban and water stressed areas.

Table-12: Types of Artificial Recharge structures feasible

Block/District	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential for Artificial recharge (MCM)	Types of Structures Feasible and their Numbers			
			Percolation tank	Nalas bunding/ cement plug/ check dam	Gravity head /Dug well/ tube well/Recharge shaft	Gully plugs/ Gabion structures
Recharge Capacity - (MCM)/structure			0.2192	0.0326	0.00816	0.0073
Balrampur	205.00	8.008	18	62	150	112
Kushmi	8.35	0.780	2	5	13	10
Rajpur	52.57	4.408	10	34	82	60
Ramchandrapur	8.57	0.813	2	6	13	10
Sankargarh	16.27	0.972	2	8	20	15
Wadrafnagar	142.42	6.346	13	54	134	88
Total	433.18	21.327	47	169	412	295

(iv) Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.

(v) In urban areas STP may be installed for the treatment of sewage water in proper numbers to avoid contamination of ground water. Treatment of sewage water in village through soak pit for the individual houses and Seechewal model or similar model for community level may be adopted to avoid contamination of ground water. Treated water may also be reused for irrigation and other industrial purposes.

(vi) Since the stage of development in the district is 40.06 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the block. The ground water is presently developed through dug wells and tube wells. Yield potential for the block has been shown in Aquifer map (fig 13). Sites for wells need to be selected only after proper scientific investigation. The ground water quality

also needs to be ascertained and the wells used for water supply should be first checked for Iron, Fluoride and other pollutants.

Table 13: Potential of Additional GW abstraction structure creation

Block/ District	Net Groundwater availability (ham)	Stage of ground water Development (%)	Present ground water draft (Ham)	Ground water draft at 70% stage of development (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW/ BW Recommended in each block (Assuming unit draft as 1.6 ham/structure/year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/year)
Balrampur	5961.79	30.51	1818.90	4173.25	2354.35	883	1308
Kusumi	9390.26	22.08	2073.19	6573.18	4499.99	1687	2500
Rajpur	8232.51	30.44	2505.77	5762.76	3256.98	1221	1809
Ramchandrapur	9384.40	39.76	3731.21	6569.08	2837.87	1064	1577
Shankergarh	5553.75	30.59	1698.72	3887.63	2188.91	821	1216
Wadrafnagar	12744.31	32.85	4186.43	8921.02	4734.59	1775	2630
Total (District)	51267.02	40.06	16014.22	35886.91	19872.69	7452	11040

7. CONCLUSION:

For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the district (Table: 14).

Table 14: Detail of groundwater saved through change in cropping pattern and other interventions

Block/District	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham (Assuming 30 % saving)	GW Potential created after Artificial recharge structure in Ham	Development by new GW abstraction structure	Additional GW irrigation Potential created in Ham	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Percent increase in Crop area compare to Gross cropped area
Balrampur	1541.41	462.42	800.84	2354.35	3617.61	7235.23	20.18
Kusmi	1804.84	541.45	78.05	4499.99	5119.49	10238.98	24.81
Rajpur	2232.60	669.78	440.75	3256.98	4367.52	8735.03	20.38
Ramchandrapur	3302.07	990.62	81.31	2837.87	3909.80	7819.60	17.54
Shankergarh	1525.25	457.57	97.19	2188.91	2743.67	5487.34	20.18
Wadraf nagar	3782.10	1134.63	634.58	4734.59	6503.80	13007.60	25.49
Total (District)	14188.27	4256.48	2132.72	19872.69	26261.89	52523.79	21.63

