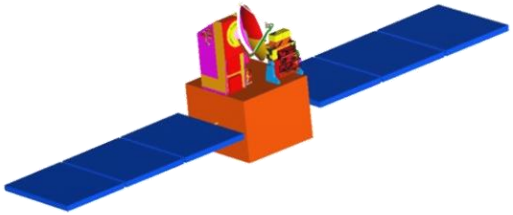
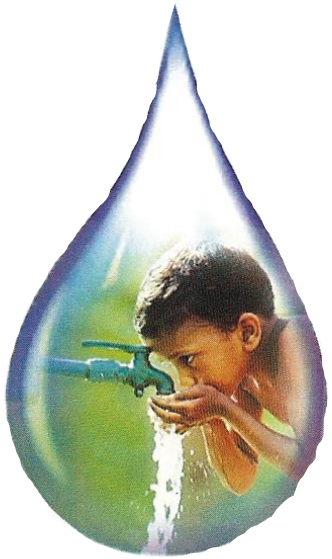
Sustainable Groundwater Development Planning at Village level

(1:10K scale hydro-geological mapping for the country using Remote Sensing, Geospatial data analytics & Ground Based Observations)



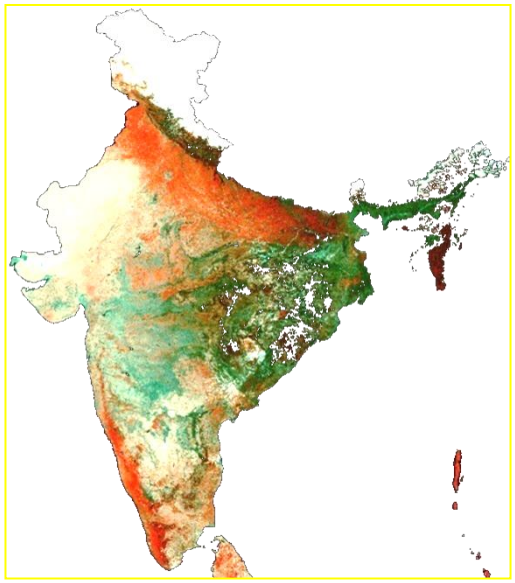


AN EFFORT TOWARDS
A SAFE AND SUSTAINABLE FUTURE

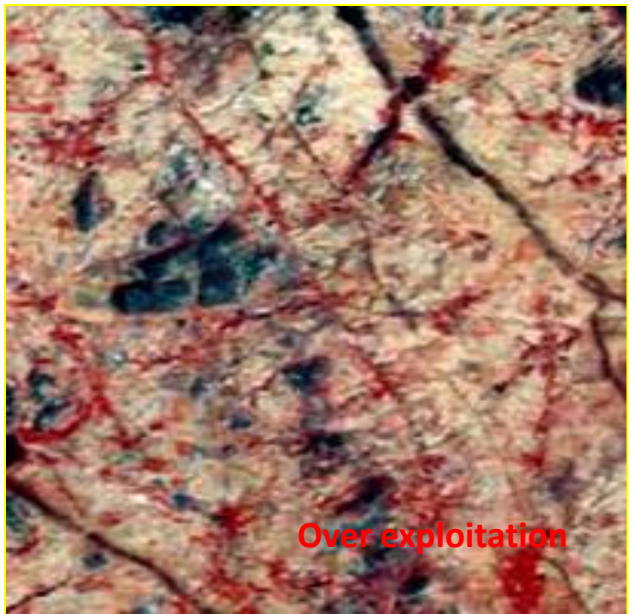
National Remote Sensing Centre (NRSC), ISRO

Dept. of Space, Hyderabad

WHY DRINKING WATER SCARCITY IN INDIA ?



Varied geological formations



CGWB Report 2011

DYNAMIC GROUND WATER RESOURCES OF INDIA (As on 31st March 2011)

1.	Annual Replenishable Ground Water Resources	433 bcm
2.	Net Annual Ground Water Availability	398 bcm
3.	Annual Ground Water Draft for Irrigation, Domestic & Industrial uses	245 bcm
4.	Stage of Ground Water Development	62%
5.	Categorization of Blocks / Mandals/Firkka Talukas	
	Total Assessed units	6607
	Safe	4530
	Semi-Critical	697
	Critical	217
	Over-Exploited	1071
	Saline	92

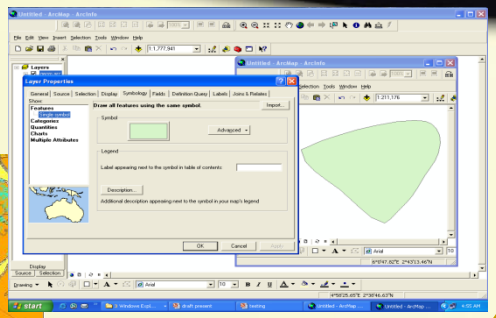
Source of Drinking water

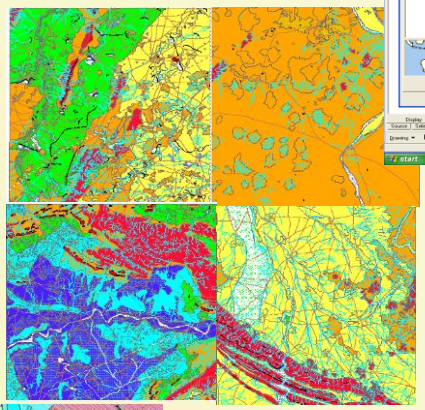
- **Ground water is the major source in the country**
- **>90% of rural and nearly 30% of urban population depend on ground water for drinking.**
- **The dependency on the ground water is expected to increase in future.**

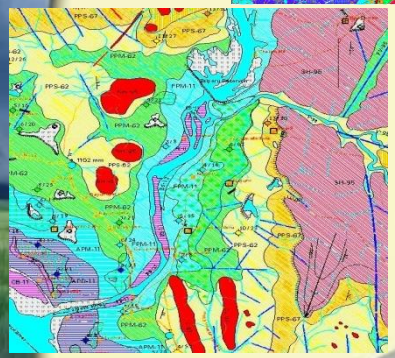
GWQ Monitoring Organization: State PHE & RWSS

Available Database: *https://indiawater.gov.in/IMISReports/*

Technical advancement in mapping







Phase-I

Polyconic projection
Sheet wise mapping
General methodology
Digital data-Soft copy
Visual interpretation
QC by NRSA

Phase-II

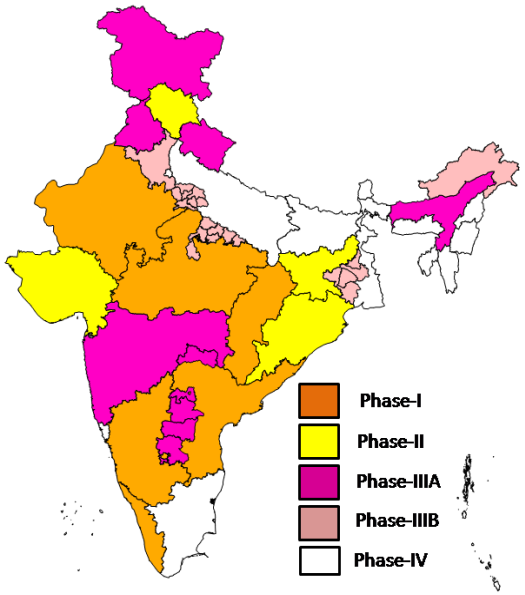
Polyconic projection
Edge matching
General methodology/modifications
Digital data-Soft copy
Visual interpretation
Internal QC + QC by NRSA

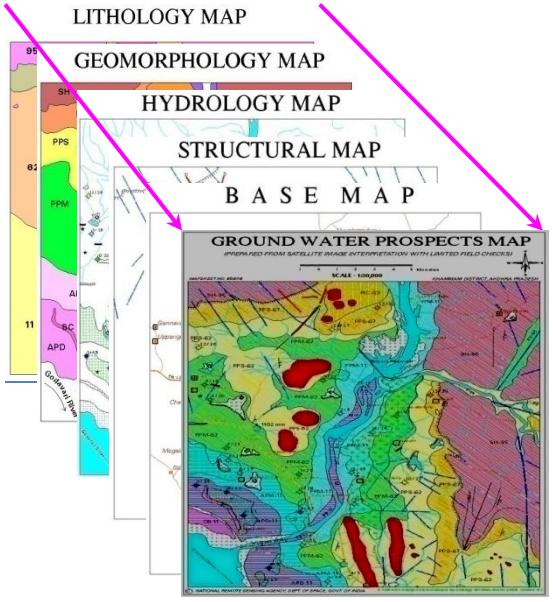
Phase-III

WGS 84 Datum, UTM Projection
State wise seamless mosaic
Geo database
On screen interpretation
Independent QC mechanism

Phase-IV

NATIONAL RURAL DRINKING WATER PROGRAMME (NRDWP)



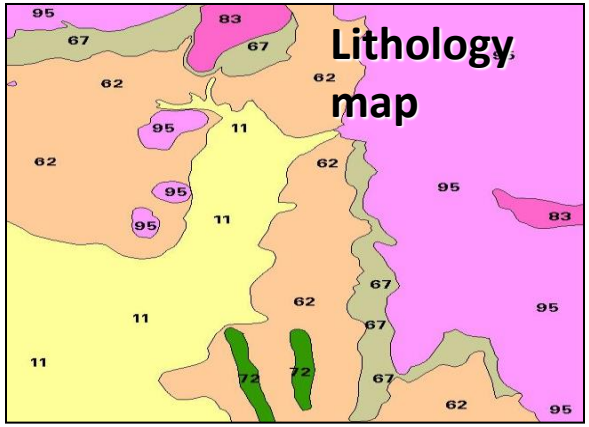


GROUND WATR PROSPECTS MAPS

Phase		Coverage	No. of Maps	Schedule / Status
I.		6 states (AP -Part, MP,Rajasthan, Karnataka, Kerala, Chattisgarh)	1654	Completed
II		4 states (Gujarat, Orissa, HP, Jharkhand)	724	Completed
III	A	6 states(Maharashtra, AP-Part, Assam, Punjab, J&K, Uttarakhand)	1290	Completed.
	B	4 states (UP-Part, WB-Part, Haryana, Arunachal Pradesh)	339	Completed
IV		13 States & 5 UTs (Remaining States & UTs including Islands)	891	Completed
		TOATL (No. of Maps)	4898	

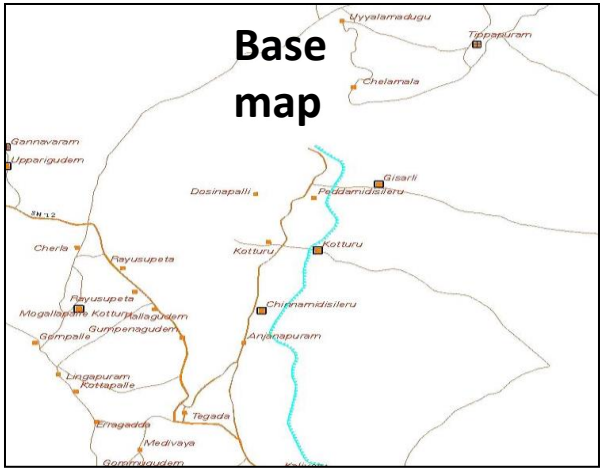
Individual thematic maps

Lithology map



CODE	LITHO UNIT
11	ALLUVIUM
95	QUARTZITE
67	SHALE
62	SAND STONE
72	BASICK ROCKS
83	GRANITOID GNEISS

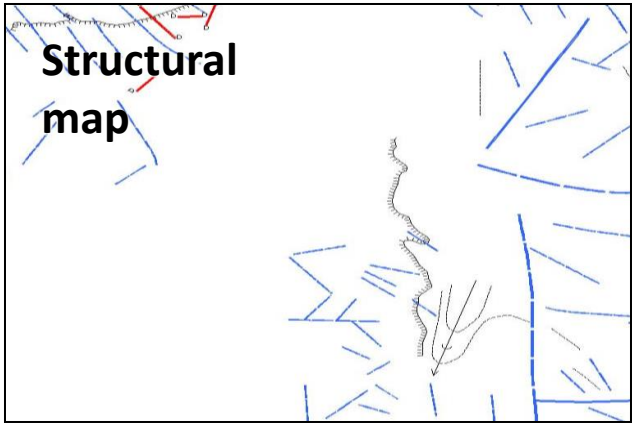
Base map



	METALLED ROAD
	OTHER ROAD
	RAILWAY
	CITY / VILLAGE
	HABITATIONS: NOT COVERED (NC)/ PARTIALLY COVERED (PC)
	BOUNDARY : STATE
	DISTRICT

SYMBOL	DESCRIPTION
	RIVER / STREAM
	WATER BODY / SPRING
	CANAL
NH - 7	NATIONAL HIGHWAY
SH - 9	STATE HIGHWAY

Structural map

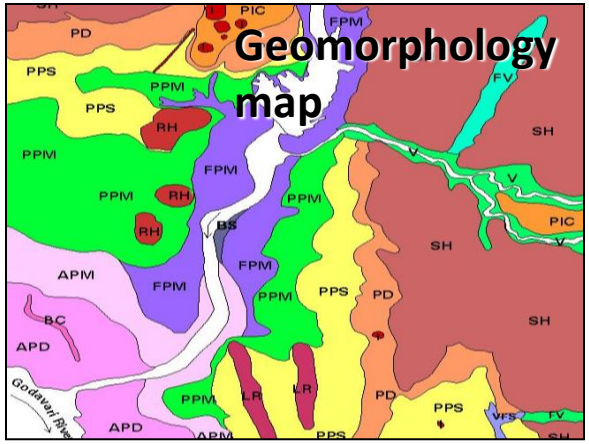


DIPS	BEDDING	SCHISTOSITY/ FOLIATION
GENTLE (< 15°)		
MODERATE (15° - 45°)		
STEEP (45° - 80°)		
SUB-VERTICAL TO VERTICAL (> 80°)		
ANTICLINE / ANTIFORM		
SYNCLINE / SYNFORM		
TREND LINE		

ESCARPMENT		
LITHOLOGIC / GEOMORPHIC UNIT BOUNDARY		
FAULT	MINOR	MAJOR
FRACTURE / LINEAMENT		
FRACTURE / LINEAMENT (Inferred)		
DYKE	(Confirmed / Inferred)	
QUARTZ REEF	(Confirmed / Inferred)	
PEGMATITE	(Confirmed / Inferred)	

(Lithologic contacts are inferred at places & Geomorphic boundaries are gradational)

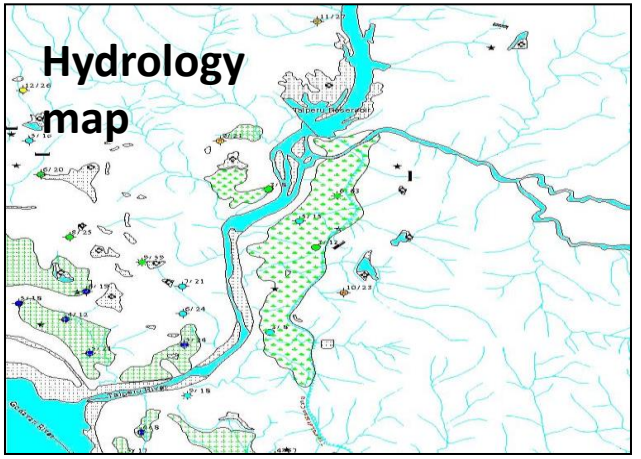
Geomorphology map



BC	BURRIED CHANNEL
APD	ALLUVIUM PLAIN DEEP
APM	ALLUVIUM PLAIN MODERATE
BS	BACK SWAMP
FPM	FLOOD PLAIN MODERTE
VFS	VALLEY FILL SHALLOW
FV	FRACTURED VALLEY
V	VALLEY

PPM	PEDIPLAIN MODERATLY WEATHERED
PPS	PEDIPLAIN SHALLOW WEATHERED
PD	PEDIMENT
PIC	PEDIMENT INSELBERG COMPLEX
I	INSELBERG
LR	LINEAR RIDGE
RH	RESIDUAL HILL
SH	STRUCTURAL HILL

Hydrology map



DESCRIPTION	SYMBOL
CANAL/TANK IRRIGATED AREA	
GROUND WATER IRRIGATED AREA	
RAIN GAUGE STATION	

RECHARGE STRUCTURES SUGGESTED

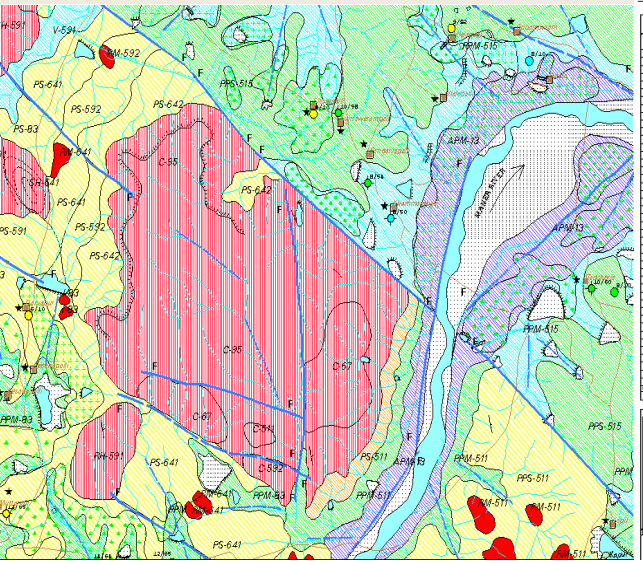
PERCOLATION TANK	CHECK DAM
NALA BUND	RECHARGE WELL
DESILTING OF TANK	RECHARGE PIT

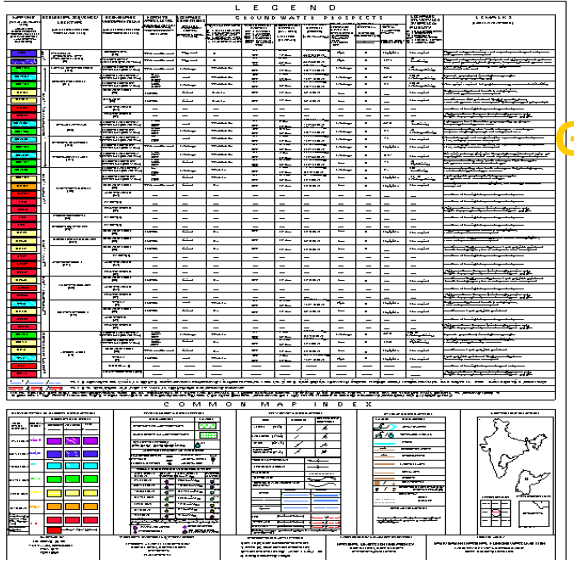
WELLS OBSERVED DURING FIELD VISIT

YIELD RANGE IN LPM	BORE/ TUBE WELL	YIELD RANGE IN M³/DAY	DUG WELL RING WELL
> 800 LPM		> 400 M³/DAY	
400-800 LPM		200-400 M³/DAY	
200-400 LPM		100-200 M³/DAY	
100-200 LPM		50-100 M³/DAY	
50-100 LPM		25-50 M³/DAY	
10-50 LPM		5-25 M³/DAY	
< 10 LPM		< 5 M³/DAY	

color inside well symbol indicates yield range. The figures on the top right hand side of well indicate the depth to water level and total depth of well in meters.

DUG-CUM-BORE WELL
HAND PUMP WELL
ARTESIAN WELL
OBSERVATION WELL OF G.W. DEPT./C.G.W.B.





Contents of Ground water Prospects Map

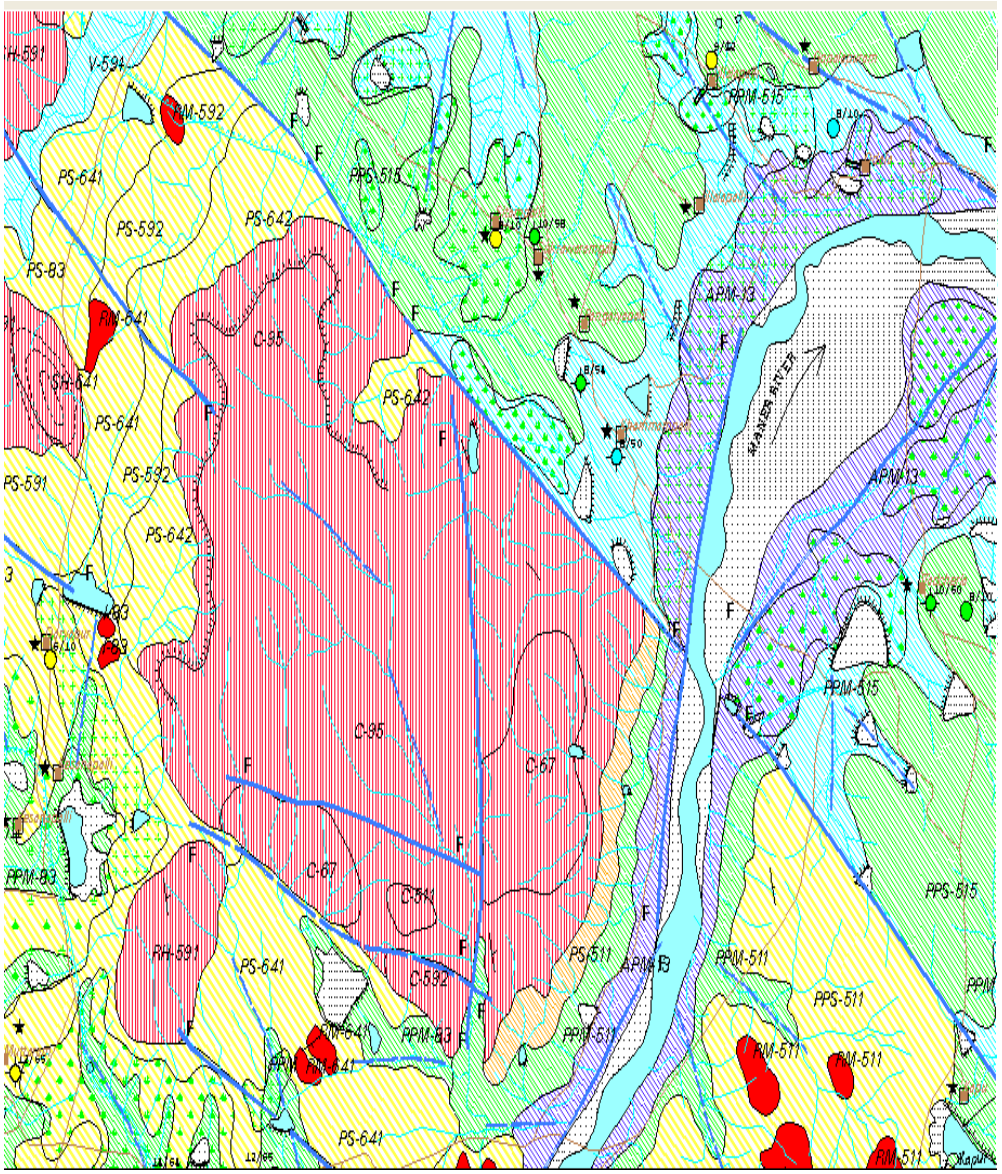
- Column- 1 — Geological sequence / Rock type
- Column- 2 — Geomorphic unit / Landform
- Column- 3 — Depth to WT / No. of wells
- Column- 4 — Recharge conditions
- Column- 5 — Nature of aquifer material
- Column- 6 — Type of wells suitable
- Column- 7 — Depth range of wells (suggested)
- Column- 8 — Yield range of wells (expected)
- Column- 9 — Homogeneity & Success rate
- Column- 10 — Quality of water (P/NP)
- Column- 11 — Irrigated area (exploitation status)
- Column- 12 — Recharge structures & Priority
- Column- 13 — Remarks (problems / limitations)

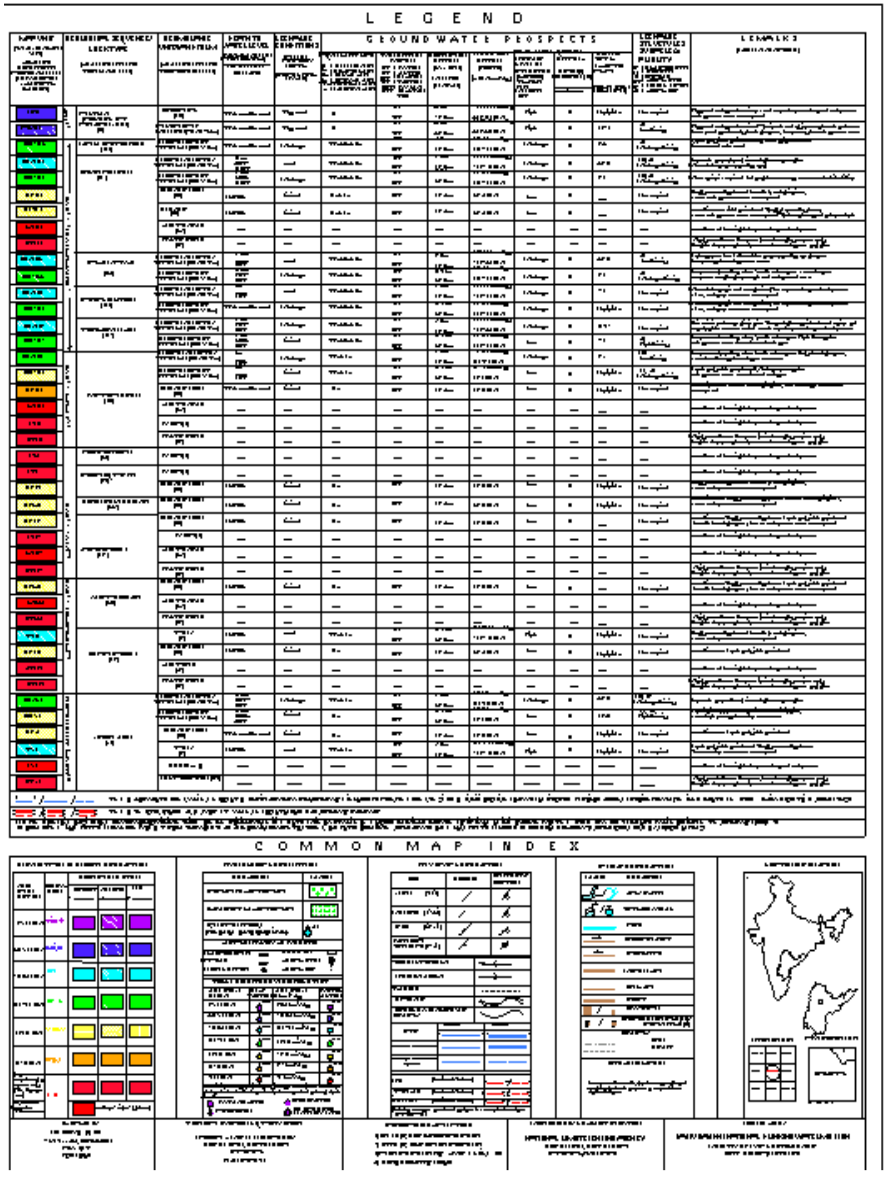
Color Scheme for representing Groundwater Prospects

COLOUR	YIELD RANGE OF WELLS	DEPTH RANGE OF WELLS: SHALLOW < 30 M	MODERATE 30 – 80 M	DEEP > 80 M
	> 800 LPM			
	400 – 800 LPM			
	200 – 400 LPM			
	100 – 200 LPM			
	50 – 100 LPM			
	30 – 50 LPM			
	20 – 30 LPM			
	10 – 20 LPM			
	Prospects limited to valley portions only (Hills & Plateaus)			

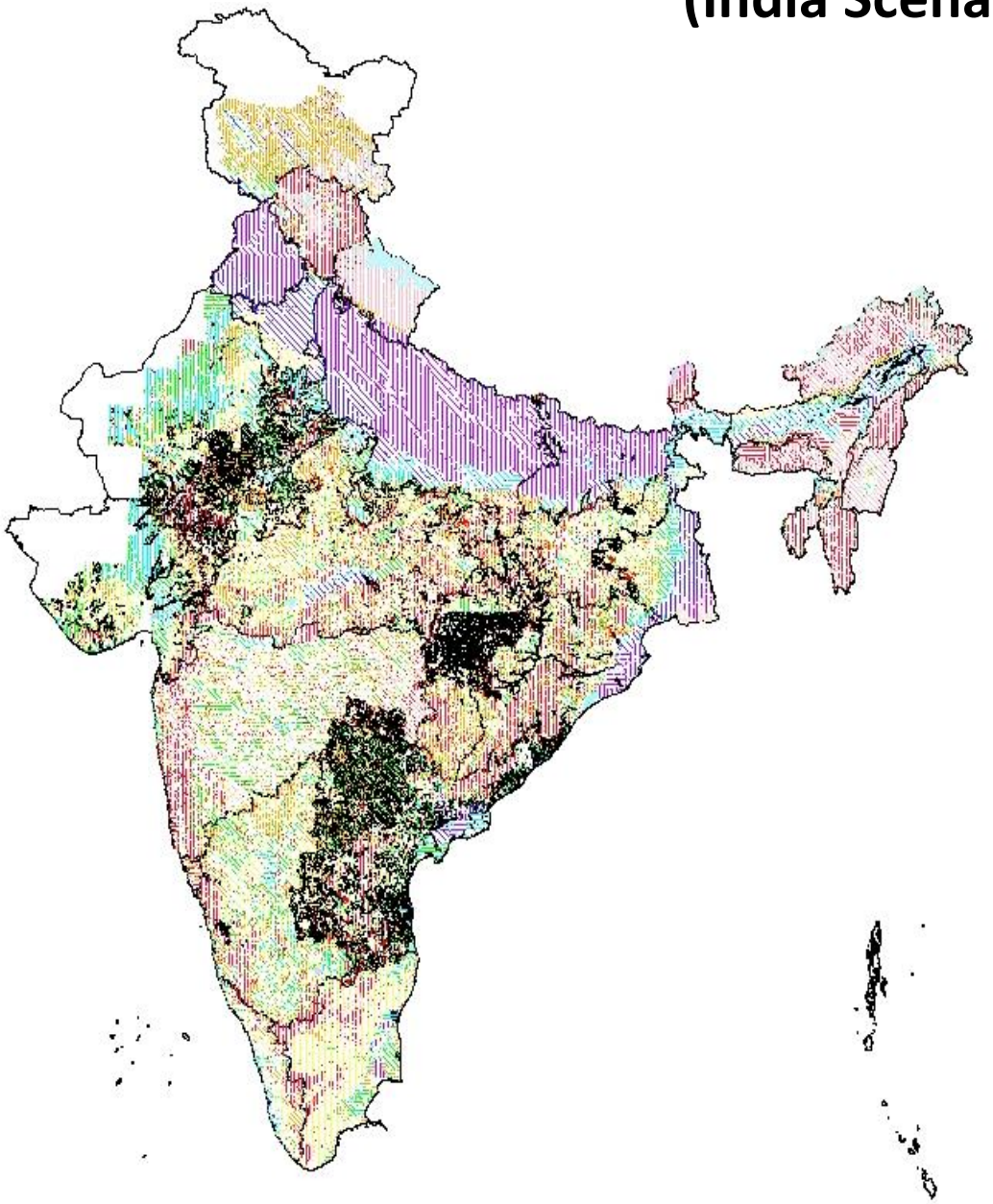
Run off zones / Barriers
(Linear ridges / Dykes ridges / Inselbergs)

Methodology





Groundwater prospects map on 1:50,000 scale (India Scenario)



GROUND WATER PROSPECTS INFORMATION

YIELD RANGE OF WELLS	COLOUR CODE	DEPTH RANGE OF WELLS		
		SHALLOW < 30 METERS	MODERATE 30-60 METERS	DEEP > 60 METERS
> 800 LPM	Violet			
400-800 LPM	Indigo			
200-400 LPM	Blue			
100-200 LPM	Green			
50-100 LPM	Yellow			
30-50 LPM	Orange			
20-30 LPM	Brown			
10-20 LPM	Pink			
Prospects limited to valley portions only (Hills, Plateaus etc.)	Red			
Run-off zone/ Barrier for G.W. movement		(Inselberg / Ridge / Dyke etc.)		

