केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

KORBA BLOCK, KORBA DISTRICT, CHHATTISGARH

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

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AQUIFER MAPPING AND MANAGEMENT PLAN FOR KORBA BLOCK (KORBA DISTRICT), CHHATTISGARH

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ABBREVIATIONS

DW	Dugwell	**m bgl**	meter below ground level
EC	Electrical Conductivity	**m2/day**	Square meter/ day
GS	Gabion structures	**m3/day**	cubic meter/day
GW/ gw	Ground Water	**MCM/mcm**	Million Cubic Meter
ha	Hectare	**mm**	Milimeter
Ham	Hectare meter	**OE**	Overexploited
HP	Handpump (Shallow)	**Sq Km**	Square Kilometer
lpm	litres per minute	**STP**	Sewage Treatment Plant
lps	liters per second	**T**	Transmissivity
m	meter	**TW**	Tubewell

BLOCK-WISE AQUIFER MAPS AND MANAGEMENT PLANS

1. Salient Information:

About the area: Korba Block is situated on the eastern part of Korba district of Chhattisgarh and is bounded on the north by Podi Uprora block and sarguja district, in the west by Katghora Block, in the south by Kartala block and in the east by Raigarh district. The block area lies between 22.19 and 22.75 N latitudes and 82.60 and 83.13 E longitudes. The geographical extension of the study area is 2040 sq.km representing around 29 % of the district's geographical area. Administrative map of the block is shown in Fig. 1. Geomorphology mainly comprises of structural plains and denudational hills on Gondwana rocks and structural plains on Proterozoic rocks. Geomorphology map is shown in Figure 2. The major drainage of the block includes Hasdeo River, Dhengur Nala, Chuia Nala, Jharri Nala and Bating Nala all of which are parts of Mahanadi Basin. Drainage map shown in Fig.3.

Population: The total population of Korba block as per 2011 Census is 369257 out of which rural population is 133033 while the urban population is 236224.The population break up i.e. male- female, rural & urban is given below -

Table- 1: Population Break Up

Block	Total population	Male	Female	Rural population	Urban population
Korba	369257	188711	180546	133033	236224

Source: CG Census, 2011

Growth rate: The decadal growth rate of the block is 10.68 as per 2011 census.

Rainfall: The study area receives rainfall mainly from south-west monsoon. The months of July and August are the heaviest rainfall months and nearly 95% of the annual rainfall is received during June to September months. Average annual rainfall in the study area is (Average of the last five years i.e. 2012 to 2017) 1213.6 mm with 50 to 60 rainy days.

Table-2: Rainfall data in Korba block in mm

Year	2012-13	2013-14	2014-15	2015-16	2016-17
Annual rainfall	1113.0	1152.00	1039.00	1478.50	1285.4

