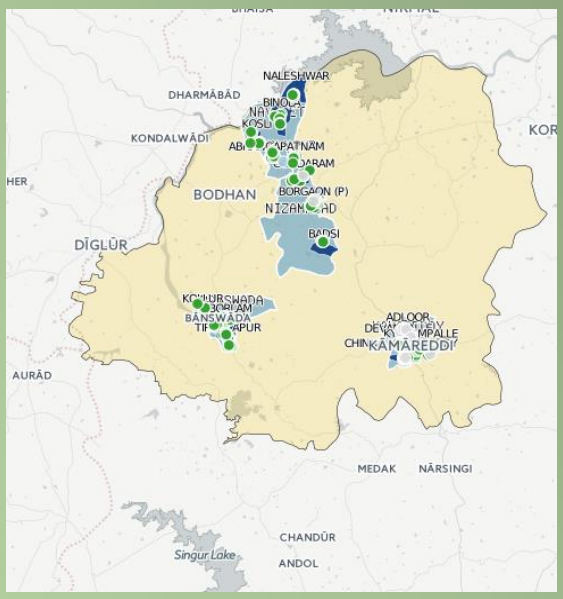
WATER QUALITY GIS REPORT



SaciWATERs
2015-16

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1. Introduction

Considering safe drinking water a basic necessity, the rural drinking water supply has been included in the Eleventh Schedule of the Constitution of India. The new program, National Rural Drinking Water Programme (NRDWP) focused on three critical issues; availability, quality and sustainability. The aim was to bring down the coverage from habitation level to household level and moving from single source to multiple sources to increase water availability, developing the capability of preliminary drinking water testing kit at gram panchayat level and establishing water testing laboratory at district and subdivision level to deal with water quality challenges.

The importance of GIS for capturing, storing, querying, analysing and visualizing data-sets and use of Global Positioning Systems (GPS) for unique identification up-to household level and demarcation up-to individual point source level has been taken into consideration during the planning of National Rural Drinking Water quality and surveillance Programme (NRDWQMSP). As the program also talks about periodic monitoring to keep track on variations so it is obligatory to have accurate digital spatial data-set.

Geo-informatics tools were used for this exercise to attain the vision "Safe drinking water for all, at all times, in rural India", and to meet the need by resolving "Issue of portability, reliability, sustainability, convenience, equity" through periodic monitoring. Also, one of the major aim behind this entire exercise was to assist the States in using technologies like GIS/Remote Sensing for preparing good quality hydro-geo-morphological maps and identification of appropriate sites for drilling for groundwater sources and for recharge structures.

Though, the overall objective of the study is to plug the gaps in the existing National Rural Drinking Water Quality Monitoring Programme (NRDWQMSP) in the state and activate the dormant existing systems and institutions at local level to make the programme active and sustainable, the GIS component mainly focused on visualization the GPS data on water quality testing data and parameters in GIS platform for the selected villages of Nizamabad district.

In the first phase there were spatial maps from government water quality data for the year 2014-15 and maps for comparative ground verification. Now in the second phase of this study we prepared comparative spatial maps for the year 2014-15 and 2015-16. These comparative maps will be helpful to develop an understanding of

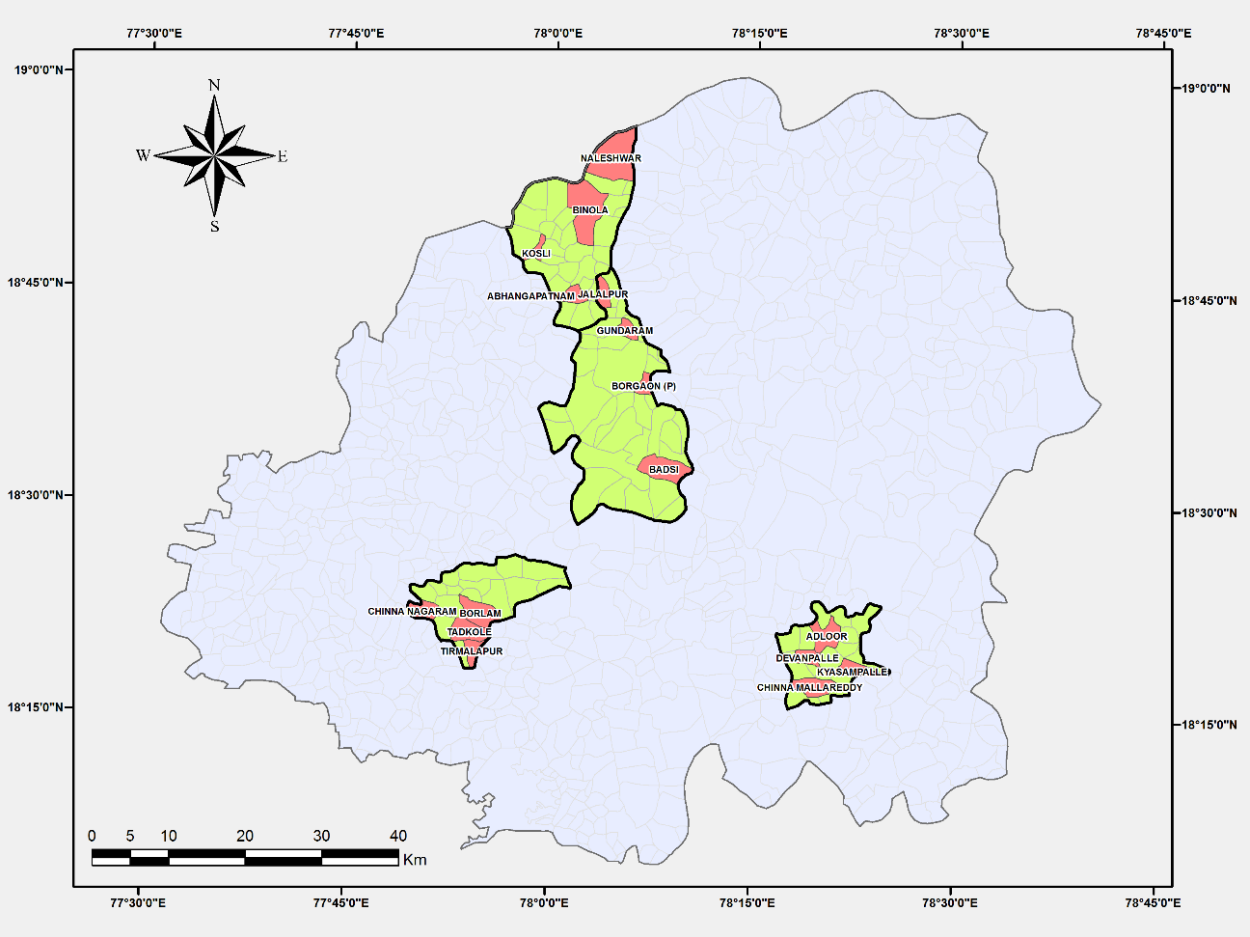
- How the value of a parameter is changing at particular source point?
- If the water was safe earlier or it is safe now?
- If there is change in type of contamination?

2. Study Area

The initial project objective was to present water quality testing data in GIS platform for the entire state of Telangana but with the "limited data availability" from government department this could be achieved only for 16 villages (Table 1) from four Mandals of Nizamabad district of Telangana. (Map1).

Table 1: list of Mandal and villages

Mandal	Banswada	Kamareddy	Navipet	Nizamabad
Villages	Borlam	Adloor	Abangapatnam	Badsi
	Chinna Nagaram	Chinnamallareddy	Binola	Borgaon P
	Tadkole	Devunpally	Kosli	Gundaram
	Tirmanpally	Kyasampally	Naleshwer	Jalalpur



Map 1: Village boundary map of Nizamabad district showing four mandals and sixteen villages

3. Spatial data

The data which define a location or a shape and size of an object on the earth is known as spatial data. For this exercise we have used GPS point (location) data with water quality parameters and polygon (shape and size) village boundary data to display the GPS data.

1. **Water quality data along with GPS co-ordinates**:

The original intent of the GIS mapping exercise is to map and display all the secondary data available under the NRDWQMSP.

The water quality parameters data for the first phase was received from the Nizamabad district lab for each of the sources present in the sixteen villages of the project however, the corresponding GPS values were missing. Later on the GPS data was received but many points were not falling under the respective villages so it was concluded that the corresponding value of GPS latitude and longitude is wrong. The same was communicated to RWS&S department and later the corrected spatial database was received. Later on the correct GPS data was received but there was co-ordinates for only 362 points.

In the second phase data was received from the same laboratory again for the year 2014-15 and 2015-16. Since there were some data discrepancies about the old 2014-15 data and new 2014-15 so we have taken this new dataset only to prepare comparative maps. We received GPS latitude longitude values as well along with the data only. A comparative table for the received data is below:

Table 2: Classification of received data

Year	All Source points	Source Points with GPS co-ordinates
2014-15	500	463
2015-16	477	396

2. **Village boundary shape-file:**

Shape-files are geospatial vector data format used for geographic Information system (GIS) Software. These village boundary shape-files (unverified on ground) have been procured from Survey of India, Dehradun to visually display the GPS point data. The same time this was also helpful to identify the dislocation of the GPS points at village-level.

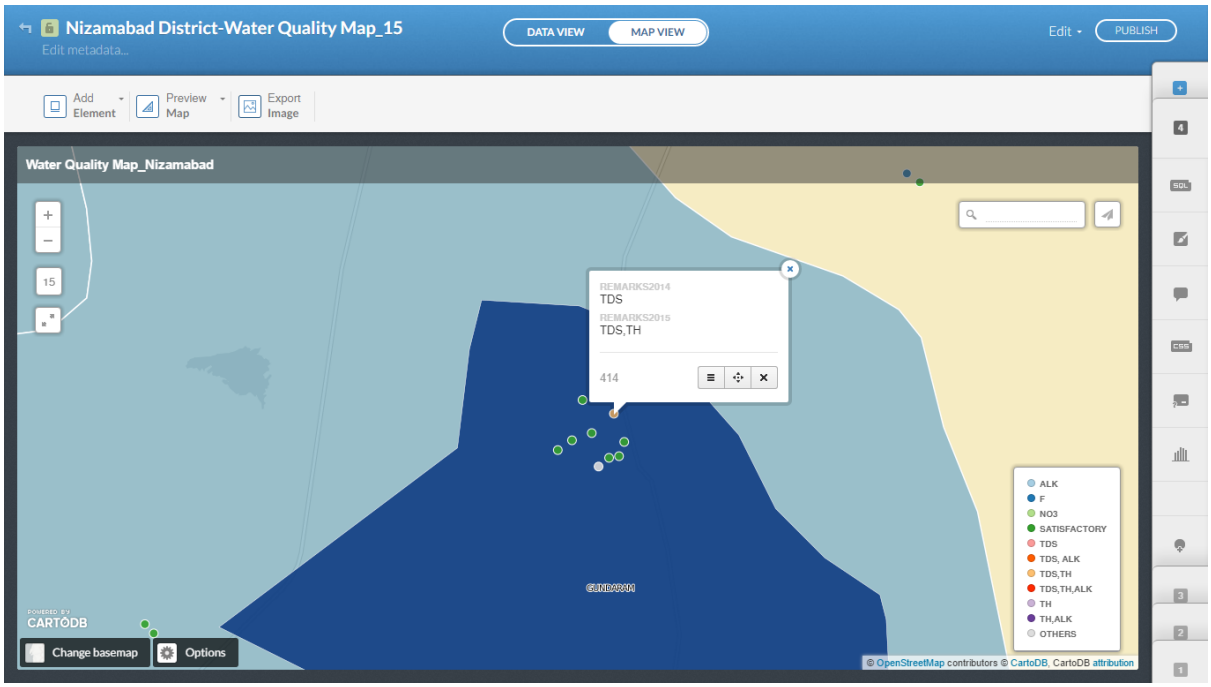
4. Methodology

Desktop and web maps, both have been created using data and village boundary shape-files from Survey of India.

1. **Web maps:**

Freely available platform CartoDB is used for generating and displaying those maps with data. The data can be imported directly from either a "Microsoft excel (.xls) file" or from "comma separated value (.csv) files" Based on geo-spatial co-ordinates, the platform would generate a point for each set of co-ordinates and display the data over base map or on satellite image (Map 2). The interactive map will also allow to display the detailed location of the point and date of testing along with values for each parameter like pH, TDS, Chloride and Fluoride etc. for a particular source on clicking the point. CartoDB maps have been useful to validate the accuracy of spatial co-ordinates at particular location level. Web GIS maps are more user friendly and will enable a better interaction between user and data.

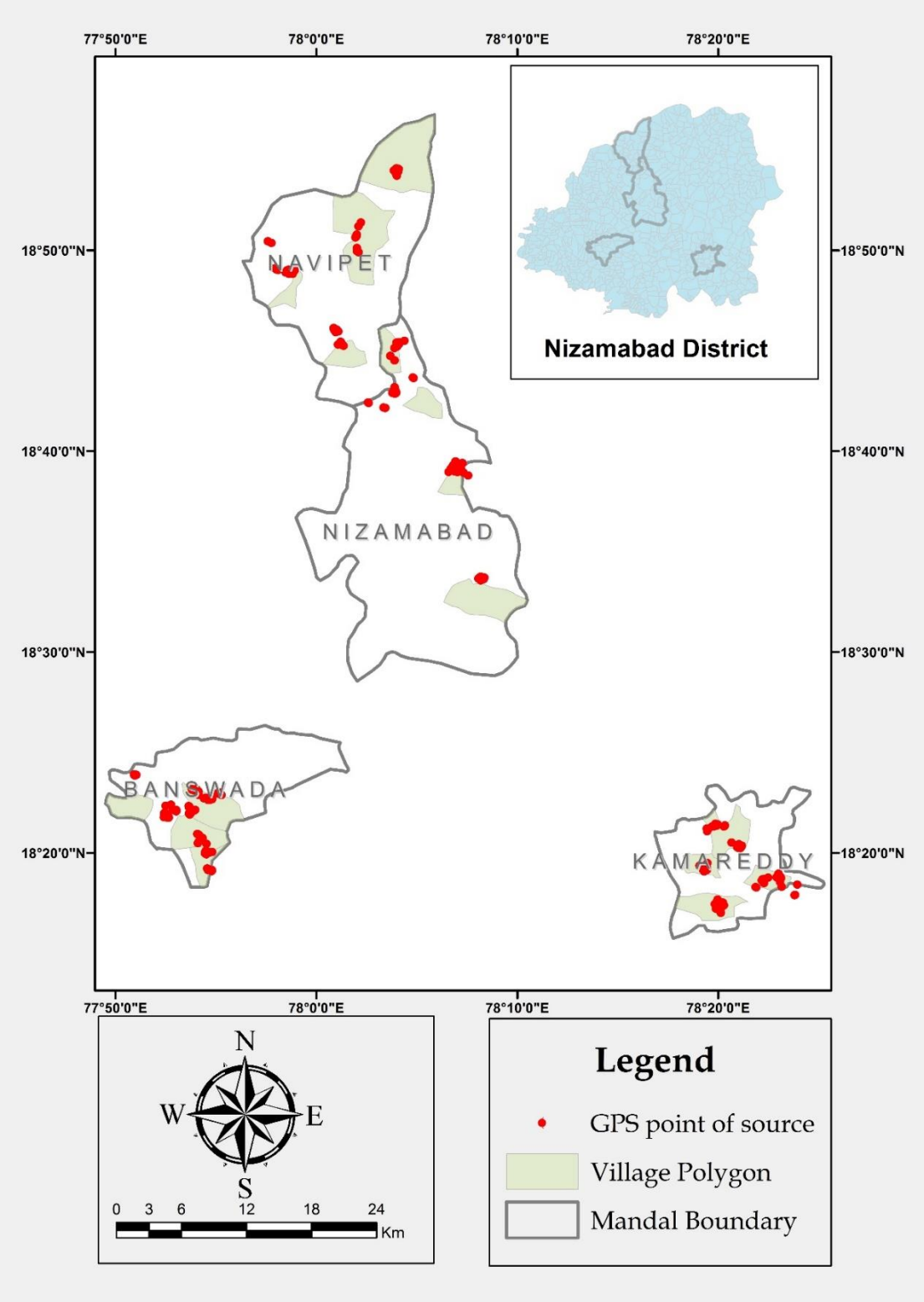
Map 2: location of GPS sources over CartoDB maps



Map 3: GPS Point location of Water source on base-map showing the name of contamination in excess during 2014-15 and 2015-16

2. Desktop maps:

The GIS platform have been used to display the GPS data over the village boundary shape-files. GIS tools provide opportunity to generate the point layer based on particular set of lat-long. The platform also helped to visually display the parameters and analyse the data for further planning and interpretation (Map 4). These are basically desktop/offline maps for report purpose.



Map 2: location of GPS sources over village boundary polygons in GIS platform

5. Data Presentation

Though, we have received the water quality data for all the 549 source points from sixteen villages of the study area but the GPS co-ordinates have been received just for 463 points for the year 2014-15 and 396 points for the year 2015-16. For rest of the

points there were no spatial values. Now, the demerit is, the water quality parameters and other data for the missing GPS points could not be displayed over the map.