MINISTRY OF DRINKING WATER & SANITATION

National Rural Drinking Water Programme

MDWS Site | About the Site | Online Applications | Contact Us | HelpLine | Site Map | Themes

View Habitation details of your Village

Citizen Information Grievance Redressal

State

- ANDAMAN & NICOBAR
- ANDHRA PRADESH
- ARUNACHAL PRADESH
- ASSAM
- BIHAR
- CHHATTISGARH
- GOA
- GUJARAT
- HARYANA
- HIMACHAL PRADESH
- JAMMU & KASHMIR
- JHARKHAND
- KARNATAKA
- KERALA
- MADHYA PRADESH
- MAHARASHTRA
- MANIPUR
- MEGHALAYA
- MIZORAM
- NAGALAND
- ODISHA
- PUDUCHERRY
- PUNJAB
- RAJASTHAN
- SIKKIM

[B] Basic Information

- Format B1- Basic Habitation Information
- Format B2- List of LWE Districts
- Format B3- List of DDP Blocks
- Format B4- List of Minority Districts/Blocks
- Format B5- List of SC/ST Concentrated Habitations

More ...

[D] Financial Progress Reports

- Format D1 - Alloc, Rel & Exp (State wise)
- Format D1 A - Rel & Exp (State wise) - NCEF
- Format D2 - Alloc, Rel & Exp (District wise)
- Format D5 - List of Sanction Orders
- Format D8 A - Component wise Expenditure (State Wise)

More ...

[F] Data Entry Status

- Format F22 - Difference between IMIS and SBM Habitations Directory **(New)**
- Format F19 - Entry Status of reason for delay of schemes **(New)**
- Format F18 - Estimated Cost of covering Ar/Fl Habitations **(New)**
- Format F17 - Entry Status of Phy Progress / SLSSC date / Work Order date of Ongoing Schemes **(New)**
- Format F16-No of Implementing Agencies

More ...

[H] Miscellaneous Reports

- Format H1- SAGY Panchayats Details
- Format H2 (A) - Status of Rural Habitations (SAGY Panchayats)
- Format H2 (B) - Status of Rural Habitations (SAGY Panchayats)
- Format H3- Month Wise Scheme Expenditure Statement in SAGY Habs
- Format H4 (A) - RWS Coverage of Habitation in ODF

[A] Alerts

- Format A16- Duplicate Data in Habitation Directory
- Format A12- Completed Schemes in ProjectShelf with No Expenditure & no subsequent data
- Format A18- Scheme where Expenditure reported with No Physical Progress
- Format A11- Completed Schemes in ProjectShelf with No Expenditure
- Format A13- Differences in IMIS & Census 2011 Village list

More ...

[C] Physical Progress Reports

- Format C14 - Progressive Coverage Status (MPR)
- Format C14 A- Progressive Coverage Status (MPR Unapproved Data)
- Format C29 - Progressive Expenditure Status
- Format C16 - Financial And Physical Progress
- Format 1 - Target Habitations & Achievement

More ...

[E] Water QM & Surveillance

- Format E1 - Contamination wise Report
- Format E2 - Water Sample testing(Labwise)
- Format E4 - FinancialYear wise Sample Testing Details
- Format E3 - Water Sample testing(Habitation wise)
- Format E5 - GramPanchayatWise Tested Sources

More ...

[G] Annual Action Plan

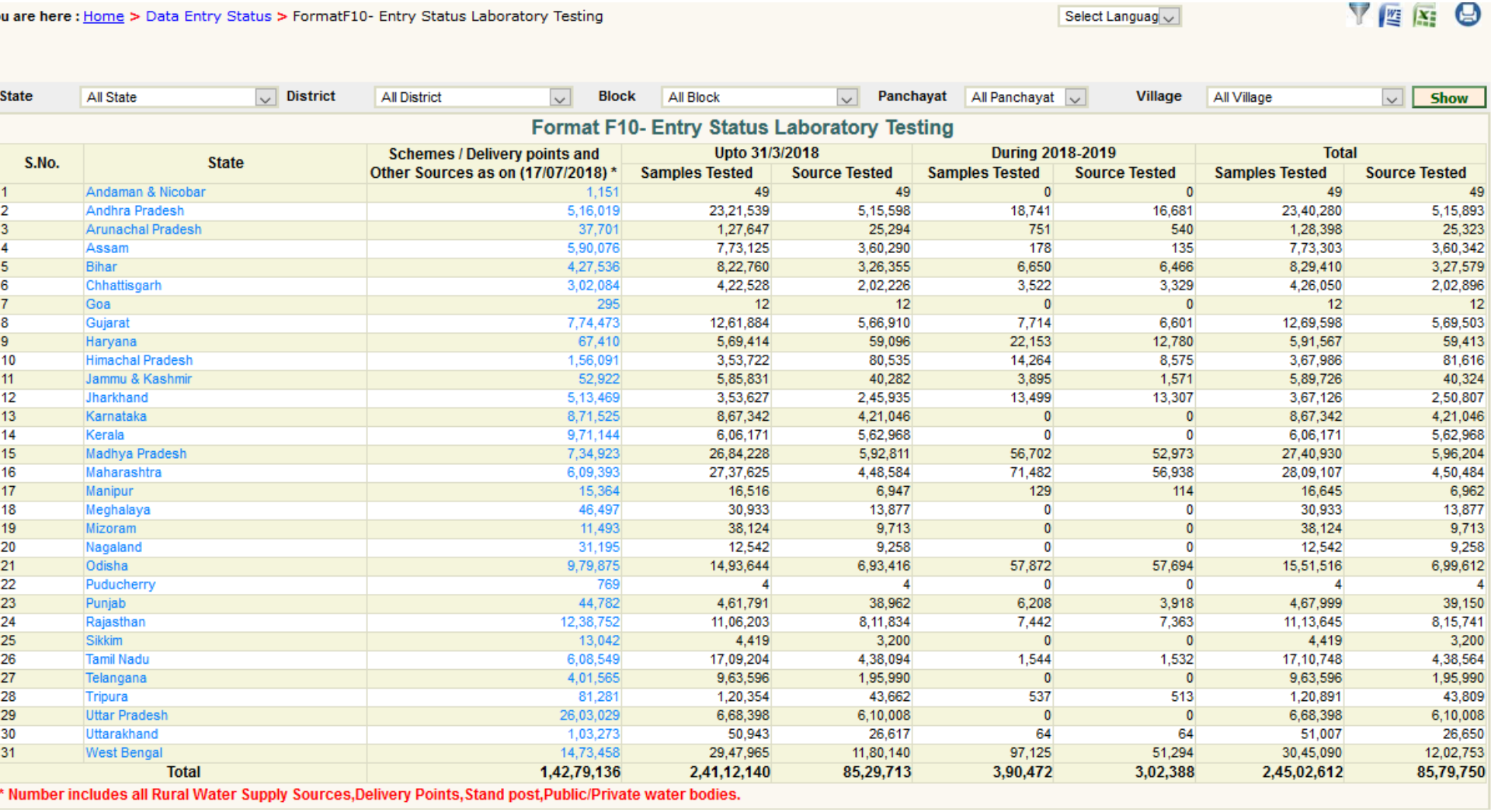
- FORMAT - 1 Coverage
- FORMAT - 1 A Coverage
- FORMAT - 2 Support
- FORMAT - 3 WQMS
- FORMAT - 4 Physical Progress Entry

More ...

Select Language

National Water Quality Sub-Mission

IMIS Data Source



u are here : Home > Data Entry Status > FormatF10- Entry Status Laboratory Testing

Select Languag

State: All State | District: All District | Block: All Block | Panchayat: All Panchayat | Village: All Village | Show

Format F10- Entry Status Laboratory Testing

S.No.	State	Schemes / Delivery points and Other Sources as on (17/07/2018) *	Upto 31/3/2018		During 2018-2019		Total	
			Samples Tested	Source Tested	Samples Tested	Source Tested	Samples Tested	Source Tested
1	Andaman & Nicobar	1,151	49	49	0	0	49	49
2	Andhra Pradesh	5,16,019	23,21,539	5,15,598	18,741	16,681	23,40,280	5,15,893
3	Arunachal Pradesh	37,701	1,27,647	25,294	751	540	1,28,398	25,323
4	Assam	5,90,076	7,73,125	3,60,290	178	135	7,73,303	3,60,342
5	Bihar	4,27,536	8,22,760	3,26,355	6,650	6,466	8,29,410	3,27,579
6	Chhattisgarh	3,02,084	4,22,528	2,02,226	3,522	3,329	4,26,050	2,02,896
7	Goa	295	12	12	0	0	12	12
8	Gujarat	7,74,473	12,61,884	5,66,910	7,714	6,601	12,69,598	5,69,503
9	Haryana	67,410	5,69,414	59,096	22,153	12,780	5,91,567	59,413
10	Himachal Pradesh	1,56,091	3,53,722	80,535	14,264	8,575	3,67,986	81,616
11	Jammu & Kashmir	52,922	5,85,831	40,282	3,895	1,571	5,89,726	40,324
12	Jharkhand	5,13,469	3,53,627	2,45,935	13,499	13,307	3,67,126	2,50,807
13	Karnataka	8,71,525	8,67,342	4,21,046	0	0	8,67,342	4,21,046
14	Kerala	9,71,144	6,06,171	5,62,968	0	0	6,06,171	5,62,968
15	Madhya Pradesh	7,34,923	26,84,228	5,92,811	56,702	52,973	27,40,930	5,96,204
16	Maharashtra	6,09,393	27,37,625	4,48,584	71,482	56,938	28,09,107	4,50,484
17	Manipur	15,364	16,516	6,947	129	114	16,645	6,962
18	Meghalaya	46,497	30,933	13,877	0	0	30,933	13,877
19	Mizoram	11,493	38,124	9,713	0	0	38,124	9,713
20	Nagaland	31,195	12,542	9,258	0	0	12,542	9,258
21	Odisha	9,79,875	14,93,644	6,93,416	57,872	57,694	15,51,516	6,99,612
22	Puducherry	769	4	4	0	0	4	4
23	Punjab	44,782	4,61,791	38,962	6,208	3,918	4,67,999	39,150
24	Rajasthan	12,38,752	11,06,203	8,11,834	7,442	7,363	11,13,645	8,15,741
25	Sikkim	13,042	4,419	3,200	0	0	4,419	3,200
26	Tamil Nadu	6,08,549	17,09,204	4,38,094	1,544	1,532	17,10,748	4,38,564
27	Telangana	4,01,565	9,63,596	1,95,990	0	0	9,63,596	1,95,990
28	Tripura	81,281	1,20,354	43,662	537	513	1,20,891	43,809
29	Uttar Pradesh	26,03,029	6,68,398	6,10,008	0	0	6,68,398	6,10,008
30	Uttarakhand	1,03,273	50,943	26,617	64	64	51,007	26,650
31	West Bengal	14,73,458	29,47,965	11,80,140	97,125	51,294	30,45,090	12,02,753
	Total	**1,42,79,136**	**2,41,12,140**	**85,29,713**	**3,90,472**	**3,02,388**	**2,45,02,612**	**85,79,750**

* Number includes all Rural Water Supply Sources,Delivery Points,Stand post,Public/Private water bodies.

Habitation wise GWQ information

State>District>Block> Panchayet> Village> Habitation ; Source; tasting Date; GWQ elements

Concentration Limits (in mg/l) of elements for classification of Ground Water Quality (BIS 2015)

Element	Potable		Non Potable
	Desirable	Permissible	
pH	6.5-8.5	-	6.5>pH>8.5
TH	<250	250-600	TH>600
TDS	<500	500-2000	TH>2000
Alk	<200	200-600	Alk>600
F	<1.0	1.0-1.5	F>1.5
Cl	<250	250-1000	Cl>1000
NO_3	<45	-	NO_3>45
SO_4	<200	200-400	SO_4>400
Fe	<1.0	-	Fe>1.0
Ca	<75	75-200	Ca>200
Mg	<30	30-100	Mg>100
As	<0.01	-	>0.01

Range Filters for Anomalous GWQ Obsn. Removal

Element	Range Filter
pH	5.5> pH>10
TH	TH>2000
TDS	TDS>12000
Alk	Alk>2000
F	F>10
Cl	Cl>6000
NO_3	NO_3>500
SO_4	SO_4>2000
Fe	Fe>20
Ca	Ca>1000
Mg	Mg>500
As	As>0.5

Mapping Legend

Polygon features	Symbol Codes	Symbol
Potable water with desirable limits (Pre-monsoon)	01	
Potable water with permissible limits (Pre-monsoon)	02	
Non-potable water (Pre-monsoon)	03	
Potable water with desirable limits (Post-monsoon)	04	+
Potable water with permissible limits (Post-monsoon)	05	•
Non-potable water (Post-monsoon)	06	_
Potable water with desirable limits (Pre-monsoon) + Potable water with desirable limits (Post-monsoon)	07	+++++
Potable water with desirable limits (Pre-monsoon) + Potable water with permissible limits (Post-monsoon)	08	••••••
Potable water with desirable limits (Pre-monsoon) + Non-potable water (Post-monsoon)	09	– – – –
Potable water with permissible limits (Pre-monsoon) + Potable water with desirable limits (Post-monsoon)	10	+++++
Potable water with permissible limits (Pre-monsoon) + Potable water with permissible limits (Post-monsoon)	11	••••••
Potable water with permissible limits (Pre-monsoon) + Non-Potable water (Post-monsoon)	12	– – – –
Non-potable water (Pre-monsoon) + Potable water with desirable limits (Post-monsoon)	13	+++++
Non-potable water (Pre-monsoon) + Potable water with permissible limits (Post-monsoon)	14	••••••
Non-potable water (Pre-monsoon) + Non-potable water (Post-monsoon)	15	– – – –
No-Data - Legacy data not available	16	
No-Data – Hills and steep slope areas where there are no habitations	17	+++++

Pre Monsoon GWQ Obsn. Point Distribution

Post Monsoon GWQ Obsn. Point Distribution

- Pre Monsoon GWQ Obsn.: 3,65,000
- Non Potable GWQ Obsn.: 1,10,000 (30%)

- Post Monsoon GWQ Point Obsn.: 3,50,000
- Non Potable GWQ Obsn. : 99,000 (28%)

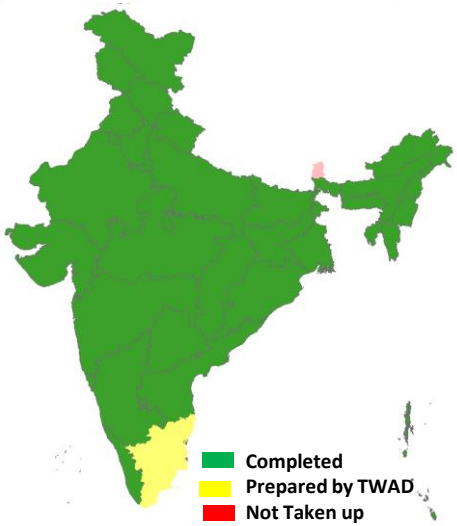
Summary :

- Habitation wise Ground water Quality (GWQ) point database prepared for **34** state & UTs.
- Seamless State Mosaic GWQ database prepared for **34** state & UTs.

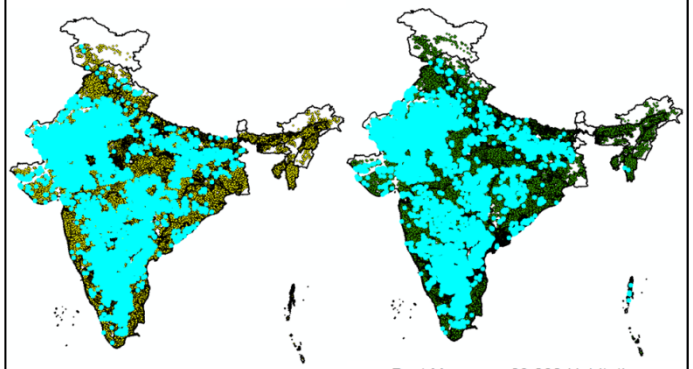
Major Pre-GWQ Contaminants

- **Arsenic:** 13,469 (in U.P, Punjab, Haryana, W.B. Tripura etc.)
- **Fluoride:** 32,601 (in U.P, Punjab, Rajasthan, M.P, A.P, W.B etc.)
- **Nitrate:** : 44,259 (in U.P Punjab, Haryana, Maharashtra, M.P A.P, Kerala, Karnataka etc.)
- **Iron:** 36,207 (in Rajasthan, Maharashtra, M.P, Jharkhand, Odhisa,Jharkhand, Tripura etc.)

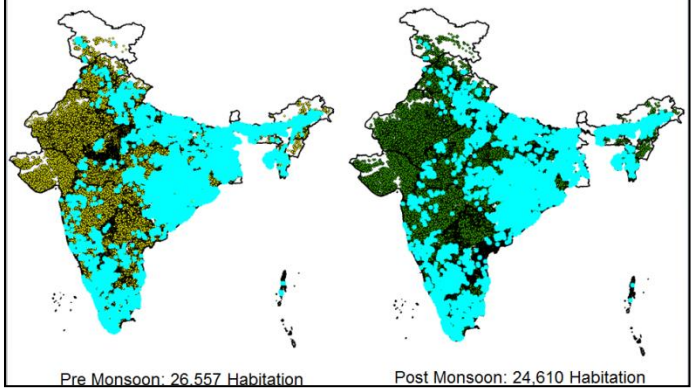
State Mosaic GWQ Mapping Status (March,2019)



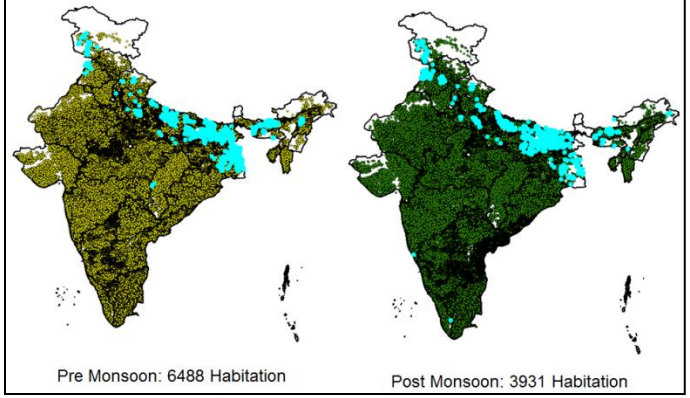
Groundwater Quality Scenario for Fluoride (F) Contamination In India



Groundwater Quality Scenario for Iron (Fe) Contamination In India



Groundwater Quality Scenario for Arsenic (As) Contamination In India



http://bhuvan.nrsc.gov.in/bhuvan_links.php#

Indian Geo-Platform of ISRO

Ministry of Drinking Water and Sanitation

Bhuvan - Bhujal (Ground Water Prospects Information System)

Bhuvan

National Remote Sensing Centre (NRSC), ISRO has prepared nationwide ground water prospects maps, sponsored by Department of Drinking Water and Sanitation (erstwhile RGNDWM), Ministry of Drinking water Sanitation (MDWS), Government of India (GOI). The above maps are generated under Accelerated Rural Water Supply Programme (ARWSP) which was the major developmental activity of GOI in water sector to provide drinking water to all the habitations in a time-bound-period. However, scientific database on ground water, which facilitates identification of prospective ground water zones for systematic selection of appropriate sites for drilling, is not available in many states to tackle the drinking water problem on war footing by the concerned state officials involved in rural water supply. Hence entire India ground water database was created (spread over 4898 maps) covering all the habitation in a phased manner (Phase-I to IV) on priority basis. The possible ground water sources were delineated for drinking within the radius of 1.5 km covering for all habitations using Indian Remote Sensing (IRS) series of satellite data (1C, 1D & Resourcesat) on 1:50,000 scale. Presently the GOI has renamed this programme as National Rural Drinking Water Programme (NRDWP).

About Bhuvan-Bhujal

Ground water being a hidden resource is difficult to dig out without proper understanding. Hence NRSC/ISRO has brought out nationwide scientific database on prospective ground water information from the state-of-the-art ground water prospects maps generated for the past one and half decade through Bhuvan-Bhujal portal. This information can be utilized by the govt/private agencies for development of ground water. It provides the required information on geological parameters connected to ground water exploration and the probable ground water prospects. It narrow down the area of investigation for prolific selection of 1) sites for drilling and 2) for planning recharge structures, ultimately to address the drinking water problem more effective manner.

i. Geological parameters : • Lithology (rock type), • Geomorphology (landform), • Geological structures (fractures/faults)

ii. Ground water prospects (For Authorized users only) : • Probable Depth and yield range of wells.

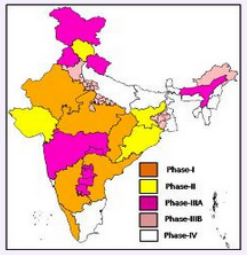
Features of Bhuvan-Bhujal

a) Spatially user can visualizes the Ground Water Prospects information in terms of depth (shallow, moderate and deep) shown with three colour hatching patterns (horizontal, inclined and vertical) and yield shown in seven colours (Violet, Indigo, Blue, Green, Yellow, Orange and Red).

