STUDY ON GROUND WATER RECHARGE IN NCT DELHI

PREFACE

The years 1987, 2002 and 2008 are grim reminders of the failure of the monsoon. Normally, the post-monsoon water table [measured in November] is higher than the pre-monsoon [measured in May]. In these particular years the dependence on groundwater was far more than usual, and in the absence of natural replenishment the yearly hydrographs show that the post-monsoon level was lower than the pre-monsoonal level. This information demonstrates the importance of the groundwater reserve as a buffer in rainfall deficient years, in case of successive years of drought and for providing resilience against climate change.

An uncertain water future has been dogging Delhi for the last two decades. While thus far the gap between supply and demand has been met by mining the aquifer the rate of groundwater exploitation is proving unsustainable. In some areas of South Delhi the fresh water strata has nearly exhausted. Of late, supply side constraints from external surface water resources have begun catching up. Reservoirs in the Himalayas are clouded with uncetainity with local resistance, environmental constraints, Supreme Court directives and seismological threats putting precautionary brakes on construction.

By 2025 the Upper Yamuna Accord will expire and renewal will involve tough negotiations with demands of the other states also increasing. Internal demand is rising, surface resources are static, soft surfaces are being sealed with concretization cutting off rainwater access to the aquifers. This apart, 50% of NCT Delhi is officially urbanized and a total of 900 sq.km. come under the urban heel as per the Master Plan 2021.

Thus, NCT Delhi has no option but to rebuild its underground reserves which are its uncontested internal resource. Options such as roof water harvesting and rain water harvesting at the campus level have been suggested. However, in a decade of efforts no measurable results have emerged. Thus, it is time to recast the artificial recharge strategy in NCT Delhi and nourish the aquifers to secure Delhi’s water future.

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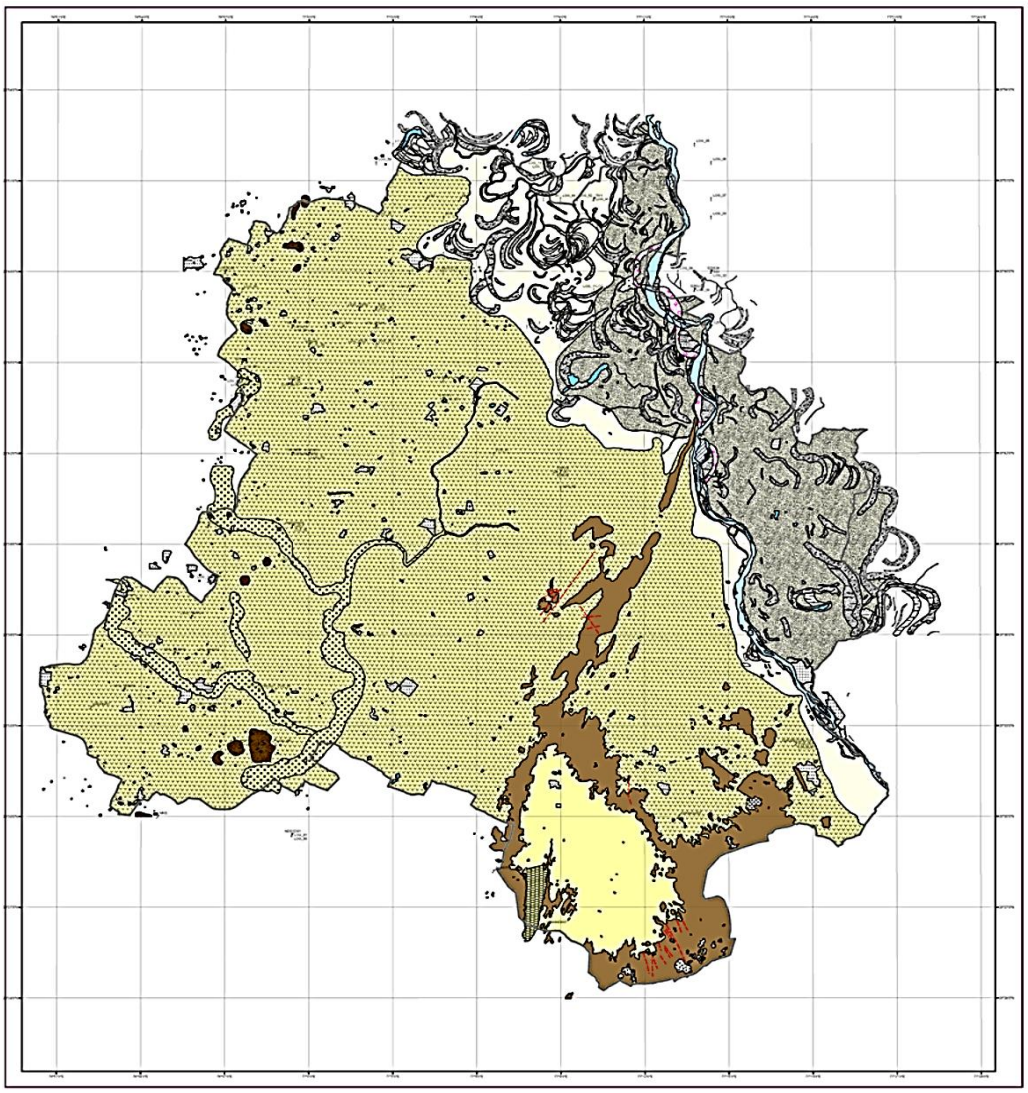
1. Module I: Current Ground Water Scenario In Delhi

1.1 The NCT of Delhi is spread over an area of 1485 sq.km. with at least 7 different landforms posing different technological challenges for the recharge process. Further, these landforms are spread over 6 drainage sub-basins, command areas of 17 STPs and 10 functional CETPs and thus having different resource allocations. As such it is necessary to appreciate the hydro-geological conditions in NCT Delhi.

2.0 Hydrogeology

2.1 The NCT area is constituted of quaternary alluvium and the Alwar quartzites of Delhi super group rocks of the Aravalli Mountain Range. The ridge extending from south to northeast in Delhi represents the northern-most tip of the Aravalli stratigraphy. The territory is occupied by quartzites inter-bedded with mica schist overlain by unconsolidated quaternary to recent sediments.



Map No. 1: Geomorphology Of NCT Delhi [Source : GSI]

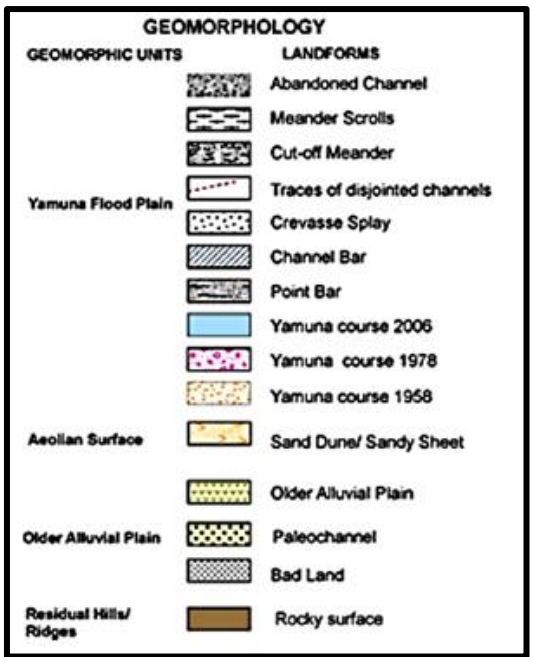


Fig. 1 : Index With Map No. 1 [Source : GSI]

Map No. 2: Geology Of NCT Delhi [Source : GSI]

2.2 Hydro-geologically, the NCT Delhi comprises Pre-Cambrian quartzite rock formation which extend as NE-SW ridge in Delhi. Most area west of the Ridge is occupied with older alluvium that comprises sand, silt, clay, silty clay and kankar beds in various proportions. The kankar occurs both as beds and as nodular lenses. The Younger alluvium is present east of the Ridge alongside Yamuna River. Alluvium forms the main aquifer in the area and is characterized by the presence of number of sand beds which form water bearing zones as aquifers. The Yamuna flood plain is characterised by abandoned channels, cut off meanders, meander scrolls, channel and point bars.

Table No. 1 : Stratigraphic Section of NCT Delhi

Alluvium	Newer Alluvium	Unconsolidated, inter-bedded lenses of sand, silt gravel and clay confined to narrow flood plains of Yamuna river.
	Older Alluvium	Unconsolidated thickness varies upto 300m. Interbedded, inter-fingering deposits of sand, clay and kankar, poor to moderately sorted.
Delhi Super Group	Alwar Quartzites	Well stratified, thick bedded, brown to buff colour, hard and compact, intruded locally by pegmatite and quartz veins interbedded with mica schists.