Source: IMD

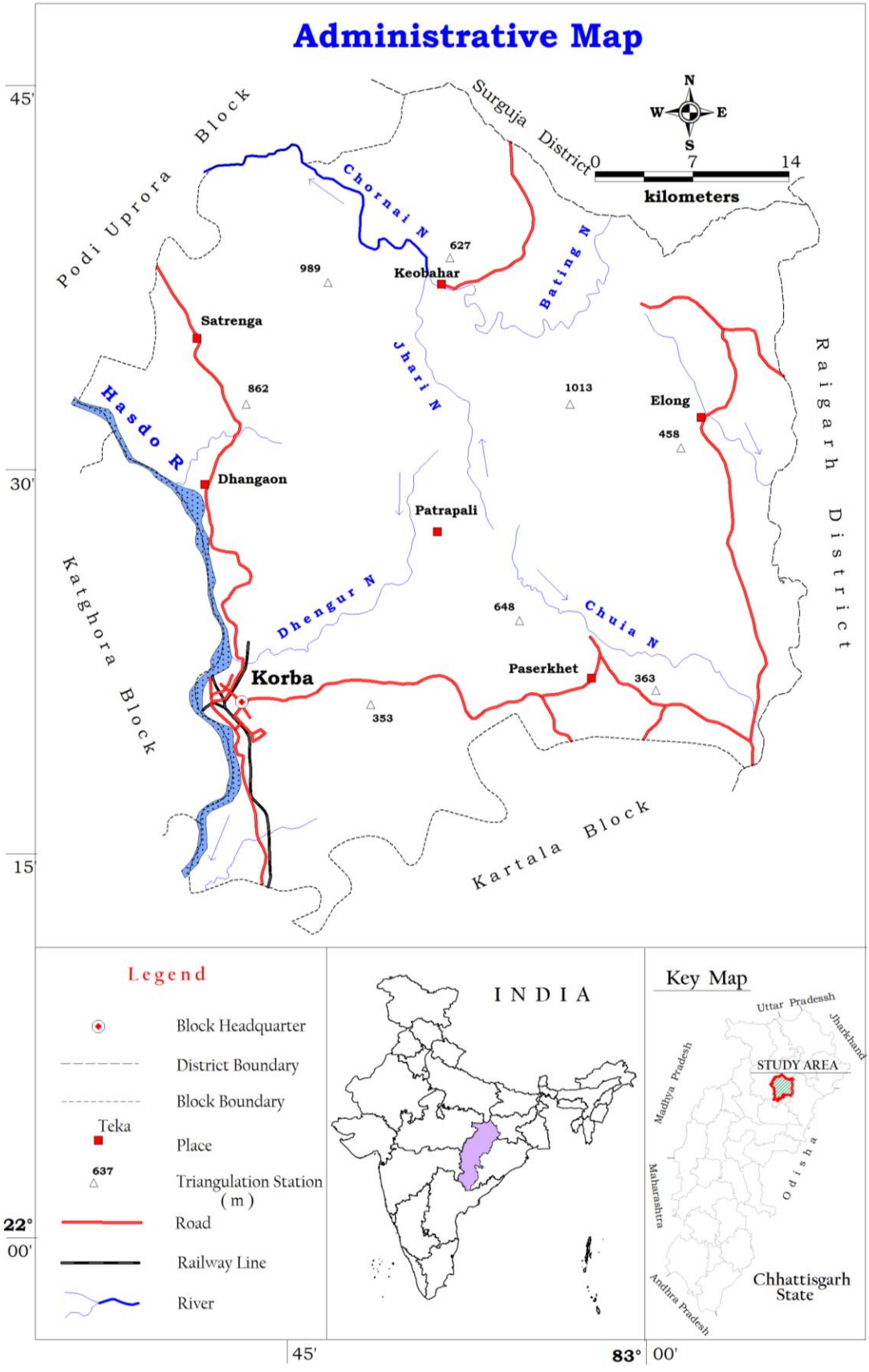


Figure 1 Administrative Map of Korba Block

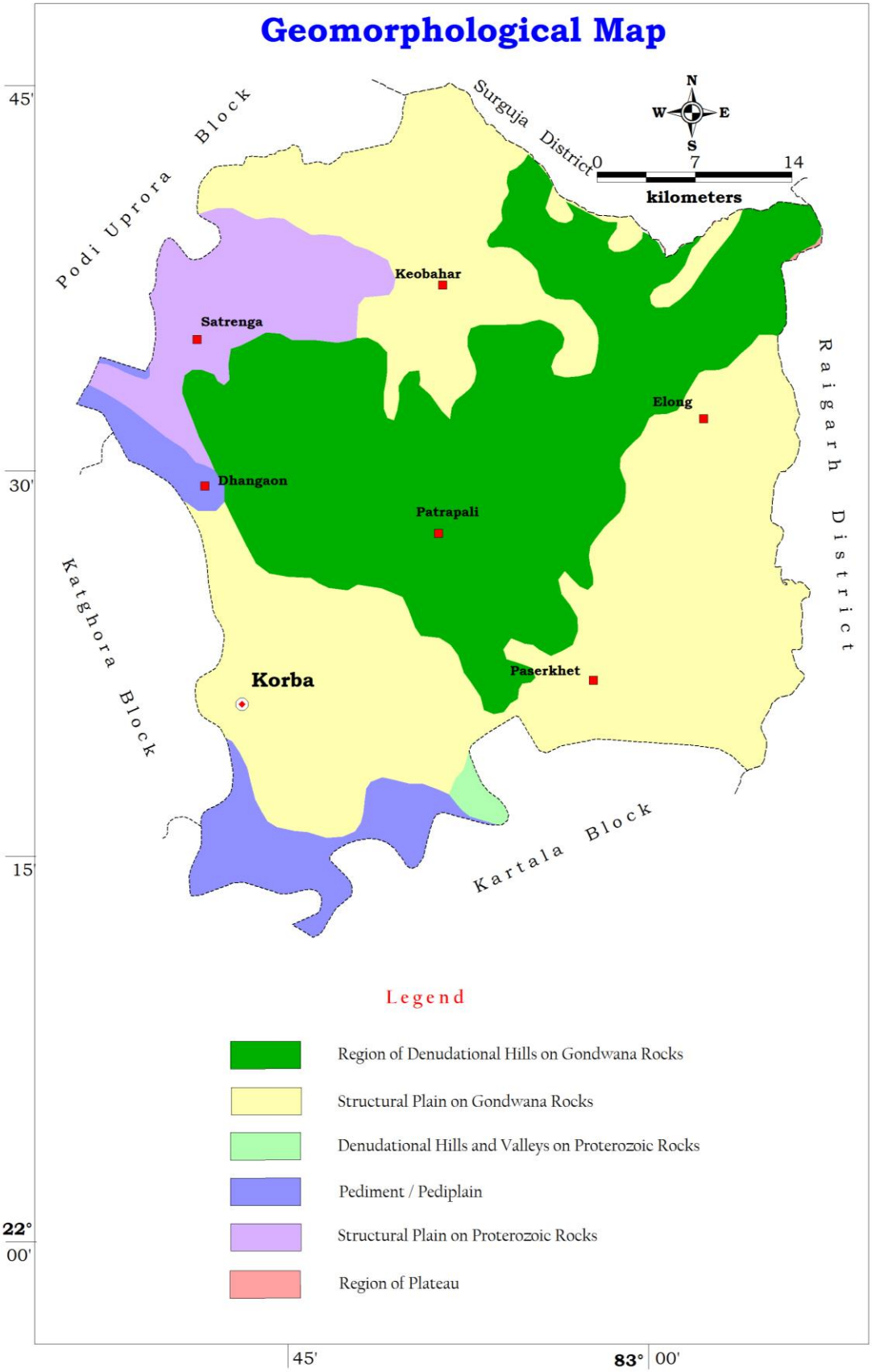


Figure 2 Geomorphology Map of Korba Block

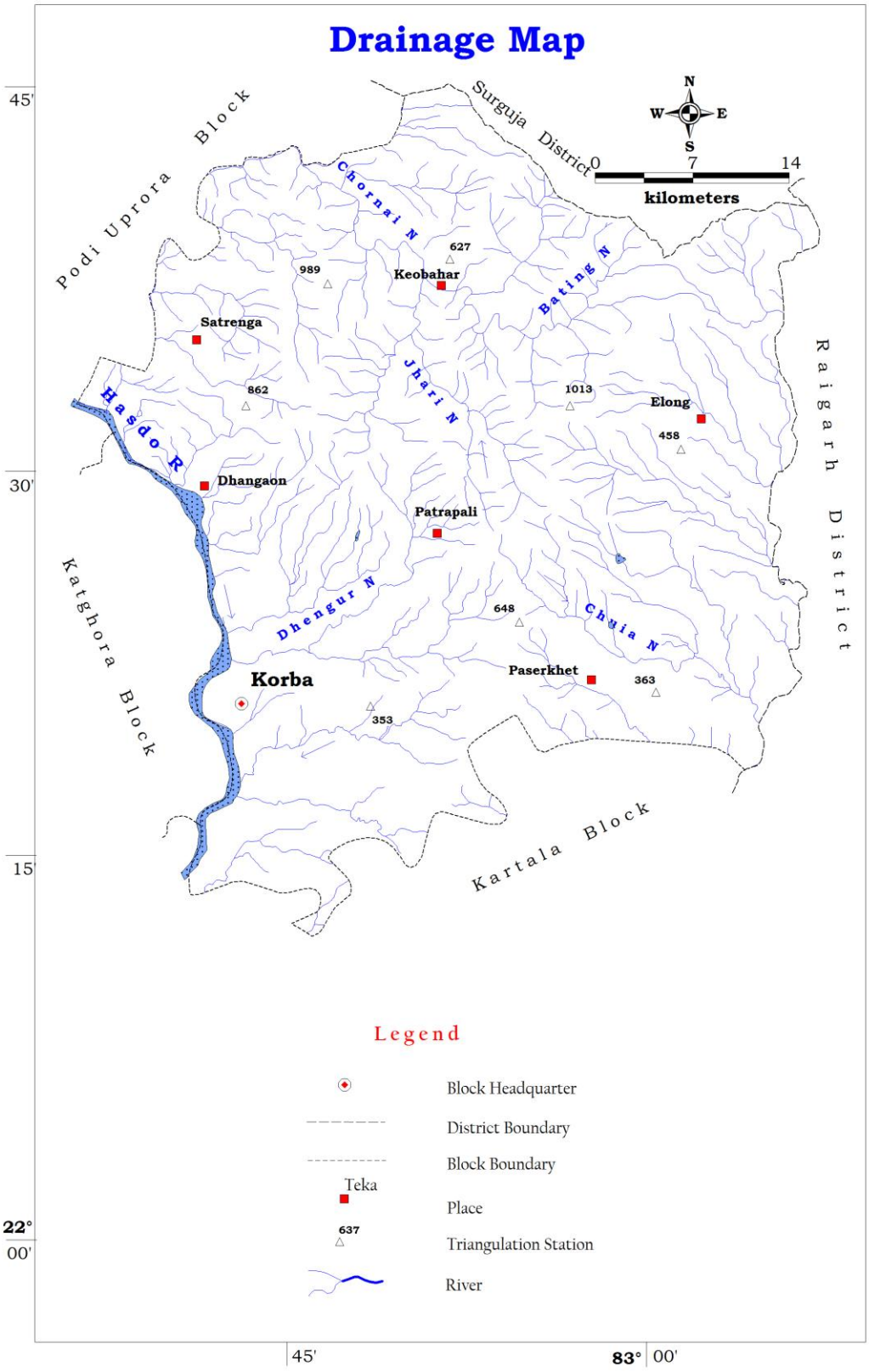


Figure 3 Drainage Map of korba Block

Agriculture and Irrigation**:** Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season, it is done through ground water as well as partly through surface water like canals and other sources.The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops in the block are Paddy, Wheat, Vegetables and pulses.

In some areas, double cropping is also practiced. The agricultural pattern,cropping pattern and area irrigated data of Korba block is given in Table 3 (A, B, C, D, E).

Table 3 (A): Agricultural pattern (in ha)

Block	Total geographical area	Revenue forest area	Area not available for cultivation	Net sown area	Double cropped area	Gross cropped area
Korba	204000	46319	8084	20911	774	21685

Table 3 (B): Land use pattern (in ha)

Block	Total geographical area	Revenue forest area	Area not available for cultivation	Non agricultural & Fallow land	Agricultural Fallow land	Net sown area	Double cropped area	Gross cropped area
Korba	204000	46319	8084	8554	3788	20911	774	21685

Table 3 (C): Cropping pattern (in ha)

Block	Kharif	Rabi	Cereal				Pulses	Tilhan	Fruits Vegetables	Reshe	Mirch Masala
			Wheat	Rice	Jowar & Maize	Others					
Korba	20881	804	22	17294	388	15	2712	705	490	9	50

Table 3 (D):Area irrigated by various sources (in ha)

No. of canal s (private and Govt.)	Irrigated area	No.of bore wells/ Tube wells	Irrigated area	No. Of dug wells	Irrigated area	No. of Talabs	Irrigate d area	Irrigated area by other sources	Net Irri-gated area	Gross irrigat ed area	% of irrigated area wrt. Net sown area
-	102	-	25	-	152	-	3	739	1021	1021	4.71 %

Table 3 (E): Statistics showing Agricultural land Irrigated

Block	Net Irrigated Area	Net Irrigated Area by ground water	Percentage of Area Irrigated by ground water
Korba	1021	177	17.33

Groundwater Resource Availability and Extraction: Based on the resource assessment made, the resource availability in aquifer wise in Korba block is given in the table-4.

Table – 4 (A): Ground Water Budget of Korba block in Ham

Assessment Unit Name	Assessment Unit code	Ground Water Recharge(Ham)				Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)
		Monsoon Season		Non-monsoon season			
		Recharge from Rainfall	Recharge from Other Sources	Recharge from Rainfall	Recharge from Other Sources		
Korba	CGKO0003	6198.94	102.93	836.67	251.49	7390.03	739.01

Table – 4 (B): Ground Water Dynamic Resource of Korba block in Ham

Annual Extractable Ground Water Recharge (Ham)	Current Annual Ground Water Extraction(Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semicritical/Safe)
	Irrigation Use	Industrial Use	Domestic Use	Total Extraction				
6651.02	1095.00	7.94	1012.80	2115.74	860.81	4687.27	31.81	Safe

Table – 4 (C): Ground Water Static Resource of Korba block in Ham

Static Resources Area	**Pre-monsoon water level**	**Bottom of unconfined aquifer**	**Difference**	**Specific Yield**	**Total Static Resources**
204001	7.67	100	92.33	0.002	37670.82

Existing and Future Water Demand (2020)*:* The existing draft for irrigation in the area is 1095 Ham while the total extraction for all uses is 2115.74 Ham. At present scenario to meet the future demand for water, a total quantity of 4687.27 ham of ground water is available for future use.

Water Level Behavior: (i) Pre- monsoon water level: In the pre-monsoon period, it has been observed that in Korba block, water level in dugwells (phreatic aquifer) vary between 3.3 to 11.9 mbgl with average water level of 6.89 mbgl. In semiconfined aquifer, the maximum water level is 20.87 mbgl, the average water level is 10.98 mbgl.

Table 5A: Aquifer wise Depth to Water Level (Pre-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Korba	3.3	11.9	6.89

Water Level (in mbgl)

Table 5B: Aquifer wise Depth to Water Level (Pre-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Korba	4.8	20.87	10.98

(ii) Post- monsoon water level**:** In the post-monsoon period, it has been observed that the water level varies from 1.9 to 10.36 mbgl with an average of 4.76 mbgl in phreatic aquifer. In semiconfined/fractured formation, the post monsoon water level variation range is 2.85 to 22.55 mbgl with average of 8.25 mbgl.

Table 5C: Aquifer wise Depth to Water Level (Post-monsoon)

Block Name	Phreatic Aquifer		
	Min	Max	Avg

Korba	1.9	10.36	4.76

Water Level (in mbgl)

Table 5D: Aquifer wise Depth to Water Level (Post-monsoon)

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Korba	2.85	22.55	8.25

(iii) Seasonal water level fluctuation: The water level fluctuation data indicates that in Korba block, water level fluctuation in phreatic aquifer varies from 0 to 4.74 m with an average fluctuation of 2.13 m. Water level fluctuation in semiconfined Aquifer varies from -5.05 to 11.97 m with an average fluctuation of 2.72 m.

Table 5E: Aquifer wise Depth to Water Level Fluctuation

Block Name	Phreatic Aquifer		
	Min	Max	Avg
Korba	0	4.74	2.13

Table 5F: Aquifer wise Depth to Water Level Fluctuation

Block Name	Semiconfined Aquifer		
	Min	Max	Avg
Korba	-5.05	11.97	2.72

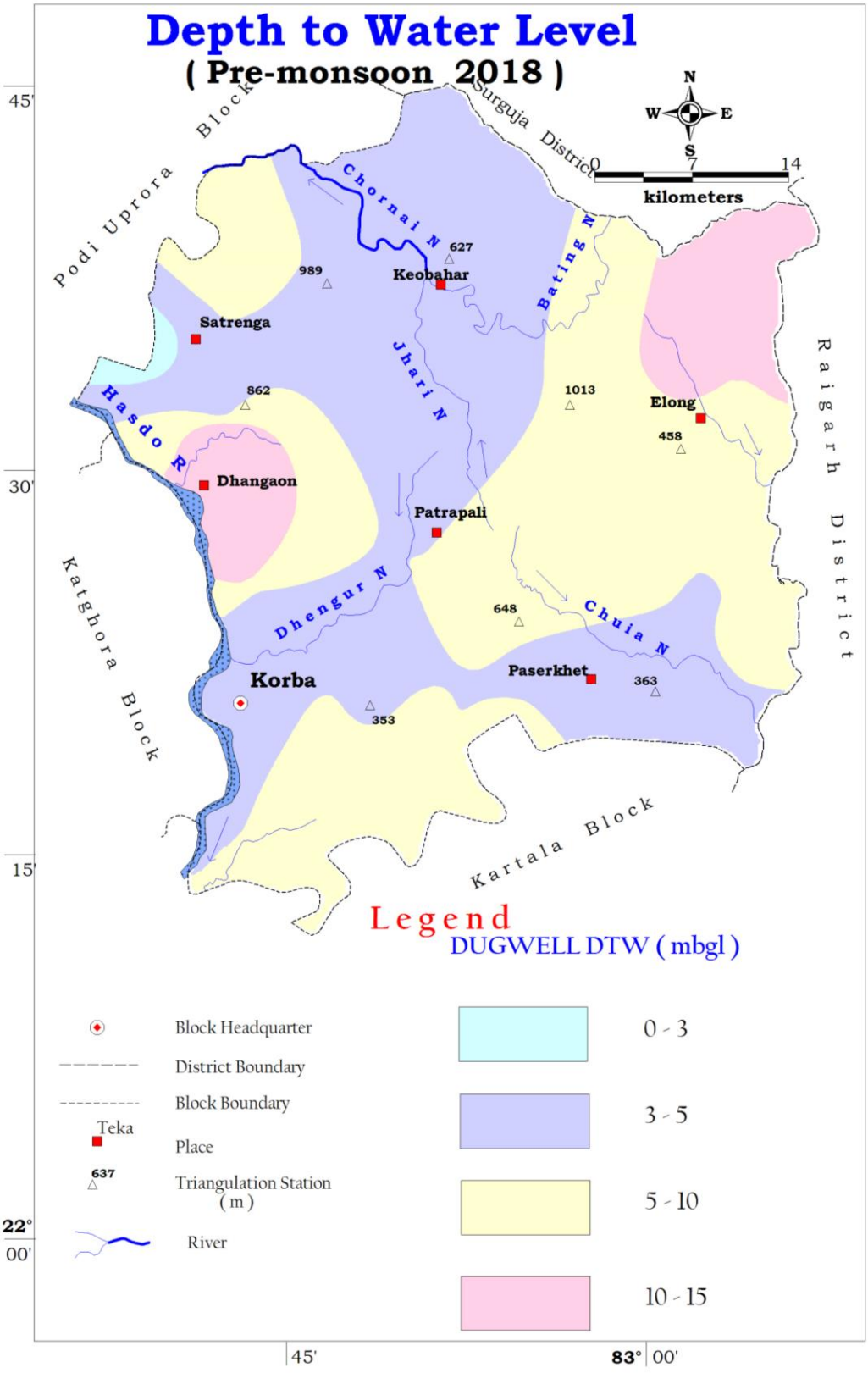


Figure 4 Depth to water level map Phreatic Aquifer (Pre-monsoon)

