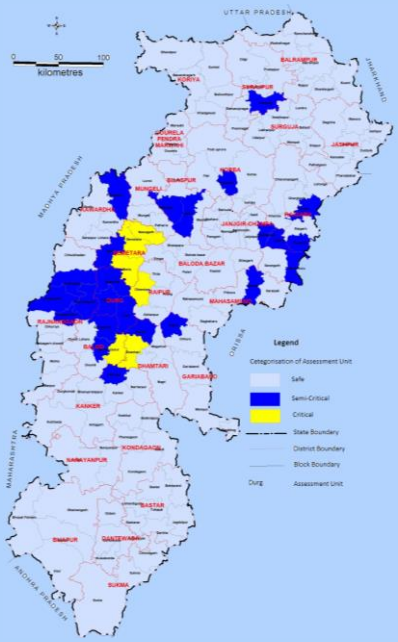
भूमि जल संसाधन छत्तीसगढ़

DYNAMIC GROUND WATER RESOURCES OF CHHATTISGARH

(As on March 2022)



केंद्रीय भूमि जल बोर्ड
उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
जल शक्ति मंत्रालय
भारत सरकार

भूजल सर्वेक्षण मंडल
जल संसाधन विभाग
छत्तीसगढ़ शासन

रायपुर
2022

DYNAMIC GROUND WATER RESOURCES OF CHHATTISGARH (As on March 2022)

By

Ground Water Survey
Water Resources Department, Raipur
Government of Chhattisgarh

&

Central Ground Water Board
North Central Chhattisgarh Region, Raipur
Department of Water Resources,
River Development & Ganga Rejuvenation
Ministry of Jal Shakti
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Raipur
2022

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PREFACE

Ground Water has emerged as important source of water to meet the different requirements. However, uncontrolled use has resulted in depletion of water levels, more so in hard rocks, where the resource is limited and indeed prone to vagaries of monsoon. The sustainability of ground water is dependent upon ground water availability and prevailing development status.

The state of Chhattisgarh is in the process of an accelerated development in the fields of irrigation and industrial activities and ground water occupies a key position in the developmental activities of the state. Although, ground water is a replenishable resource, over dependence on ground water, recurrent droughts, varied monsoon pattern etc., are leading to a situation where in several blocks of the state have been categorized as over exploited to Semi- critical.

In order to precisely quantify the ground water resources available for various uses and judiciously plan the development of water supply programs as well as ensuring food security, there is a need for assessing the ground water resources periodically. Keeping this in view, Central Ground Water Board and State Ground Water Department took up the task of estimating the Dynamic Ground Water Resources of Chhattisgarh based on GEC'15 methodology. Resource computed with the help of IN-GRES Software which is Web-based Application developed by CGWB in collaboration with IIT-Hyderabad.

The report on "Dynamic Ground Water Resources of Chhattisgarh" is the outcome of the combined efforts of CGWB and State Ground Water Survey, Water Resources Department, Government of Chhattisgarh and is expected to form the basis for ground water development and planning in the state. This report presents the assessment of ground water resources of Chhattisgarh which have been computed with a logical and scientific approach based on methodology recommended by the "Ground Water Resource Estimation Committee 2015". The report indicates that out of 116 blocks, 6 blocks are Critical, and 24 blocks are falling under the "Semi-Critical" category. The figures arrived at are very realistic, however, there is always a scope for improvement in methodology and up-gradation of information regarding the quantum of ground water resource and resultant ground water available for future use and irrigation potential. Considering Ground water resource assessments for Chhattisgarh are yet to be approved by State Level Committee, draft version is prepared .

A deep sense of gratitude is expressed to all the state Officers of State Ground Water Survey, Water Resources Department, Government of Chhattisgarh who was associated with this work at one stage or the other. A lot of effort was put in by the Shri Uddeshya Kumar, Scientist 'B' of Central Ground Water Board for compilation of data, validation and assessment along with preparation of report on 'Dynamic Ground Water Resource of Chhattisgarh (As on March' 2022)' in the present form is appreciable.

I hope that, this report will be useful to all the user agencies engaged in planning and development of ground water in the state.

(Dr. Prabir K Naik)
Regional Director
CGWB NCCR

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to Shri Sunil Kumar, Chairman, Central Ground Water Board, Ministry of Water Resources, River Development and Ganga Rejuvenation, Govt. of India for giving me an opportunity to estimate the Ground Water Resource as on March 2022 for the state of Chhattisgarh.

I express my sincere thanks to Sh Satish Kumar, Member(East), Central Ground Water Board, Ministry of Jal Shakti, Govt. of India for his valuable suggestions at the time of resource estimation.

I am deeply thankful to Dr. Prabir K. Naik, Regional Director, Central Ground Water Board, North Central Chhattisgarh Region, Raipur for his valuable guidance at the time for assessment of Dynamic Ground Water Resources (as on March 2022) of Chhattisgarh state. I would like to express my deepest thanks to Shri A K Biswal, Scientist-E of CGWB NCCR for the valuable inputs provided during resource assessment. I also would like to thank Shri Rakesh Dewangan, Scientist-C for the help rendered in quality tagging of assessment units.

I am very much thankful to Shri Ajay Thakur, Suptd. Engineer for his co-operation and suggestions for resource assessment of the state. I would like to express my deepest thanks to Shri A.K. Shukla, Senior Geo-Hydrologist, (Divisional Ground Water Survey, Unit 8, Raipur) and N. Meshram, Senior Geo-Hydrologist (Divisional Ground Water Survey, Unit 9, Bilaspur) and their respective team for their valuable contribution in collection of data and resource assessment.

I would like to express my deepest thanks to Shri B. Abhishek, Scientist-B, Shri Mukesh Anand, Scientist-B and Ms Gurpreet Kaur, Scientist-B of CGWB NCCR for their consistent effort throughout the assessment. I am also thankful to Shri G. Sreenath, Scientist-C for contribution made during assessment. I am also thankful to Technical Section, CGWA section, Chemical Section, NAQUIM Section of CGWB along with departments and district offices of Govt. of Chhattisgarh for providing requisite data for assessment of groundwater resource.

We feel immensely thankful to members of State Level Ground Water Resource Re-Estimation Committee for their valuable suggestions and kind co-operation during Ground Water Resource Estimation as on 2022.

The report processing and publication section for issuance of the report is also duly acknowledged.

Uddeshya Kumar

Uddeshya Kumar
(Scientist 'B')
CGWB, NCCR, Raipur

DYNAMIC GROUND WATER RESOURCES OF CHHATTISGARH

AT A GLANCE

(As on March 2022)

1.	Total Annual Ground Water Recharge	**12.05 BCM**
2.	Annual Extractable Ground Water Resource	**11.01 BCM**
3.	Total All Uses Annual Extraction	**5.46 BCM**
4.	Stage of Ground Water Extraction	**49.58 %**
5.	Categorization of Blocks	
	Total Assessed Blocks	**146**
	• Safe Blocks	**116**
	• Semi-Critical Blocks	**24**
	• Critical Blocks	**6**
	• Over-Exploited Blocks	**0**
6.	**Poor Quality**	**Nil**
7.	**Shallow Water Level Area**	**Nil**

DYNAMIC GROUND WATER RESOURCES OF CHHATTISGARH
(As on 2022)

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Annexures, Tables and Plates

Annexures

Tables

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Abbreviation

m	meter
cm	centimeter
mm	millimeter
ft	foot
m agl	meter above ground Level
m bgl	meter below ground Level
lps	liter per second
lpm	liter per minute
m/d	meter per day
mdd	meter drawdown
Ha	hectare
Ham	hectare meter
MCM	million cubic meters
BCM	billion cubic meters
mg/l	milligram per liter
ppm	part per million

CHAPTER 1

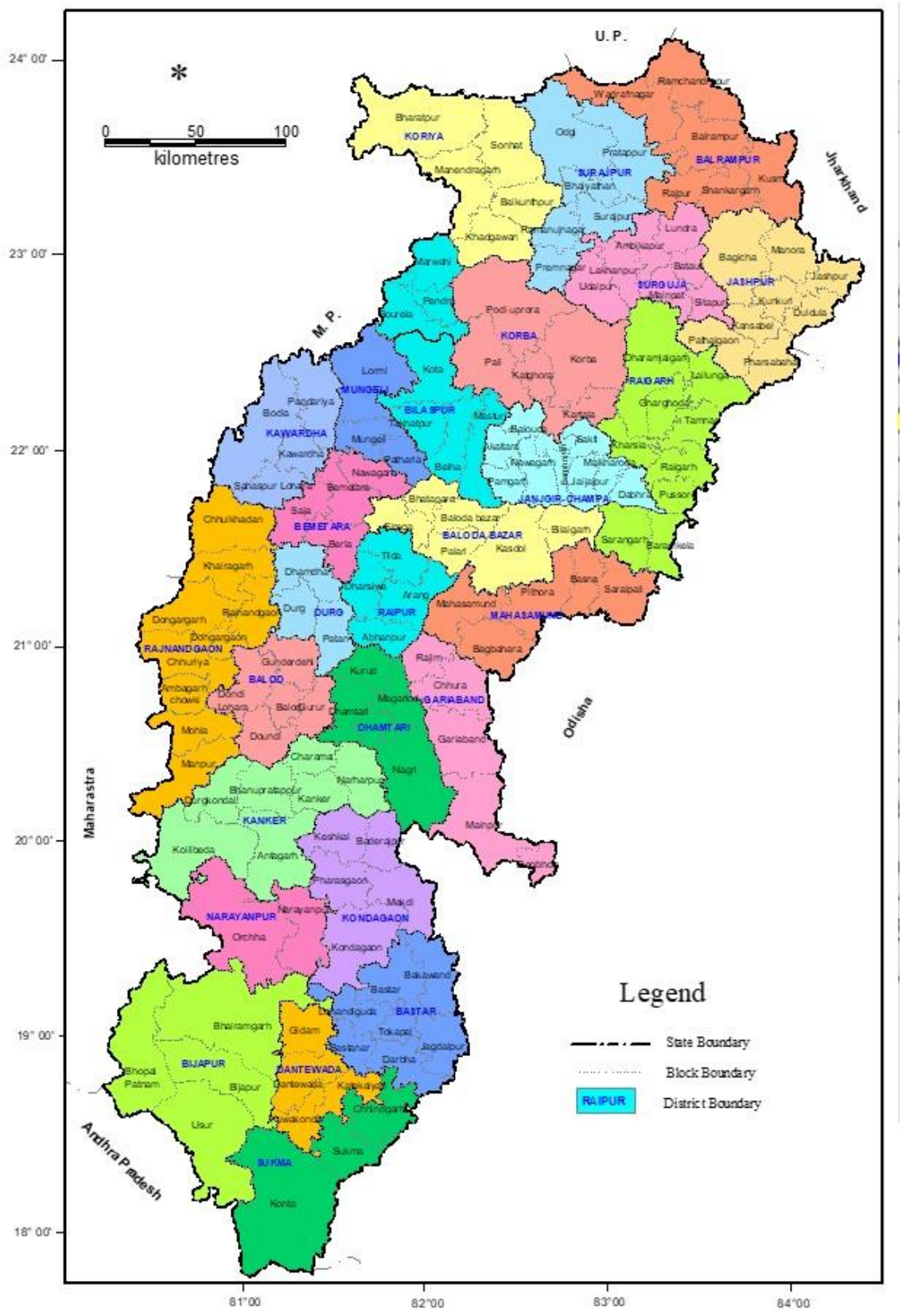
INTRODUCTION

Groundwater is the backbone of India's agriculture and drinking water security in urban and rural areas. Nearly 90% of rural domestic water use is based on groundwater while 70% of water used in agriculture is pumped from aquifers. Ground water is an important source for meeting the water requirements for development of the state. Ground water is annually replenishable resource, but its availability is non-uniform in space and time. Hence, the sustainable development of ground water resources warrants precise quantitative assessment based on the reasonably valid scientific principles. Technically, the dynamic ground water refers to the quantity of ground water available in the zone of water level fluctuation, which is active recharge zone and replenished annually. In addition to the dynamic ground water resource, there exists a huge ground water reservoir in the deeper zones below the active recharge zone and in the confined aquifers. The demand for ground water irrigation is increased more than 6 times in last decade. The majority of ground water exploitation is confined in the shallow aquifer only. Hence, the development of shallow aquifers plays an important role, therefore correct assessment of dynamic ground water resources becomes significant for a planned agricultural growth.

Chhattisgarh is known as the state of 'Rice bowl', and 'Power hub' of the country, Chhattisgarh state is basically a backward and agrarian state and it is abundantly endowed with natural resources and has a thick forest cover (about 44.8% of the total geographical area). The state extends from 17^0 47' to 24^0 6' North Latitudes and 80^0 15' to 84^0 24' East Longitudes in the central part of India. It has an area of about 135191 Sq. Km thus forming the 10^{th} largest state of India with 4.12% of the country's area. Chhattisgarh is bounded by the states of Orissa in the east, Uttar Pradesh in the north, Jharkhand in the north east, Andhra Pradesh in the south, Maharashtra in the south west and Madhya Pradesh in the north western part. The State has been divided into 28 districts and 146 blocks (Plate-1). The population of state as per census 2011 is 25540196 with a population density of 189 persons per sq.km area. Out of total population, 79.9 % is rural.

The present report is an outcome of the concerted efforts made by the Central Ground Water Board, North Central Chhattisgarh Region, Raipur and the State Ground Water Survey, Water Resources Department, Govt of Chhattisgarh to bring out the status of dynamic ground water resources of the State based on the methodology recommended by Ground Water Resources Estimation Committee, 2015 (GEC-2015).

Administrative Divisions of Chhattisgarh Plate-1



a. Background for re-estimating the ground water resources of the state

First attempt to estimate the ground water resources of the country was made in the year 1979. A Committee known as Ground Water Over-exploitation Committee was constituted by Agriculture Refinance and Development Corporation (ARDC) of Govt. of India. Based on the methodology and norms recommended by the above Committee, ground water resources of the country were assessed. Subsequently, the necessity was felt to refine the methodologies and the "Ground Water Estimation Committee (GEC)" headed by the Chairman, CGWB came into existence. Based on the detailed surveys and studies by the various offices and projects of CGWB, the Committee recommended a revised methodology in 1984 (GEC'84) for estimation of ground water resources. In 1997, the Ground Water Estimation Committee reviewed the previous studies and work done in various states and suggested a modified methodology in 1997 (GEC'97) for computation of ground water resources. Again in 2015, the Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India, constituted a committee headed by Chairman, CGWB to review and revise the Ground Water Resource Estimation Methodology 1997 (GEC-97) and suggested a modified methodology GEC-2015 Subsequently, a few modifications have been made in the methodology as per the recommendations of the R&D Advisory Committee.

The first ground water resource of Chhattisgarh after it's carved out of erstwhile Madhya Pradesh, was estimated for the year 2001-02 based on the revised methodology (GEC'97). These estimations were carried out jointly by Central Ground Water Board, NCCR, Raipur and State Ground Water Survey, Raipur. After approval by the State Level Committee and the recommendations of the standing Committee on R&D Advisory Committee, New Delhi, the final report was released during the year 2005. As per the guidelines of the Central Ground Water Board, Faridabad, the ground water resource has been estimated for the base year 2008-09, 2010-11, 2012-13, 2016-17 and 2020-21. This report has been prepared for the base year 2021-22 and resource has been assessed as on March'2022 by Central Ground Water Board in association with State Ground Water Survey, Water Resources Department, Govt. of Chhattisgarh. The report has been prepared as per the format provided by Central Headquarter, Central Ground Water Board, Ministry of Water Resources, Faridabad.

b. Constitution of state-level ground water resources estimation committee

As per resolution no-T-13014/1/2019-GW dated 08.02.2022 for constitution of Central Expert Group for overall Re-assessment of ground water resources of the country, as on 31st march 2022 (Annexure-1), the Water Resources Department, Govt of Chhattisgarh has constituted a committee vide letter no. 703 /F-1-66/31/s-2/GW/2010 dated 10.02.2022 for Ground Water Resources Assessment March, 2022 for the state of Chhattisgarh as on March 2012 (Annexure-2) for assessment of annual replenishable ground

water resource of Chhattisgarh for the reference year March, 2022 and to estimate status of utilization of the annual replenishable ground water resources as on 31st March 2022 of Chhattisgarh State.

The composition of the committee is as follows:

1. Secretary, Water Resources Department, Govt. of Chhattisgarh	-	Chairman
2. Engineer-in-Chief, Water Resources Department, Govt. of Chhattisgarh	-	Member
3. Engineer-in-Chief, PHE Department, Govt. of Chhattisgarh	-	Member
4. Chief Engineer, Mahanadi Godavari Basin, WRD, Govt. of Chhattisgarh	-	Member
5. Director, Department of Agriculture, Govt. of Chhattisgarh	-	Member
6. Director, Department of Industries, Govt. of Chhattisgarh	-	Member
7. Chief General Manager NABARD, Nava Raipur, Atal Nagar	-	Member
8. Regional Director, CGWB, NCCR, Raipur	-	Member Secretary

C. Proceedings of the resource estimation and outcome of various meetings

Ground water resources assessment for reference year 2022 have been carried out jointly by Ground Water Survey, Water Resource Departments, Raipur, Govt. of Chhattisgarh and Central Ground Water Board, North Central Chhattisgarh Region, Raipur under the supervision of State Level Committees, with technical guidance from Central Level Expert Group (Annexure 3)

CHAPTER 2

HYDROGEOLOGICAL CONDITION OF CHHATTISGARH STATE

The state is underlain by various rock types of different geological ages from Pre-Cambrian to Recent age. These include the Archaean Crystalline, Precambrian Sedimentaries, Gondwanas, Deccan Traps and Unconsolidated Sediments (Plate-2). There exists a huge diversity in the distribution of groundwater in the state due to the varied hydrogeological characters of the rock types, which ultimately forms the aquifers. To understand the regional hydrogeological behavior of Chhattisgarh State, the complex hydrogeological setup has been classified into two groups based on their characters viz. Fissured Formations and Porous Formations.

a. Description of rock types with area coverage.

POROUS FORMATIONS

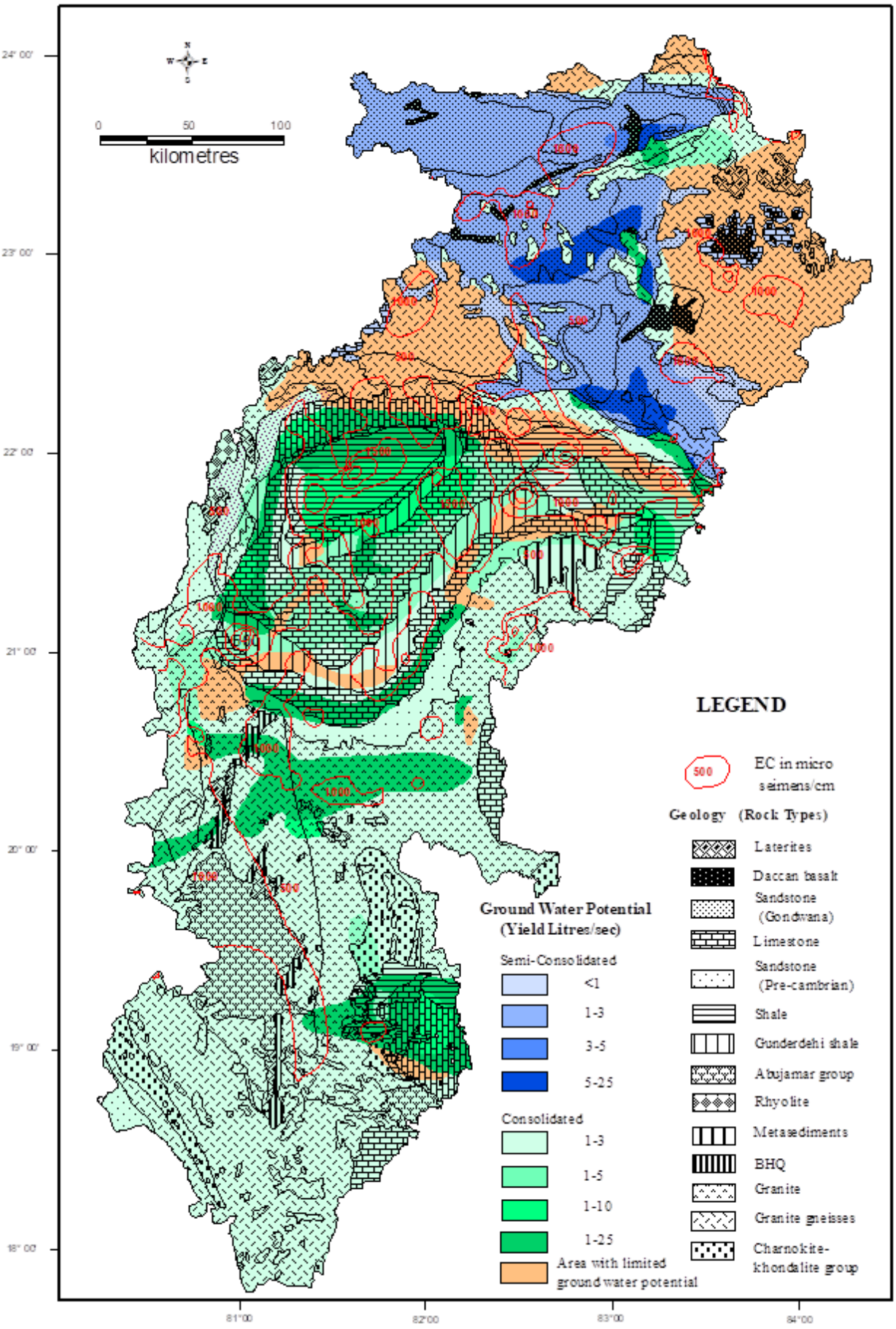
Porous formations have been further subdivided into unconsolidated and Semi-consolidated formations.

Unconsolidated formation

Unconsolidated formations of Quaternary age include alluvium, clay, silt, and laterite etc. Quaternary alluvium forms thin unconfined aquifers with maximum thickness up to 40 m bgl. Extent of such formation is very much limited to 338 sq. km. which is 0.44 % area of the state, but they form potential aquifers in localized areas. They occur in several isolated patches mainly along major river courses like Mahanadi, Arpa, Hasdeo, Seonath, Kharun, Mand, Kelo etc. These aquifers have good potential for ground water yield and are being developed through dug wells, shallow bore wells and filter point wells. Potential alluvial aquifer, which is highly developed, found in Bilaspur and Janjgir–Champa district. Laterites also occur in detached patches over various rock types. Wells tapping laterite profile can be seen mostly on traps in Surguja and Jashpur districts. Ground water occurs in these rocks in phreatic condition and is restricted up to the upper level of the lithomargic clays. Ground water in this province is developed mainly through dug wells. Laterite aquifers are having moderately good yield.

Semi-consolidated formation

The rocks belonging to Gondwana Super Group are found mostly in Raigarh, Korba, Surguja and Koriya districts. A small part is also found in Bilaspur and Kawardha districts. They cover nearly 12 % of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kilometres
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23° 00'
22° 00'
21° 00'
20° 00'
19° 00'
18° 00'
81°00
82°00
83°00
84°00
LEGEND
500
EC in micro seimens/cm
Geology (Rock Types)
Laterites
Daccan basalt
Sandstone (Gondwana)
Limestone
Sandstone (Pre-cambrian)
Shale
Gunderdehi shale
Abujamar group
Rhyolite
Metasediments
BHQ
Granite
Granite gneisses
Charnokite-khondalite group
Ground Water Potential (Yield Litres/sec)
Semi-Consolidated
<1
1-3
3-5
5-25
Consolidated
1-3
1-5
1-10
1-25
Area with limited ground water potential

area in the state. These consist mainly of sandstone, shale, clay, siltstone and coal seams. The Gondwana sandstones have primary and occasional secondary porosity. They form thick and extensive unconfined to confined aquifers down to 300 m bgl. Groundwater, sometimes, occurs under flowing conditions in localised belts. The Barakar sandstones, which occupy the largest part within Gondwana area, are good productive aquifers with discharge ranges from 1 to 10 lps. Thick shale and clay beds of Barakar formation act as confining layer. At places high groundwater temperature even up to 50^{o} C have been recorded. Ground water development in these formations is through dug wells as well as through bore wells and tube wells.

FISSURED FORMATIONS (CONSOLIDATED FORMATIONS)

The consolidated formations occupy nearly 87% of the area of the State. The occurrence of ground water in these rocks is largely controlled by fracture patterns and brittleness developed in them due to various tectonic activities or due to solution cavities formed by fluid activities. From the hydro-geological point of view the fissured rocks (having fractures) are broadly divided into three types, viz. Igneous and metamorphic, and carbonate rocks, Volcanic rocks and consolidated sedimentary rocks excluding carbonate rocks and Carbonate rocks.

The various rock formations with distinctive hydrogeological characteristics act as different aquifer systems of various dimensions. The various major rock formations of India can be broadly categorized in to 14 Principal aquifer Systems based on their broad hydrogeological properties. A brief account of the Principal Aquifer Systems is discussed in the following paragraphs. The principal Aquifer systems as identified by Central Ground Water Board are shown in Plate-4**.** The Principal Aquifers are further divided into 42 Major Aquifers (Table-4) depending on their distinctive hydrological characteristics and their spatial distribution.

b. Hydrometeorology

The region experiences a sub-tropical climate with wide variation in temperature. There are four seasons during the year. The summer season from March to Mid-June, the monsoon season from Mid-June to September, the post monsoon season in October-November, and the winter season from December to February, May is the hottest month, while January is the coldest.

Temperature

The State climate is characterized by extreme summer and moderate winter. The summer extends from March to Mid-June and May is the hottest month. The mean daily maximum temperature during the month of May goes up to 45^{o}C. The winter season lasts till end of February. January is the coldest month with the mean daily maximum temperature at 30°C and the mean daily minimum temperature at 10.2°C. The salient features of the meteorological data are given in Table 1.

Table-1. Meteorological data of Chhattisgarh

Month	Mean monthly rainfall (mm)	Mean monthly temperature		Mean monthly relativity humidity (%)	Mean monthly wind velocity (km/hr)	Mean Monthly Evapo-transpiration (mm)	number of rainy days
		Max °C	Min °C				
January	6.1	27.6	13.3	54.0	3.1	32.0	3.0
February	3.6	30.3	16.1	48.0	6.1	44.0	2.0
March	24.5	34.7	20.2	40.0	6.9	54.0	2.0
April	4.4	39.2	25.0	37.0	8.4	91.0	2.0
May	19.6	42.2	28.7	35.0	10.7	116.0	2.0
June	164.2	37.7	26.9	61.0	12.1	68.0	11.0
July	361.0	30.3	24.1	82.0	11.8	37.0	19.0
August	357.1	30.0	24.1	83.0	10.4	37.0	19.0
September	295.6	30.9	24.0	79.0	7.4	36.0	12.0
October	79.8	31.1	21.4	68.0	6.0	39.0	5.0
November	0.0	29.0	15.9	62.0	4.1	35.0	2.0
December	0.0	27.3	13.1	57.0	4.4	30.0	3.0

Evapotranspiration: The trend of evapotranspiration is almost sympathetic with the variation of temperature as shown in Table 1. Evapotranspiration is maximum in the month of May, which is more than 120 mm. and minimum during the month of December and January.

Humidity: The atmospheric humidity is usually low (maximum humidity around 30-40%) during summer months (March-May). The humidity again decreases from October onwards due to decrease in temperature and due to receding monsoon also, as tabulated in Table 1.

Rainfall

About 90% of the annual rainfall occurs during the south west monsoon periods from June to September. August is the rainiest month. The normal annual rainfall for the Region has been estimated as 1351 mm. The normal monsoon rainfall is 1201 mm. The rainfall decreases as we move from South-East to North-West. The normal rainfall varies with highest 1481 in Bastar district to lowest 1112 mm in Rajnandgaon district. Distribution of normal annual rainfall is depicted in Plate-3. The district wise annual rainfalls are presented in the Table 2.