Source : GSI

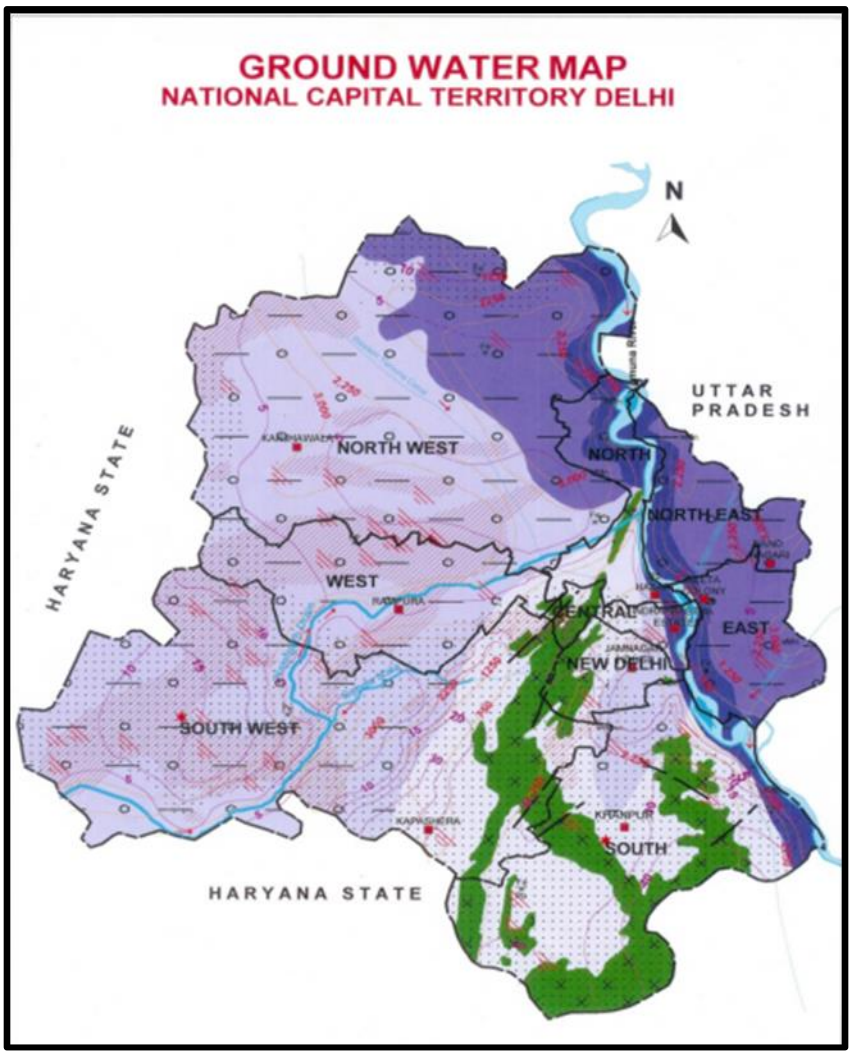
2.3 The Delhi Ridge which is the northernmost extension of the Aravallis mountain consists of quartzite rocks and extends from the southern part to the western banks of the river Yamuna for about 35 kms. The Ridge consists of quartzites. The Ridge forms the principal watershed of the area and acts as groundwater divide between the western and the eastern parts of Delhi.

Hard Rock Formation

2.4 The alluvium is underlain by the Alwar quartzites west of the ridge. The quartzites are grey to brownish grey, massive to thinly bedded, hard, compact, highly jointed/fractured and weathered. The prominent joint sets are strike joints, bedding joints and dip joints. The quartzites are ferruginous and gritty types which on weathering and subsequent disintegration give rise to coarse sand (Badarpur sand). Chemical weathering of deeper horizons is also common. Joints are a few mm to 40mm wide. The nature of bedrock topography is rendered uneven due to the occurrence of sub-surface ridges.

Alluvial Deposits

2.5 The alluvial deposits of Quaternary age are mainly composed of unconsolidated clay, silt, sand with varying proportions of gravel and kankar (pans of lime carbonate). The alluvial formation is further divided into Newer Alluvium, belonging to recent age and referring to the sediments deposited in the flood plains of Yamuna river and also along water courses of major streams flowing from the hills, and Older



Map No. 3: Hydrogeological Map of NCT Delhi [Source : CGWB]

Rock Types	Wells feasible & Formation	Rigs suitable	Depth of Well (m)	Discharge (lpm)	Suitable Artificial Recharge Structures **
Soft Rock	Tube Wells Yamuna Flood Plain	Reverse / Direct Rotary	25-65*	300-2400	Not Feasible
Soft Rock	Tube wells Younger Alluvium	Reverse /Direct Rotary	25-45*	300-1500	Shaft/Trench with recharge well, Recharge Pit with/without bore
Soft Rock	Tube Wells Older Alluvium	Reverse / Direct Rotary	25-90*	120-600	Shaft/Trench with recharge well, Recharge Pit with/without bore
Hard Rock	Tube Wells Quartzites	DTH / Rotary cum DTH	60-120*	90-240	Shaft/Trench with recharge well
Depth to Water level in m (Pre-monsoon decadal mean, 1993-2002) 5		Electrical Conductivity (Micro mhos/cm at 25° C) 3000		Major river / Drain	Faults/Lineaments
Fluoride > Permissible limit (1.5 ppm)		Nitrate > Permissible limit (100 ppm)		Iron > Permissible Limit (1.0 ppm) / * Fe	
State boundary		District boundary		Tehsil boundary	
District head quarter		Over exploited block		Area feasible for Artificial recharge structures	

* Depth of the well is restricted to the availability of fresh water. ** Feasible in areas where depth to water level is more than 8 m below ground level.

Index to Map No.2 [Source : CGWB]

Alluvium which is the sediments deposited as a result of past cycles of sedimentation of Pleistocene age and occurring extensively in the alluvial plains of the territory.

2.6 Newer alluvium, which is confined to the flood plains of Yamuna, is characterised by the absence of permanent vegetation (due to periodic flooding) and lack of kankar and is recent in age. It is mainly formed of sand, silt and clay lenses. The water bearing sands in the newer alluvium, lying in the east and south-east of the ridge, are in close contact with the sands of the Yamuna river bed. The thickness of the newer alluvium is not less than 122m in any location. The newer alluvium along the surface water course consists of generally unconsolidated stream-laid silt, sand and kankar and is impregnated with salt.

2.7 The older alluvium occurs as interbedded lenticular and interfingering deposits of clay, silt, sand and kankar ranging in size from very fine to very coarse with occasional gravel. The kankar or secondary carbonates of lime occur with clay/silt deposits and sometimes as hard/compact pans. The sand component ranges from 8.3% to 2.2% whereas the clay component ranges from 91.7% to 97.8%. The older alluvium occurs in the western part of the NCT of Delhi. Older alluvium is predominantly clayey in nature in major parts of territory excepting the nearly closed alluvial basin of Chattarpur where the alluvial formation is derived from the weathered quartzite rocks.

2.8 In the western and northern areas of Najafgarh, Kanjhawala and Alipur the thickness of alluvium is 300m and more. In the Chattarpur basin the alluvium thickness varies from a few meters near the periphery to 125m in the central part near Satbari bandh. In the City area between the ridge and river Yamuna and the northern parts of Mehrauli the thickness of alluvium increases away from the outcrops and is within 100m at most places. In the flood plains of river Yamuna, covering parts of Alipur, City and Shahdara, the thickness of alluvium varies from 66m to 300m. These areas exhibit predominantly clayey nature of alluvial formation generally beyond shallow depths. The top horizons in the depth range of 10m to 50m are generally sandy in nature.

3.0 Surface Geological Situation

3.1 Down to 450m depth, the CGWB have identified 3 ground water aquifer groups in Delhi. Aquifer–1, the top aquifer is unconfined and occurs down up to 65m depth. A semi-confined aquifer as Aquifer group-2occurs between 65 and 200 m depth range. The 3rd Aquifer group lies beyond 300m depth and is categorised as confined aquifer.