Table 3: Desirable and permissible limit of Water quality Parameters

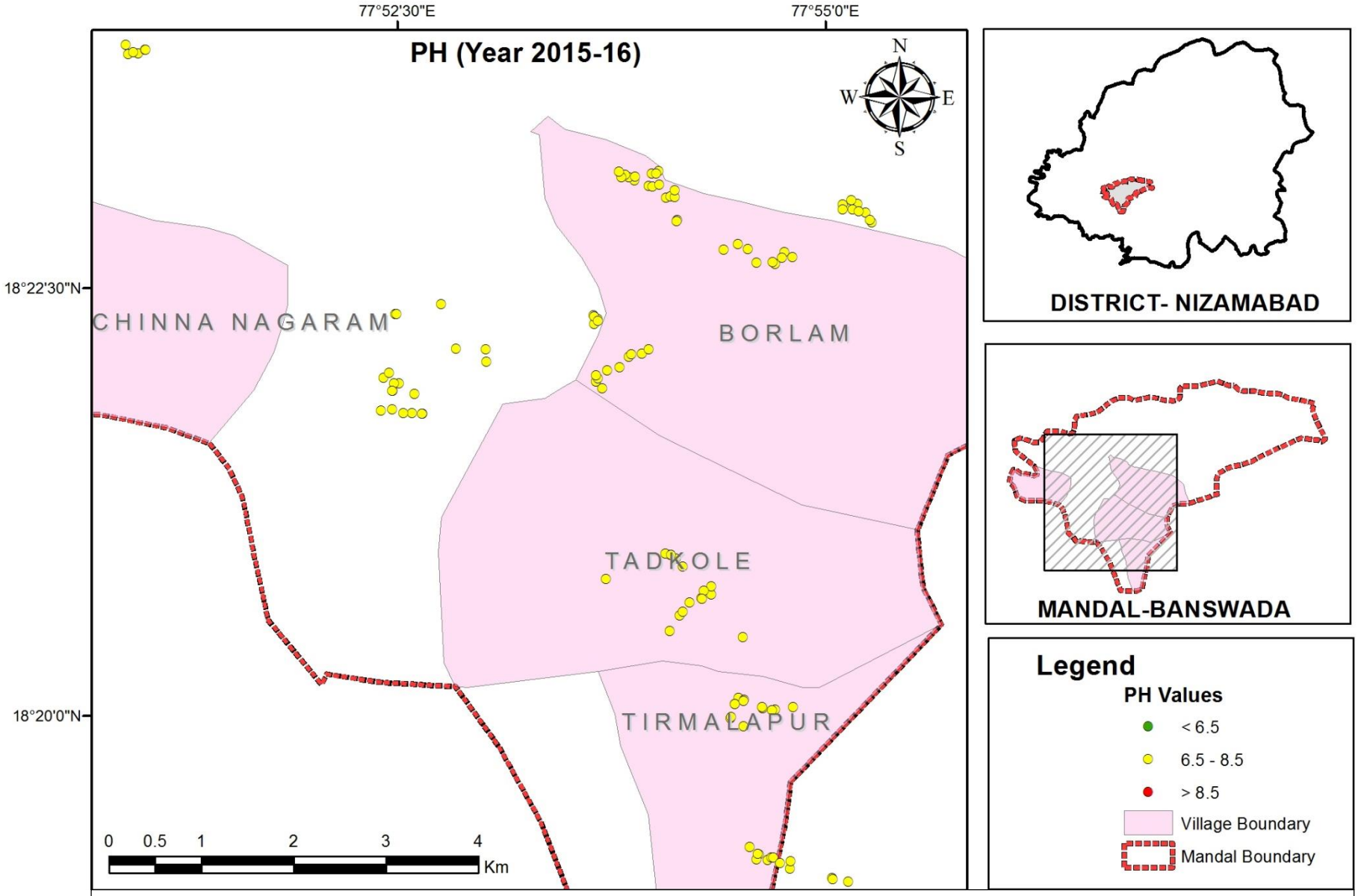
Sr.	Parameters	Desirable Limit	Maximum permissible limit in absence of alternative source
1	pH	6.5 to 8.5	No Relaxation
2	TDS	500	2000
3	Alkalinity	200	600
4	Total Hardness	300	600
5	Chloride	250	1000
6	Fluoride	1	1.5
7	Nitrate	45	No relaxation
8	Iron	0.3	1

As per the data from RWS&S department, Mandal-wise maps for each water quality parameters have been prepared in GIS.

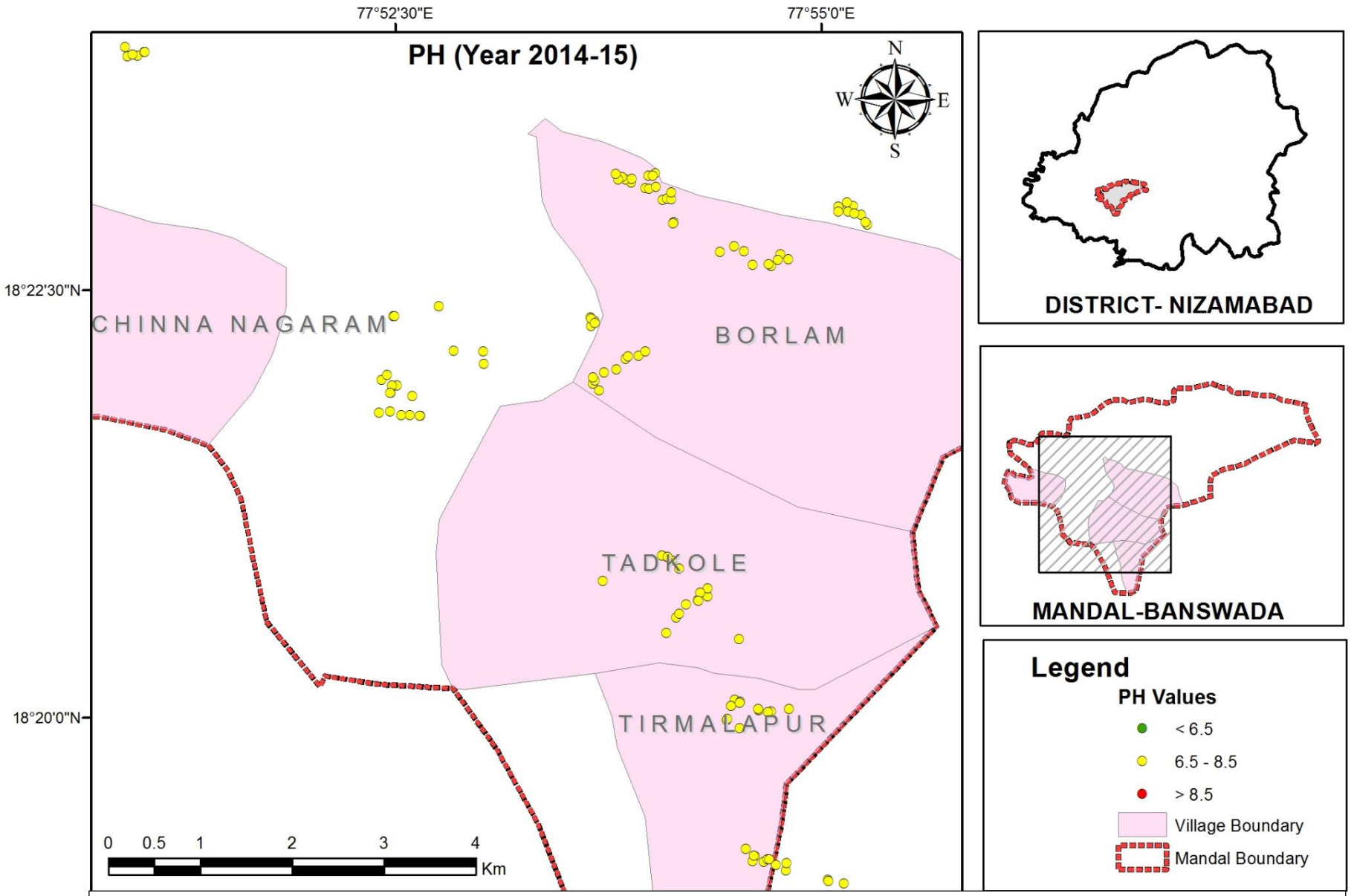
To display the data in GIS a colour coding has been adapted to show the range of values. The data values has been classified to three classes for all parameters and the colour codes for each class as follows (Table 3).

Table 4: Colour scheme for water quality parameters except for pH

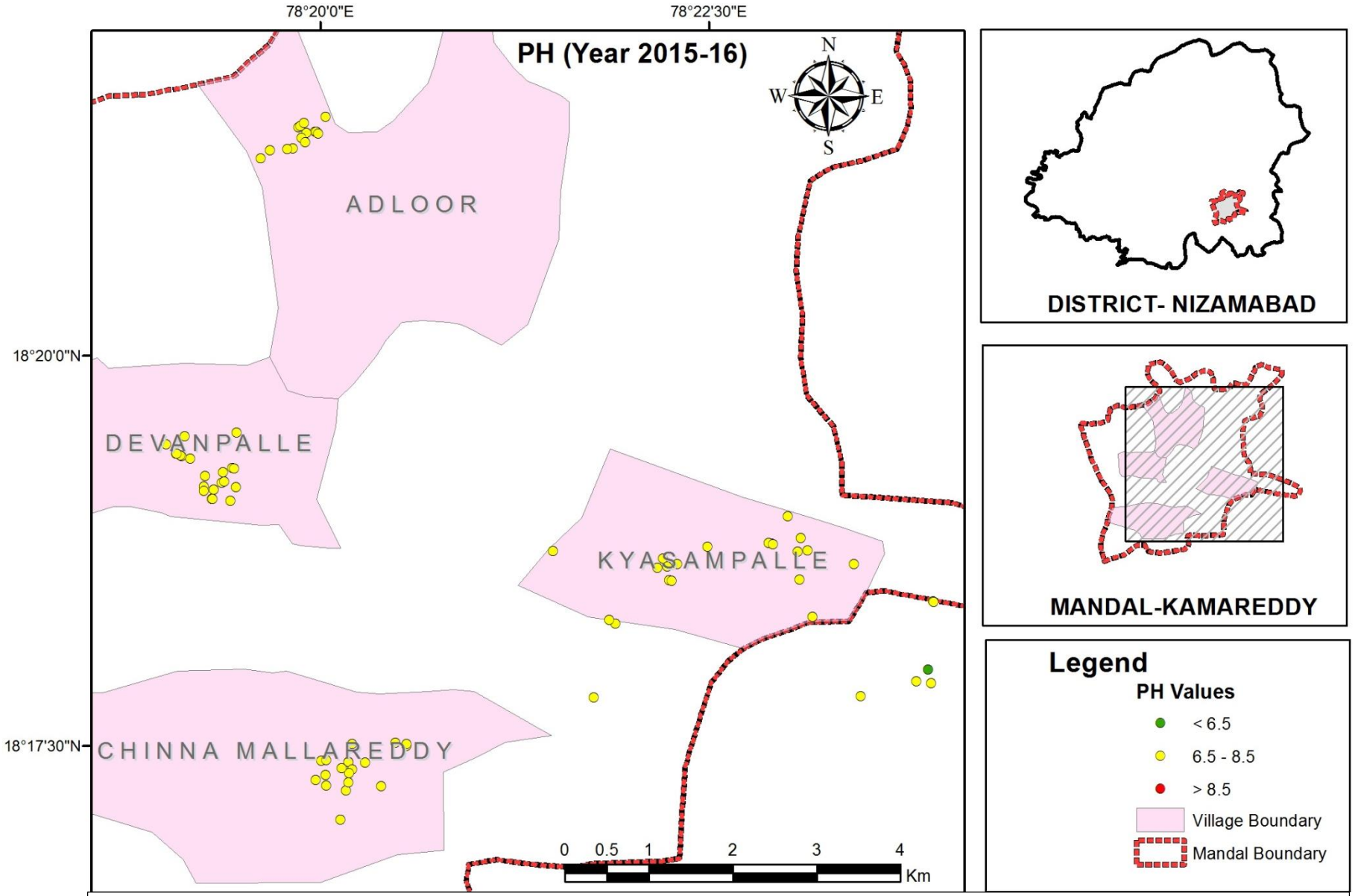
Symbol	Colour	Class
●	Green	Displaying values up-to desirable limit
●	Yellow	Displaying values between desirable and maximum permissible limit
●	Red	Displaying values beyond permissible limit



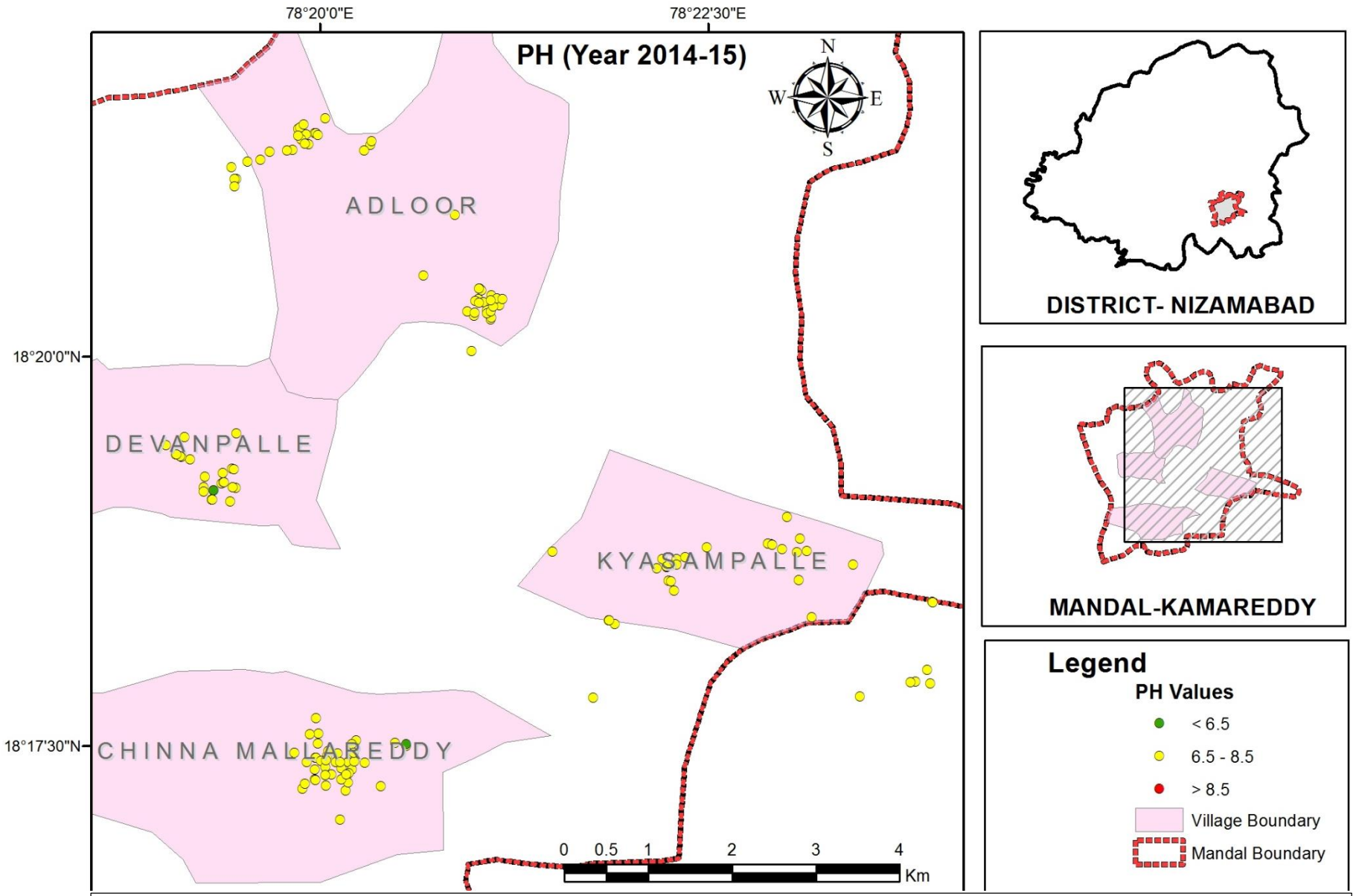
Map 3.1 showing *p*H values of Water sources points- Banswada Mandal
Note-All values for the given GPS points are showing within maximum permissible limit (Yellow)