Rainfall distribution in Chhattisgarh Plate-3

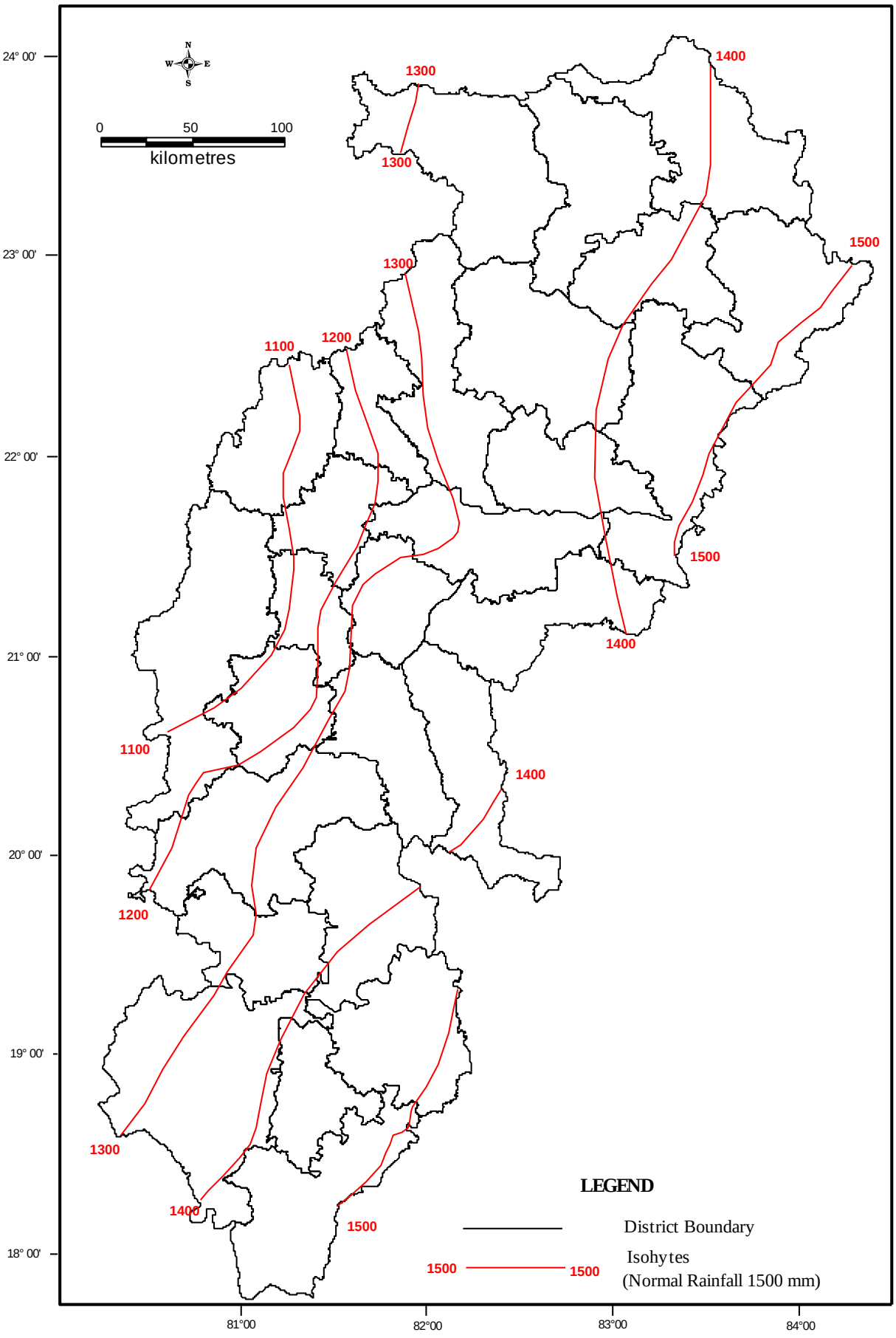


Table-2. District wise annual rainfall

Sl. No.	District	Year					
		2016	2017	2018	2019	2020	2021
Q6	Balod	1222.5	1025.2	1036.4	1132.9	1122.9	1122.9
2	Baloda Bazar	830.2	736.4	915.9	1005.8	1385.61	1385.61
3	Balrampur	1797.3	1103.2	1066.3	1096.1	1317	1317
4	Bastar	1581.6	1476	1240	2011.1	1362.6	1362.6
5	Bemetara	878.8	762.3	880.4	971.2	1122.9	1122.9
6	Bijapur	1713.4	1475.1	1953.5	2374	1528.1	1528.1
7	Bilaspur	1112.1	841.9	843.1	1134.9	1229.8	1114.46
8	Dantewara	1391.6	1264.2	1196.9	1779.9	1327.9	1327.9
9	Dhamtari	1224.3	892.1	1250	1236.1	1385.3	1385.3
10	Durg	1088.9	705.8	865.8	932.5	1122.9	1122.9
11	Gariaband	1117.9	991.1	1149.4	1288.9	1385.3	1385.3
12	Janjgir-Champa	1197	925.8	987.3	1108.9	1386	1229.8
13	Jashpur	1178.4	1186.9	1000.1	1297.6	1476.92	1209.32
14	Kawardha	855.5	862.6	644.4	893.8	1117	1117
15	Kanker	1814	1125.5	1345.3	1501.3	1397.51	1397.51
16	Kondagaon	1645.6	1375.4	1261.3	1774.3	1362.4	1362.4
17	Korba	1229.3	1099.2	1026.4	1372.7	1392	1392
18	Koriya	1203.9	776.1	903.4	1099	1317	1317
19	Mahasamund	1030.9	1010.8	1069.9	1240.6	1406.24	1406.24
20	Mungeli	761.5	640.9	835.4	813.7	1351	1351
21	Narayanpur	1775.3	1097.7	1226.3	2027.3	1404.1	1404.1
22	Raigarh	1400.4	961.8	942.9	1350.2	1468.16	1468.12
23	Raipur	1032.8	762.1	877.2	977.1	1376.34	1376.31
24	Rajnandgaon	1091.9	790	941.2	966.4	1208.7	1208.7
25	Sukma	1532	1767.4	1778.3	1821.9	1403.85	1403.81
26	Surajpur	1128.3	1529.1	1557.8	1282.7	1317	1317
27	Surguja	1098.3	1171.3	966	926.9	1317	1369.16

c. Description of Hydrogeological units

The hydrogeological framework of Chhattisgarh state consists both fracture and porous media. Based on the prevailing porosity type, the rocks of the state have been divided into two broad types (1) hard rocks and (2) soft rocks. Both these types of rocks were further subdivided into groups to simplify the complex geological classification for the purpose of study of ground water behavior The distribution of hydrogeological units is presented in Table-3 and hydro-geological map of Chhattisgarh is presented in Plate-2.

Table-3 Distribution of Hydrogeological Units in Chhattisgarh

Geological Age		Rock Formations	Districts/ Hydrogeological Characters
Consolidated Formations:			
Upper Cretaceous to Eocene	Deccan traps	Basalts, Dolerites and acidic derivatives of Basaltic magma	Jashpur, Surguja, Kawardha, Bilaspur
Pre Cambrian (Proterozoics)	Chhattisgarh Super Group, Indravati Group, Khariyar Group, Sukma Group and Pakhal Group	a) Consolidated sandstones b) Shales c) Limestones and Dolomites	Raipur, Durg, Dhamtari, Janjgir-Champa, Bilaspur, Mahasamund, Rajnandgaon, Raigarh, Kawardha, Korba, Bastar, Dantewada Karstified and Cavernous, Lime-stones, Recrystallised fractured dolomites and fractured Shales forms the unconfined to confined aquifers.
	Dongargarh Supergroup (Abhujmar Group, Chilpi group, Dongargarh and Kanker Granites, Nandgaon Group)	a) Granites b) Schists and Phyllites c) Arkose and Conglomerate d) Rhyolites and Andesites	Bastar, Kanker, Raipur, Maha-samund, Dhamtari, Rajnandgaon, Kawardha, Durg, Bilaspur, Raigarh, Surguja, Dantewada Unconfined shallow aquifer
Archaeans	Bengpal / Amgaon Group Peninsular Gneiss and unclassified basement	a) Granites, Gneiss and Metasediments b) Charnockites and Khondalites	Dantewada, Bastar, Kanker, Raipur, Raigarh, Bilaspur, Mahasamund, Rajnandgaon, Surguja, Jashpur, Kawardha,Champa, Korba, Durg, Koriya Unconfined shallow aquifer
Semi-consolidated formation:			
Carboniferous to Cretaceous	Gondwana Supergroup	a) Pebbles and boulders b) Sandstones c) Shales d) Coal Seams	Raigarh, Surguja, Koriya, Korba Unconfined to confined aquifers
Unconsolidated formation:			
Quaternary	Alluvium and Laterites	a) Sand, Silt and Gravels b) Laterites	All over the State along major drainages. In isolated patches. Unconfined aquifers.

Hard rock:

Rocks having secondary porosity- much dominated over primary porosity are grouped under hard rock category. The rock type and their distribution along with their broad characteristics are Basement

Crystallines, Plutonic-Volcanic and Meta Sedimentary- Precambrian Sedimentary rocks and Deccan Volcanics.

Soft Rocks

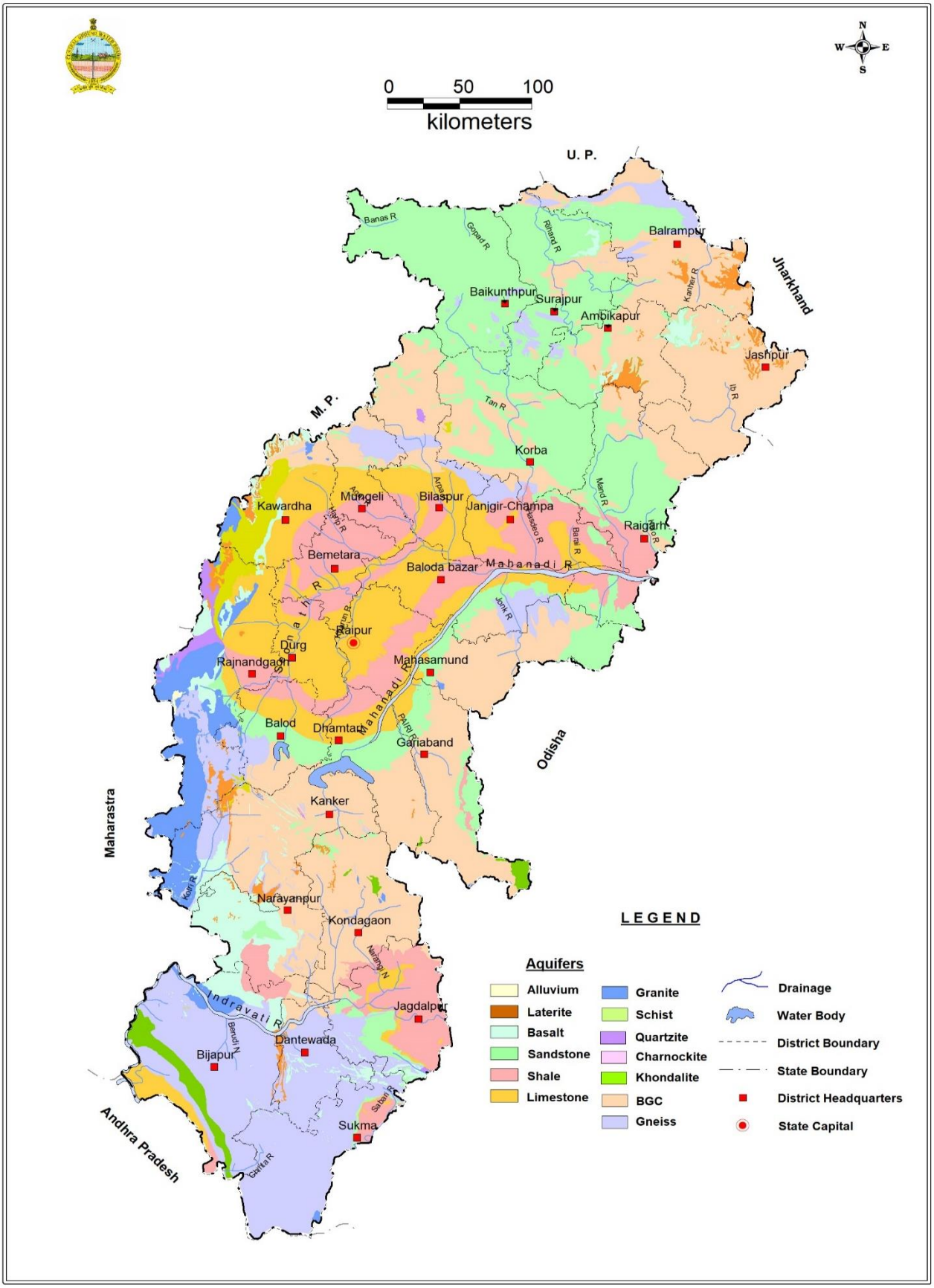
Rocks having primary porosity much dominated over secondary porosity are grouped under soft rock category. Semi Consolidated Sedimentary and Unconsolidated Sedimentary rocks

d. AQUIFER SYSTEMS OF CHHATTISGARH

Alluvial Aquifers

The unconsolidated Quaternary sediments comprising Recent Alluvium and Older Alluvium, forming by and large the major Alluvial Aquifers. These sediments are essentially composed of clays, silts, sands, pebbles, Kanker etc. found around Dhamtari- along Mahanadi, Bilaspur- along Arpa, Gandai- along Surhi, Jagdalpur- along Indravati, Bamnidih- along of Hasdeo, Dongargaon- along Seonath and Khairagarh- along Amner. The maximum thickness of the alluvium is found as 30 m in Bilaspur and 70m in Dhamtari area. In addition to the Annual Replenishable Ground Water Resources in the zone of Water Level Fluctuation (Dynamic Ground Water Resource), a huge ground water reserve occurs below the zone of fluctuation in unconfined aquifers and as well as in the deeper confined aquifers. This formation consists of sand, silt, clay and pebbles. Ground water occurs in phreatic to semi-confined condition. Water level in this area varies between 2 and 20 m. Though isolated, shallow and small, these aquifers have good potential for ground water yield and development through dug wells, shallow bore wells and filter point wells.

The dug wells in Bilaspur urban area can yield between 4.5 and 19 lps & the safe yield for large diameter dug wells in alluvium is between 4 and 6 lps (345 and 518 m^3/day). Laterites also occur in detached patches over various rock types. Ground water occurs in these rocks in phreatic condition, which is restricted up to the upper level of the lithomargic clays. Ground water in this province is developed mainly through dug wells, where discharge is found up to 2 lps. The depth of dug wells in laterites in Surguja district ranges from 4 to 5 m and yield 0.46 to 0.70 lps (40-60 m^3/day)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Korba
Kawardha
Mungeli
Bilaspur
Janjgir-Champa
Raigarh
Bemetara
Baloda bazar
Raipur
Durg
Rajnandgaon
Mahasamund
Balod
Dhamtari
Gariaband
Kanker
Narayanpur
Kondagaon
Jagdalpur
Dantewada
Bijapur
Sukma
Mahanadi R
Indravati R
LEGEND
Aquifers
Alluvium
Laterite
Basalt
Sandstone
Shale
Limestone
Granite
Schist
Quartzite
Charnockite
Khondalite
BGC
Gneiss
Drainage
Water Body
District Boundary
State Boundary
District Headquarters
State Capital

Table-4: Aquifer Systems of Chhattisgarh

Sl No	Principal Aquifer Code	Principal Aquifer Name	Major aquifer and Colour Code	Major Aquifer Name	Area Covered (Sq km)	%
1	**AL**	**Alluvium**	AL01	Fluvial Alluvium (Clay/Silt/Sand/ Calcareous concretions)	40.41	0.03
2	**LT**	**Laterite**	LT01	Laterite / Ferruginous concretions	1989.47	1.47
3	**BS**	**Basalt**	BS01	Basic Rocks (Basalt)	875.47	0.65
4			BS02	Ultra-Basic	4514.5	3.33
5	**ST**	**Sandstone**	ST02	Sandstone with Shale	10727.4	7.91
6			ST03	Sandstone with Shale/ Coal beds	9137.84	6.74
7			ST05	Sandstone/Conglomerate	7257.58	5.35
8			ST06	Sandstone with Shale	854.03	0.63
9	**SH**	**Shale**	SH03	Shale, Limestone and Sandstone	860.69	0.63
10			SH05	Shale/Shale with Sandstone	5374.75	3.96
11			SH06	Shale with Limestone	9792.08	7.22
12	**LS**	**Limestone**	LS03	Limestone/Dolomite	13651.1	10.07
13			LS04	Limestone with Shale	2910.47	2.15
14	**GR**	**Granite**	GR02	Acidic Rocks (Pegmatite, Granite, Syenite, Rhyolite, etc.)	4453	3.28
15	**SC**	**Schist**	SC02	Phyllite	1551.04	1.14
16			SC03	Slate	39.55	0.03
17	**QZ**	**Quartzite**	QZ01	Quartzite	569.07	0.42
18	**CK**	**Charnokite**	CK01	Charnockite	1198	0.88
19	**KH**	**Khondalite**	KH01	Khondalite	12	0.01
20	**BG**	**Banded Gneissic Complex (BGC)**	BG01	Banded Gneissic Complex (BGC)	39716.6	29.29
21	**GN**	**Gneiss**	GN01	Undifferentiated metasedimentary/ Undifferentiated metamorphic	6570.55	4.85
22			GN02	Gneiss	13500.4	9.96

Laterite Aquifer

Laterites are formed due to leaching (chemical weathering) of parent sedimentary rocks (sandstones, clays, limestones); metamorphic rocks (schists, gneisses, migmatites) and igneous rocks (granites, basalts, gabbros, peridotites) under hot and humid climatic conditions. Laterites rich in iron and aluminium contents are the most widespread and extensively developed aquifer especially in Jashpur District, Kumhari area in Durg district, Mainpat and Bodal Daldali area of Surguja- Kawardha districts in Chhattisgarh. Laterite forms potential aquifers along valleys and topographic lows where thick saturated zone sustain large diameter open wells for domestic and irrigation use.

Sandstone and Shale Aquifer

The sandstone and shale generally belong to the group of rocks ranging in age from Carboniferous to Mio-Pliocene forms this aquifer. These aquifers are found in Raigarh, Sarguja, Surajpur, Koriya, Janjgir-Champa and Korba. The terrestrial freshwater deposits belonging to Gondwana System and the Tertiary deposits along the west and east coast of the peninsular region are included under this category. The Gondwana sandstones form highly potential aquifers locally. Elsewhere, they have moderate potential and in places they yield meagre supplies. The Gondwana sandstones is the most extensive and productive aquifers.

The Gondwana Super Group and Lameta Group of rocks consist of sandstone, shale, clay, siltstone and coal. They possess both primary and secondary porosity, where primary porosity dominates over secondary porosity. Ground water occurs in both phreatic and semi-confined to confined conditions. Shallow aquifers are phreatic to semi-confined whereas deeper aquifers are generally confined, many time giving rises to flowing artesian wells. These rocks have good potential aquifer system (except the Talchir formation), ground water development in this area is still moderate and exploitation is restricted to the upper aquifers (within 120m). Dug wells tapping the Lametas in Surguja district have yield upto 0.80 lps (70 m3/day). the specific capacity ranges between 50-150 lpm/m of drawdown, hydraulic conductivity varies between 10-25 m/d and specific yield is from 10-15%

Limestone Aquifer

The consolidated sedimentary rocks include carbonate rocks such as limestone, dolomite and marble. Limestone is the dominating rock type among the carbonate rocks, which is widely distributed in Bastar, Raipur, Durg, Dhamtari, Janjgir-Champa, Mahasamund, Rajnandgaon, Raigarh, Kawardha, Bilaspur, Korba and Dantewad. In the carbonate rocks the secondary porosity like fractures and solution cavities form the aquifer. Consolidated sedimentary rocks of Chhattisgarh Supergroup, Indravati, Sukma, Khariar and Pakhal Groups consist of limestone/dolomites apart from other major litho-units such as conglomerates, sandstones, shale, slates and quartzite form this principal aquifer. These are Unconfined to semi-confined aquifer, developed by dug /dug cum bore wells.

The rocks of Chhattisgarh Super Group, which are sedimentary rocks of marine origin consists of arenaceous-argillaceous-calcareous rocks and are dominated by limestone/ dolomites and calcareous shale and ortho-quartzite. The limestone is more ground water productive. The ortho-quartzites and shale are poor aquifers. The weathered zone is restricted to upper 30 m depth. The ground water in these formations occurs under water table, semi-confined and confined conditions. The weathered and cavernous part of the formation constitutes the good potential aquifers in the area. The transmissivity value of Maniyari formation is varying from 100 to 600 m^2/day. The Charmuria and Chandi formation having Transmissivity value ranging from 5 to 400 m^2/day. The Storativity is poor to moderate as calculated, ranges from 1.19 x 10^{-2} to 9.72 x 10^{-4} , field permeability ranges from 4 to 65 m/day. The specific capacity for the bore wells ranges from 0.0002 to 1.39 m^3/min/m drawdown.

Basalt aquifers

Basalt is the basic volcanic rock which forms alternate layers of compact and vesicular beds of lava flows as seen in isolated patches in Koriya, Surguja, Jashpur, Kawardha and Bilsapur districts, generally occupying the hill tops. The groundwater occurrence in the basalts are controlled by nature and extent of weathering, presence of vesicles and lava tubes, thickness, number of flows and the nature of inter-trappean layers. The basalts have usually medium to low permeability. Groundwater occurrence in the Deccan Traps is controlled by the contrasting water bearing properties of different flow units, thus, resulted in multiple aquifer system, at places. The water bearing zones are the weathered and fractured zones.

This consists of basaltic lava flows and each flow is separated from other flow by intertrappean or red boles. The vesicular top parts of various flows and inter flow red boles form the aquifer along with weathered and fractured zones. The area is being developed through construction of dug wells and shallow bore wells fitted with hand pumps and have limited discharge. In general, the weathered part of trap is converted to Laterites and can yield substantial water to the dug wells. The Laterites of Jashpur area can yield up to 2 lps (173 m^3/day) discharge. In some areas the control of dolerite dykes on occurrence of ground water was observed. Wells located on the upstream side of these dykes and also on tectonic lineaments gave better yields.

Crystalline Aquifers

The crystalline hard rock aquifers such as granite, gneisses and high grade metamorphic Charnockite and Khondalite constitute moderate to good repository of ground water. Hard rocks generally neither receive nor transmit water, due to negligible or limited primary porosity. However, these may form good aquifers if weathered and/or have good secondary porosity in the form of faults, fractures, joints, bedding planes, and solution cavities. The crystalline rocks also form the aquifers with weathered

zone or the fracture system. The weathered mantle cover and associated secondary porosity do not occur uniformly but are rather localised phenomena. The weathered zone is underlain by semi-weathered saprolite zone followed by fractured and massive rock. These aquifers distributed in Dantewara, Sukma and Bijapur, Bastar, Narayanpur, Kondagaon, Kanker, Rajnandgaon, Durg, Kawardha, Bilaspur, Janjgir-Champa, Mahasamund, Korba, Jashpur, Balrampur. Surguja, Koriya and parts of Raigarh districts.

In these aquifers, ground water occurs under phreatic condition in the weathered mantle cover and under semi-confined to confined state in underlying fissured, fractured, and jointed hard rock. The volume of ground water stored under semi-confined condition within the body of the hard rock is much lower than the storage in the overlying phreatic aquifer which is often much greater. Hydraulically connected fissures and fractures underlying weathered mantle cover generally serves as a permeable conduit feeding the deeper wells. Ground water flow rarely occurs across the topographical water divides so far as the unconfined aquifer is concerned and each basin or sub-basin can be treated as a separate hydro geological unit for planning the development of ground water resources.

The dug wells in the area have yield in the range of 0.23 to 2.30 lps. The bore wells have drill time discharge generally below 3 lps & specific capacity ranges from 20-200 lpm/m drawdown. These aquifers have low Transmissivity in the range of 1 to 55 m^2/day (having less Storativity). The specific capacity for the open dug wells of BHQ and Gneisses in Durg district varies from 1.37 x 10^{-2} to 7.86 x 10^{-3} m^3/min/m drawdown. Hydraulic conductivity is generally less than 1 m/d and specific yield less than 5%.

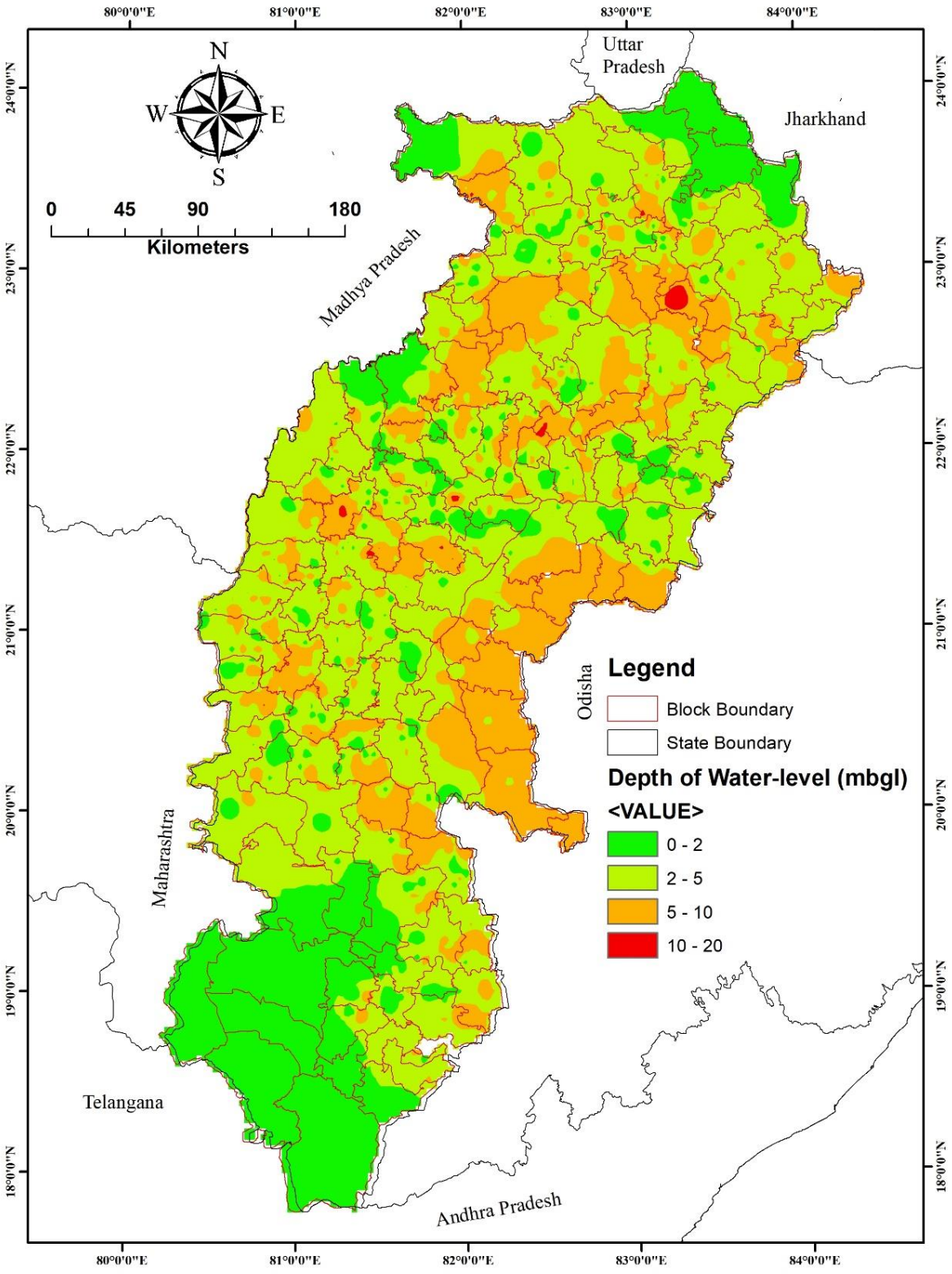
Plutonic-Volcanic meta-sedimentary group constitutes of granites, acid and basic volcanics and Proterozoic meta-sedimentaries. Ground water in this rock mainly occurs in phreatic to semi-confined condition. These aquifer groups have better potential than the basement crystallines. The bore wells in the province can yield upto 5 lps (432 m^3/day) with general discharge up to 3 lps. The Transmissivity ranges between 2 and 150 m^2/day, which is good in comparison with other aquifers of the state.

e. Ground water level conditions

Depth to Water Level

i) Pre-Monsoon (May 2021)

In general, the depth to water level ranges 5 to 10 mbgl is observed in approximately 42.52% of the wells and depth to water level range up to 20 mbgl is observed in 7.22% of the wells in the state. Deeper water levels ranging between 10 and 20 to 40 mbgl occur only in 0.24% of the observation wells only in parts of Bilaspur district. The deepest water level of 40.0 m bgl was monitored in Achanakmar PZ observation well (piezometer) of Bilaspur district.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State Boundary
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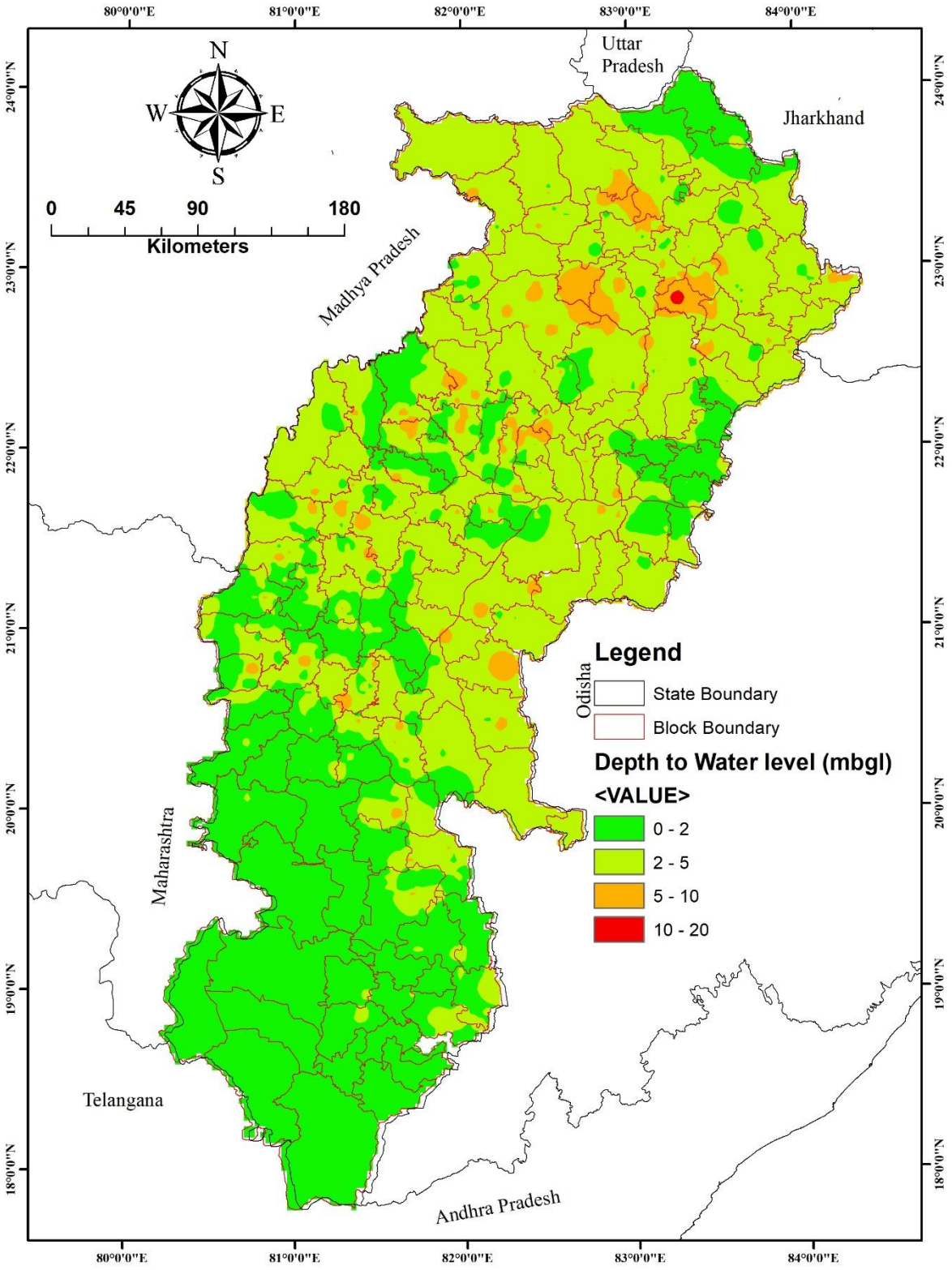
5 - 10
10 - 20

Post-monsoon water level (Nov 2021) Plate-6



86 numbers of wells (approximately 26.51% of the monitored wells) in the state are showing water levels between 0-2 m bgl in almost all the distrcts of Chhattisgarh State except Bilaspur, Jashpur, Kawardha, Korba, Rajnandgaon and Surguja districts. Water levels in the range of 2-5 m bgl are recorded in about 393 of the observation wells monitored.