3.2 The curved length of river Yamuna in Delhi is about 50 kms with floodplains having width of 1.5 to 3 kms. The Yamuna floodplains are characterized by a complex geomorphology set up. The total area of active floodplain including river bed is about 97 sq. km. of which about 16.5 sq. km. is under water and the remaining 80.5 sq. km is water logged or has very shallow water table. The flood plain area has been categorised as follows:

- Active flood plain area : This covers the area along the active river bed which gets flooded during the monsoon period. It is underlain by coarser sediments comprising of sand, gravel, and pebbles. The infiltration rate of water in this area is very high. The aquifers available in this area have high transmissivity.

- Flood prone areas: These areas on both sides of the river are characterized by lower elevations and get inundated during heavy rains/floods. These are underlain by finer sediments comprising of fine sand, silt, and clay. Paleo-channels and meander belts located in these areas are suitable for groundwater development and subsequent recharge from flood water.

4.0 Ground Water Occurrence

4.1 The shallow groundwater in the NCT originates from a combination of rainfall, river/canal water and irrigation return flows. Groundwater in the deeper aquifers is mostly recharged as a result of leakage from the upper unconfined aquifer and partly from lateral flow from the north.

4.2 Groundwater occurs under the following three hydro-geological conditions in the NCT Delhi.

i. Alluvial basin of Chhatterpur in the Mehrauli Block, south of Delhi, enclosed within rocky surroundings of the Delhi ridge. The basin acts as a single aquifer under unconfined groundwater conditions.

ii. Alluvial deposits to the west of the ridge. The aquifer is under semi-confined conditions.

iii. Alluvial deposits to the east of the ridge: (i) between the ridge and the Yamuna river, and (ii) east of the Yamuna river. The aquifers here are under semi-confined conditions.

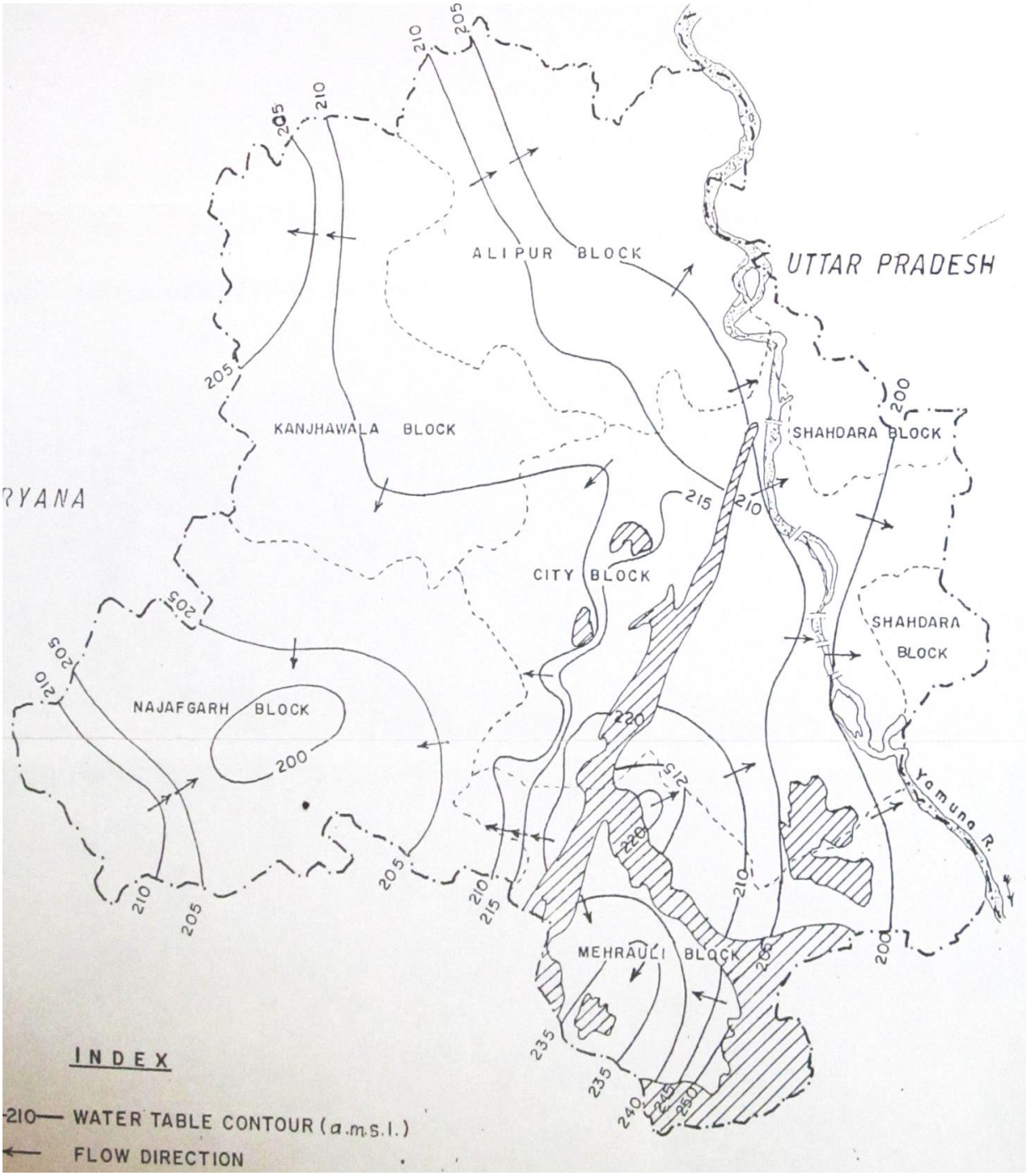
4.3 The water table slopes away from the ridge on both sides. The water table is relatively shallower in northern and north-western parts and deeper levels exist in the southern parts. The south-western part of the NCT has a large groundwater trough at Najafgarh Block. The alignment of the Delhi Branch of the Western Yamuna Canal acts as a groundwater ridge diverting the flow of water to the south-west and east towards the Yamuna.

4.4 The permeable formations are present in the space between the land surface and the water table. By and large the water table configuration follows the general topography.

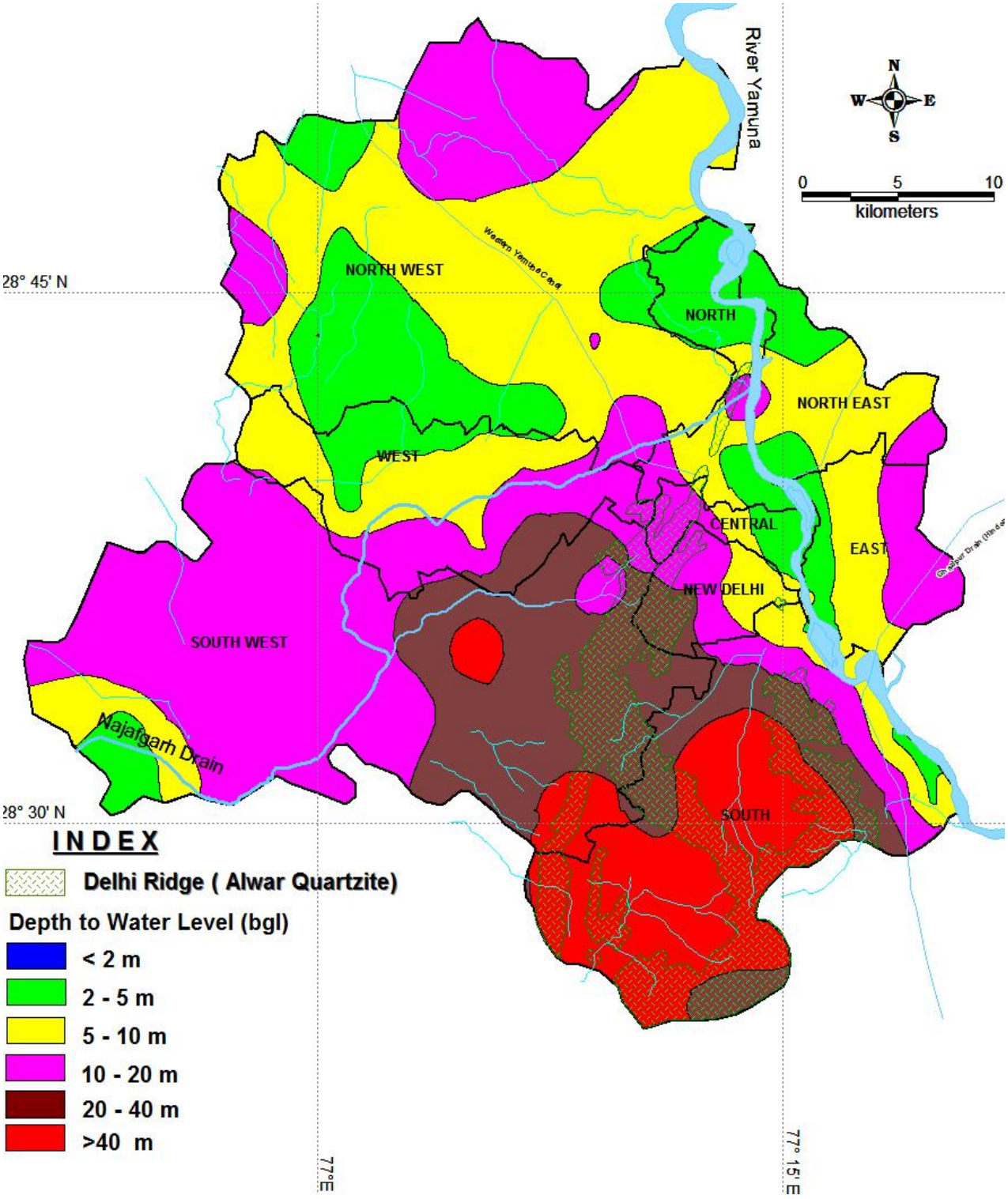
Table No. 2 : Fluctuation in Water Table Depth 2001 - 2010