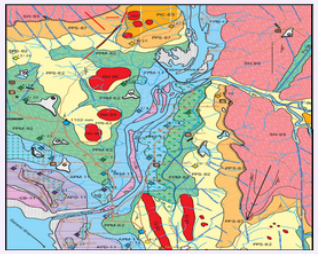
b) Legend for understanding the ground water prospects information

c) Portal contains seamless state-wise mosaics of groundwater prospect maps. Presently it is populated with ground water prospects information for 24 states viz. Andaman & Nicobar, Arunachal Pradesh, Assam, Bihar, Chattisgarh, Delhi, Goa, Haryana, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizpram, Nagaland, Puducherry, Punjab, Sikkim, Tripura, Uttarakhand, Uttar Pradesh and West Bengal

d) Remaining 12 states maps information will be available very soon



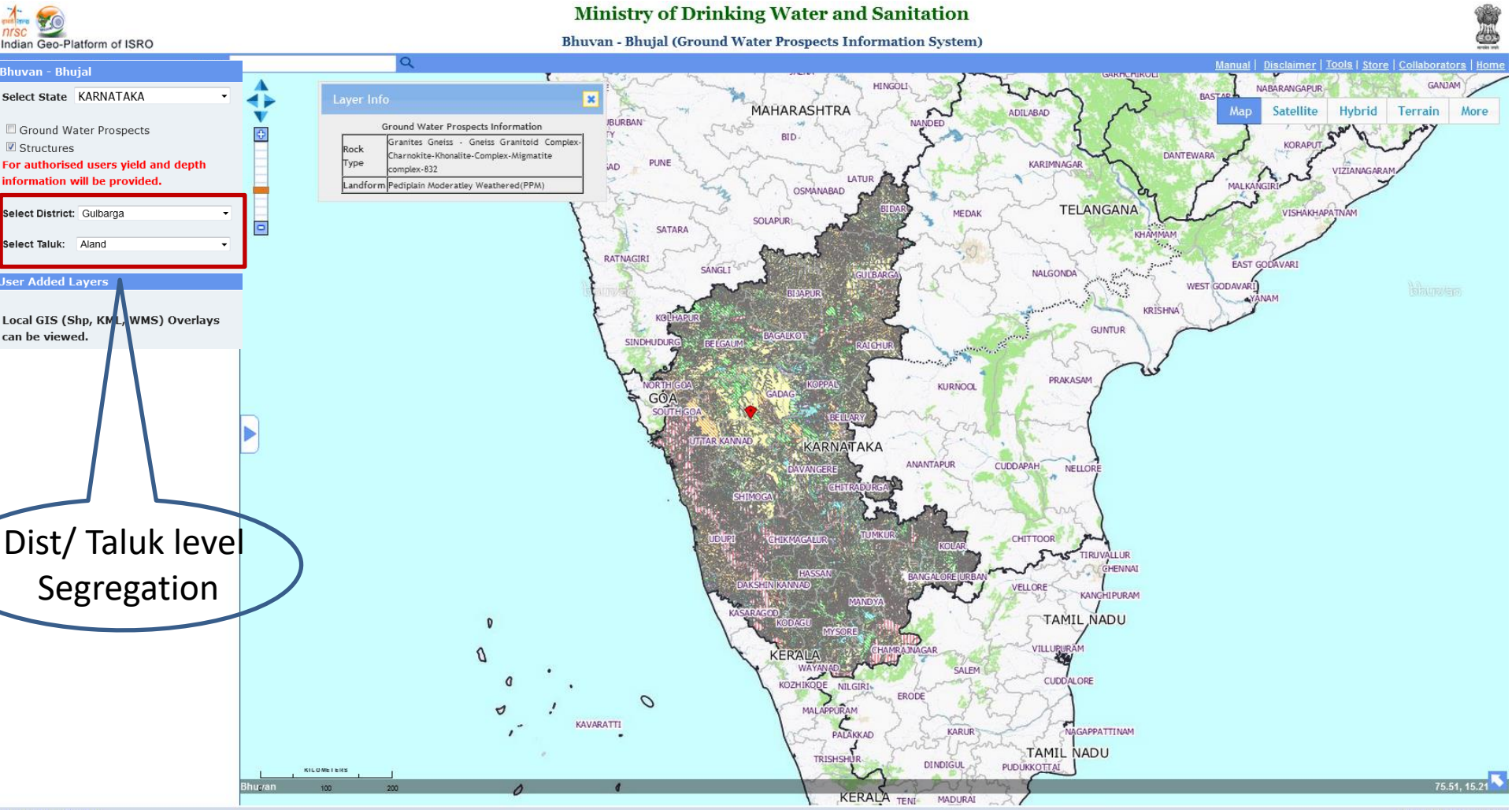
Visit the site



Discussion-Forum

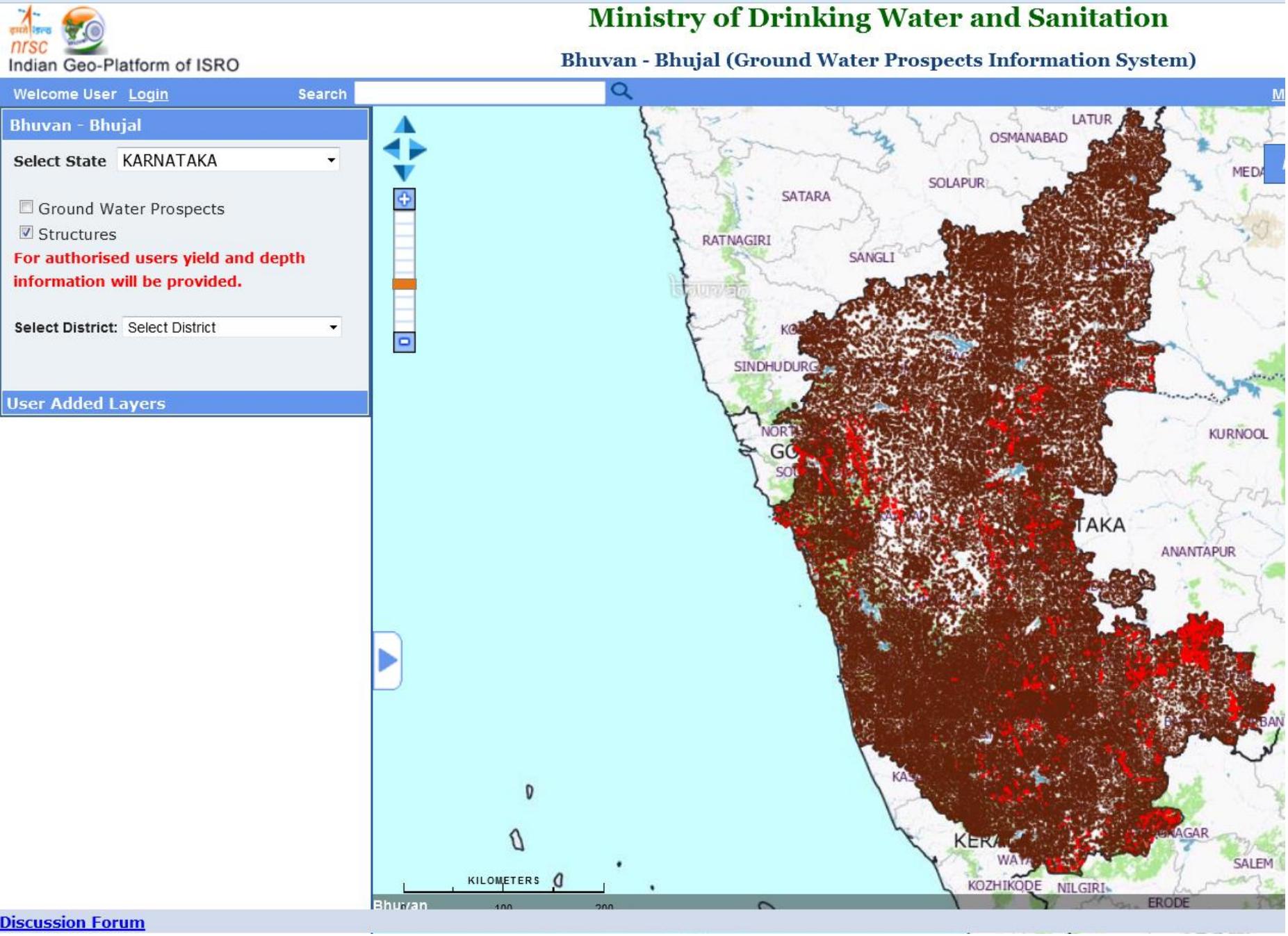
Contact us | Terms

Bhuwan-Bhujal
(Ground Water Information System)



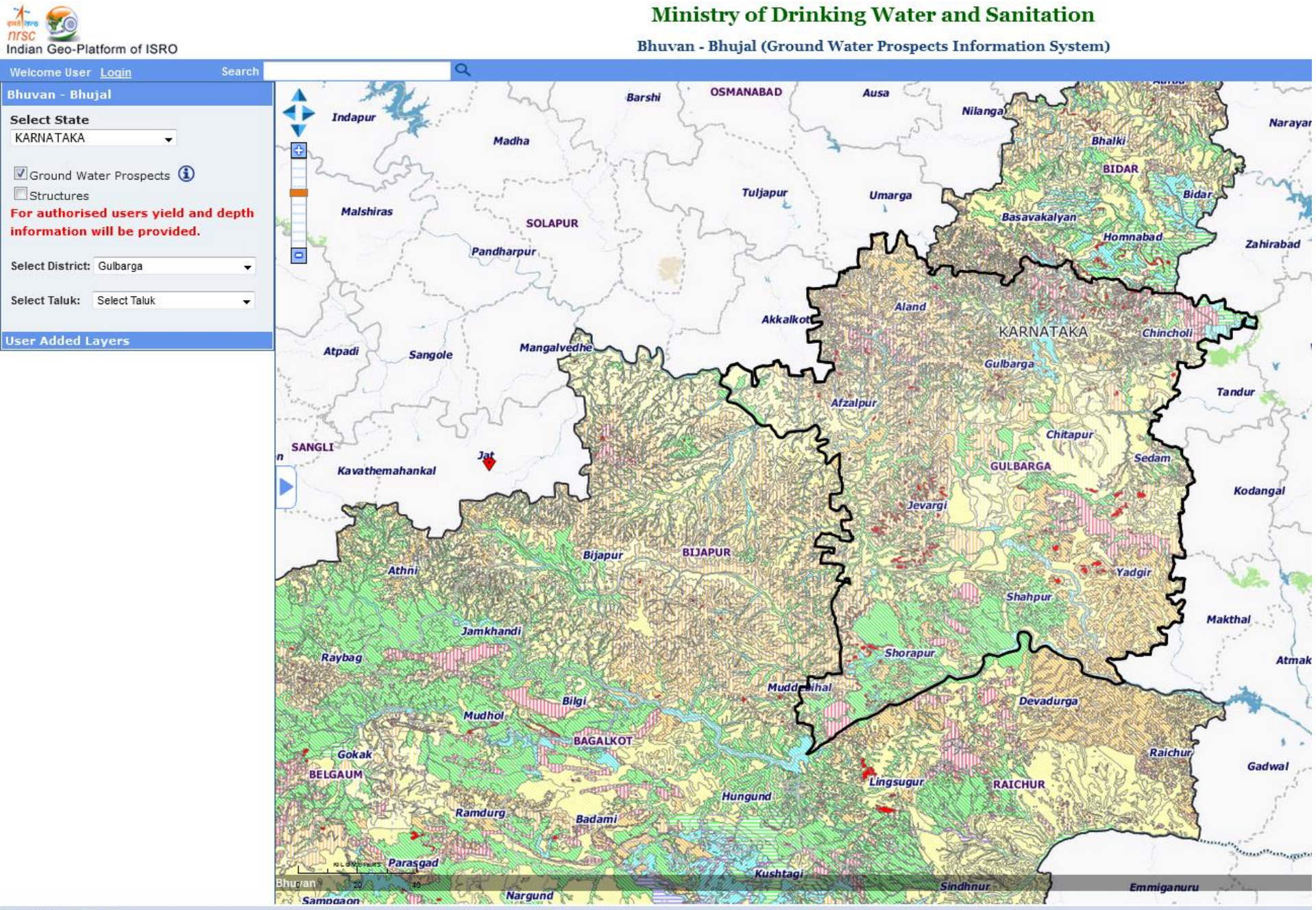
Dist/ Taluk level Segregation

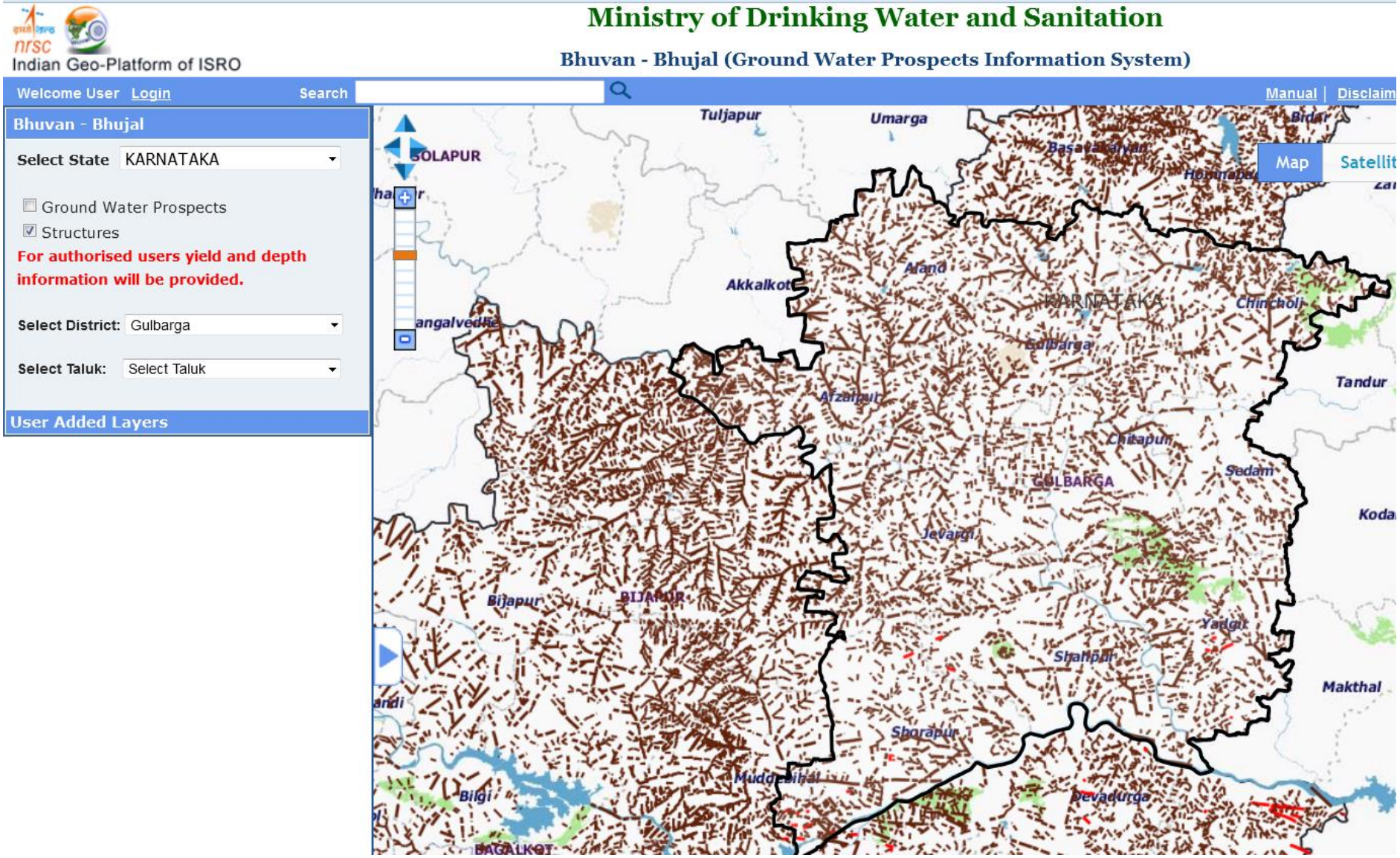
Seamless Ground Water Prospect Maps of Karnataka State



Seamless Lineament Maps of Karnataka State

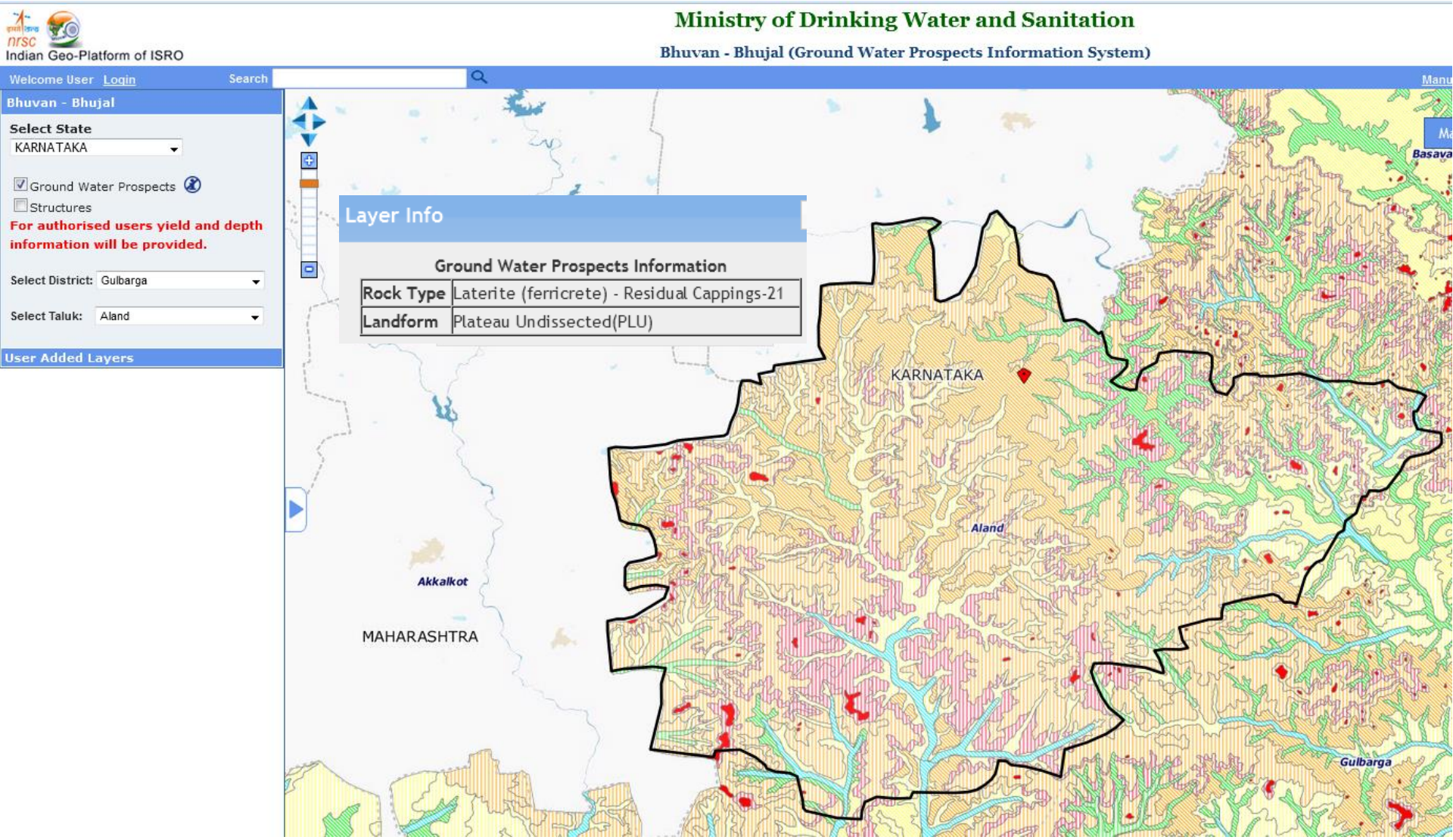
Seamless GWP Map OF Gulbarga Dist, Karnataka

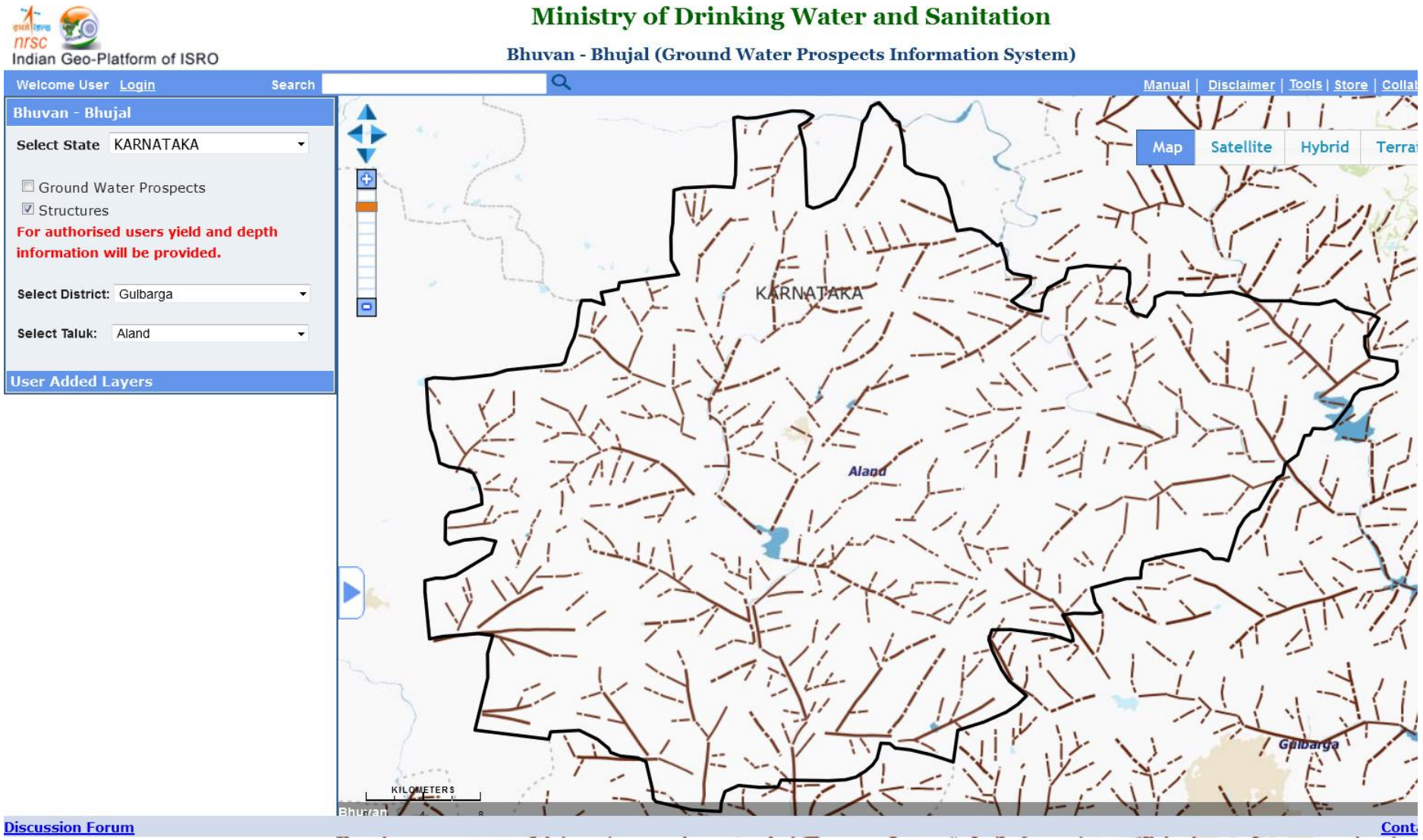




Lineaments Map of Gulbarga Dist, Karnataka

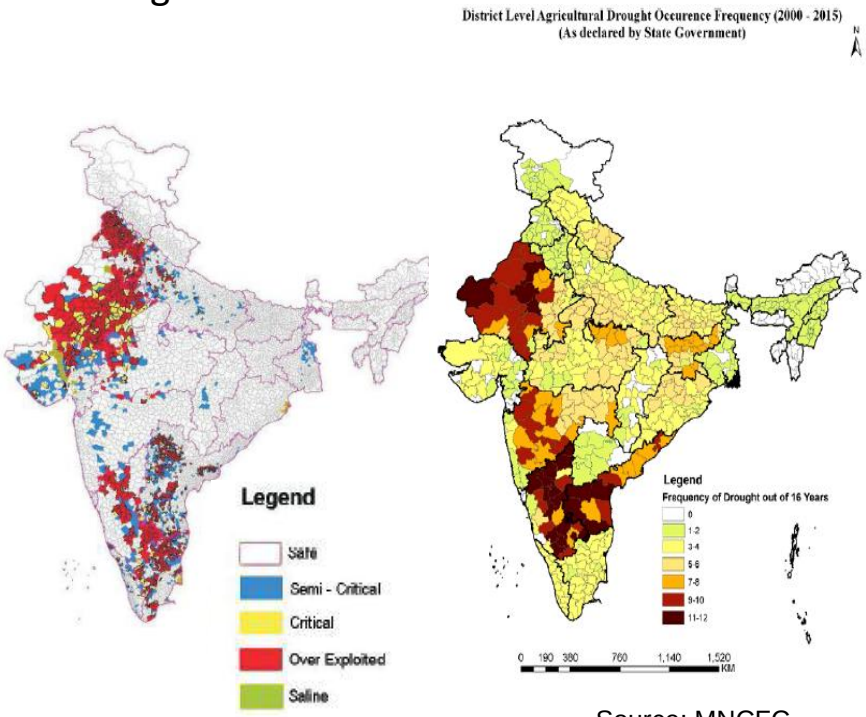
Seamless GWP Map OF ALAND taluk (Gulbarga Dist, Karnataka)



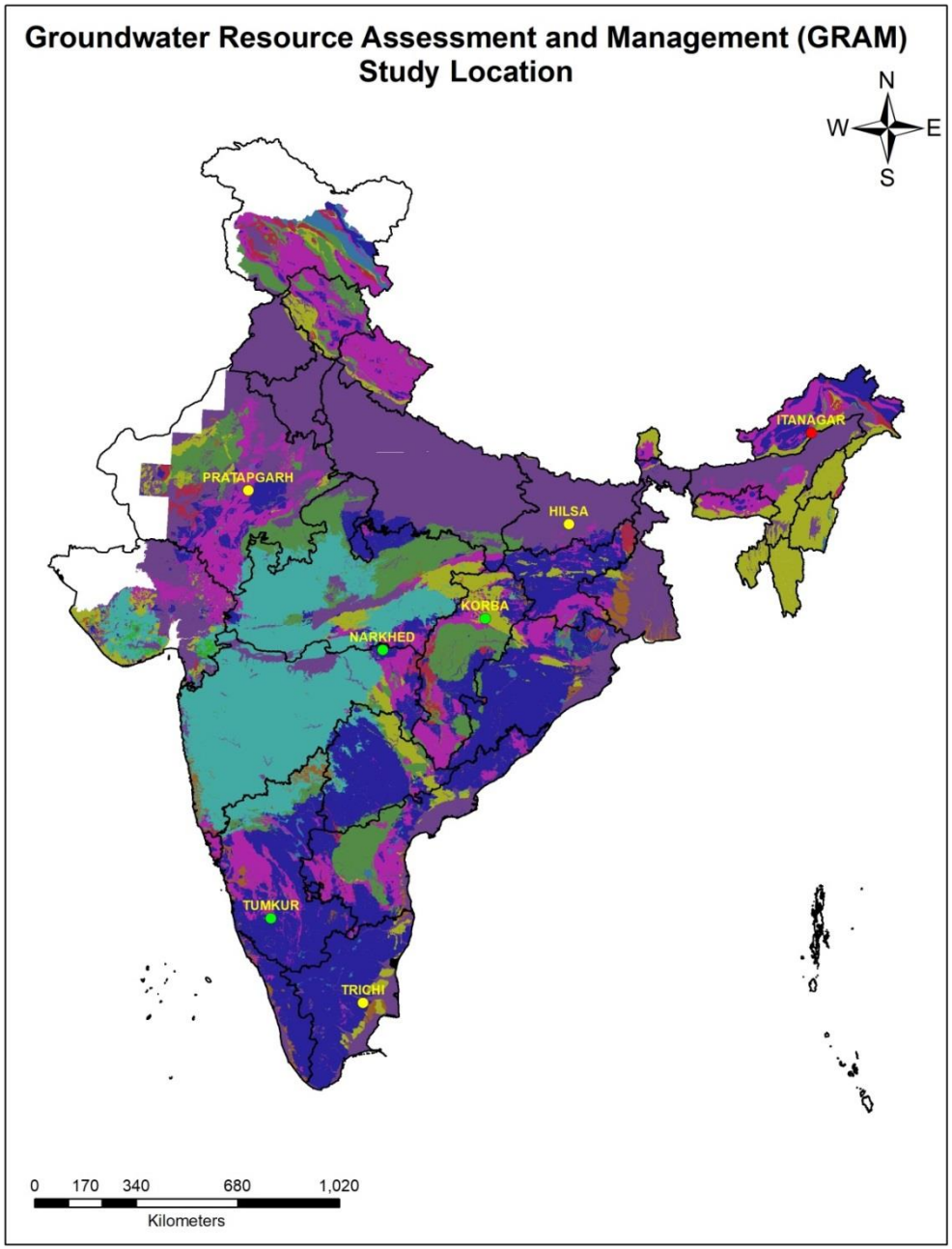


Lineaments Map of ALAND taluk (Gulbarga Dist, Karnataka)

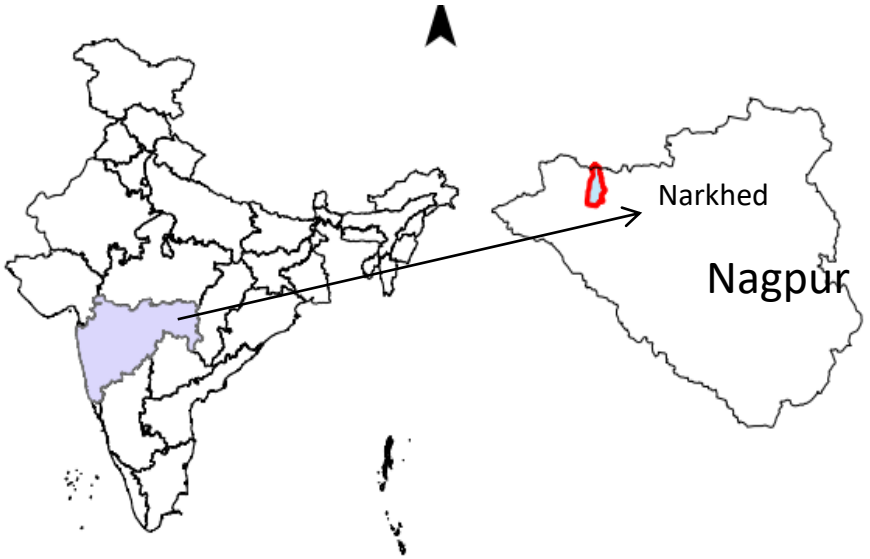
- Based on our experience of 1:50K mapping, it was felt that we need to address each hydrogeological province of the county for ground water source finding and sustainability.
- Pilot study for ground water assessment in nine (9) major provinces are initiated on 1:10K scale.
- Village level ground water source finding and sustainability is the key issue for making the country safe and sustainable for ground water.