Different ranges of depth to water table as observed in May 2021 are represented on a map and appended as Plate-5.

ii) Post Monsoon (November 2019)

In general, the depth to water level range up to 5 mbgl is observed in approximately 80.83% of the wells and depth to water level range up to 10 mbgl is observed in approximately 18.27% of the wells in the state. Deeper water levels ranging between 10 and 20 mbgl occur only in 0.89% of the observation wells and mostly in parts of Durg, Kawardha and Surguja districts. The deepest water level of 18.02 mbgl was monitored in Daundi Lohara new observation well of Durg district.

267 numbers of wells (approximately 26.51% of the monitored wells) in the state are showing water levels between 0-2 m bgl in almost all the distrcts of Chhattisgarh State. Water levels in the range of 2-5 m bgl are recorded in about 547 (54.32) of the observation wells monitored. The highest percentages of wells in this range are in Durg, Surguja, Bilaspur, Raipur and Korba districts. Nearly 18.27% of observation wells are exhibiting water level in the range of 5-10 mbgl in most of the districts of the state. Different ranges of depth to water table as observed in November 2021 are represented on a map and appended as Plate-6.

f. Quality of Ground Water

In Chhattisgarh, the chemical quality of the ground water is suitable for drinking, domestic, industrial and agriculture uses in most of the places whereas in few places instinct of contamination is observed that is due to local phenomena. The ground water is neutral to low alkaline in nature.

The Chemical analysis results reveals the lowest pH value 6.1 was recorded at Gunderdehi village of Durg district and highest pH value 8.28 was recorded at Rakhi (Joba) village of Dhamdha block of Durg district. The highest conductivity value 2730 µS/cm at 25°C was recorded at Patharia village of Bemetra district and lowest conductivity 52µS/cm at 25°C was recorded at Samarumi village of Tamnar Block Raighar district. The minimum hardness 15 mg/l was recorded at Hanumangarh village of Ramanujnagar of Surguja district and maximum total hard ness 1100 mg/l was observed at Jhalam village of Bemetra district. The minimum calcium concentration 04 mg/l was recorded at Hanumangarh village, of Surguja district and maximum calcium concentration 670 mg/l was observed at Sagona village, Saja block of Bemetra district. The highest magnesium concentration 216 mg/l was recorded at Tuman village, Kartala block of Korba district and lower most magnesium concentration < 1 mg/l was observed at Gariyabandh

village, Dharamjaighar block of Raighar district. The minimum sodium concentration 0.8 mg/l was recorded at Balachhappar village of Jashpur district and maximum sodium concentration 210mg/l was recorded at Patharia village of Mungeli district. The highest potassium concentration 132 mg/l was recorded at Janjgiri village of Durg district and lowest potassium concentration was recorded at Delirajhara of Balod district. The carbonate alkalinity was recorded only at Rakhi village, Dhamdha block of Durg district. The lowest chloride concentration 3.6 mg/l was recorded at Rajpurikhurd village, Ambicapur block of Surguja district. Highest chloride concentration 504 mg/l was recorded at Tarkori village, Dhamdha block of Durg district. The high sulphate content was recorded in some locations of Bilaspur, Bemetra, Kawardha, Korba, Mungeli, Durg and Raighar district. The highest concentration 1012 mg/l was recorded at Sagona village, Saja block of Bametra district. The high fluoride content (> 1.5 mg/l) was observed in 20 ground water samples most of these were collected from of Raighr, Korba, Bilaspur, Mahasamund and Jashpur district. The highest fluoride concentration 3.19 mg/l was recorded at Hamunanghar village, Ramanujnagar of Surguja district. Around 5.5 % of ground water (51 samples) in the state having nitrate concentration is above the permissible limit (>45 mg/l). The highest nitrate concentration 176.2 mg/l was recorded at Chorbhati village, Pathariya block of Mungeli district.

The Chemical analysis results of heavy metals shows that the no chromium was observed in ground water samples were collected in NHS wells in Chhattisgarh. At 187 locations manganese was recorded in collected water samples. The highest concentration 1.97 was recorded at Khodri village, Sonhat block of Koriya district. In 10% of the locations i.e 92 nos, of water samples, were iron concentrations was recorded above the permissible limit (>1.0 mg/l) in the ground water of Chhattisgarh. At 11 locations zinc concentration was recorded > 5 mg/l. In two locations high concentration > 15 mg/l zinc was recorded at Kanekera and Jhalkhanhariya 19.9 and 20.4 mg/l respectively. Only at one location i.e. Borgaon village, Pharasgaon of Kondaghar district were high copper concentration (0.24 mg/l) has recorded. In 07 location high nickel > 0.02 mg/l recorded in Chhattisgarh State, mainly observed in Raighar, Koriya and Korba district. The lead contamination was observed in few locations of Korba, Raighar, Bilaspur, Kankar and Kondagaon district. High value of arsenic 0.01 mg/l was recorded in 8 locations of Koriya, Raighar and Raipur district. The highest value was observed at Borgaon village of Pharsagaon block at Kondagaon district. In 12 locations high uranium content > 30 µg/l recommended by The United States Environmental Protection Agency (USEPA 2000) and World Health Organisation (WHO, 2011, 4th ed) for drinking propose is observed in ground water of Bilaspur Kanker, Jashpur, Korba, Mungeli and Surguja districts of Chhattisgarh.

The Arsenic contamination more than permissible limits reported in the 11 villages of Ambagarh Chowki block of Rajnandgaon district. Quality Problems in Ground Water Resources Assessment -2022 has been summarised in Annexure-7.

CHAPTER 3

GROUND WATER RESOURCES ESTIMATION METHODOLOGY (GEC' 2015)

The ground water resource estimation of the entire country has been done broadly within the guidelines and recommendations of the GEC'2015. In Chhattisgarh, the unit of assessment to ground water resources has been taken as the smallest administrative unit i.e. Block. The hilly areas (slope greater than 20%) have been excluded from the computations. The assessment unit has been divided into command and non-command areas and ground water resources have been estimated separately for command and non-command areas. The ground water recharge in the monsoon season and non-monsoon season has also been estimated separately.

Ground Water Recharge during Monsoon season

The two approaches adopted for estimation of rainfall recharge are Water Level Fluctuation (WLF) Method and Rainfall Infiltration Factor (RIF) Method

Water Level Fluctuation (WLF) Method

Under this method the change in storage has been computed by multiplying water level fluctuations between pre and post monsoon periods with the area of assessment and specific yield. The ground water resources during monsoon season have been estimated as the sum of change in storage and Ground water Extraction which can be expressed as:

R = (h X Sy X A) + GE

Where,

R= Recharge, h= rise in water level in the monsoon season, A=area for computation of recharge, Sy= Specific yield, GE= Ground water Extraction.

The specific yield values considered in the computations have been taken preferably from field tests, in absence of which, the recommended values of specific yield have been considered.

The ground water recharge calculated from above relation gives the recharge from rainfall and other sources during the monsoon period. In order to segregate the rainfall recharge, contribution from the other sources such as recharge from recycled water from irrigation, recharge from stream, seepage from canal, recharge from tanks and ponds and recharge from water conservation structures have been estimated separately based on the recommended norms. The rainfall recharge has been normalized for the normal monsoon rainfall.

Rainfall Infiltration Factor (RIF) method

Recharge from rainfall is estimated by using the following relationship -

R_{rf} = RFIF * A* (R – a)/1000, Where,

R_{rf} = Rainfall recharge in Ham

A = Area in Hectares

RFIF = Rainfall Infiltration Factor

R = Rainfall in mm

a = Minimum threshold value above which rainfall induces ground water recharge in mm

The same Rainfall Infiltration Factor has been used for computation of recharge due to monsoon and non-monsoon rainfall. The norms adopted for computation of recharge as recommended by GEC'2015

The ground water recharge computed by WLF method has been compared with recharge computed by RIF method. In case the difference between the two sets of data are more than 20%, then RIF figure has been considered, otherwise monsoon recharge from WLF has been considered. While adopting the rainfall recharge figures, weightage has been given to WLF method over adhoc norms method of RIF. Hence, wherever the difference between RIF & WLF is more than 20%, data have been scrutinized and corrected accordingly.

The total recharge in monsoon season is the sum of the normalized rainfall recharge and recharge from other sources.

Ground Water Recharge During Non-Monsoon season

The recharge from rainfall during the non-monsoon season has been estimated by Rainfall Infiltration Factor (RIF) method provided the normal rainfall in the non-monsoon season is greater than 10% of the normal annual rainfall. If the rainfall is less than 10% the recharge due to rainfall has been taken as zero. The total recharge in non-monsoon has been obtained as the sum of recharge from rainfall and recharge from other sources.

Total Annual Ground Water Recharge

The Annual Ground Water Recharge of the area has been worked out by adding monsoon and non-monsoon recharge.

Natural Ground Water Discharge

Natural ground water discharge as base flow during non-monsoon season is considered 5% & 10 % of the total annual replenishable ground water where recharge during monsoon period computed by WLF & RIF methods respectively.

Annual Extractable Ground Water Recharge (EGR)

The Annual Extractable Ground Water Recharge has been computed after deducting the natural discharge from the Annual Replenishable Ground Water Resource and can be expressed as:

Annual Extractable Ground Water Recharge (EGR) *=*

Annual Ground Water Recharge - Natural Discharge during non-monsoon season.

Annual Ground Water Extraction

The Annual Ground Water Extraction has been computed for Irrigation, Domestic and Industrial uses which includes the ground water extraction from all existing ground water structures during monsoon as well as non-monsoon period.

Stage of ground water extraction

The Stage of ground water extraction has been computed as given below: -

$$Stage\ of\ Ground\ Water\ Extraction(\%) = \frac{Existing\ \ gross\ \ ground\ water\ extraction\ for\ all\ uses}{Annual\ Extractable\ \ Ground\ water\ Resources} \times 100$$

Categorisation of Assessment Units

As emphasized in the National Water Policy, 2012, a convergence of Quantity and Quality of ground water resources is required while assessing the ground water status in an assessment unit. Therefore, it is recommended to separate estimation of resources where water quality is beyond permissible limits for the parameter salinity.

Categorization of Assessment Units Based on Quantity**:** The categorization based on status of ground water quantity is defined by Stage of Ground Water extraction as given below:

Stage of Ground Water Extraction	Category
≤70%	Safe
> 70% and ≤90%	Semi-Critical
> 90% and ≤100%	Critical
> 100%	Over Exploited

In addition to this Category every assessment subunit should be tagged with potentiality tag indicating its ground water potentiality viz. Poor Potential (Unit Recharge <0.025m), Moderately Potential (Unit Recharge in between 0.025 and 0.15m) and Highly Potential (Unit Recharge > 0.15m)

Categorization of Assessment Units Based on Quality: The Quantity based categorization (safe, semi-critical, critical and over-exploited) should bear a quality hazard identifier. Such quality hazards are to be based on available ground water monitoring data of State Ground Water Departments and/or Central Ground Water Board. If any of the three quality hazards in terms of Arsenic, Fluoride and Salinity are

encountered in the assessment subunit in mappable units, the assessment subunit may be tagged with the Quality hazard.

Allocation of Ground Water Resource for Utilization

The Annual Extractable Ground Water Resources are to be apportioned between domestic, industrial and irrigation uses. Among these, as per the National Water Policy, requirement for domestic water supply is to be accorded priority. This requirement is based on population as projected to the year 2025, per capita requirement of water for domestic use, and relative load on ground water for urban and rural water supply. The estimate of allocation for domestic water requirement may vary for one subunit to the other in different states. In situations where adequate data is not available to make this estimate, the following empirical relation is recommended.

$$\textbf{Alloc} = 22 \times N \times L_g \textbf{ mm per year}$$

Where,

Alloc = Allocation for domestic water requirement

N = population density in the unit in thousands per sq. km.

L_g = fractional load on ground water for domestic and industrial water supply (≤ 1.0)

Net Annual Ground Water Availability for Future Use

The water available for future use is obtained by deducting the allocation for domestic use and current extraction for Irrigation and Industrial uses from the Annual extractable Ground Water Recharge. The resulting ground water potential is termed as the net annual ground water availability for future use. The Net annual ground water availability for future use should be calculated separately for non-command areas and command areas.

CHAPTER 4

PROCEDURE AND ASSUMPTIONS

a. Data Source for each of the data element and how the data was used in the computation (constraint in the database if any)

As per the decision taken by the State Level Ground Water Resource Estimation Committee, most of the data have been provided by state water resources department, mainly collected from concerned state department. The water level data collected by CGWB through NHS monitoring and from state ground water survey, has been utilised for resource estimation. The rainfall data, irrigation data for tube wells and dug wells were provided by Water Resources Department. The state could not get success to obtain the stream data from the concern department. The domestic dug wells & bore wells data are not available, therefore per capita consumption of 60 litres per day per person for rural areas and 100 litres per day per person for urban areas have been taken into consideration. The data of ground water withdrawal for industries incorporated from the NOC issued by CGWA.

b. Changes, if any, applied in the original methodology proposed by GEC along with justification

All the data provided by the state department have been computerised and the GEC'2015 methodology has been used for calculations of recharge, Extraction, natural discharge, Stage of ground water extraction etc.

c. Norms used in Rainfall Recharge

GEC'2015 methodology has recommended norms for various parameters are used in ground water recharge estimation. In order to segregate the rainfall recharge, contribution from the other sources such as recharge from recycled water from irrigation, seepage from canal, recharge from tanks and ponds and recharge from water conservation structures have been estimated separately based on the recommended norms. The rainfall recharge computed by WLF has been normalized for the normal monsoon rainfall.

Ground water recharge from monsoon and non-monsoon rainfall has been computed separately for command and non-command areas. For computations of recharge from monsoon rainfall both methods i.e., water level fluctuation method and rainfall infiltration factor method have been used. For comparison, figures obtained from these two methods, the percent deviation is calculated, and figures of recharge have been accepted as recommended in this methodology. For computation of non-monsoon rainfall recharge rainfall infiltration factor method is adopted when ratio of normal non-monsoon rainfall to normal annual rainfall is more than 10% as suggested in the methodology.

The specific yield of the formation for calculating the recharge for monsoon rainfall is used for most of the cases, as recommended by GEC'97. The specific yield used for particular areas based on field conditions in between the maximum and minimum value as per norms GEC'97 and is given in Table-5

Table-5 Specific Yield values and Rainfall Infiltration Factor for different formations.

S. No.	Formation	Sp. Yield	Rainfall Infiltration Factor
1	Alluvium	0.10	0.10
2	Gondwana Sandstone	0.02	0.09
3	Limestone	0.025	0.06
4	Weathered or Vesicular jointed Basalt.	0.02	0.06
5	Weathered Granite, Granite Gneiss and (with clay content)	0.010 - 0.02	0.06 - 0.09
6	Quartzite and Hard compact (Precambrian) Sandstone	0.010	0.06
7	Schist, Phyllite and Shale	0.010	0.03 – 0.05

Norms Used in Recharge from other sources- As per recommendations of methodology, recharge from other sources have been calculated separately for monsoon and non-monsoon periods. The factors for calculation of return flow from irrigation, canal seepage, recharge from Tanks and Ponds and water conservation structures have been taken as those recommended by GEC '97. The canals in Chhattisgarh by and large run during monsoon period, as major part of the area is falling under paddy cultivation in all parts of the state. Considering the hydrogeological conditions and irrigation practices in the State recharge computation parameters for various formations are given in Table – 6.

Table– 6 Factors for Recharge from Other Sources

S.No.	Sources of Recharge Other than Rainfall	Value Range	Unit of Recharge
1	Seepage from Canal	3.5 (for all canals in hardrocks)	Ha-m/day per million square meters of wetted areas
2.	Return flow from Surface Water Irrigation	0.26 – 0.45 (Depends on average DWL)	As a fraction
3.	Return flow from Ground Water Irrigation	0.4 – 0.45 (Depends on average DWL)	As a fraction
4.	Seepage from Tanks and Ponds	0.00144	Meters per day per hectare

Norms used in Ground Water Extraction for Domestic and Industrial Water Supply

Ground Water Extraction for domestic and industrial water supply has been computed based on block wise population for the base year. The population figures were available for the year 2011. The average per capita consumption has been considered 60 litters per day for rural areas & 100 litres per day

for urban areas. The dependency on ground water has also been considered in computation. Extraction during monsoon and non-monsoon periods have been calculated separately taking 4 months as monsoon period and 8 months as non-monsoon period.

Norms Used in Ground Water Extraction for Irrigation Uses

Block wise ground water extraction for irrigation has been calculated based on the number of ground water structures and the unit discharge of different types of structures. The unit extraction of different ground water abstraction structures in different lithological formations has been taken as per field studies carried out by CGWB and State departments. Dug wells and tube wells are main two main structures, which are used for irrigation in the State. Extraction from dug wells is varying between 0.4 Ham/year (dug wells fitted with low discharge pumps) and 1 Ham/year (dug wells in high potential Gondwana sandstone). The ground water extraction from tube wells is ranging between 0.9 Ham/year and 2.5 Ham/year (based on formation).

INDIA -GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN-GRES)

INDIA-GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN-GRES) is a Software/Web-based Application developed by CGWB in collaboration with IIT-Hyderabad. It will provide common and standardized platform for Ground Water Resource Estimation for the entire country and its pan India operationalization (Central and State Governments). The system will take 'Data Input' through Excel as well as Forms, compute various ground water components (recharge, extraction etc.) and classify assessment units into appropriate categories (safe, semi-critical, critical and over-exploited). The Software uses GEC 2015 Methodology for estimation and calculation of Groundwater resources. It allows for unique and homogeneous representation of groundwater fluxes as well as categories for all the assessment units (AU) of the country.

URL of IN-GRES http://ingres.iith.ac.in

The detailed description about IN-GRES Software is given in Annexure-5.

CHAPTER 5

COMPUTATION OF GROUND WATER RESOURCES FOR CHHATTISGARH

a. Salient features of the dynamic ground water resource assessments

Year of assessment – Ground water resources assessment is based on the recommendation of Ground Water Resource Estimation Methodology – 2015 (GEC' 2015) and on advice of R&D committee. The base year for data collection is 2019-20 and water level fluctuation data is considered from 2017 to 2021.

Assessment Unit – The administrative block has been considered as a unit of assessment. The unit was further divided into sub-unit Command and Non-Command as the mappable poor-quality area and shallow ground water area are not in the state. The ground water resources have been computed for all 146 blocks of the state.

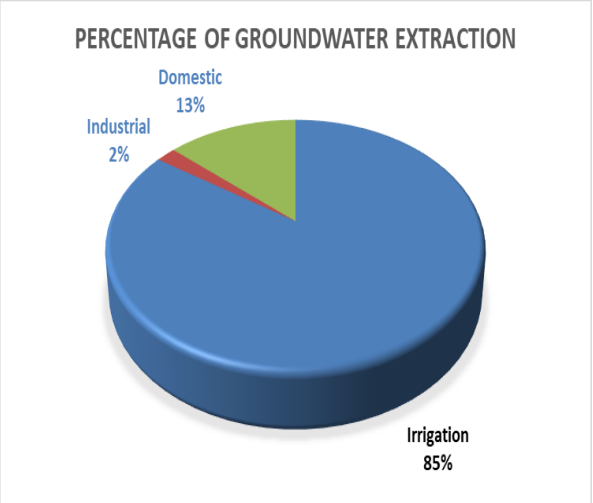
b. Assessment sub-unit-wise method adopted for computing rainfall recharge during monsoon season

In GEC' 2015, two approaches are recommended – Water Level Fluctuation Method and Rainfall Infiltration Method. The Water Level Fluctuation method adopted for assessment of sub-unit wise recharge during monsoon season. The method is based on the concept of storage change due to the difference between various input and output components. Input refers to recharge from rainfall and other sources and subsurface inflow into the unit of assessment. Output refers to ground water extraction, ground water evapotranspiration, base flow to streams and subsurface outflow from the unit. The lateral inflow is considered as equal to the outflow because the assessment unit is block. The evapotranspiration is considered as zero because no shallow water level less than 3 meter below ground surface is available in the state. Total recharge to ground water has several components, rainfall being the major one. Other components include seepage from canals, recharge from stream, return flow from surface water irrigation, return flow from ground water irrigation, seepage from tanks and ponds and seepage from water conservation structure etc. has been used in the assessment.

c. Ground Water Resources of the Chhattisgarh

Total Ground Water Recharge – Total Annual Ground Water Recharge is 12.05 bcm and Natural Discharge during Non-Monsoon Period is 1.04 bcm. Thus, the Annual Extractable Ground Water Resource of the state is 11.01 bcm.

Ground Water Extraction - The existing ground water extraction for all uses in the state is 5.45 bcm with Rajnandgaon district having the highest extraction of ground water (46411.69 Ham) and Narayanpur district having the lowest (1020.99 Ham) ground water extraction. Rajnandgaon is the most developed district in the state in terms of agricultural production and dependence on ground water is very high in the district. Comparison of ground water extraction for various uses reveals that extraction for irrigation accounts for more than 85 % of the total ground water extraction, whereas extraction for domestic purposes accounts for 13 % and for Industrial purposes is 2 % of the total ground water extraction in the state (Chart-1).



Annual Extractable Ground Water Recharge for Future Development – Annual extractable ground water recharge for future development of the state is in order of 5.56 bcm which is 50.50 % of the total resource of the state.

Stage of Ground Water Extraction- Stage of groundwater extraction of Chhattisgarh state is 49.58%, which is low as compared to the national extraction of 63.33%. Four districts in the state namely Balod, Bametra, Dhamtari, Durg have stage of development more than 70% i.e. 71.75%, 93.83%, 80.22%, 83.8% respectively. The Gurur block of Balod district reached at highest ground water extraction of 98.37% and Bemetara district shows highest ground water extracted district i.e. 93.83 % in state. Sukma district has lowest stage of ground development of less than 3.83%.

Out of 146 blocks, 38 blocks have stage of extraction < 30 %, 29 blocks are having stage of development between 30 to 50%, 49 blocks within 50 and 70 %. Only 30 blocks have attained stages of development more than 70%. The state as a whole has a stage of extraction of 49.58 % only (Table-8).

Categorization of Assessment Units- Out of 146 assessment units (blocks), 6 units (4.11 %) as 'Critical', 24 units (16.44 %) have been categorized as 'Semi-critical' and 116 units (79.45 %) as 'Safe' categories of assessment units (Annexure 8, Plate-7). There are no 'Over-exploited' and 'Saline' categories of assessment units. Critical and Semi-critical blocks are distributed in Balod, Bemetara, Bilaspur, Dhamtari, Durg, Gariaband, Janjgir-champa, Kabirdham, Kanker, Korba, Mahasamund, Raigarh, Raipur, Rajnandgaon, and Surajpur districts. Rest all subunits have been categorized as safe from groundwater extraction point of view.

Categorisation of Assessment Unit Plate-7

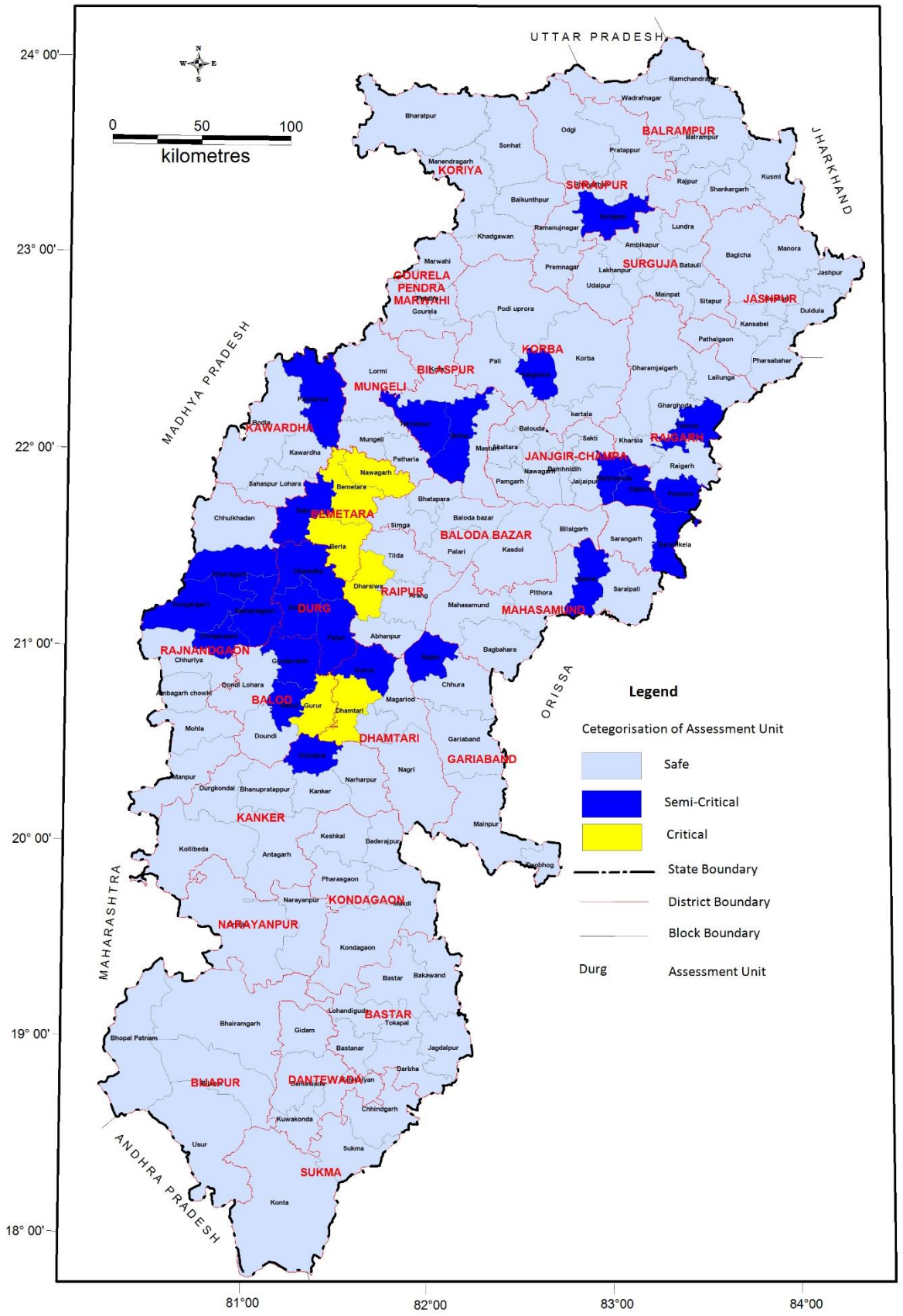


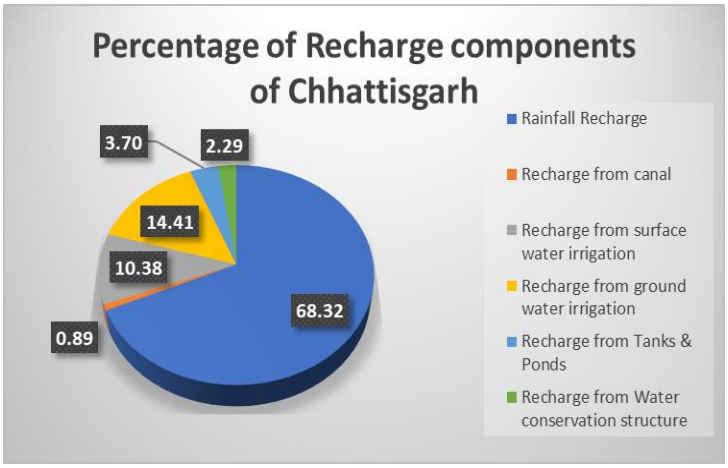
Table-7. Assessment of dynamic ground water resource of Chhattisgarh (As on March'2022)