District	Total No. Of Observation Wells Monitored	No. Of Wells Showing Fall In Ground Water Levels	Minimum Fall (M)	Maximum Fall (M)
Central	2	1	1.91	1.91
East	21	14	0.13	3.34
New Delhi	23	22	0.05	5.83
North	11	9	0.01	1.10
North East	7	5	0.07	0.91
North West	40	27	0.04	3.97
South	39	34	0.04	7.92
South West	46	39	0.05	9.25
West	12	9	0.16	2.36

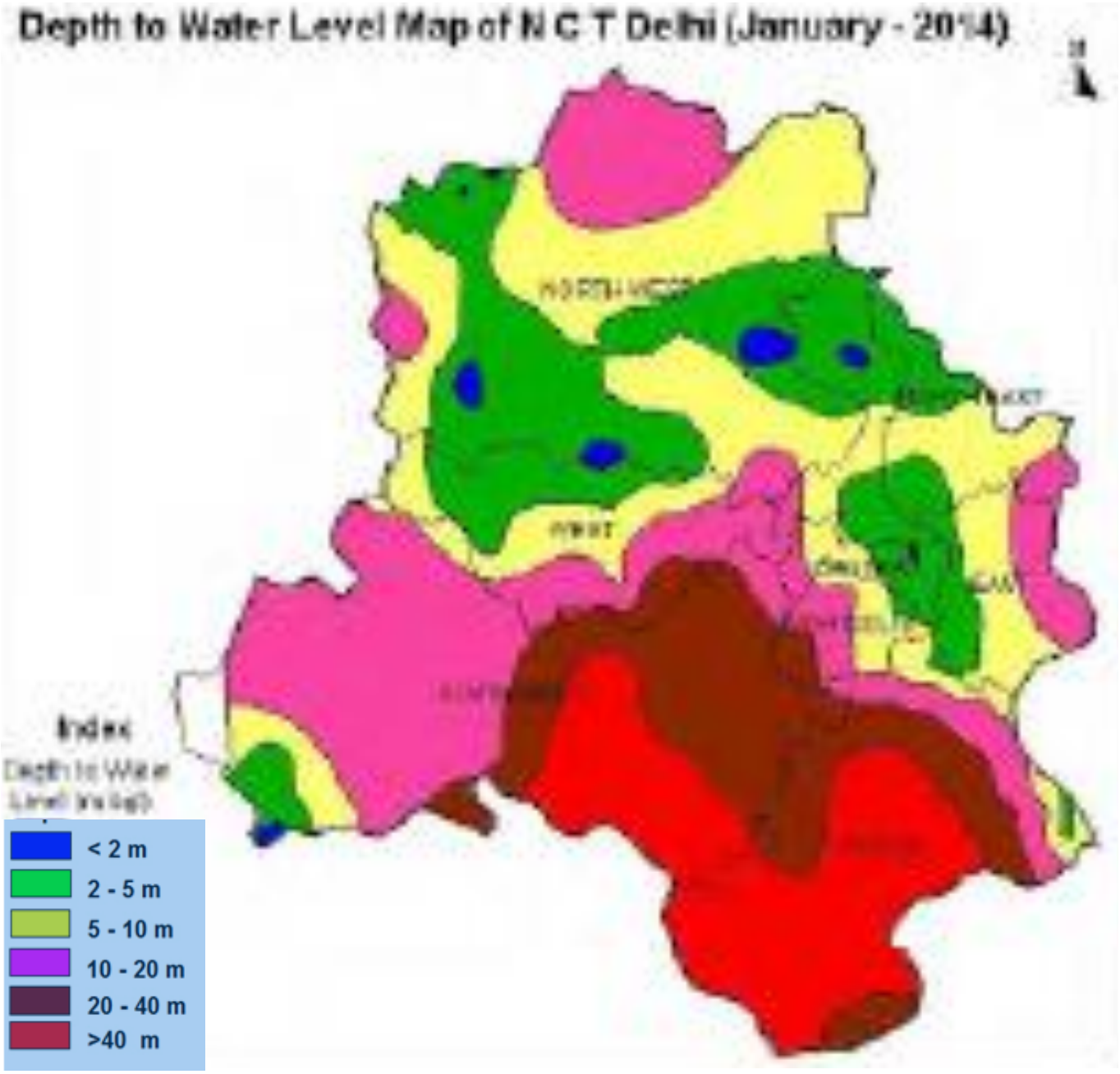
[Source : CGWB]



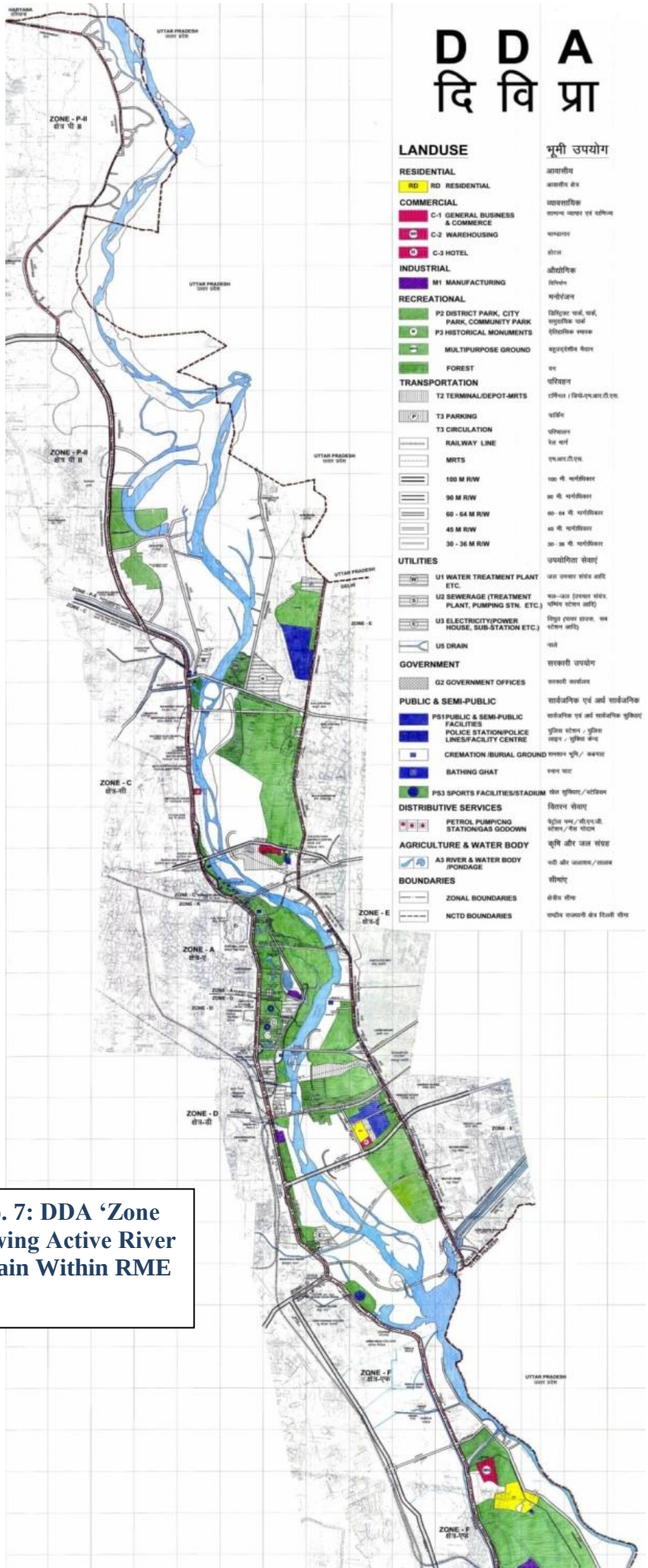
Map No. 4: Ground Water Table Elevation Map [Source : CGWB]