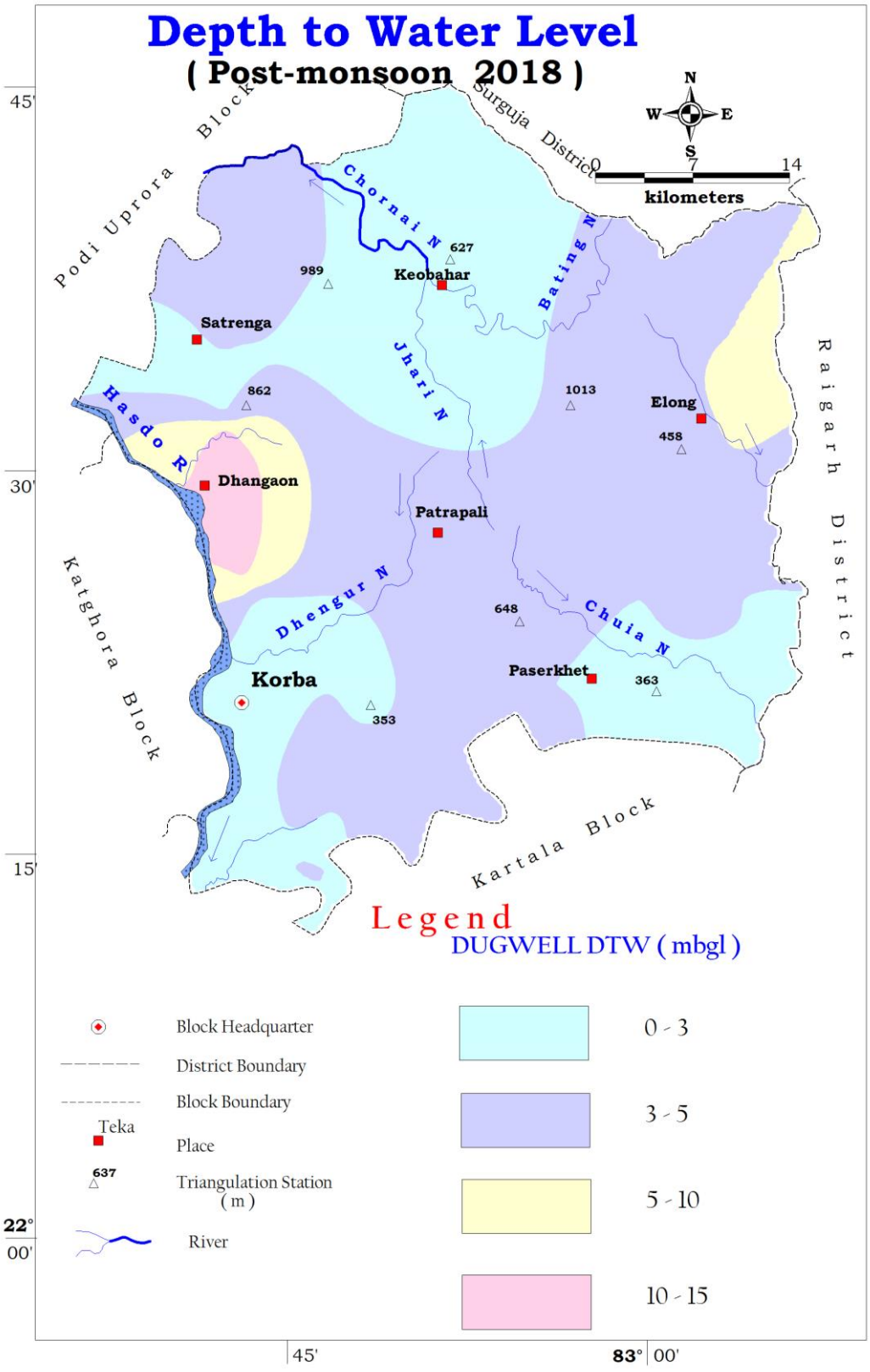


Figure 5 Depth to water level map Phreatic Aquifer (Post-monsoon)