Annexure: Probable sites for Artificial Recharge

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
1	83.7151	23.568	Maharajganj	Maharajganj	Balrampur	Check dam
2	83.7298	23.5567	Radhakrishannagar	Jhalpi	Balrampur	Check dam
3	83.7596	23.5793	Jarhadih	Jarhadih	Balrampur	Check dam
4	83.7555	23.539	Bhawanipur Urf Mahke	Baskepi	Kusmi	Check dam
5	83.7586	23.5263	Bhawanipur Urf Mahke	Baskepi	Kusmi	Check dam
6	83.7127	23.5276	Sauni	Sauni	Balrampur	Check dam
7	83.7049	23.5413	Sauni	Sauni	Balrampur	Check dam
8	83.7007	23.4868	Kotpali	Sauni	Balrampur	Check dam
9	83.6515	23.529	Budhudih	Khadiya Damar	Balrampur	Check dam
10	83.6432	23.5491	Dumar Khorka	Bhelwadih	Balrampur	Check dam
11	83.6481	23.5656	Bhelwadih	Bhelwadih	Balrampur	Check dam
12	83.6692	23.6267	Chitvishrampur	Chitvishrampur	Balrampur	Check dam
13	83.6506	23.6152	Bhawanipur	Obari	Balrampur	Check dam
14	83.5963	23.6832	Sendur	Sendur	Balrampur	Check dam
15	83.6121	23.6835	Nawadih	Tatapani	Balrampur	Check dam
16	83.6469	23.4916	Kotpali	Sauni	Balrampur	Check dam
17	83.6428	23.5023	Kotpali	Sauni	Balrampur	Check dam
18	83.635	23.5175	Budhudih	Khadiya Damar	Balrampur	Check dam
19	83.6278	23.5355	Budhudih	Khadiya Damar	Balrampur	Check dam
20	83.6285	23.5574	Khadiya Damar	Khadiya Damar	Balrampur	Check dam
21	83.6451	23.587	Tangar Mahari	Tangar Mahari	Balrampur	Check dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
22	83.6986	23.663	Dhaneshpur	Sarangpur	Balrampur	Check dam
23	83.7231	23.6282	Bardar	Bardar	Balrampur	Check dam
24	83.5302	23.6695	Sendur	Sendur	Balrampur	Check dam
25	83.4037	23.6431	Murka	Girwarganj	Balrampur	Check dam
26	83.3086	23.5405	Makro	Ranhat	Balrampur	Check dam
27	83.2953	23.5352	Makro	Ranhat	Balrampur	Check dam
28	83.252	23.5296	Bhairopur(Bhutka)	Chemee (Chaman	Balrampur	Check dam
29	83.3856	23.6145	Kapildevpur	Kapildevpur	Balrampur	Check dam
30	83.4185	23.7082	Chainpur (Kert	Chainpur (Kert	Balrampur	Check dam
31	83.4713	23.7117	Chainpur (Kert	Chainpur (Kert	Balrampur	Check dam
32	83.4942	23.6702	Manikpur	Manikpur	Balrampur	Check dam
33	83.5379	23.5804	Putsu	Khadiya Damar	Balrampur	Check dam
34	83.5655	23.5997	Badki Mahari	Badki Mahari	Balrampur	Check dam
35	83.5319	23.4924	Padhi	Padhi	Balrampur	Check dam
36	83.5197	23.4852	Sargawan	Padhi	Balrampur	Check dam
37	83.5113	23.4823	Sargawan	Padhi	Balrampur	Check dam
38	83.5371	23.4739	Padhi	Padhi	Balrampur	Check dam
39	83.4686	23.485	Sargadi	Sargadi	Balrampur	Check dam
40	83.4559	23.4846	Sargadi	Sargadi	Balrampur	Check dam
41	83.4453	23.4725	Govindpur	Sargadi	Balrampur	Check dam
42	83.387	23.5926	Banda	Banda	Balrampur	Check dam
43	83.4551	23.7313	Chainpur (Kert	Chainpur (Kert	Balrampur	Check dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
44	83.4075	23.7243		Chainpur (Kert	Balrampur	Check dam
45	83.3317	23.5301	Lurgi khurd	Lurgi khurd	Balrampur	Check dam
46	83.3368	23.5773	Chandaura	Chandaura	Balrampur	Check dam
47	83.6099	23.54	Jhapra	Khadiya Damar	Balrampur	Check dam
48	83.5924	23.6623	Nawadih	Tatapani	Balrampur	Check dam
49	83.598	23.6384	Adhaura	Bhanora	Balrampur	Check dam
50	83.6252	23.6684	Nawadih	Tatapani	Balrampur	Check dam
51	83.6	23.6218	Bhanora	Bhanora	Balrampur	Check dam
52	83.5722	23.6391	Jabrahi	Sendur	Balrampur	Check dam
53	83.7103	23.6702	Dhaneshpur	Sarangpur	Balrampur	Check dam
54	83.6671	23.6851	Rajbandha	Sarangpur	Balrampur	Check dam
55	83.4232	23.6313	Basera kalan	Girwarganj	Balrampur	Check dam
56	83.5233	23.5372	Jhalariya	Jhalariya	Balrampur	Check dam
57	83.476	23.558	Ghaghara	Kochali	Balrampur	Check dam
58	83.5808	23.4721	Sitarampur	Sitarampur	Balrampur	Check dam
59	83.5255	23.4745	Sargawan	Padhi	Balrampur	Check dam
60	83.4014	23.6139	Kapildevpur	Kapildevpur	Balrampur	Check dam
61	83.4358	23.6229	Basera kalan	Girwarganj	Balrampur	Check dam
62	83.4017	23.574	Kapaut	Banda	Balrampur	Check dam
63	83.5496	23.5278	Kanda	Sitarampur	Balrampur	Check dam
64	83.7328	23.4749	Sukhari	Sukhari	Kusmi	Check dam
65	83.7289	23.4613	Sukhari	Sukhari	Kusmi	Check dam
66	83.8262	23.3214	Amarpur	Amarpur	Kusmi	Check dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
67	83.8602	23.2992	Karkali Pashachim	Karkali Pashac	Kusmi	Check dam
68	83.7834	23.3606	Harri	Harri	Kusmi	Check dam
69	83.4215	23.3111	Chatakpur	Budha Bagicha	Rajpur	Check dam
70	83.4068	23.3205	Rajpur	Rajpur	Rajpur	Check dam
71	83.3853	23.3435	Nawki	Nawki	Rajpur	Check dam
72	83.3823	23.3576	Nawki	Nawki	Rajpur	Check dam
73	83.3261	23.317	Karji	Karji	Rajpur	Check dam
74	83.2946	23.3308	Chilma kalan	Chilma kalan	Rajpur	Check dam
75	83.3	23.2729	Dakuwa	Dakuwa	Rajpur	Check dam
76	83.2604	23.259	Sidhama	Sidhama	Rajpur	Check dam
77	83.2223	23.3118	Rewatpur	Rewatpur	Rajpur	Check dam
78	83.2474	23.3627	Markadand	Markadand	Rajpur	Check dam
79	83.4515	23.3192	Ghorghadi	Ghorghadi	Rajpur	Check dam
80	83.4457	23.383	Karra	Karra	Rajpur	Check dam
81	83.5062	23.3685	Kawdu	Alakhdiha	Rajpur	Check dam
82	83.4929	23.4197	Ladkund	Ladkund	Rajpur	Check dam
83	83.4728	23.4198	Ladkund	Ladkund	Rajpur	Check dam
84	83.5244	23.4039	Uphiya	Uliya	Rajpur	Check dam
85	83.5285	23.3951	Uphiya	Uliya	Rajpur	Check dam
86	83.6405	23.2386	Amera	Kharkona	Shankargarh	Check dam
87	83.6376	23.261	Amera	Kharkona	Shankargarh	Check dam
88	83.6206	23.3108	Belsar	Belsar	Shankargarh	Check dam
89	83.5673	23.3014	Sargawan	Sargawan	Shankargarh	Check dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
90	83.5676	23.3404	Bhairopur	Dipadih Khurd	Shankargarh	Check dam
91	83.5567	23.3531	Jagima	Jagima	Shankargarh	Check dam
92	83.5385	23.3162	Murka	Murka	Shankargarh	Check dam
93	83.6152	23.2909	Jamdi	Jamdi	Shankargarh	Check dam
94	83.5167	23.3582	Pendari	Bhadar	Rajpur	Check dam
95	83.5633	23.4616	Parti	Parti	Rajpur	Check dam
96	83.2953	23.3547	Narsinghpur	Narsinghpur	Rajpur	Check dam
97	83.2593	23.3359	Dhandhapur	Dhandhapur	Rajpur	Check dam
98	83.2173	23.3634	Chaura	Chaura	Rajpur	Check dam
99	83.22	23.2694	Badauli	Badauli	Rajpur	Check dam
100	83.2251	23.2548	Akhora Khurd	Sidhama	Rajpur	Check dam
101	83.3067	23.25	Bariyon	Bariyon	Rajpur	Check dam
102	83.3398	23.3063	Karji	Karji	Rajpur	Check dam
103	83.5112	23.3977	Jigdi	Jigdi	Rajpur	Check dam
104	83.4854	23.4013	Alakdiha	Alakhdiha	Rajpur	Check dam
105	83.4466	23.3621	Dand khadua	Kotagahna	Rajpur	Check dam
106	83.4375	23.4123	Ladkund	Ladkund	Rajpur	Check dam
107	83.4026	23.4052	Ladkund	Ladkund	Rajpur	Check dam
108	83.3846	23.3897	Karwan	Karwan	Rajpur	Check dam
109	83.3478	23.8015	Palgi	Palgi	Ramchandrapur	Check dam
110	83.4318	23.7995	Krishnanagar	Krishnanagar	Ramchandrapur	Check dam
111	83.7248	23.7581	Krishnanagar	Bhawar Mal.	Ramchandrapur	Check dam
112	83.2755	23.9988	Kundru	Talkeshwarpur	Ramchandrapur	Check dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
113	83.5042	23.801	Kewali	Kewali	Ramchandrapur	Check dam
114	83.4914	23.787	Chumra	Chumra	Ramchandrapur	Check dam
115	83.1722	23.781	Kotrahi	Kotrahi	Wadrafnagar	Check dam
116	83.1626	23.7757	Kotrahi	Kotrahi	Wadrafnagar	Check dam
117	83.1473	23.7743	Pendari	Pendari	Wadrafnagar	Check dam
118	83.133	23.7734	Pendari	Pendari	Wadrafnagar	Check dam
119	83.1198	23.77	Ikanara	Pendari	Wadrafnagar	Check dam
120	83.1096	23.7448	Ikanara	Pendari	Wadrafnagar	Check dam
121	83.2102	23.7764	Wadrafnagar	Wadrafnagar	Wadrafnagar	Check dam
122	83.2242	23.7365	Rajkheta	Rajkheta	Wadrafnagar	Check dam
123	83.2508	23.7577	Rajkheta	Rajkheta	Wadrafnagar	Check dam
124	83.3117	23.7851	Gowardhanpur	Gowardhanpur	Wadrafnagar	Check dam
125	83.3455	23.7796	Dhadhia	Dhadhia	Wadrafnagar	Check dam
126	83.3176	23.7929	Gowardhanpur	Gowardhanpur	Wadrafnagar	Check dam
127	83.3345	23.7894	Surhul	Gowardhanpur	Wadrafnagar	Check dam
128	83.3103	23.8143	Shardapur	Shardapur	Wadrafnagar	Check dam
129	83.3316	23.8312	Mahuli	Mahuli	Wadrafnagar	Check dam
130	83.3196	23.8673	Sulsuli	Sulsuli	Wadrafnagar	Check dam
131	83.3286	23.8575	Belsar	Belsar	Wadrafnagar	Check dam
132	83.3021	23.8479	Sulsuli	Sulsuli	Wadrafnagar	Check dam
133	83.2946	23.8446	Shardapur	Shardapur	Wadrafnagar	Check dam
134	83.2423	23.8521	Lamori	Murkaul	Wadrafnagar	Check dam
135	83.2127	23.8396	Basantpur	Basantpur	Wadrafnagar	Check dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
136	83.1859	23.8811	Kundi	Gobara	Wadrafnagar	Check dam
137	83.1909	23.829	Basantpur	Basantpur	Wadrafnagar	Check dam
138	83.1788	23.8364	Ruppur	Ruppur	Wadrafnagar	Check dam
139	83.1771	23.8247	Pashupatipur	Pashupatipur	Wadrafnagar	Check dam
140	83.1391	23.8332	Kaknesa	Kaknesa	Wadrafnagar	Check dam
141	83.1296	23.8337	Kaknesa	Kaknesa	Wadrafnagar	Check dam
142	83.1132	23.8333	Ramnagar	Ramnagar	Wadrafnagar	Check dam
143	83.0704	23.8388	Pandari	Pandari	Wadrafnagar	Check dam
144	83.0308	23.8501	Girwani	Girwani	Wadrafnagar	Check dam
145	82.9483	23.8461	Sarna	Sarna	Wadrafnagar	Check dam
146	82.982	23.809	Gaina	Gaina	Wadrafnagar	Check dam
147	83.0127	23.8176	Jaurahi	Jaurahi	Wadrafnagar	Check dam
148	83.0354	23.8107	Harigawan	Harigawan	Wadrafnagar	Check dam
149	83.0892	23.7964	Gurmuti	Gurmuti	Wadrafnagar	Check dam
150	83.1257	23.7997	Madanpur	Gurmuti	Wadrafnagar	Check dam
151	83.2763	23.7912	Bengo	Karamdiha	Wadrafnagar	Check dam
152	83.2636	23.7893	Mendhari	Mendhari	Wadrafnagar	Check dam
153	83.2494	23.7864	Mendhari	Mendhari	Wadrafnagar	Check dam
154	83.2233	23.6752	Parasdiha	Parasdiha	Wadrafnagar	Check dam
155	83.2413	23.6809	Barti Khurd	Shiwari	Wadrafnagar	Check dam
156	83.2463	23.7125	Pansara	Pansara	Wadrafnagar	Check dam
157	83.3034	23.7278	Dhadhia	Dhadhia	Wadrafnagar	Check dam
158	83.3052	23.6806	Odari	Odari	Wadrafnagar	Check dam