Map No. 5 : Depth to Water Level Map – May, 2013 [Source : CGWB]



Map No. 6 : Depth to Water Level Map - January, 2014 [Source : CGWB]



Map No. 7: DDA 'Zone O' Showing Active River Floodplain Within RME & LME

Map No. 8: Location of Hydrograph Monitoring Stations in NCT, Delhi [CGWB]

Table No. 3 : District, Monitoring Well Location, Measurement Date, Groundwater Level [mbgl]

BLOCK_NAME	DATE_TIME	SITE_NAME	WATER-LEVEL[mbgl]
CENTRAL	31-05-2013 11:00	Rajghat Pz	2.09
EAST	31-05-2013 11:00	Akshardham Temple Pz	4.94
EAST	31-05-2013 11:00	Nizamuddin Bridge-2	4.12
EAST	31-05-2013 11:00	Nizamuddin Bridge-1	4.55
EAST	31-05-2013 11:00	Chillasaroda Pz	8.95
EAST	31-05-2013 11:00	Chilla Regulator	8.19
EAST	31-05-2013 11:00	Ghazipur Crossing Pz	17.66
EAST	31-05-2013 11:00	Mayur Vihar B Block Ph-II	6.46
EAST	31-05-2013 11:00	Nagali Rajapur Pz	3.79
EAST	31-05-2013 11:00	Cbd Shahdara Pz	9.8
NEW DELHI	31-05-2013 11:00	Birla mandir	14.86
NEW DELHI	31-05-2013 11:00	India gate	7.46
NEW DELHI	31-05-2013 11:00	Safdarjung tomb	17.95
NEW DELHI	31-05-2013 11:00	Nehru Park Dw	22.68
NEW DELHI	31-05-2013 11:00	Shram Shakti Bhawan 2	14.87
NEW DELHI	31-05-2013 11:00	Lodhi Graden Dw	13.6
NEW DELHI	31-05-2013 11:00	Lodhi Garden.(SH)	10.06
NEW DELHI	31-05-2013 11:00	Lodhi Garden (D)	10.25
NEW DELHI	31-05-2013 11:00	Presidents Estate-2	12.89
NEW DELHI	31-05-2013 11:00	Presidents Estate-1	20.57
NEW DELHI	31-05-2013 11:00	Shram Shakti Bhawan 3	15.8
NEW DELHI	31-05-2013 11:00	Shram Shakti Bhawan 1	15.38
NEW DELHI	31-05-2013 11:00	Mahabir Vansth.	25.92
NORTH	31-05-2013 11:00	ISBT (Kashmiri Gate) Dw	2.58
NORTH	31-05-2013 11:00	Jagatpur Pz-2	2.13

NORTH	31-05-2013 11:00	Jagatpur Pz-1	2.74	
NORTH	31-05-2013 11:00	Majanu Ka Tila Dw	12.8	
NORTH	31-05-2013 11:00	Burari Auger Pz	3.68	
NORTH	31-05-2013 11:00	Kingsway Camp Police Ground Pz	6.64	
NORTH	31-05-2013 11:00	Burarai-Pz	3.98	
NORTH EAST	31-05-2013 11:00	Gokulpuri E Pz	7.95	
NORTH EAST	31-05-2013 11:00	Gokulpuri W Pz	7.71	
NORTH EAST	31-05-2013 11:00	Ushmanpur Pz	3.88	
NORTH EAST	31-05-2013 11:00	Wazirabad Raf	4.45	
NORTH WEST	31-05-2013 11:00	Auchandi Pz	3.92	
NORTH WEST	31-05-2013 11:00	Balsawa Landfill	6.73	
NORTH WEST	31-05-2013 11:00	Barwala Pz	5.62	
NORTH WEST	31-05-2013 11:00	Jaunti Dw	12.97	
NORTH WEST	31-05-2013 11:00	Kanjhawala (pz)	1.97	
NORTH WEST	31-05-2013 11:00	Sainik Vihar Pz	2.81	
NORTH WEST	31-05-2013 11:00	Bakoli - Shallow Pz	9.27	
NORTH WEST	31-05-2013 11:00	Bakoli- Deep Pz	9.29	
NORTH WEST	31-05-2013 11:00	Rohini Sector - 11	7.06	
NORTH WEST	31-05-2013 11:00	Rohini Sec-28	5.22	
NORTH WEST	31-05-2013 11:00	Haiderpur Pz	10.27	
NORTH WEST	31-05-2013 11:00	Singhola Pz	14.14	
NORTH WEST	31-05-2013 11:00	Ashok Vihar - IV	12.48	
NORTH WEST	31-05-2013 11:00	Qatlupur Pz	2.35	
NORTH WEST	31-05-2013 11:00	Bankner-Pz	17.97	
NORTH WEST	31-05-2013 11:00	Tiggipur Shallow Pz	6.7	
NORTH WEST	31-05-2013 11:00	Tiggipur Deep Pz	8.32	
NORTH WEST	31-05-2013	Balswa Lake	2.23	

	11:00			
NORTH WEST	31-05-2013 11:00	Rani Khera	3	
NORTH WEST	31-05-2013 11:00	Nizampur	7.64	
NORTH WEST	31-05-2013 11:00	Mubarakpur	3.68	
NORTH WEST	31-05-2013 11:00	Khera Kalan Pz	6.12	
NORTH WEST	31-05-2013 11:00	Delhi College of Engineering	5.88	
NORTH WEST	31-05-2013 11:00	Hareoli Dw	4.58	
NORTH WEST	31-05-2013 11:00	Bawana Dw New	7.57	
NORTH WEST	31-05-2013 11:00	Mangolpuri Pz	3.4	
NORTH WEST	31-05-2013 11:00	Palla Zero RD	7.64	
NORTH WEST	31-05-2013 11:00	Palla Temple	5.63	
NORTH WEST	31-05-2013 11:00	Majara Dabas	3.87	
NORTH WEST	31-05-2013 11:00	BBMB Narela Pz	17.03	
SOUTH	31-05-2013 11:00	Bhatti-Pz	47.98	
SOUTH	31-05-2013 11:00	Jheel Khoh	50.02	
SOUTH	31-05-2013 11:00	Ayanagar Pz	44.8	
SOUTH	31-05-2013 11:00	Madan Gir	53.56	
SOUTH	31-05-2013 11:00	Humayun Tomb	6.4	
SOUTH	31-05-2013 11:00	Kalindi Kunj Barrage Pz	4.74	
SOUTH	31-05-2013 11:00	Jaunapur DJB	55.15	
SOUTH	31-05-2013 11:00	Balbir Nagar	20.4	
SOUTH	31-05-2013 11:00	Satbari Pz	45.2	
SOUTH	31-05-2013 11:00	Saket D Block Pz	56.38	
SOUTH	31-05-2013 11:00	Pusp Vihar Pz	66.22	
SOUTH	31-05-2013 11:00	Gadaipur Pz	56.43	
SOUTH	31-05-2013 11:00	Fatehpur Beri Pz	50.63	
SOUTH	31-05-2013 11:00	Asola Pz	50.17	