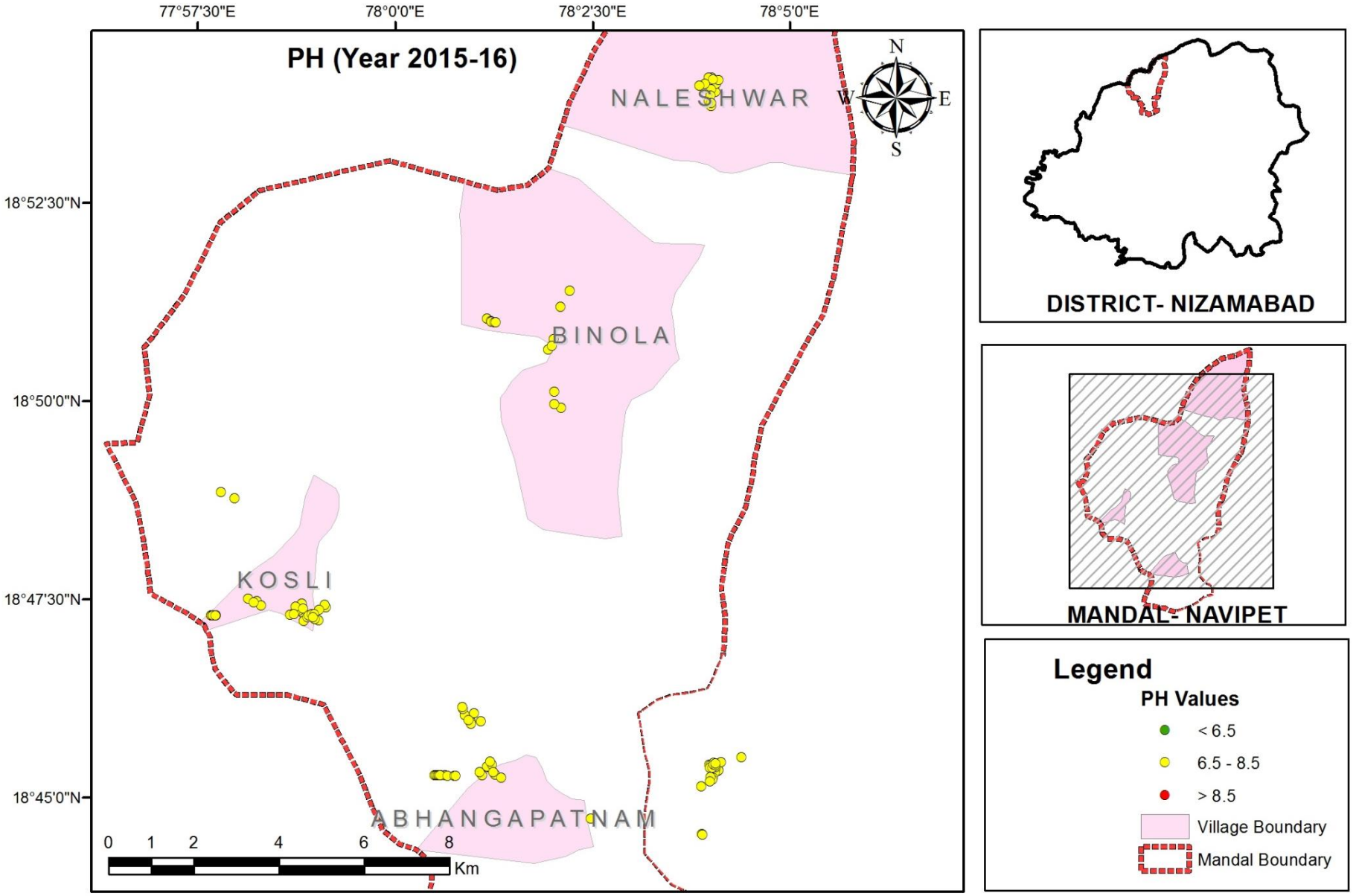
Map 3.2 showing *p*H values of Water sources points- Banswada Mandal
Note-All values for the given GPS points are within maximum permissible limit (Yellow)



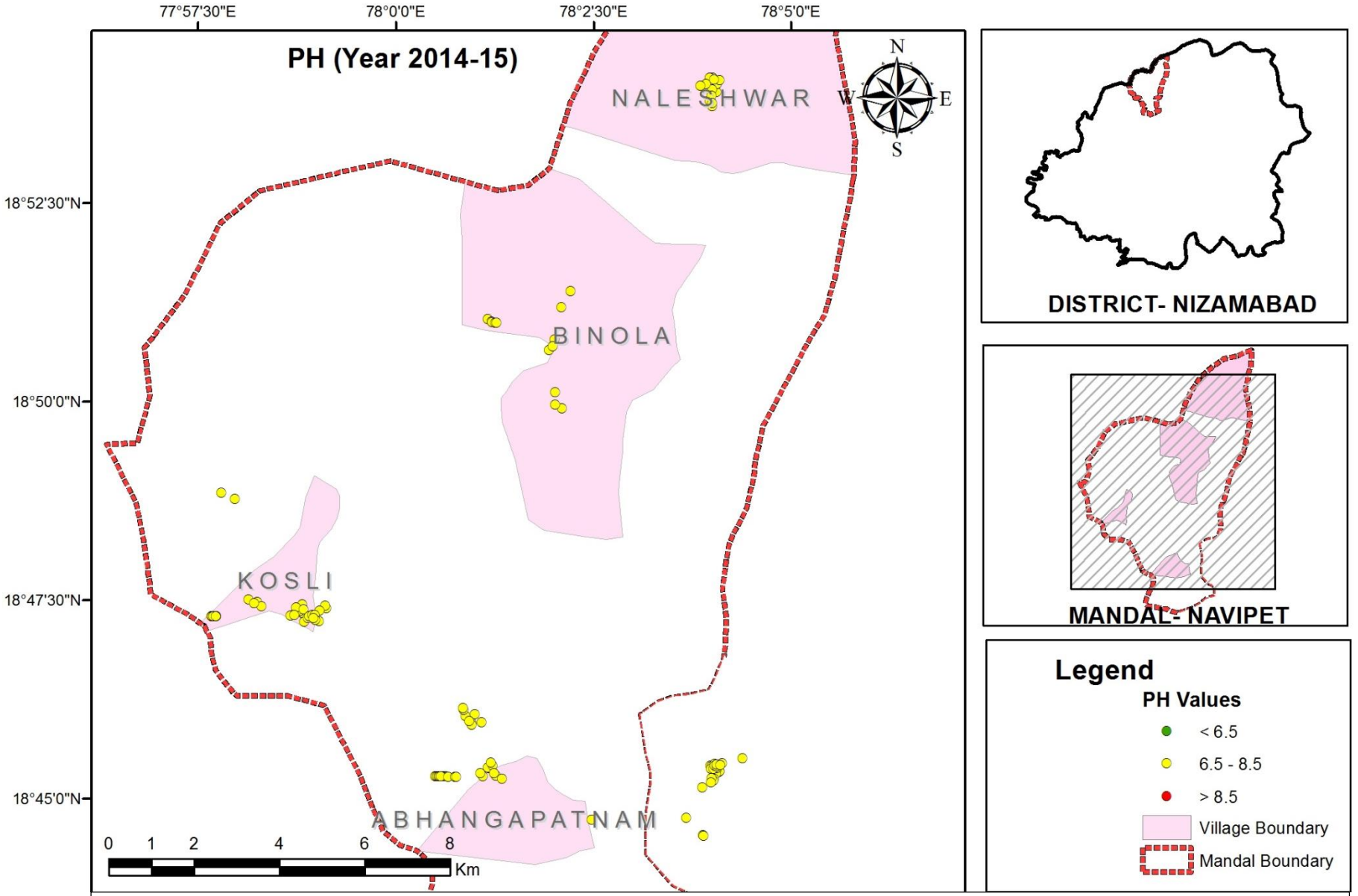
Map 4.1 showing pH values of Water sources points- Kamareddy Mandal
Note- All values for the given GPS points are between desirable and maximum permissible limit (Yellow)



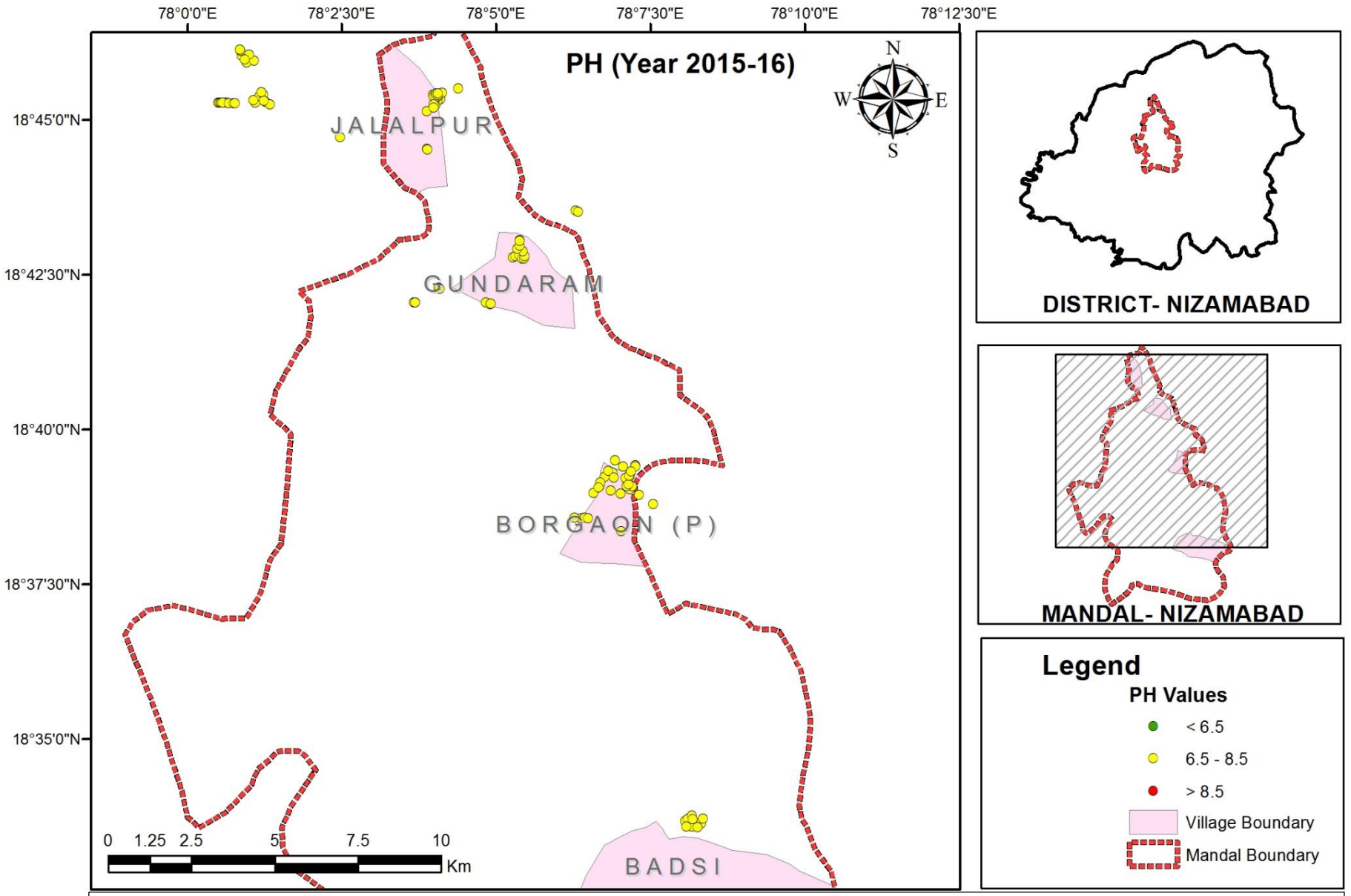
Map 4.2 showing pH values of Water sources points- Kamareddy Mandal
Note-Few values for the given GPS points are within desirable and most of them are in between Desirable and maximum permissible limit (Green-Yellow)



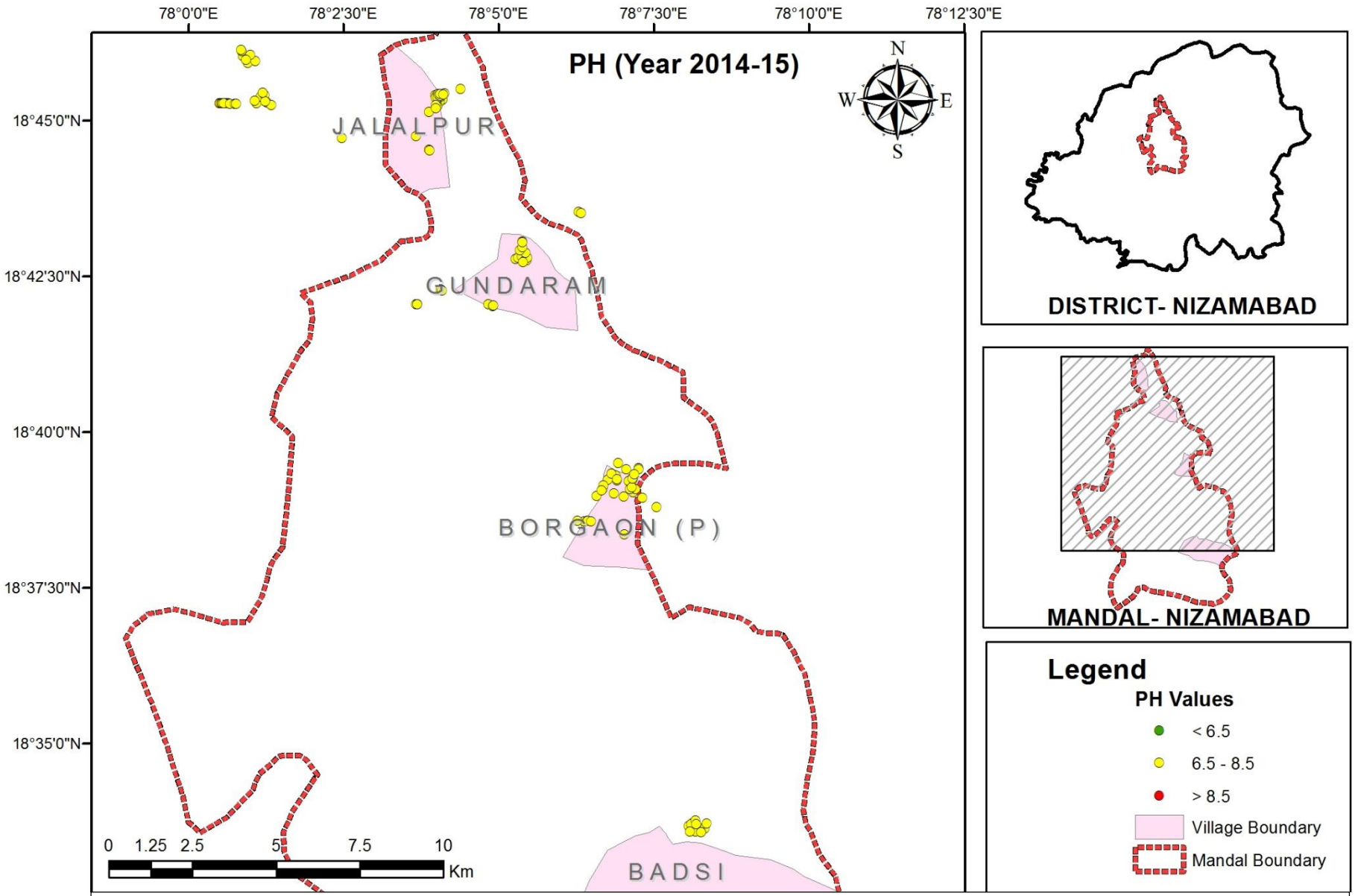
Map 5.1 showing pH values of Water sources points - Navipet Mandal
Note- All values for the given GPS points are between desirable and maximum permissible limit (Yellow)



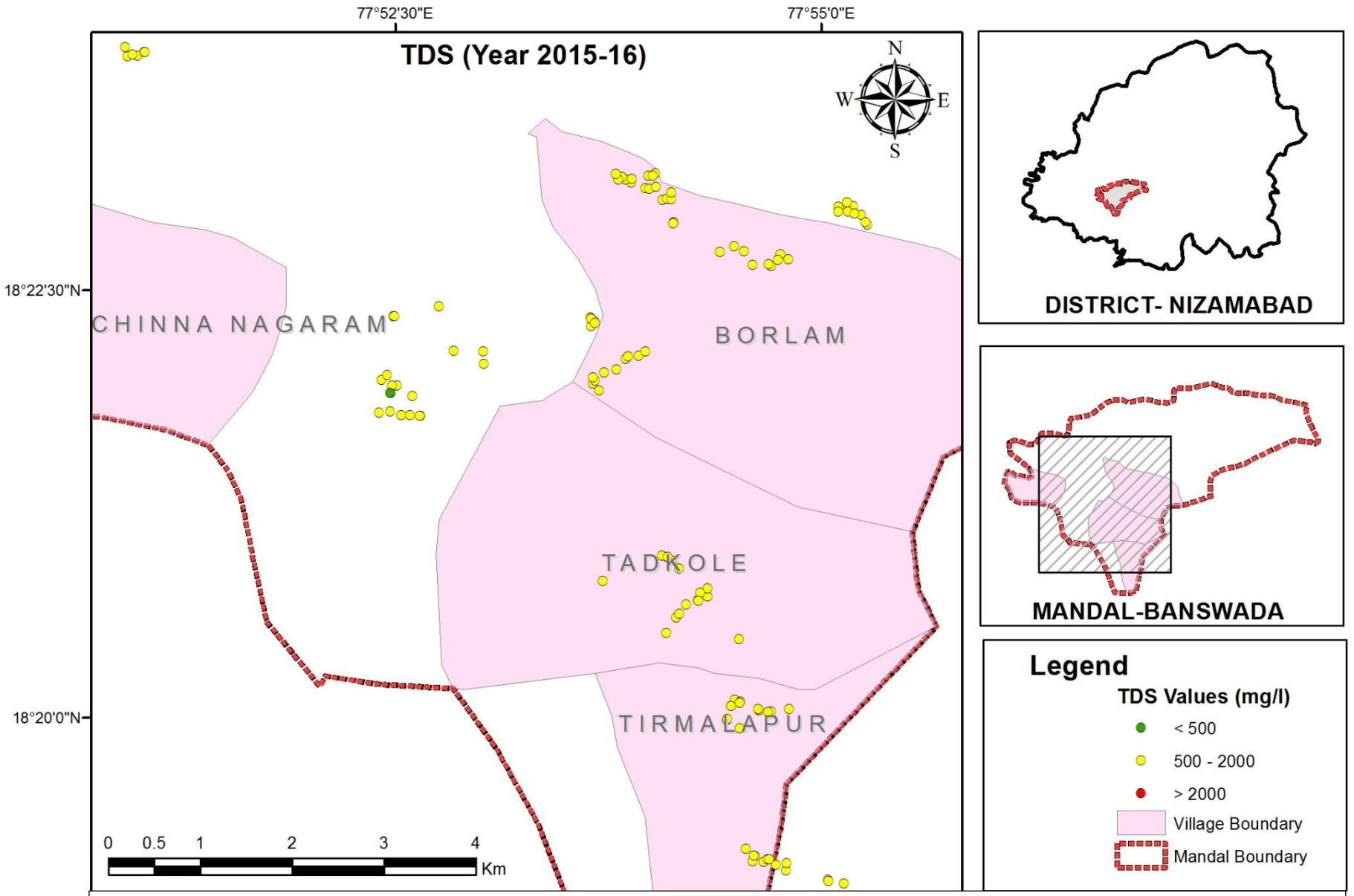
Map 5.2 showing pH values of Water sources points - Navipet Mandal
Note- All values for the given GPS points are between desirable and maximum permissible limit (Yellow)