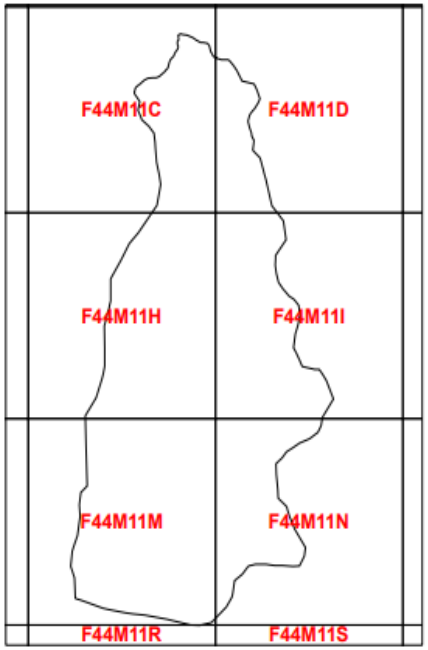


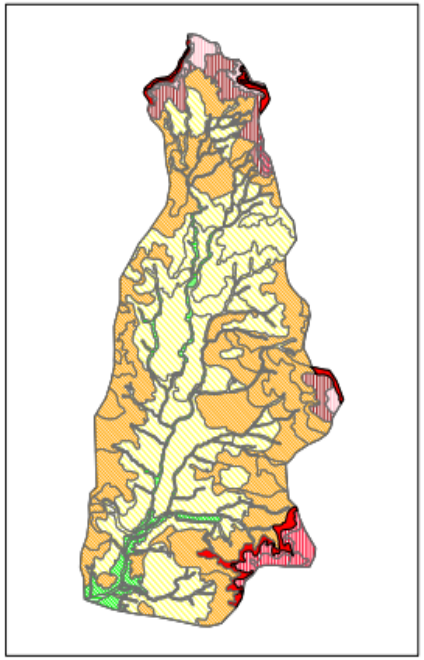
Source: MNCFC



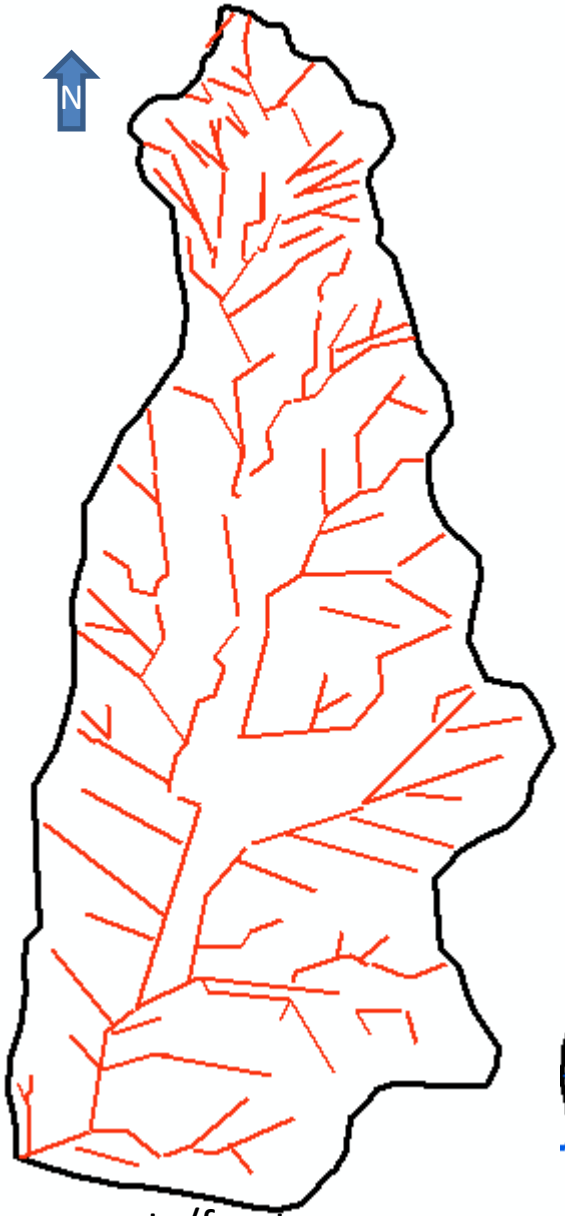
Basaltic Pilot study region
Swargaon micro-watershed (69 sq. km.) in Deccan Basaltic province



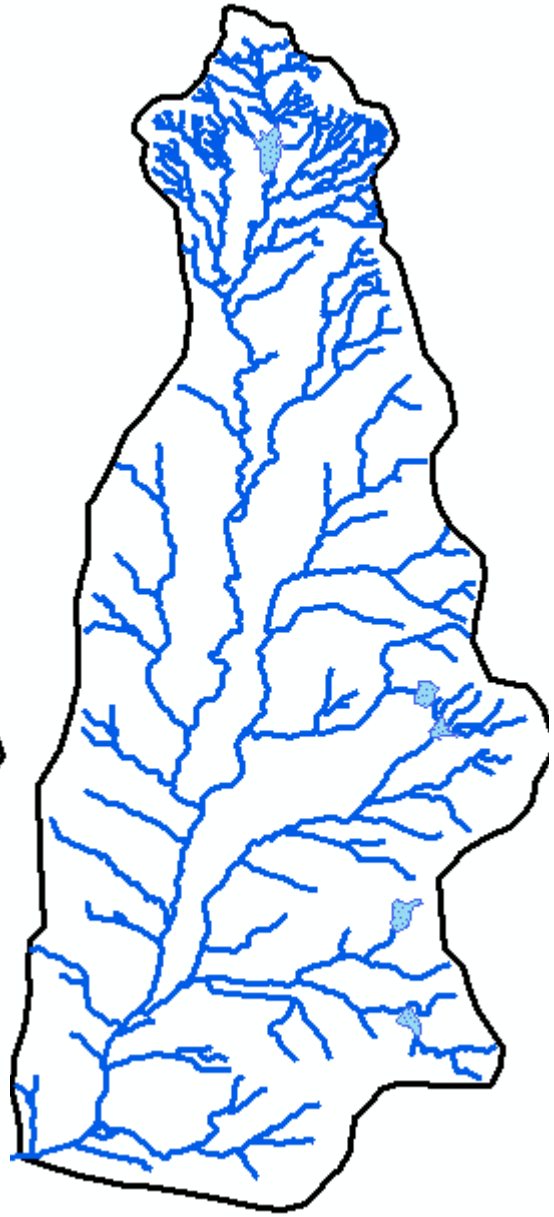




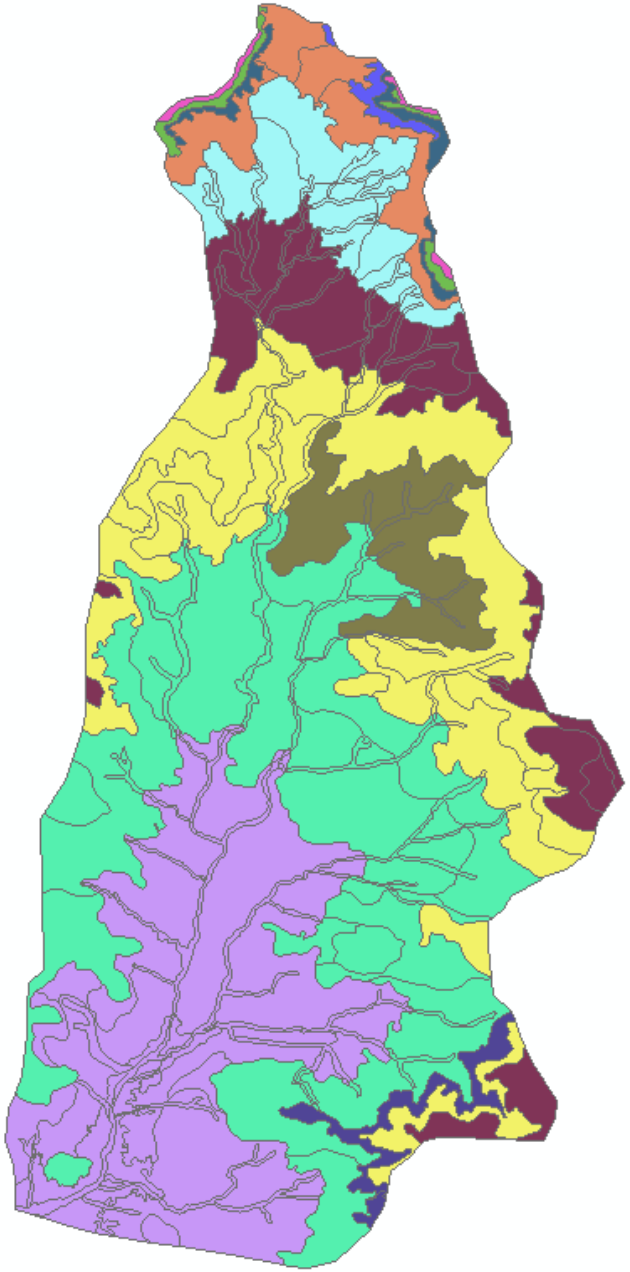
INPUT LAYERS



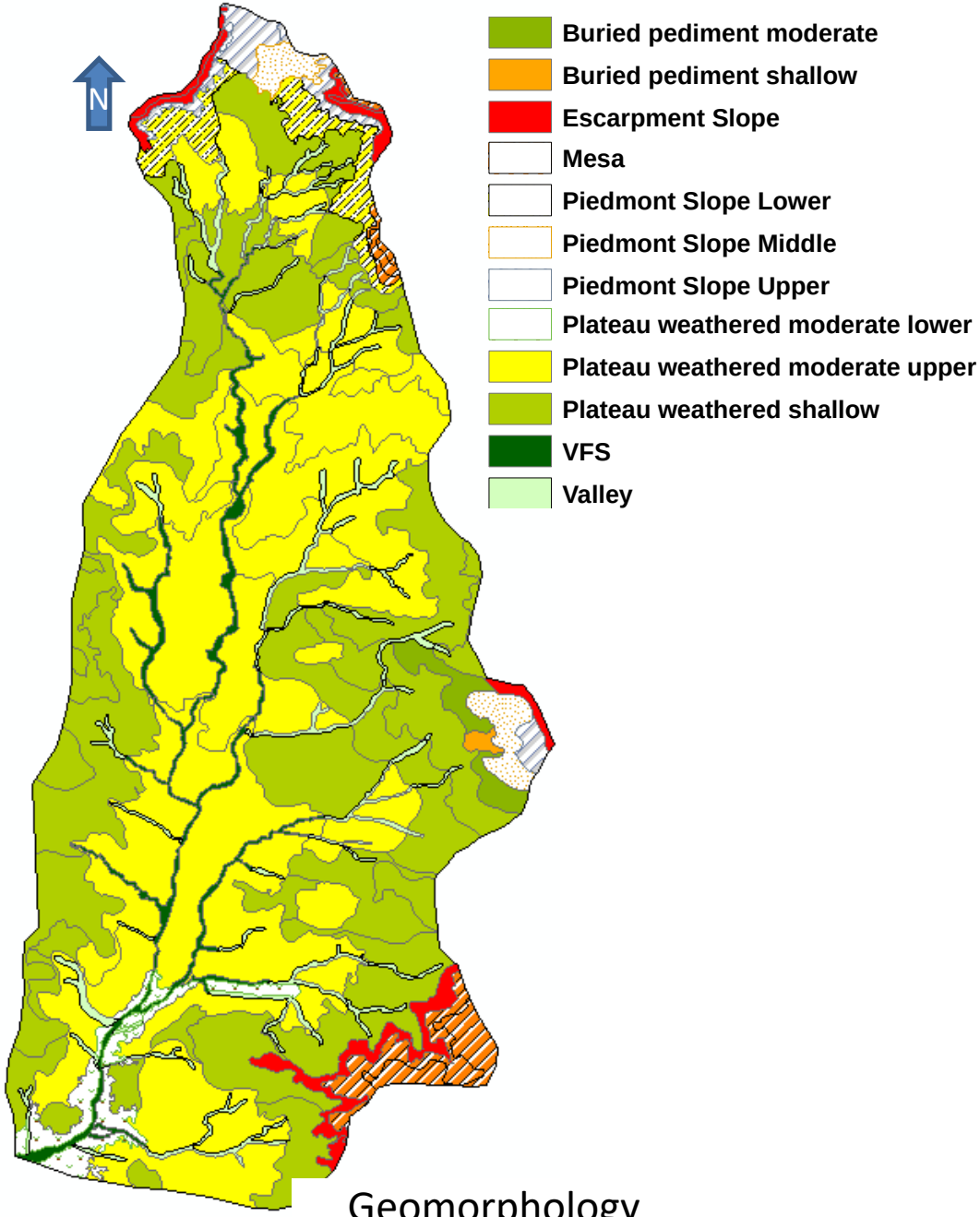
Lineaments/fractures



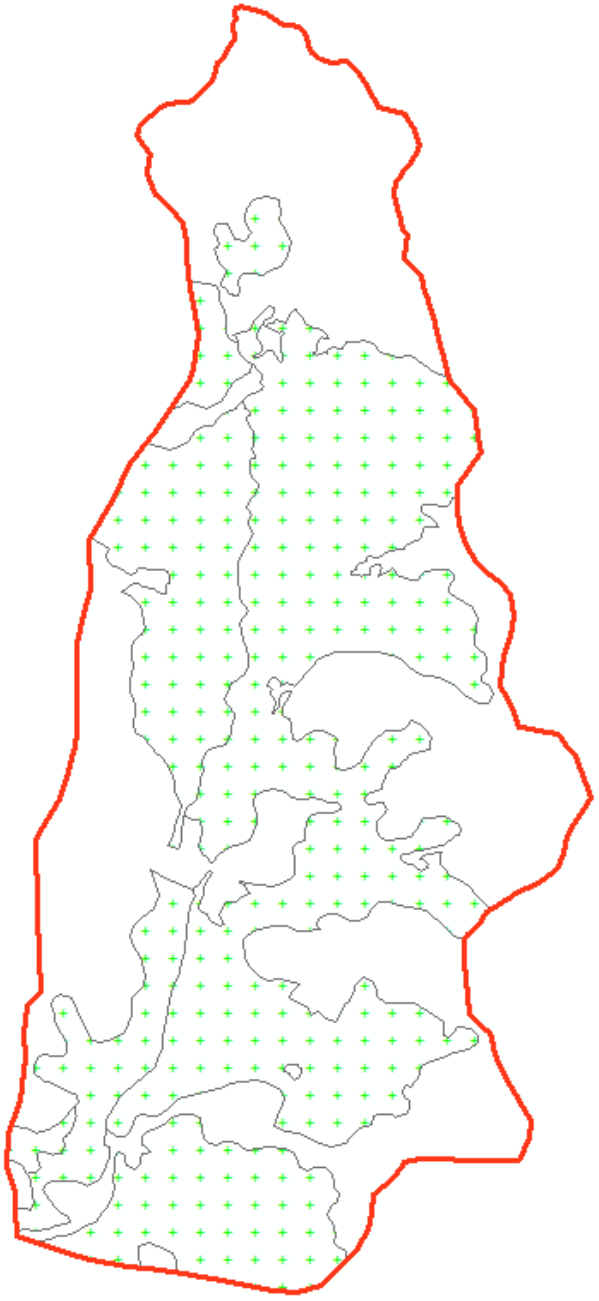
Drainages



Basalt flows

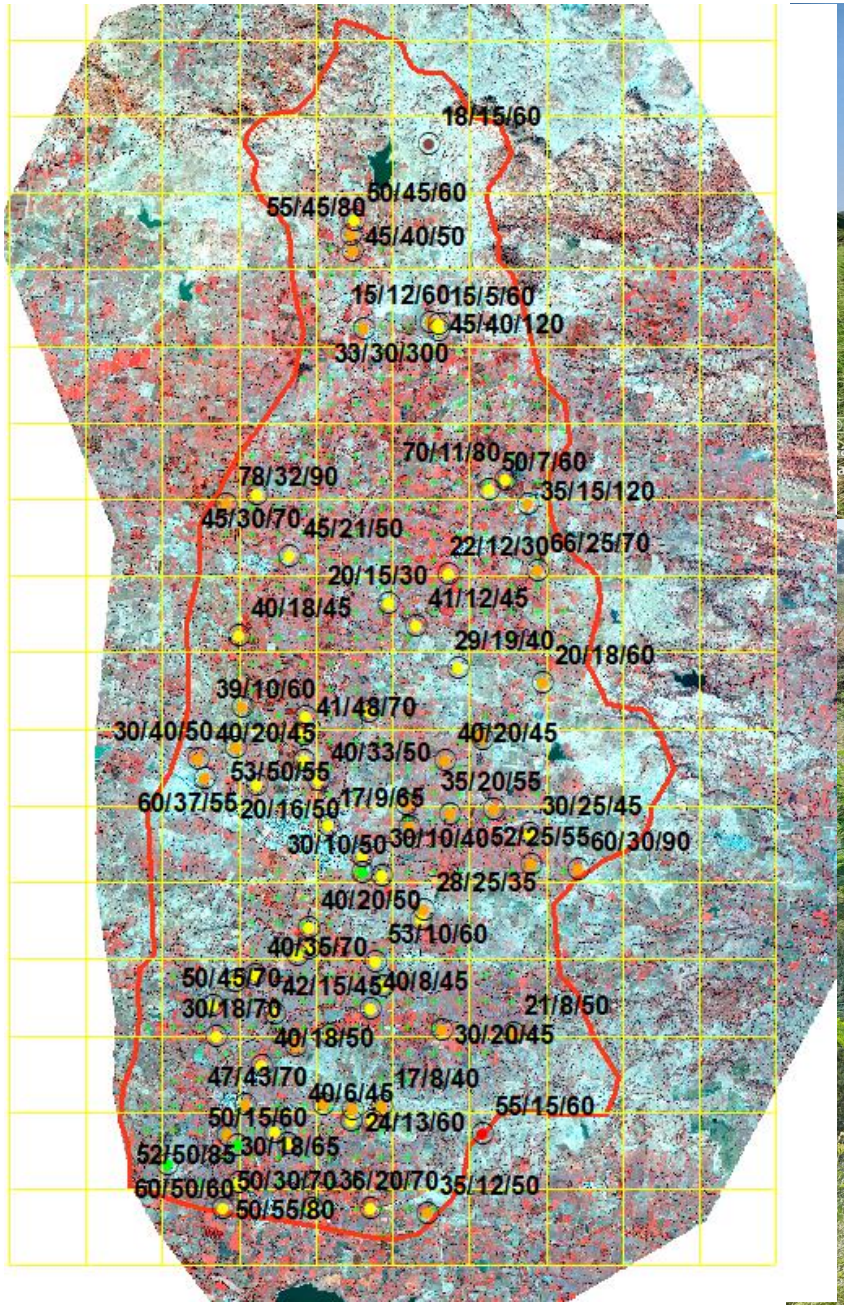


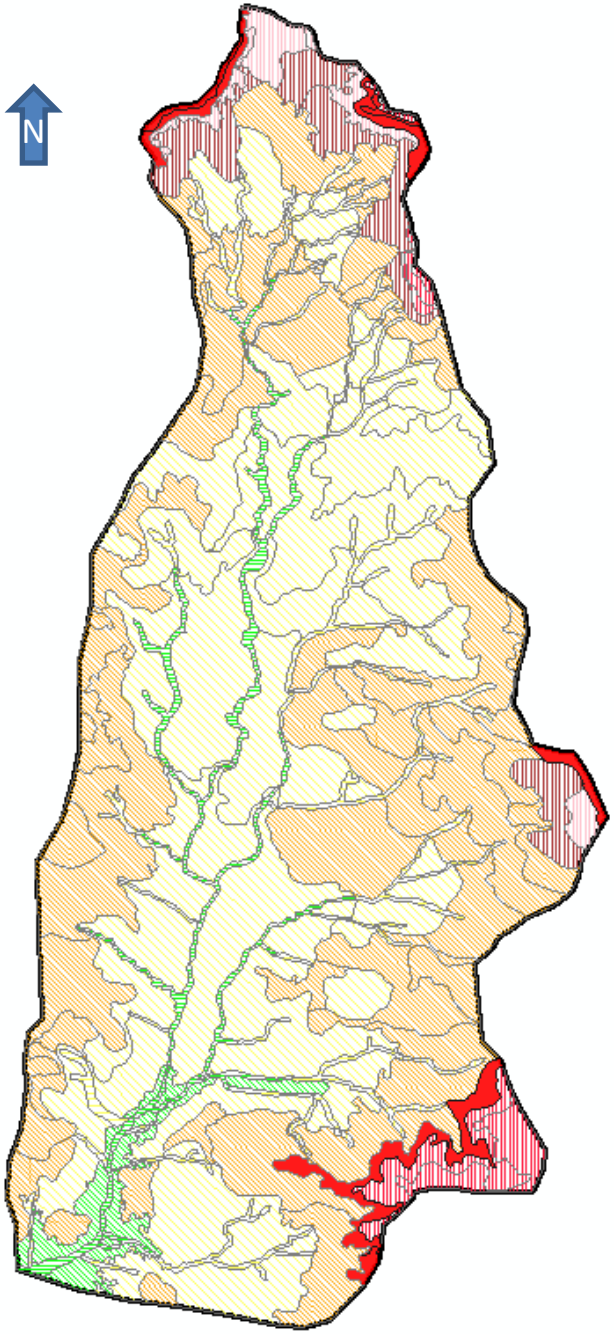
Geomorphology



Ground water irrigated areas

Systematic well data collection in each grid of 1KmX1Km for 10K mapping



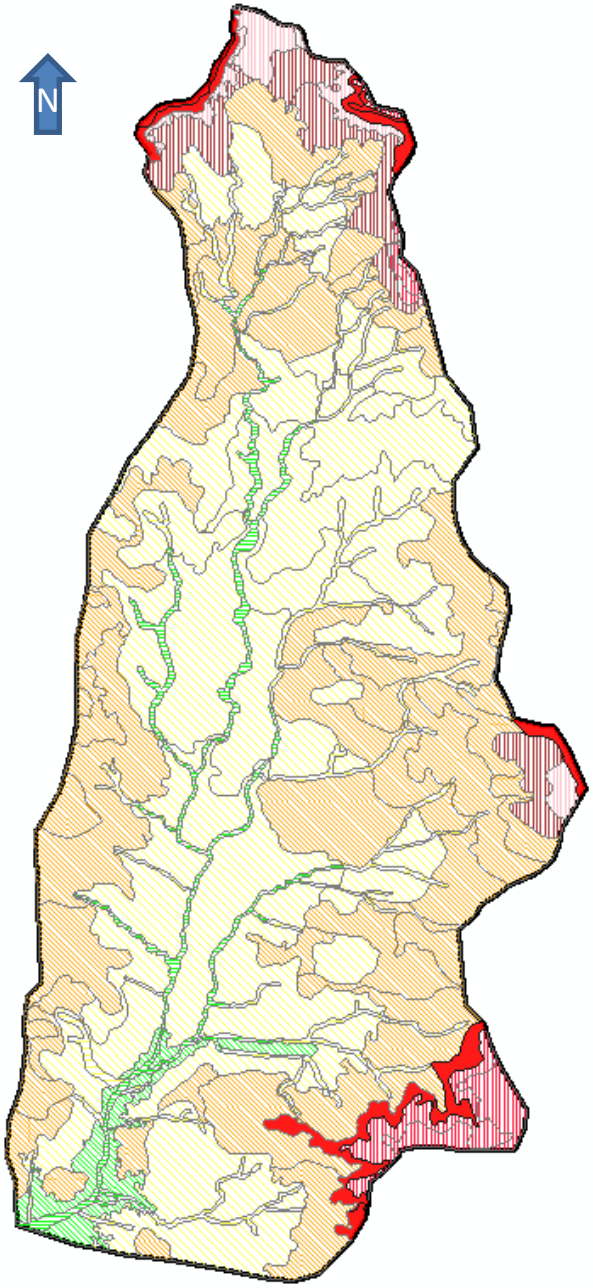


GROUND WATER PROSPECTS INFORMATION

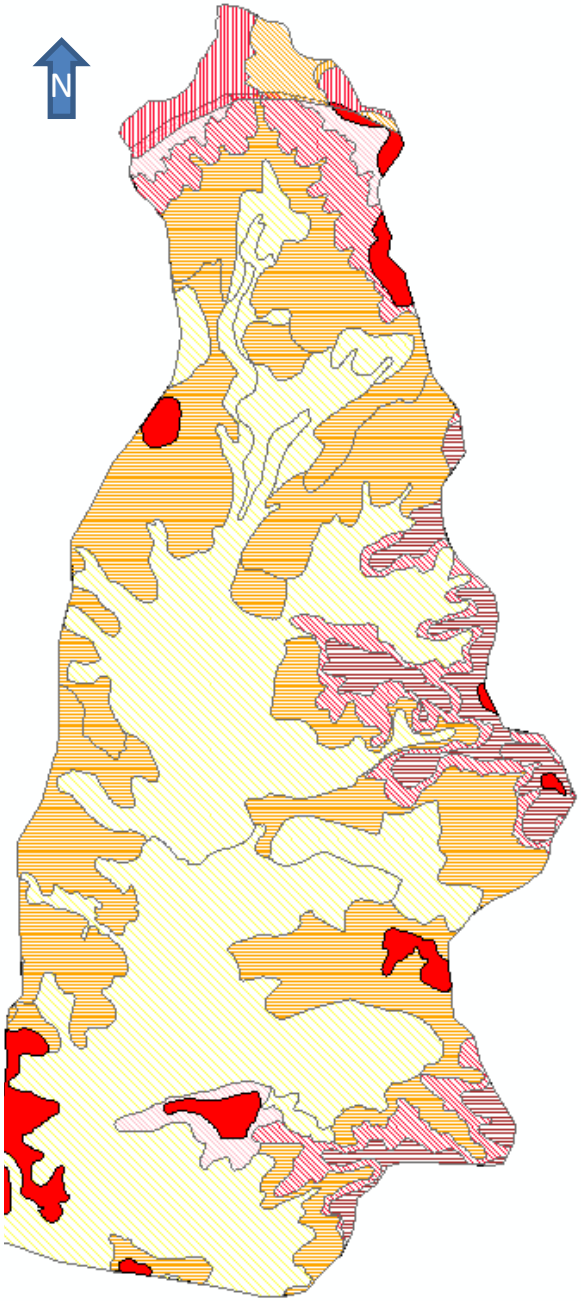
YIELD RANGE OF WELLS IN INCHES	YIELD RANGE OF WELLS LPM	COLOUR CODE	DEPTH RANGE OF WELLS				
			< 30 METERS	30 - 100 METERS	100 - 200 METERS	200 - 300 METERS	> 300 METERS
> 6.0	> 800	VIOLET					
4.6 - 6.0	400 - 800	INDIGO					
3.5 - 4.6	200 - 400	BLUE					
2.5 - 3.5	100 - 200	GREEN					
2.0 - 2.5	50 - 100	YELLOW					
1.6 - 2.0	30 - 50	ORANGE					
1.3 - 1.6	20 - 30	BROWN					
1.0 - 1.3	10 - 20	PINK					
	Prospects limited to valley portions only (Hills, Plateaus etc.)	RED					
	Run-off zone/ Barrier for G.W. movement		(Inselberg / Ridge / Dyke etc.)				