SOUTH	31-05-2013 11:00	Sultanpur IMS	54.33	
SOUTH	31-05-2013 11:00	Jaitpur Khadar RD-3500	6.6	
SOUTH	31-05-2013 11:00	Jaitpur Khadar RD-2600	4.7	
SOUTH	31-05-2013 11:00	Madanpur Khadar	4.4	
SOUTH	31-05-2013 11:00	Hauz Khas Pz	35.15	
SOUTH	31-05-2013 11:00	Sundar Nursery Pz	7.75	
SOUTH	31-05-2013 11:00	Jamali Kamali	30.2	
SOUTH WEST	31-05-2013 11:00	Daryapur Khurd	4.49	
SOUTH WEST	31-05-2013 11:00	Mandela Khurd Pz	13.3	
SOUTH WEST	31-05-2013 11:00	Jharoda Kalan Pz	14.23	
SOUTH WEST	31-05-2013 11:00	Dichaon Kalan	11.94	
SOUTH WEST	31-05-2013 11:00	Tagore Garden Pz	9.82	
SOUTH WEST	31-05-2013 11:00	Chawla	14.82	
SOUTH WEST	31-05-2013 11:00	Najafgarh Town	19.78	
SOUTH WEST	31-05-2013 11:00	JUN Pz-13 Upstreem	37.48	
SOUTH WEST	31-05-2013 11:00	JUN Pz-3 (D) Downstream	29.7	
SOUTH WEST	31-05-2013 11:00	CVD Depot Cant (Sh)	21.23	
SOUTH WEST	31-05-2013 11:00	CVD Depot Cant (Md)	21.95	
SOUTH WEST	31-05-2013 11:00	Jhuljhuli Pz	3.05	
SOUTH WEST	31-05-2013 11:00	Dwarka Sect.-20	14.28	
SOUTH WEST	31-05-2013 11:00	CVD Depot Cant (Dp)	20.5	
SOUTH WEST	31-05-2013 11:00	Palam Signal Camp	54.22	
SOUTH WEST	31-05-2013 11:00	Kabul Line Pz	26.9	
SOUTH WEST	31-05-2013 11:00	Kirbi Place Pz	24.19	
SOUTH WEST	31-05-2013 11:00	Nicolsan Range Pz	13.5	
SOUTH WEST	31-05-2013 11:00	Shekhawati Line Pz	40.41	
SOUTH WEST	31-05-2013	Ojwah Pz	15.43	

	11:00		
SOUTH WEST	31-05-2013 11:00	Issapur Khera Pz	10.01
SOUTH WEST	31-05-2013 11:00	Daulatpur Pz	16.98
SOUTH WEST	31-05-2013 11:00	Raota	2.71
SOUTH WEST	31-05-2013 11:00	Jhuljhuli Dw	2.16
SOUTH WEST	31-05-2013 11:00	Sikarpur Shallow	12.07
SOUTH WEST	31-05-2013 11:00	Dwarka Sec-16 (Tp)	18.42
SOUTH WEST	31-05-2013 11:00	PUSA (WTC)	20.65
SOUTH WEST	31-05-2013 11:00	PUSA Indrapuri Gate	23.44
SOUTH WEST	31-05-2013 11:00	PUSA (NRL)	19.17
SOUTH WEST	31-05-2013 11:00	Deorala Pz	2.11
WEST	31-05-2013 11:00	Baprola Dw	3.85
WEST	31-05-2013 11:00	Hiran Kudna Dw	5.53
WEST	31-05-2013 11:00	Tikri Kalan Pz	8.62
WEST	31-05-2013 11:00	Tilangpur Kotla Dw	8.09
WEST	31-05-2013 11:00	Vikashpuri Pz	12.78
WEST	31-05-2013 11:00	Mayapuri Pz	35.54
WEST	31-05-2013 11:00	Peera Garhi Pz	5.71
WEST	31-05-2013 11:00	Janakpuri Pz	9.52
WEST	31-05-2013 11:00	Nangloi Pz	3.53

Source : CGWB

5.0. Stage of Groundwater Development

The **fluctuation analysis** of water level during January, 2014, when compared with the decadal mean (January 2004-2013) indicates that in general there is rise as well as fall in water level.

- About 48 % of analysed wells have shown rise in water level
- Out of this 42 % of the wells have shown rise in the range of 0-2 m, 6 % of analysed wells have shown rise in the range of 2 to 4 m
- About 52% wells have shown a decline in water level. Out of this 30 % of the wells have shown decline in water level in the range of 0-2 m, 15% of the wells

have shown decline in water level in the range of 2-4 m, 8 % of the wells have shown decline in water level in the range of more than 4 m

5.1 **Water Level Fluctuation – January, 2014 to January, 2013 [Post Monsoon to Post Monsoon] :** Water level data of January 2014 was compared to January 2013 and the analysis shows that there is rise in water level in about 64 % of the wells and fall in about 36% of the wells analysed. Out of 64% wells showing rise, 57% shows rise in 0-2 m range. Almost all the 36% wells have shown fall in 0-2m range. Maximum rise in water level has been recorded as 4.48 m and maximum fall in water level has been recorded as 2.10 m in the State.

5.2 **Water Level Fluctuation – January, 2014 to May, 2013 [Post Monsoon to Pre-Monsoon] :** Water level of Pre Monsoon 2013 when compared to water level of January 2014 in the state indicates that about 83 % of the wells analysed have recorded a rise in water level, out of which 66 % of analysed wells have recorded a rise in the range of 0 to 2 m, 14 % of analysed wells have shown rise in the range of 2 to 4 m and 3% of the wells have shown rise more than 4 m. About 17 % of the wells have shown fall in water level, out of which 16 % fall in the range of 0 to 2m.

5.3 Except for a small area in Central and North Districts the water table is overexploited. The average level of exploitation in Delhi is 170 %.

Table No. 4: Groundwater Development of the NCT Delhi [2013]

	Assessment Unit	Stage of Groundwater Development %	Categorisation Of Future Groundwater Development
1.	Central	88.08	Safe
2.	East	130.27	Over-exploited
3.	North	34.61	Safe
4.	New Delhi	170.82	Over-exploited
5.	North East	129.15	Over-exploited
6.	North West	136.31	Over-exploited
7.	South	243.00	Over-exploited
8.	South West	214.41	Over-exploited
9.	West	111.56	Over-exploited
	TOTAL	**170.28**	

Source: CGWB

5.4 As per CGWB [2013] the total annual groundwater draft in Delhi is 389 MCM and the net natural recharge is 281 MCM resulting in an overdraft of 108 MCM. [see Table No. 5]. In view of this overdraft the CGWA has notified most parts of NCT Delhi as areas where no new tube wells can be installed except with specific permission of the authorities for drinking water purposes only.

5.5 The groundwater consumption by sector is :

- Irrigation 40%
- Domestic Sector 50%
- Industrial Sector 10%

5.6 **Depth to Water Table : January, 2014**

The depth to water level recorded in NCT Delhi during January 2014 ["Ground Water Scenario In India – January, 2014", CGWB], ranged from :

- 0.70 m bgl (NW District) to 72.96 mbgl (SW District)
- 8% of the wells show water level in the range of 0-2 mbgl
- About 20 % of wells show water level in the range of 2-5 mbgl
- About 27% of wells show water level in the range of 5-10 mbgl
- 24 % wells show water level in the range of 10-20 mbgl
- Deeper water level in the range of 20-40 mbgl and more than 40 mbgl are shown by 10% & 11% of the wells analysed respectively.

5.7 As per CGWB the water table depth obtaining district-wise was :

- In Central District the water table depth ranges between 2.0 – 10.0 mbgl
- In East District the water table depth ranges between 2.0 – 10.0 mbgl
- In New Delhi District the water table depth ranges between 5.0 – 20.0 mbgl
- In North-East District the water table depth ranges between 2.0 – 8.0 mbgl
- In North-West District the water table depth ranges between 2.0 – 10.0 mbgl
- In South District the water table depth ranges between 8.0 – 60.0 mbgl
- In South-West District the water table depth ranges between 2.0 – 15.0 mbgl
- In West District the water table depth ranges between 2.0 – 15.0 mbgl

Table No. 5 : Groundwater Draft Development of the NCT Delhi [ham]

S.No	Assessment Unit	GW Draft [domestic purpose]	GW Draft [industrial purpose]	GW Draft for Irrigation	Total Draft
1.	Central	165.18	0	0	165.18
2.	East	466.17	179.38	141.99	787.54
3.	North	254.56	0	0	254.56
4.	New Delhi	509.49	0	0	509.49
5.	North East	810.54	192.92	150.01	1153.5
6.	North West	821.75	1607.14	9799	12228
7.	South	7428.13	805.72	109	8342.9
8.	South West	11766.6	438.97	8567	20773
9.	West	1421.2	1075.44	1234.99	3731.6
	TOTAL	23643.61	4299.57	20002	38945*