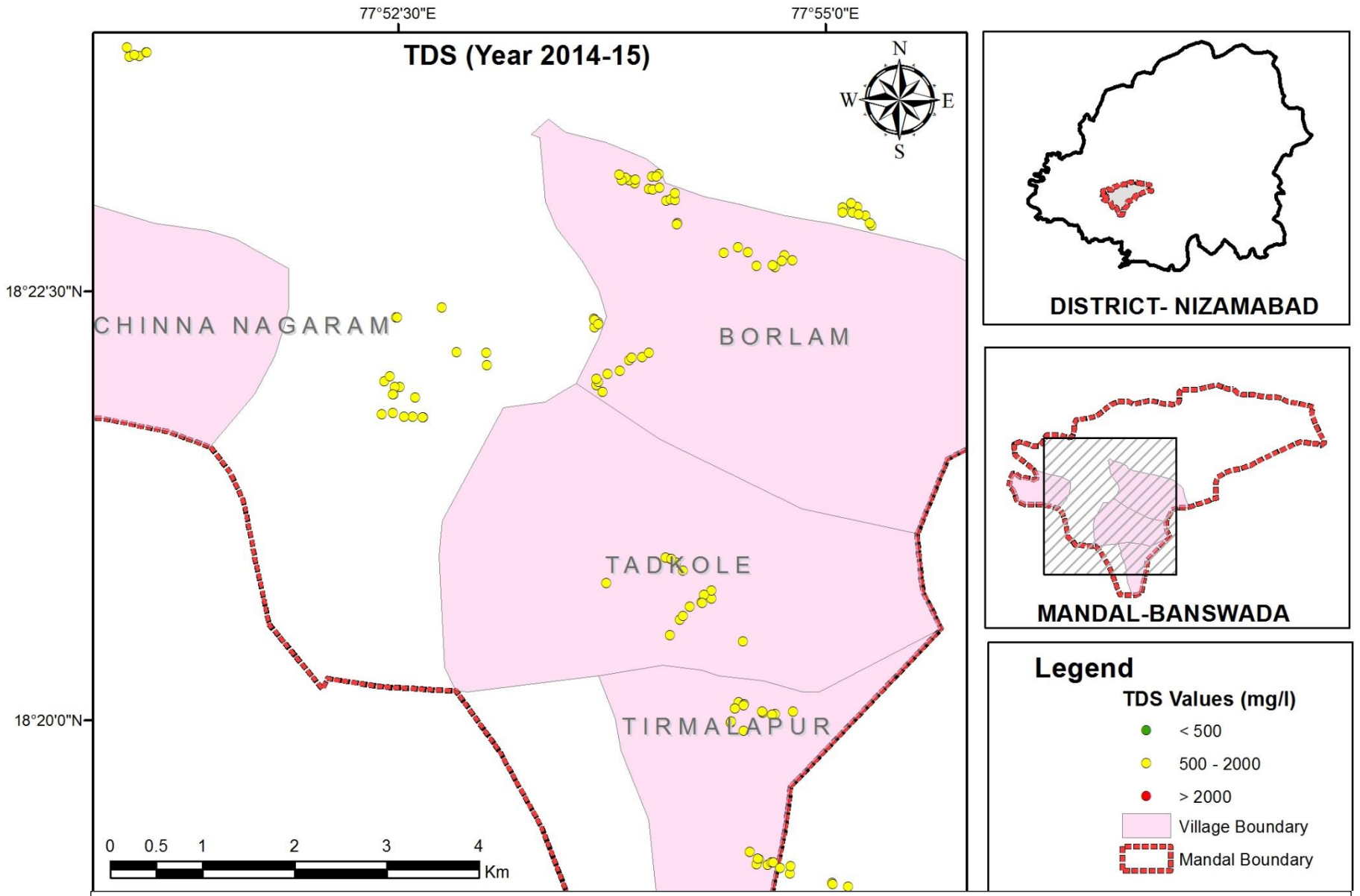
Map 6.1 showing pH values of Water sources points- Nizamabad Mandal
Note- All values for the given GPS points are between desirable and maximum permissible limit (Yellow)



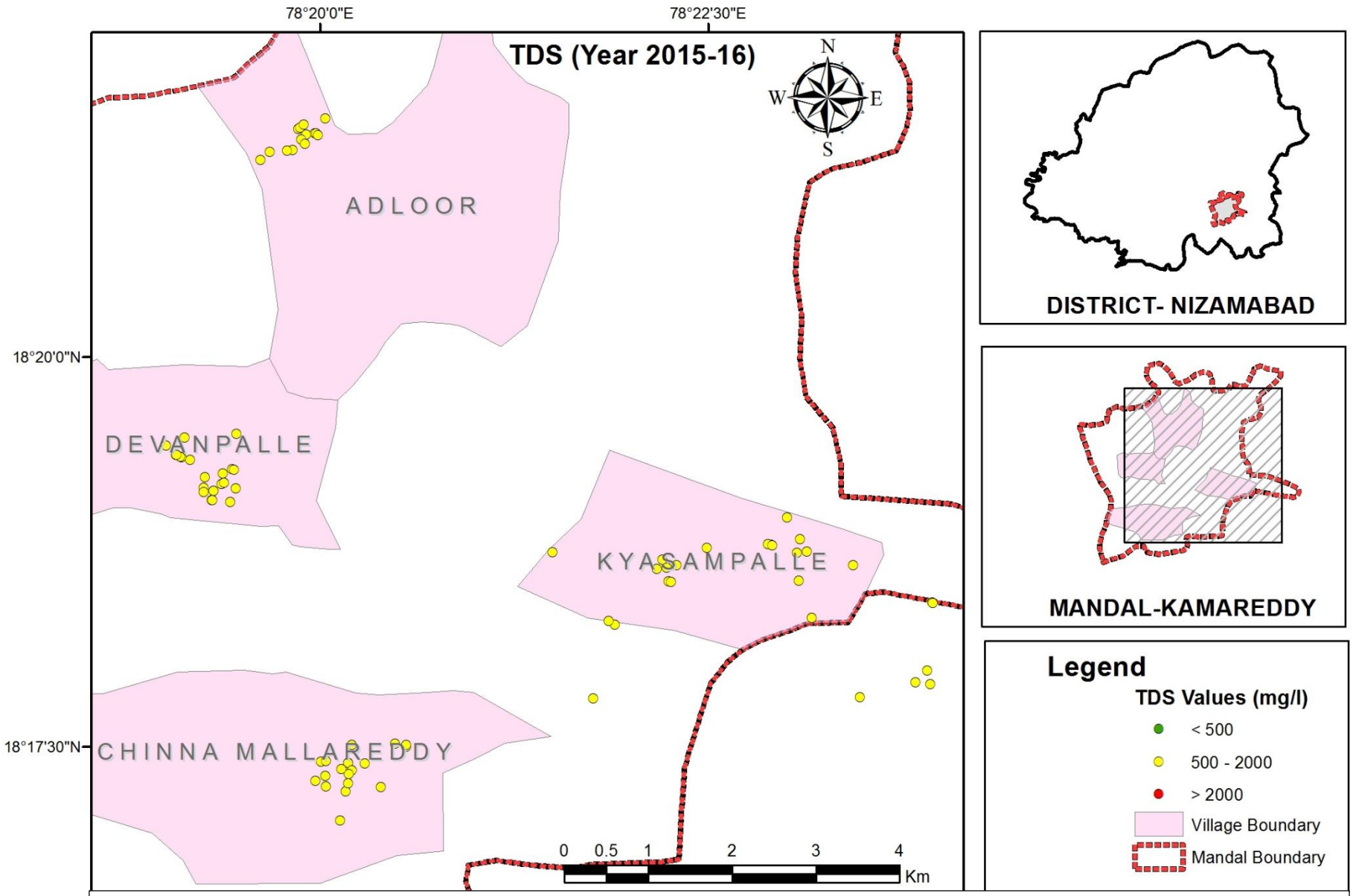
Map 6.2 showing pH values of Water sources points- Nizamabad Mandal
Note- All values for the given GPS points are between desirable and maximum permissible limit (Yellow)



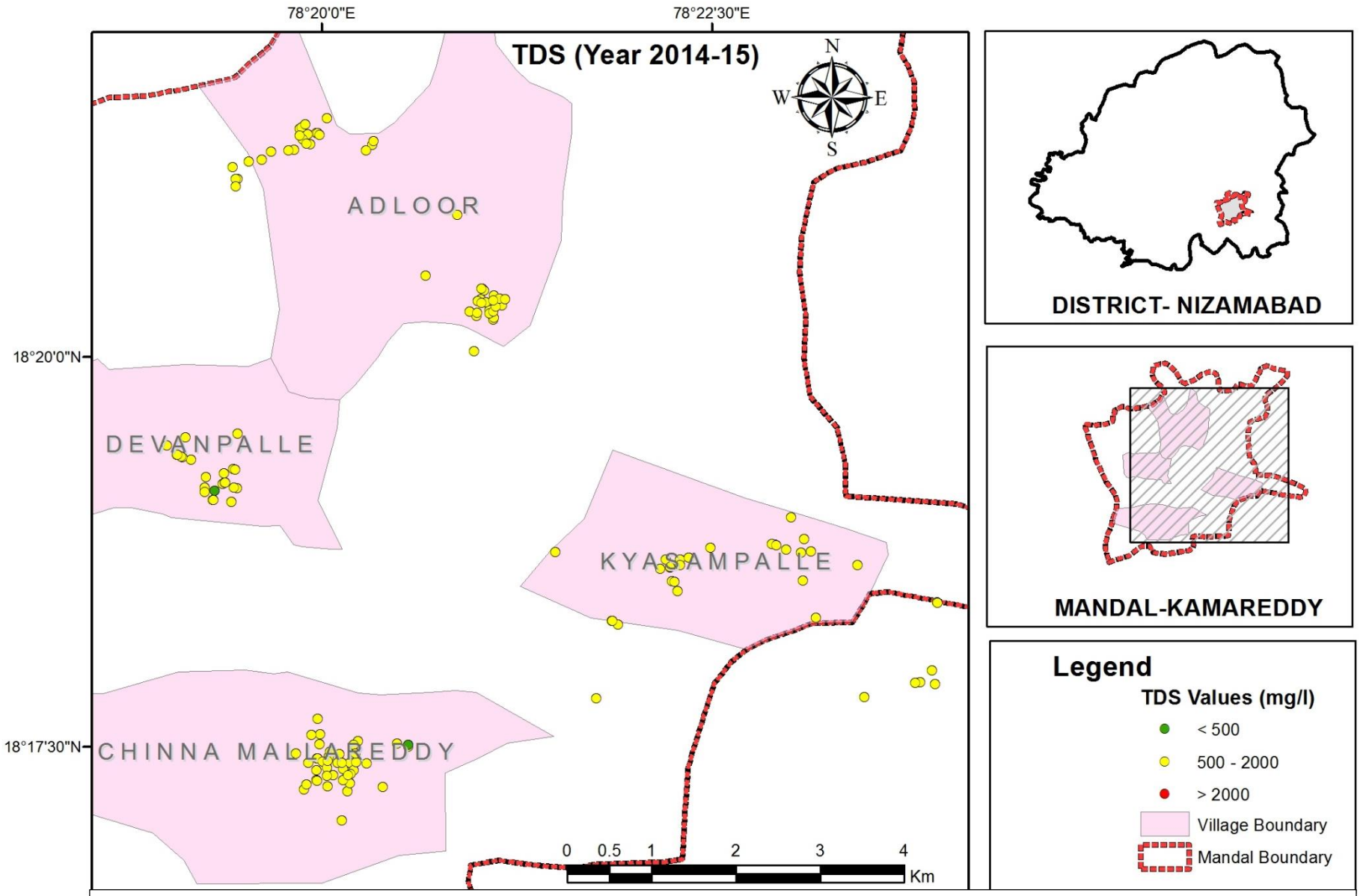
Map 7.1 showing TDS values of Water sources points - Banswada Mandal
Note- most of the values for the given GPS points are between desirable and maximum permissible limit (Yellow), only one value is within desirable limit(Green).



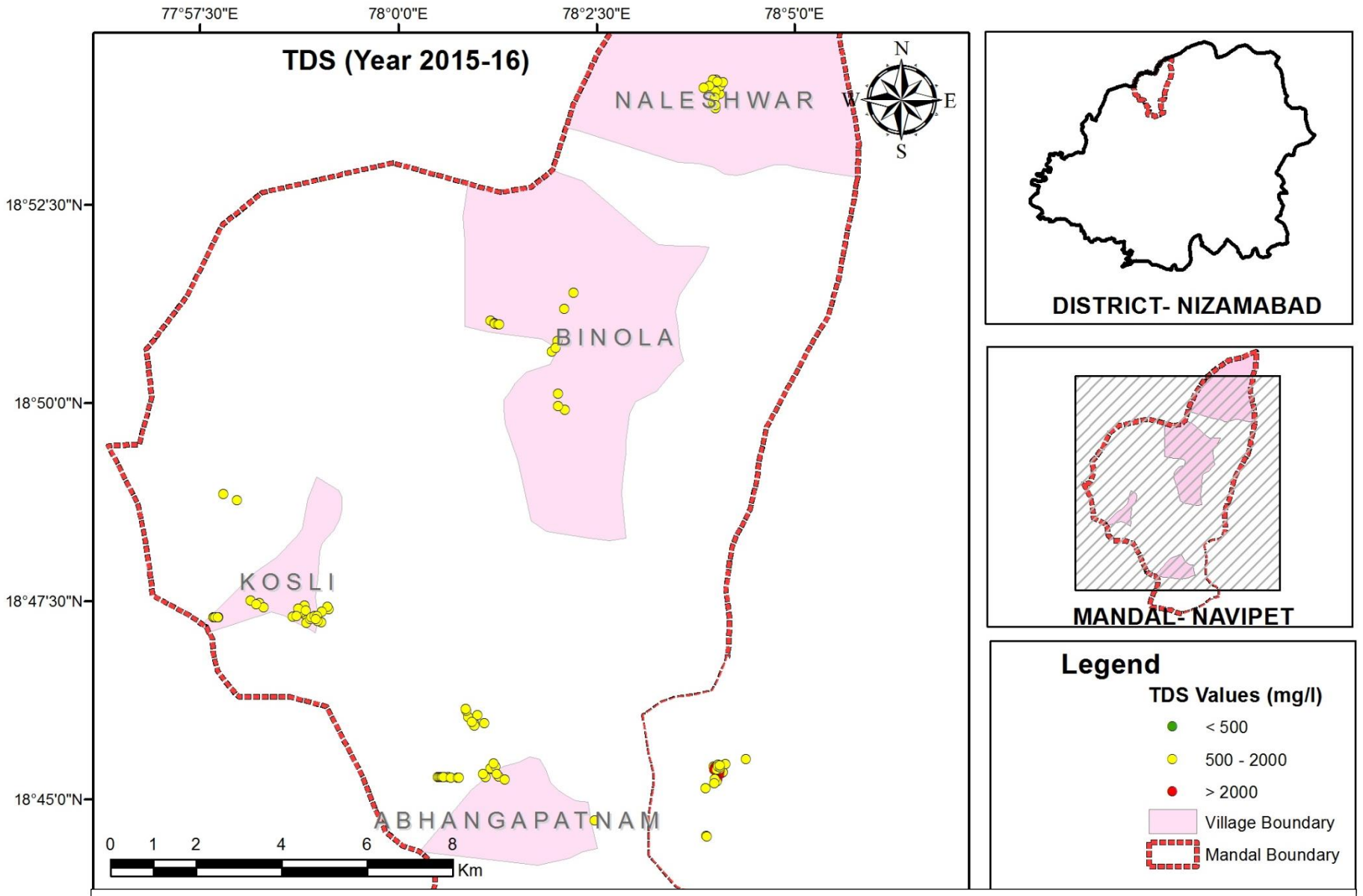
Map 7.2 showing TDS values of Water sources points - Banswada Mandal
Note- All values for the given GPS points are between desirable and maximum permissible limit (Yellow)