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
159	83.2866	23.6642	Shardapur	Shardapur	Wadrafnagar	Check dam
160	83.2713	23.6642	Injani	Injani	Wadrafnagar	Check dam
161	83.2343	23.6596	Barti Kalan	Barti Kalan	Wadrafnagar	Check dam
162	83.2321	23.6299	Injani	Injani	Wadrafnagar	Check dam
163	83.2183	23.6232	Injani	Injani	Wadrafnagar	Check dam
164	83.3092	23.646	Badkagaon	Badkagaon	Wadrafnagar	Check dam
165	83.3044	23.6281	Shardapur	Shardapur	Wadrafnagar	Check dam
166	83.3125	23.6635	Badkagaon	Badkagaon	Wadrafnagar	Check dam
167	83.2618	23.7475	Dhadhia	Dhadhia	Wadrafnagar	Check dam
168	83.1513	23.7378	Pendari	Pendari	Wadrafnagar	Check dam
169	83.471	23.7402	Chainpur (Kert	Chainpur (Kert	Balrampur	Gully plug
170	83.4546	23.7427	Chainpur (Kert	Chainpur (Kert	Balrampur	Gully plug
171	83.4409	23.7438	Chainpur (Kert	Chainpur (Kert	Balrampur	Gully plug
172	83.4208	23.7332	Chainpur (Kert	Chainpur (Kert	Balrampur	Gully plug
173	83.4055	23.7362	Chainpur (Kert	Chainpur (Kert	Balrampur	Gully plug
174	83.4333	23.7132	Chainpur (Kert	Chainpur (Kert	Balrampur	Gully plug
175	83.4866	23.7094	Chainpur (Kert	Chainpur (Kert	Balrampur	Gully plug
176	83.4852	23.7279	Chainpur (Kert	Chainpur (Kert	Balrampur	Gully plug
177	83.5027	23.6743	Manikpur	Manikpur	Balrampur	Gully plug
178	83.4848	23.6808	Manikpur	Manikpur	Balrampur	Gully plug
179	83.5371	23.6794	Sendur	Sendur	Balrampur	Gully plug
180	83.5148	23.6635	Sendur	Sendur	Balrampur	Gully plug
181	83.3969	23.6448	Murka	Girwarganj	Balrampur	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
182	83.3947	23.6327	Kapildevpur	Kapildevpur	Balrampur	Gully plug
183	83.4135	23.6077		Banda	Balrampur	Gully plug
184	83.37	23.5676	Chandaura	Chandaura	Balrampur	Gully plug
185	83.3774	23.5666	Chandaura	Chandaura	Balrampur	Gully plug
186	83.3974	23.5665	Banda	Banda	Balrampur	Gully plug
187	83.4154	23.5737	Banda	Banda	Balrampur	Gully plug
188	83.3251	23.5693	Chandaura	Chandaura	Balrampur	Gully plug
189	83.3351	23.5649	Sarsawatipur	Chandaura	Balrampur	Gully plug
190	83.316	23.5489	Ranhat	Ranhat	Balrampur	Gully plug
191	83.3065	23.5471	Ranhat	Ranhat	Balrampur	Gully plug
192	83.2964	23.5418	Karri Chalgali	Karri Chalgali	Balrampur	Gully plug
193	83.2917	23.5413	Karri Chalgali	Karri Chalgali	Balrampur	Gully plug
194	83.2589	23.5337	Chemee (Chamanpur)	Chemee (Chaman	Balrampur	Gully plug
195	83.2467	23.523	Bhairopur(Bhutka)	Chemee (Chaman	Balrampur	Gully plug
196	83.345	23.5395	Lurgi khurd	Lurgi khurd	Balrampur	Gully plug
197	83.3381	23.541	Lurgi khurd	Lurgi khurd	Balrampur	Gully plug
198	83.3228	23.5392	Ranhat	Ranhat	Balrampur	Gully plug
199	83.3555	23.539	Fatepur	Lurgi khurd	Balrampur	Gully plug
200	83.3625	23.5574	Chandaura	Chandaura	Balrampur	Gully plug
201	83.4355	23.6529	Barauli	Chainpur (Kert	Balrampur	Gully plug
202	83.4191	23.6457	Girwarganj	Girwarganj	Balrampur	Gully plug
203	83.48	23.6711	Manikpur	Manikpur	Balrampur	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
204	83.4836	23.6608	Manikpur	Manikpur	Balrampur	Gully plug
205	83.4946	23.6486	Sendur	Sendur	Balrampur	Gully plug
206	83.4966	23.6354	Shankarpur	Tarkakhand	Balrampur	Gully plug
207	83.4997	23.6267	Shankarpur	Tarkakhand	Balrampur	Gully plug
208	83.5033	23.6145	Shankarpur	Tarkakhand	Balrampur	Gully plug
209	83.5223	23.6051	Maheshpur	Maheshpur	Balrampur	Gully plug
210	83.5178	23.6416	Shankarpur	Tarkakhand	Balrampur	Gully plug
211	83.5821	23.6884	Sendur	Sendur	Balrampur	Gully plug
212	83.5715	23.685	Sendur	Sendur	Balrampur	Gully plug
213	83.5561	23.6725	Sendur	Sendur	Balrampur	Gully plug
214	83.5533	23.6545	Sendur	Sendur	Balrampur	Gully plug
215	83.5547	23.6385	Sonhara	Maheshpur	Balrampur	Gully plug
216	83.5702	23.6529	Jabrahi	Sendur	Balrampur	Gully plug
217	83.5787	23.6631	Sendur	Sendur	Balrampur	Gully plug
218	83.5868	23.6806	Sendur	Sendur	Balrampur	Gully plug
219	83.5815	23.6222	Bhanora	Bhanora	Balrampur	Gully plug
220	83.5562	23.6185	Sonhara	Maheshpur	Balrampur	Gully plug
221	83.5802	23.5867	Badki Mahari	Badki Mahari	Balrampur	Gully plug
222	83.5585	23.5878	Putsu	Khadiya Damar	Balrampur	Gully plug
223	83.6105	23.6736	Nawadih	Tatapani	Balrampur	Gully plug
224	83.6311	23.6764	Nawadih	Tatapani	Balrampur	Gully plug
225	83.6693	23.6318	Chitvishrampur	Chitvishrampur	Balrampur	Gully plug
226	83.6645	23.6338	Pindra	Obari	Balrampur	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
227	83.6405	23.6038	Darridih	Sarnadih	Balrampur	Gully plug
228	83.6379	23.6111	Turridih	Sarnadih	Balrampur	Gully plug
229	83.6422	23.6213	Majhauli	Obari	Balrampur	Gully plug
230	83.6168	23.5466	Jhapra	Khadiya Damar	Balrampur	Gully plug
231	83.6052	23.5539	Jhapra	Khadiya Damar	Balrampur	Gully plug
232	83.6459	23.5566	Bhelwadih	Bhelwadih	Balrampur	Gully plug
233	83.6517	23.557	Bhelwadih	Bhelwadih	Balrampur	Gully plug
234	83.6623	23.5584	Bhelwadih	Bhelwadih	Balrampur	Gully plug
235	83.6703	23.5686	Bhelwadih	Bhelwadih	Balrampur	Gully plug
236	83.673	23.5749	Magarhara	Jawar	Balrampur	Gully plug
237	83.6509	23.5196	Sauni	Sauni	Balrampur	Gully plug
238	83.6471	23.5089	Kotpali	Sauni	Balrampur	Gully plug
239	83.6249	23.5081	Budhudih	Khadiya Damar	Balrampur	Gully plug
240	83.6134	23.5208	Budhudih	Khadiya Damar	Balrampur	Gully plug
241	83.6718	23.4951	Kotpali	Sauni	Balrampur	Gully plug
242	83.6807	23.4936	Kotpali	Sauni	Balrampur	Gully plug
243	83.6938	23.5431	Sauni	Sauni	Balrampur	Gully plug
244	83.6806	23.5364	Sauni	Sauni	Balrampur	Gully plug
245	83.7045	23.5625	Maharajganj	Maharajganj	Balrampur	Gully plug
246	83.7182	23.5526	Chirkoma	Jhalpi	Balrampur	Gully plug
247	83.7281	23.5404	Radhakrishannagar	Jhalpi	Balrampur	Gully plug
248	83.6826	23.6531	Jatro	Chitvishrampur	Balrampur	Gully plug
249	83.6722	23.6707	Rajbandha	Sarangpur	Balrampur	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
250	83.4879	23.5956	Champapur	Lurgi kalan	Balrampur	Gully plug
251	83.4757	23.5855	Tarkakhand	Tarkakhand	Balrampur	Gully plug
252	83.4655	23.5734	Dumar khola	Dumar khola	Balrampur	Gully plug
253	83.4554	23.552	Dumar khola	Dumar khola	Balrampur	Gully plug
254	83.4376	23.5006	Kotasaripodi	Kotasaripodi	Balrampur	Gully plug