Source : CGWB

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6.0 Groundwater Quality

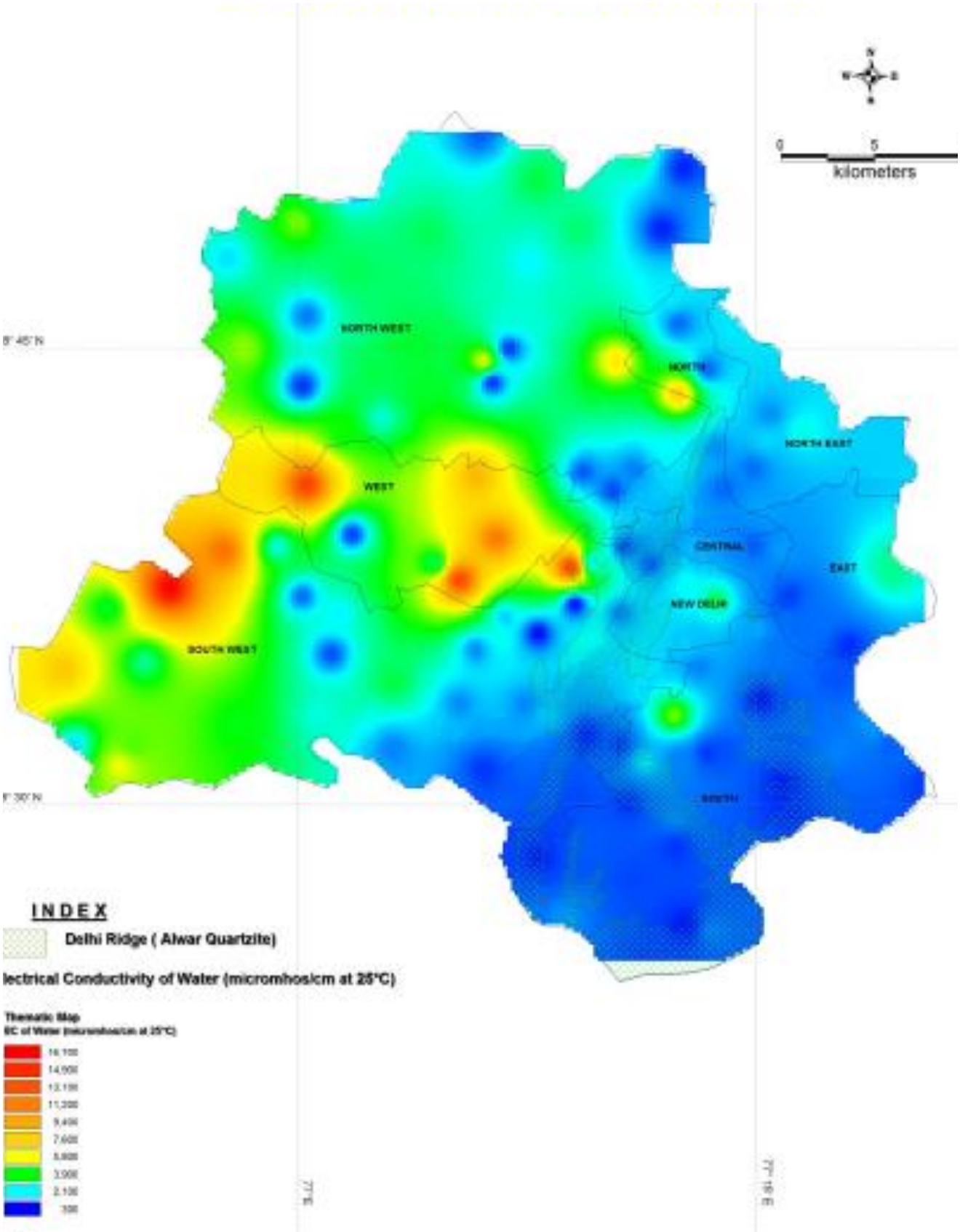
6.1 Groundwater quality varies with depth and space.

6.2 In most parts of the Northwest District, chemical quality of shallow ground water is brackish with Electrical Conductivity more than 3000 ms/cm except north eastern part i.e. all along western Yamuna Canal and its tributaries, shallow ground water is fresh with electrical conductivity in-between 1000 ms/cm to 3000 ms/cm. In other parts of NCT Delhi falling Central, New Delhi, East and North-east Districts ground water is fresh.

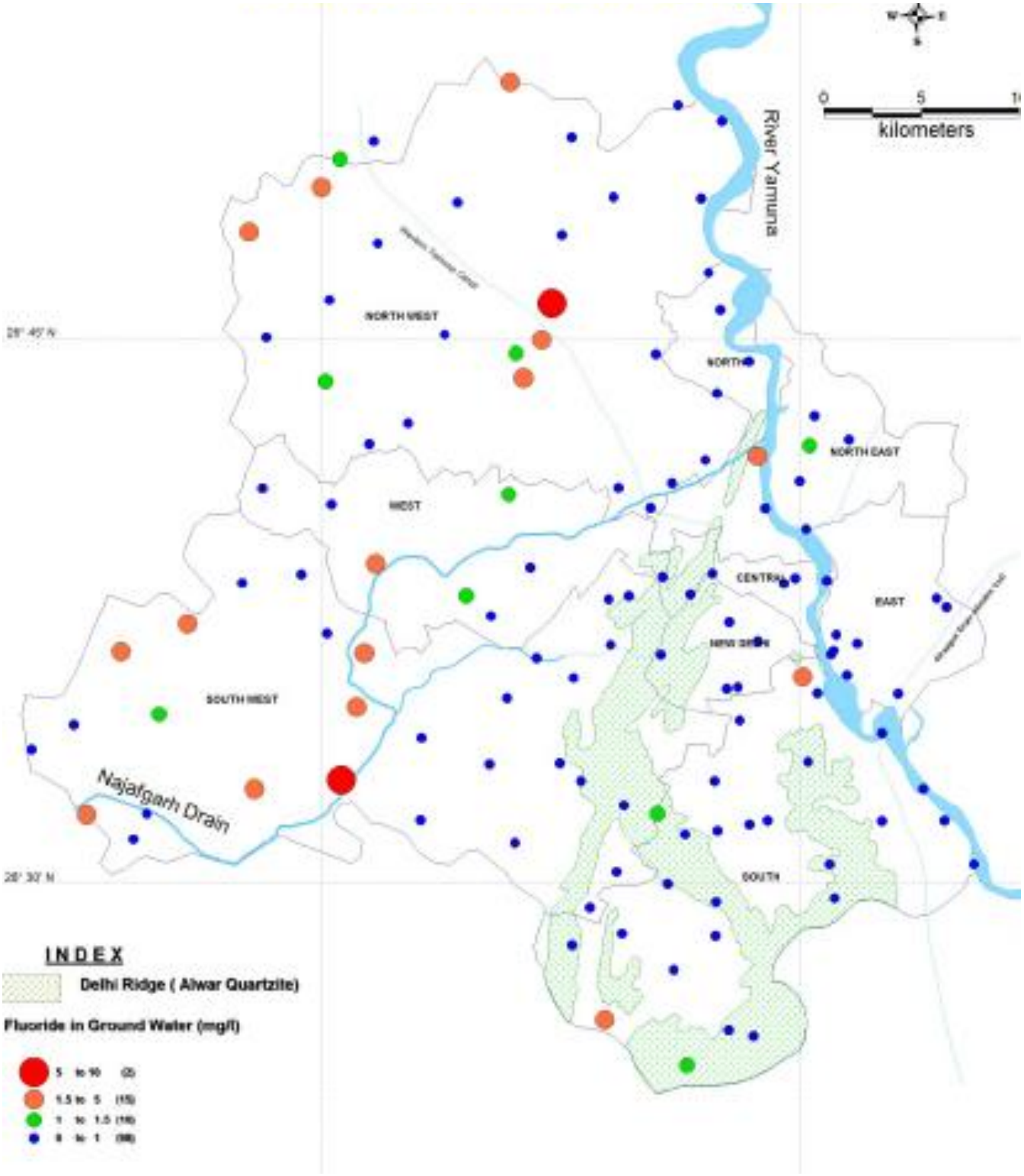
6.3 In over 30 percent of the area in NCT Delhi, the fluoride contents in ground water is more than permissible limit (1.5mg/1) particularly in the South-western and Western part of the city comprising Southwest, West and Northwest Districts.

6.4 The nitrate pollution in the ground water is also significantly high which may be attributed due to combined effect of contamination from domestic sewage, livestock rearing, landfills and run off from fertilized fields, unlined drains and cattle sheds.