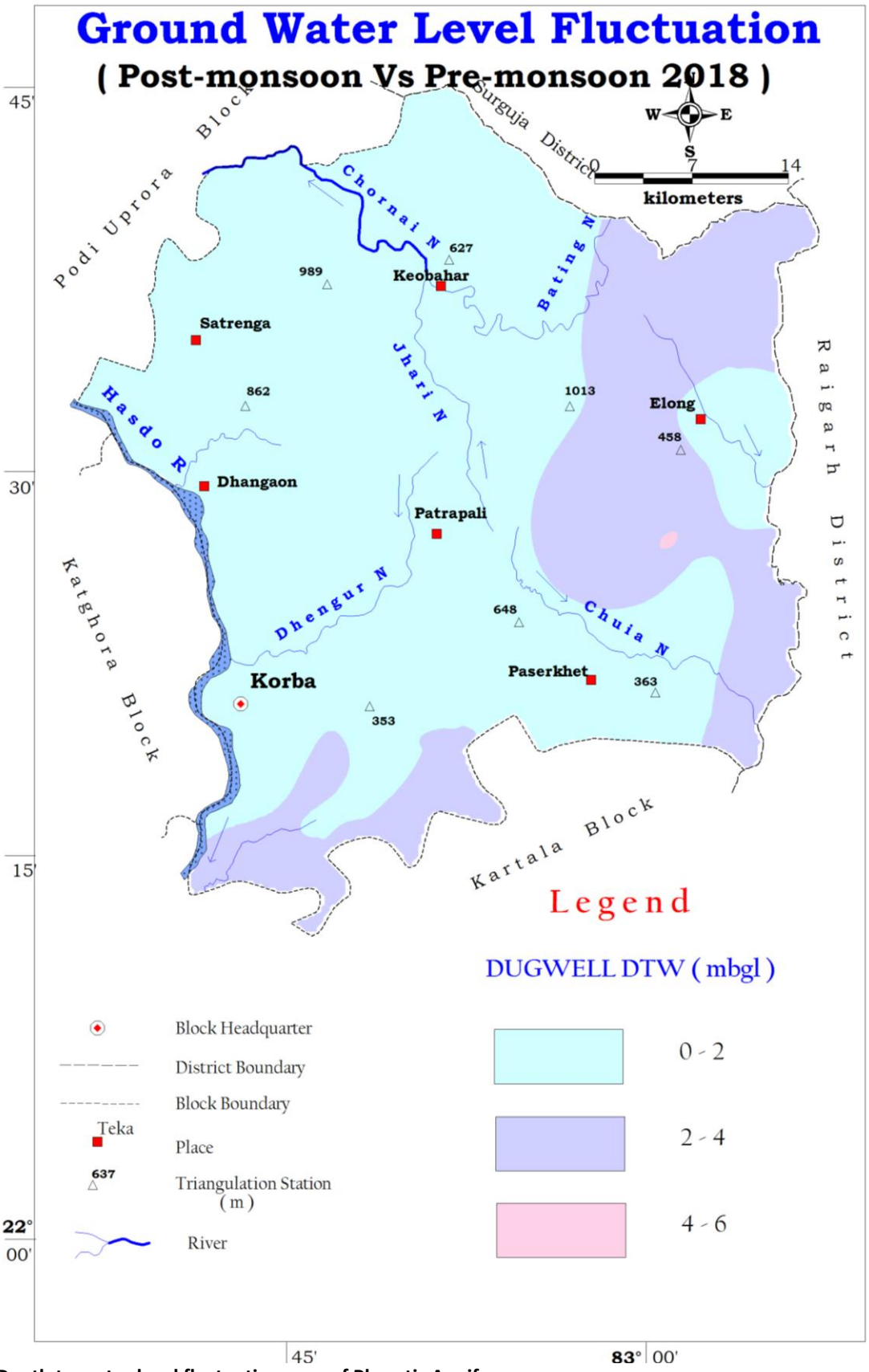


Figure 6 Depth to water level fluctuation map of Phreatic Aquifer

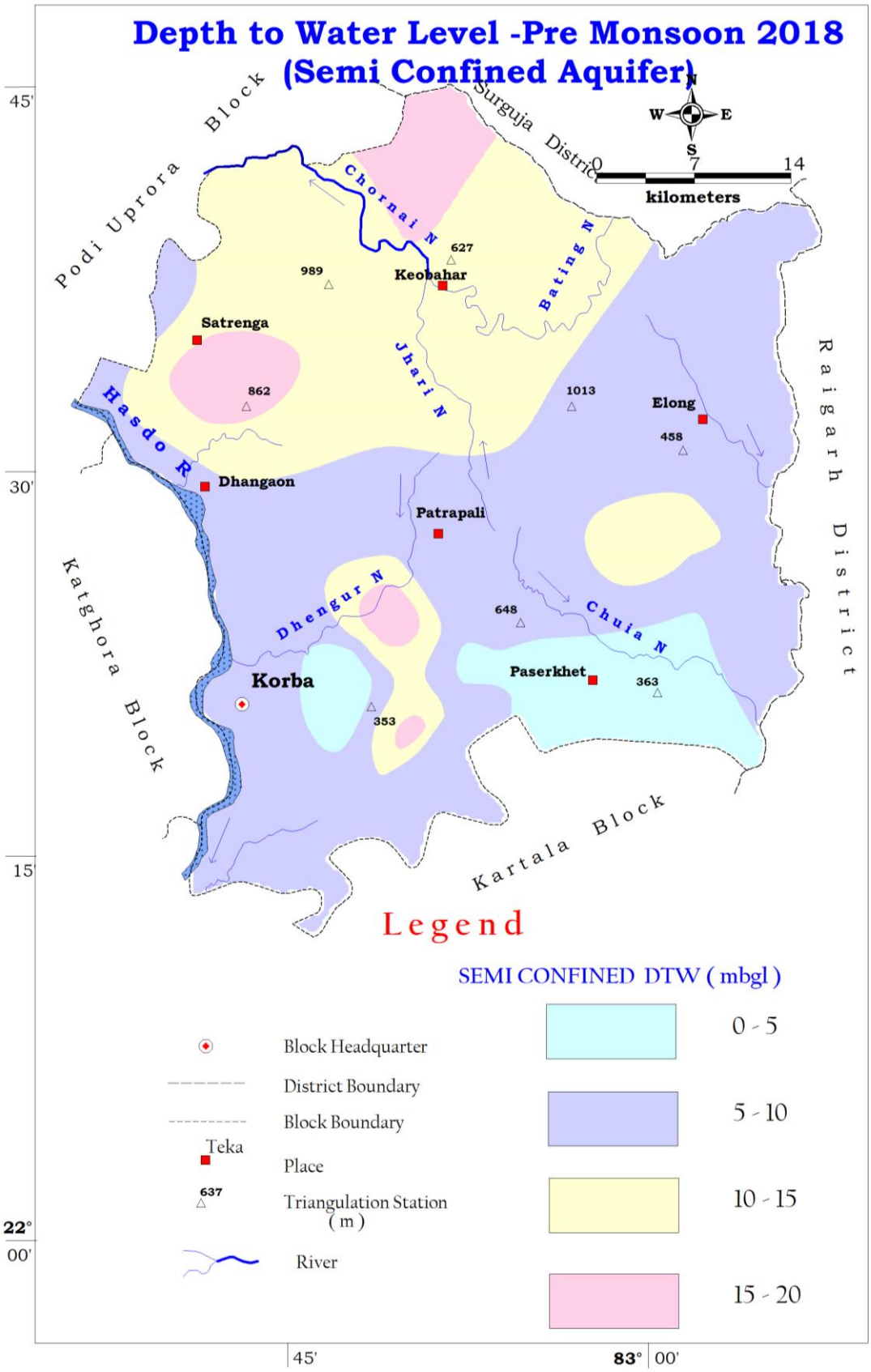


Figure 7 Depth to water level map Semiconfined Aquifer (Pre-monsoon)

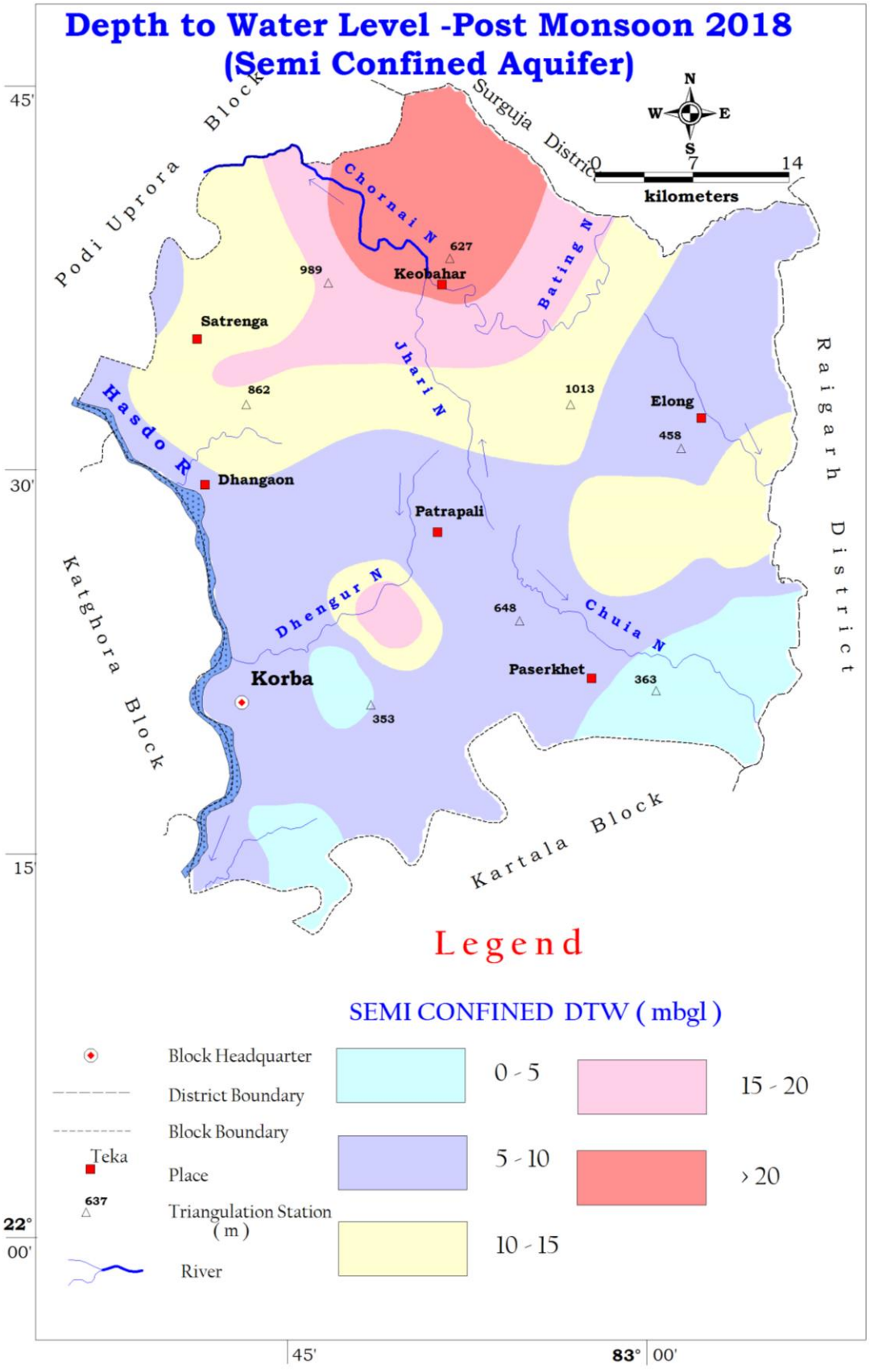


Figure 8 Depth to water level map Semiconfined Aquifer (Post-monsoon)

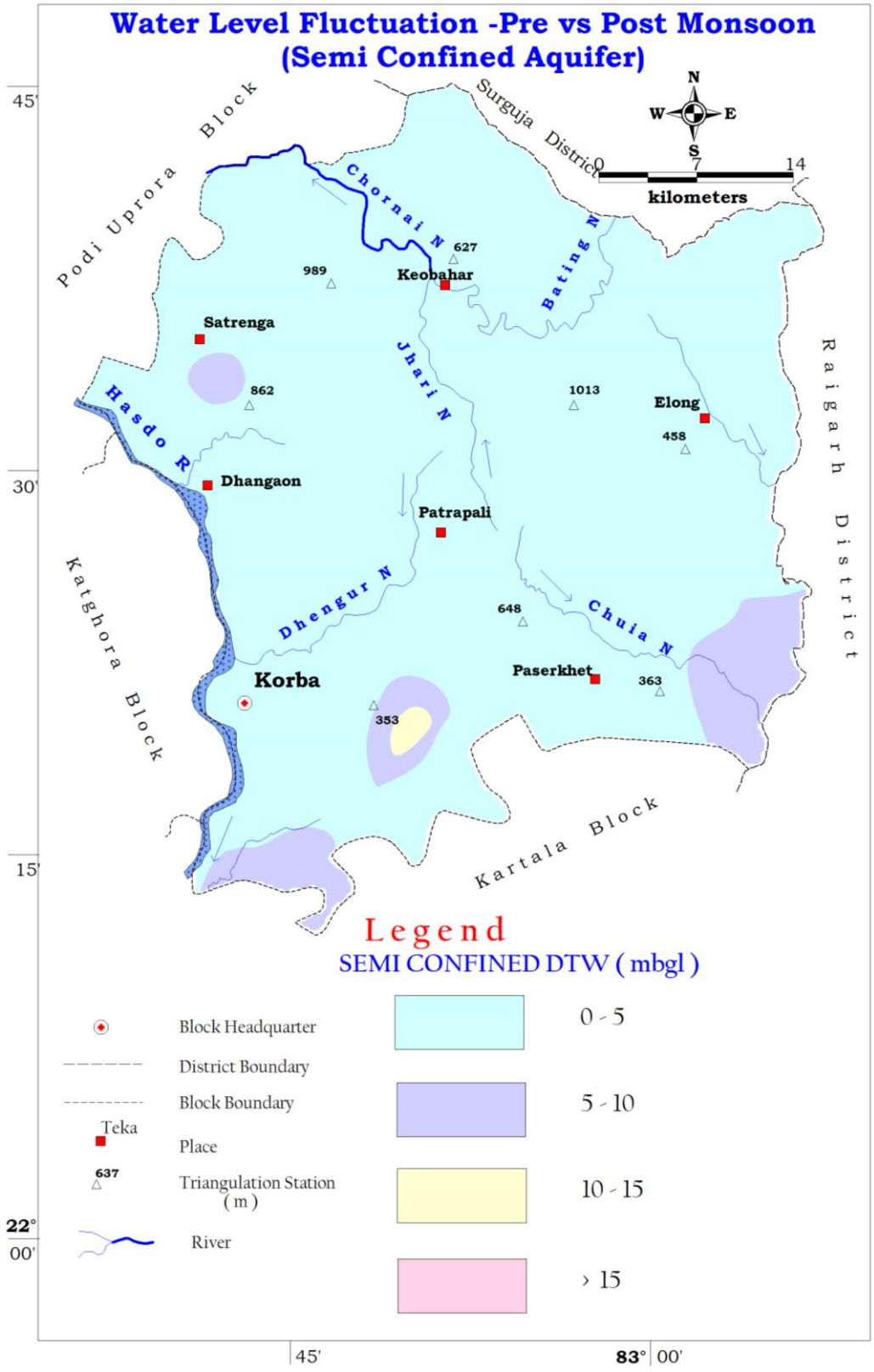


Figure 9 Depth to water level fluctuation map of Semiconfined Aquifer

(iv) <u>The long term water level trend</u>: There is no significant decline in water level in pre and post monsoon period in all observed NHS networks.