255	83.4634	23.4936	Sargadi	Sargadi	Balrampur	Gully plug
256	83.4333	23.4894	Lilauti	Lilauti	Balrampur	Gully plug
257	83.4253	23.4749	Lilauti	Lilauti	Balrampur	Gully plug
258	83.4331	23.4597	Lilauti	Lilauti	Balrampur	Gully plug
259	83.5415	23.4999	Padhi	Padhi	Balrampur	Gully plug
260	83.5309	23.5009	Padhi	Padhi	Balrampur	Gully plug
261	83.522	23.502	Bairamu	Jhalariya	Balrampur	Gully plug
262	83.5088	23.4977	Sargawan	Padhi	Balrampur	Gully plug
263	83.5145	23.4894	Sargawan	Padhi	Balrampur	Gully plug
264	83.4992	23.487	Lurgi	Padhi	Balrampur	Gully plug
265	83.4955	23.4817	Lurgi	Padhi	Balrampur	Gully plug
266	83.4875	23.4735	Lurgi	Padhi	Balrampur	Gully plug
267	83.5393	23.4848	Padhi	Padhi	Balrampur	Gully plug
268	83.5851	23.4787	Sitarampur	Sitarampur	Balrampur	Gully plug
269	83.5585	23.5173	Kanda	Sitarampur	Balrampur	Gully plug
270	83.5623	23.5231	Kanda	Sitarampur	Balrampur	Gully plug
271	83.5511	23.5164	Kanda	Sitarampur	Balrampur	Gully plug
272	83.5348	23.5248	Padhi	Padhi	Balrampur	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
273	83.5227	23.5258	Jhalariya	Jhalariya	Balrampur	Gully plug
274	83.509	23.5308	Bathaura	Jhalariya	Balrampur	Gully plug
275	83.5304	23.5715	Putsu	Khadiya Damar	Balrampur	Gully plug
276	83.5221	23.5822	Putsu	Khadiya Damar	Balrampur	Gully plug
277	83.5332	23.589	Daldhowa	Maheshpur	Balrampur	Gully plug
278	83.563	23.4876	Sitarampur	Sitarampur	Balrampur	Gully plug
279	83.5687	23.4754	Sitarampur	Sitarampur	Balrampur	Gully plug
280	83.6239	23.6326	Adhaura	Bhanora	Balrampur	Gully plug
281	83.6373	23.6627	Lurghuta	Tatapani	Balrampur	Gully plug
282	83.6437	23.6709	Nawadih	Tatapani	Balrampur	Gully plug
283	83.785	23.3696	Harri	Harri	Kusmi	Gully plug
284	83.7955	23.3666	Harri	Harri	Kusmi	Gully plug
285	83.828	23.342	Bhulsi Khurd	Bhulsi Khurd	Kusmi	Gully plug
286	83.8369	23.3385	Bhulsi Khurd	Bhulsi Khurd	Kusmi	Gully plug
287	83.8619	23.313	Jirhul	Jirhul	Kusmi	Gully plug
288	83.8692	23.3062	Karkali Pashachim	Karkali Pashac	Kusmi	Gully plug
289	83.8717	23.2906	Karkali Purva	Karkali Pashac	Kusmi	Gully plug
290	83.8802	23.292	Semara	Semara	Kusmi	Gully plug
291	83.8206	23.3377	Bhulsi Kalan	Amarpur	Kusmi	Gully plug
292	83.8102	23.3539	Bakaspur	Harri	Kusmi	Gully plug
293	83.2497	23.3067	Rewatpur	Rewatpur	Rajpur	Gully plug
294	83.237	23.3	Rewatpur	Rewatpur	Rajpur	Gully plug
295	83.2249	23.2981	Rewatpur	Rewatpur	Rajpur	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
296	83.265	23.3208	Dhandhapur	Dhandhapur	Rajpur	Gully plug
297	83.3084	23.3478	Chilma kalan	Chilma kalan	Rajpur	Gully plug
298	83.2548	23.3763	Duppi	Markadand	Rajpur	Gully plug
299	83.2258	23.3774	Chaura	Chaura	Rajpur	Gully plug
300	83.3309	23.3243	Karji	Karji	Rajpur	Gully plug
301	83.3302	23.2951	Chanchi	Dakuwa	Rajpur	Gully plug
302	83.3192	23.3088	Chilma kalan	Chilma kalan	Rajpur	Gully plug
303	83.3041	23.3323	Chilma kalan	Chilma kalan	Rajpur	Gully plug
304	83.2903	23.3206	Chilma kalan	Chilma kalan	Rajpur	Gully plug
305	83.3075	23.2836	Dakuwa	Dakuwa	Rajpur	Gully plug
306	83.3199	23.2431	Bariyon	Bariyon	Rajpur	Gully plug
307	83.3241	23.2514	Bariyon	Bariyon	Rajpur	Gully plug
308	83.4194	23.3258	Budha Bagicha	Budha Bagicha	Rajpur	Gully plug
309	83.4171	23.2932	Patrapara	Patrapara	Rajpur	Gully plug
310	83.4621	23.3245	Ghorghadi	Ghorghadi	Rajpur	Gully plug
311	83.4454	23.3504	Dand khadua	Kotagahna	Rajpur	Gully plug
312	83.5339	23.4121	Uliya	Uliya	Rajpur	Gully plug
313	83.4976	23.4231	Basen	Jigdi	Rajpur	Gully plug
314	83.4829	23.4261	Ladkund	Ladkund	Rajpur	Gully plug
315	83.5465	23.3989	Uphiya	Uliya	Rajpur	Gully plug
316	83.5308	23.4141	Uliya	Uliya	Rajpur	Gully plug
317	83.5208	23.4142	Basen	Jigdi	Rajpur	Gully plug
318	83.5534	23.4115	Parti	Parti	Rajpur	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
319	83.493	23.3637	Kawdu	Alakhdiha	Rajpur	Gully plug
320	83.5026	23.3802	Kawdu	Alakhdiha	Rajpur	Gully plug
321	83.5045	23.3549	Sewari	Sewari	Rajpur	Gully plug
322	83.5139	23.3461	Pendari	Bhadar	Rajpur	Gully plug
323	83.4662	23.307	Lau	Lau	Rajpur	Gully plug
324	83.4582	23.3586	Pahad khadua	Kotagahna	Rajpur	Gully plug
325	83.462	23.3815	Alakhdiha	Alakhdiha	Rajpur	Gully plug
326	83.4016	23.3366	Rajpur	Rajpur	Rajpur	Gully plug
327	83.4049	23.3589	Bagadi	Nawki	Rajpur	Gully plug
328	83.4029	23.3716	Patratu	Karra	Rajpur	Gully plug
329	83.4051	23.3039	Okra	Okra	Rajpur	Gully plug
330	83.4271	23.2858	Amdari	Patrapara	Rajpur	Gully plug
331	83.3498	23.3125	Karji	Karji	Rajpur	Gully plug
332	83.3571	23.3033	Chandragarh	Dignagar	Rajpur	Gully plug
333	83.2974	23.2773	Khukhri	Khukhri	Rajpur	Gully plug
334	83.2579	23.2663	Kundi kalan	Kundi kalan	Rajpur	Gully plug
335	83.2335	23.2494	Akhora Khurd	Sidhama	Rajpur	Gully plug
336	83.2643	23.2833	Shivpur alias Deori	Kundi kalan	Rajpur	Gully plug
337	83.2373	23.2718	Badauli	Badauli	Rajpur	Gully plug
338	83.3146	23.2363	Kakna	Kakna	Rajpur	Gully plug
339	83.3373	23.2601	Bheski	Baghima	Rajpur	Gully plug
340	83.3401	23.2834	Chanchi	Dakuwa	Rajpur	Gully plug
341	83.3723	23.2929	Dignagar	Dignagar	Rajpur	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
342	83.4568	23.3912	Alakhdiha	Alakhdiha	Rajpur	Gully plug
343	83.3923	23.3634	Bagadi	Nawki	Rajpur	Gully plug
344	83.3878	23.395	Karwan	Karwan	Rajpur	Gully plug
345	83.399	23.4135	Lilauti	Lilauti	Balrampur	Gully plug
346	83.4438	23.419	Ladkund	Ladkund	Rajpur	Gully plug
347	83.4296	23.4216	Lilauti	Lilauti	Balrampur	Gully plug
348	83.2841	23.3372	Chilma kalan	Chilma kalan	Rajpur	Gully plug
349	83.2918	23.3114	Chilma kalan	Chilma kalan	Rajpur	Gully plug
350	83.3416	23.3408	Parsagudi	Parsagudi	Rajpur	Gully plug
351	83.3485	23.3583	Singchaura	Singchaura	Rajpur	Gully plug
352	83.3127	23.3633	Narsinghpur	Narsinghpur	Rajpur	Gully plug
353	83.2448	23.3764	Duppi	Markadand	Rajpur	Gully plug
354	83.5672	23.3511	Jagima	Jagima	Shankargarh	Gully plug
355	83.5636	23.3603	Jagima	Jagima	Shankargarh	Gully plug
356	83.5469	23.3133	Lodhi	Lodhi	Shankargarh	Gully plug
357	83.532	23.3051	Damodarpur	Murka	Shankargarh	Gully plug
358	83.6258	23.3005	Bijadih	Jamdi	Shankargarh	Gully plug