S. No.	Name of District	Ground Water Recharge					Total Natural Discharges	Annual Extractable Ground Water Resource
		Monsoon Season		Non-monsoon Season		Total Annual Ground Water Recharge		
		Recharge from rainfall	Recharge from other sources	Recharge from rainfall	Recharge from other sources			
1	2	3	4	5	6	7	8	9
1	BALOD	15674.05	9416.22	0	12630.07	37720.34	3235.23	34485.11
2	BALODA BAZAR	30723.54	17527.7	466.32	7052.11	55769.67	5473.18	50296.48
3	BALRAMPUR	39755.94	1217.6	284.83	1971.04	43229.41	3862.35	39367.06
4	BASTAR	21473.75	482.11	1752.02	1381.62	25089.5	2191.94	22897.56
5	BEMETARA	16047.69	13451.23	0	18704.76	48203.68	4178.86	44024.82
6	BIJAPUR	49859.36	85.13	214.88	597.92	50757.29	5075.74	45681.55
7	BILASPUR	18736.8	8510.94	414.06	8749.6	36411.4	3494.22	32917.18
8	DANTEWADA	25082.97	178.14	342.85	1197.27	26801.23	2453.79	24347.44
9	DHAMTARI	19625.76	10967.99	0	16548.16	47141.91	4281.22	42860.69
10	DURG	14807.5	8963.38	0	11265.01	35035.89	3013.83	32022.06
11	GARIABAND	20976.06	5660.4	0	6340.16	32976.62	3153.67	29822.95
12	GOURELA-PENDRA-MARWAHI	11462.8	995.4	545.15	975.53	13978.88	1218.42	12760.47
13	JANJGIR-CHAMPA	17697.23	14878.92	537.27	11473.74	44587.16	3918.25	40668.9
14	JASHPUR	26963.04	1779.68	883.67	3437.39	33063.78	2754.25	30309.52
15	KABIRDHAM	31633.99	17711.74	1408.77	10452.67	61207.17	5172.58	56034.59
16	KANKER	58270.55	2476.42	2224.16	7755.35	70726.48	6571.37	64155.12
17	KONDAGAON	27298.24	685.49	2064.15	2097.03	32144.91	1615.96	30528.95
18	KORBA	29950.35	3725.48	635.62	3815.32	38126.77	3523.24	34603.53
19	KOREA	55327.42	4409.87	289.29	3740.5	63767.08	5452.31	58314.77
20	MAHASAMUND	41364.48	11016.35	325.68	13221.88	65928.39	4560.72	61367.67
21	MUNGELI	8457.22	5202.78	0	4505.92	18165.92	1816.59	16349.32
22	NARAYANPUR	24792.42	258.98	772.79	447.36	26271.55	2627.16	23644.39
23	RAIGARH	36368.48	4295.87	582.13	5561.05	46807.53	3041.84	43765.69
24	RAIPUR	19506.5	14254.43	42.18	12908.78	46711.89	4378.55	42333.34
25	RAJNANDGAON	40313.87	17246.36	478.96	19423.45	77462.64	6325.28	71137.36
26	SUKMA	44273.29	323.97	0	457.55	45054.81	4505.47	40549.34
27	SURAJPUR	27753.95	2774.89	187.47	10072.9	40789.21	3027.98	37761.24
28	SURGUJA	34075.09	1923.21	854.71	4610.16	41463.17	3441.53	38021.64
	Total (Ham)	808272.3	180420.7	15306.96	201394.3	1205394.28	104365.53	1101028.74
	Total (BCM)	8.08	1.8	0.15	2.01	12.05	1.04	11.01

Table-8. Ground Water Extraction in Chhattisgarh (As on March' 2022)

S.No.	Name of District	Current Annual Ground Water Extraction				Annual GW Allocation for for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)
		Irrigation	Industrial	Domestic	Total			
		10	11	12	13	14	15	16
1	BALOD	22390.68	156.53	2196.09	24743.3	2356.22	9646.95	71.75
2	BALODA BAZAR	19454.95	1256.92	4941.31	25653.18	6482.56	23635.52	51
3	BALRAMPUR	7861.56	4.04	2003.82	9869.43	2200.65	29300.8	25.07
4	BASTAR	5001.44	462.52	2233.38	7697.34	2400.33	15033.27	33.62
5	BEMETARA	38913.3	67.64	2327.49	41308.42	2889.52	7761.68	93.83
6	BIJAPUR	1936.38	1.25	663.2	2600.85	711.88	43032.02	5.69
7	BILASPUR	16867.73	467.64	5404.51	22739.91	6529.12	9767	69.08
8	DANTEWADA	2838.73	152.05	758.31	3749.09	820	20536.66	15.4
9	DHAMTARI	32298.86	13.94	2068.02	34380.81	2180.05	10199.85	80.22
10	DURG	21880.79	110.98	4841.24	26833.01	5135.19	6143.18	83.8
11	GARIABAND	18582.67	21.07	1666.41	20270.12	1877.55	9393.54	67.97
12	GOURELA-PENDRA-MARWAHI	3720.68	1.01	1086.46	4808.13	1324.53	7714.27	37.68
13	JANJGIR-CHAMPA	18401.54	135.98	4622.07	23159.59	5146.64	17039.09	56.95
14	JASHPUR	10846.65	1.42	2190.08	13038.15	2320.47	17140.99	43.02
15	KABIRDHAM	31784.78	27.28	2461.91	34274	2837.22	21385.27	61.17
16	KANKER	19413.75	73.14	1997.25	21484.14	2150.07	42518.15	33.49
17	KONDAGAON	10777.12	4.12	1541.51	12322.75	1658.78	18844.58	40.36
18	KORBA	9175.17	2670.57	3516.68	15362.41	3879.21	18878.59	44.4
19	KOREA	11348.93	6.55	1726.69	13082.17	1819.79	45139.5	22.43
20	MAHASAMUND	36223.17	64.01	2823.42	39110.58	3077.95	22002.55	63.73
21	MUNGELI	7652.85	32.5	1816.62	9501.97	2236.98	6426.98	58.12
22	NARAYANPUR	630.2	10.13	380.64	1020.99	412.02	22592.02	4.32
23	RAIGARH	15847.53	1865.43	4113.63	21826.56	4491.91	21560.85	49.87
24	RAIPUR	20776.86	2718.57	5886.12	29381.57	6815.31	12354.96	69.41
25	RAJNANDGAON	41254.1	351.3	4806.29	46411.69	6010.03	23521.95	65.24
26	SUKMA	949.48	0.18	611.67	1561.33	636.6	38963.08	3.85
27	SURAJPUR	21995.88	24.42	2120.64	24140.96	2298.05	13442.86	63.93
28	SURGUJA	12958.14	334.49	2263.01	15555.66	2436.01	22292.99	40.91
Total (Ham)		461783.9	11035.67	73068.46	545888	83134.64	556269.15	49.58
Total (BCM)		4.62	0.11	0.73	5.46	0.83	5.56	49.58

d. Spatial variation of the Ground water recharge and extraction scenario in Chhattisgarh



In Chhattisgarh, recharge from rainfall is 8.08 billion cubic meter (BCM) whereas from other sources is 1.8 billion cubic meter (BCM). District-wise ground water resources of Chhattisgarh as on March 2022 are given in Table-7 and Table-8 and block-wise figures also given in Annexure-6A & 6B. Comparison of recharge from rainfall and recharge from sources other than rainfall shows the later accounts for 31.80 % of the total recharge. However, the recharge from sources other than rainfall is as high as 66.7 % of the total annual recharge of the district in Bemetara district. This is since district practices intensive irrigation from surface water as well as ground water resources. Due to the above reasons seepage from canal and return flow from irrigation becomes substantial in the above district. In the state of Chhattisgarh, recharge from other sources other than rainfall, return flow from ground water irrigation accounts for 14.41%, return flow from surface water irrigation accounts for 10.38%, recharge from tanks and ponds accounts for 3.70%, recharge from water conservation structure accounts for 2.29% and seepage from canals accounts for 0.89%.

The ground water resource of the individual block /assessment unit shows wide variation in the resource available and Stage of ground water extraction, In Chhattisgarh, the ground water development concentrates in the central part of the state i.e. within Chhattisgarh basin only. The other part of the state has very low development of ground water. District-wise ground water resource scenario is described below: -

1. BALOD

Nearly 87 % of the total geographical area of the district is covered by sedimentary formations of Chhattisgarh Super group comprising gypsiferous Maniyari shale, Chandi limestone, Gunderdehi shale, Charmuria limestone, Chandarpur sandstone. The Bastar Gneiss, Dongargarh Granite, Bijli Rhyolite and other similar rocks cover the rest of the area. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **37720.34** Ham and **34485.11** Ham respectively. Gross ground water Extraction for all uses in the district is only **24743.3** Ham. Stage of ground water extraction in the district is 71.75%, which is comparatively higher to the state average of 48.43%. Out of the five blocks of the district one block i.e. Gurur is categorised as Critical, while the blocks Balod

and Gunderdehi are falling in semi Critical Category and the rest two blocks namely Doundi Lohara and Doundi are in Safe category. In addition to the phreatic aquifer, potential deeper aquifers also exist.

2. BALODABAZAR

Major parts of the total geographical area of the district is covered by sedimentary formations of Chhattisgarh Super group comprising gypsiferous Maniyari shale, Chandi limestone, Gunderdehi shale, Charmuria limestone, Chandarpur sandstone. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **55769.67** Ham and **50296.48** Ham respectively. Gross ground water Extraction for all uses in the district is only **25653.18** Ham. Stage of ground water extraction in the district is only 51 %, which is higher than the Stage of ground water extraction of the state. All six blocks in the district have been categorised as 'safe' category. In addition to the phreatic aquifer, potential deeper aquifers also exist.

3. BALRAMPUR

The major geological formations in the district are rocks belonging to Archean, Gondwanas, Lametas and Deccan trap group of rocks. Archaean rocks comprise granitoids and occupy the eastern part. Talchir Shale, Barakar Sandstone and Supra Barakars represent the Gondwana Supergroup and are exposed in the northern part. Lametas and Deccan Basalts occur as patches. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **43229.41** Ham and **39367.06** Ham respectively. The gross ground water Extraction for all uses in the district is only **9869.43** Ham. Stage of ground water extraction in the district is 25.07%. All 6 blocks in the district have been categorised as 'safe'. In addition to the phreatic aquifer, potential deeper aquifers also exist in the district.

4. BASTAR

Major geological formations in the district are high-grade gneiss, granulite and charnockite complex (Bengpal group) of Archaen age. These are overlain by Bailadila Group of rocks comprising Banded Iron Formation. The Bailadila Group of rocks are intruded by acid igneous rocks like granites/granitoids. Besides these main cratonic rocks formations, the sediments of Indravati Group are also found. Laterites are found as hill's capping. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **25089.5** Ham and **22897.56** Ham respectively. Gross ground water Extraction for all uses in the district is only **7697.34** Ham. Stage of ground water extraction in the district is only **33.62** %, which is very low in comparison to the state average of 48.43%. All the blocks in the district have been categorised as 'safe'. In addition to the phreatic aquifer, potential deeper aquifers also exist.

5. BEMETARA

Nearly 87 % of the total geographical area of the district is covered by sedimentary formations of Chhattisgarh Super group comprising gypsiferous Maniyari shale, Chandi limestone, Gunderdehi shale, Charmuria limestone, Chandarpur sandstone. The Bastar Gneiss, Dongargarh Granite, Bijli Rhyolite and other similar rocks cover the rest of the area. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **48203.68** Ham and **44024.82** Ham respectively. Gross ground water Extraction for all uses in the district is **41308.42** Ham. Stage of ground water extraction in the district is **93.83**%. Stages of development in the blocks vary from 88.56% in Saja to 97.69% in Bemetara block. Bemetara, Nawagarh and Berla blocks of the district have been categorised as '**Critical'** and Saja falls under semi-critical category.

6. BIJAPUR

Major geological formations in the district are high-grade gneiss, granulite and charnockite complex (Bengpal group) of Archaen age. Granitoids including Dongargarh Granites and Bastar Gneisses are the major rock types in the district. These are overlain by Bailadila Group of rocks comprising Banded Iron Formation. The Bailadila group of rocks are intruded by acid igneous rocks. Argillo-calcareous sediments of Sabri and Pakhal Group are also found. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **50757.29** Ham and **45681.55** Ham respectively. Gross ground water Extraction for all uses in the district is only **2600.85** Ham. Stage of ground water extraction in the district is only **5.69**%, which is lowest Stage of ground water extraction in the state. All the blocks in the district have been categorised as 'safe'. In addition to the phreatic aquifer, potential deeper aquifers also exist.

7. BILASPUR

High-grade gneisses and unclassified metamorphics of Archean Age are the major rock types, which occur, in the northern part. The southern half is almost entirely covered by sedimentary formations of upper Proterozoic known as Chhattisgarh Super Group consisting of limestones, siltstones, shales, sandstone and marlstone. Rocks belonging to Gondwana Super Group occur as a small patch in western boundary. Recent to sub recent- alluvial deposits and laterite also occur at places in the district. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **36411.4** Ham and **32917.18** Ham respectively. Gross ground water Extraction for all uses in the district is **22739.91** Ham. The of Stage of ground water extraction in the district is **69.08%**. Belha and Takhatpur block with a stage of development of 88.31% and 87.18 is categorized as '**Semi-critical**'. The rest of the blocks in the district have been categorised as safe.

8. DANTEWARA

Granitoids including Dongargarh Granites and Bastar Gneisses are the major rock types in the district. These are overlain by Bailadila Group of rocks comprising Banded Iron Formation. The Bailadila group of rocks are intruded by acid igneous rocks. Argillo-calcareous sediments of Sabri and Pakhal Group are also found. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **26801.23** Ham and **24347.44** Ham respectively. gross ground water Extraction for all uses in the district is only **3749.09** Ham. Stage of ground water extraction in the district is a meagre **15.4**%, which is very low in comparison to the state average. This is the third lowest developed district in the state in terms of ground water development. Katekalyan block in the district have lowest stages of development is **9.64** %. All the blocks in the district have been categorised as 'safe'. Besides the phreatic aquifer, potential deeper aquifers also exist.

9. DHAMTARI

More than 50% of the area of the district-mostly in the southern and south-central part is covered by Dongargarh Granite. These rocks have been intruded by quartz veins and dykes of basic to ultra-basic composition. The northern half is covered by rocks belonging to Proterozoic Chhattisgarh Supergroup. Chhattisgarh Supergroup in this part is represented by Chandarpur sandstone, Charmuria Limestone and Gunderdehi Shale. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **47141.91** Ham and **42860.69** Ham respectively. Gross ground water Extraction for all uses in the district is **34380.81** Ham. Average Stage of ground water extraction in the district is **80.22**%. Stages of development in the blocks vary from 62.87% in Nagri to 94.62% in Dhamtari block. Dhamtari has been categorized as critical and Kurud is categorized as semi-critical. Potential deeper aquifers exist in the district. Central Ground Water Board has drilled 97 bore wells under the ground water exploration programme. These wells in the depth range of 45 to 200 m have yielded 0.5 to 16 lps.

10. DURG

The major parts of is underlain by the chandi formation which is dominantated stromatolitic limestone sequence. The bottom most (Newari member) comprises of stromatolitic limestone and dolomite which is pink to light grey in colour and thickly bedded followed by dark grey flaggy limestone (Pendri member) with intercalations of calcareous shale and Deodongar sandstone of lensoid shape. The topmost unit (Nipania member) comprises of pink to purple dolomitic limestone. Towards upper part it changes into bedded limestone and purple shale and is devoid of stromatolitic structure. This formation has very good ground water potential due to development of caverns at places. A total of 27 no. of exploratory wells have been drilled in this formation. The depth of bore wells drilled in this rock types

varies from 19.5 to 304.57 m bgl. The casing length inserted varies from 6.00 to 30.50 m, which also represents the weathered thickness in this formation. The deep-seated fractures have been encountered in this formation during drilling down to depth of 152.5 m. Within a depth range of 6 to 152.5 m, 2-8 fracture zones were encountered. The discharge varies from 0.27 to 17 lps (Parpori) and the maximum drawdown was 35m. The static water level is varying between 1.90 m bgl and 15.10 m bgl.

Other formation occurring at northern parts of the district is Tarenga formation of dark grey, bedded dolomite associated with light grey laminated argillaceous dolomite. This formation has also good ground water potential.

Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **35035.89** Ham and **32022.06** Ham respectively. Gross ground water Extraction for all uses in the district is **26833.01** Ham. Stage of ground water extraction in the district is **83.8**%. Durg, Dhamdha and Patan blocks in the district have been categorised as '**Semi-critical** having stage of development 88.15%, 87.33 and 73.32% respectively.

11. GARIABAND

Major parts of the district is covered by the rocks of Lower Proterozoic Dongargarh Super Group, Comprising mainly of fine to medium grained Potash rich Dongargarh Granite and its equivalents are distributed in northern and central parts of the district. Big Granite boulders on hills, formed due to the differential weathering, are a common sight in granitic terrain. Well-developed wide joints can also be seen in various areas. Effect of weathering through joints down to 40 metres can be very well observed during drilling in this formation. Intrusive of pegmatite /quartz vein can be often seen in this granite, So far 16 no of exploratory bore wells have been drilled in granites and gneisses down to a maximum depth of 157 meters. Based on the drilling data it can be inferred that the weathered thickness varies from 13 meters to 29 meters. Weathered mantle is the main aquifer which holds considerable potential of ground water. Generally, the weathered zone is immediately followed by a fracture.

In granite and gneisses, the yield of well depends upon structure, lithology and landform. The structure controlled by lineament plays a major role in controlling the yield. Generally, the site located along the lineaments or in close vicinity of lineaments have given high yields whereas sites away from the lineaments have yielded poorly. Felsic rocks (Pink granite) have more fractures compared to mafic and felsic rocks. The depth of wells ranges between 60 and 135 m bgl. Based on the exploration data it can be inferred that the weathered thickness in granites ranges between 16 and 40 m bgl. Weathered granite followed by a fracture at bottom is the only aquifer which possess good quantity of water. In general, the shallow fractured zone lies within 80 m. depth. The yield of this zone varies from 3 to 15 lps and specific capacity varies between 23 and 37 lpm/mdd. The south eastern part of the district is underlain by the Charnokite-Khodalite group of rocks.

Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **32976.62** Ham and **29822.95** Ham respectively. Gross ground water Extraction for all uses in the district is **20270.12** Ham. Stage of ground water extraction in the district is **67.97**%. All the blocks in the district have been categorised as 'safe except Rajim which is falling in '**Semi-critical**' category having stage of development **83.70%**.

12. GOURELA-PENDRA-MARWAHI

High-grade gneisses and unclassified metamorphics of Archean Age are the major rock types in district. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **13978.88** Ham and **12760.47** Ham respectively. Gross ground water Extraction for all uses in the district is **4808.13** Ham. Stage of ground water extraction in the district is **37.68**%. All the blocks in the district have been categorised as 'safe'.

13. JANJGIR – CHAMPA

Chhattisgarh Super Group of rocks and its equivalents covers almost the entire district. The cavernous limestone/ dolomite and fractured rocks form potential deeper aquifers in the district. The potential cavernous zones in general are restricted to 40 m bgl. However cavernous zone followed by fractures are identified down to 130 m bgl (Kotmi). 51 exploratory bore wells have been drilled by CGWB in the depth range of 66 to 200 m. Drill time discharges recorded in these wells are in the range of 0.2 to 12 lps. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **44587.16** Ham and **40668.9** Ham respectively. Gross ground water Extraction for all uses in the district is **23159.59** Ham. Stage of ground water extraction in the district is 56.95%. All the blocks in the district have been categorised as 'safe except **Malkharoda and Dhabra** which are falling in **Semi-critical** category with **77.07% and 78.77**%.

14. JASHPUR

The district is mainly underlain by crystalline rocks of Proterozoic age belonging to Chota Nagpur gneissic complex. Presence of sandstone of Lameta Formation (infra-trappeans) and Deccan trap basalt though insignificant, have also been reported. Extensive lateritisation with occasional bauxite deposits are also found. Laterite, which forms the phreatic aquifer, is extensive and is exploited through dug wells. Average thickness of laterite is 15m. At places it is as high as 30m. Potential of the basalts as aquifer material has not been explored properly as this part is covered mostly by forests and is thinly populated. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **33063.78** Ham and **30309.52** Ham respectively. Gross ground water Extraction for all uses in the district is only **13038.15** Ham. Stage of ground water extraction in the district is **43.02**%. All the blocks in the district have been categorised as '**safe**'. Out of the 52 bore wells drilled by CGWB in the

granitic terrain, 33 are either dry or have negligible discharge. Drill time discharge in only 7 wells was more than 3lps.

15. KANKER

The district is covered almost entirely by granitic rocks. Dongargarh granite and Bastar gneisses are the major geological formations. Bijli Rhyolite occurs as a thin band in the central part. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **70726.48** Ham and **64155.12** Ham respectively. Gross ground water Extraction for all uses in the district is **21484.14** Ham. Stage of ground water extraction in the district is only **33.49**%. All the blocks in the district have been categorised as '**safe**' except **Charama** block which has been categorized as **'Semi-critical'**. Exploratory drilling by CGWB indicates that deeper aquifer system exists. 63 exploratory bore wells with depth range of 79 to 243m drilled in the district have yielded in the range of 0.4 to 23 lps.

16. KAWARDHA

Western part of the district is covered by granitoids and other hard rocks including andesites and meta-sediments of Chilpi Group. The eastern part is covered by sandstones-shale-limestone/dolomite belonging to Precambrian Chhattisgarh Supergroup. Extensive lateritisation has taken place at many places. Under the exploration programme, the Central Ground Water Board has drilled 21 boreholes to assess the aquifer systems and their potential. These wells drilled in the hard rock areas ranged in depth from 21 to 274m and yielded 1 to 14.5lps drill time discharge. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **61207.17** Ham and **56034.59** Ham respectively, gross ground water Extraction for all uses in the district is only **34274** Ham. Stage of ground water extraction in the district is only **61.17**%. All the blocks in the district have been categorised as '**safe**' except **Pandariya** block which has been categorized as **'Semi-critical'**.

17. KONDAGOAN

Major parts of the district is covered by the rocks of Lower Proterozoic Dongargarh Super Group, Comprising mainly of fine to medium grained Potash rich Dongargarh Granite and its equivalents are distributed in northern and central parts of the district. Big Granite boulders on hills, formed due to the differential weathering, are a common sight in granitic terrain. Well-developed wide joints can also be seen in various areas. Effect of weathering through joints down to 40 metres can be very well observed during drilling in this formation. Intrusives of pegmatite /quartz vein can be often seen in this granite, So far 16 no of exploratory bore wells have been drilled in granites and gneisses down to a maximum depth of 157 meters. Based on the drilling data it can be inferred that the weathered thickness varies from 13 meters to 29 meters. Weathered mantle is the main aquifer which holds considerable potential of ground water. Generally, the weathered zone is immediately followed by a fracture.

In granite and gneisses, the yield of well depends upon structure, lithology and landform. The structure controlled by lineament plays a major role in controlling the yield. Generally, the site located along the lineaments or in close vicinity of lineaments have given high yields whereas sites away from the lineaments have yielded poorly. Felsic rocks (Pink granite) have more fractures compared to mafic and mafelsic rocks. The depth of wells ranges between 60 and 135 m bgl. Based on the exploration data it can be inferred that the weathered thickness in granites ranges between 16 and 40 m bgl. Weathered granite followed by a fracture at bottom is the only aquifer which possess good quantity of water. In general, the shallow fractured zone lies within 80 m. depth. The yield of this zone varies from 3 to 15 lps and specific capacity varies between 23 and 37 lpm/mdd. The south eastern part of the district is underlain by the Charnokite-Khodalite group of rocks.

Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **32144.91** Ham and **30528.95** Ham respectively. The gross ground water Extraction for all uses in the district is only **12322.75** Ham. Stage of ground water extraction in the district is only **40.36** %, which very low in comparison to the state average. All the blocks in the district have been categorised as '**safe**'.

18. KORBA

Talchir Shale, Barakar Sandstone with coal and Suprabarkars are the major rock types in the district. They are exposed in the northern and north eastern part of the district. Bastar Gneisses occupy the western and the southern part of the district. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **38126.77** Ham and **34603.53** Ham respectively. The gross ground water Extraction for all uses in the district is only **15362.41** Ham. Stage of ground water extraction in the district is only **44.4** %, which very low in comparison to the state average of **46.34**% of the state. All the blocks in the district have been categorised as '**safe**' except **Katghora (82.38%)** block which has been categorized as **'Semi-critical'**. Ground water exploration in the district carried out by CGWB has proved that the deeper aquifers though present in the district are not that potential.

19. KORIYA

The rocks belonging to Gondwana supergroup occupy more than 90% of the area of the district. Nearly 60% area of the district is covered by Barakar Sandstone and Supra Barakars. Southern part of the district is occupied by Talchir Shale. The granites/gneisses/phyllites etc occur mostly as inliers and in isolated patches. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **63767.08** Ham and **58314.77** Ham respectively. The gross ground water Extraction for all uses in the district is only **13082.17** Ham. Stage of ground water extraction in the

district is only **22.43** %, which very low in comparison to the state average. All the blocks in the district have been categorised as '**safe**'. Underground water exploration programme 12 tube wells have been drilled in the area occupied by the Gondwanas. Depth of the wells range between 181 to 397m and the yields range from 0.5 to 4.2 lps.

20. MAHASAMUND

Major part of the district is covered by Dongargarh Granite and its variants. Precambrian sedimentaries equivalent of Chhattisgarh Supergroup are exposed in the eastern part. Chandarpur Sandstone and Charmuria Limestone occupy nearly 15% area in the western part of the district. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **65928.39** Ham and **61367.67** Ham respectively. Gross ground water Extraction for all uses in the district is only **39110.58** Ham. Stage of ground water extraction in the district is **63.73** %. All the blocks in the district have been categorised as 'safe' except **Basna** which is '**Semi-Critical**' with stage of extraction is **84.04**%. Ground water exploration carried out by CGWB in the district has proved the existence of potential deeper aquifers. 34 exploratory bore wells have been constructed by CGWB in the depth range of 67 to 275m have yielded in the range of 0.5 to 12.8 lps.

21. MUNGALI

The Bastar granite & gneiss of Archaean age consist of granite & gneiss, cover northern part of the district. They are coarse to medium grained & grey to pinkish grey in colour. The predominant mineralogical constituents are quartz & feldspar with other accessories minerals, such as biotite, hornblende, chlorite etc. In plain area they are affected by the prolonged denudation & weathering action. The weathred mantle extends up to a depth of 15 m bgl. The exposed rocks are hard & compact in nature.

In granite and gneisses, the yield of well depends upon structure, lithology and landform. The structure controlled by lineament plays a major role in controlling the yield. Generally, the site located along the lineaments or in close vicinity of lineaments have given high yields whereas sites away from the lineaments have yielded poorly. The depth of wells ranges between 60 and 157 m.bgl. The weathered thickness in granites ranges between 16 and 40 m bgl. Weathered granite is followed by a fracture at bottom is the only aquifer which possess good quantity of water. In general, the shallow fractured zone lies within 80 m depth. The yield of this zone varies from 3 to 15 lps and specific capacity varies between 23 and 37 lpm/mdd.

Pandaria formation of Chhattisgarh group covers central part of the district. This formation represents the cale-argillite facies overlying the Chanderpur arenites and is characterized by predominance of purple coloured calcareous shale with lenses and pockets of bedded flaggy limestone, stromatolitic limestone and dolomite. From ground water point of view this formation is highly potential

Central Ground Water Board has drilled 16 numbers of exploratory bore wells in the area maximum down to a depth of 128 m bgl. The wells have yielded water in the range of 7 and 14 lps. The transmissivity of the formation was measured to be 405 m^2/day. Due to the collapsible nature and high ground water potential of the formation drilling of deep borewell is a difficult job. Deep bore wells can be constructed only by using telescopic method by gradually decreasing the diameter of bore well and lowering slotted sections against the collapsible strata.

The southern part of the district is underlain by the Maniyari formation of Chhattisgarh group consist of mainly bedded dolomite associated with light grey laminated argillacoues dolomite and maniary formation is gypsiferous shale.

Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **18165.92** Ham and **16349.32** Ham respectively. Gross ground water Extraction for all uses in the district is only **9501.97** Ham. Stage of ground water extraction in the district is **58.12**%. All the blocks in the district have been categorised as '**safe**'.

22. NARAYANPUR

Major geological formations in the district are the intracratonic, volcano-sedimentary suite of rocks of Abhujhmar Group overlies high-grade gneiss, granulite and charnockite complex (Bengpal group) of Archaen age. The Group of rocks are intruded by acid igneous rocks like granites/granitoids. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **26271.55** Ham and **23644.39** Ham respectively. Gross ground water Extraction for all uses in the district is only **1020.99** Ham. Stage of ground water extraction in the district is **4.32**%. All the blocks in the district have been categorised as '**safe**'. In addition to the phreatic aquifer, potential deeper aquifers also exist.