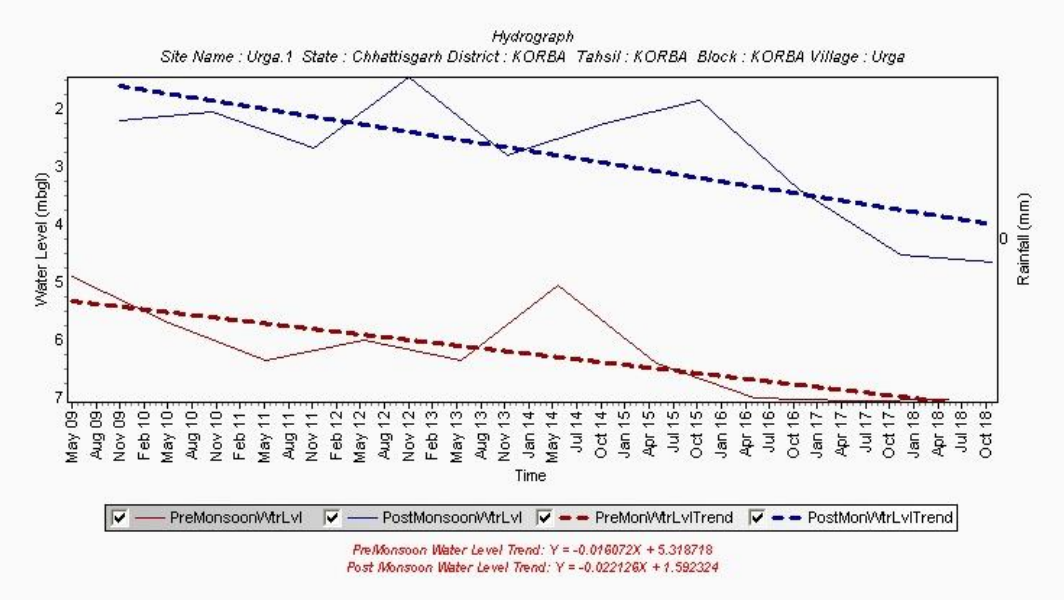


Figure 10 a: Hydrograph of Urga village, Korba block

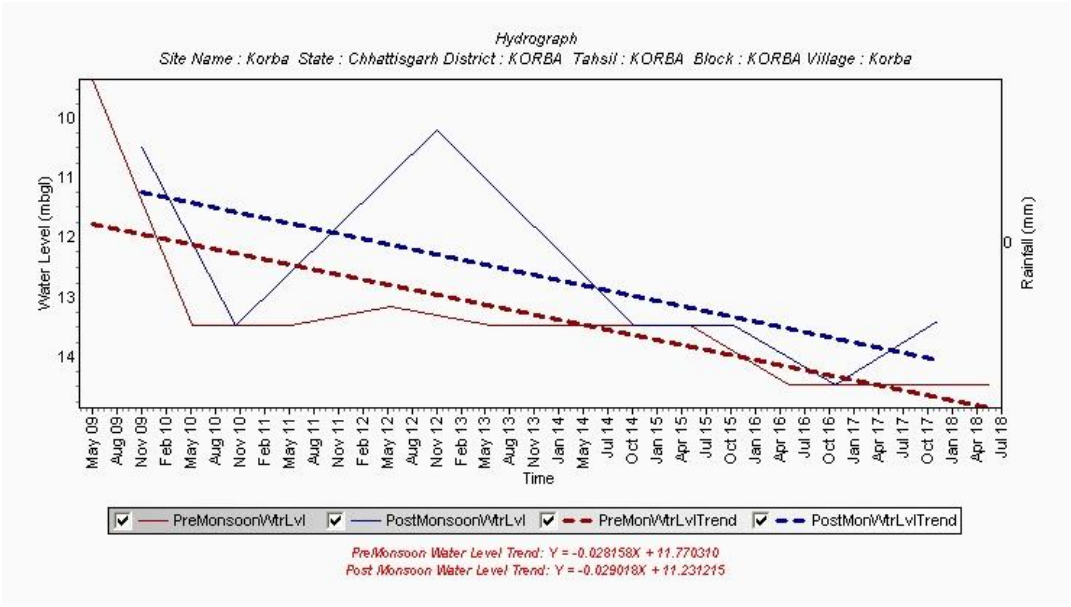


Figure 10 b: Hydrograph of Korba town, Korba block

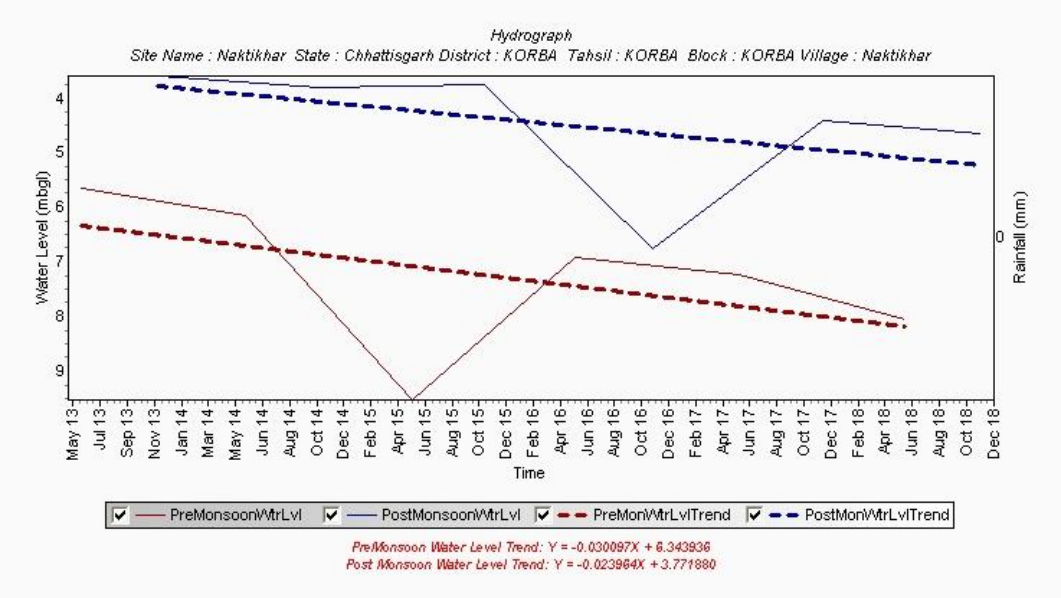


Figure 10 c : Hydrograph of Naktikhar village, Korba block

2. Aquifer Disposition:

Number of Aquifers: There are two major aquifer system viz. Granite Aquifer system and Sandstone Aquifer system. Both the aquifer system have the shallow aquifer and deeper aquifer which occurs in phreatic and Semiconfined condition respectively. Although there are few patches of Laterite, Deccan basalt, unclassified metamorphic, biotite schist and other rocks.

3-d aquifer disposition and basic characteristics of each aquifer:

Sandstone Aquifer System: The average thickness of the weathered portion in the area is around 21 m. In general, the discharge varies from 1 lps to 9.8 lps with an average yield of 4.5 lps. The average drawdown of the formation is around 24.40 m. rotary drilling technique is preferred in sandstone aquifer where well construction is required depending upon the water zone and formation encountered. Water zone has been encountered up to 200 meter. Transmissivity range observed is 3.74 to 115.28 sq meter/day with average of 21.86 sqm /day. Details of the aquifer characteristics and water zone encountered is shown in annexure.

Granite Aquifer System: The average thickness of the weathered portion in the area is around 10.5 m. In general, the discharge varies from negligible to 1 lps. The average drawdown of the formation is around 27 m. DTH drilling technique is preferred in Granite aquifer where well construction is required depending upon the thickness of weathered zone. Water zone has been encountered up to 85 meter in the block. Transmissivity range observed is upto 7.38 sq meter/day.

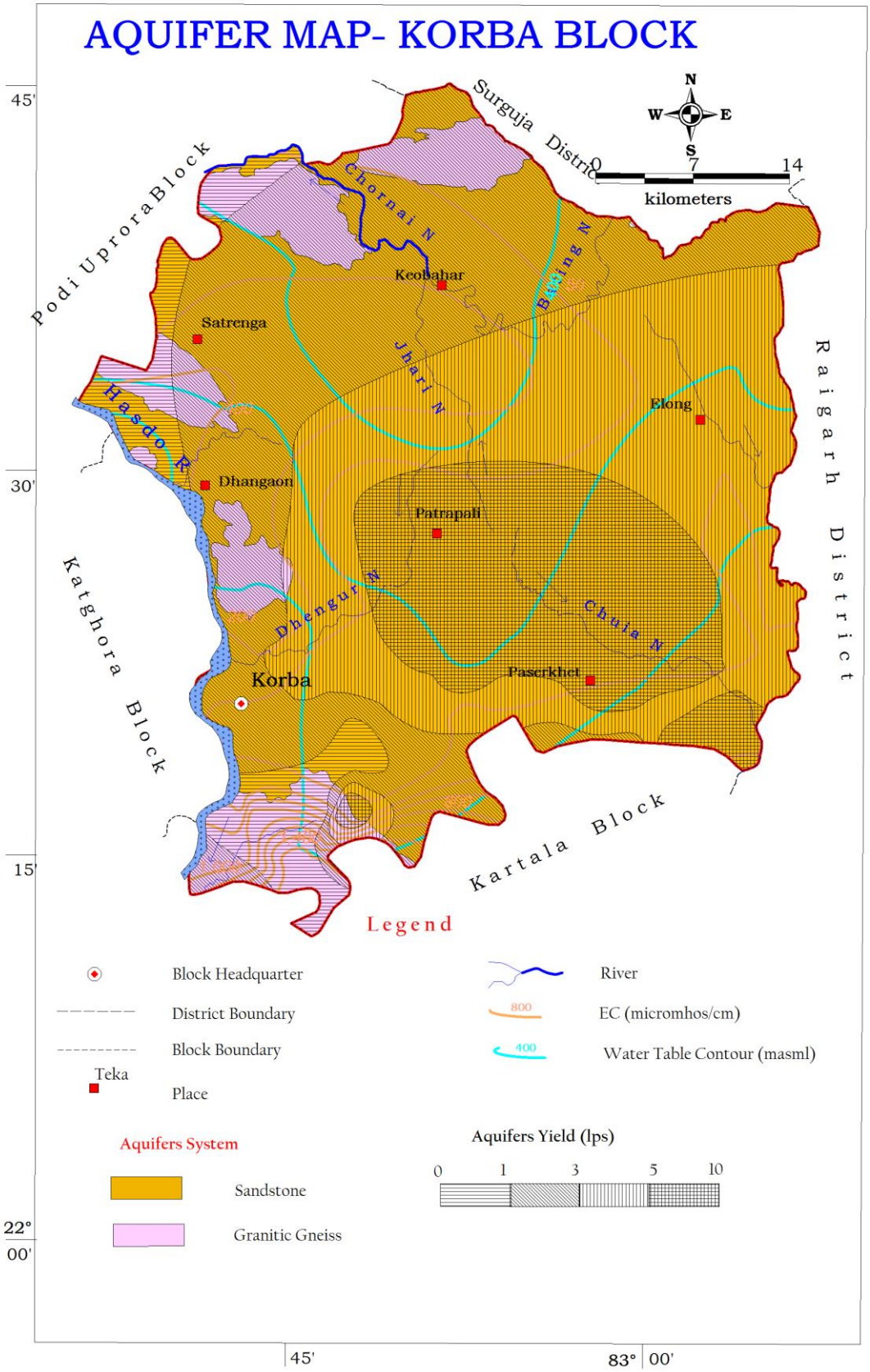
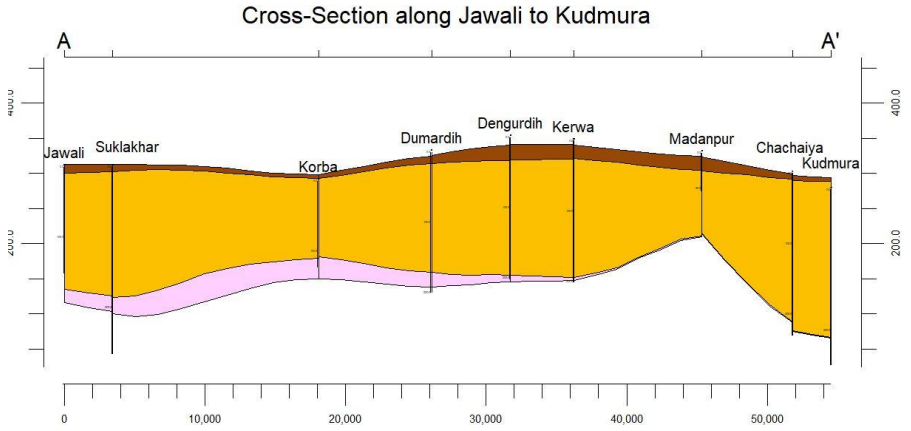
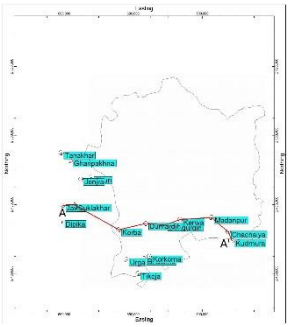
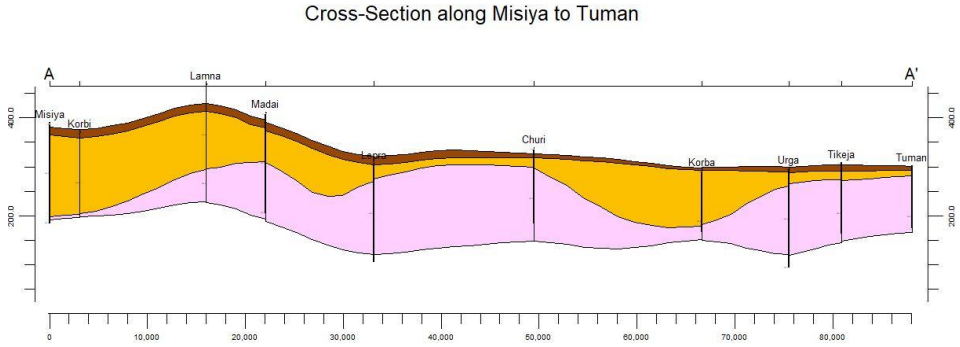