359	83.6337	23.3049	Bijadih	Jamdi	Shankargarh	Gully plug
360	83.631	23.2329	Amera	Kharkona	Shankargarh	Gully plug
361	83.6258	23.2421	Amera	Kharkona	Shankargarh	Gully plug
362	83.6483	23.2288	Amera	Kharkona	Shankargarh	Gully plug
363	83.6547	23.2376	Bhubneshwarpur	Bhubneshwarpur	Shankargarh	Gully plug
364	83.6532	23.2454	Amera	Kharkona	Shankargarh	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
365	83.6436	23.2269	Amera	Kharkona	Shankargarh	Gully plug
366	83.5751	23.2917	Sihar	Sihar	Shankargarh	Gully plug
367	83.583	23.3476	Jagima	Jagima	Shankargarh	Gully plug
368	83.573	23.3564	Patana	Jagima	Shankargarh	Gully plug
369	83.5077	23.8088	Kewali	Kewali	Ramchandrapur	Gully plug
370	83.5017	23.8103	Kewali	Kewali	Ramchandrapur	Gully plug
371	83.4901	23.7802	Chumra	Chumra	Ramchandrapur	Gully plug
372	83.4888	23.7877	Chumra	Chumra	Ramchandrapur	Gully plug
373	83.4912	23.7967	Chumra	Chumra	Ramchandrapur	Gully plug
374	83.437	23.7866	Krishnanagar	Krishnanagar	Ramchandrapur	Gully plug
375	83.4248	23.7869	Krishnanagar	Krishnanagar	Ramchandrapur	Gully plug
376	83.4199	23.7996	Krishnanagar	Krishnanagar	Ramchandrapur	Gully plug
377	83.3544	23.8102	Palgi	Palgi	Ramchandrapur	Gully plug
378	83.3584	23.8048	Chalkhi	Trikunda	Ramchandrapur	Gully plug
379	82.9523	23.8611	Kesari	Kesari	Wadrafnagar	Gully plug
380	82.9576	23.8528	Kesari	Kesari	Wadrafnagar	Gully plug
381	82.976	23.8212	Sarna	Sarna	Wadrafnagar	Gully plug
382	82.9886	23.8187	Beto	Gaina	Wadrafnagar	Gully plug
383	82.969	23.8032	Gaina	Gaina	Wadrafnagar	Gully plug
384	82.9912	23.8002	Chanwarsarai	Jaurahi	Wadrafnagar	Gully plug
385	83.0167	23.8259	Jaurahi	Jaurahi	Wadrafnagar	Gully plug
386	83.0051	23.825	Jaurahi	Jaurahi	Wadrafnagar	Gully plug
387	83.0364	23.855	Girwani	Girwani	Wadrafnagar	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
388	83.0247	23.8545	Girwani	Girwani	Wadrafnagar	Gully plug
389	83.0157	23.8478	Girwani	Girwani	Wadrafnagar	Gully plug
390	83.076	23.8471	Kharra	Ramnagar	Wadrafnagar	Gully plug
391	83.0887	23.8455	Ramnagar	Ramnagar	Wadrafnagar	Gully plug
392	83.0526	23.8121	Lodhi	Lodhi	Wadrafnagar	Gully plug
393	83.0521	23.8233	Pandari	Pandari	Wadrafnagar	Gully plug
394	83.0368	23.8243	Harigawan	Harigawan	Wadrafnagar	Gully plug
395	83.0795	23.8047	Lodhi	Lodhi	Wadrafnagar	Gully plug
396	83.0852	23.7886	Gurmuti	Gurmuti	Wadrafnagar	Gully plug
397	83.134	23.8098	Kaknesa	Kaknesa	Wadrafnagar	Gully plug
398	83.1208	23.8099	Madanpur	Gurmuti	Wadrafnagar	Gully plug
399	83.1469	23.8448	Pashupatipur	Pashupatipur	Wadrafnagar	Gully plug
400	83.132	23.8415	Kaknesa	Kaknesa	Wadrafnagar	Gully plug
401	83.1177	23.8406	Kaknesa	Kaknesa	Wadrafnagar	Gully plug
402	83.1644	23.8642	Phulidumar	Phulidumar	Wadrafnagar	Gully plug
403	83.181	23.8933	Dhanwar	Phulidumar	Wadrafnagar	Gully plug
404	83.1735	23.8821	Phulidumar	Phulidumar	Wadrafnagar	Gully plug
405	83.2029	23.8523	Basantpur	Basantpur	Wadrafnagar	Gully plug
406	83.2167	23.8493	Basantpur	Basantpur	Wadrafnagar	Gully plug
407	83.2262	23.8425	Basulapath	Syahi	Wadrafnagar	Gully plug
408	83.2261	23.8347	Basulapath	Syahi	Wadrafnagar	Gully plug
409	83.195	23.8441	Basantpur	Basantpur	Wadrafnagar	Gully plug
410	83.1881	23.8441	Basantpur	Basantpur	Wadrafnagar	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
411	83.1722	23.8389	Mithilapur	Ruppur	Wadrafnagar	Gully plug
412	83.1616	23.8248	Mithilapur	Ruppur	Wadrafnagar	Gully plug
413	83.1327	23.7675	Pendari	Pendari	Wadrafnagar	Gully plug
414	83.1184	23.7627	Ikanara	Pendari	Wadrafnagar	Gully plug
415	83.1004	23.7516	Ikanara	Pendari	Wadrafnagar	Gully plug
416	83.1221	23.7549	Ikanara	Pendari	Wadrafnagar	Gully plug
417	83.2779	23.7435	Dhadhia	Dhadhia	Wadrafnagar	Gully plug
418	83.272	23.7353	Dhadhia	Dhadhia	Wadrafnagar	Gully plug
419	83.1856	23.7688	Wadrafnagar	Wadrafnagar	Wadrafnagar	Gully plug
420	83.1718	23.7644	Kotrahi	Kotrahi	Wadrafnagar	Gully plug
421	83.2252	23.7691	Rajkheta	Rajkheta	Wadrafnagar	Gully plug
422	83.2115	23.7681	Wadrafnagar	Wadrafnagar	Wadrafnagar	Gully plug
423	83.2416	23.6902	Pansara	Pansara	Wadrafnagar	Gully plug
424	83.2527	23.6877	Pansara	Pansara	Wadrafnagar	Gully plug
425	83.259	23.6735	Barti Khurd	Shiwari	Wadrafnagar	Gully plug
426	83.2477	23.6502	Savitripur	Shiwari	Wadrafnagar	Gully plug
427	83.2356	23.6493	Savitripur	Shiwari	Wadrafnagar	Gully plug
428	83.2361	23.6381	Barti Kalan	Barti Kalan	Wadrafnagar	Gully plug
429	83.2466	23.6264	Injani	Injani	Wadrafnagar	Gully plug
430	83.2333	23.6197	Injani	Injani	Wadrafnagar	Gully plug
431	83.2238	23.6149	Injani	Injani	Wadrafnagar	Gully plug
432	83.2132	23.6139	Injani	Injani	Wadrafnagar	Gully plug
433	83.2539	23.6191	Injani	Injani	Wadrafnagar	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
434	83.3248	23.6406	Badkagaon	Badkagaon	Wadrafnagar	Gully plug
435	83.3168	23.6363	Badkagaon	Badkagaon	Wadrafnagar	Gully plug
436	83.3099	23.6314	Badkagaon	Badkagaon	Wadrafnagar	Gully plug
437	83.313	23.6149	Badkagaon	Badkagaon	Wadrafnagar	Gully plug
438	83.3046	23.6149	Shardapur	Shardapur	Wadrafnagar	Gully plug
439	83.2945	23.6145	Shardapur	Shardapur	Wadrafnagar	Gully plug
440	83.3206	23.6528	Badkagaon	Badkagaon	Wadrafnagar	Gully plug
441	83.3249	23.6615	Badkagaon	Badkagaon	Wadrafnagar	Gully plug
442	83.3203	23.6766	Dhadhia	Dhadhia	Wadrafnagar	Gully plug
443	83.3098	23.6874	Dhadhia	Dhadhia	Wadrafnagar	Gully plug
444	83.2704	23.6428	Injani	Injani	Wadrafnagar	Gully plug
445	83.2799	23.6438	Shardapur	Shardapur	Wadrafnagar	Gully plug
446	83.2916	23.6461	Shardapur	Shardapur	Wadrafnagar	Gully plug
447	83.309	23.6504	Badkagaon	Badkagaon	Wadrafnagar	Gully plug
448	83.2949	23.6777	Odari	Odari	Wadrafnagar	Gully plug
449	83.2865	23.6856	Odari	Odari	Wadrafnagar	Gully plug
450	83.278	23.6788	Budhatand (Budhadand	Budhatand	Wadrafnagar	Gully plug
451	83.342	23.7655	Gowardhanpur	Gowardhanpur	Wadrafnagar	Gully plug
452	83.3595	23.7747	Dhadhia	Dhadhia	Wadrafnagar	Gully plug
453	83.3251	23.771	Gowardhanpur	Gowardhanpur	Wadrafnagar	Gully plug
454	83.3066	23.7706	Gowardhanpur	Gowardhanpur	Wadrafnagar	Gully plug
455	83.2908	23.7784	Bengo	Karamdiha	Wadrafnagar	Gully plug