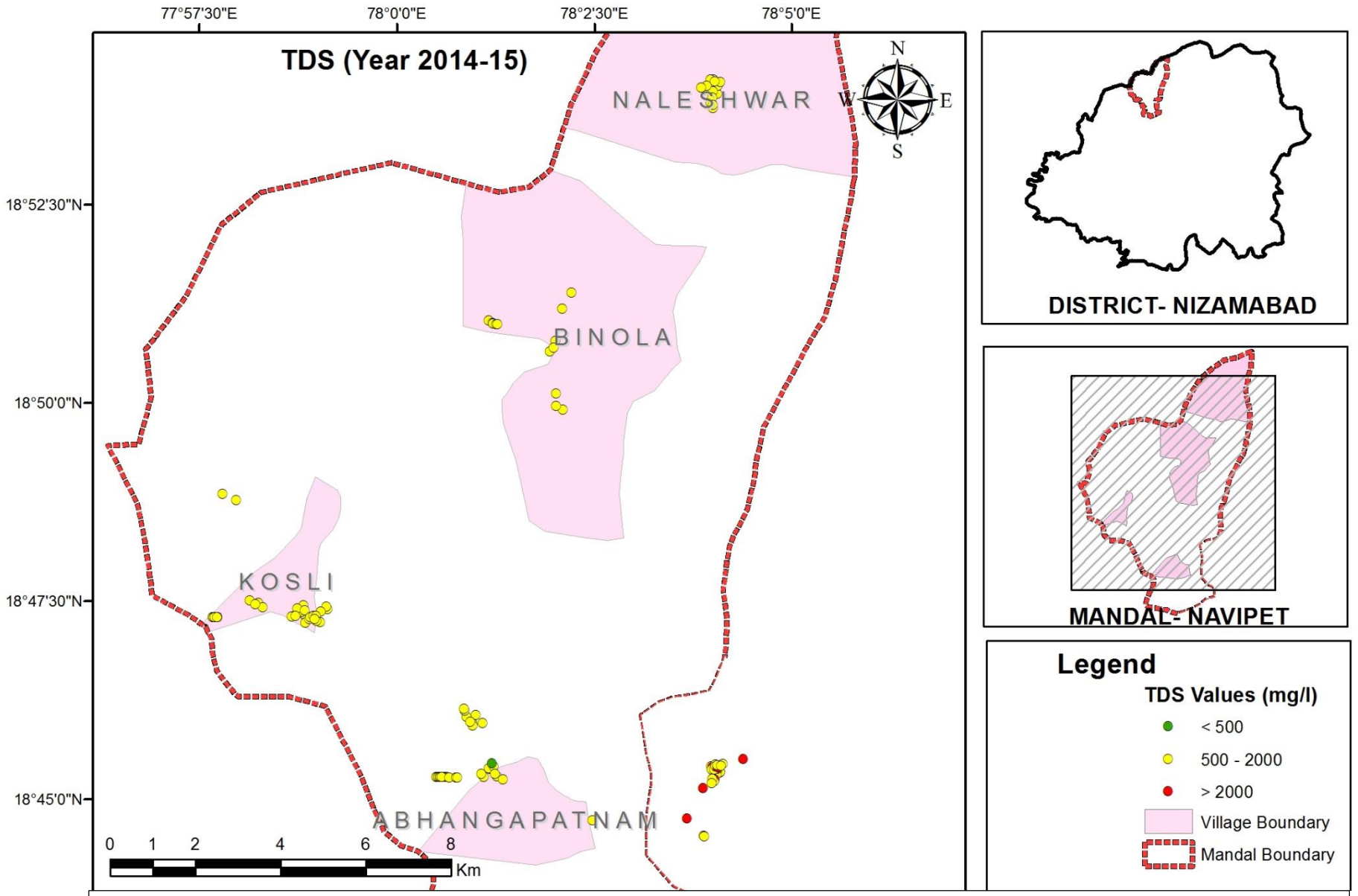
Map 8.1 showing TDS values of Water sources points - Kamareddy Mandal
Note- All values for the given GPS points are between desirable and maximum permissible limit (Yellow)



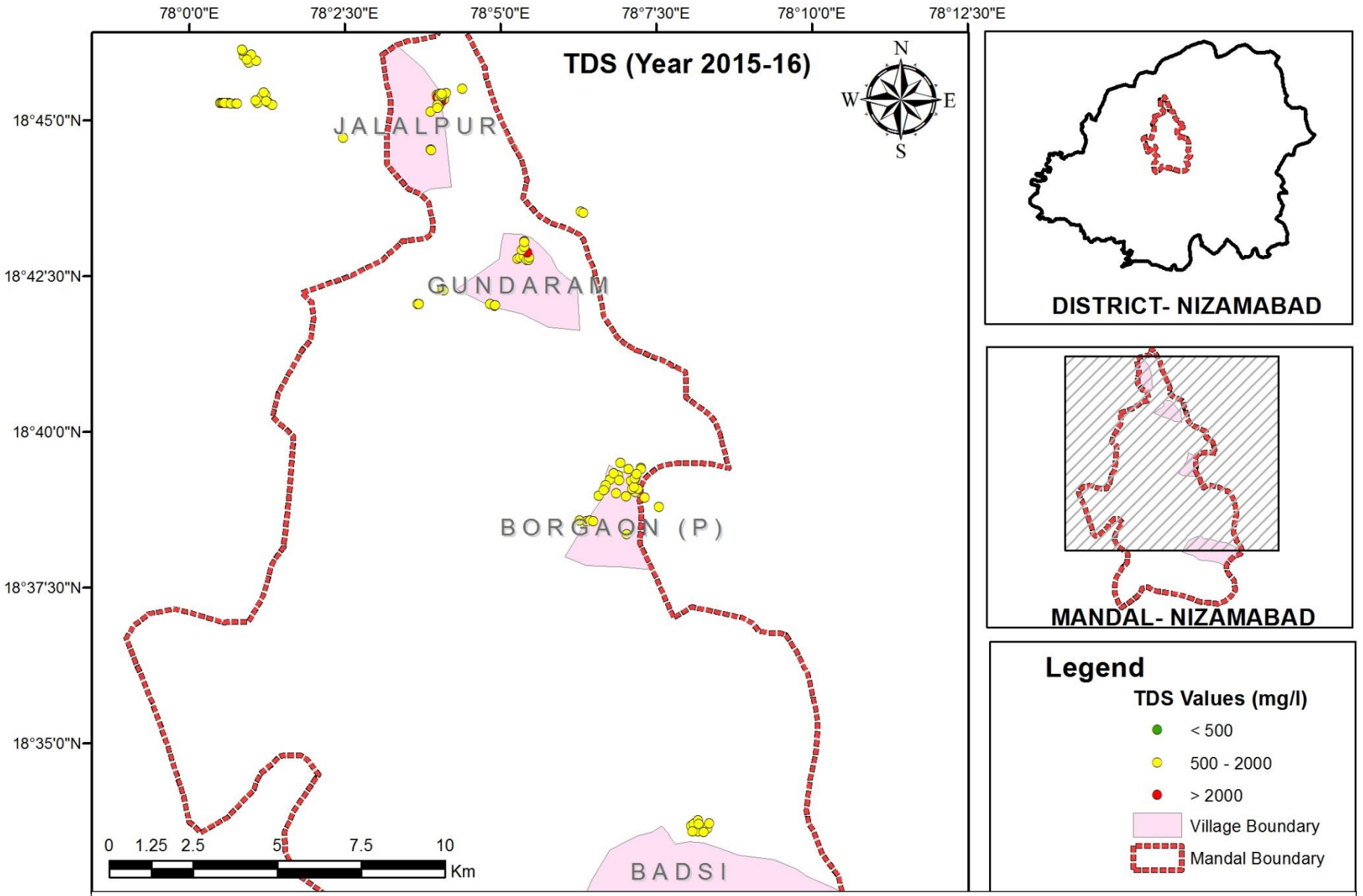
Map 8.2 showing TDS values of Water sources points - Kamareddy Mandal
Note- most of the values for the given GPS points are between desirable and maximum permissible limit (Yellow), few points are within desirable limit (Green).



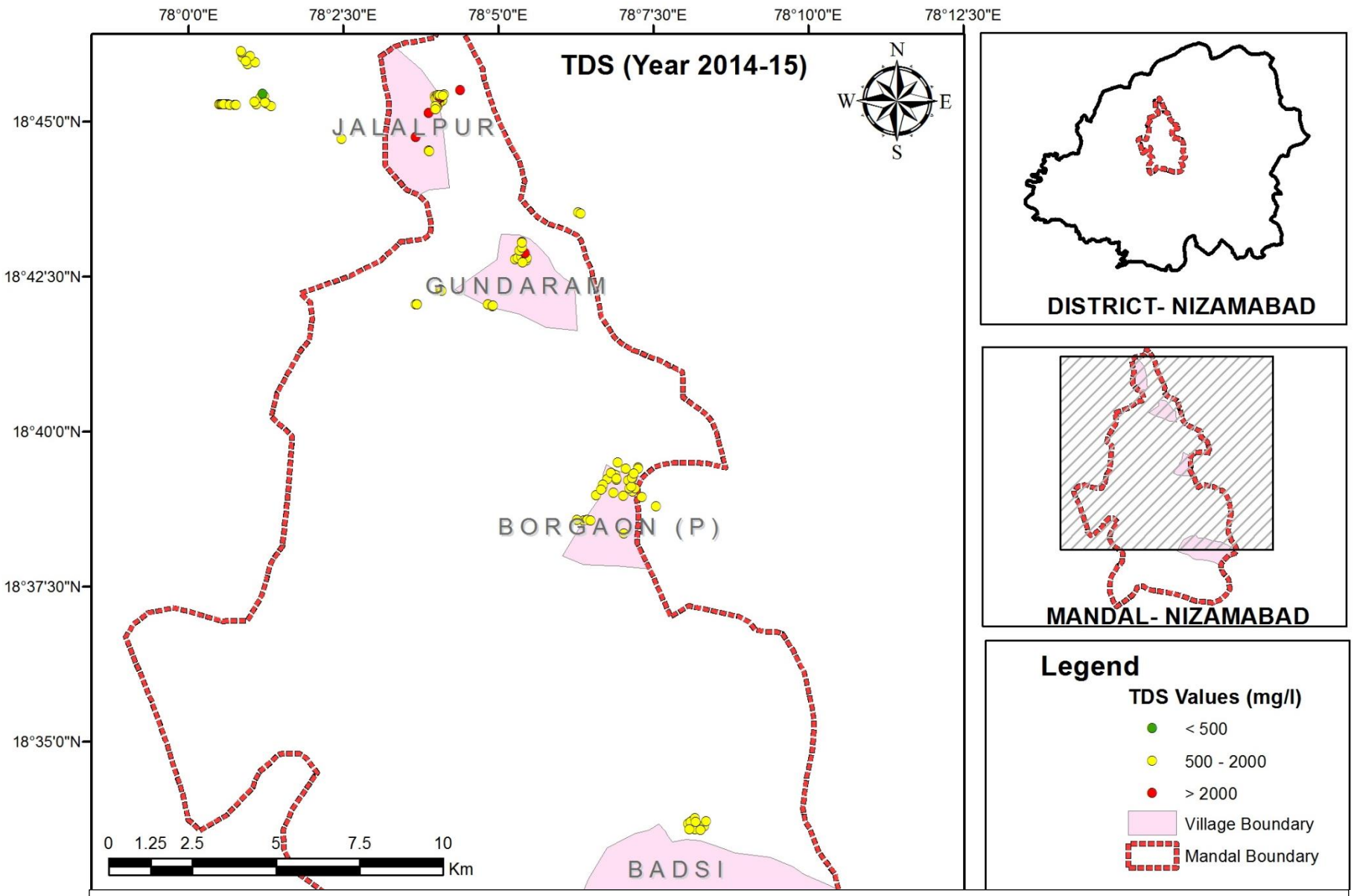
Map 9.1 showing TDS values of Water sources points - Navipet Mandal
Note-Two values of the given GPS points showing exceeding permissible limit (Red), and other values are between desirable limit and maximum permissible limit (Yellow).



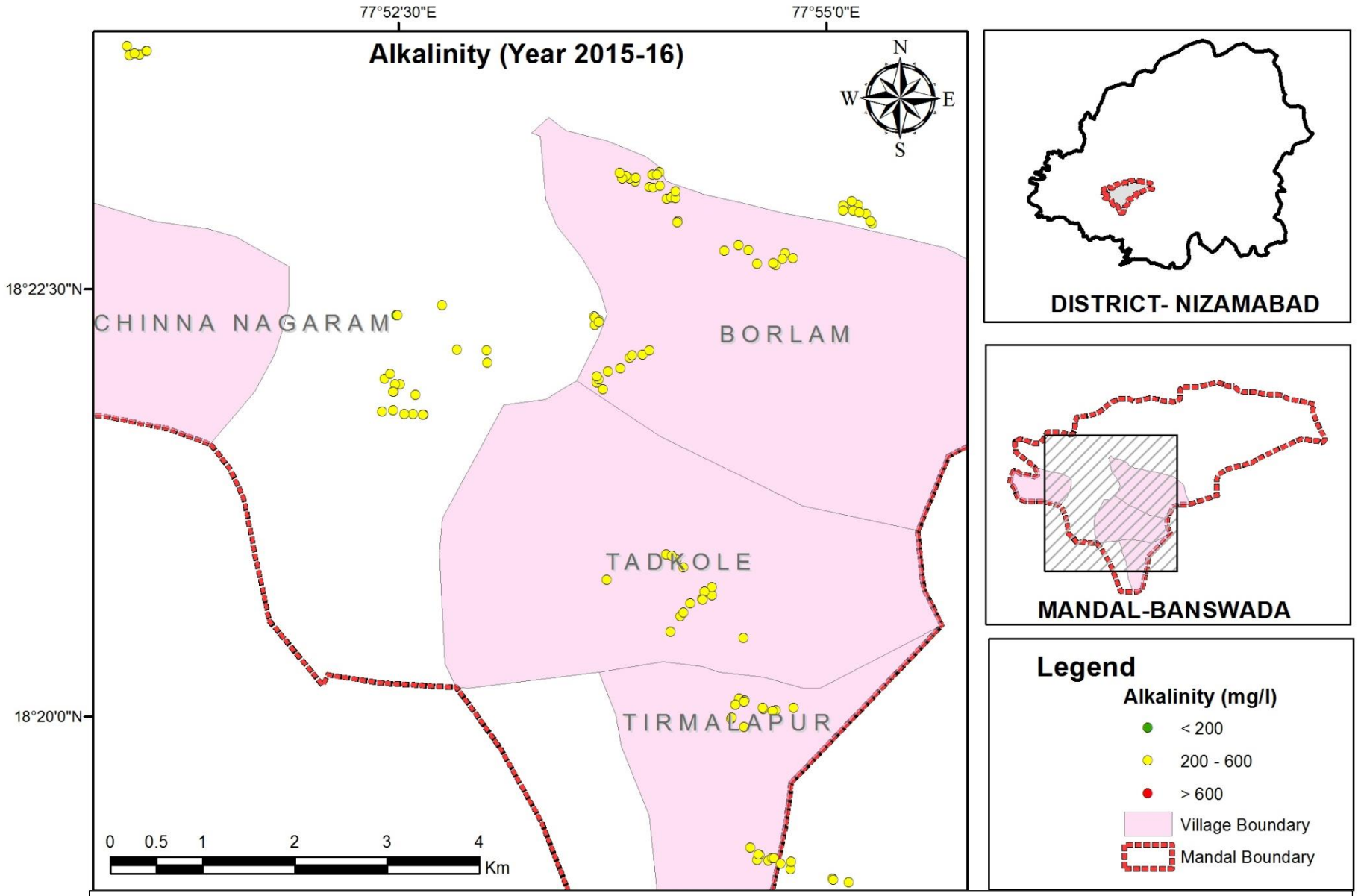
Map 9.2 showing TDS values of Water sources points - Navipet Mandal
Note-only one value showing within desirable limit (Green), and all other values for the given GPS points are between desirable limit and maximum permissible limit (Yellow).