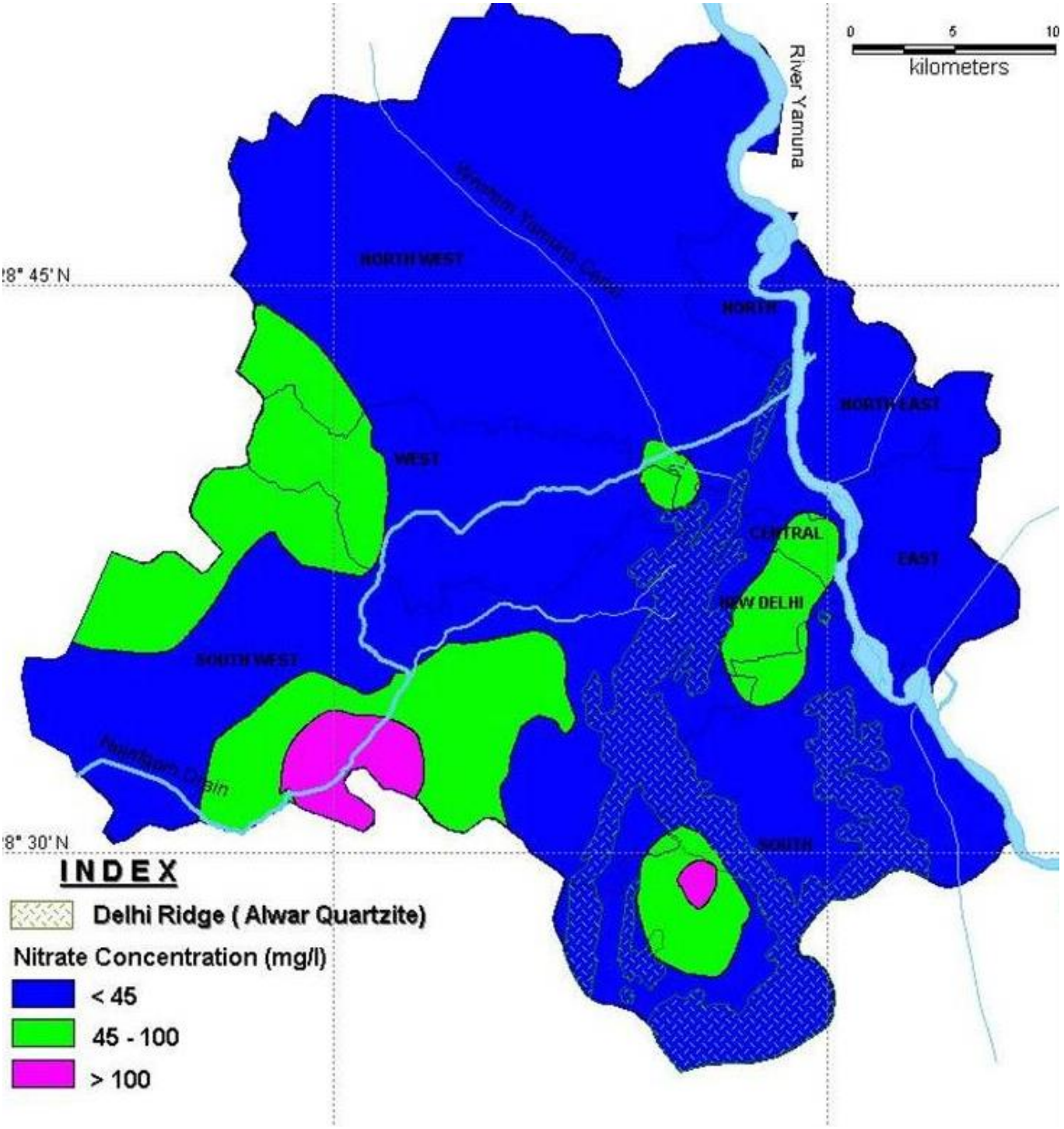
6.5 About 45.5% of ground water samples in NCT, Delhi have been found unsuitable for drinking based on overall impact of physico-chemical characteristics including heavy metals, total dissolved solids, nitrate, fluoride, trace metals or due to synergic effects of some or all of these.



Map No. 9: Electrical Conductivity Map of NCT Delhi [Source : CGWB]



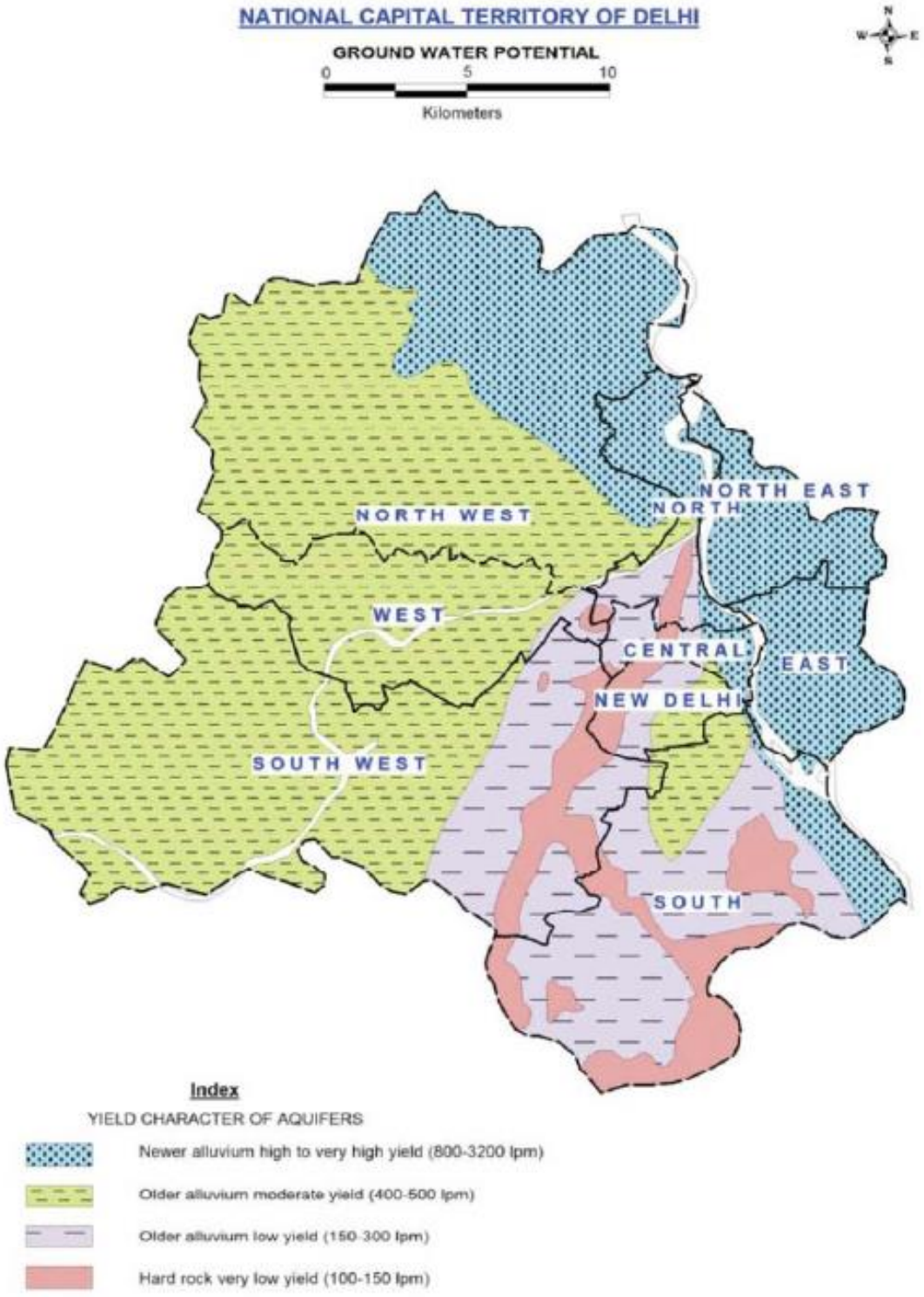
Map No. 10: Fluoride Distribution In Ground Water In NCT, Delhi [Source : CGWB]



Map No. 11: Nitrate Distribution In Ground Water In NCT, Delhi [Source : CGWB]

7.0 Ground Water Yield

7.1 Ground water yield varies in different areas of NCT Delhi with variation in aquifer characteristics. The most prolific aquifers are in the newer alluvium along the Yamuna whereas the lowest yield is from the hard rock formations. [see Map No. 12]



Map No. 12 : Ground Water Potential Distribution in NCT Delhi, 2013 [CGWB]

Bibliography

Groundwater Yearbook 2011-2012, NCT Delhi, CGWB, 2012
Contributions Of Geological Survey Of India In Delhi Area, GSI, 1997
Development and Augmentation of Ground Water Resources In National Capital Territory Of Delhi, CGWB, 1996
Master Plan for Artificial Recharge to Ground Water in India, CGWB, 2013
CGWB Data, 2010 [provided by CGWB]
CGWB Data, 2013 [provided by CGWB]
CGWB Data, 2014 [provided by CGWB]
Groundwater Year Book 2013 – 2014 [CGWB]
Ground Water Scenario in India, January, 2014 [CGWB]