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
456	83.3004	23.7862	Bengo	Karamdiha	Wadrafnagar	Gully plug
457	83.3238	23.8167	Shardapur	Shardapur	Wadrafnagar	Gully plug
458	83.308	23.8197	Shardapur	Shardapur	Wadrafnagar	Gully plug
459	83.2921	23.8198	Shardapur	Shardapur	Wadrafnagar	Gully plug
460	83.3018	23.8547	Shardapur	Shardapur	Wadrafnagar	Gully plug
461	83.2913	23.8538	Virendranagar	Virendranagar	Wadrafnagar	Gully plug
462	83.321	23.878	Belsar	Belsar	Wadrafnagar	Gully plug
463	83.3305	23.874	Belsar	Belsar	Wadrafnagar	Gully plug
464	83.341	23.8652	Belsar	Belsar	Wadrafnagar	Gully plug
465	83.342	23.8555	Belsar	Belsar	Wadrafnagar	Gully plug
466	83.3398	23.8395	Mahuli	Mahuli	Wadrafnagar	Gully plug
467	83.6752	23.5921	Magarhara	Jawar	Balrampur	Percolation Tank
468	83.6597	23.6263	Pindra	Obari	Balrampur	Percolation Tank
469	83.5925	23.6774	Sendur	Sendur	Balrampur	Percolation Tank
470	83.6288	23.4747	Khatwa Bardar	Padhi	Balrampur	Percolation Tank
471	83.7132	23.587	Maharajganj	Maharajganj	Balrampur	Percolation Tank
472	83.5069	23.4644	Lurgi	Padhi	Balrampur	Percolation Tank
473	83.4642	23.4646	Chilma khurd	Pasta	Balrampur	Percolation Tank
474	83.5338	23.4642	Padhi	Padhi	Balrampur	Percolation Tank
475	83.6133	23.5731	Chandrapur	Tangar Mahari	Balrampur	Percolation Tank
476	83.6526	23.5354	Budhudih	Khadiya Damar	Balrampur	Percolation Tank
477	83.6588	23.5864	Nawadih kalan	Jawar	Balrampur	Percolation Tank
478	83.6543	23.6093	Darridih	Sarnadih	Balrampur	Percolation Tank