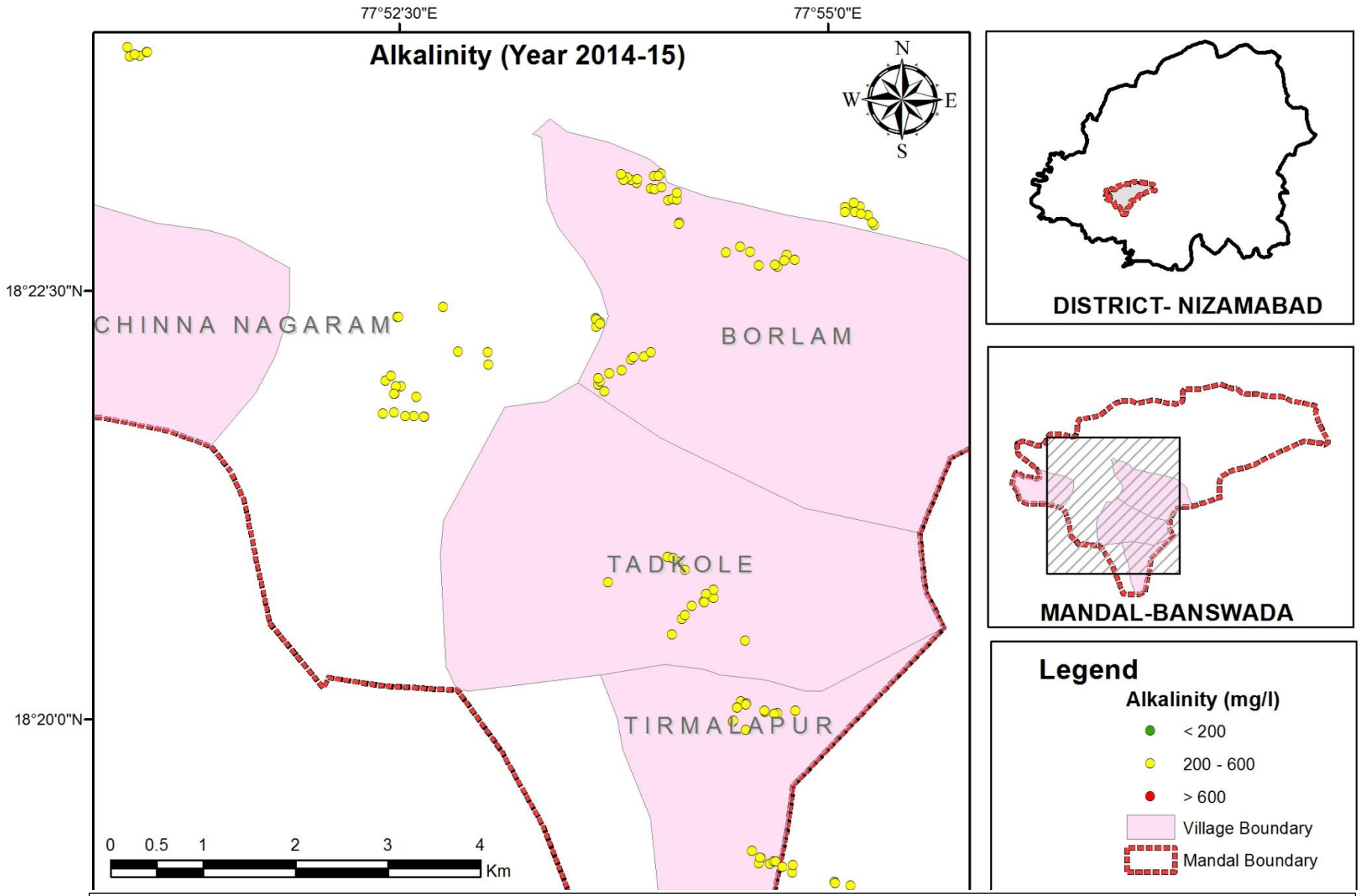
Map 10.1 showing TDS values of Water sources points - Nizamabad Mandal
Note-Seven values for the given GPS points showing exceeding permissible limit (Red) and all other values showing between desirable and maximum permissible limit (Yellow).



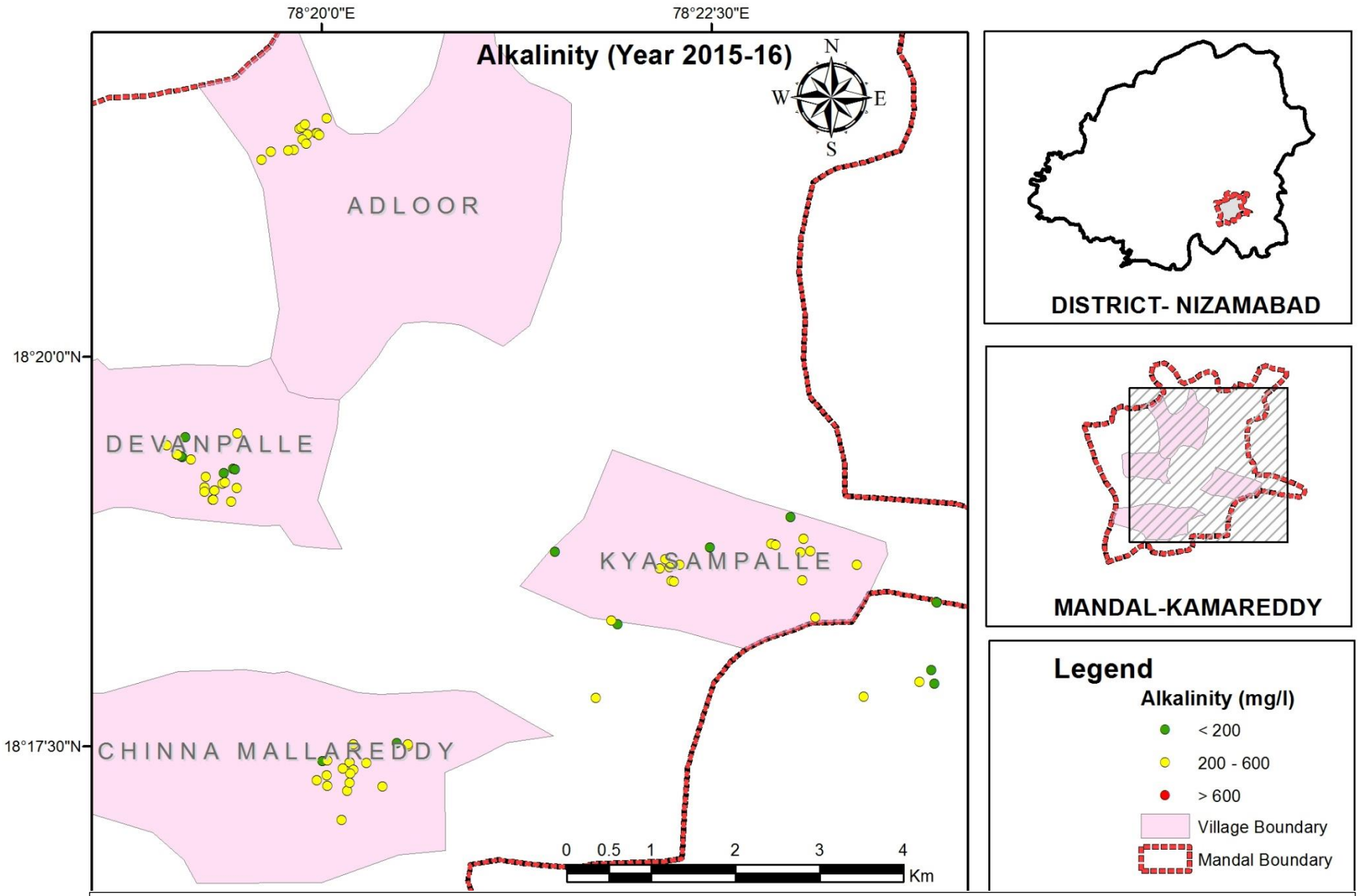
Map 10.2 showing TDS values of Water sources points - Nizamabad Mandal
Note- Nine values for the given GPS points showing exceeding permissible limit (Red), few points within desirable limit(Green) and the remaining values showing between desirable and maximum permissible limit (Yellow).



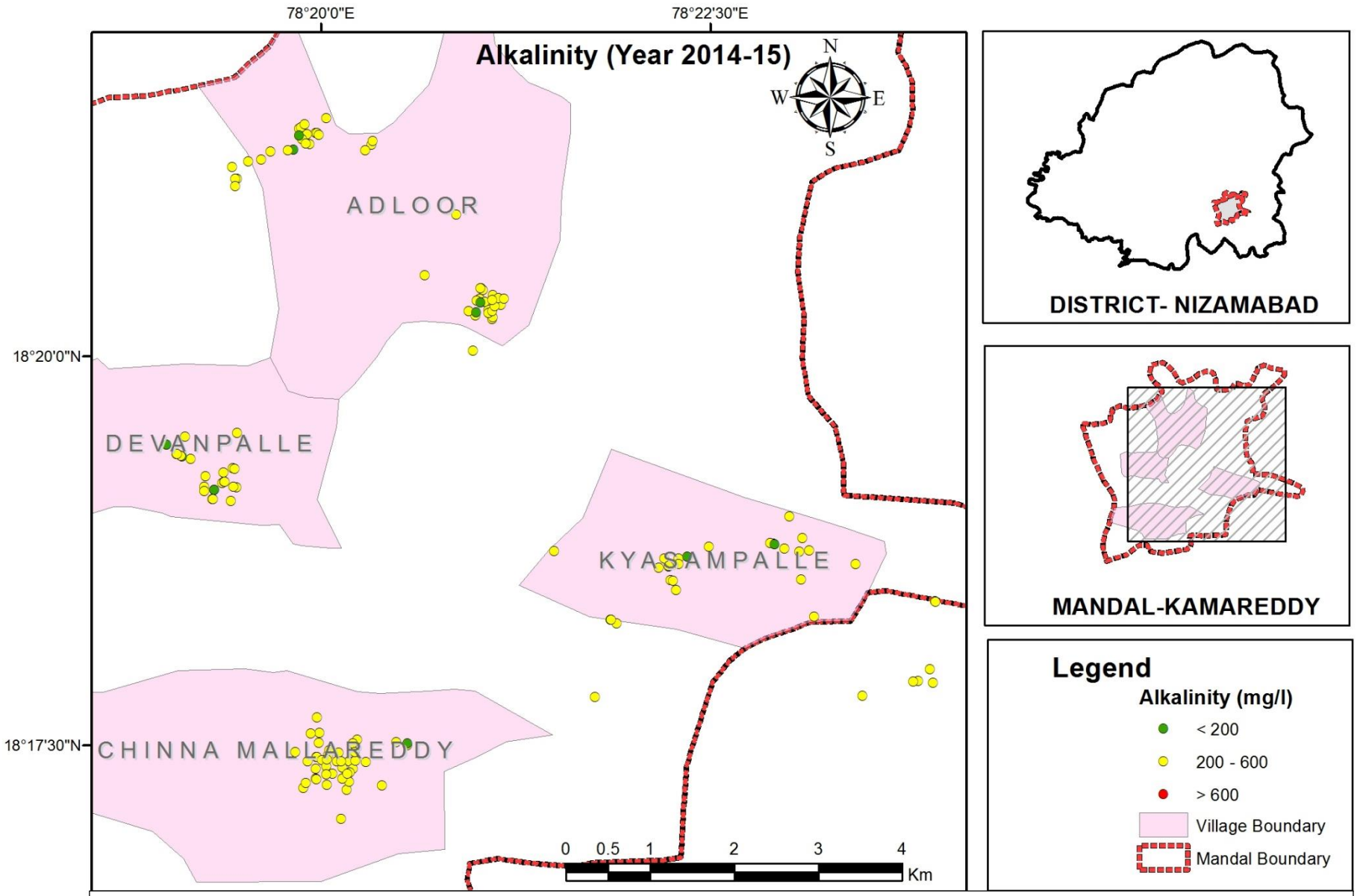
Map 11.1 showing Alkalinity values of Water sources points - Banswada Mandal
Note- All values for the given GPS points showing between desirable limit and maximum permissible limit (Yellow).



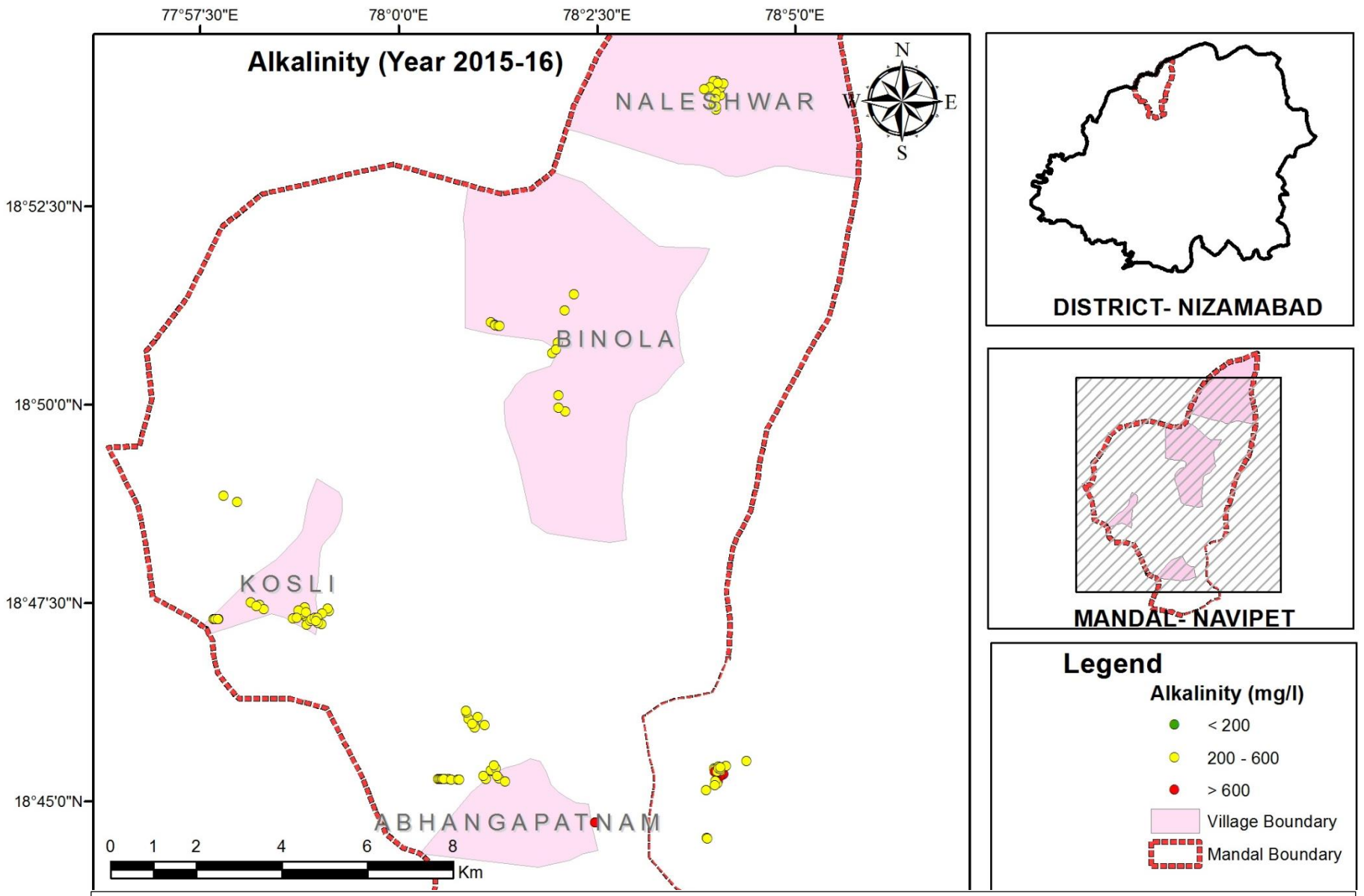
Map 11.2 showing Alkalinity values of Water sources points - Banswada Mandal
Note- All values for the given GPS points showing between desirable limit and maximum permissible limit (Yellow).