Design of symbology file for 10K mapping

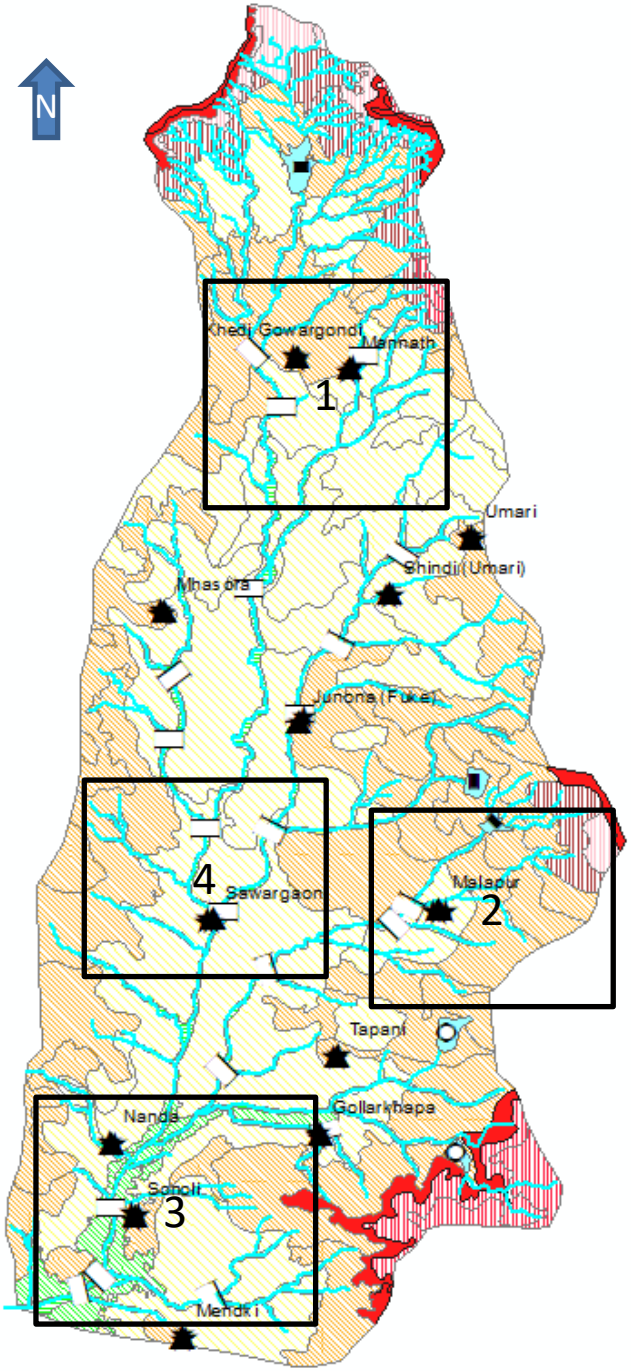
1:10.000 Scale



1:50.000 Scale



	10K (Sq Km)	50K (Sq Km)
	1.70	2.45
	1.80	0.00
	1.50	0.00
	2.10	0.00
	29.10	31.75
	0.15	0.00
	0.00	23.10
	27.00	0.00
	0.00	5.80
	1.73	1.10
	0.00	3.20
	2.72	0.00
	0.00	1.6
	1.20	0.00



HYDROLOGICAL INFORMATION

DESCRIPTION	SYMBOL
CANAL / TANK IRRIGATED AREA	
GROUND WATER IRRIGATED AREA	
RIVER / STREAM	
WATER BODY / SPRING	
CANAL	
RAIN GUAGE STATION (With average annual rainfall in mm)	

RECHARGE STRUCTURES SUGGESTED

PERCOLATION TANK	CHECK DAM
NALA BUND	RECHARGE WELL
DESILTING OF TANK	RECHARGE PIT
SUBSURFACE DYKE	RECHARGE SHAFT
CONTOUR BUNDING	STORAGE TANK

WELLS OBSERVED DURING FIELD VISIT

YIELD RANGE IN LPM	BORE / TUBE WELL	YIELD RANGE IN m^3/ day	DUG WELL / RING WELL
> 800 LPM		> 400 m^3/ day	
400 - 800 LPM		200 - 400 m^3 / day	
200 - 400 LPM		100 - 200 m^3 / day	
100 - 200 LPM		50 - 100 m^3 /day	
50 - 100 LPM		25 - 50 m^3 /day	
30 - 50 LPM		15 - 25 m^3 /day	
20 - 30 LPM		10 - 15 m^3 /day	
10 - 20 LPM		5 - 10 m^3 /day	
< 10 LPM		< 5 m^3 / day	

Colour inside well symbol indicates yield range. The figures on the top right hand side of well indicate the depth to water level and depth of well in meters

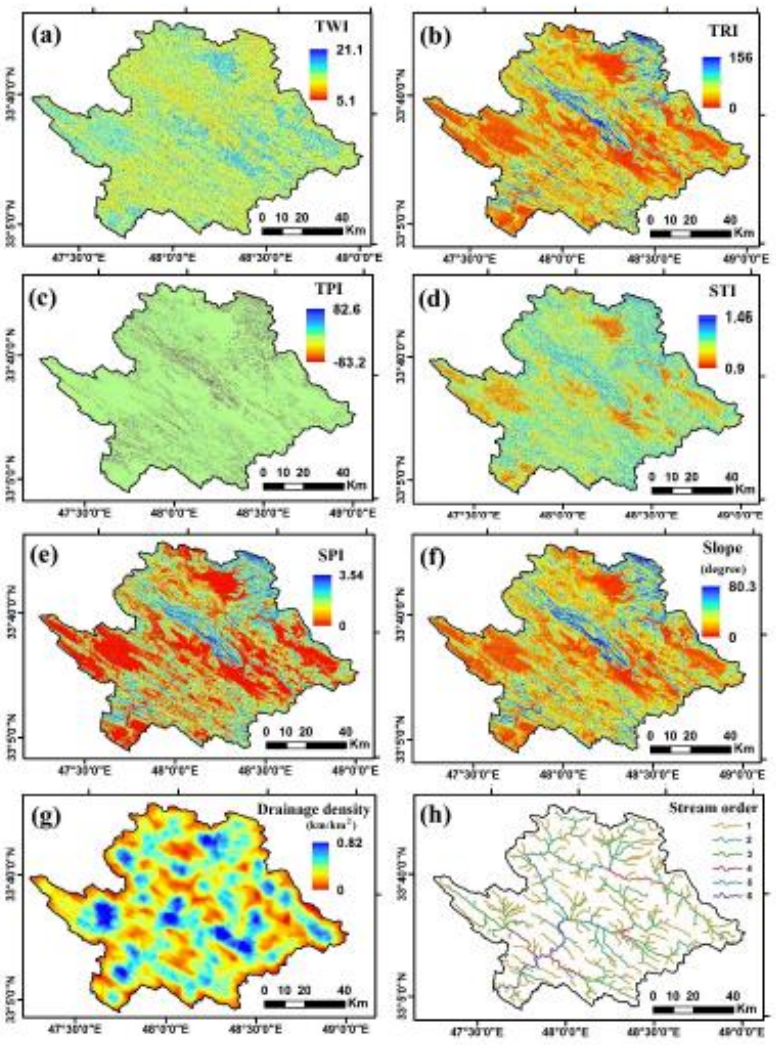
DUG - CUM- BORE WELL

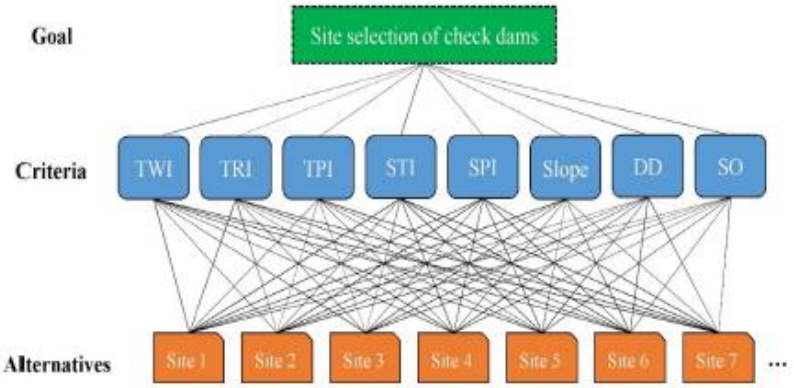
HAND PUMP WELL

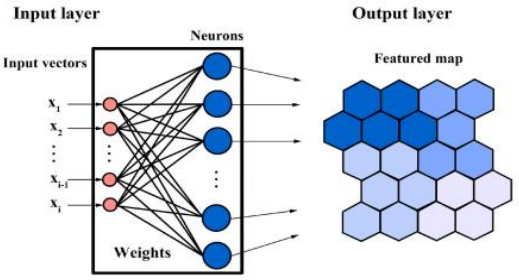
ARTESIAN WELL

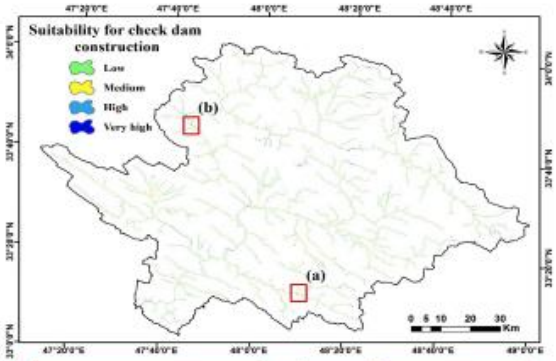
OBSERVATION WELL OF G.W DEPT. / C.G.W.B.

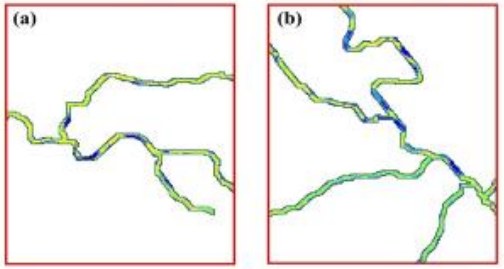
Site Suitability for Check Dams (CD) using Remote Sensing & Geo-Spatial Techniques

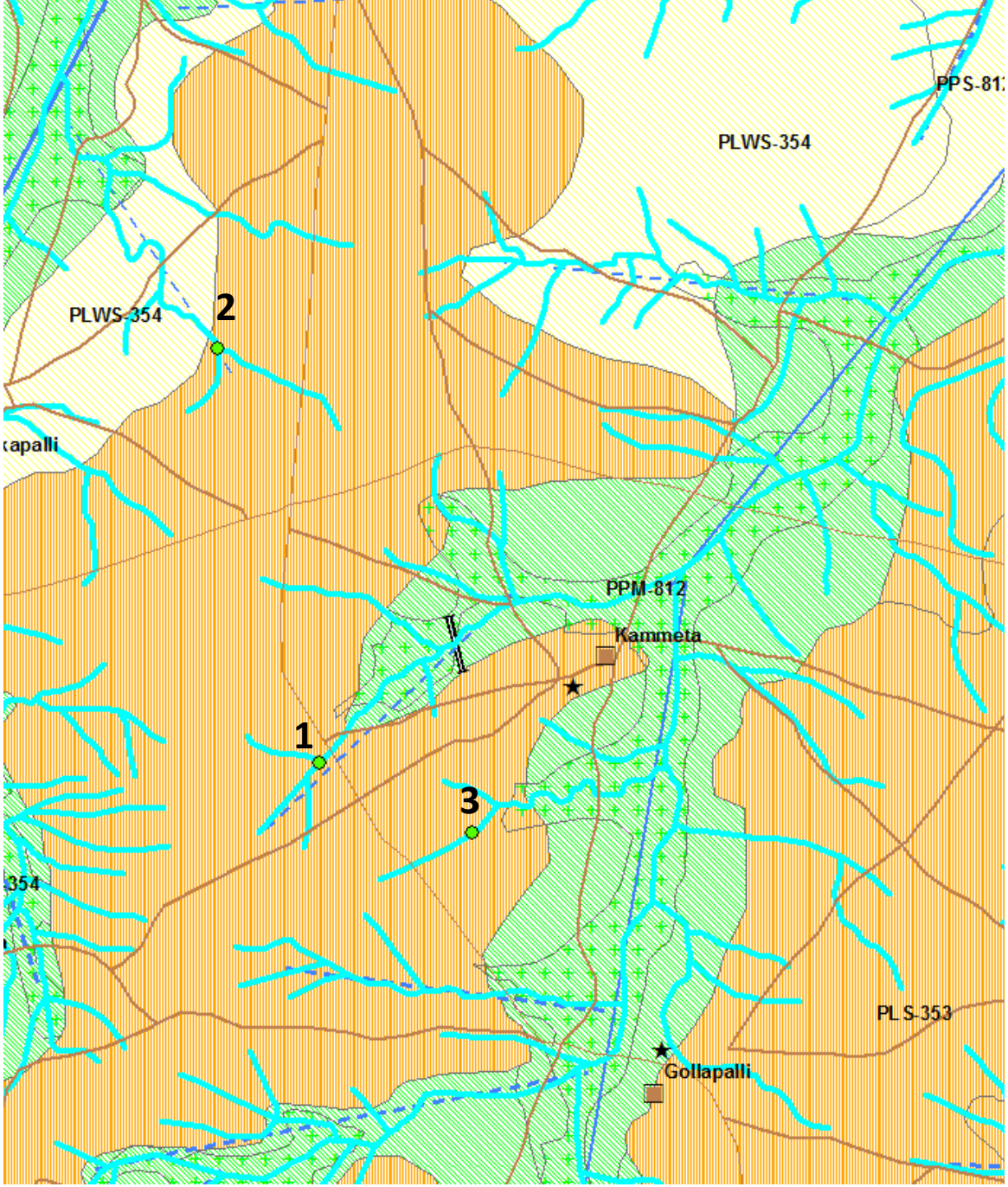








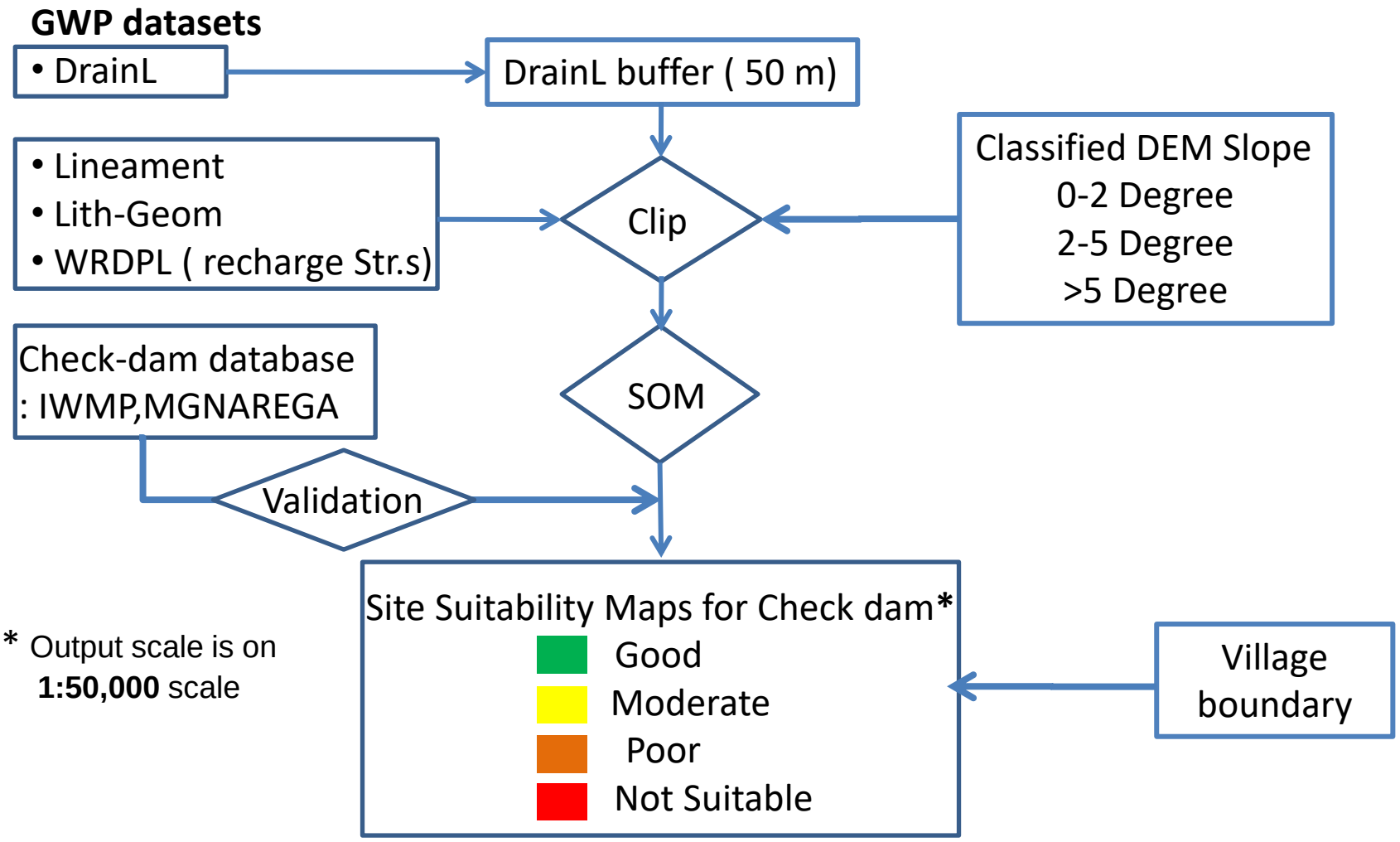




Field Observation

GWP map on 1:50,000 scale prepared under NRDWP for Ministry of Jal Shakti (MJS)

Methodology

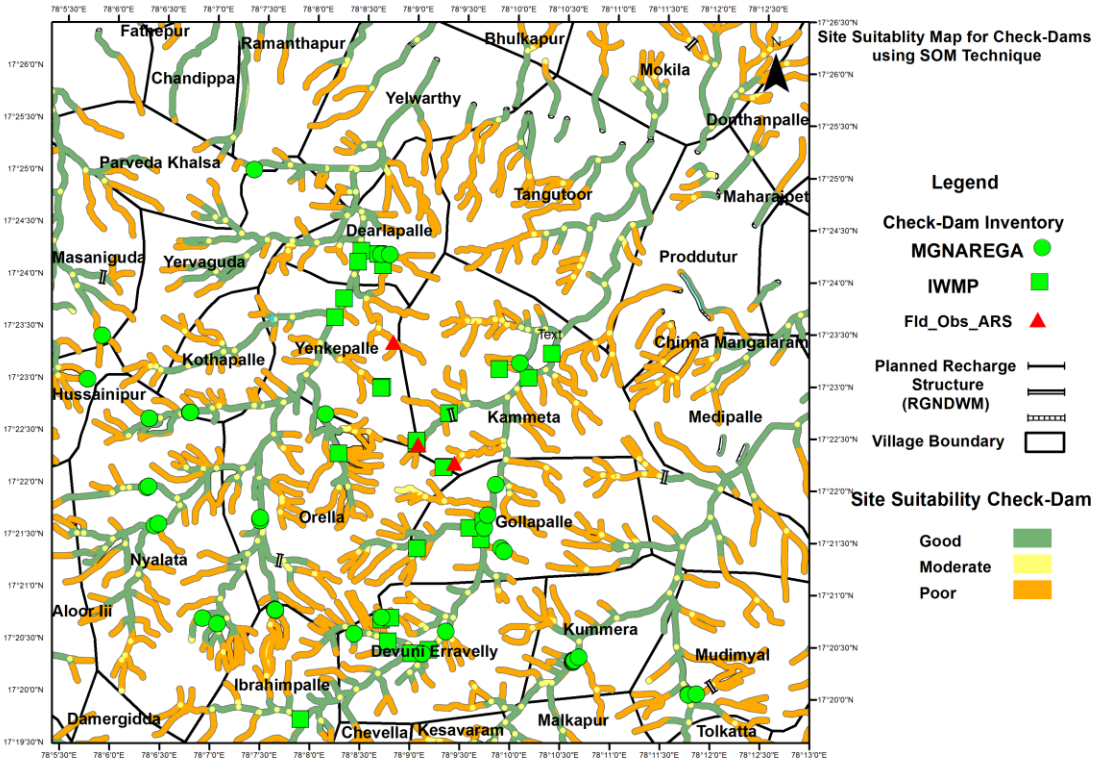


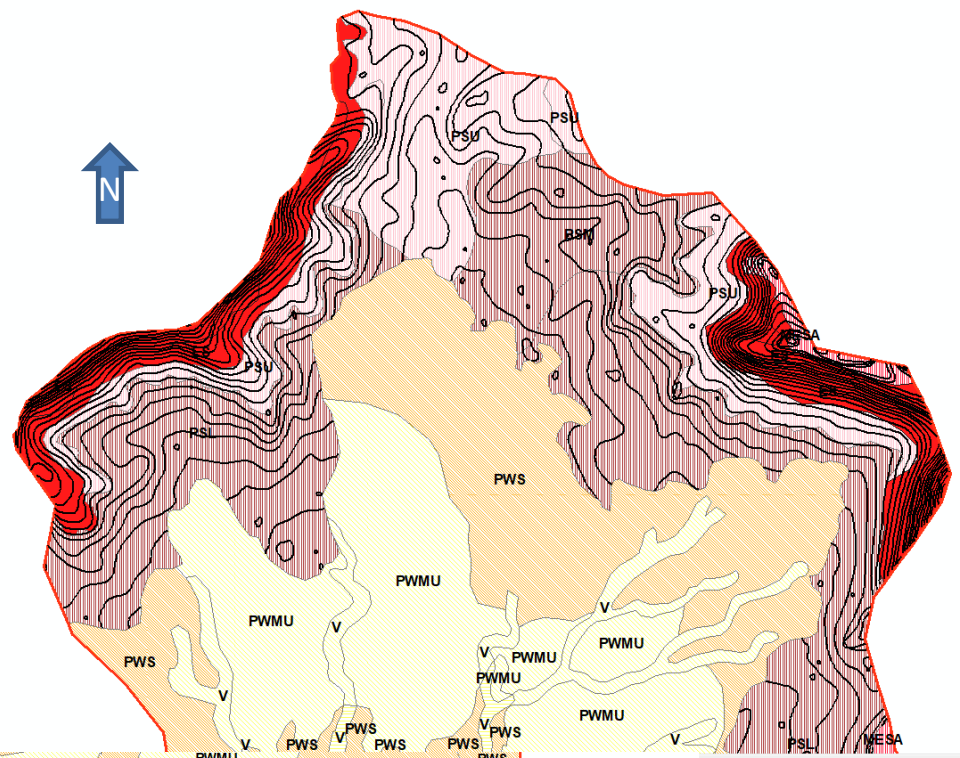
Self Organising Map (SOM) is a powerful method to explore the inter-relationships of the high dimensional multivariate datasets and classify the obtained pattern into a low dimensional output layers

Neuron Rules

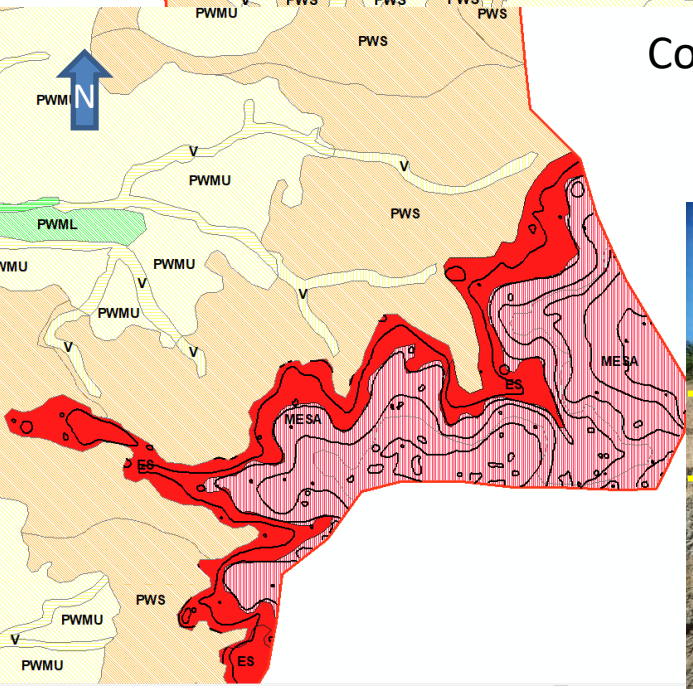
- 1st order drainage buffer :- Poor
- intersection between 1st order drainage, shape: circle:Area:0.007848 sq.km:- Moderate
- Slope condition:- 0-2(Good);2-5 (moderate);>5 (Poor)
- Lith-geom (symcode 8-19):-Good; (symcode 20-25): Poor
- Weathering condition(based on lithgeom depth):-
- 2nd -3rd order Drainage:- Good
- Lineament intersection with drainage buffer: Good