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
479	83.708	23.4814	Kotpali	Sauni	Balrampur	Percolation Tank
480	83.9613	23.291	Ratasili	Ratasili	Kusmi	Percolation Tank
481	83.8927	23.277	Kusmi	Kusmi	Kusmi	Percolation Tank
482	83.5205	23.3728	Makad	Uliya	Rajpur	Percolation Tank
483	83.2215	23.3536	Paraswar kalan	Paraswar kalan	Rajpur	Percolation Tank
484	83.507	23.4099	Basen	Jigdi	Rajpur	Percolation Tank
485	83.4576	23.4238	Mahudand	Ladkund	Rajpur	Percolation Tank
486	83.3637	23.3348	Parsagudi	Parsagudi	Rajpur	Percolation Tank
487	83.3944	23.2904	Okra	Okra	Rajpur	Percolation Tank
488	83.4397	23.2779	Amdari	Patrapara	Rajpur	Percolation Tank
489	83.4291	23.3422	Mahuapara	Rajpur	Rajpur	Percolation Tank
490	83.2424	23.3277	Rewatpur	Rewatpur	Rajpur	Percolation Tank
491	83.242	23.2649	Badauli	Badauli	Rajpur	Percolation Tank
492	83.5692	23.3335	Bhairopur	Dipadih Khurd	Shankargarh	Percolation Tank
493	83.5505	23.3074	Lodhi	Lodhi	Shankargarh	Percolation Tank
494	83.3463	23.9814	Tendua	Sundarpur	Ramchandrapur	Percolation Tank
495	83.3858	24.0342	Sanawal	Sanawal	Ramchandrapur	Percolation Tank
496	83.3104	23.8343	Sulsuli	Sulsuli	Wadrafnagar	Percolation Tank
497	83.2576	23.8414	Murkaul	Murkaul	Wadrafnagar	Percolation Tank
498	83.2005	23.8368	Basantpur	Basantpur	Wadrafnagar	Percolation Tank
499	83.2213	23.7832	Bhagwanpur	Wadrafnagar	Wadrafnagar	Percolation Tank
500	83.1609	23.7601	Pendari	Pendari	Wadrafnagar	Percolation Tank
501	83.2867	23.7537	Dhadhia	Dhadhia	Wadrafnagar	Percolation Tank