23. RAIGARH

Nearly 50% area of the district is covered by rocks of Gondwana Supergroup, which comprise Barakar sandstone, Kamthi Sandstone and Talchir Shale. Southern part is occupied by sandstone, limestone and shale, which are equivalents of Chhattisgarh Supergroup. Granitoids occupy the northern part, which accounts for nearly 20% of the total geographical area of the district. Extensive Lateritisation with occasional bauxite deposits are also found. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **46807.53** Ham and **43765.69** Ham respectively. Gross ground water Extraction for all uses in the district is only **21826.56** Ham. Stage of ground water extraction in the district is only **49.87**%. Baramkela, Tamnar & Pussore blocks with a stage of development of **74.84%, 74.65% & 82.87%** respectively have been categorised as '**Semi critical'**. The rest of the blocks in the district have been categorised as '**safe'**. Rocks belonging to Gondwana Supergroup form potential aquifers. Out of 29 tube wells drilled in the Gondwanas up to a maximum

depth of 400m, only two have yielded less than 1 lps and 20 wells yielded more than 3 lps. Wells drilled in hard rock areas have yielded between 0.5 to 22.42 lps.

24. RAIPUR

More than 60% area of the district is covered by Chhattisgarh Supergroup of rocks, which comprise Sandstone, Limestone/dolomite and Shale. Nearly 30% area is occupied by Dongargarh Granite and rocks of Charnockite-Khondalite Group. Nawagarh Group of rocks exposed in the eastern boundary occupies nearly 10% area of the district. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **46711.89** Ham and **42333.34** Ham respectively. Gross ground water Extraction for all uses in the district is only **29381.57** Ham. Stage of ground water extraction in the district is **69.41**%. The **Dharsiwa** block with **96.21**% stage of development has been categorised as '**Critical**' while the remaining assessed subunits in the district have been categorised as '**safe**'. Hard rock areas in the district have been proved to be potential aquifers. Underground water exploration programme 131 bore wells have been drilled in the district ranging in depth from 45 to 301m. They have yielded up to 40 lps.

25. RAJNANDGAON

The geology of Rajnandgaon from south to north varies widely. Older metamorphics, igneous and iron ore series of rocks covers almost entire southern part. The middle and upper middle occupied by Chilpi group, Dongargarh supergroup & Chhattisgarh supergroup of rocks. The northern part comprises Chhattisgarh sediments and Chilpi group of metasediments. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **77462.64** Ham and **71137.36** Ham respectively. The gross ground water Extraction for all uses in the district is only **46411.69** Ham. Stage of ground water extraction in the district is **65.24**%. **Dongargarh, Dongargaon, Khairagarh and Rajnandgaon** blocks with a stage of development of **78.32%, 86.34%, 88.76% and 73.81** respectively have been categorised as '**Semi-critical**'. A total of 82 bore wells ranging in depth from 32 to 240 m. have been constructed in the district by Central Ground Water Board. They have yielded in the range of 0.5 to 12.4 lps.

26. SUKMA

The major portion of the district is underlain by Bengpal Group comprises high-grade metamorphites (Amphibolite-Granulite facies) including metasedimetaries, matabasites, gneisses-migmatite enclaves, bands and patches within Bastar gneissic complex and Charnockites. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **45054.81** Ham and **40549.34** Ham respectively. The gross ground water Extraction for all

uses in the district is only **1561.33** Ham. Stage of ground water extraction in the district is **3.85**%. All the blocks of the district have been categorised as **safe**.

27. SURAJPUR

The major geological formations in the district are rocks belonging to Gondwanas, group of rocks represented by Talchir Shale, Barakar Sandstone and Supra Barakars Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **40789.21** Ham and **37761.24** Ham respectively. The gross ground water Extraction for all uses in the district is only **24140.96** Ham. Stage of ground water extraction in the district is **63.93**%. All the blocks in the district have been categorised as '**safe**' except **Surajpur** block which has been categorized as **'Semi-Critical'** with stage of development **79.85%**. In addition to the phreatic aquifer, potential deeper aquifers also exist in the district. Under the exploration programme, the Central Ground Water Board (CGWB) has constructed 24 in the Gondwana area. Nearly 75% wells in the Gondwana area yielded more than 1 lps.

28. SURGUJA

The major geological formations in the district are rocks belonging to Archean, Gondwanas, Lametas and Deccan trap group of rocks. Archaean rocks comprise granitoids and occupy the eastern part. Talchir Shale, Barakar Sandstone and Supra Barakars represent the Gondwana Supergroup and are exposed in the western part. Lametas and Deccan Basalts occur as patches in the north-western part. Total Annual Ground Water Recharge and Annual Extractable Ground Water Recharge of the district have been estimated to be **41463.17** Ham and **38021.64** Ham respectively. The gross ground water extraction for all uses in the district is only **15555.66** Ham. Stage of ground water extraction in the district is **40.91**%. All the blocks in the district have been categorised as '**safe**'. In addition to the phreatic aquifer, potential deeper aquifers also exist in the district. Under the exploration programme, the Central Ground Water Board (CGWB) has constructed 20 bore wells in the hard rock areas and 42 tube wells in the Gondwana area. Nearly 45% wells in the hard rock area and 75% wells in the Gondwana area yielded more than 1 lps.

e. Ground water recharge in poor ground water quality zone

No poor-quality area has been in the state except few localised patches in the state.

f. Additional annual potential recharges

No shallow water level or waterlogged area are found in the state. Thus, the annual potential recharge is zero for the state

g. Comparison with the earlier ground water resources estimate and reasons for significant departure from earlier estimates

The ground water resource of all blocks of Chhattisgarh were estimated in 2020 using GEC'2015 methodology and the present ground water resource assessment as on March 2022 is also based on the GEC'2015 methodology. All the 146 administrative blocks of 28 districts has been considered as a unit of assessment for state.

As compared to 2020 assessment, there is an increase in groundwater extraction from 5.35 to 5.46 bcm. Due to increase in number of abstraction structure mainly for irrigation, resulted in the increase of total extraction.

For state the stage of development in the year of 2020 was 46.34 % which is raised to 49.58 % in the year 2022. As compared to 2020 assessment, Critical blocks decreased from 09 from 06, Semi-Critical decreased from 27 from 24 and Safe categorization increased from 110 compared to 116. In current 2022 assessment there is decrease in the number of Critical and Semi Critical units, mainly due to increase in recharges in the semi-critical and critical blocks.

h. Details of Assessment units Improved & Deteriorated from 2020 to 2020 Ground Water Resources Assessment

There is improvement of categorization in 11 assessment units comparing to 2020 assessment mainly because of increase in recharge component. While 03 assessment units have shown deteriorated categorization mainly because of increase in irrigation extraction. Details of which described in Table-10.

Table-9 Comparison of Assessment units Improved & Deteriorated from 2020 to 2022 Ground Water Resources Assessment

S. No	Name of District	Name of Assessment Unit	Stage of Ground Water Extraction (%) in 2020	Categorization in 2020	Name of District	Name of Assessment Unit	Stage of Ground Water Extraction (%) in 2022	Categorization in 2022
Improved								
1	DHAMTARI	MAGARLOD	70.48	semi critical	DHAMTARI	MAGARLOD	69.85	safe
2	JANJGIR-CHAMPA	SAKTI	70.64	semi critical	JANJGIR-CHAMPA	SAKTI	60.22	safe
3	BALODA BAZAR	SIMGA	73.2	semi critical	BALODA BAZAR	SIMGA	67.19	safe
4	MAHASAMUND	PITHORA	77.32	semi critical	MAHASAMUND	PITHORA	67.9	safe
5	KABIRDHAM	SAHASPUR LOHARA	83.12	semi critical	KABIRDHAM	SAHASPUR LOHARA	58.87	safe
6	RAJNANDGAON	CHHUIKHADAN	85.71	semi critical	RAJNANDGAON	CHHUIKHADAN	67.15	safe
7	DHAMTARI	NAGRI	88.86	semi critical	DHAMTARI	NAGRI	62.87	safe
8	DURG	DURG	90.48	critical	DURG	DURG	88.15	semi critical
9	RAJNANDGAON	KHAIRAGARH	93.38	critical	RAJNANDGAON	KHAIRAGARH	88.76	semi critical
10	KABIRDHAM	PANDARIYA	93.59	critical	KABIRDHAM	PANDARIYA	77.31	semi critical
11	KABIRDHAM	KAWARDHA	96.1	critical	KABIRDHAM	KAWARDHA	66.58	safe
Deteriorated								
1	BILASPUR	TAKHATPUR	61.12	safe	BILASPUR	TAKHATPUR	87.18	semi critical
2	RAJNANDGAON	RAJNANDGAON	65.28	safe	RAJNANDGAON	RAJNANDGAON	73.81	semi critical
3	BEMETARA	NAWAGARH	84.72	semi critical	BEMETARA	NAWAGARH	94.02	critical

ANNEXURES

ANNEXURE 01

(TO BE PUBLISHED IN THE GAZETTE OF INDIA PART-I, SECTION -I)

No. T-13014/1/2019-GW Section
Government of India
Ministry of JAL SHAKTI
Department of Water Resources, River Development & Ganga Rejuvenation
****

Shram Shakti Bhavan, Rafi Marg,
New Delhi, Dated: 08.02.2022

RESOLUTION

Sub: Constitution of Central Level Expert Group (CLEG) for periodic re-assessment of ground water resources of the country.

The State-wise annual assessment of Dynamic Ground Water Resources for the entire country are made based on the methodology and norms recommended by Ground Water Resources Estimation Committee (GEC) 1997 and 2015. There are changes in ground water scenario in various parts of the country because of various interventions by Government/public. Groundwater being a dynamic resource, its periodic assessment in the country can help the policy makers/planners to take suitable timely intervention for sustainable management of this precious resource. Accordingly, a Central Level Expert Group (CLEG) is hereby constituted for over-all supervision of the assessment of ground water resources in the entire country for each Water Year. The composition and Terms of Reference of the Expert Group are as follows:-

1. **Composition:**

S.No	Designation and Name of Department	Committee
1.	Chairman, CGWB	**Chairman**
2.	Member(RM), CWC	**Member**
3.	Member (CGWA), CGWB	**Member**
4.	Director, NIH, Roorkee or representative	**Member**
5.	Joint Secretary, Ministry of Agriculture & Farmer Welfare or his nominee.	**Member**
6.	Joint Secretary, Department of Drinking Water Supply & Sanitation, Ministry of Jal Shaktior his nominee.	**Member**
7.	Joint Secretary, Ministry of Housing and Urban Affairs or his nominee.	**Member**
8.	Representative of Department of Civil Engg., Indian Institute of Technology-Hyderabad	**Member**
9.	Member(South), CGWB	**Member Secretary**

The assessment of 'Dynamic Ground Water Resources' is carried out jointly by Central Ground Water Board and State Nodal/Ground Water Departments under the guidance of State Level Committee (SLC) of each State/UT and overall supervision of Central Level Expert Group (CLEG). Further, the states shall submit the information with the CLEG as per their requirement for compilation of National Ground Water Resource Assessment.

2. Terms of Reference: –

i. To ensure the assessment of annual ground water recharge of the States in coordination with the respective SLC. The Committee will work on ground water assessments for water year (June to May) in accordance with the approved latest methodology and will adopt improved procedures and practices wherever possible for the sake of achieving greater accuracy of assessment.

ii. To supervise the estimation of status of utilization of the annual extractable ground water resource as in specified water year to be carried by the respective SLC.

iii. To supervise compilation of a National level report on assessment of ground water resources and status of its utilization as in the specific reference year.

iv. Any other aspect relevant to the terms referred in TOR above.

3. Time frame:-

The Committee will submit its report as per the timelines prescribed by the Ministry from time to time.

4. **Expenditure**

Expenditure on account of TA/DA to official Members of the Expert Group will be met from the source from which they draw their salaries and that of non-official Members (if any), will be borne by the Central Ground Water Board as per Govt. norms.

These issues with the approval of competent authority.

(Ashish Kumar)
Director (GW)

आशीष कुमार/ASHISH KUMAR
निदेशक/Director
जल संसाधन, नदी विकास एवं गंगा संरक्षण मन्त्रालय
Ministry of Water Resources, River Development
& Ganga Rejuvenation
भारत सरकार/Govt. of India
नई दिल्ली/New Delhi-110001

ORDER

Ordered that the Resolution be published in the Gazette of India for general information.

Ordered that a copy of the Resolution published be communicated to this Ministry for record.

(Ashish Kumar)
Director (GW)

आशीष कुमार/ASHISH KUMAR
निदेशक/Director
जल संसाधन, नदी विकास एवं गंगा संरक्षण मन्त्रालय
Ministry of Water Resources, River Development
& Ganga Rejuvenation
भारत सरकार/Govt. of India
नई दिल्ली/New Delhi-110001

To
The Manager,
Government of India Press,
Faridabad (Haryana).

Copy to:

1. PS to Minister (JAL SHAKTI)
2. PS to MoS (JAL SHAKTI)
3. PS to MoS (JAL SHAKTI)
4. Sr PPS to Secretary (DoWR, RD & GR)
5. PPS to Joint Secretary (IC & GW)
6. All members concerned.
7. Chairman, CGWB, Faridabad.
8. Member (S), CGWB and Member Secretary of the CLEG, CGWB, CHQ, Faridabad for information and necessary action.

Copy also to:
NIC for uploading the Resolution on Ministry's website.

ANNEXURE 02

Govt. of Chhattisgarh,
Water Resources Department
Mantralaya, Mahanadi Bhawan,
Nava Raipur Atal Nagar,
Distt.- Raipur (C.G.)
//Order// Pin- 492101

No. 703 /F-1-66/31/S-2/GW/2010 Atal Nagar, Dated 10/02/ 2022

The State Level Committee (SLC), for Ground Water Resources Assessment in 2022 for the State of Chhattisgarh, is here by constituted as under-

1	Secretary, Government of Chhattisgarh Water Resources Department	-	Chairman
2	The Engineer in Chief, Water Resources Department	-	Member
3	The Engineer in Chief, Public Health Engineering Department	-	Member
4	Director , Department of Agriculture, Raipur	-	Member
5	Chief Engineer, Mahanadi Godavari Basin Raipur	-	Member
6	Director of Industries Raipur	-	Member
7	Chief General Manager NABARD Nava Raipur-Atal Nagar	-	Member
8	Regional Director Central Ground Water Board Raipur	-	Member -Secretary

2.Terms of Reference:-

I To ensure the assessment of annual replenishable ground water resource of Chhattisgarh for the reference year 2022. The committee will work on ground water assessment in accordance with the GEC methodology and will adopt improved procedures and practices wherever possible for the sake of achieving greater accuracy of assessments.

II To estimate status of utilization of the annual replenishable ground water resources as on March 2022 of Chhattisgarh State.

3. Time Frame:-

The Committee will submit its report within one year.

4. Expenditure:-

Expenditure on account of TA/DA to official Members of the Committee will be met from the source from which the draw their salaries and that of non- official members (if any) will be borne by the concerned State Water Resources Department.

On behalf of and in the name of
The Governor of the State of Chhattisgarh

10/02/2022

(PremSingh Gharendra)
Under Secretary
Water Resources Department,
Mantralaya, Atal Nagar

Office of the Director * Diary No. 504 Date 18/2/22 * C.G.W.B., N.C.C.R. Raipur (C.G.)

..2

Endt. No. 704/ F-1-66/31/S-2/GW/2010 Atal Nagar, Dated 10 /01/ 2022

Copy to:

1. The Additional Chief Secretary to Hon'ble Chief Minister, Government of Chhattisgarh, Mantralaya, Nava Raipur-Atal Nagar for information please.
2. The Chief Secretary, Government of Chhattisgarh, Mantralaya, Nava Raipur-Atal Nagar for information please.
3. Personal Secretary to Hon'ble Minister of Water Resources Department, Govt of Chhattisgrah, Manrtalaya Nava Raipur-Atal Nagar for information please.
4. The Secretary, Government of India, Jal Shakti Mantralaya, Deptt. of Water Resources, River Development & Ganga Rejuvenation, Shram Shakti Bhawan, Rafi Marg, New Delhi-110 001 for information please.
5. The Engineer-in- Chief, Water Resources Department, Shivnath Bhawan Sector-19, North Block, Nava Raipur-Atal Nagar.
6. The Engineer-in- Chief, Public Health Engineering Department, Indravati Bhawan, Nava Raipur-Atal Nagar
7. The Director, Department of Agriculture, Krishak Bhawan, Sector-19, North Block, Nava Raipur-Atal Nagar.
8. The Chief Engineer, Mahanadi Godavari Basin, Water Resources Department, Raipur.
9. The Director of Industries, 1st Floor, Udyog Bhawan, Opp Ring Road No.1, Telibandha, Raipur, Chhattisgarh
10. Chief General Manager NABARD, Chattisgarh Regional Office, Ananya, Plot No-01, Sector-24, Behind Central Bank, Nava Raipur-Atal Nagar.
11. The Regional Director. Central Ground Water Board, NCCR, 2ND Floor LK Corporates & Logistic Park Dhamtari Road, Dumartarai with reference his letter No13.3/CGWB/ NCCR/Ts-220, dated 17.07.2020

for information and necessary action please.

Encl.:- Nil

10/02/2022

Under Secretary
Water Resources Department,
Mantralaya, Atal Nagar

Minutes of 1st Meeting of Central Level Expert Group (CLEG) for Assessment of Ground Water Resources of India as on 2022

The 1st meeting of the Central Level Expert Group (CLEG) for assessment of the Replenishable Ground Water Resources of India as on 2022 was held under the Chairmanship of Sh. Sunil Kumar, Chairman, Central Ground Water Board & Chairman, CLEG through Video Conferencing at 11.00 Hrs on 28.02.2022. The list of participants is annexed.

Dr Ratikanta Nayak, Scientist-E, welcomed all the members of Central Level Expert Group and briefed about the background of the resource assessment. Dr. S.K. Jain, Member (South), CGWB & Member Secretary, CLEG, explained about the ongoing processes of the replenishable assessment, 2022 and the role of CLEG and State Level Committees (SLCs) for ensuring timely completion the whole process of the resource assessment by September, 2022. The Chairman, in his opening remarks, emphasized the need for timely completion of GWRA-2020 by using the Web based application ''INDIA-GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN-GRES)''.

A presentation on 'Activities under Ground Water Resource Assessment-2022 along with time-line' was made by Sh. D. N. Mandal, Scientist-D, CGWB. It was informed that SLCs have been constituted in 11 States/UTs and for rest of the States/UTs the constitution of SLCs is under process by the concerned States/UTs. Similarly 17 States/UTs have created the GW Resource Assessment Cells comprising Scientists/Engineers from CGWB as well as State GW Nodal Departments. Creation of GW Assessment Cells for rest of the States/UTs are under process by respective State GW Nodal Departments/CGWB. The presentation was followed by detailed discussions on various aspects of the resource assessment.

The decisions taken during the meeting are listed below:

Sl No.	Activity	Action Points	Time line
1	Constitution of SLCs	For the remaining states / UTs, the concerned Regional Director, CGWB to pursue the concerned State GW Nodal Departments to expedite the constitution of SLCs	**March, 2022**
2	Creation of GW Resource Assessment Cells	For the remaining States / UTs, Nodal officer, GWRA, CHQ to pursue with Regional Directors, CGWB for creation of GW Resource Assessment	**10th March, 2022**

Sl No.	Activity	Action Points	Time line
		Cell	
3	Organizing State Level Meetings between CGWB and State GW/Nodal Dept.	Concerned Regional Director, CGWB to organise the meeting with State	**10th March, 2022**
4	Firming up Assessment Units as per latest data and providing Shape files of the same.	Concerned RD, CGWB to look into the issue with State agencies and submit the status to CHQ	**10th March, 2022**
5	Organizing online workshop (Zone-wise) to facilitate interaction with State level Officials and IIT-H	IIT-H has to finalise dates / communicate to all concerned State Nodal Departments and CGWB Regional Offices & organise online workshops.	**15 to 20 March, 2022**
6	Interactive Training for states facing difficulties in assessment (Telangana, Andhra Pradesh, Maharashtra and Rajasthan) Interaction with Telangana, Andhra Pradesh carried out at Hyderabad on 22.02.0222.	IIT-H to discuss the issue with the nodal department in State of Maharashtra and Rajasthan & the concerned Regions of CGWB to resolve the matter through physical interaction on priority.	**Before March 15, 2022**
7	Re-launching/Opening of IN-GRES for GWR Assessment Cells of rest 32 State/UTs	IIT-H to Re-launching/Opening of IN-GRES for GWR Assessment Cells of rest 32 State/UTs	**07th March, 2022**
8	Functionality to add in IN-GRES	IIT-H to make provision in the INGRES for apportionating / integrating information / data for Basin-wise, grid-wise or polygon-wise etc. utility	**April, 2022**

The Nodal officer CLEG at CGWB, CHQ to pursue with all Regional Offices of the Board and IIT-H for completion of the above action points within the timeline as indicated.

The meeting ended with thanks to the Chair.

Annexure

List of participants of the 1st meeting of Central Level Expert Group (CLEG) on 28.02.2022

S.No	Participants	
1.	Shri. Sunil Kumar, Chairman, CGWB	Chairman, CLEG
2.	Dr. S. K. Jain, Member (South), CGWB	Member Secretary, CLEG
3.	Shri. K B V N Phanindra, Professor, Department of Civil Engg., Indian Institute of Technology-Hyderabad	Member
4.	Dr. Anupma Sharma, Scientist 'F', National Institute of Hydrology, Roorkee	Member
5.	Shri Sunil Kumar, Director, Basin Planning-1, Directorate, Basin Planning Management Organization, Central Water Commission	Member
6.	Sh. A.K. Agarwal, Regional Director, CGWB, Patna.	
7.	Dr. Poonam Sharma, Scientist-E, CGWB, CHQ	
8.	Dr. Ratikanta Nayak, Scientist-E, CGWB, CHQ	
9.	Sh. D. N. Mandal, Scientist-D, CGWB, CHQ	

Minutes of Meeting of Central Level Expert Group for Re-assessment of Ground Water Resources of India for 2022 (held through Hybrid Mode)

Date: 28.09.2022

The meeting of the Central Level Expert Group (CLEG) for re-assessment of the Ground Water Resources of India for 2022 was held under the Chairmanship of Shri Sunil Kumar, Chairman, Central Ground Water Board (CGWB) through Video Conferencing on 28.09.2022 at 03.00p.m. The list of participants is attached (Annexure).

Dr.A.Subburaj, Member (South), CGWB & Member Secretary, CLEG, welcomed all the Members of Central Level Expert Group and participants. He briefed the participants about the Ground Water Resource Assessment 2022 and requested Chairman, CGWB to address the participants. **Chairman, Central Ground Water Board, congratulated all Officers of State GW/Nodal Departments, Regional offices of CGWB and IIT Hyderabad for their sincere efforts for completion of GW Resource Assessment for 2022 through web based application ''INDIA-GROUNDWATER RESOURCE ESTIMATION SYSTEM (IN-GRES)''.** He also appreciated the CLEG members for their valuable inputs which have helped in the realistic assessment of ground water resources in the country. He then requested the Member Secretary to take up the Agenda items:

Agenda 2.1: Confirmation of Minutes of 1st CLEG Meeting & Action Taken on Decisions:

As no comments were received from any of the members, minutes of the previous meeting of CLEG held on 28.02.2022 were confirmed.

Dr.A.Subburaj, Member Secretary, CLEG mentioned that various actions for improvements in the IN-GRES software, as discussed during the previous meeting have been initiated in consultation with IIT Hyderabad and that all such improvements will be carried out over the next couple of years in a phased manner.

Agenda 2.2: Presentation on Ground Water Resource Assessment 2022:

A brief presentation on findings of 'Ground Water Resource Assessment-2022 (GWRA-2022)' as in 2022 was made by Dr. Ratikanta Nayak, Scientist-E, CGWB, CHQ, Faridabad. It was informed that all the States/UTs have successfully assessed their ground water resources jointly with CGWB. State Level Committees (SLCs) of 33 States/UTs have approved the GW Resource Assessment for their respective States/UTs. The GWRA-2022 for Andhra Pradesh, Chhatisgarh and Jammu & Kashmir are yet to be approved by their respective States/UTs. However, the results of joint assessment of State Government and CGWB has been considered for National Compilation of Dynamic Ground Water Resources of India, 2022.

Salient features of the national scenario of dynamic ground water resources of India, based on the outputs of assessment as in 2022 in respect of 36 States and outputs of

assessment as in 2022 in respect of India were presented and discussed. The members appreciated the work done by CGWB, State Departments and IIT Hyderabad and expressed their agreement with the whole process of assessment.

The presentation was followed by discussions and few points are listed below.

	Actionable point	Action taken/ to be taken by
1	Basin Wise Ground Water Resources of India, 2022	In the previous assessment GWRA-2020, a report on basin wise resources was published. A Report on basin wise resources -2022 will also be prepared by CGWB.
2	Quality Tagging of Assessment Units	In the National Report of Dynamic Ground Water Resources of India-2022, an annexure of Quality Tagging of Assessment Units is already included. Further it was suggested by the Chairman, CLEG to collect state wise feed back on salinity issues from the coastal states where saline assessment units were reported.
3	Assessment of GWR of Urban areas.	In GWRA-2022, 99 Urban Assessment units has been assessed separately.
4	Tagging of Deteriorated Assessment Units (GWRA 2022) for management of ground water resources.	In the National Report of Dynamic Ground Water Resources of India-2022, an annexure of Improvement/ Deterioration of Assessment Units (based on Categorization) in GWRA-2022 in comparison with GWRA-2020 is already included.
5	Analysis of Recharge from Other Sources	A detailed Analysis to be carried out by the Resource cell, CGWB, CHQ Faridabad for Components of Recharge from Other Sources.
6	Grided Data in IN-GRES	IIT-Hyderabad was requested to explore the feasibility of generating resources data in gridded format in INGRES.

The gist of findings of GWRA-2022 has been shared with all Members of CLEG. In principle the CLEG approved the Ground Water Resource Assessment -2022 of India.

The meeting ended with thanks to the Chair.

Annexure

List of participants of the meeting of Central Level Expert Group (CLEG) held on 28.09.2022

S.No	Participants
1.	Shri. Sunil Kumar, Chairman, Central Ground Water Board and Chairman, Central Level Expert Group.
2.	Shri A. K. Agrawal, Member (CGWA), Central Ground Water Board.
3.	Smt. D.Thara, Joint Secretary, Ministry of Housing and Urban Affairs.
4.	Dr.A.Subburaj, Member (South and HQ), Central Ground Water Board and Member Secretary, Central Level Expert Group.
5.	Shri Satish Kumar, Member (East), Central Ground Water Board.
6.	Shri. A. Murlidharan, Deputy Adviser(PHE), Department of Drinking Water Supply & Sanitation, Ministry of Jal Shakti.
7.	Dr. Anupma Sharma, Scientist 'F', National Institute of Hydrology, Roorkee
8.	Dr. K B V N Phanindra, Associate Professor, Department of Civil Engg., Indian Institute of Technology-Hyderabad.
9.	Smt. Deep Shikha, Deputy Director, Basin Planning-1,Central Water Commission .
10.	Dr. Ratikanta Nayak, Scientist-E, CGWB, CHQ, Faridabad
11.	Shri. Tapan Chakraborty, Scientist-E, CGWB, CHQ, Faridabad
12.	Shri. D.N.Mandal, Scientist-E, CGWB, CHQ, Faridabad
13.	Shri. Sanjeev Mehrotra, Scientist-D, CGWB, CHQ, Faridabad
14.	Shri. G. Praveen Kumar, Scientist-D, CGWB, CHQ, Faridabad
15.	Shri. A.K. Singh, Scientist-C, CGWB, CHQ, Faridabad
16.	Miss. Subhra Satapathy, Scientist-B, CGWB, CHQ, Faridabad

Appendix-C

IN-GRES (INDIA GROUND WATER RESOURCE ESTIMATION SYSTEM)

URL: https://ingres.iith.ac.in

A. Objectives of IN-GRES

- IN-GRES allows for unique and homogeneous representation of groundwater fluxes as well as categories for all the assessment units (AU) of the country.
- The visibility dashboards and System allows user to view data in both MIS (tabular) as well as GIS (map) formats, and to download reports.
- Removes the hurdles associated with manual data entry, computations, representation, report generation, approvals, and visualization
- Improves accuracy, efficiency and minimizes time in groundwater (GW) resource computation
- Helps the district / state level GW scientists in effective planning and management of GW resources of their region, and draw regulations on GW withdrawals.
- Create awareness among the public through access, visualize, and compare the status of GW resources to the level of a mandal/district

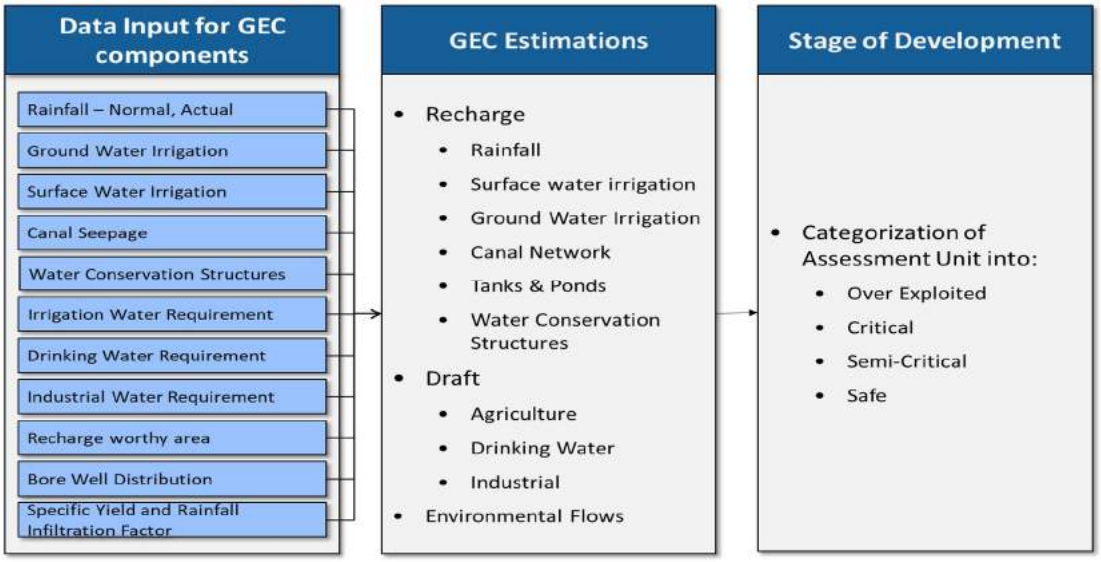


Figure 1: Overview of Ground Water Resource Estimation Platform – GEC 2015

B. Modules

IN-GRES is divided into 3 modules namely: Input, Computation and Output.