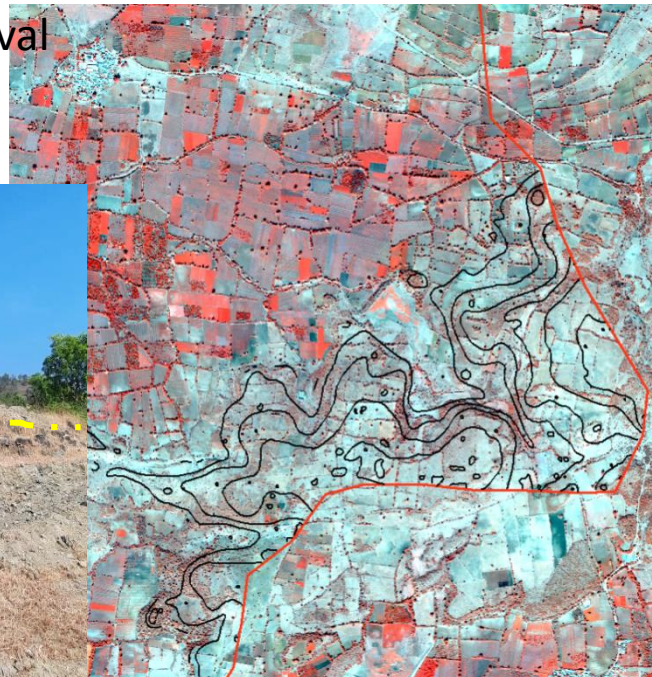
Result & Observations



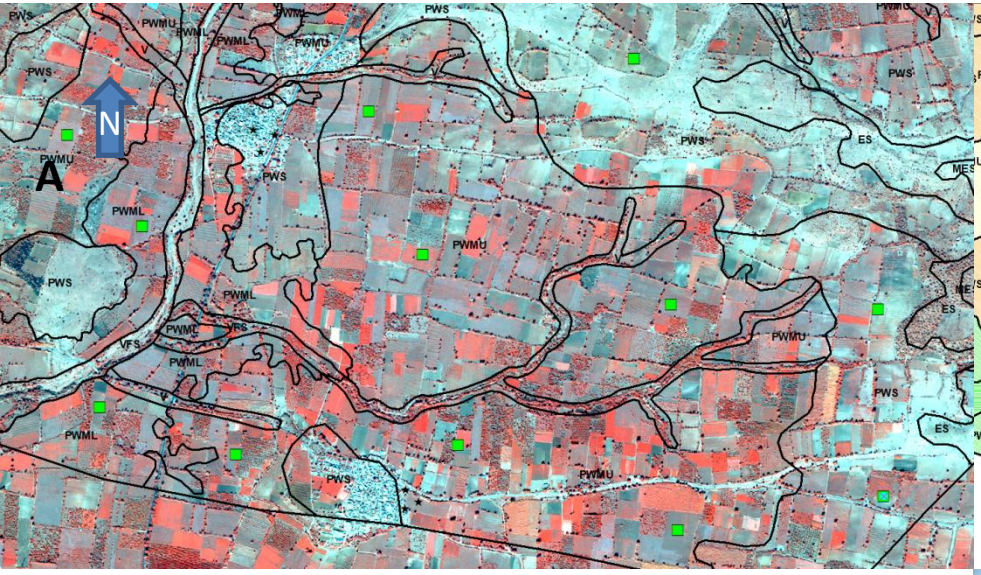


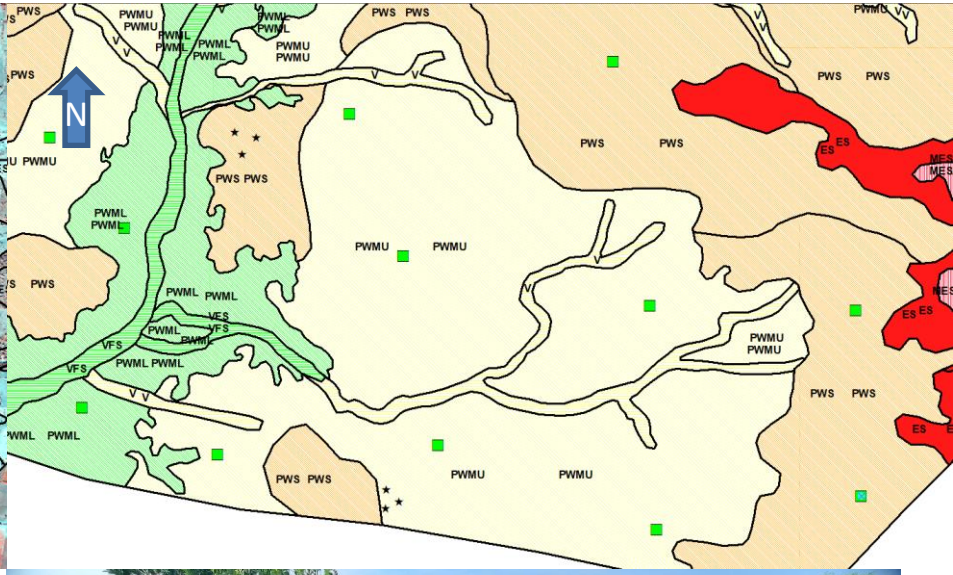
Contour bunding with 5 m interval



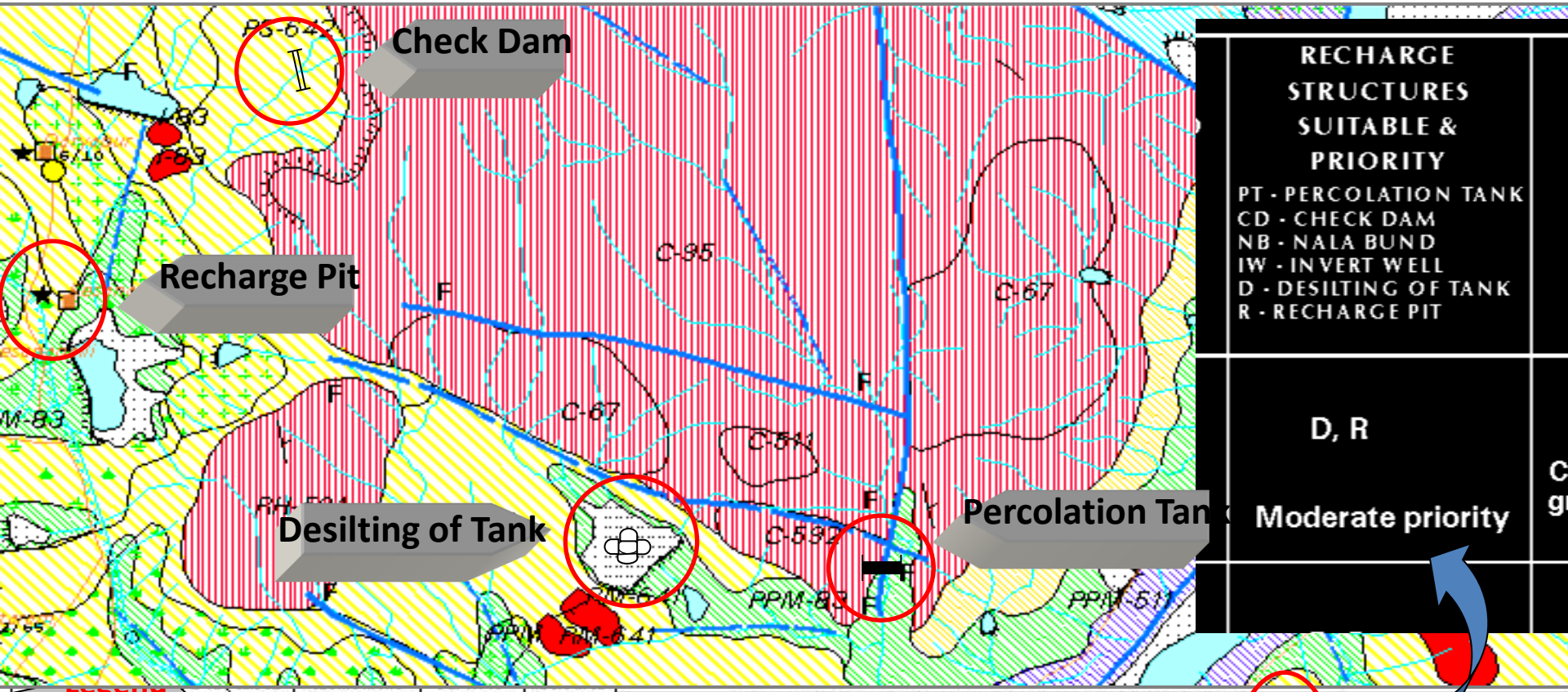


Farm pond without clay lining with semi leaky nature





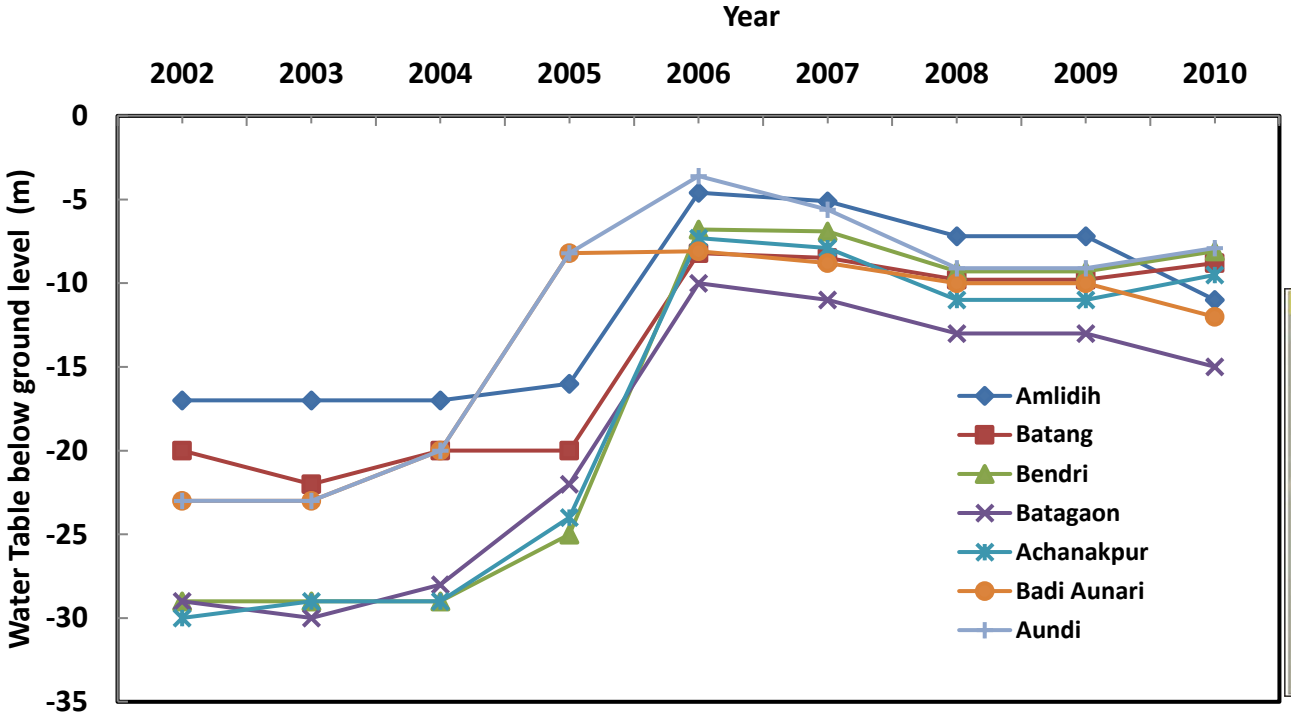
Sustainability of ground water through recharging



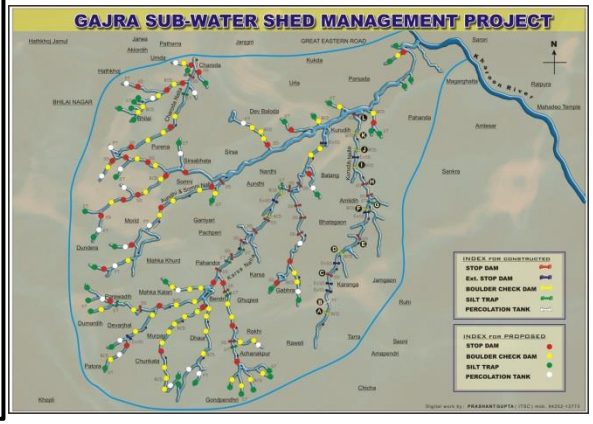
Legend	UNIT AND FORM	NO. OF WELLS OBSERVED	CONDITIONS								REMARKS
BC-II	Alluvium (Sand/Silt dominant) (II)	Buried channel (BC)	5-6 / No wells	Very Good	LS	TW	5-10	> 300 lpm	Very High	P	Nil	Not required	Very good scope for ground water development. Recharge structures not required.
CB-II		Channel Bar (CB)	5-6 / No wells	Very Good	LS	TW	5-10	> 300 lpm	Very High	P	Nil	Not required	Very good scope for ground water development. Recharge structures not required.
PB-II		Point Bar (PB)	5-6 / No wells	Very Good	LS	TW	5-10	> 300 lpm	Very High	P	Nil	Not required	Suitable for further Ground water development. Casing is required.
APB-II		Alluvium Plain Deep (APD)	6-7 / 5TW	Good	LS	TW	10-12	400-600 lpm	High	P	30-35	Not required	Suitable for further Ground water development. Casing is required.
APM-II		Alluvium Plain Moderate (APM)	5-6 / 5TW	Good	LS	TW	10-30	500-600 lpm	High	P	15-30	PT	Further ground water development is suggested. Casing is required.

Impact of Recharge structures on ground water sustainability

JAL SHAKTI ABHIYAN

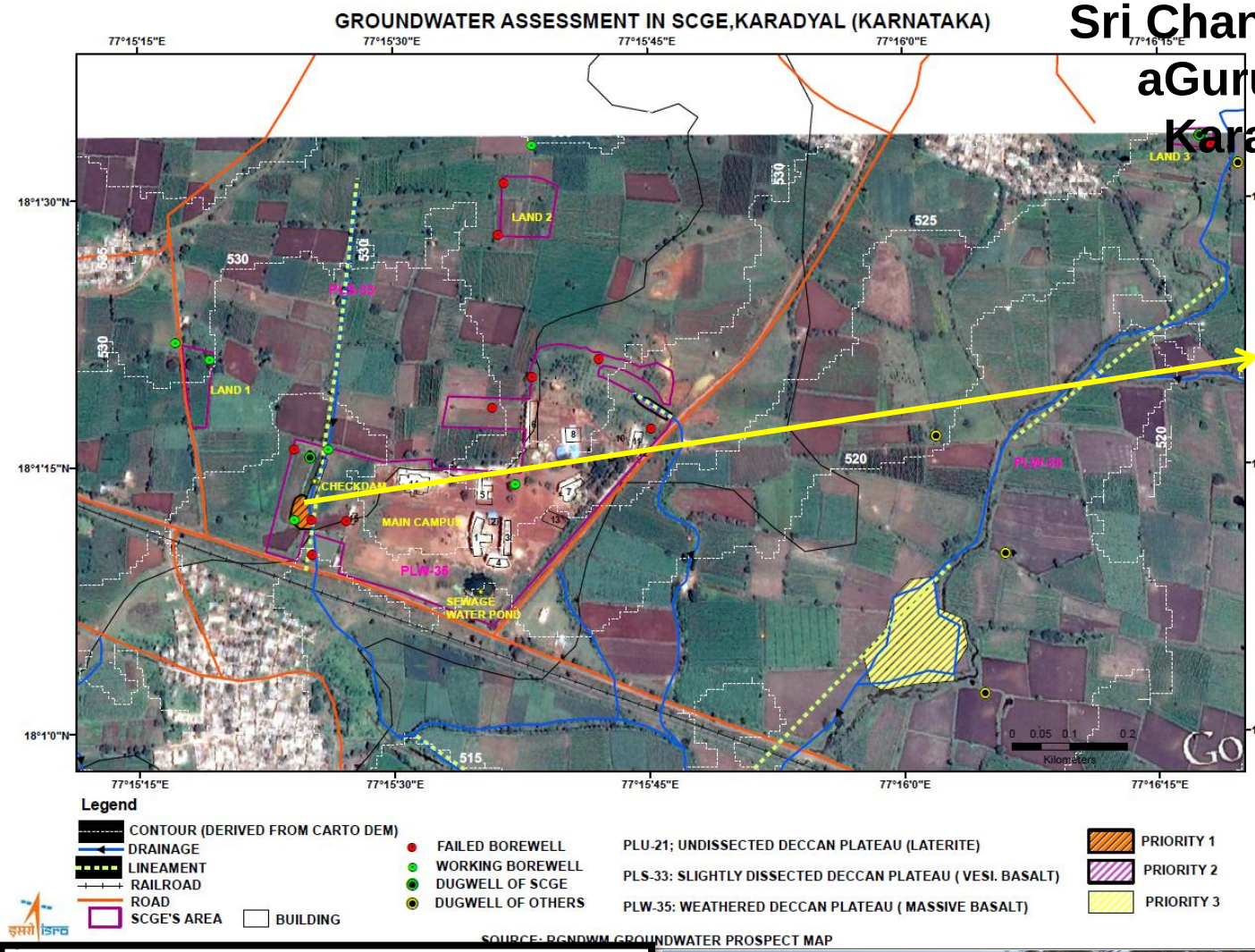


Gajra sub-watershed, Patan Block, Durg Dist., Chhattisgarh.



- **101 recharge structures (Masonary stop dam-23, percolation tank-12, Boulder check dam-25, Nala bund-13 and desilting of pond-28) were constructed in this sub-watershed based on the knowledge gained from RGNDWM ground water prospects maps.**
- **It was observed that the water table has risen to a maximum of 20m at places with average rise of 15m in the area.**

Sri Channabasaveshwar aGurukul campus, Karadiyal, Bidar



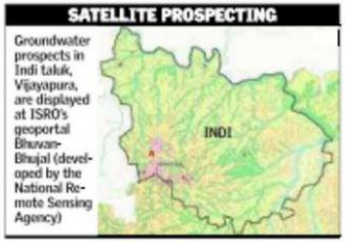
Remote sensing and 'divining' in a desperate quest for water

KARNATAKA BUREAU

BENGALURU: In the quest for groundwater this summer, people seem to be relying on both cutting edge satellite images and traditional beliefs like 'water divining'.

Over a month back, the State Government decided to use the Indian Space Research Organisation's satellite images to locate borewells in four taluks of three districts of North Karnataka: Indi in Vijayapura; Afzalpur and Aland in Kalaburagi; and

SATELLITE PROSPECTING

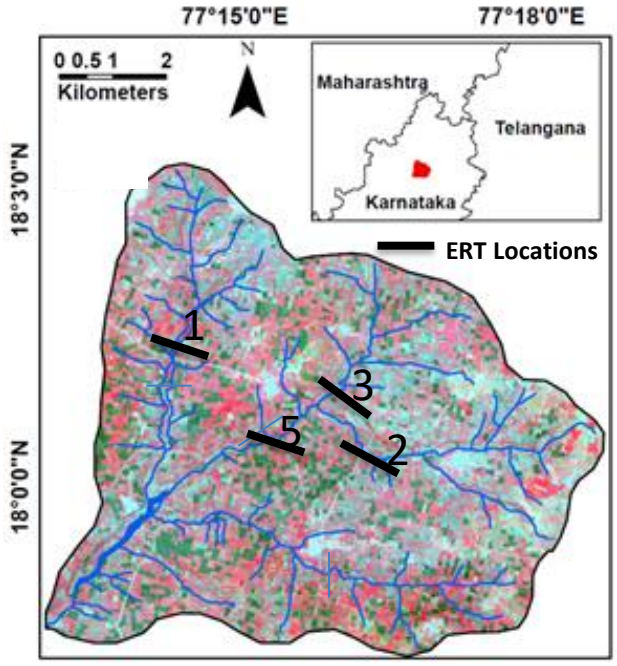


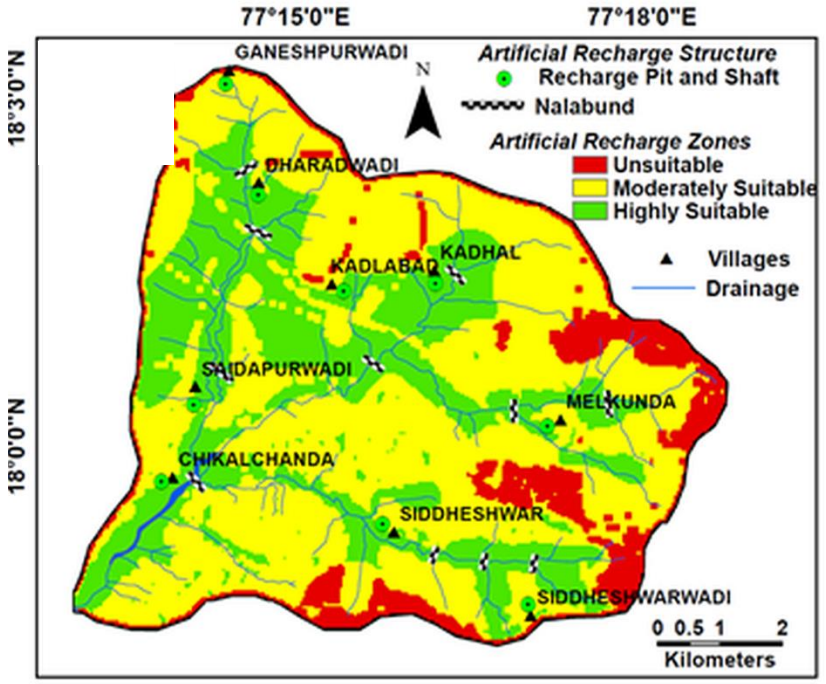
Groundwater prospects in Indi taluk, Vijayapura, are displayed at ISRO's geoportal Bhuvan-Bhujal (developed by the National Remote Sensing Agency)

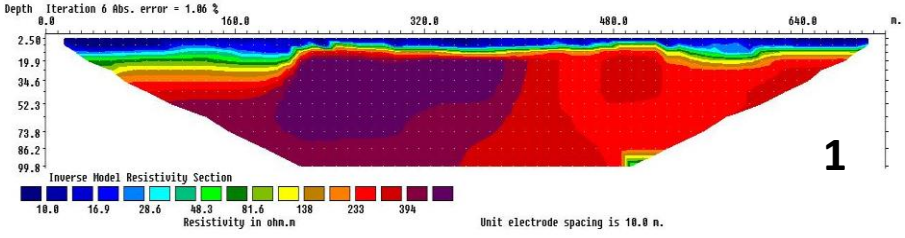
claims have powers to detect groundwater with the throbbing of his veins. He walked around the 12-acre campus and identified a spot, and when the borewell was dug there was water, said a resident.

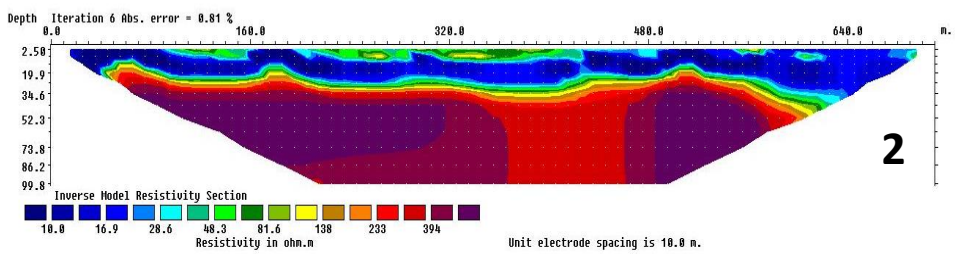
There are nearly two dozen water diviners from Karnataka actively involved in the practice of locating underground water. Their fees range from anywhere between Rs 5,000 and Rs 7,000 for every successful find.

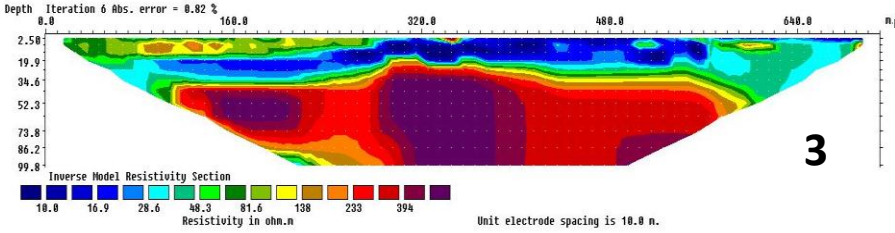
Electrical Resistivity Tomography (ERT) study of Bidar area, Karnataka

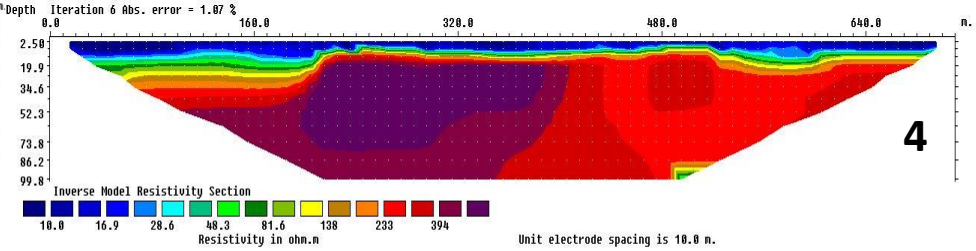






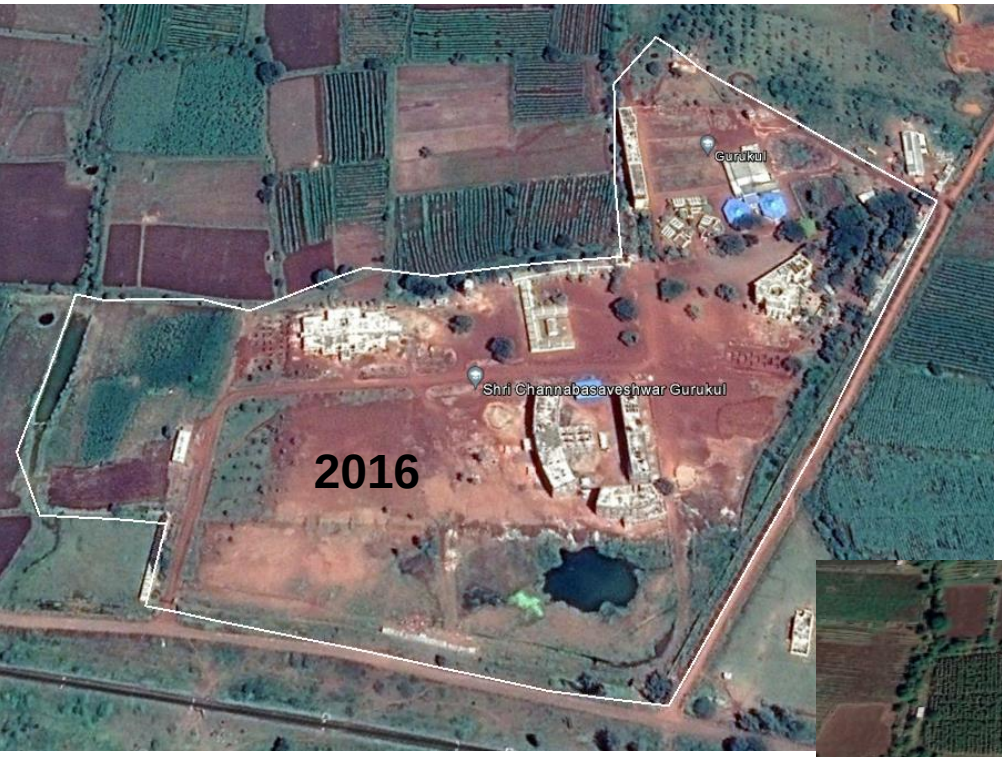






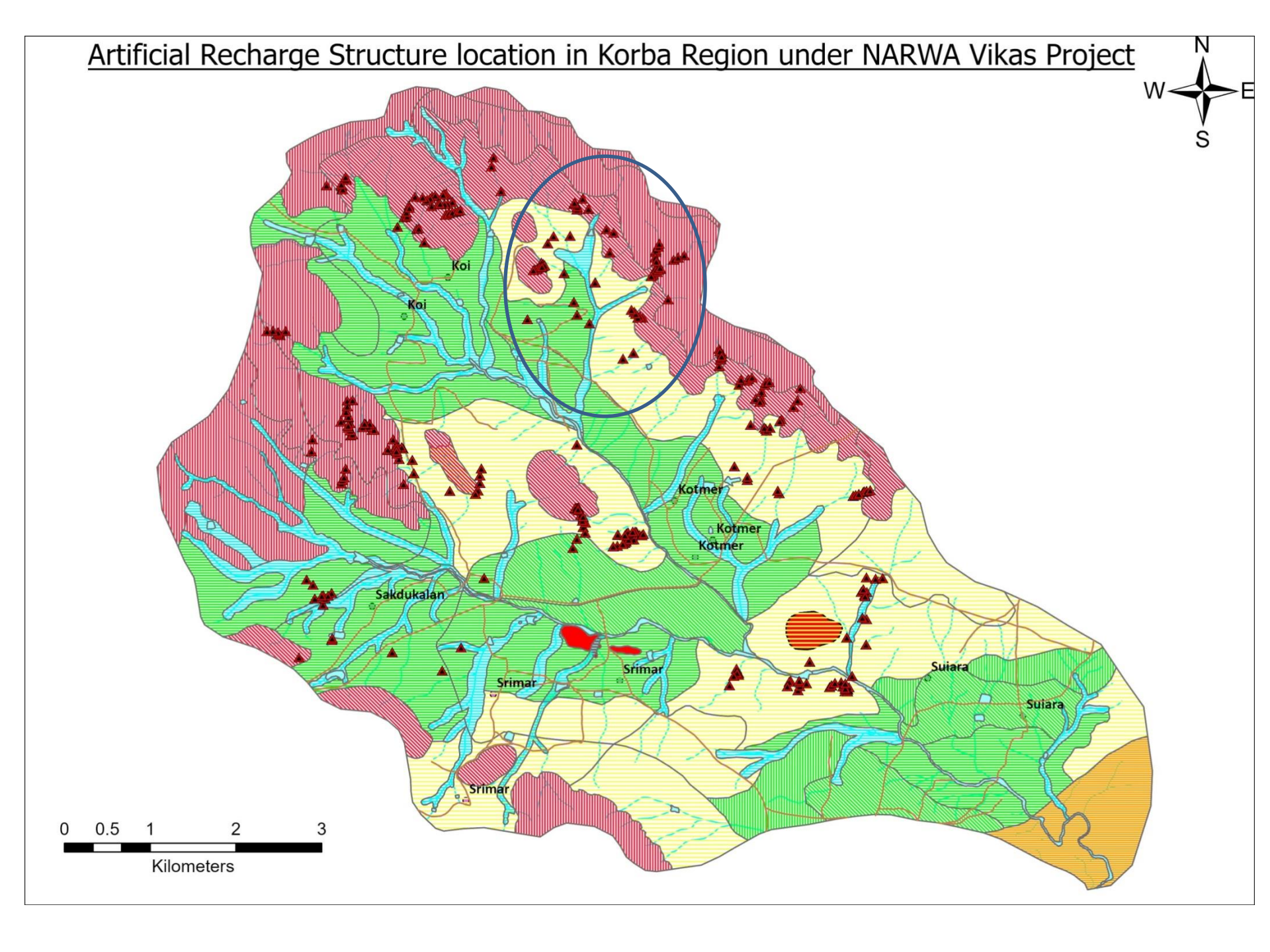
Success story
(Village level 1:10K mapping)

Sri Channabasaveshwar Gurukul campus, Karadiyal, Bidar



- **An initiative towards water resources sustainability planning under ISRO/ANTRIX CSR initiatives.**