Sl No	Longitude	Latitude	Village	Panchayat	Block	Feasible AR Structure
502	83.2292	23.6897	Bhaisamunda	Pansara	Wadrafnagar	Percolation Tank
503	83.2231	23.7297	Rajkheta	Rajkheta	Wadrafnagar	Percolation Tank
504	83.0998	23.7886	Gurmuti	Gurmuti	Wadrafnagar	Percolation Tank
505	83.1228	23.7418	Pendari	Pendari	Wadrafnagar	Percolation Tank
506	82.9963	23.8114	Chanwarsarai	Jaurahi	Wadrafnagar	Percolation Tank
507	83.0862	23.8266	Ramnagar	Ramnagar	Wadrafnagar	Percolation Tank
508	83.1338	23.8225	Kaknesa	Kaknesa	Wadrafnagar	Percolation Tank

Annexure II Chemical analysis data of Balrampur district

Sl No	Block	Location	Formation	Source	pH	EC	CO3 (ppm)	HCO3 (ppm)	Cl (ppm)	F (ppm)	SO4 (ppm)	TH (ppm)	Ca (ppm)	Mg(ppm)	Na(ppm)	K (ppm)	Si (ppm)	PO4 (ppm)	NO3 (ppm)
1	Wadrafnagar	Parsadiha	Gondwana	Hand Pump	8.4	423	3	244	10.6	0.03	4.9	210	46	24	14.9	4.9	5.3	0.01	2
2	Wadrafnagar	Barti kalan	Gondwana	Hand Pump	8.05	673	0	378	17.8	0.31	18	290	30	51.6	22.5	14.1	4.3	0.04	1.8
3	Wadrafnagar	Savithripur	Gondwana	Hand Pump	8.27	575	0	275	28.6	0.03	29.1	215	28	34.8	24	21.1	3.5	0.01	0
4	Wadrafnagar	Bhagwanpur	Gondwana	Hand Pump	8	76.2	0	36.6	2.5	0.17	5.1	30	8	2.4	2.1	20	9.2	0.02	0
5	Wadrafnagar	Sardapur	Gondwana	Hand Pump	8.37	586	3	311	10.6	0.71	18.9	200	40	24	30.1	2.1	5	0	8.7
6	Wadrafnagar	Badkagaon	Gondwana	Hand Pump	8.33	880	3	457	428	0.59	3.7	75	12	10.8	160	12.5	4.5	0.06	1.4

7	Wadraf nagar	Jhorli	Gondwana	Hand Pump	8.36	490	3	256	17.7	0.58	30.9	185	34	24	32.1	12.5	5.9	0	0
8	Wadraf nagar	Beliya	Gondwana	Hand Pump	8.38	402	3	189	17.7	0.82	24.5	135	40	8.4	32.1	2.5	11.7	0.01	0
9	Wadraf nagar	Saraswathipur	Gondwana	Hand Pump	7.91	403	0	244	7.1	0.037	3.8	190	40	21.6	5.7	3.9	16.9	0.03	0
10	Wadraf nagar	Kodari	Gondwana	Hand Pump	8	464	0	256	14.2	0.01	15.1	175	38	19.2	26.8	1.8	21	0.03	0
11	Wadraf nagar	Makro	Gondwana	Hand Pump	8.02	280	0	104	28.5	0.023	4.4	100	26	8.4	13.9	1.8	17.5	0.05	8.3
12	Rajpur	Parsawar	Gneissic complex	Hand Pump	8.33	198	3	103	7.1	0.04	4.4	70	18	6	10.9	1.89	14.7	0.04	13.8
13	Rajpur	Vendri	Gneissic complex	Hand Pump	8.08	245	0	97	14.2	0.05	9.6	95	24	8.4	9.4	1.2	12.7	0.05	21.5
14	Rajpur	Usskuni	Gneissic comple	Hand Pum	7.98	265	0	79	10.6	0.032	9.6	100	24	9.6	6.4	2	9.7	0.07	41.7

			s	p															
15	Rajpur	Kodoura	Gneissic complex	Hand Pump	7.94	264	0	55	17.7	0.01	8.1	75	16	8.4	19.03	3.05	16.1	0.02	54.3
16	Rajpur	Sidma	Gneissic complex	Hand Pump	8.05	280	0	146	10.6	0.29	3.6	125	26	14.4	7.9	1.4	14.8	0.06	17.5
17	Balrampur	Alkadiha	Gneissic complex	Hand Pump	8.34	553	3	305	14.2	1.15	32.3	175	40	18	41.3	1.1	9.8	0.03	0
18	Balrampur	Jhingidi	Gneissic complex	Hand Pump	7.94	192	0	97	10.6	1.51	4.6	65	16	6	13.2	0.6	16.3	0.04	17.6
19	Balrampur	LADKUND	Gneissic complex	Hand Pump	8.08	235	0	67	10.6	0.089	14.7	65	24	1.2	13.01	1.8	17.9	0.06	48.3
20	Balrampur	Semersot	Gneissic complex	Hand Pump	8.5	423	9	20.1	14.2	1.51	31.2	25	8	1.2	75.2	0.78	8.7	0.05	0.4
21	Balrampur	lalmati	Gneissic complex	Hand Pump	8.4	289	3	165	7.1	0.17	5	45	16	1.2	40	1.1	12.1	0.1	0

22	Balrampur	Dora	Gneissic complex	Hand Pump	8.18	120	0	43	7.1	0.04	5.9	45	12	3.6	8.2	0.69	6.2	0.04	12.9
23	Balrampur	Semarkatra	Gneissic complex	Hand Pump	8.08	180	0	67	10.6	0.42	6.2	50	14	3.6	15.9	0.95	19.1	0.04	23.3
24	Balrampur	Lokdiha	Gneissic complex	Hand Pump	8.13	164	0	91.5	3.5	0.19	4	55	18	2.4	15.8	1.8	19.1	0.12	0
25	Rajpur	Sevari	Gneissic complex	Hand Pump	8.18	388	0	213	10.6	0.04	8.6	155	16	9.6	12.5	1.2	15.7	0.12	16.4
26	Shankergarh	Jeswatnhpur	Gneissic complex	Hand Pump	8.25	348	0	146	17.7	0.06	8	160	32	19.2	3.8	0.66	22.7	0.04	35
27	Shankergarh	Durgapur	Gneissic complex	Hand Pump	8.17	281	0	73	17.5	0.39	10.8	85	8	15.6	15.5	1.67	15.7	0.06	38
28	Shankergarh	Jarhadiha	Gneissic complex	Hand Pump	8.29	325	0	165	17.5	0.145	8.1	150	50	6	9.9	1.58	16.2	0.09	11.6
29	Shankergarh	Podikala	Gneissic comple	Hand Pum	8.3	115	0	54.9	3.5	0.1	6.1	30	10	1.2	12.8	1.59	18.4	0.06	14.1

			s	p															
30	Shankergarh	Bharathpur	Gneissic complexs	Hand Pump	7.85	153	0	54.9	7.1	0.1	4.8	35	1.2	1.2	14.4	1.49	12.7	0.07	26.2
31	Kusmi	Dipadiha	Gneissic complexs	Hand Pump	7.8	170	0	165	10.6	0.1	5.4	90	30	3.6	15.5	1.67	4.7	0.06	0
32	Kusmi	Kodhva	Gneissic complexs	Hand Pump	8.17	195	0	85	14.2	0.1	4.3	65	20	3.6	13.9	1.72	10.7	0.06	8.9
33	Kusmi	Karkali	Gneissic complexs	Hand Pump	8	180	0	54.9	14.2	0.1	4.8	50	14	3.6	18.1	1.2	12.8	0.09	32.2
34	Kusmi	Kusmi	Gneissic complexs	Hand Pump	7.89	89	0	24.4	10.6	0.1	5.4	20	6	1.2	7.8	0.3	3.5	0.08	38.9
35	Wadrafnagar	Chalga	Gondwana	Hand Pump	7.91	443	0	122	3.9	0.1	25.6	125	40	6	30.9	2.4	17.4	0.07	11.1

स्वच्छ जल - स्वच्छ भारत

केन्द्रीय भूमि जल बोर्ड

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