1. **Input module**– Input Module refers to the Data Entry module at an Assessment Unit (AU) level. Data Input is done via 2 methods i.e.

    a. **Excel based input**– In this, the user needs to download district level data sheet template where he/she can fill the data at an Assessment Unit level. User then needs to upload their fully filled excel sheet into the system.

"Basic Data" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers should not be changed. They are taken from the shapefile.
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	*Total Geographical Area (ha)	*Hilly Area (ha)	*Total Recharge Worthy Area (ha)				Static/In-Storage Unconfined Ground Water Resources		If Assessment Unit is Urban						Deep Water Level ? (Default: False)
						*Command	*Non Command	*Poor Quality	Total	Bottom of the Unconfined aquifer (m)	Specific Yield in Static/in-Storage zone	Command		Non Command		Poor Quality		
												Paved	UnPaved	Paved	UnPaved	Paved	UnPaved	

Figure 2: Basic Data Template

b. Form based input – In this, the user is shown a form and he/she can fill/edit the data in data sheet in an online mode. Once user is done with editing online, he/she can submit the data file.

- A User needs to upload a State **shape file** with Assessment unit, hierarchy and geometry. This information needs to be embedded into the shape file's attribute table. The shape file should be in .shp format consisting of 6 associated files with extensions: .cpg, .dbf, prj, qpj,.shp, .shx.

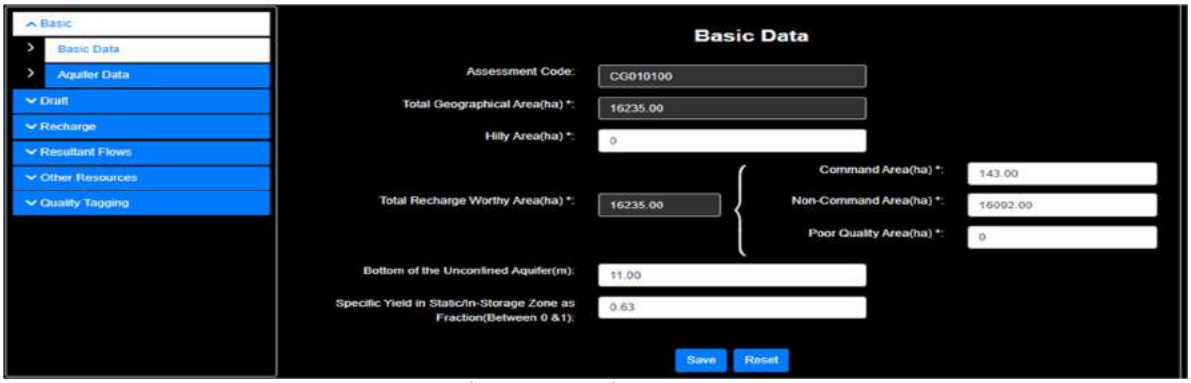


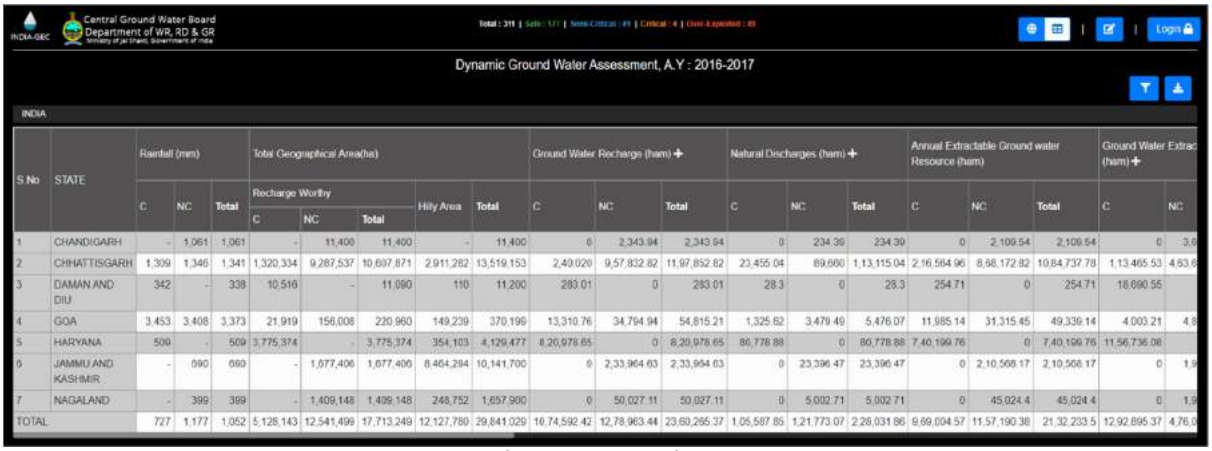
Figure 3: Basic Data Form Input

2. Computation module– Computation Module refers to the ground water level calculations for an assessment unit. These computations are based on GEC 2015 methodology and are used to calculate Annual Extractable Ground Water Resource, Total Current Annual Ground Water Extraction (utilization) and the percentage of ground water utilization with respect to recharge (stage of Ground Water Extraction) for an assessment unit. Based on these percentages an assessment unit is categorized into one of the SAFE, SEMI-CRITICAL, CRITICAL, and OVEREXPLOITED categories.

3. Output module - Once categorized, the results are shown in two views:

a. MIS Dashboard – MIS dashboard shows the results of the assessment for the entire India, and also for each state State in a tabular form. The MIS dashboard shows all type of recharges, extractions, inflows and outflows computed for both monsoon and non-monsoon periods of the year and then reflect the overall stage

of extraction at the selected Geo-Zoom Level. User can see the calculations for each component by drilling down to the Assessment Unit level.



S No	STATE	Rainfall (mm)			Total Geographical Area(ha)					Ground Water Recharge (ham)			Natural Discharges (ham)			Annual Extractable Ground water Resource (ham)			Ground Water Extrac (ham)	
		C	NC	Total	Recharge Worthy			Hilly Area	Total	C	NC	Total	C	NC	Total	C	NC	Total	C	NC
					C	NC	Total													
1	CHANDIGARH	-	1,061	1,061	-	11,400	11,400	-	11,400	0	2,343.94	2,343.94	0	234.39	234.39	0	2,109.54	2,109.54	0	3,6
2	CHHATTISGARH	1,309	1,346	1,341	1,320,334	9,287,537	10,697,871	2,911,282	13,519,153	2,40,020	9,57,832.82	11,97,852.82	23,455.04	89,660	1,13,115.04	2,16,564.96	8,68,172.82	10,84,737.78	1,13,465.53	4,83,6
3	DAMAN AND DIU	342	-	338	10,516	-	11,090	110	11,200	283.01	0	283.01	28.3	0	28.3	254.71	0	254.71	18,690.55	
4	GOA	3,453	3,408	3,373	21,919	156,008	220,960	149,239	370,199	13,310.76	34,794.94	54,815.21	1,325.62	3,479.49	5,476.07	11,985.14	31,315.45	49,339.14	4,003.21	4,8
5	HARYANA	509	-	509	3,775,374	-	3,775,374	354,103	4,129,477	8,20,978.65	0	8,20,978.65	86,778.88	0	80,778.88	7,40,199.76	0	7,40,199.76	11,56,736.08	
6	JAMMU AND KASHMIR	-	690	690	-	1,677,406	1,677,400	8,464,294	10,141,700	0	2,33,964.63	2,33,964.63	0	23,396.47	23,396.47	0	2,10,568.17	2,10,568.17	0	1,9
7	NAGALAND	-	399	399	-	1,409,148	1,409,148	248,752	1,657,900	0	50,027.11	50,027.11	0	5,002.71	5,002.71	0	45,024.4	45,024.4	0	1,9
TOTAL		727	1,177	1,052	5,128,143	12,541,499	17,713,249	12,127,780	29,841,029	10,74,592.42	12,78,963.44	23,60,265.37	1,05,587.85	1,21,773.07	2,28,031.86	9,69,004.57	11,57,190.38	21,32,233.5	12,92,895.37	4,76,0

Figure 4: MIS View

b. GIS Dashboard– GIS dashboard shows the data in Web Geo-Server format, implemented in interactive GIS platform allowing user to all GEC related information in the map itself. GIS view represents the data on India map and color codes each District/Assessment unit based on the categorization.

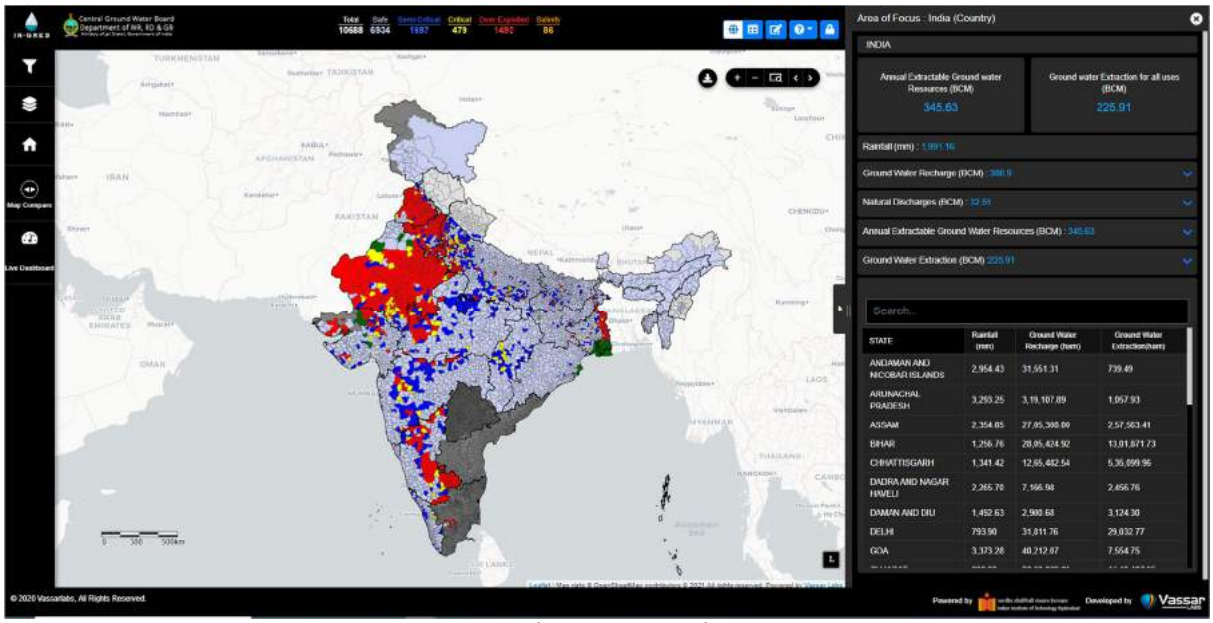


Figure 5: GIS View

C. Excel Download and Upload Templates

To compute data in IN-GRES, 11 excel templates are provided for the user to fill and submit the data in the system for an Assessment Unit. These include:

i. **Basic Data File (**with 2 internal sub-sheets**)**

"Basic Data" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers should not be changed. They are taken from the shapefile.
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	*Total Geographical Area (ha)	*Hilly Area (ha)	*Total Recharge Worthy Area (ha)				Static/In-Storage Unconfined Ground Water Resources		If Assessment Unit is Urban						Deep Water Level ? (Default: False)
						*Command	*Non Command	*Poor Quality	Total	Bottom of the Unconfined aquifer (m)	Specific Yield in Static/in-Storage zone	Command		Non Command		Poor Quality		
												Paved	UnPaved	Paved	UnPaved	Paved	UnPaved	

Figure 6: Basic Data Template

"Aquifer Data" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers should not be changed. They are taken from the shapefile.
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Principal Aquifer	Major Aquifer	*Major Aquifer Code	Command			Non Command			Poor Quality		
							*Percentage of geographical area	* Recommended Specific Yield for assessment (%)	* Recommended Infiltration Factor for assessment (%)	*Percentage of geographical area	* Recommended Specific Yield for assessment (%)	Recommended Infiltration Factor for assessment (%)	*Percentage of geographical area	Recommended Specific Yield for assessment (%)	* Recommended Infiltration Factor for assessment (%)

Figure 7: Aquifer Data Template

ii. Rainfall Data File (with 5 internal sub-sheets**)**

"Rainfall Data at Assessment unit level" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	*Year	Monsoon		Non-Monsoon	
						*Actual (mm)	*Normal (mm)	*Actual (mm)	*Normal (mm)

Figure 8: Rainfall – Assessment Unit Data Template

"Rainfall Data at Rain Gauge level" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) Only the raingauge station data of the state are considered to compute rainfall values.Neighbouring state's rainguage data is not considered in the interpolation method.
(4) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Name of Raingauge	*Latitude	*Longitude	*Year	Monsoon		Non-Monsoon	
					*Actual (mm)	*Normal (mm)	*Actual (mm)	*Normal (mm)

Figure 9: Rainfall – Rain Gauge Data Template

"Rainfall Data at IMD Grid level" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) Only the IMD Grid in the state are considered to compute rainfall values. Neighbouring state's grid data is not considered in the interpolation method.
(4) All columns will be pre-populated from the values entered in the previous assessment year

S.No	GRID ID	*Latitude	*Longitude	*Year	Monsoon		Non-Monsoon	
					*Actual (mm)	*Normal (mm)	*Actual (mm)	*Normal (mm)

Figure 10: Rainfall – IMD Grid Data Template

"Rainfall Data at Time Series level" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year
(4) This data can be given via an API

S.No	Station Name	Station ID	*Latitude	*Longitude	Date	Time	Value (mm)

Figure 11: Rainfall – Time Series Data Template

"Rainfall Data Threshold Value" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Threshold Value (mm)	
					Minimum	Maximum

Figure 12: Rainfall – Threshold Data Template

iii. Ground Water Well Data File (with 3 internal sub-sheets)

"Ground Water Well - Assessment Unit Level" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed if rainguage station data for the state is not uploaded into the system
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	* Year	Level (m)	
						*Pre-monsoon	*Post-Monsoon

Figure 13: Ground Water Well – Assessment Unit Data Template

"Ground Water Well - Well Level Data" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed if rainguage station data for the state is not uploaded into the system
(2) * Marked column headers are mandatory
(3) Only the Ground water observation well data of the state are considered to compute Ground water level values. Neighbouring state's Ground water observation well data is not considered in the interpolation method.
(4) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Name of the observation well	*Longitude (degree decimal)	*Latitude (degree decimal)	*Year	Level (mbgl)		Dry (Yes/No)
					*Pre-monsoon	*Post-Monsoon	

Figure 14: Ground Water Well – Well Data Template

"Ground Water Well - Time Series Data" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed if rainguage station data for the state is not uploaded into the system
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year
(4) This data can be given via an API

S.No	Station ID	*Longitude (degree decimal)	*Latitude (degree decimal)	*Date (DD-MM-YYYY)	Time	Level (mbgl)

Figure 15: Ground Water Well – Time Series Data Template

iv. Recharge Data File (with 6 internal sub-sheets)

"Recharge from Other Sources - Surface Water Irrigation" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Source Type	* Distributory in which it is located	* Design discharge (ha.m/day)	Average discharge (ha.m/day)	Command												Non Command										Poor GW Quality									
								Paddy					Non Paddy							Paddy					Non Paddy							Paddy					Non Paddy					
								Continous Water supply (Yes/No)	Area under Paddy (ha)		RFF Factor		Continous Water supply (Yes/No)	Crop name	Area under Non Paddy (ha)		RFF Factor		Weighted RFF	* No of days water released	Continous Water supply (Yes/No)	Area under Paddy (ha)		RFF Factor		Continous Water supply (Yes/No)	Crop name	Area under Non Paddy (ha)		RFF Factor		Weighted RFF	* No of days water released	Continous Water supply (Yes/No)	Area under Paddy (ha)		RFF Factor		Continous Water supply (Yes/No)	Crop name	Area under Non Paddy (ha)		RFF Factor		Weighted RFF	No of days water released
									Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Monsoon	Non - Monsoon	Monsoon	Non - Monsoon		Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Monsoon	Non - Monsoon	Monsoon	Non - Monsoon		Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Monsoon	Non - Monsoon	Monsoon	Non - Monsoon

Figure 16: Recharge – Surface Water Irrigation – Canal Outlet Template

"Recharge from Other Sources - Surface Water Irrigation" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Command Area													
				Paddy						Non-Paddy							
				Continous Water Supply (Yes/No)	* Estimated Crop Water Requirement (mm)		* Area under crop (ha)		RFF Factor		Continous Water Supply (Yes/No)	* Crop Name	* Estimated Crop Water Requirement		* Area under crop (ha)		RFF Factor	
					Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon
				Non-Command Area														
				Paddy						Non-Paddy							
				Continous Water Supply (Yes/No)	* Estimated Crop Water Requirement (mm)		* Area under crop (ha)		RFF Factor		Continous Water Supply (Yes/No)	* Crop Name	* Estimated Crop Water Requirement (mm)		* Area under crop (ha)		RFF Factor	
					Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon
				Poor GW Quality Area														
				Paddy						Non-Paddy							
				Continous Water Supply (Yes/No)	* Estimated Crop Water		* Area under crop		RFF Factor		Continous Water Supply (Yes/No)	* Crop Name	* Estimated Crop		* Area under crop		RFF Factor	
					Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon

Figure 17: Recharge – Surface Water Irrigation– Crop Water Requirement Template

"Recharge from Other Sources - Canal Seepage" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year
(4) It is mandatory to fill either (J or K , L & M) or N
(5) It is mandatory to enter I or O

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Poor Quality)	* Name of the canal Segement	Canal Type (Main/Minor)	Type (Lined/Unlined)	Length of Canal (m)	Design depth of flow (m)	Average Supply Depth (m)	Bed width (m)	Side Slope (degrees)	Wetted Perimeter (m)	Wetted Area (million sq m)	Canal seepage factor (ha.m/d/million sq.m)		* No.of canal running days	
															Monsoon	Non-Monsoon	Monsoon	Non-Monsoon

Figure 18: Recharge – Canal Seepage Template

"Recharge from Other Sources - Tanks & Ponds" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year
(4) Either Design Water Spead Area or Average Water Spread Area or Both Should be given

S.No	Location Code	District	Assessment Unit	*Name of Tank/Pond	Command area						
					Number of Tanks/Ponds	Recharge Factor (mm/day)	Design water spread area of single tank (ha)	Average Water Spread area of single tank (ha)		* No. of days water is available	
								Monsoon	Non monsoon	Monsoon	Non monsoon
					Non Command area						
					Number of Tanks/Ponds	Recharge Factor (mm/day)	Design water spread area of single tank (ha)	* Average Water Spread area of single tank (ha)		* No. of days water is available	
								Monsoon	Non monsoon	Monsoon	Non monsoon
					Poor GW Quality area						
					Number of Tanks/Ponds	Recharge Factor (mm/day)	Design water spread area of single tank (ha)	* Average Water Spread area of single tank (ha)		* No. of days water is available	
								Monsoon	Non monsoon	Monsoon	Non monsoon

Figure 19: Recharge – Tanks and Ponds Template

"Recharge from Other Sources - Water Conservation Structures" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	* Name of the Structure	Recharge Factor of Structure		Structure information								
							Command			Non Command			Poor Quality		
					Monsoon	Non-Monsoon	* Number of Structures	* Storage Capacity (ha.m)	* No. of Fillings	* Number of Structures	* Storage Capacity (ha.m)	* No. of Fillings	* Number of Structures	* Storage Capacity (ha.m)	* No. of Fillings

Figure 20: Recharge – Water Conservation Structure Template

"Recharge from Other Sources - Ground Irrigation " input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Command / Non Command / Poor GW Quality	Paddy: Continous Water Supply (Yes/No)	Paddy: Area under Paddy (ha) Kharif	Paddy: Area under Paddy (ha) Rabi	Paddy: RFF Factor Monsoon	Paddy: RFF Factor Non - Monsoon	Non Paddy: Continous Water Supply (Yes/No)	Non Paddy: Crop name	Non Paddy: Area under Non Paddy (ha) Kharif	Non Paddy: Area under Non Paddy (ha) Rabi	Non Paddy: RFF Factor Monsoon	Non Paddy: RFF Factor Non - Monsoon	Weighted RFF Monsoon	Weighted RFF Non - Monsoon	* No of days water released Monsoon	* No of days water released Non - Monsoon
				Command															
				Non Command															
				Poor GW Quality															

Figure 21: Recharge – Ground Water Irrigation Template

v. Draft Data File (with 6 internal sub-sheets**)**

"Domestic (Unit Draft)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year
(4) Actual number of wells in use (column H) is considered to be 80% of number of wells (column G)

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	* Type of Structure	* No. of wells in assessment year	Actual No. of wells in use	* Estimated draft per well (ha.m) Monsoon	* Estimated draft per well (ha.m) Non-Monsoon

Figure 22: Draft – Domestic Unit Draft Template

"Domestic (Consumptive Use)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Command / Non Command / Poor GW Quality	* Reference Year	* Population as on Reference Year Rural	* Population as on Reference Year Urban	* Growth Rate (%) Rural	* Growth Rate (%) Urban	* Per capita Requirement (lpcd - litres per capita per day) Rural	* Per capita Requirement (lpcd - litres per capita per day) Urban	* Fractional load on ground water Lg Rural	* Fractional load on ground water Lg Urban	No. of Days Monsoon	No. of Days Non Monsoon
				Command											
				Non Command											
				Poor GW Quality											

Figure 23: Draft – Domestic Consumptive Use Template

"Irrigation (Unit Draft)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	* Type of Structure	* No. of wells in assessment year	Actual No. of wells in use	* Estimated draft per well (ha.m)	
								Monsoon	Non-Monsoon

Figure 24: Draft – Irrigation Unit Draft Template

"Irrigation (Power Consumption)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Command Area			
				Monsoon		Non Monsoon	
				* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)	* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)
				Non-Command Area			
				Monsoon		Non Monsoon	
				* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)	* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)
				Poor GW Quality Area			
				Monsoon		Non Monsoon	
				* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)	* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)

Figure 25: Draft – Irrigation Power Consumption Template

"Industrial (Unit Draft)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	* Type of Industries	* Type of Structure	* No. of wells in assessment year	Actual No. of wells in use	* Estimated draft per well (ha.m)	
									Monsoon	Non-Monsoon

Figure 26: Draft – Industrial Unit Draft Template

"Industrial (Consumptive Use Pattern)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit						
				Command Area					
				* Type of Industry	* No of Such Industries	* Estimated Consumptive Requirement (ha.m/day)	* Fractional load on ground water Lg	No. of days water is being extracted	
								Monsoon	Non Monsoon
				Non Command Area					
				* Type of Industry	* No of Such Industries	* Estimated Consumptive Requirement (ha.m/day)	* Fractional load on ground water Lg	No. of days water is being extracted	
								Monsoon	Non Monsoon
				Poor Quality Area					
				* Type of Industry	* No of Such Industries	* Estimated Consumptive Requirement (ha.m/day)	* Fractional load on ground water Lg	No. of days water is being extracted	
								Monsoon	Non Monsoon

Figure 27: Draft – Industrial Consumptive Use Template

vi. Inflow and Outflow Data File (with 8 internal sub-sheets)

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	River Gauge name	Day	Average Stream Discharge (cumecs)	Direct Runoff Spells					
								Spell No.	Start day	End Day	Day Number in the Spell	Discharge at Start Day (cumecs)	Discharge at End Day (cumecs)

Figure 28: Environmental Flows – Base Flow Template

"Fluxes : Additional Base Flow" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	No. of stream gauges	Name of up stream river gauge	Catchment area of upstream river gauge	Name of down stream river gauge	Catchment area of downstream river gauge

Figure 29: Environmental Flows – Base Flow Template

"Fluxes : Vertical Inter Aquifer Flow" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Zone No	Hydraulic Conductivity of the Aquitard	Thickness of Aquitard (m)	Monsoon		Non Monsoon	
								Average Change in Head (m)	Area of the Zone (ha)	Average Change in Head (m)	Area of the Zone (ha)

Figure 30: Environmental Flows – Vertical Inter Aquifer Flow Template

"Fluxes : Lateral Aquifer Flow" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Graved out column headers are occulated from shapefile and should not be chanced
(2) * Marked column headers are mandatory
(3) All columns will be pre-occulated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Section No.	Transmissivity	Monsoon					Non Monsoon				
							Length of the section (m)	Up Contour (m)	Down Contour (m)	Distance between two contours on ground in (m)	InFlow/ OutFlow	Length of the section (m)	Up Contour (m)	Down Contour (m)	Distance between two contours on ground in (m)	InFlow/ OutFlow

Figure 31: Environmental Flows – Lateral Aquifer Flow Template

"Fluxes : Evapotranspiration" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Graved out column headers are occulated from shapefile and should not be chanced
(2) * Marked column headers are mandatory
(3) All columns will be pre-occulated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Zone Number	Zone Description	Evapotranspiration rate in mm/day	Average Root Depth in m	Capillary rise in m	Area in hectare		Average ground water level in the zone in m		No of days Evapotranspiration takes place	
										Monsoo	Non	Monsoo	Non	Monsoo	Non
						0.0-0.5						0.25	0.25		
						0.5-1.0						0.75	0.75		
						1.0-1.5						1.25	1.25		
						1.5-2.0						1.75	1.75		
						2.0-2.5						2.25	2.25		
						2.5-3.0						2.75	2.75		
						3.0-3.5						3.25	3.25		
						3.5-4.0						3.75	3.75		
						4.0-4.5						4.25	4.25		
						4.5-5.0						4.75	4.75		

Figure 32: Environmental Flows – Evapotranspiration Template

"Fluxes : Evaporation" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Graved out column headers are occulated from shapefile and should not be chanced
(2) * Marked column headers are mandatory
(3) All columns will be pre-occulated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Zone Number	Zone Description	Evaporation rate in mm/day	Capillary rise in m	Area in hectare (ha)		Average ground water level in the zone in m		No of days Evaporation takes place	
									Monsoon	Non Monsoon	Monsoon	Non Monsoon	Monsoon	Non Monsoon
						0.0-0.5					0.25	0.25		
						0.5-1.0					0.75	0.75		
						1.0-1.5					1.25	1.25		
						1.5-2.0					1.75	1.75		

Figure 33: Environmental Flows –Evaporation Template

"Fluxes : Transpiration" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Graved out column headers are occulated from shapefile and should not be chanced
(2) * Marked column headers are mandatory
(3) All columns will be pre-occulated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Zone Number	Zone Description	Transpiration rate in mm/day	Average Root Depth in m	Capillary rise in m	Area in hectare		Average ground water level in the zone in m		No of days Transpiration takes place	
										Monsoo	Non	Monsoo	Non	Monsoo	Non
						0.0-0.5						0.25	0.25		
						0.5-1.0						0.75	0.75		
						1.0-1.5						1.25	1.25		
						1.5-2.0						1.75	1.75		
						2.0-2.5						2.25	2.25		
						2.5-3.0						2.75	2.75		
						3.0-3.5						3.25	3.25		
						3.5-4.0						3.75	3.75		
						4.0-4.5						4.25	4.25		
						4.5-5.0						4.75	4.75		

Figure 34: Environmental Flows – Transpiration Template

"Recharge from Other Sources - Stream Recharges" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Section No.	Transmissivity	Monsoon				Non Monsoon			
							Length of the section (m)	Up Contour h2 (m)	Down Contour h1 (m)	Distance between two contours on ground in (m)	Length of the section (m)	Up Contour h2 (m)	Down Contour h1 (m)	Distance between two contours on ground in (m)

Figure 35: Environmental Flows – Stream Channels Template

vii. Additional Potential Resources Data File (with 3 internal sub-sheets)

"Shallow Water Table Zone" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Shallow Water Table Zone	
				* Pre-Monsoon DTWL (m bgl)	* Area (ha)
				0.0-0.5	
				0.5-1.0	
				1.0-1.5	
				1.5-2.0	
				2.0 -2.5	
				2.5 -3.0	
				3.0 -3.5	
				3.5-4.0	
				4.0-4.5	
				4.5 -5.0	

Figure 36: Additional Potential Resources – Shallow Water Area Template

"Flood Prone Area" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Flood Prone Area		
				* Flood Prone Area (ha)	* Flood Impound Days in a year	Seepage Factor (m)

Figure 37: Additional Potential Resources – Flood Prone Area Template

"Spring Discharge" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Name of Spring	Spring Discharge (lph)		Number of Days Spring	
					* Monsoon	* Non-Monsoon	* Monsoon	* Non-Monsoon

Figure 38: Additional Potential Resources – Spring Discharge Template

viii. Resources of Confined and Semi-Confined AquiferData File (with 2 internal sub-sheets**)**