Figure 11: Aquifer map of Korba block

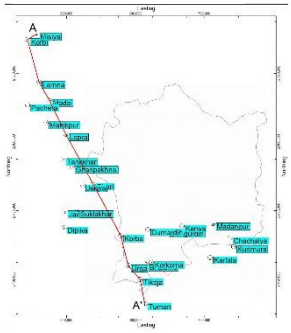


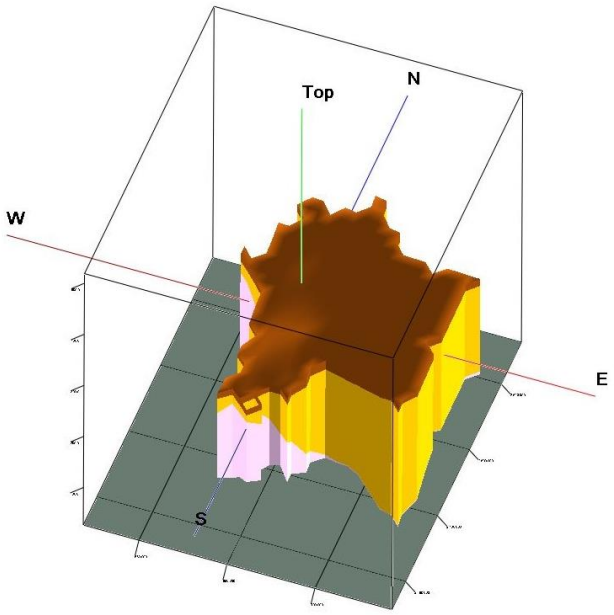
Location Map





Location Map





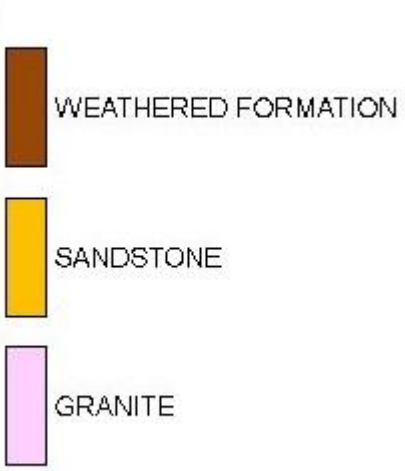


Figure-12, Disposition of Aquifer, Korba Block

3. Ground water Resource, extraction, contamination and other issues:

Resource availability of Korba block is given in the table -4 where net ground water availability for future use is 4378.064 ham. The extraction details and the future scenario (2025) along with the categorisation is also depicted in the table-4.

Table 7 Categorization of Assessment Unit

District	Block	Stage of Ground water development (%)	Categorisation
Korba	Korba	31.81	Safe

Categorisation: Korba block falls in safe category. The stage of Ground water development is 31.81 %. The Net Ground water availability is 6651.02 ham. The Ground water draft for all uses is 2115.74 Ham. The Ground water resource for future uses for Korba Block is 4687.27 Ham.

Chemical Quality of Ground water and Contamination**:** Throughout the study area, the water samples from both dugwell and handpumps were collected and chemical analysis has been completed. (Annexure I & II).

The study conducted in Korba Industrial area reveals that the ground water is polluted by fluoride, nitrate, phosphate, in certain locations. Iron and manganese in ground water have their concentration well above the standard norms for the drinking water. Copper, zinc and chromium also present in water of study area but mostly below the permissible limit.

The industrial effluent discharges by the industries containing high fluoride and phosphate that may be contaminate the nearby ground water sources. Industries should be fulfilling the criteria decided for industrial effluent disposal for the effluent. Nitrate pollution are exists up to shallow aquifer, it is due to poor sanitation condition prevailing around the well. The iron and manganese are observed beyond the permissible limit due to geological formation. Chromium also observed at few places is due to local pollution, otherwise no chromium and lead contamination is prevailing in the study area. The thermal power plant and other industries discharging their effluent in the surfaces water drainage and nearby shallow ground water in most of the area has deteriorated and turned pale to yellow colour of surface water. Not much variation is observed with time in most of the parameter however some parameters are recorded slightly higher than the previous study. Overall ground water of the study area is suitable for the drinking, agriculture and industrial purpose.

4. Ground Water Resource enhancement:

Aquifer wise space available for recharge and proposed interventions:

Table -8: Summarised detail of Volume of porous space available for recharge (Aquifer wise)

Aquifer	Area Identified for Artificial Recharge (Sq Km)	Sp. Yield for the formation	Volume of unsaturated space available for recharge (MCM)
Gondwana sandstone	393.43	0.002	4.4745

5. Issues:

(i) During summer, dugwells in villages are dry except a few locations. Several handpumps also stop yielding water. The aquifer itself is a low yielding one.

(ii) High value of Fluoride and Iron has been reported from several locations (annexure I & II).

6. Management Plan:

6.1 Supply side interventions

(i) It has been observed during fieldwork in pre-monsoon period, there is colossal wastage of groundwater through public water supply system. In this state, the government has dug borewells/ existing handpump of about 150-200feet depth, lowered a pump in the well to draw out water and constructed a small tank to hold water. Unfortunately, people do not switch off the pump once the tank is full. Also the pipes are not fitted with taps to control the flow of water.
So Information, education and Communication (IEC) activities to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance community participation in saving water.

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

(iii) It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At location near urban areas water level is declining, so we have to go for artificial recharge on a long term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in this block to arrest the huge non-committed run-off and augment the ground water

storage in the area. The different types of artificial structures feasible in the block are described in table-9.

Table-9: Types of Artificial Recharge structures feasible

Name of Block	Area Feasible for recharge (sq.km)	Volume of Sub Surface Potential for Artificial recharge (MCM)	Types of Structures Feasible and their Numbers			
			Percolation tank	Check dam	RS	G
Korba	393.43	4.4745	15	49	90	210
	Recharge Capacity (MCM)		3	0.49	0.9	1.05

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

(v) STP may be installed for the treatment of sewage water in proper numbers to avoid contamination of ground water. Treated water may be reused for irrigation and other industrial purposes.

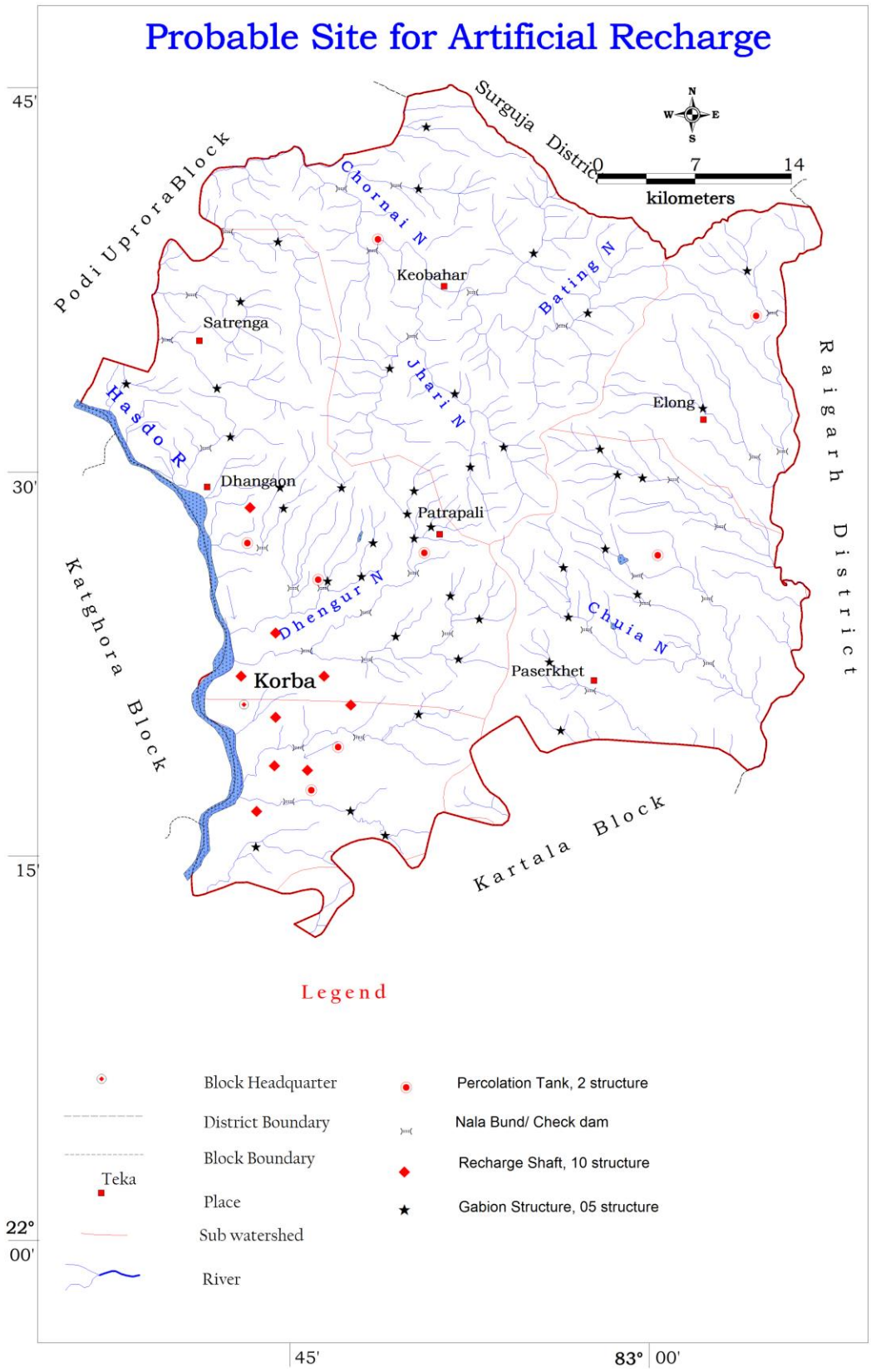


Figure 13: Map of proposed sites for artificial recharge of groundwater in Korba block

6.2 Demand Side Interventions

Since the stage of development in the block is 31.81 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the block

Table 10: Potential of Additional GW abstraction structure creation

Net Groundwater availability (ham)	Stage of ground water Development (%)	Present ground water draft (HaM)	Ground water draft at 70% stage of development (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW Recommended in each block (Assuming unit draft as 1.6 ham/structure/year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/year)
4687.27	31.81	2115.74	3281.089	1165.349	437	647

7. Conclusion:

For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the block (Table: 11).