Artificial Recharge Structure location in Korba Region under NARWA Vikas Project

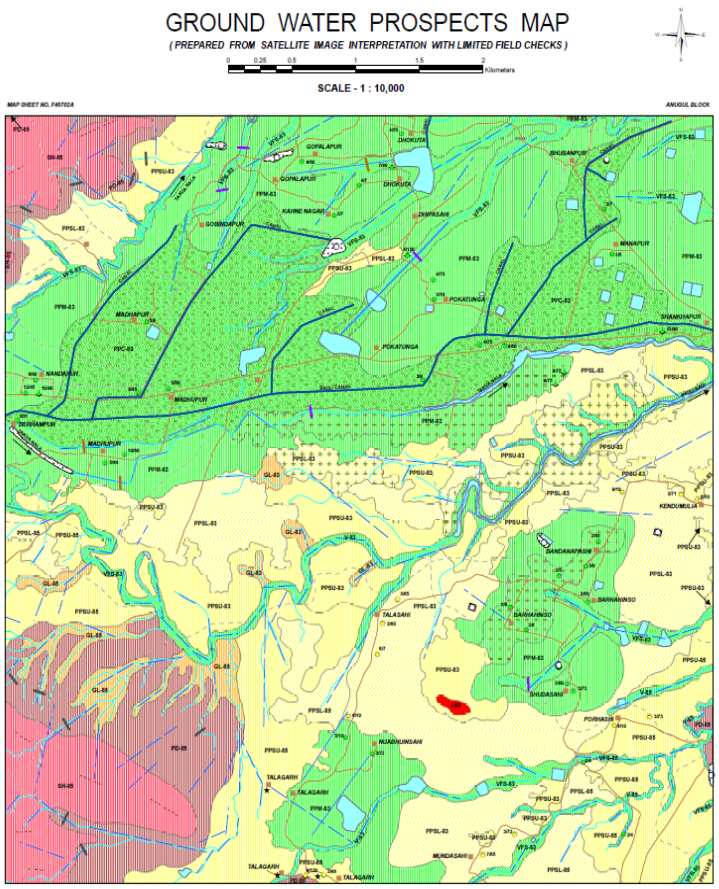


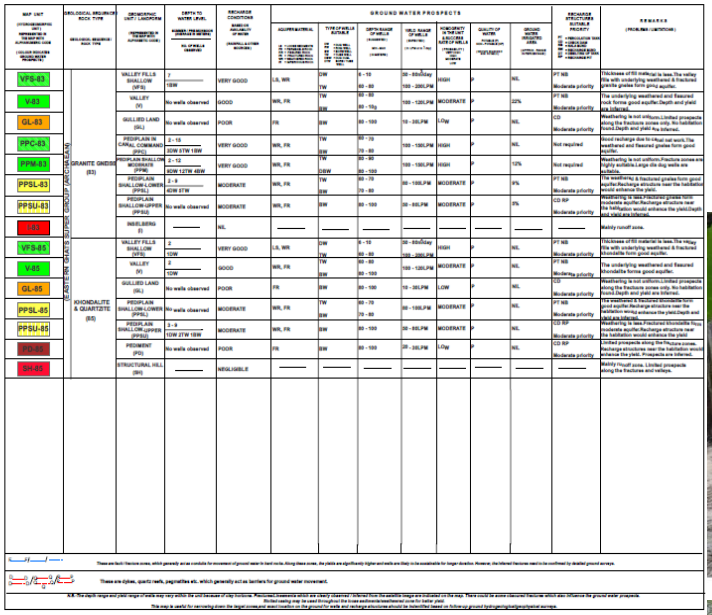
Earthen Dam - Before

Continuous stretch of summer paddy – impact of the recharge structure

Earthen Dam - after

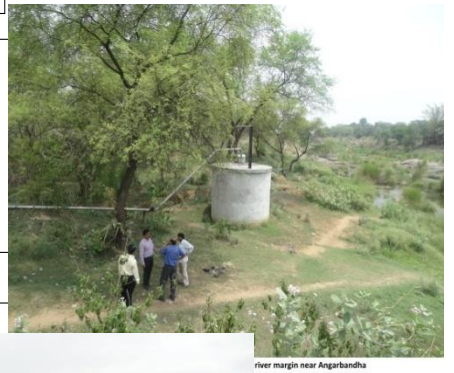
ODISHA






Observation of landform and well inventory data collection in presence of Sarpanch near Susuda


Bore well data collection from ground irrigated area (Banana plantation)

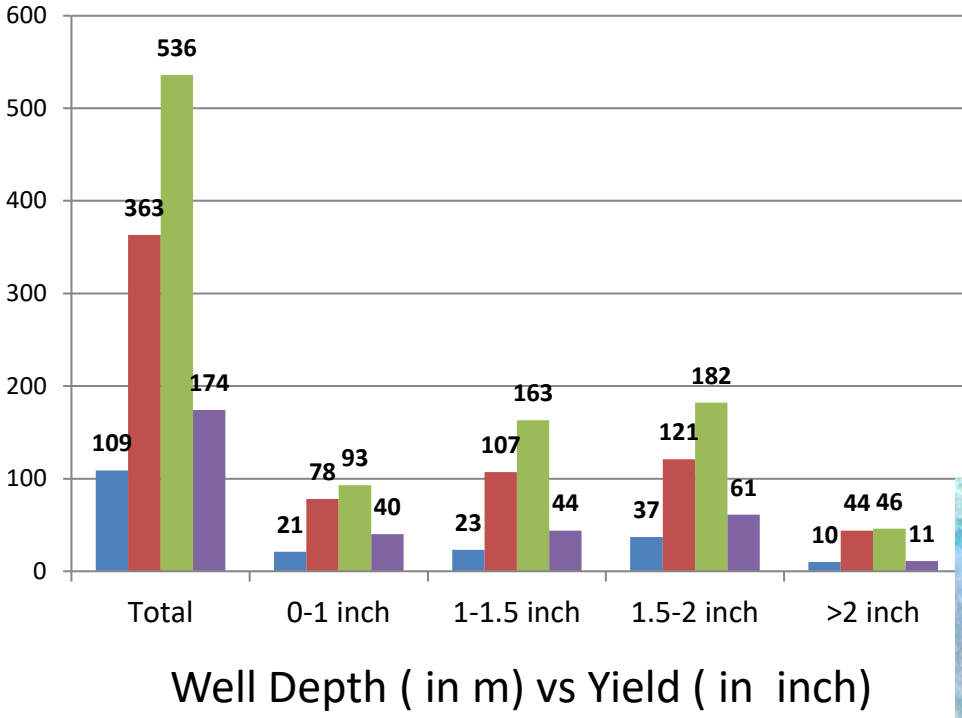

river margin near Angarbandha


Well (Dug well) inventory data collection

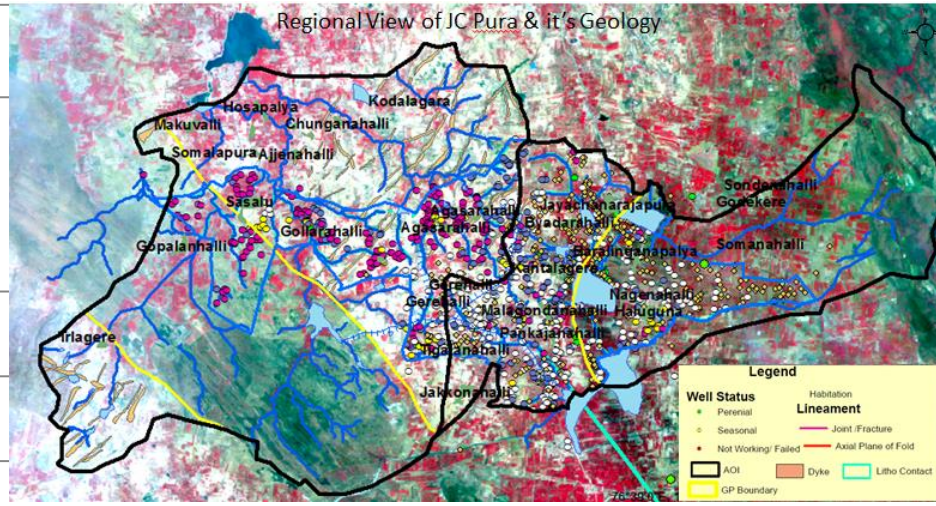

Well (Bore well) inventory data collection and interaction with RWSS ,Govt.of Odisha field staff

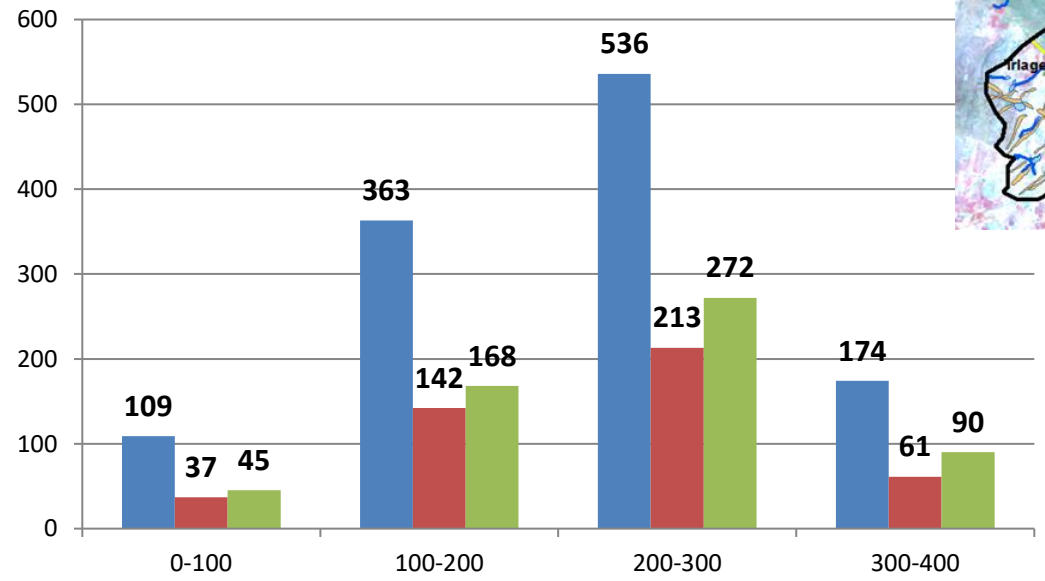

Suitable site selection for bore well in presence of ORSAC & RWSS official near Kothabhuin

Village level ground water data analysis for Jayachandrapura GP, Tumakur, Karnataka



Well Depth (in m) vs Yield (in inch)



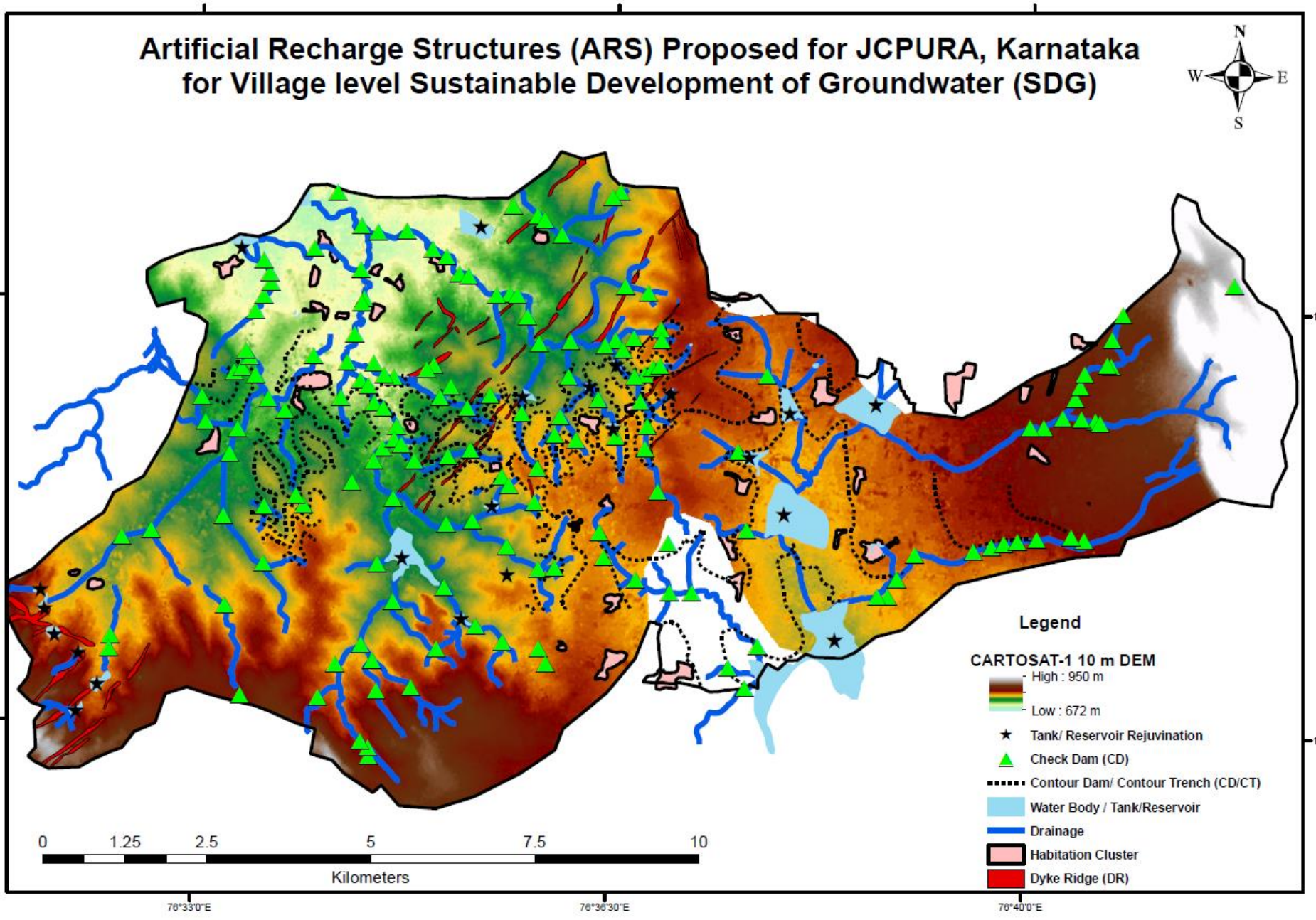


Well Depth (in m) vs Pereniality

Decadal Monthly Rainfall Observation of Chickanayaknahalli

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Pre Monsoon	Post Mons	Monsoo
1990	2.00	0.00	0.00	0.00	70.60	44.80	0.00	0.00	0.00	0.00	27.20	0.00	144.60	70.60	29.20	0.00
1991	0.00	0.00	22.00	96.80	221.00	99.60	49.80	69.70	86.00	0.00	0.00	0.00	644.90	339.80	22.00	205.50
1992	0.00	0.00	0.00	8.00	24.40	107.50	36.20	70.40	34.00	0.00	47.00	0.00	327.50	32.40	47.00	140.60
1993	0.00	0.00	0.00	3.40	56.00	143.00	0.80	92.80	46.90	263.60	3.20	28.00	687.70	59.40	31.20	404.10
1994	60.00	0.00	0.00	70.70	48.80	31.20	55.60	32.10	134.40	84.00	11.00	0.00	527.80	119.50	71.00	306.10
1995	0.00	0.00	0.00	23.30	29.50	101.10	128.20	73.20	120.50	58.10	68.60	0.00	602.50	52.80	68.60	380.00
1996	0.00	0.00	0.00	89.60	62.00	95.40	32.80	93.20	427.60	48.90	17.00	38.00	904.50	151.60	55.00	602.50
1997	8.20	0.00	13.00	16.60	110.00	88.00	22.80	41.30	218.70	106.70	154.20	3.00	782.50	139.60	178.40	389.50
1998	0.00	0.00	0.00	33.00	57.50	109.50	185.70	177.90	174.40	206.20	48.00	6.50	998.70	90.50	54.50	744.20
1999	0.00	20.00	0.00	77.00	194.50	38.40	23.60	47.60	25.70	330.50	29.00	0.00	786.30	271.50	49.00	427.40
2000	0.00	19.20	0.00	7.40	57.20	26.60	52.60	284.10	225.00	283.60	0.00	0.00	1018.70	64.60	19.20	845.30
2001	0.00	0.00	0.00	91.00	11.80	15.00	42.10	109.70	166.20	103.90	28.40	0.00	568.10	102.80	28.40	421.90
2002	3.00	46.00	0.00	7.30	77.30	133.00	23.00	58.20	123.60	135.60	25.00	0.00	632.00	84.60	74.00	340.40
2003	0.00	0.00	14.20	0.00	14.40	68.80	72.70	18.80	12.60	199.40	12.00	0.00	412.90	28.60	26.20	303.50
2004	0.00	0.00	82.80	96.90	152.50	152.30	58.90	45.60	137.90	48.30	12.30	0.00	787.50	332.20	95.10	290.70
2005	21.20	15.30	0.00	22.20	71.40	19.20	222.70	213.30	66.40	350.30	74.50	12.60	1089.10	93.60	123.60	852.70
2006	0.00	0.00	46.00	22.20	115.90	118.70	26.40	12.10	61.10	80.30	39.90	0.00	522.60	184.10	85.90	179.90
2007	0.00	0.00	0.00	2.10	58.30	91.00	0.00	0.00	65.50	46.60	164.80	103.10	531.40	60.40	267.90	112.10
2008	0.00	60.90	102.50	13.00	86.40	62.10	121.90	261.50	115.50	113.40	37.20	0.00	974.40	201.90	200.60	612.30
2009	0.00	0.00	26.20	42.50	87.50	117.80	40.40	214.90	259.80	65.20	0.00	0.00	854.30	156.20	26.20	580.30
2010	0.00	0.00	0.00	99.20	97.60	57.50	144.30	211.30	109.60	226.30	197.50	0.00	1143.30	196.80	197.50	691.50
2011	0.00	0.00	5.50	67.10	79.60	56.10	59.00	75.90	31.60	69.30	31.60	0.00	475.70	152.20	37.10	235.80
2012	0.00	0.00	0.00	210.70	41.60	18.60	33.40	149.40	52.70	31.20	104.00	0.00	641.60	252.30	104.00	266.70
2013	0.00	0.00	2.00	8.00	68.20	82.70	55.50	48.20	266.50	44.90	0.00	0.00	576.00	78.20	2.00	415.10
2014	0.00	50.60	0.00	33.40	76.20	24.40	34.60	156.80	78.20	317.60	17.00	0.00	788.80	109.60	67.60	587.20
2015	0.00	0.00	0.00	105.40	113.20	142.00	25.00	77.20	164.00	102.60	175.70	0.00	905.10	218.60	175.70	368.80
2016	0.00	0.00	0.00	0.00	22.00	211.70	138.90	51.00	16.20	0.00	0.00	12.00	451.80	22.00	12.00	206.10
2017	0.00	0.00	0.00	7.40	103.00	66.00	5.60	80.90	247.20	0.00	0.00	0.00	729.10	110.40	0.00	333.70
2018	0.00	0.00	73.00	36.00	134.00	65.50	0.00	40.00	119.00	59.00	29.00	0.00	555.50	243.00	102.00	218.00
2019	0.00	0.00	0.00	0.00	78.30	118.40	0.00	80.80	235.00	0.00	0.00	28.00	540.50	78.30	28.00	315.80
2020	0.00	0.00	0.00	53.00	65.00	49.00	117.90	100.60	177.70	129.20	45.20	10.00	747.60	118.00	55.20	525.40

Artificial Recharge Structures (ARS) Proposed for JCPURA, Karnataka for Village level Sustainable Development of Groundwater (SDG)



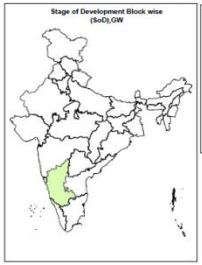
GROUND WATER PROSPECTS MAP

(PREPARED FROM SATELLITE IMAGE INTERPRETATION WITH LIMITED FIELD CHECKS)

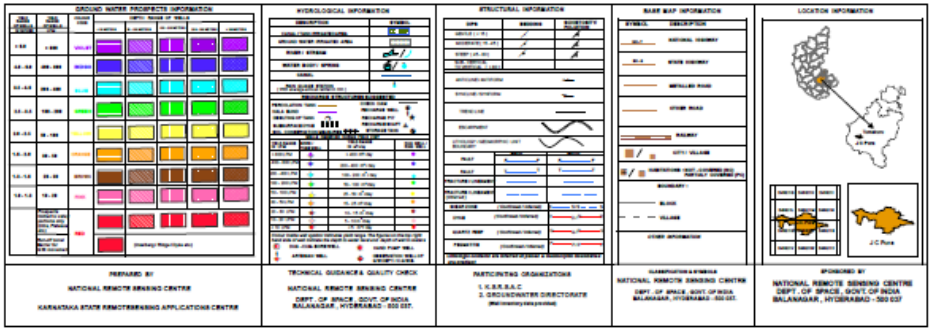
0 0.425 0.85 1.7 2.55 3.4 Kilometers

SCALE - 1 : 17,000

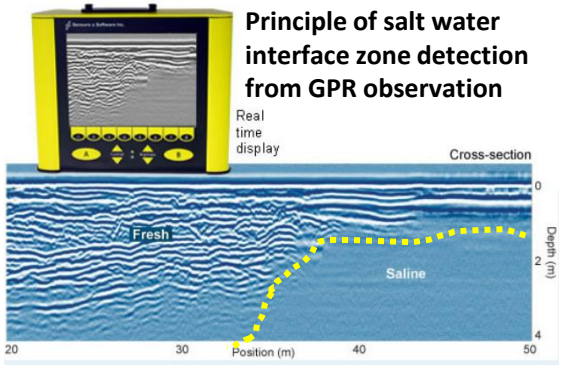
JCPura Grampanchayat



Legend Lower

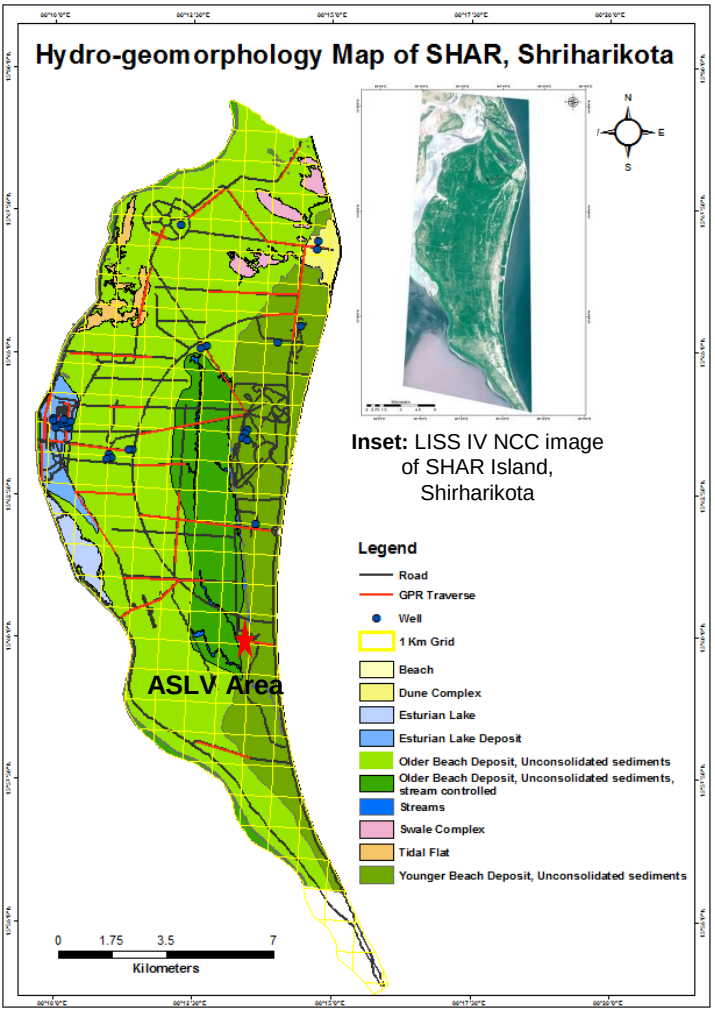


Salt Water Intrusion study

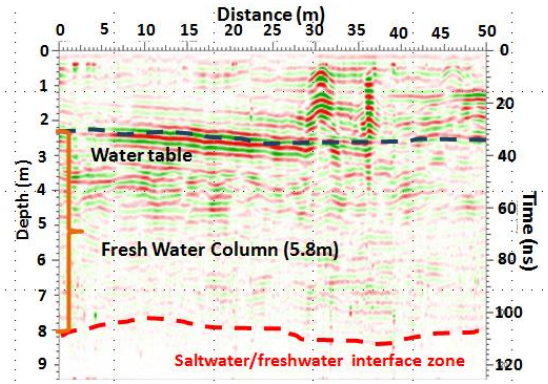


200 MHz GPR Antenna

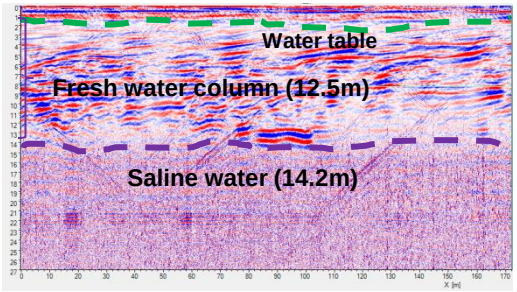
25 MHz GPR Antenna



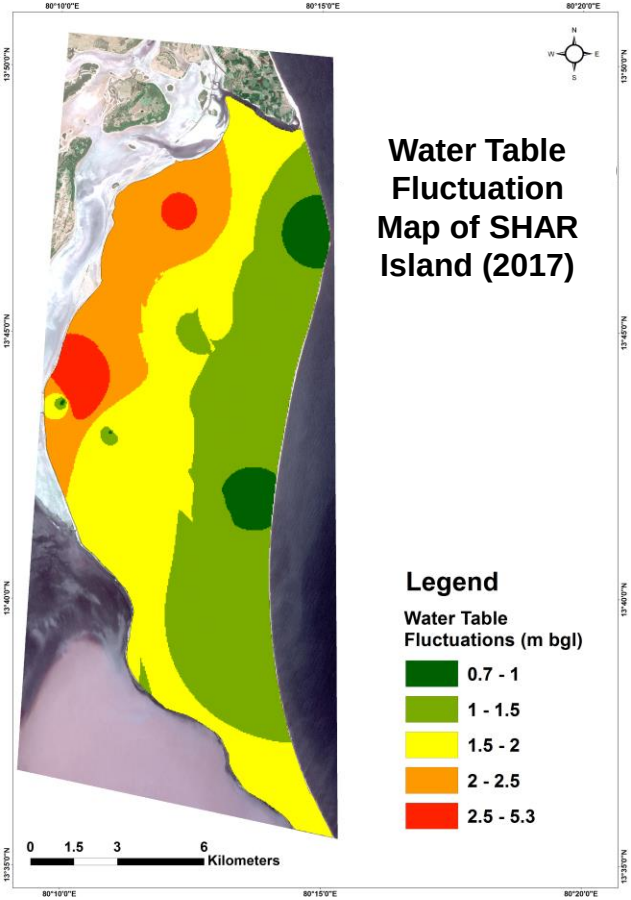
Inset: LISS IV NCC image of SHAR Island, Shirharikota



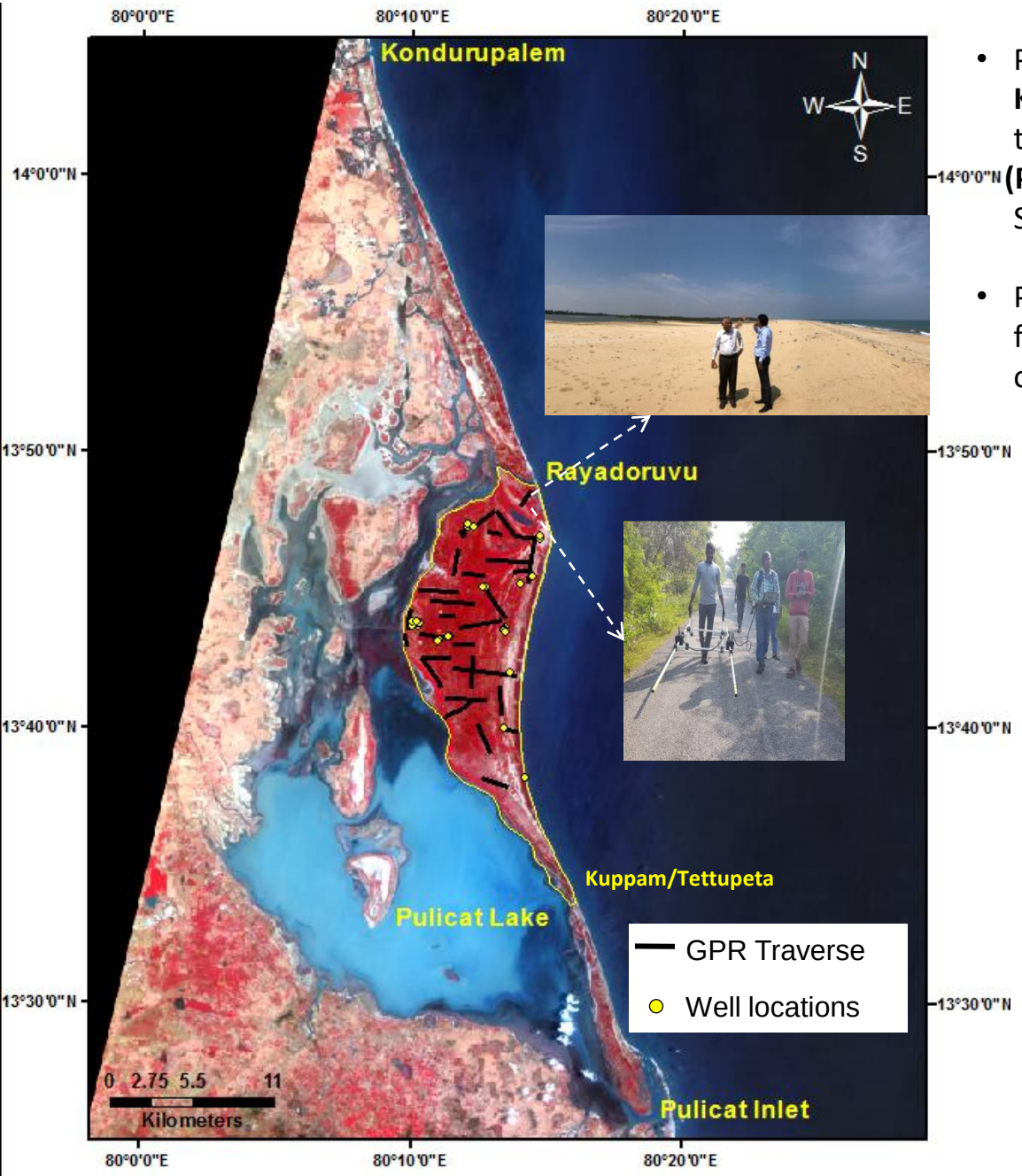
Pre Monsoon GPR observation of ASLV area using 200 MHz antenna