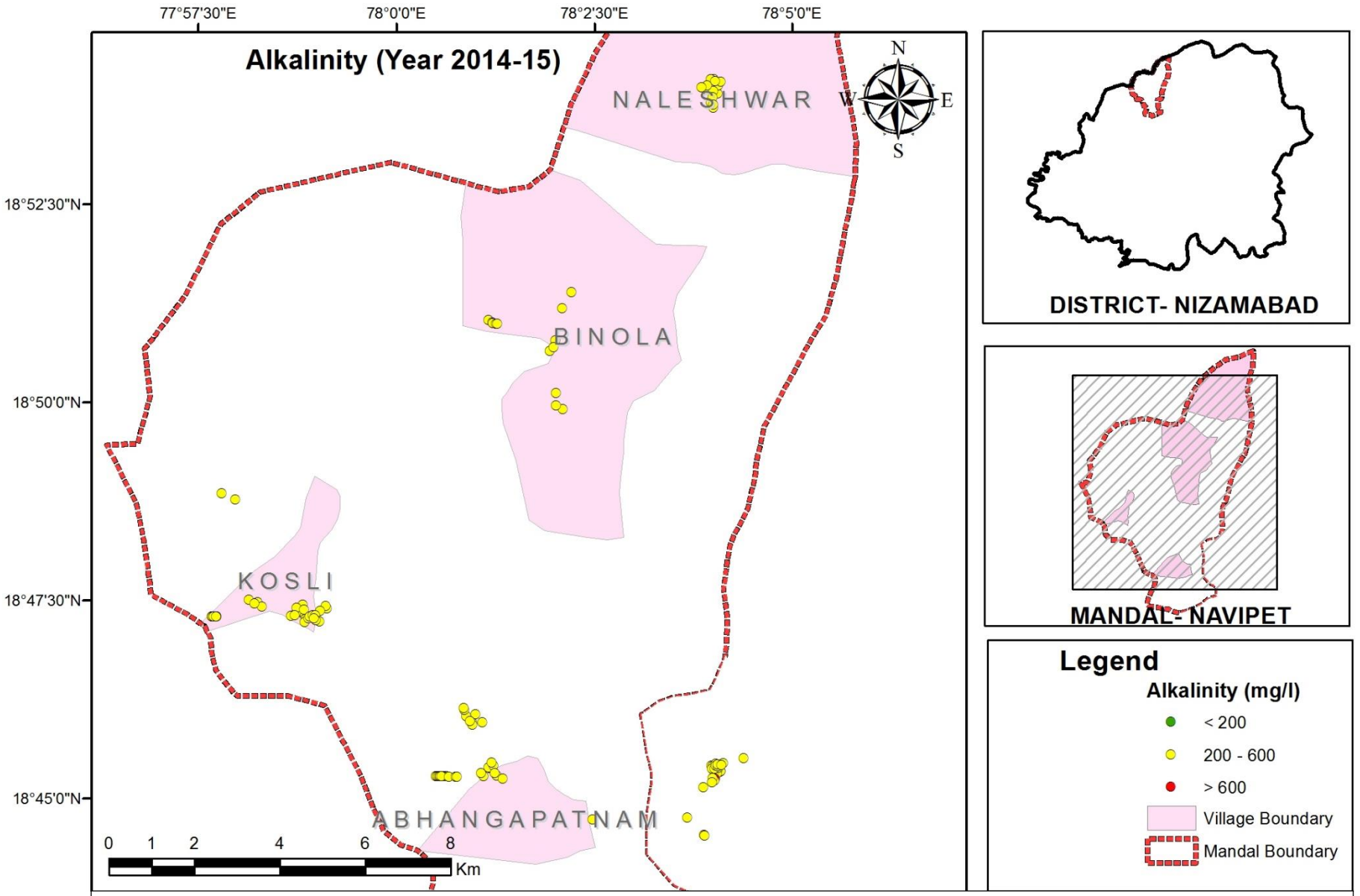
Map 12.1 showing Alkalinity values of Water sources points - Kamareddy Mandal
Note- Some values for the given GPS points shows within desirable limit (Green) and all other values showing between desirable limit and maximum permissible limit (Yellow)



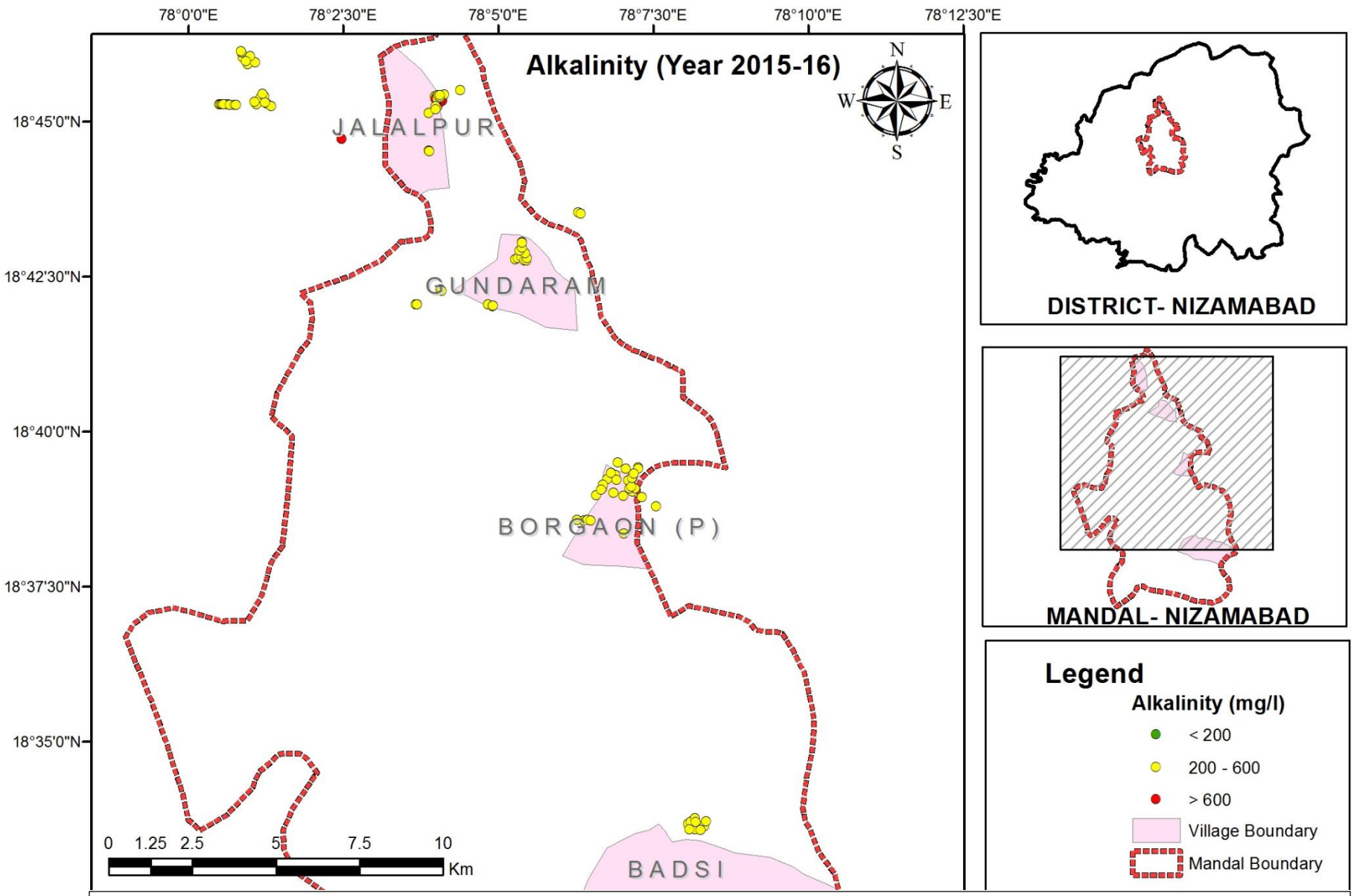
Map 12.2 showing Alkalinity values of Water sources points - Kamareddy Mandal
Note- Some values for the given GPS points shows within desirable limit (Green) and all other values showing between desirable limit and maximum permissible limit (Yellow)



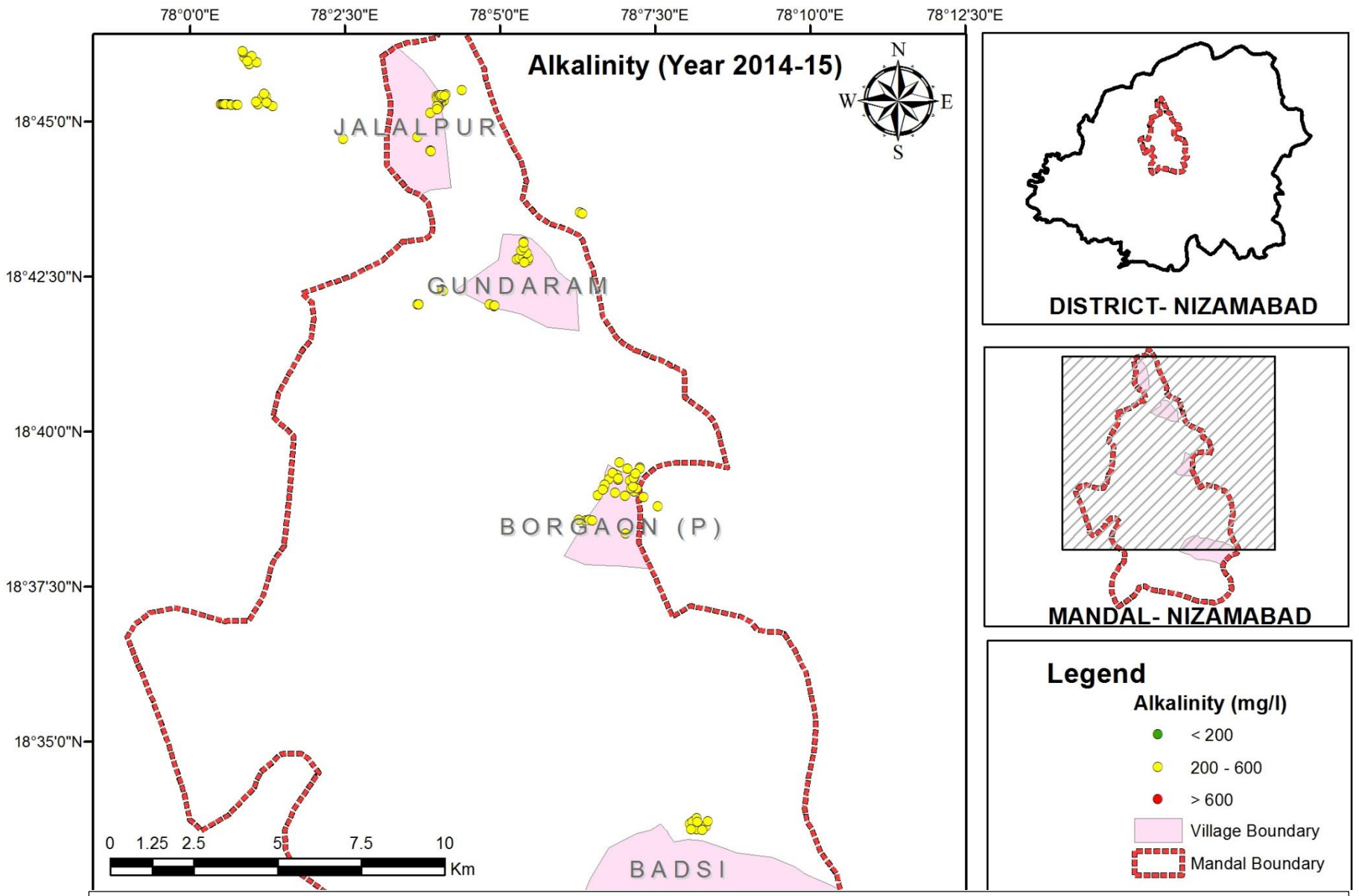
Map 13.1 showing Alkalinity values of Water sources points – Navipet Mandal
Note-one point shows exceeding permissible limit and other values for the given GPS points showing between desirable limit and maximum permissible limit (Yellow)



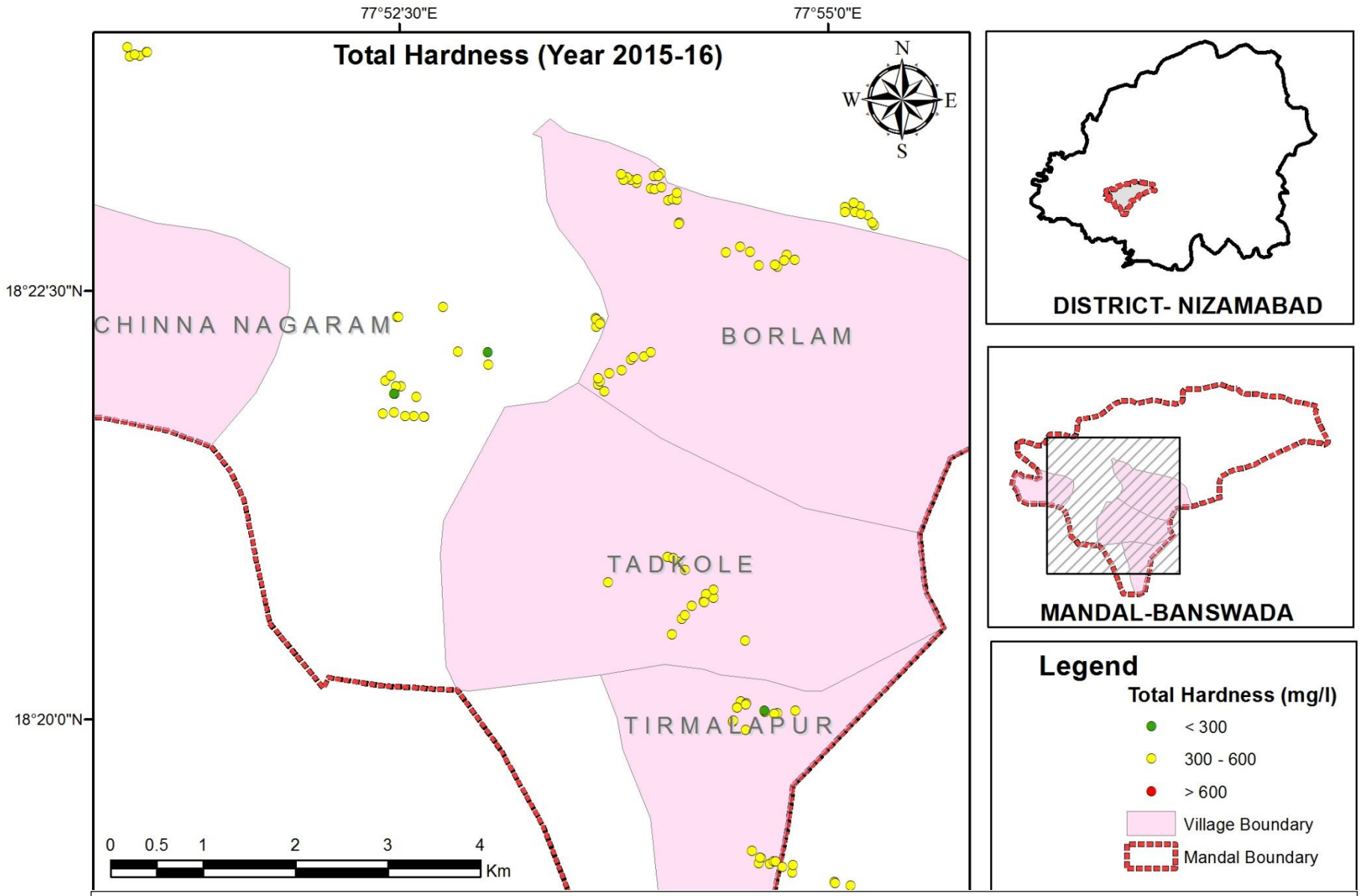
Map 13.2 showing Alkalinity values of Water sources points – Navipet Mandal
Note- All values for the given GPS points showing alkalinity within maximum permissible limit (Yellow)



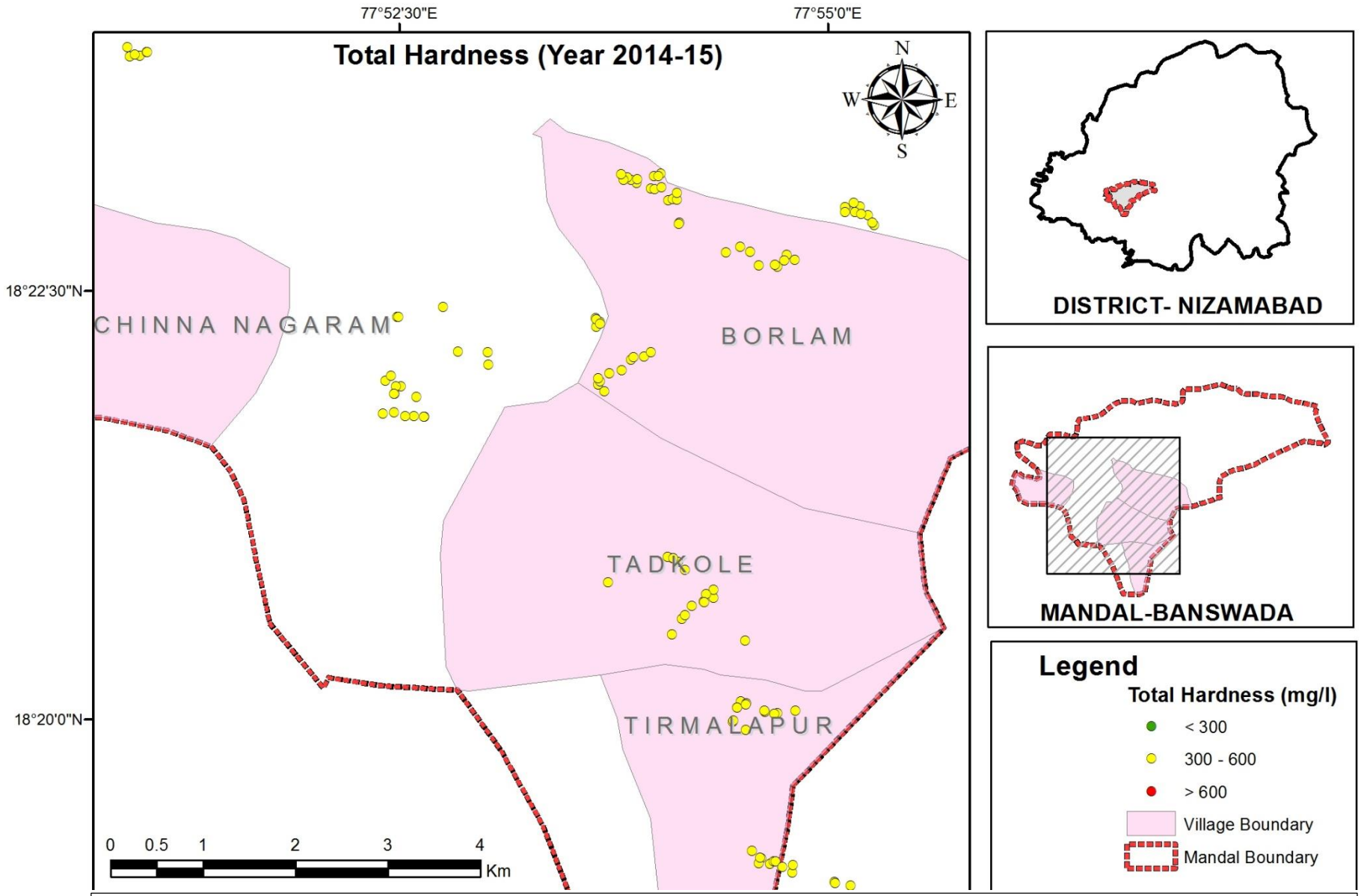
Map 14.1 showing Alkalinity values of Water sources points - Nizamabad Mandal
Note- Some points are exceeding permissible limit (Red) and all other values for the given GPS points showing alkalinity within maximum permissible limit (Yellow)