Table 11: Detail of groundwater saved through change in cropping pattern and other interventios

Block	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham(Assuming 30 % saving)	GW Potential created after Artificial recharge structure in Ham	Development by new GW abstraction structure	Additional GW irrigation Potential created in Ham	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Percent increase in Crop area compare to Gross cropped area
Korba	1095.00	328.5	447.45	1165.35	1941.3	3882.6	17.90%

Annexure I Chemical Analysis of Ground water during NAQUIM study in Korba block

Sl No	Location	Source of Sample	pH	EC at 25°C (µS/cm)	CO3	HCO3	Cl	F	SO4	TH	Ca	Mg	Na	K	Si	PO4
					Concentration in mg/l											
1	Parsabhata	dw	6.75	209	Nil	61	18	0.0	13.6	55	12	6	23.1	1.6	12.7	0.04
2	Parsabhata	hp	7.22	493	Nil	230	32	0.3	6.2	125	30	12	72.3	1.7	11.2	0.037
3	Chhuhiya	hp	7.5	483	Nil	280	7	0.4	0.1	195	56	13.2	21.2	1.1	13.1	0.047
4	Gadkatora	hp	7.6	605	Nil	293	25	1.8	17.8	165	54	7.2	79.5	0.8	14.5	0.049
5	Gaduprora	hp	7.5	391	Nil	119	11	2.9	20.3	95	30	4.8	49	1.7	14.5	0.062
6	Devpahari	hp	7.68	341	Nil	55	46	0.3	18.6	90	12	3.6	58.4	1.2	7.5	0
7	Aretara	hp	7.45	554	Nil	293	28	0.1	19.2	150	42	12	72.5	37.5	6.9	0.001
8	Gahania-Phutamuda	hp	6.69	57	Nil	31	7	0.0	0.8	25	4	3.6	1.7	5.2	10.9	0.005
9	Dumardih(Nehrunagar	hp	6.68	44	Nil	24	7	0.2	0.8	90	6	18	1.8	3.5	10.6	0.07
10	Kesla	hp	7.3	196	Nil	98	11	0.0	11.0	80	20	7.2	12.8	9.1	11.1	0.002
11	Kerwa	hp	6.87	60	Nil	43	7	0.1	0.8	35	6	4.8	1.9	2.6	8.4	0.01
12	Parsakhet	dw	6.79	124	Nil	37	14	0.0	0.4	50	8	7.2	5	5.1	13.5	0.013
13	Basin	hp	6.98	88	Nil	46	7	0.0	0.1	45	12	3.6	1.9	2.1	13.2	0.016
14	Fulsary	hp	7.11	74	Nil	49	7	0.0	1.1	40	4	7.2	1.6	4.1	12.2	0.014
15	Siyang	hp	7.2	107	Nil	61	7	0.0	0.1	60	10	8.4	3.1	2.3	16.8	0.005
16	Gurma	hp	7.22	127.4	Nil	92	7	0.1	0.5	85	12	13.2	2.5	5	12.8	0.007
17	Girari	hp	6.83	300	Nil	49	25	0.0	2.5	75	18	7.2	6	25	12.2	0.004
18	Jilga	hp	7.37	202	Nil	98	14	0.1	1.0	130	14	22.8	5.2	12.4	11.3	0.009
19	Kudmura	hp	7.41	377	Nil	182	18	0.4	2.8	90	26	6	27.1	29.4	8.0	0.012
20	Bhulsidih	dw	7	102	Nil	55	11	0.2	3.0	50	12	4.8	2.9	3.6	12.6	0.019
21	Korkoma	hp	7.08	205	Nil	43	18	0.0	1.4	45	8	6	12.1	22.1	14.0	0.009
22	Mudhunara	hp	6.98	153	Nil	31	11	0.0	0.6	40	10	3.6	3.9	24.6	18.2	0.036
23	Chakamar	hp	6.76	157	Nil	37	14	0.1	0.8	55	8	8.4	6.7	14.4	14.1	0.045
24	Raunadhab	hp	7.29	216	Nil	24	57	0.1	2.1	80	18	8.4	6.5	7.7	13.7	0.004
25	Tilkeja	hp	7.08	1758	Nil	476	202	0.4	93.7	630	150	61.2	76	5.9	26.3	0.004
26	Koddal	hp	7.33	676	Nil	207	64	0.4	48.3	225	62	16.8	38.3	1.1	35.3	0.021
27	Urga	hp	7.49	859	Nil	256	75	0.6	75.1	350	52	52.8	23	2	24.1	0.001
28	Godhi	hp	7.01	133	Nil	31	11	0.0	1.1	40	12	2.4	5.4	7.3	15.5	0.005
29	Barbaspur	hp	7.37	260	Nil	127	7	0.2	5.9	95	32	3.6	11.9	1	10.7	0.004
30	Vikas Nagar	hp	7.28	160	Nil	61	14	0.2	14.7	55	10	7.2	22.1	2.65	18.1	0.007

Annexure II Chemical Analysis of Korba Industrial Area

Physicochemical parameters of ground and surface water of Korba industrial area.

S. No.	Location	Source	Temperature (°C)	pH	EC at 25°C (µS/cm)	TDS (mg/l)	TH	TA
1	Barbaspur	DW	27	8	550	352	145	125
2	Barpali	DW	27	7.2	210	134	55	45
3	Bhaiskhatal	DW	26	8.2	755	483	170	175
4	Bhilai	DW	27	7	424	271	100	25
5	Dadar	DW	27	7.7	583	373	130	50

6	Daganiyakhar	DW	26	6.8	125	80	35	10
7	Delwadih	DW	26	8	490	314	95	60
8	Dumarmunda	DW	27	8.1	1250	800	450	220
9	Gewra ghat	DW	27	7.5	810	518	225	110
10	Gopalpur	DW	26	8.1	175	112	55	45
11	Indira Nagar	DW	27	7.7	1800	1152	530	200
12	Kharmora	DW	28	7.8	240	154	60	25
13	Krishnanagar	DW	27	7.4	338	216	85	35
14	Kuchena	DW	27	7.6	513	328	145	70
15	Kudurmal-1	DW	26	8.2	1510	966	375	410
16	Lata	DW	26	7.8	252	161	55	55
17	Mangaon	DW	27	7.5	538	344	145	60
18	Parsabhata	DW	26	8	210	134	60	65
19	Pondibahar	Dw	26	7.5	425	272	80	35
20	Saliabhata	DW	27	6.6	356	228	65	5
21	Sonpuri	DW	27	7.2	588	376	210	110
22	Suwalpara	DW	28	7.4	735	470	155	10
23	Balrampur	HP	27	7.2	865	554	330	200
24	Bankimongra	HP	27	8.5	697	446	215	255
25	Bhaiskhatal	HP	27	7.7	110	70	45	25
26	Bhilai	HP	26	7.5	204	131	60	10
27	Chhatghat	HP	27	7.5	421	269	165	65
28	Dadar	HP	27	6.1	183	117	55	15
29	Daganiyakhar	HP	26	8.1	160	102	75	75
30	Dumarmunda	HP	27	8.5	881	564	335	275
31	Gewra ghat	HP	26	7.8	809	518	235	35
32	Gopalpur	HP	26	8	577	369	230	150
33	Jamnipali	HP	27	7.2	360	230	95	15
34	Kharmora	HP	27	8	331	212	70	45
35	Kohadiya	HP	28	8.3	288	184	105	90
36	Kosabadi	HP	28	8.3	661	423	190	120
37	Krishnanagar	HP	27	7.8	174	111	70	55
38	Kuchena	HP	28	7.5	96	61	30	15
39	Kudurmal-2	HP	27	7.8	722	462	205	330
40	Kusmunda	HP	27	7.2	329	211	75	15
41	Lata	HP	26	7.7	128	82	55	15

42	Mandwadoda	U/G	26	8	486	311	205	160
43	Mangaon	HP	26	7	117	75	60	60
44	Parsabhata	HP	26	8	485	310	155	225
45	Pondibahar	HP	26	7	350	224	115	30
46	Saliabhata	HP	27	7.8	192	123	50	55
47	satnam nagar	HP	27	8.1	409	262	90	130
48	Semipali	HP	28	8.1	468	300	110	215
49	Serwamangala	HP	28	7.7	78	50	20	20
50	Sitamadi	BW	27	7.7	145	93	50	45
51	Sonpuri	HP	28	7	100	64	35	10
52	Surakachhar	HP	27	7.7	836	535	270	110
53	Suwalpara	HP	27	6.8	550	352	100	35
54	Surakachhar	M/W	26	7.9	294	188	110	100
55	Barpali	TW	26	7.2	65	42	25	20
56	Kudurmal-3	TW	27	7.5	1543	988	455	475
57	Dhanras Ash	SW	26	8.1	292	187	125	65
58	Chhatghat	SW	27	7.7	137	88	50	35
59	Daganiyakhar	SW	27	7.1	76	49	25	15
60	Kolar River	SW	26	8	249	159	110	100
61	Satnam nagar	SW	27	7.9	105	67	50	30
62	Kudurmal-SW	SW	27	7.6	171	109	65	45

HP= hand pump, DW= dug well, SW= surface water,

M/W= mine water, U/G= underground water

Major ions in ground and surface water of Korba industrial area.