Post Monsoon GPR observation of ASLV Area using 25 MHz antenna

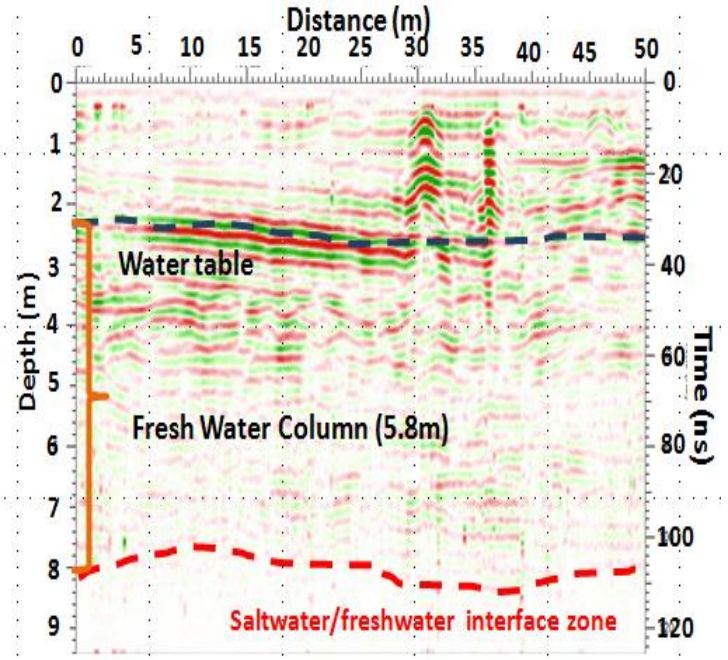


Synoptic view of sea inlets of Pulicat Lake & SHAR Island

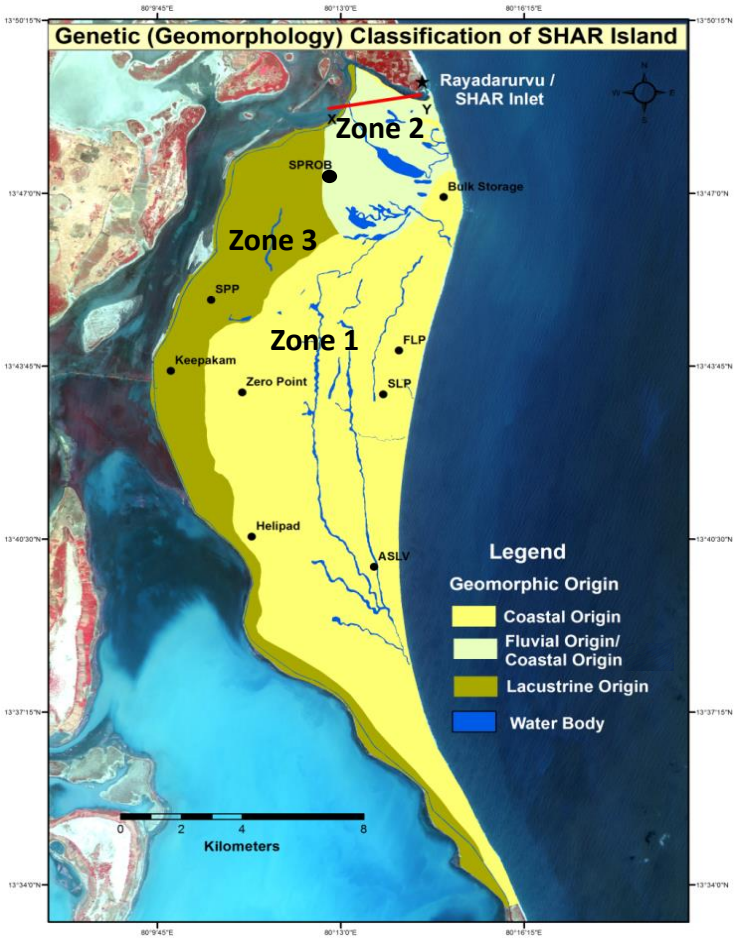


- Pulicat Lake has three sea inlets, namely **Kondurupalem, Rayadoruvu (SHAR Inlet)** along the northern and **Pazhaverkadu (Pulicat inlet)** along the southern part of Sriharikota Island respectively.

- Present study showcases probable impact on fresh groundwater aquifer of SHAR Island due to opening of Rayadoruvu/SHAR inlet.



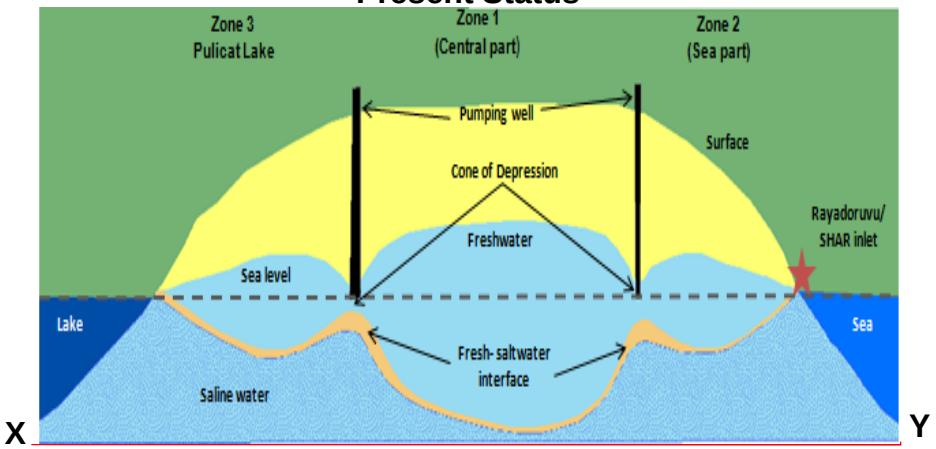
Conceptual Groundwater scenario of SHAR Island



Present status of freshwater aquifer

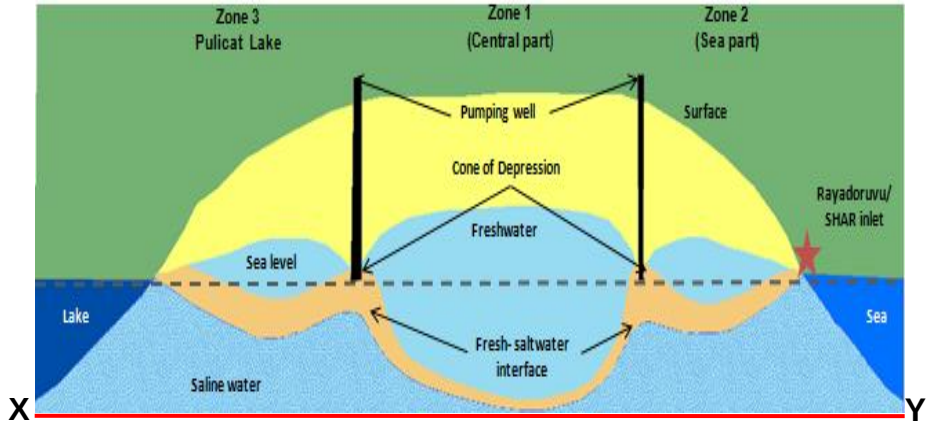
Depth (BGL in m)	Zone 1 (central part)	Zone 2 (near sea Part)	Zone 3 (near Pulicat lake)
Fresh water level/table	3	0.6-2	0.6-3
Fresh- Salt water interface	8	3-5	2-5

Present Status



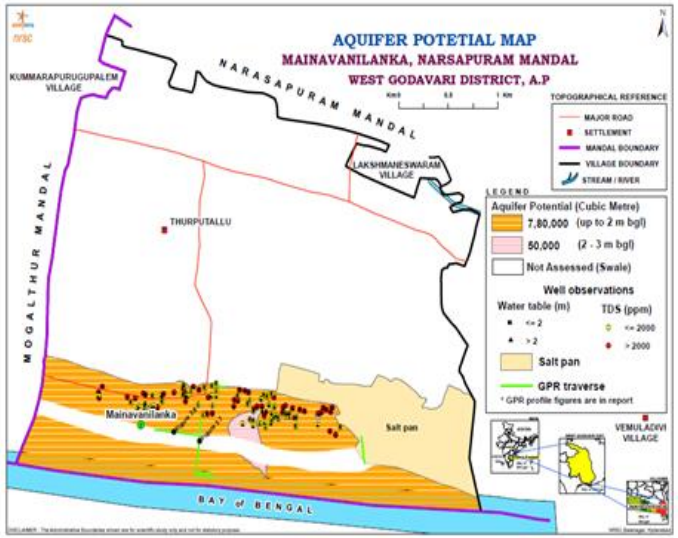
- Rayadoruvu/SHAR inlet remains naturally closed blittoral deposition from sea and no riverine discharge, hence **salt water intrusion in zone 2, is minimal**.
- **Saline water intrusion prevails due to high extraction of freshwater in zone 3.**
- Freshwater aquifers in **zone 1 is unaffected by saline water intrusion** due to its **lithological and geomorphological** control.

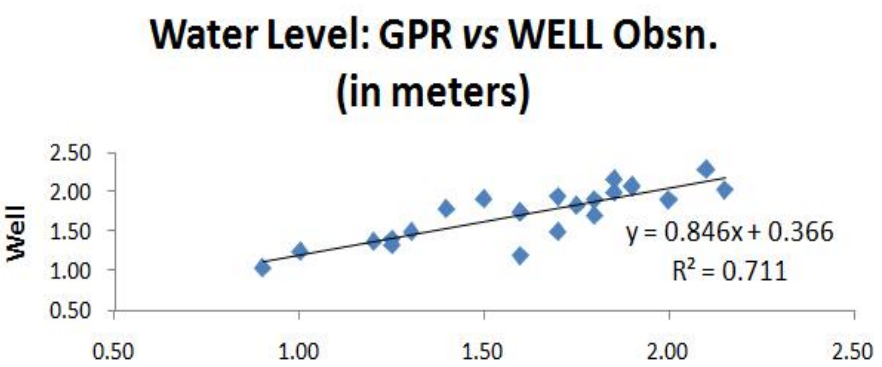
Probable status of freshwater aquifer after Rayadoruvu (SHAR inlet) opening

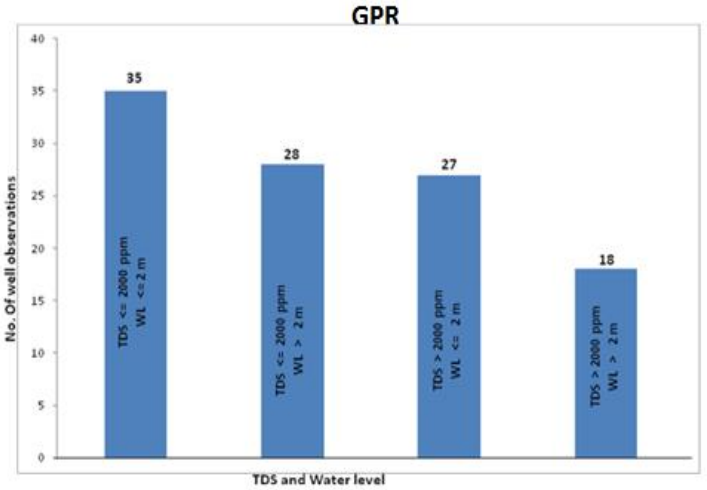


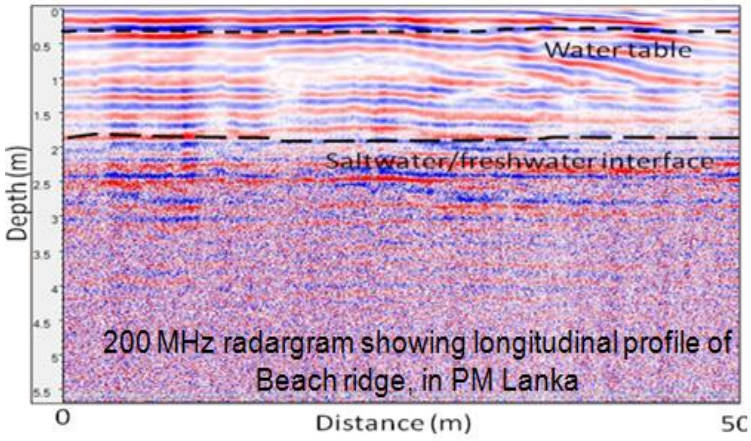
- **Opening of Rayadoruvu/SHAR inlet, fresh –salt water interface in zone 2** may move upward & **reduce the freshwater column thickness**.
- Large cone of depression, and high drawdown of freshwater in **zone 3,** may result in **saline water ingression from Pulicat Lake**.
- High clay content in lacustrine deposits of **zone 3**, will restrict further saline water intrusion to freshwater aquifer of **zone 1.** Freshwater aquifer in **zone 1 remains unaffected from saline water intrusion**

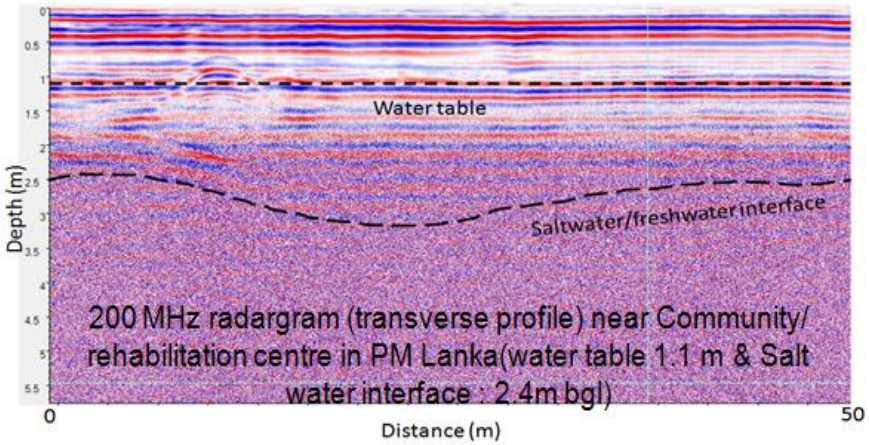
Assessment of Coastal Aquifer Vulnerability in parts of Narshapur mandal, W. Godavari district, A.P











Groundwater overdraft induced land subsidence detection for parts of Delhi from MTInSAR

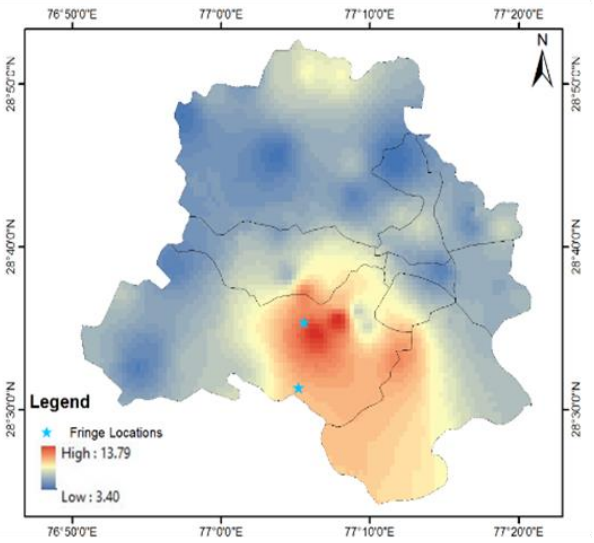


Fig.1a: Pre monsoon water level fluctuation (2013-16) from CGWB well observations for Delhi region)

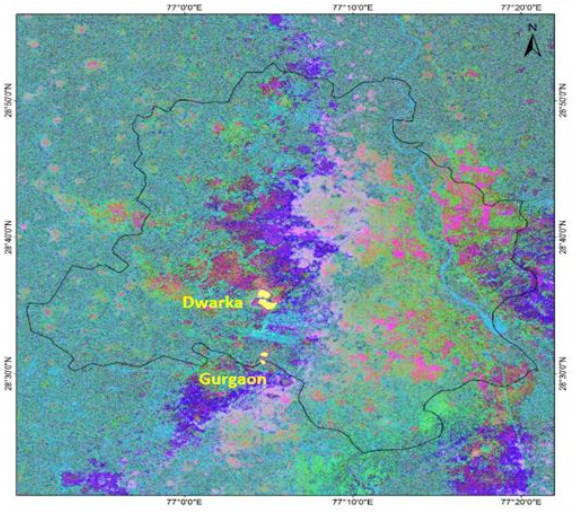
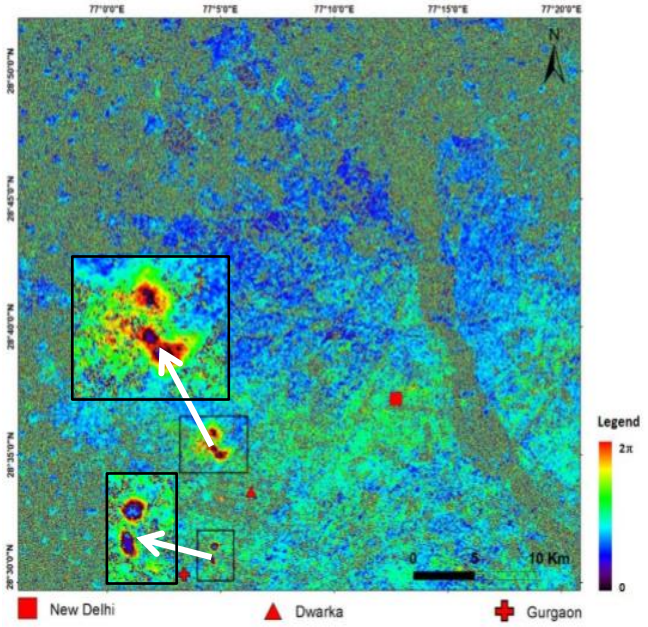


Fig.1b: Temporal coherence map of Delhi region derived from S-1 A IWS data



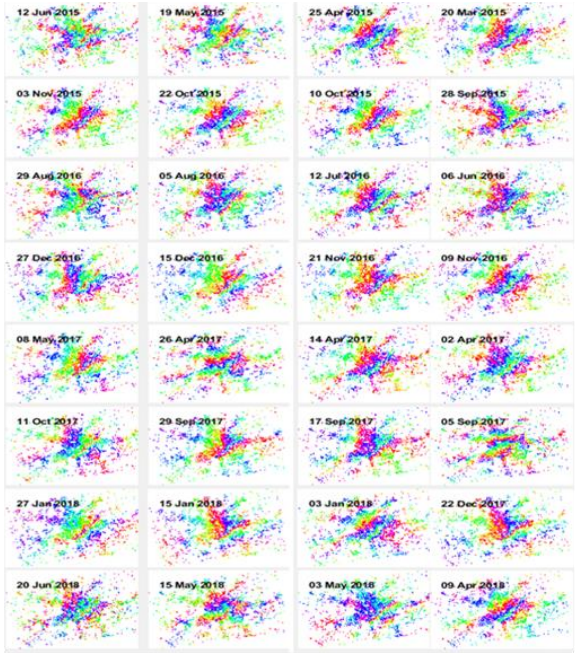


Fig.1c: S1-A derived Temporal (2014-16) LOS deformation for Delhi region

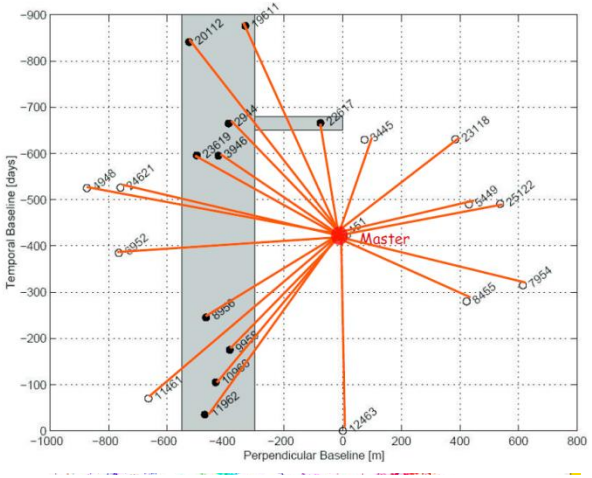
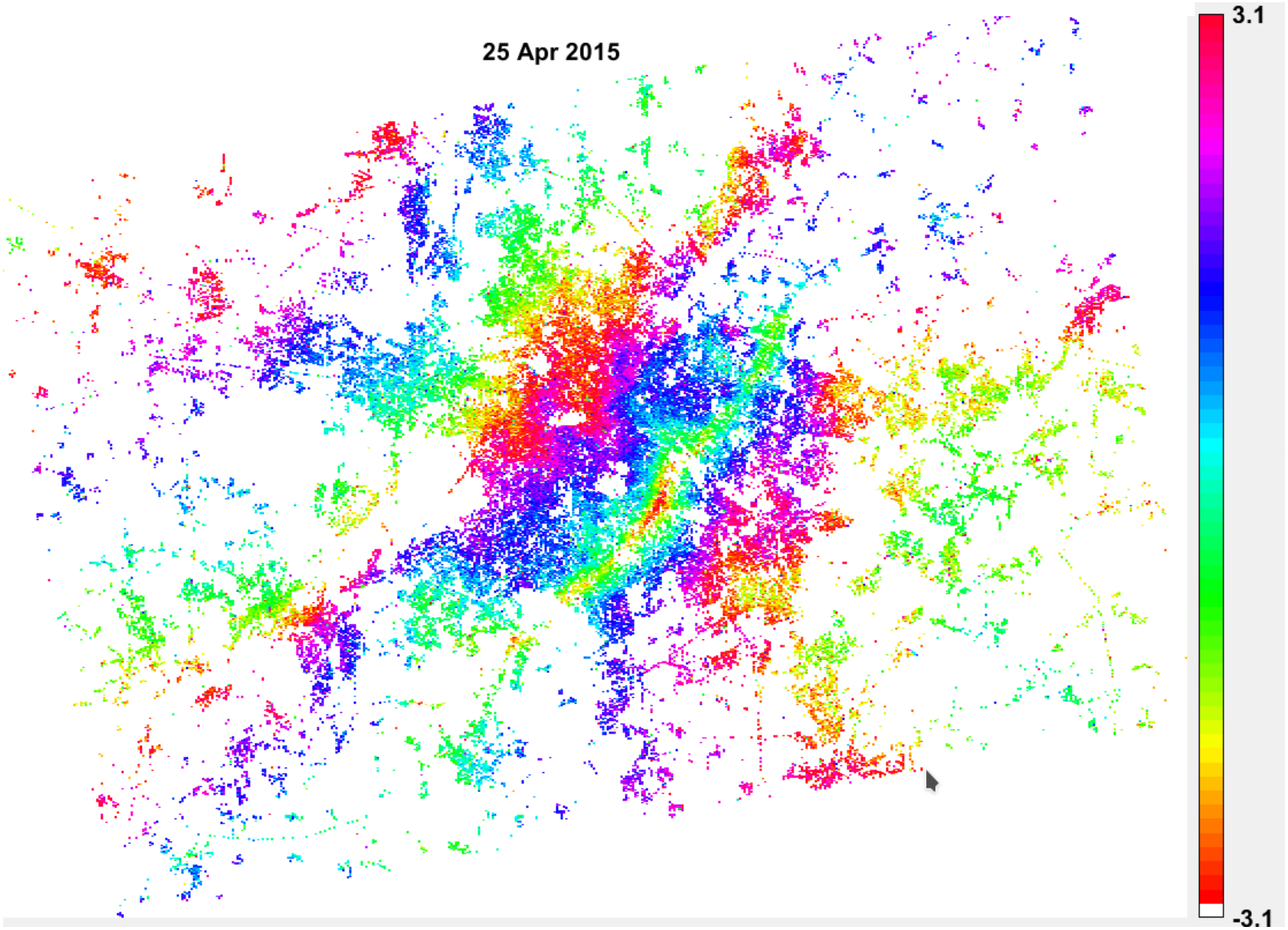


Fig.1d: Spatial & Temporal baseline of S1-A IWS data for 2015-18 period used for PS-InSAR processing

ALOS PALSAR 2009-10 DInSAR observation over Delhi region showing Subsidence fringes due to GW overdraft

EO Data used:

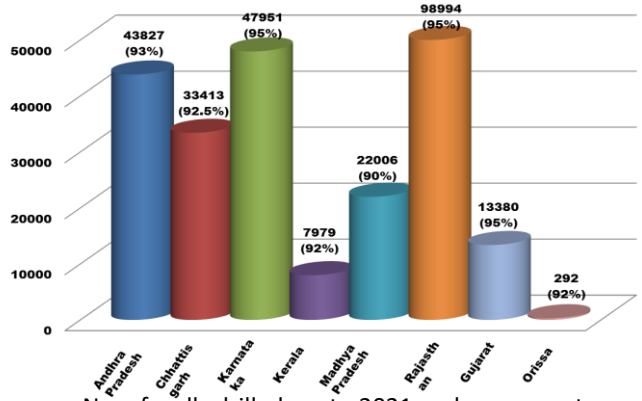
- Sentinel 1 (SIR-C) –C band IWS data (2015-18)
- ALOS-1 –L band FBS data (2009-10)



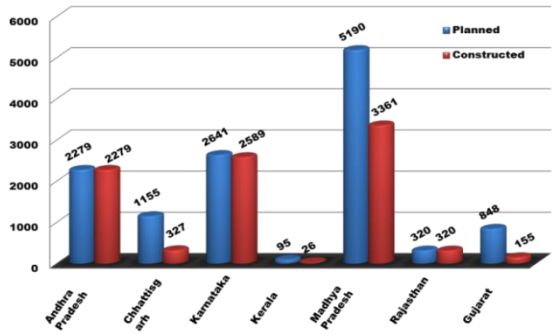
PS based displacement for parts of Delhi region (2015-2018)

❖ Demand side intervention:- Data, Skill and knowledge transfer

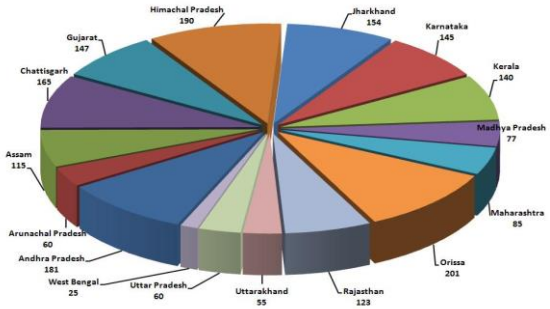
CAPACITY BUILDING & FEEDBACK



No. of wells drilled up to 2021 and success rate



Recharge structures planned and constructed till 2021



Total manpower trained till 20121

TRAINING IN CHHATTISGARH

Thank You