"Confined Aquifer Piezometer Data" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	* Name of the Confined Aquifer	* Area of Confined Aquifer (Sq. m)	* Storativity (Fraction)	* Bottom of top confining layer (m)	Being Extracted or Not (Yes/No)	* Average Piezometric head (m amsl)	
									Pre-Monsoon	Post-Monsoon

Figure 39: Resources of Confined and Semi-Confined Aquifer – Confined Aquifer Template

"Semi-Confined Aquifer Piezometer Data" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	* Name of the Semi-Confined Aquifer	Recommended Specific Yield for assessment (%)	* Area of Semi-Confined Aquifer (Sq. m)	* Storativity (Fraction)	* Bottom of top confining layer (m)	Being Extracted or Not (Yes/No)	* Average Piezometric head (m amsl)	
										Pre-Monsoon	Post-Monsoon

Figure 40: Resources of Confined and Semi-Confined Aquifer – Semi-Confined Aquifer Template

ix. Urban Area Resource – Pipelines and Sewages (with 1 internal sub-sheet**)**

"Pipelines and Sewages" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Per capita water requirement (lpcd)	Pipelines				Sepage through Sewages/Flash floods				
						Water Supply (ham/day)	(%) Loss	No. of days of flow		Wetted Perimeter (m)	Length (m)	No. of days of flow		Seepage factor
								Monsoon	Non-monsoon			Monsoon	Non-monsoon	

Figure 41: Urban Area Resource –Pipelines & Sewage Template

x. Unconfined Dynamic Aquifer Other Details (with 1 internal sub-sheet**)**

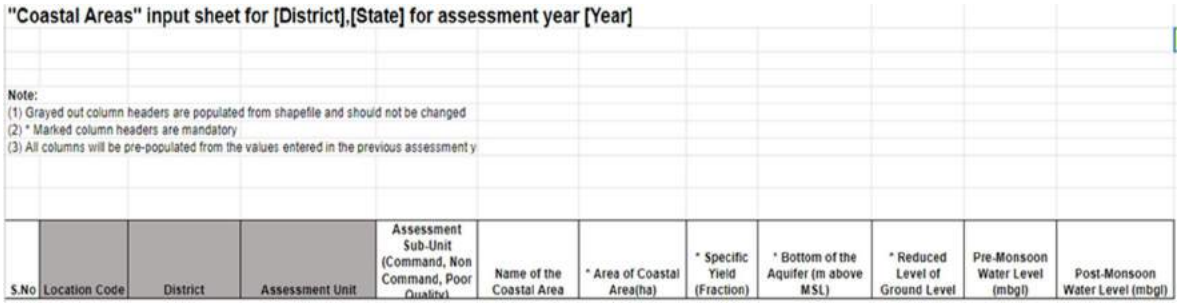
"Unconfined Dynamic and Other Detail" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed if Monitoring station data for the state is not uploaded into the system
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Quality Tagging		Environmental Flows in ham/year	Population Details				* Per capita Requirement (lpcd - litres per capita per day)		* Fractional load on ground water Lg	
					Major parameter present in mappable areas (Salinity/Fluoride/Arsenic)	Other Parameters present in mappable areas		* Reference Year	* Population as on Reference Year		* Growth Rate (%)				
									Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban

Figure 42: Unconfined Dynamic Aquifer Other Details Template

xi. Coastal Areas (with 1 internal sub-sheet)



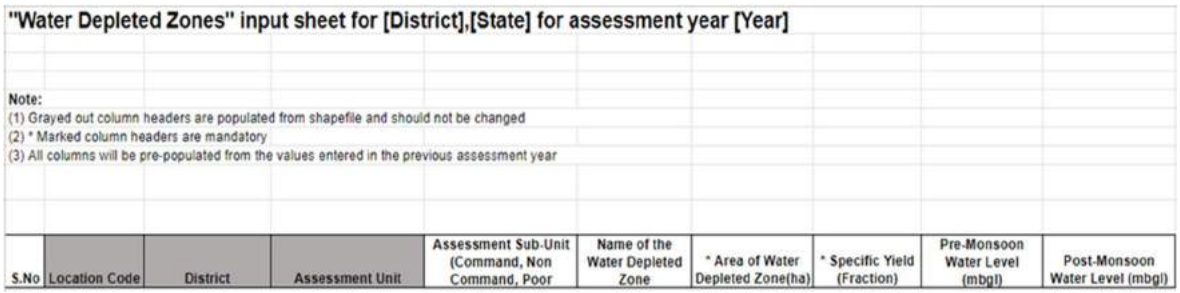
"Coastal Areas" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment y

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Name of the Coastal Area	* Area of Coastal Area(ha)	* Specific Yield (Fraction)	* Bottom of the Aquifer (m above MSL)	* Reduced Level of Ground Level	Pre-Monsoon Water Level (mbgl)	Post-Monsoon Water Level (mbgl)

Figure 43: Coastal AreasTemplate

xii. Water Depletion Zones (with 1 internal sub-sheet)



"Water Depleted Zones" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor	Name of the Water Depleted Zone	* Area of Water Depleted Zone(ha)	* Specific Yield (Fraction)	Pre-Monsoon Water Level (mbgl)	Post-Monsoon Water Level (mbgl)

Figure 44: Water Depletion ZonesTemplate

D. Approval Levels

The data is uploaded at the root Level by the District/State Level Experts. After data entry, the datasets are TRIGGERED and sent for approval by Higher Authorities. There are 6 stages of approvals in IN-GRES. The hierarchies of data approvals are shown in Fig 6

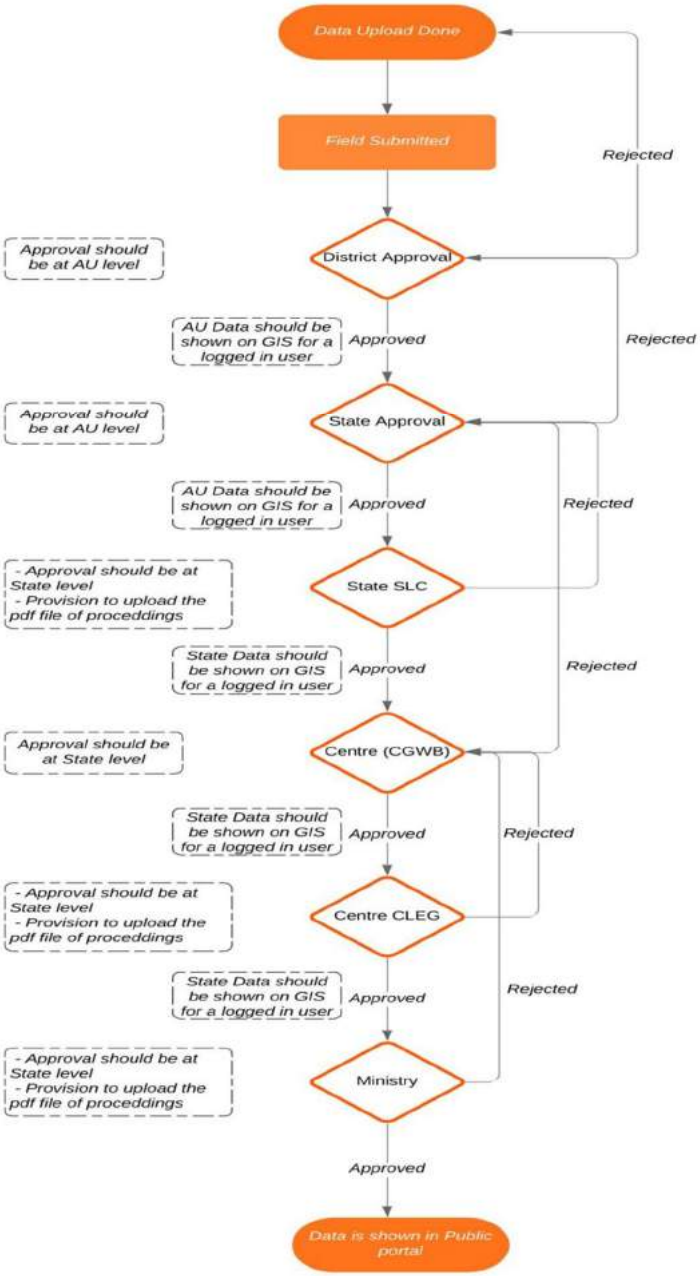


Fig 45 :Approval Levels

E. Report and Annexure

The download option in MIS View allows the user to download reports in 6 formats:

1. **Central Level Report** option allows user to download the state-wise district level data for an assessment year, computation type and view.
2. **State Report** option allows user to download the Assessment Unit-wise data for the selected state for an assessment year, computation type and view.
3. **Annexure 1** – State-wise Resources
4. **Annexure 2** – District-wise Resources
5. **Annexure 3** – Categorization
6. **Annexure 4** – List of Categorization
7. **Custom Report** - Custom reports allow user to generate report for a specific assessment unit which fall under a certain criterion. User has an option to define ranges for Recharge Worthy Area, Annual Rainfall, Ground Water Recharge, Ground Water Extraction and Stage of Extraction. User also has an option to choose to download the report for a specific Category.

Note:-The above 4 Annexures are as per standard CGWB formats.

F. Other System Features-

1. Live Ground Water Dashboard

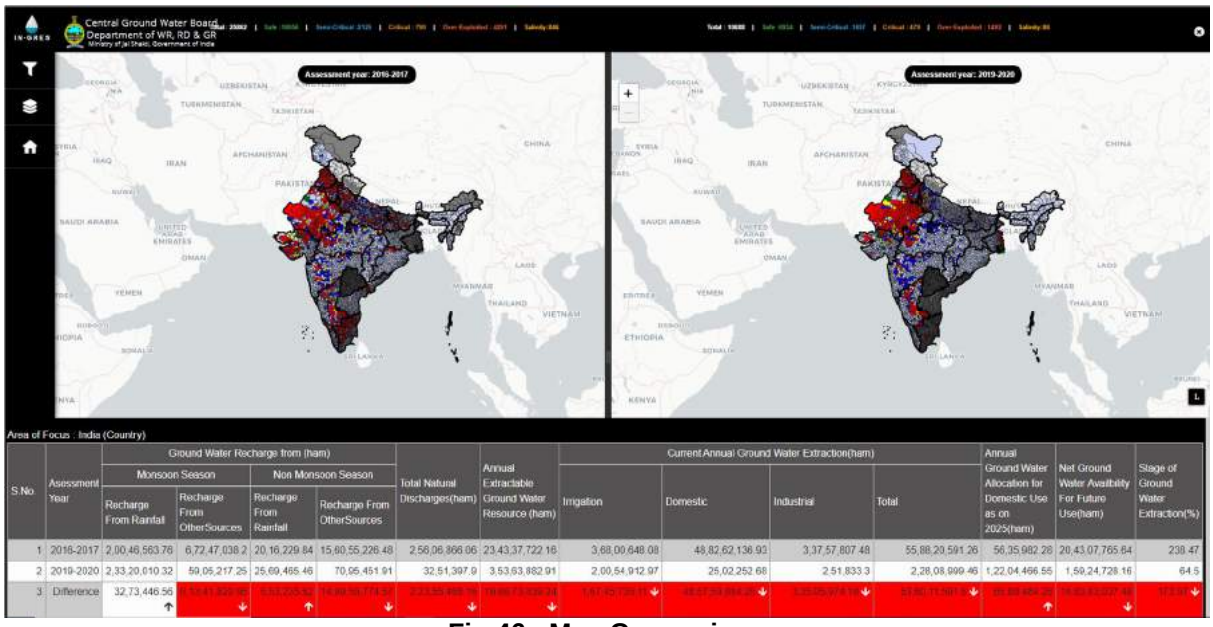
Live Ground Water Dashboard shows the live Change in Ground Water Storage for a specific assessment unit. The live ground water level is fetched from the India WRIS website via an API. Change in Ground Water Storage can be expressed as follows:

$$\Delta S = A * (Pre - Current) * SY$$

Where,
ΔS = Change in Ground water Storage
A = Area of Water Depletion Zones
Pre = Pre - monsoon Ground water level
Current = Current Ground water level
SY = Specific Yield

2. Map comparison

Map comparison allows user to compare the Ground water estimation done for two years. The GIS view shows the categorization at an assessment unit level. The MIS View table will show the data for year 1, year 2 and also the percentage difference in the value between these two years.



S.No.	Assessment Year	Ground Water Recharge from (ham)				Total Natural Discharges(ham)	Annual Extractable Ground Water Resource (ham)	Current Annual Ground Water Extraction(ham)				Annual Ground Water Allocation for Domestic Use as on 2025(ham)	Net Ground Water Availbility For Future Use(ham)	Stage of Ground Water Extraction(%)
		Monsoon Season		Non Monsoon Season				Irrigation	Domestic	Industrial	Total			
		Recharge From Rainfall	Recharge From OtherSources	Recharge From Rainfall	Recharge From OtherSources									
1	2016-2017	2,00,46,563.76	6,72,47,038.2	20,16,229.84	15,60,55,226.48	2,56,06,866.06	23,43,37,722.16	3,68,00,648.08	48,82,62,136.93	3,37,57,807.48	55,88,20,591.26	56,35,982.28	20,43,07,765.84	238.47
2	2019-2020	2,33,20,010.32	59,05,217.25	25,69,465.46	70,95,451.91	32,51,397.9	3,53,63,882.91	2,00,54,912.97	25,02,252.68	2,51,833.3	2,28,08,999.46	1,22,04,466.55	1,59,24,728.16	64.5
3	Difference	32,73,446.56												

Fig 46 : Map Comparison

3. Heat Maps

Allows to visualize geospatial view of the output data based on different parameters which include:

- Categorization for future Ground Water development
- Annual Normal Rainfall
- Annual Ground water recharge
- Annual Ground water extraction
- Aqufier

4. Computational Popup

Provide an overview of the summary of the computations.

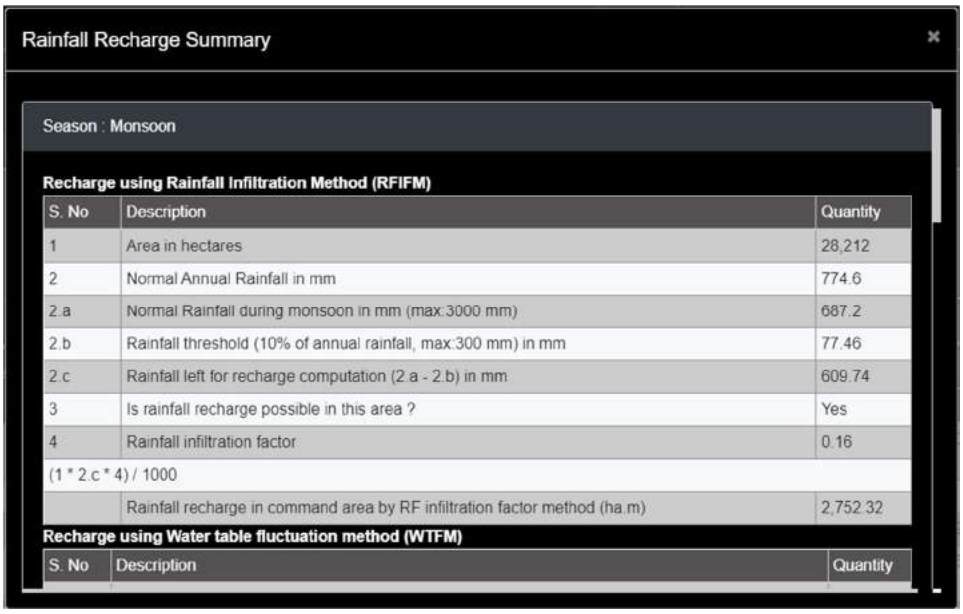


Fig 47 : Computation Popup

5. Map Download

Provision to download Map.

Annexure – 6A

Block wise Ground Water Resources Assessment -2022, Chhattisgarh

PART-A

Sl. No	District	Assessment Unit Name	Total Area of Assessment Unit (Ha)	Recharge Worthy Area(Ha)	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources-Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
1	BALOD	BALOD	30425	30425	1672.49	1236.8	0	2279.26	5188.55	518.86	4669.69
2	BALOD	DOUNDI	52919	40963	2481.22	1088.86	0	1303.79	4873.87	332.16	4541.71
3	BALOD	DOUNDI LOHARA	88332	88332	5203.91	3346.09	0	3004.52	11554.52	909.35	10645.17
4	BALOD	GUNDERDEHI	68070	68070	2666.69	2874.97	0	3242.46	8784.12	742.93	8041.19
5	BALOD	GURUR	41128	33680	3649.74	869.5	0	2800.04	7319.28	731.93	6587.35
6	BALODA BAZAR	BALODA BAZAR	62320	62320	3199.57	2272.84	188.25	600.28	6260.94	522.31	5738.62
7	BALODA BAZAR	BHATAPARA	47115	47115	3230.53	1797.17	156.9	1783.4	6968.00	696.8	6271.2
8	BALODA BAZAR	BILAIGARH	92692	92692	5940.81	2073.5	54.08	290.28	8358.67	835.87	7522.8
9	BALODA BAZAR	KASDOL	176339	176339	9774.11	1504.89	0	1217.84	12496.84	1249.68	11247.16
10	BALODA BAZAR	PALARI	59468	59468	3774.18	5030.31	29.52	637.41	9471.42	947.14	8524.28
11	BALODA BAZAR	SIMGA	61506	61506	4804.34	4848.99	37.57	2522.9	12213.8	1221.38	10992.42
12	BALRAMPUR	BALRAMPUR	108416	82416	4811.12	197.55	35.89	266.74	5311.3	531.13	4780.17

Sl. No	District	Assessment Unit Name	Total Area of Assessment Unit (Ha)	Recharge Worthy Area(Ha)	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources-Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
13	BALRAMPUR	KUSMI	150973	119559	7835.52	220	58.66	247.82	8362	836.2	7525.8
14	BALRAMPUR	RAJPUR	100066	89540	6704.56	214.28	50.42	452.66	7421.92	742.2	6679.72
15	BALRAMPUR	RAMCHANDRAPUR	127833	105873	6748.4	300.93	50.32	542.42	7642.07	764.21	6877.86
16	BALRAMPUR	SHANKARGARH	90038	63645	4599.23	113.42	34.58	196.13	4943.36	494.34	4449.02
17	BALRAMPUR	WADRAFNAGAR	136594	105098	9057.11	171.42	54.96	265.27	9548.76	494.27	9054.49
18	BASTAR	BAKAWAND	106455	68134	3499.14	47.32	302.09	380.75	4229.3	217.58	4011.72
19	BASTAR	BASTANAR	59987	47888	3108.9	4.73	275.4	14.21	3403.24	340.32	3062.92
20	BASTAR	BASTAR	125149	89027	4103.46	122.58	363.51	479.02	5068.57	506.85	4561.72
21	BASTAR	DARBHA	98449	34077	2109.05	117.94	186.84	26.89	2440.72	244.08	2196.64
22	BASTAR	JAGDALPUR	101017	50170	3669.1	38.07	217.08	201.15	4125.4	412.54	3712.86
23	BASTAR	LOHANDIGUDA	79793	57951	3068.21	65.87	271.03	64.63	3469.74	346.98	3122.76
24	BASTAR	TOKAPAL	42148	36286	1915.89	85.6	136.07	214.97	2352.53	123.59	2228.94
25	BEMETARA	BEMETARA	72779	72779	2996.35	4041.62	0	4746.8	11784.77	820.07	10964.7
26	BEMETARA	BERLA	77718	77718	5338.67	2406.01	0	4944.53	12689.21	1268.92	11420.29
27	BEMETARA	NAWAGARH	62498	62498	3129.26	2014.6	0	3178.07	8321.93	549.09	7772.84
28	BEMETARA	SAJA	72486	72486	4583.41	4989	0	5835.36	15407.77	1540.78	13866.99

Sl. No	District	Assessment Unit Name	Total Area of Assessment Unit (Ha)	Recharge Worthy Area(Ha)	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources-Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
29	BIJAPUR	BHAIRAMGARH	228284	146370	16598	13.64	71.53	67.25	16750.42	1675.05	15075.37
30	BIJAPUR	BHOPALPATTNAM	144418	92598	9042.22	23.43	38.97	281.75	9386.37	938.64	8447.73
31	BIJAPUR	BIJAPUR	114011	86778	10515.44	30.98	45.32	181.02	10772.76	1077.27	9695.49
32	BIJAPUR	USOOR	174535	111983	13703.7	17.08	59.06	67.9	13847.74	1384.78	12462.96
33	BILASPUR	BELHA	87890	87890	6350.66	1804.67	164.05	2936.03	11255.41	1125.54	10129.87
34	BILASPUR	KOTA	116598	83345	4028.8	1741.58	0	1432.64	7203.02	720.3	6482.72
35	BILASPUR	MASTURI	73920	73920	3890.22	2952.33	250.01	847.6	7940.16	647.1	7293.06
36	BILASPUR	TAKHATPUR	72440	72440	4467.12	2012.36	0	3533.33	10012.81	1001.28	9011.53
37	DANTEWADA	DANTEWADA	177296	160453	12313.31	74.85	166.98	523.14	13078.28	1307.83	11770.45
38	DANTEWADA	GEEDAM	58628	55110	4062.28	69.33	57.8	349.39	4538.8	227.54	4311.26
39	DANTEWADA	KATEKALYAN	48800	43920	4764.91	13.3	64.61	130.45	4973.27	497.33	4475.94
40	DANTEWADA	KUAKONDA	56326	52383	3942.47	20.66	53.46	194.29	4210.88	421.09	3789.79
41	DHAMTARI	DHAMTARI	67883	67883	4336.74	4054.89	0	5601.24	13992.87	1399.28	12593.59
42	DHAMTARI	KURUD	59242	59242	4769.4	2763.21	0	3928.82	11461.43	1146.14	10315.29
43	DHAMTARI	MAGARLOD	88191	88191	7069.25	1724.23	0	3328.49	12121.97	779.23	11342.74
44	DHAMTARI	NAGRI	192877	33390	3450.37	2425.66	0	3689.61	9565.64	956.57	8609.07

Sl. No	District	Assessment Unit Name	Total Area of Assessment Unit (Ha)	Recharge Worthy Area(Ha)	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources-Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
45	DURG	DHAMDHA	88249	88249	6666	3116.63	0	5752.78	15535.41	1553.54	13981.87
46	DURG	DURG	67517	67517	4242.03	2919.35	0	2975.72	10137.1	729	9408.1
47	DURG	PATAN	76233	76233	3899.47	2927.4	0	2536.51	9363.38	731.29	8632.09
48	GARIABAND	CHHURA	111127	44880	2799.25	1211.29	0	1787.79	5798.33	579.84	5218.49
49	GARIABAND	DEOBHOG	39129	30000	1922.16	276.3	0	681.32	2879.78	143.99	2735.79
50	GARIABAND	GARIABAND	154517	80280	6885.33	1124.42	0	1256.63	9266.38	926.64	8339.74
51	GARIABAND	MAINPUR	217963	48450	3968.66	684.42	0	663.08	5316.16	531.61	4784.55
52	GARIABAND	RAJIM/FINGESHWAR	59530	59530	5400.66	2363.97	0	1951.34	9715.97	971.59	8744.38
53	GOURELA-PENDRA-MARWAHI	GAURELA	94846	50655	3534.35	488.83	177.89	287.92	4488.99	448.9	4040.09
54	GOURELA-PENDRA-MARWAHI	MARWAHI	100972	79547	4738.54	201.62	244.62	245.57	5430.35	543.04	4887.31
55	GOURELA-PENDRA-MARWAHI	PENDRA	34921	34921	3189.91	304.95	122.64	442.04	4059.54	226.48	3833.07
56	JANJGIR-CHAMPA	AKALTARA	39699	39699	2240.43	1396.74	31.86	827.28	4496.31	355.35	4140.96

Sl. No	District	Assessment Unit Name	Total Area of Assessment Unit (Ha)	Recharge Worthy Area(Ha)	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources-Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
57	JANJGIR-CHAMPA	BALODA	58631	36331	2458.85	675.66	34.8	937.59	4106.90	252.05	3854.85
58	JANJGIR-CHAMPA	BAMHANIDIH	34334	34334	1709.11	1533.83	22.48	1010.42	4275.84	427.58	3848.26
59	JANJGIR-CHAMPA	DABHARA	42064	42064	2471.65	1211.64	27.73	1817.94	5528.96	410.36	5118.6
60	JANJGIR-CHAMPA	JAIJAIPUR	44026	44026	2581.37	2714.35	28.89	2138.96	7463.57	746.35	6717.22
61	JANJGIR-CHAMPA	JANJGIR (NAWAGARH)	60361	60361	335.25	3076.82	317.53	1237.24	4966.84	496.68	4470.15
62	JANJGIR-CHAMPA	MALKHARODA	34068	34068	1875.09	1369.8	22.96	1556.93	4824.78	482.48	4342.3
63	JANJGIR-CHAMPA	PAMGARH	44533	44533	2271.6	2002.66	28.91	844.63	5147.8	463.37	4684.43
64	JANJGIR-CHAMPA	SAKTI	65230	34231	1753.88	897.42	22.11	1102.75	3776.16	284.03	3492.13
65	JASHPUR	BAGICHA	181040	110890	5329.3	212.86	226.01	391.78	6159.95	322.28	5837.67
66	JASHPUR	DULDULA	51364	31968	1770.4	66.5	50.03	207.62	2094.55	106.9	1987.65
67	JASHPUR	JASHPUR	58986	44936	2553.52	140.36	70.4	435.85	3200.13	164.13	3035.99

Sl. No	District	Assessment Unit Name	Total Area of Assessment Unit (Ha)	Recharge Worthy Area(Ha)	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources-Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
68	JASHPUR	KANSABEL	50715	39155	2539.78	181.53	85.79	396.39	3203.49	320.36	2883.13
69	JASHPUR	KUNKURI	55737	47537	2232.02	283.22	74.39	430.22	3019.85	301.99	2717.86
70	JASHPUR	MANORA	89049	56129	3252.52	197.67	109.54	317.14	3876.87	387.68	3489.19
71	JASHPUR	PATHALGAON	79200	57040	3725.51	469.21	124.97	760.41	5080.1	508.02	4572.08
72	JASHPUR	PHARSABAHAR	79650	63350	5559.99	228.33	142.54	497.98	6428.84	642.89	5785.95
73	KABIRDHAM	BODLA	172264	162892	10020.31	2376.86	458.39	2911.83	15767.39	1016.12	14751.27
74	KABIRDHAM	KAWARDHA	53143	53143	5260.01	5605.95	250.54	3539.27	14655.77	1078.06	13577.71
75	KABIRDHAM	PANDARIYA	121778	111646	8064.59	3163.69	343.14	2061.2	13632.62	1363.26	12269.36
76	KABIRDHAM	SAHASPUR LOHARA	97520	96282	8289.08	6565.24	356.7	1940.37	17151.39	1715.14	15436.25
77	KANKER	ANTAGARH	79632	78039	9247.27	224.49	133.31	199.8	9804.87	980.48	8824.39
78	KANKER	BHANUPRATAPUR	91366	89539	9390.04	199.87	152.95	520.55	10263.41	525.05	9738.36
79	KANKER	CHARAMA	50595	45535	5359.45	486.67	77.78	2131.6	8055.5	805.55	7249.95
80	KANKER	DURGUKONDAL	62714	61460	7282.73	194.47	104.99	422.21	8004.4	800.44	7203.96
81	KANKER	KANKER	81071	80260	6374.86	303.55	137.1	1435.85	8251.36	825.15	7426.21
82	KANKER	KOYALIBEDA	204312	198183	15234.63	574.61	1096.23	1215.01	18120.48	1812.06	16308.43
83	KANKER	NARHARPUR	73758	73020	5381.57	492.76	521.8	1830.33	8226.46	822.64	7403.82

Sl. No	District	Assessment Unit Name	Total Area of Assessment Unit (Ha)	Recharge Worthy Area(Ha)	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources-Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
84	KONDAGAON	BADERAJPUR	47376	46676	3280.43	102.65	235.77	412.36	4031.21	201.57	3829.64
85	KONDAGAON	KESHKAL	74916	73004	5893.15	117.66	474.12	487.29	6972.22	348.61	6623.61
86	KONDAGAON	KONDAGAON	139297	132097	7585.73	255.94	571.93	325.06	8738.66	445.63	8293.03
87	KONDAGAON	MAKDI	56857	54583	4104.65	92.08	354.48	435.08	4986.29	249.32	4736.97
88	KONDAGAON	PHARASGAON	67581	65881	6434.28	117.16	427.85	437.24	7416.53	370.83	7045.7
89	KORBA	KARTALA	77999	65223	4827.06	286.56	103.61	497.41	5714.64	571.47	5143.17
90	KORBA	KATGHORA	47181	47116	3846.75	1544.96	75.73	682.72	6150.16	325.57	5824.59
91	KORBA	KORBA	204001	88256	6128.97	529.57	131.41	657.94	7447.89	744.79	6703.1
92	KORBA	PALI	150482	99201	5981.38	1245.7	128.13	1710.18	9065.39	906.54	8158.85
93	KORBA	PODI UPRORA	234881	131634	9166.19	118.69	196.74	267.07	9748.69	974.87	8773.82
94	KOREA	BAIKUNTHPUR	56221	43547	4579.51	1540.35	28.29	1277.12	7425.27	495.57	6929.7
95	KOREA	BHARATPUR	230094	226187	33691.78	280.26	168.89	456.43	34597.36	3459.74	31137.62
96	KOREA	KHADGAWAN	229601	71739	9620.4	776.51	52.6	827.6	11277.11	611.57	10665.54
97	KOREA	MANENDRAGARH	46383	31914	3150.2	265.7	17.6	568.77	4002.27	238.93	3763.34
98	KOREA	SONHAT	35471	29100	4285.53	1547.05	21.91	610.58	6465.07	646.5	5818.57
99	MAHASAMUND	BAGBAHARA	117600	96920	11318.59	963.78	0	1360.49	13642.86	782.77	12860.09