S. No	Location	HCO_3	Cl	SO4	NO3	F	Na	K	Ca	Mg	SiO2	PO4
		Concentrations in mg/l										
1	Barbaspur	152	43	50	25	0.4	57.1	3.4	20	23	9.3	0.01
2	Barpali	55	21	26	7	0.3	22.6	2.6	16	4	5.3	0.01
3	Bhaiskhatal	214	75	90	16	0.4	83.3	13.6	50	11	8.8	0.1
4	Bhilai	31	39	37	101	0.3	26.1	28	32	5	5.2	0.05
5	Dadar	61	75	57	80	0.4	55.4	10.2	26	16	4.0	0.04
6	Daganiyakhar	12	18	11	16	0.2	7.1	5.3	10	2	1.8	0.01
7	Delwadih	73	71	51	13	0.3	52.8	12.1	18	12	0.0	0.03

8	Dumarmunda	268	60	310	25	0.8	74	3.3	136	26	9.0	0.04
9	Gewra ghat	134	75	142	65	0.4	64.2	17	60	18	9.4	0.01
10	Gopalpur	55	7	0	45	0.6	14.9	1.3	20	1	12.1	0.03
11	Indira Nagar	244	199	250	210	0.5	143.5	38.4	110	61	4.7	0.02
12	Kharmora	31	21	29	42	0.4	18.9	7.9	10	8	7.0	0.02
13	Krishnanagar	43	25	51	62	0.3	24.7	12.6	22	7	3.3	0.01
14	Kuchena	85	35	50	100	0.2	12.6	57.8	30	17	7.8	0.01
15	Kudurmal-1	500	153	89	27	2.3	180	3.1	30	72	16.2	0.03
16	Lata	67	35	19	2	0.3	29.8	5.1	14	5	3.6	0.01
17	Mangaon	73	57	43	63	0.3	41.5	9.6	40	11	5.8	0.01
18	Parsabhata	79	18	10	8	0.4	20.8	2.5	16	5	5.8	0.1
19	Pondibahar	43	57	0	130	0.3	52.5	25.7	26	4	6.4	0.01
20	Saliabhata	6	39	51	85	0.6	24.7	31.9	16	6	13.1	0.04
21	Sonpuri	134	46	75	48	0.5	51.8	24.5	76	5	15.1	1.2
22	Suwalpara	12	117	57	165	0.2	90.9	25.7	34	17	7.8	0.01
23	Balrampur	244	89	56	49	0.6	40.7	2.8	88	26	5.9	0.03
24	Bankimongra	311	46	21	4	1	63.2	2.8	54	19	6.3	0
25	Bhaiskhatal	31	14	10	1	0.3	1.3	5.3	10	5	8.5	0.5
26	Bhilai	12	18	20	55	0.2	7.1	19.8	14	6	6.0	0.02
27	Chhatghat	79	43	42	50	0.3	8.5	4.8	48	11	11.4	0.1
28	Dadar	18	18	15	44	0.2	9.6	9.9	14	5	8.9	0.02
29	Daganiyakhar	91	7	0	2	0.4	4.1	2.1	20	6	5.8	0
30	Dumarmunda	336	60	30	52	0.5	49.7	1.1	114	12	9.2	0.05
31	Gewra ghat	43	96	131	160	0.3	58.3	9.7	58	22	2.6	0.01
32	Gopalpur	183	35	80	9	0.4	24.8	0.5	64	17	25.6	0.3
33	Jamnipali	18	50	50	38	0.3	26.2	5.2	16	13	5.3	0.02
34	Kharmora	55	43	53	18	0.3	38.8	10.9	10	11	10.0	0.02
35	Kohadiya	110	18	20	15	0.4	17.8	8.6	32	6	25.1	0.4
36	Kosabadi	146	57	84	48	0.4	52.5	14.7	48	17	1.4	0.05
37	Krishnanagar	67	14	0	15	0.2	0.3	5.1	18	6	8.3	0.01
38	Kuchena	18	14	0	19	0.2	4	5	10	1	5.5	0.01
39	Kudurmal-2	403	25	0	0	1.8	81	0.7	40	25	3.9	0.02
40	Kusmunda	18	46	40	70	0.2	24.4	23	18	7	6.1	0.01
41	Lata	18	25	0	26	0.4	6.7	1.7	10	7	14.1	0.01
42	Mandwadoda	195	14	48	0	0.5	14.7	10.1	68	8	2.7	0
43	Mangaon	73	7	0	0	0.4	6.8	3.2	14	6	3.0	0.01

44	Parsabhata	274	11	5	9	0.5	42.1	1.1	42	12	7.4	0.1
45	Pondibahar	37	43	29	56	0.3	16.3	12.3	24	13	8.3	0.04
46	Saliabhata	67	11	18	15	1.7	22.7	0.6	14	4	20.0	0.03
47	satnam nagar	159	35	21	0	0.6	50.7	4.2	28	5	3.8	0.07
48	Semipali	262	14	0	0	1.1	1.8	0.6	38	4	6.0	0
49	Serwamangala temple	24	14	0	3	0.2	6.2	6.8	4	2	14.5	0.01
50	Sitamadi	55	14	0	9	0.3	6.4	8.1	12	5	7.6	0.02
51	Sonpuri	12	28	0	18	0.2	2.1	9.5	6	5	6.8	0.05
52	Surakachhar	134	85	104	90	0.4	61.4	2.4	72	22	3.6	0.02
53	Suwalpara	43	64	83	70	0.3	49.3	16.8	26	8	9.3	0.01
54	Surakachhar	122	14	27	0	0.7	16	8.3	30	8	3.7	0
55	Barpali	25	7	0	15	0.2	1.8	4.6	8	1	3.9	0.02
56	Kudurmal-3	580	131	23	25	1.7	103.3	4.5	152	18	17.9	0.04
57	Ash dump Dhanras	79	7	54	0	2.8	0.5	5.4	40	6	13.0	0.2
58	Chhatghat	43	11	10	1	0.8	6.7	5	12	5	16.4	0.3
59	Daganiyakhar	18	11	0	7	1.5	3.6	4.3	6	2	17.3	0.1
60	Kolar River	122	11	0	1	0.8	13	3.2	28	10	8.6	0.01
61	Satnam nagar	37	7	9	0	0.6	1.8	5.5	10	6	3.8	0.2
62	Kudurmal-sw	55	7	26	3	1	7.5	3.9	16	6	7.0	0.05

Heavy metals in ground and surface water of Korba industrial area.

S. No.	Location	Source	Pb	Fe	Mn	Cu	Zn	Cr
			Concentration in mg/l					
1	Barbaspur	DW	0.005	0.12	bdl	bdl	bdl	0.01
2	Barpali	DW	bdl	0.44	bdl	bdl	bdl	0.04
3	Bhaiskhatal	DW	0.018	0.36	0.2	bdl	bdl	0.014
4	Bhilai	DW	bdl	0.02	0.66	bdl	bdl	bdl
5	Dadar	DW	0.006	0.09	0.1	bdl	bdl	bdl
6	Daganiyakhar	DW	0.01	0.05	0.022	bdl	bdl	0.02

7	Delwadih	DW	bdl	0.15	bdl	0.01	bdl	0.04
8	Dumarmunda	DW	0.009	0.11	bdl	bdl	bdl	0.04
9	Gewra ghat	DW	0.014	0.09	0.23	0.008	bdl	bdl
10	Gopalpur	DW	0.0034	0.15	bdl	bdl	bdl	0.005
11	Indira Nagar	DW	0.015	0.076	bdl	bdl	bdl	bdl
12	Kharmora	DW	bdl	0.132	0.1	bdl	bdl	bdl
13	Krishnanagar	DW	0.016	0.16	bdl	bdl	bdl	bdl
14	Kuchena	DW	bdl	0.048	bdl	0.02	1.3	0.014
15	Kudurmal-1	DW	0.0034	0.08	bdl	0.04	bdl	bdl
16	Lata	DW	0.026	0.06	bdl	bdl	bdl	bdl
17	Mangaon	DW	0.008	0.1	bdl	0.02	bdl	0.02
18	Parsabhata	DW	0.018	0.19	0.036	bdl	bdl	bdl
19	Pondibahar	Dw	0.0045	0.1	0.04	0.32	bdl	0.014
20	Saliabhata	DW	0.011	0.1	0.41	bdl	bdl	0.05
21	Sonpuri	DW	bdl	0.21	bdl	0.02	bdl	bdl
22	Suwalpara	DW	0.008	0.06	0.38	bdl	bdl	0.05
23	Balrampur	HP	0.0028	0.36	bdl	0.02	bdl	0.05
24	Bankimongra	HP	0.015	0.15	0.046	bdl	bdl	bdl
25	Bhaiskhatal	HP	0.012	13.68	0.25	bdl	bdl	bdl
26	Bhilai	HP	bdl	3.7	0.046	0.032	0.31	bdl
27	Chhatghat	HP	0.017	0.73	0.053	bdl	1.24	bdl
28	Dadar	HP	0.008	1.25	bdl	0.008	0.58	bdl
29	Daganiyakhar	HP	0.012	5.99	0.007	0.08	bdl	0.06
30	Dumarmunda	HP	0.012	0.9	0.146	bdl	1.2	0.03
31	Gewra ghat	HP	0.008	1.8	0.51	0.03	bdl	0.04
32	Gopalpur	HP	0.022	0.15	bdl	bdl	0.1	0.02
33	Jamnipali	HP	bdl	.....	0.58	bdl	2.49	bdl
34	Kharmora	HP	0.006	2.99	0.431	bdl	bdl	bdl
35	Kohadiya	HP	0.015	2.49	0.03	bdl	bdl	bdl
36	Kosabadi	HP	0.007	0.46	bdl	bdl	bdl	bdl
37	Krishnanagar	HP	0.008	5.16	0.007	bdl	bdl	bdl
38	Kuchena	HP	0.008	3.26	bdl	0.04	0.38	0.06
39	Kudurmal-2	HP	bdl	3.7	0.053	0.07	bdl	0.03
40	Kusmunda	HP	bdl	2.96	0.007	bdl	0.4	0.02
41	Lata	HP	0.008	6.06	0.038	bdl	bdl	bdl
42	Mandwadoda	U/G	0.01	0.3	0.015	bdl	bdl	0.08

43	Mangaon	HP	bdl	14	0.061	0.032	1.3	0.03
44	Parsabhata	HP	0.015	0.57	0.16	bdl	bdl	bdl
45	Pondibahar	HP	bdl	4.77	0.16	bdl	2.9	bdl
46	Saliabhata	HP	0.02	9.9	0.19	bdl	bdl	0.02
47	satnam nagar	HP	0.0035	1.12	0.038	bdl	0.21	bdl
48	Semipali	HP	0.021	0.64	0.015	bdl	bdl	0.04
49	Serwamangala temple	HP	bdl	0.43	bdl	bdl	bdl	0.04
50	Sitamadi	BW	0.012	1.1	bdl	bdl	bdl	bdl
51	Sonpuri	HP	bdl	8.77	bdl	0.04	bdl	0.04
52	Surakachhar	HP	0.018	0.19	0.007	0.05	bdl	0.02
53	Suwalpara	HP	0.012	2.1	bdl	0.04	0.58	bdl
54	Surakachhar	M/W	0.011	2.5	0.13	bdl	bdl	bdl
55	Barpali	TW	bdl	0.04	bdl	0.02	bdl	0.02
56	Kudurmal-3	TW	0.019	0.72	0.015	0.06	1	0.005
57	Ash dump Dhanras	SW	0.015	0.57	0.25	bdl	bdl	0.01
58	Chhatghat	SW	0.01	1.1	0.18	bdl	bdl	bdl
59	Daganiyakhar	SW	0.0023	0.5	0.046	bdl	bdl	0.04
60	Kolar River	SW	0.015	0.76	0.015	bdl	1.8	bdl
61	Satnam nagar	SW	0.008	0.78	0.038	bdl	bdl	bdl
62	Kudurmal-SW	River water	0.008	1.3	0.015	bdl	bdl	0.01