Sl. No	District	Assessment Unit Name	Total Area of Assessment Unit (Ha)	Recharge Worthy Area(Ha)	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources-Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
100	MAHASAMUND	BASNA	64300	64300	5464.37	2211.2	0	3401.35	11076.92	1107.68	9969.24
101	MAHASAMUND	MAHASAMUND	116700	116700	9823.24	3411.34	0	2664.83	15899.41	1131.29	14768.12
102	MAHASAMUND	PITHORA	97100	81200	8735.65	3541.45	0	4948.05	17225.15	1073.07	16152.08
103	MAHASAMUND	SARAIPALI	100600	100600	6022.63	888.58	325.68	847.16	8084.05	465.91	7618.14
104	MUNGELI	LORMI	162240	51146	3309.31	554.81	0	701.64	4565.76	456.58	4109.18
105	MUNGELI	MUNGELI	61332	61332	3028.05	2248.51	0	1988.64	7265.2	726.52	6538.67
106	MUNGELI	PATHARIA	51464	51464	2119.86	2399.46	0	1815.64	6334.96	633.49	5701.47
107	NARAYANPUR	NARAYANPUR	193765	102432	5342.47	257.82	225.5	429.92	6255.71	625.58	5630.13
108	NARAYANPUR	ORCHHA	497551	248611	19449.95	1.16	547.29	17.44	20015.84	2001.58	18014.26
109	RAIGARH	BARAMKELA	78134	60034	4324.88	828.81	49.72	2030.43	7233.84	413.87	6819.97
110	RAIGARH	DHARAMJAIGARH	153769	95749	6849.82	373.11	71.24	524.82	7818.99	413.64	7405.35
111	RAIGARH	GHARGHODA	43304	29935	1677.57	204.49	22.28	353.1	2257.44	225.75	2031.69
112	RAIGARH	KHARSIYA	40079	31449	2188.21	287.23	23.71	401.03	2900.18	174.3	2725.88
113	RAIGARH	LAILUNGA	91035	75115	5833.51	250.77	55.88	317.05	6457.21	348.32	6108.89
114	RAIGARH	PUSAUR	51030	51030	3188.67	752.59	28.6	895.03	4864.89	486.5	4378.39
115	RAIGARH	RAIGARH	94272	78841	5650.91	450.78	55.82	411.89	6569.4	357.24	6212.16

Sl. No	District	Assessment Unit Name	Total Area of Assessment Unit (Ha)	Recharge Worthy Area(Ha)	Recharge from Rainfall-Monsoon Season (Ham)	Recharge from Other Sources-Monsoon Season (Ham)	Recharge from Rainfall-Non Monsoon Season (Ham)	Recharge from Other Sources-Non Monsoon Season (Ham)	Total Annual Ground Water Recharge (Ham)	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)
116	RAIGARH	SARANGARH	85112	74912	4696.45	859.9	257.35	391.1	6204.8	372.13	5832.67
117	RAIGARH	TAMNAR	46900	23800	1958.46	288.19	17.53	236.6	2500.78	250.09	2250.69
118	RAIPUR	ABHANPUR	60398	60398	3314.79	4128.75	0	3070.39	10513.93	1051.4	9462.53
119	RAIPUR	ARANG	90039	90039	4619.32	3567.17	0	4699.15	12885.64	1288.56	11597.08
120	RAIPUR	DHARSIWA	65231	65231	5751.88	1889.79	0	1748.15	9389.82	938.97	8450.85
121	RAIPUR	TILDA	73530	73530	5820.51	4668.72	42.18	3391.09	13922.5	1099.62	12822.88
122	RAJNANDGAON	AMBAGARH CHOWKI	54747	47433	3348.92	890.27	34.57	1157.48	5431.24	543.13	4888.11
123	RAJNANDGAON	CHHUIKHADAN	75464	68915	3257.16	5121.64	41.25	3093.14	11513.19	916.68	10596.51
124	RAJNANDGAON	CHHURIYA	80214	74787	5260.75	2452.12	78.38	2089.34	9880.59	988.06	8892.53
125	RAJNANDGAON	DONGARGAON	41249	40736	2915.77	1727.15	30.94	2355.23	7029.09	702.91	6326.18
126	RAJNANDGAON	DONGARGARH	76732	69964	6073.55	2068.56	65.3	3688.21	11895.62	749.18	11146.44
127	RAJNANDGAON	KHAIRAGARH	81095	80123	4648.27	2531.41	56.87	3841.75	11078.3	720.43	10357.87
128	RAJNANDGAON	MANPUR	113950	57041	5805.56	964.24	59.92	644.87	7474.59	747.46	6727.13
129	RAJNANDGAON	MOHLA	70301	50408	3237.1	464.95	49.8	723.67	4475.52	447.54	4027.98
130	RAJNANDGAON	RAJNANDGAON	74265	74245	5766.79	1026.02	61.93	1829.76	8684.5	509.89	8174.61
131	SUKMA	CHHINDGARH	84871	79921	8364.17	101.08	0	176.48	8641.73	864.16	7777.57

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132	SUKMA	KONTA	382059	350479	28530.11	164.23	0	111.49	28805.83	2880.58	25925.25
133	SUKMA	SUKMA	96649	90799	7379.01	58.66	0	169.58	7607.25	760.73	6846.52
134	SURAJPUR	BHAIYATHAN	43360	42608	5284.54	398.48	29.71	1798.15	7510.88	409.87	7101.01
135	SURAJPUR	ODGI	47104	37389	3614.88	502.44	26.71	702.98	4847.01	484.71	4362.31
136	SURAJPUR	PRATAPPUR	60461	60013	5776.43	381.65	43.1	2251.7	8452.88	845.29	7607.59
137	SURAJPUR	PREMNAGAR	29198	27892	2507.5	335.35	18.85	738.59	3600.29	360.03	3240.26
138	SURAJPUR	RAMANUJNAGAR	41063	39412	4191.31	477.03	27.26	1553.89	6249.49	356.22	5893.27
139	SURAJPUR	SURAJPUR	57534	56474	6379.29	679.94	41.84	3027.59	10128.66	571.86	9556.8
140	SURGUJA	AMBIKAPUR	67632	57665	4723.19	685.27	194.21	1462.62	7065.29	484.33	6580.96
141	SURGUJA	BATAULI	40173	32460	2676.49	155.39	0	785.49	3617.37	193.19	3424.18
142	SURGUJA	LAKHANPUR	78008	64699	5134.51	223.34	205.08	978.54	6541.47	654.14	5887.33
143	SURGUJA	LUNDRA	74294	61745	5282.3	256.95	0	474.34	6013.59	321.74	5691.85
144	SURGUJA	MAINPAT	67179	35076	2575.97	55.8	10.16	91.03	2732.96	273.3	2459.66
145	SURGUJA	SITAPUR	50099	48167	3866.82	314.75	22.16	389.1	4592.83	424.87	4167.96
146	SURGUJA	UDAIPUR	141730	125630	9815.81	231.71	423.1	429.04	10899.66	1089.96	9809.7

Annexure - 6B

Block wise Ground Water Resources Assessment -2022, Chhattisgarh

PART-B

Sl. No	District	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization (Over-Exploited/Critical/Semi-Critical/Safe/Saline)
1	BALOD	BALOD	3587.63	2.52	344.35	3934.49	373.42	706.13	84.26	semi critical
2	BALOD	DOUNDI	2401.00	137.05	413.98	2952.03	436.26	1567.40	65.00	safe
3	BALOD	DOUNDI LOHARA	4955.15	2.40	516.99	5474.53	554.61	5133.02	51.43	safe
4	BALOD	GUNDERDEHI	5341.40	6.66	554.35	5902.41	603.03	2090.10	73.40	semi critical
5	BALOD	GURUR	6105.50	7.91	366.43	6479.84	388.90	150.30	98.37	critical
6	BALODA BAZAR	BALODA BAZAR	2431.00	375.51	978.75	3785.26	1407.89	2057.70	65.96	safe
7	BALODA BAZAR	BHATAPARA	3467.97	36.84	697.30	4202.11	868.04	1898.35	67.01	safe
8	BALODA BAZAR	BILAIGARH	806.19	0.48	705.99	1512.67	838.37	5877.75	20.11	safe
9	BALODA BAZAR	KASDOL	5964.23	0.33	650.59	6615.14	768.05	4514.56	58.82	safe
10	BALODA BAZAR	PALARI	1261.84	37.20	852.99	2152.03	1239.95	5985.29	25.25	safe
11	BALODA BAZAR	SIMGA	5523.73	806.56	1055.68	7385.97	1360.26	3301.87	67.19	safe
12	BALRAMPUR	BALRAMPUR	1118.77	0.00	305.86	1424.64	337.68	3323.71	29.80	safe
13	BALRAMPUR	KUSMI	964.24	2.71	289.05	1256.01	309.76	6249.08	16.69	safe
14	BALRAMPUR	RAJPUR	1353.11	0.61	300.37	1654.08	330.47	4995.54	24.76	safe
15	BALRAMPUR	RAMCHANDRAPUR	2498.00	0.22	476.41	2974.62	531.43	3848.22	43.25	safe
16	BALRAMPUR	SHANKARGARH	841.00	0.14	186.47	1027.63	199.35	3408.51	23.10	safe
17	BALRAMPUR	WADRAFNAGAR	1086.44	0.36	445.66	1532.45	491.96	7475.74	16.92	safe
18	BASTAR	BAKAWAND	1613.40	439.41	394.74	2447.56	426.04	1532.86	61.01	safe
19	BASTAR	BASTANAR	59.28	0.30	117.69	177.26	123.00	2880.35	5.79	safe

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20	BASTAR	BASTAR	1827.40	4.70	433.31	2265.40	468.32	2261.31	49.66	safe
21	BASTAR	DARBHA	45.23	1.38	202.62	249.24	215.43	1934.59	11.35	safe
22	BASTAR	JAGDALPUR	821.86	7.17	684.63	1513.63	737.43	2146.43	40.77	safe
23	BASTAR	LOHANDIGUDA	201.62	1.53	197.57	400.73	211.97	2707.63	12.83	safe
24	BASTAR	TOKAPAL	432.67	8.04	202.82	643.52	218.14	1570.10	28.87	safe
25	BEMETARA	BEMETARA	9958.56	45.73	707.51	10711.77	883.09	2635.15	97.69	critical
26	BEMETARA	BERLA	10428.00	7.41	572.04	11007.44	674.75	516.86	96.38	critical
27	BEMETARA	NAWAGARH	6610.00	9.42	688.58	7308.01	907.10	1189.79	94.02	critical
28	BEMETARA	SAJA	11916.74	5.08	359.37	12281.20	424.58	3419.88	88.56	semi critical
29	BIJAPUR	BHAIRAMGARH	153.54	0.49	241.20	395.23	273.86	14647.48	2.62	safe
30	BIJAPUR	BHOPALPATTNAM	543.22	0.05	127.91	671.17	136.84	7767.63	7.94	safe
31	BIJAPUR	BIJAPUR	921.36	0.00	161.20	1082.57	165.11	8609.01	11.17	safe
32	BIJAPUR	USOOR	318.27	0.72	132.89	451.88	136.07	12007.90	3.63	safe
33	BILASPUR	BELHA	5995.38	154.83	2795.00	8945.21	3389.32	1149.59	88.31	semi critical
34	BILASPUR	KOTA	2013.43	39.16	658.11	2710.71	732.96	3697.16	41.81	safe
35	BILASPUR	MASTURI	2043.26	173.50	1010.61	3227.40	1291.43	3784.84	44.25	safe
36	BILASPUR	TAKHATPUR	6815.65	100.15	940.79	7856.59	1115.41	1135.41	87.18	semi critical
37	DANTEWADA	DANTEWADA	1200.75	150.85	233.41	1585.01	238.99	10179.86	13.47	safe
38	DANTEWADA	GEEDAM	846.09	0.72	252.10	1098.90	296.53	3167.93	25.49	safe
39	DANTEWADA	KATEKALYAN	321.77	0.48	109.37	431.63	115.60	4038.08	9.64	safe
40	DANTEWADA	KUAKONDA	470.12	0.00	163.43	633.55	168.88	3150.79	16.72	safe
41	DHAMTARI	DHAMTARI	11172.72	4.22	738.68	11915.62	774.76	1521.23	94.62	critical
42	DHAMTARI	KURUD	8556.47	8.85	564.63	9129.94	598.16	2104.49	88.51	semi critical

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43	DHAMTARI	MAGARLOD	7606.21	0.81	315.43	7922.45	336.50	3399.22	69.85	safe
44	DHAMTARI	NAGRI	4963.46	0.06	449.28	5412.80	470.63	3174.91	62.87	safe
45	DURG	DHAMDHA	11403.45	49.92	757.43	12210.79	826.91	1701.60	87.33	semi critical
46	DURG	DURG	5035.71	53.68	3203.95	8293.34	3372.77	2194.02	88.15	semi critical
47	DURG	PATAN	5441.63	7.39	879.86	6328.88	935.51	2247.56	73.32	semi critical
48	GARIABAND	CHHURA	3272.50	0.00	304.05	3576.55	325.31	1620.68	68.54	safe
49	GARIABAND	DEOBHOG	1110.29	0.22	257.55	1368.05	283.29	1393.85	50.01	safe
50	GARIABAND	GARIABAND	4898.02	1.05	242.72	5141.78	258.05	3182.63	61.65	safe
51	GARIABAND	MAINPUR	2421.84	19.81	423.30	2864.94	544.40	1798.51	59.88	safe
52	GARIABAND	RAJIM/FINGESHWAR	6880.01	0.00	438.79	7318.80	466.50	1397.87	83.70	semi critical
53	GOURELA-PENDRA-MARWAHI	GAURELA	705.03	0.81	421.78	1127.61	500.07	2834.19	27.91	safe
54	GOURELA-PENDRA-MARWAHI	MARWAHI	1081.28	0.20	394.59	1476.06	504.23	3301.61	30.20	safe
55	GOURELA-PENDRA-MARWAHI	PENDRA	1934.37	0.00	270.09	2204.46	320.23	1578.47	57.51	safe
56	JANJGIR-CHAMPA	AKALTARA	1061.50	114.16	490.09	1665.75	538.11	2427.19	40.23	safe
57	JANJGIR-CHAMPA	BALODA	1563.54	10.84	301.67	1876.05	340.68	1939.79	48.67	safe
58	JANJGIR-CHAMPA	BAMHANIDIH	1666.61	8.36	610.93	2285.90	678.09	1549.54	59.40	safe

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59	JANJGIR-CHAMPA	DABHARA	3582.90	0.14	449.01	4032.05	488.76	1046.80	78.77	semi critical
60	JANJGIR-CHAMPA	JAIJAIPUR	3986.00	1.46	484.26	4471.73	554.73	2175.02	66.57	safe
61	JANJGIR-CHAMPA	JANJGIR (NAWAGARH)	1040.42	0.59	900.88	1941.90	1008.27	2420.86	43.44	safe
62	JANJGIR-CHAMPA	MALKHARODA	2918.56	0.07	427.98	3346.60	485.36	938.32	77.07	semi critical
63	JANJGIR-CHAMPA	PAMGARH	982.04	0.35	454.12	1436.50	495.02	3207.03	30.67	safe
64	JANJGIR-CHAMPA	SAKTI	1599.97	0.00	503.14	2103.11	557.62	1334.54	60.22	safe
65	JASHPUR	BAGICHA	1359.18	0.14	447.12	1806.46	477.21	4001.12	30.94	safe
66	JASHPUR	DULDULA	777.84	0.06	125.79	903.68	131.81	1077.95	45.46	safe
67	JASHPUR	JASHPUR	1719.29	0.00	266.65	1985.94	287.82	1028.88	65.41	safe
68	JASHPUR	KANSABEL	1334.50	0.00	188.14	1522.66	196.41	1352.21	52.81	safe
69	JASHPUR	KUNKURI	1209.75	0.66	241.50	1451.90	253.06	1254.40	53.42	safe
70	JASHPUR	MANORA	870.90	0.00	151.89	1022.78	159.92	2458.38	29.31	safe
71	JASHPUR	PATHALGAON	2034.25	0.27	504.41	2538.93	538.65	1998.91	55.53	safe
72	JASHPUR	PHARSABAHAR	1540.93	0.29	264.58	1805.80	275.59	3969.14	31.21	safe
73	KABIRDHAM	BODLA	6107.52	24.39	528.94	6660.86	591.36	8027.99	45.15	safe
74	KABIRDHAM	KAWARDHA	8346.00	0.12	693.45	9039.57	797.18	4434.41	66.58	safe
75	KABIRDHAM	PANDARIYA	8734.96	0.30	750.27	9485.53	852.50	2681.59	77.31	semi critical
76	KABIRDHAM	SAHASPUR LOHARA	8596.30	2.47	489.25	9088.04	596.18	6241.28	58.87	safe
77	KANKER	ANTAGARH	823.50	0.00	209.74	1033.24	226.70	7774.19	11.71	safe

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78	KANKER	BHANUPRATAPUR	2165.50	55.76	248.50	2469.76	265.36	7251.74	25.36	safe
79	KANKER	CHARAMA	5141.50	0.66	273.46	5415.60	289.34	1818.46	74.70	semi critical
80	KANKER	DURGUKONDAL	1038.00	12.45	165.92	1216.37	177.18	5976.33	16.88	safe
81	KANKER	KANKER	3532.75	0.52	343.41	3876.68	371.09	3521.85	52.20	safe
82	KANKER	KOYALIBEDA	2295.75	3.51	462.29	2761.56	502.77	13506.39	16.93	safe
83	KANKER	NARHARPUR	4416.75	0.24	293.93	4710.93	317.63	2669.19	63.63	safe
84	KONDAGAON	BADERAJPUR	2181.80	0.00	221.07	2402.87	234.17	1865.01	62.74	safe
85	KONDAGAON	KESHKAL	2578.25	3.00	243.17	2824.41	258.86	4087.82	42.64	safe
86	KONDAGAON	KONDAGAON	1458.32	1.03	553.67	2013.03	601.97	6231.70	24.27	safe
87	KONDAGAON	MAKDI	2302.00	0.03	264.69	2566.72	286.61	2148.33	54.18	safe
88	KONDAGAON	PHARASGAON	2256.75	0.06	258.91	2515.72	277.17	4511.72	35.71	safe
89	KORBA	KARTALA	1805.91	16.50	390.38	2212.80	424.62	2896.13	43.02	safe
90	KORBA	KATGHORA	1894.80	1950.68	952.99	4798.47	1066.77	912.34	82.38	semi critical
91	KORBA	KORBA	925.00	453.01	1111.06	2489.07	1218.49	4106.60	37.13	safe
92	KORBA	PALI	3532.00	0.60	557.51	4090.11	620.66	4005.59	50.13	safe
93	KORBA	PODI UPRORA	1017.46	249.77	504.74	1771.96	548.67	6957.93	20.20	safe
94	KOREA	BAIKUNTHPUR	3933.93	6.00	516.18	4456.11	538.44	2451.33	64.30	safe
95	KOREA	BHARATPUR	1740.14	0.00	243.73	1983.87	268.77	29128.71	6.37	safe
96	KOREA	KHADGAWAN	3110.64	0.24	435.93	3546.80	447.91	7106.76	33.25	safe
97	KOREA	MANENDRAGARH	1148.17	0.31	398.67	1547.15	419.48	2195.38	41.11	safe
98	KOREA	SONHAT	1416.06	0.00	132.18	1548.24	145.19	4257.32	26.61	safe
99	MAHASAMUND	BAGBAHARA	6072.40	12.01	544.16	6628.56	602.72	6172.97	51.54	safe
100	MAHASAMUND	BASNA	7928.53	0.33	448.95	8377.82	475.16	1565.21	84.04	semi critical

Sl. No	District	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization (Over-Exploited/Critical/Semi-Critical/Safe/Saline)
101	MAHASAMUND	MAHASAMUND	8195.80	50.26	734.90	8980.96	799.43	5722.63	60.81	safe
102	MAHASAMUND	PITHORA	10428.60	0.48	537.97	10967.05	577.67	5145.33	67.90	safe
103	MAHASAMUND	SARAIPALI	3597.83	0.93	557.43	4156.19	622.97	3396.41	54.56	safe
104	MUNGELI	LORMI	2034.00	0.07	398.67	2432.74	457.89	1617.22	59.20	safe
105	MUNGELI	MUNGELI	2881.04	0.15	769.57	3650.77	899.63	2757.84	55.83	safe
106	MUNGELI	PATHARIA	2737.81	32.28	648.37	3418.46	879.46	2051.92	59.96	safe
107	NARAYANPUR	NARAYANPUR	552.70	10.13	287.94	850.78	311.67	4755.62	15.11	safe
108	NARAYANPUR	ORCHHA	77.50	0.00	92.70	170.21	100.35	17836.40	0.94	safe
109	RAIGARH	BARAMKELA	4632.77	1.00	470.43	5104.20	556.42	1629.78	74.84	semi critical
110	RAIGARH	DHARAMJAIGARH	1879.29	248.22	536.78	2664.29	571.35	4706.49	35.98	safe
111	RAIGARH	GHARGHODA	1018.42	128.06	214.74	1361.20	232.37	652.86	67.00	safe
112	RAIGARH	KHARSIYA	1158.35	115.42	398.35	1672.13	426.13	1025.97	61.34	safe
113	RAIGARH	LAILUNGA	613.38	0.00	336.89	950.26	357.90	5137.62	15.56	safe
114	RAIGARH	PUSAUR	3167.03	76.47	385.07	3628.57	424.02	710.87	82.87	semi critical
115	RAIGARH	RAIGARH	1658.36	386.98	916.74	2962.08	1009.45	3157.37	47.68	safe
116	RAIGARH	SARANGARH	1208.66	0.15	594.89	1803.70	633.21	3990.65	30.92	safe
117	RAIGARH	TAMNAR	511.26	909.13	259.74	1680.13	281.06	549.24	74.65	semi critical
118	RAIPUR	ABHANPUR	4315.24	22.47	764.27	5101.97	903.99	4220.84	53.92	safe
119	RAIPUR	ARANG	6659.44	276.18	926.62	7862.24	1055.17	3606.29	67.79	safe
120	RAIPUR	DHARSIWA	3896.74	684.57	3548.87	8130.18	4159.65	42.27	96.21	critical
121	RAIPUR	TILDA	5905.44	1735.36	646.36	8287.18	696.50	4485.56	64.63	safe
122	RAJNANDGAON	AMBAGARH CHOWKI	2224.19	0.60	278.43	2503.22	294.67	2368.65	51.21	safe
123	RAJNANDGAON	CHHUIKHADAN	6607.99	0.03	507.59	7115.60	569.12	3419.38	67.15	safe

Sl. No	District	Assessment Unit Name	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Industrial Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization (Over-Exploited/Critical/Semi-Critical/Safe/Saline)
124	RAJNANDGAON	CHHURIYA	3650.05	2.16	486.50	4138.73	532.99	4707.31	46.54	safe
125	RAJNANDGAON	DONGARGAON	5009.51	80.11	372.40	5462.03	407.98	828.57	86.34	semi critical
126	RAJNANDGAON	DONGARGARH	8157.66	1.81	570.15	8729.62	618.04	2368.93	78.32	semi critical
127	RAJNANDGAON	KHAIRAGARH	8653.02	3.13	537.60	9193.74	592.46	1109.27	88.76	semi critical
128	RAJNANDGAON	MANPUR	1116.25	150.15	225.71	1492.12	239.55	5221.19	22.18	safe
129	RAJNANDGAON	MOHLA	1461.42	60.90	220.57	1742.88	233.60	2272.06	43.27	safe
130	RAJNANDGAON	RAJNANDGAON	4374.00	52.40	1607.35	6033.75	2521.62	1226.59	73.81	semi critical
131	SUKMA	CHHINDGARH	421.90	0.00	201.35	623.25	212.94	7142.73	8.01	safe
132	SUKMA	KONTA	160.10	0.00	235.66	395.76	236.52	25528.63	1.53	safe
133	SUKMA	SUKMA	367.48	0.18	174.67	542.32	187.14	6291.72	7.92	safe
134	SURAJPUR	BHAIYATHAN	4201.07	0.05	345.47	4546.60	369.94	2529.94	64.03	safe
135	SURAJPUR	ODGI	1536.39	0.29	241.59	1778.29	267.05	2558.56	40.76	safe
136	SURAJPUR	PRATAPPUR	4524.60	19.35	413.91	4957.86	456.08	2607.56	65.17	safe
137	SURAJPUR	PREMNAGAR	1165.93	0.04	178.78	1344.74	196.27	1878.03	41.50	safe
138	SURAJPUR	RAMANUJNAGAR	3558.97	0.46	323.16	3882.60	349.25	1984.58	65.88	safe
139	SURAJPUR	SURAJPUR	7008.92	4.23	617.73	7630.87	659.46	1884.19	79.85	semi critical
140	SURGUJA	AMBIKAPUR	2732.21	1.93	796.63	3530.77	862.94	2983.88	53.65	safe
141	SURGUJA	BATAULI	1835.00	0.04	181.58	2016.62	194.06	1395.08	58.89	safe
142	SURGUJA	LAKHANPUR	2786.99	0.00	317.10	3104.09	342.55	2757.79	52.72	safe
143	SURGUJA	LUNDRA	1946.50	1.57	315.06	2263.13	339.55	3404.23	39.76	safe
144	SURGUJA	MAINPAT	267.44	0.00	198.09	465.54	211.78	1980.43	18.93	safe
145	SURGUJA	SITAPUR	1618.50	0.95	245.36	1864.81	258.76	2289.75	44.74	safe
146	SURGUJA	UDAIPUR	1771.50	330.00	209.20	2310.70	226.37	7481.83	23.56	safe

Annexure - 7

Quality Tagging in Ground Water Resources Assessment -2022, Chhattisgarh

S. No	Name of District	S. No	Name of Assessment Unit affected by Fluoride	S. No	Name of Assessment Unit affected by Arsenic	S. No	Name of Assessment Unit affected by Salinity
1	**Rajnandgaon**			1	AMBAGARH CHOWKI	1	
2	**Baloda Bazar**	1	BILAIGARH				
		2	KASDOL				
3	**BALRAMPUR**	1	RAMCHANDRAPUR				
4	**DANTEWADA**	1	DANTEWADA				
5	**DHAMTARI**	1	KURUD				
6	**DURG**	1	DHAMDHA				
7	**GOURELA-PENDRA-MARWAHI**	1	MARWAHI				
8	**JASHPUR**	1	DULDULA				
		2	KUNKURI				
9	**KANKER**	1	ANTAGARH				
		2	KANKER				
10	**KONDAGAON**	1	BADERAJPUR				
11	**KOREA**	1	SONHAT				
12	**RAIGARH**	1	TAMNAR				
13	**RAIPUR**	1	DHARSIWA				
		2	TILDA				
14	**RAJNANDGAON**	1	KHAIRAGARH				
15	**SUKMA**	1	SUKMA				
16	**SURGUJA**	1	BATAULI				

ABSTRACT			
Total No. of Assessed Units	**Number of Assessment Unit affected by Fluoride**	**Number of Assessment Unit affected by Arsenic**	**Number of Assessment Unit affected by Salinity**
146	**19**	**1**	**0**

Annexure - 8

Summary of Critical and Semi-Critical Assessment Units, Ground Water Resources Assessment -2022 (Chhattisgarh)

S. No	Name of District	S. No	Name of Semi-Critical Assessment Unit	S. No	Name of Critical Assessment Unit	S. No	Name of Over-Exploited Assessment Unit
1	**BALOD**	1	GUNDERDEHI	1	GURUR		
		2	BALOD				
2	**BEMETARA**	1	SAJA	1	NAWAGARH		
				2	BEMETARA		
				3	BERLA		
3	**BILASPUR**	1	TAKHATPUR				
		2	BELHA				
4	**DHAMTARI**	1	KURUD	1	DHAMTARI		
5	**DURG**	1	DHAMDHA				
		2	PATAN				
		3	DURG				
6	**GARIABAND**	1	RAJIM/FINGESHWAR				
7	**JANJGIR-CHAMPA**	1	MALKHARODA				
		2	DABHARA				
8	**KABIRDHAM**	1	PANDARIYA				
9	**KANKER**	1	CHARAMA				
10	**KORBA**	1	KATGHORA				
11	**MAHASAMUND**	1	BASNA				
12	**RAIGARH**	1	TAMNAR				
		2	PUSAUR				
		3	BARAMKELA				
13	**RAIPUR**			1	DHARSIWA		
14	**RAJNANDGAON**	1	RAJNANDGAON				
		2	DONGARGAON				
		3	DONGARGARH				
		4	KHAIRAGARH				
15	**SURAJPUR**	1	SURAJPUR				

ABSTRACT			
Total No. of Assessed Units	**Number of Semi critical Assessment Unit**	**Number of Critical Assessment Unit**	**Number of Over Exploited Assessment Unit**
146	**24**	**6**	**0**

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" मायो मौष घीहि ऊं सीर्घाम्नो: घाम्नो राजस्तो वरुण नो मुंच। "

(अर्थात् हे राजन, आप अपने राज्य के स्थानों में जल और वनस्पतियों को हानि न पहुँचाओ, ऐसा उद्यम करो जिससे हम सभी को जल एवं वनस्पतियाँ सत्त रूप से प्राप्त होती रहे।)

– यजुर्वेद 6/22

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