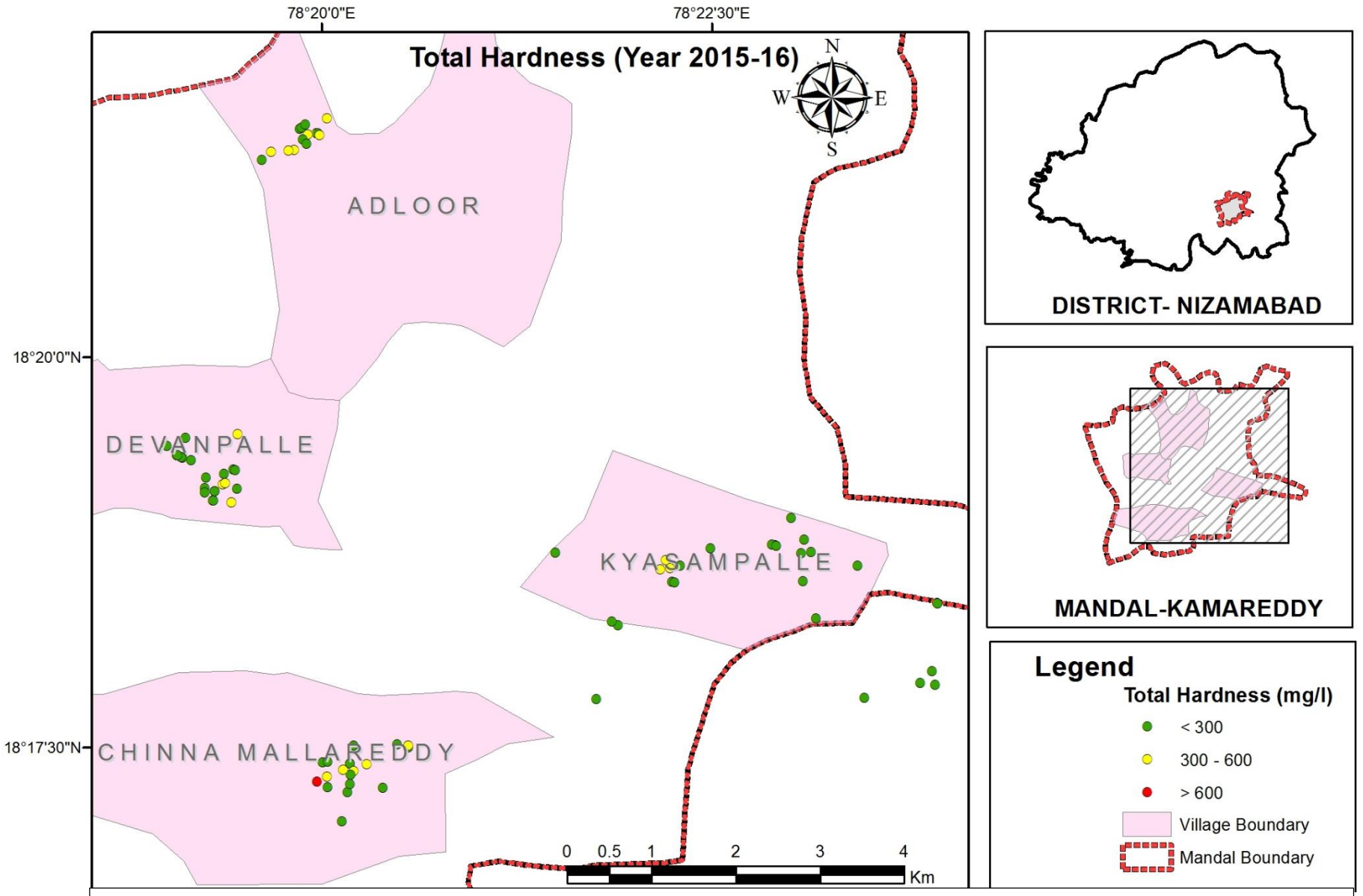
Map 14.2 showing Alkalinity values of Water sources points – Navipet Mandal
Note- All values for the given GPS points showing alkalinity within maximum permissible limit (Yellow)



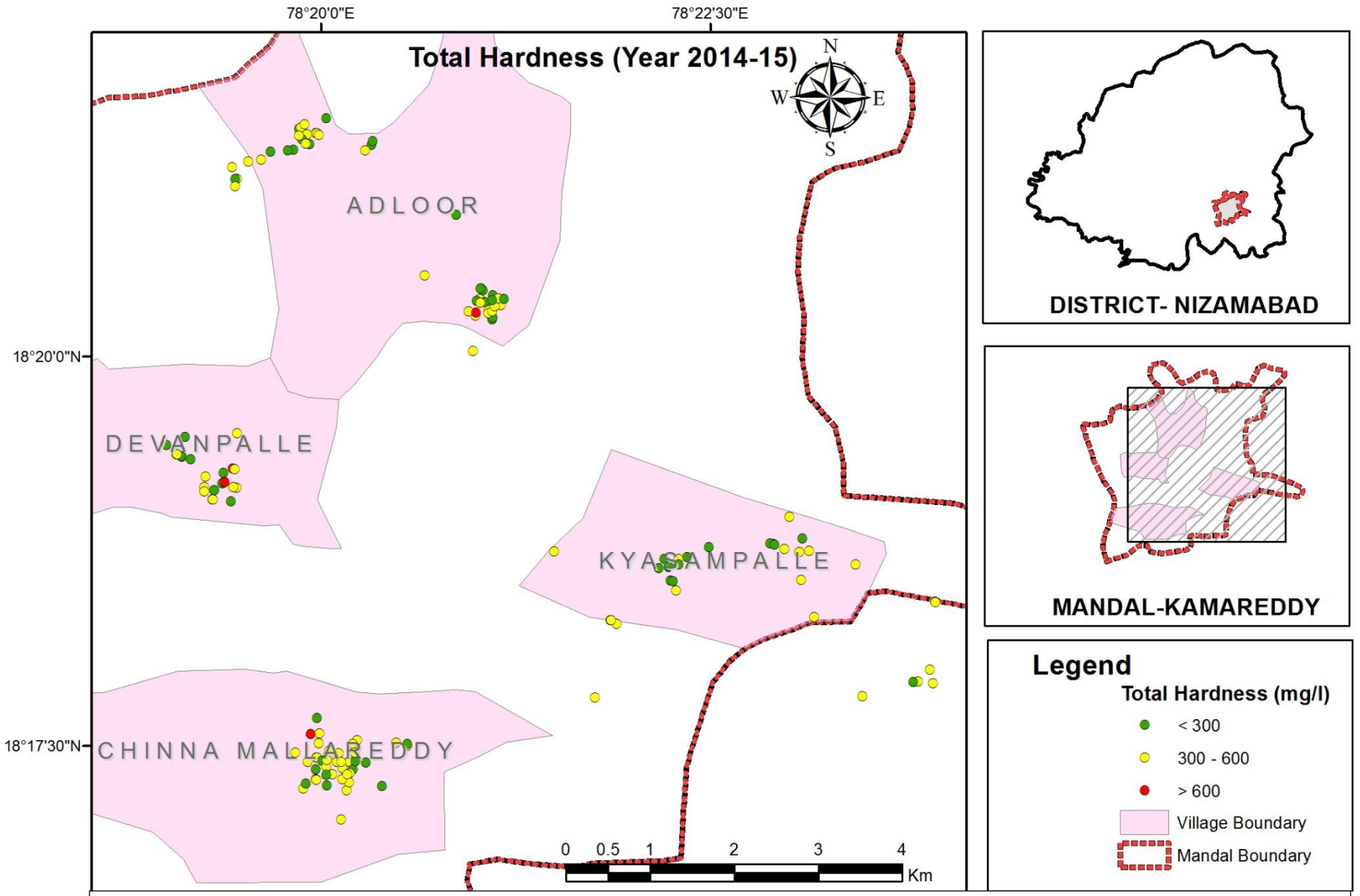
Map 15.1 showing Total Hardness values of Water sources points - Banswada Mandal
Note- Few sources in Tirmalapur and Borlum showing total hardness values within desirable limit (Green) while all other values for the given GPS points showing values within maximum permissible limit (Yellow)



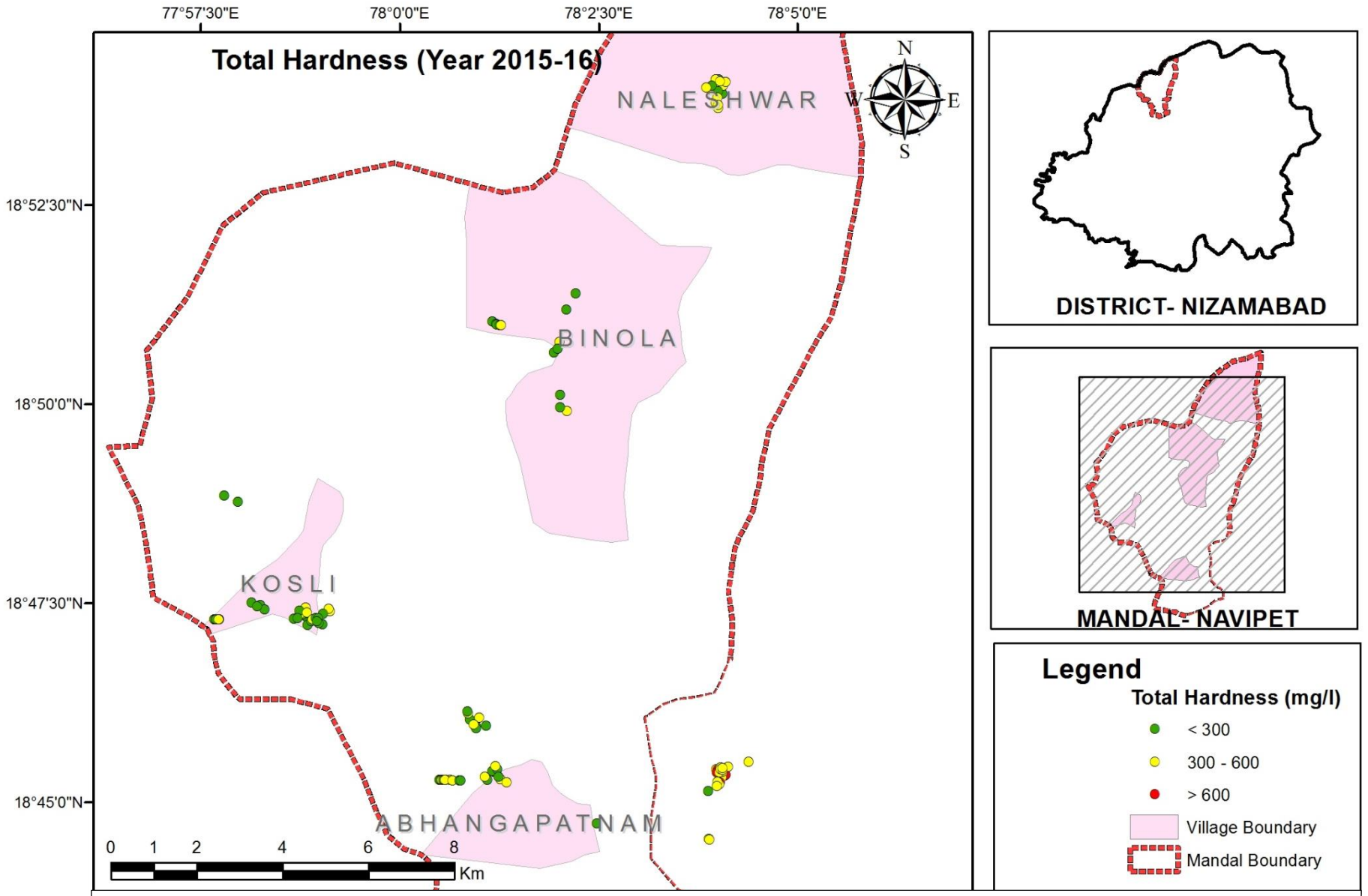
Map 15.2 showing Total Hardness values of Water sources points - Banswada Mandal
Note- All the values for the given GPS points showing values within maximum permissible limit (Yellow)



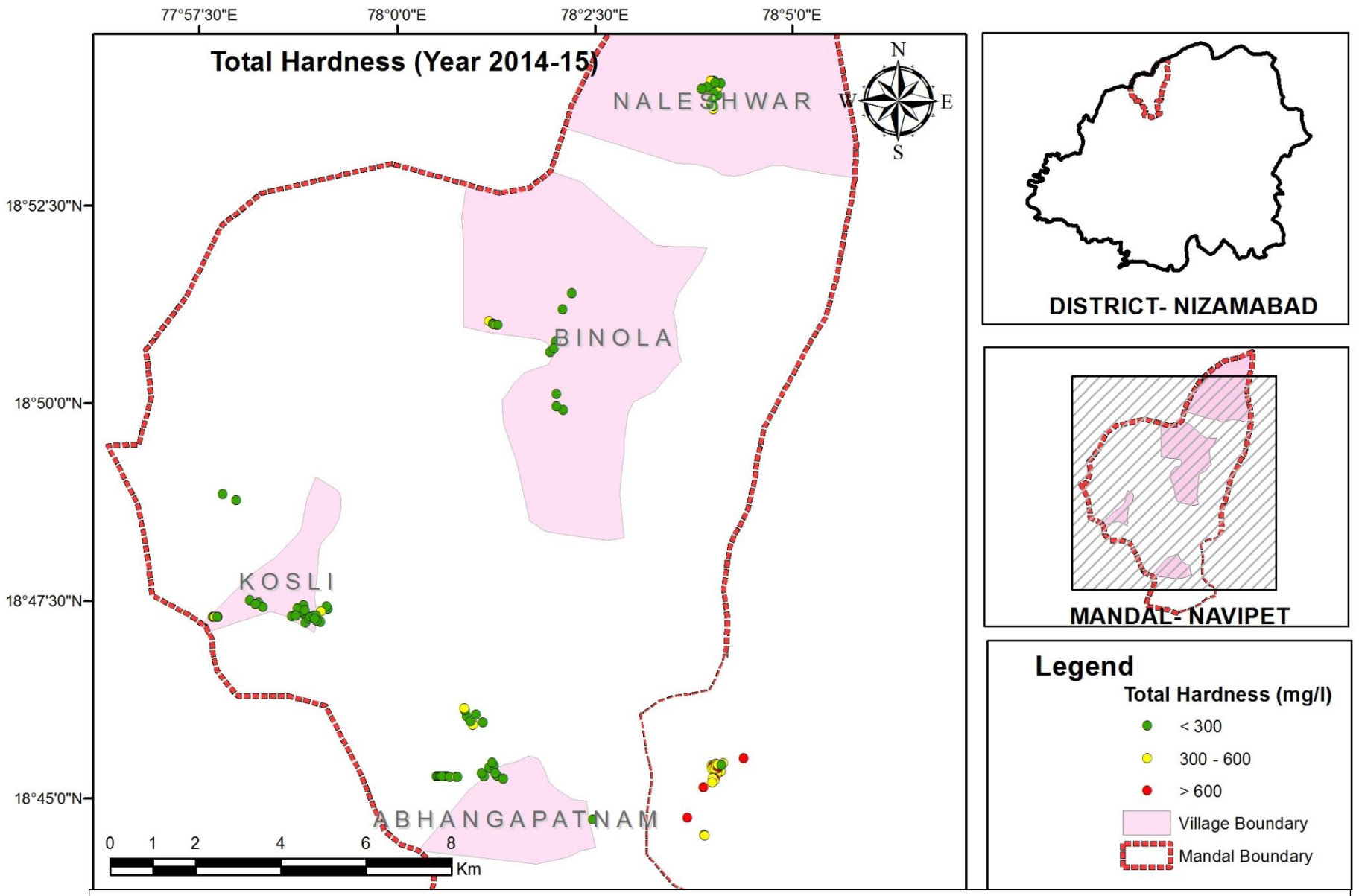
Map 16.1 showing Total Hardness values of Water sources points - Kamareddy Mandal
Note- Maximum source values shows within desirable limit (Green), some values are within maximum permissible limit (Yellow) and one value shows above permissible limit (Red).



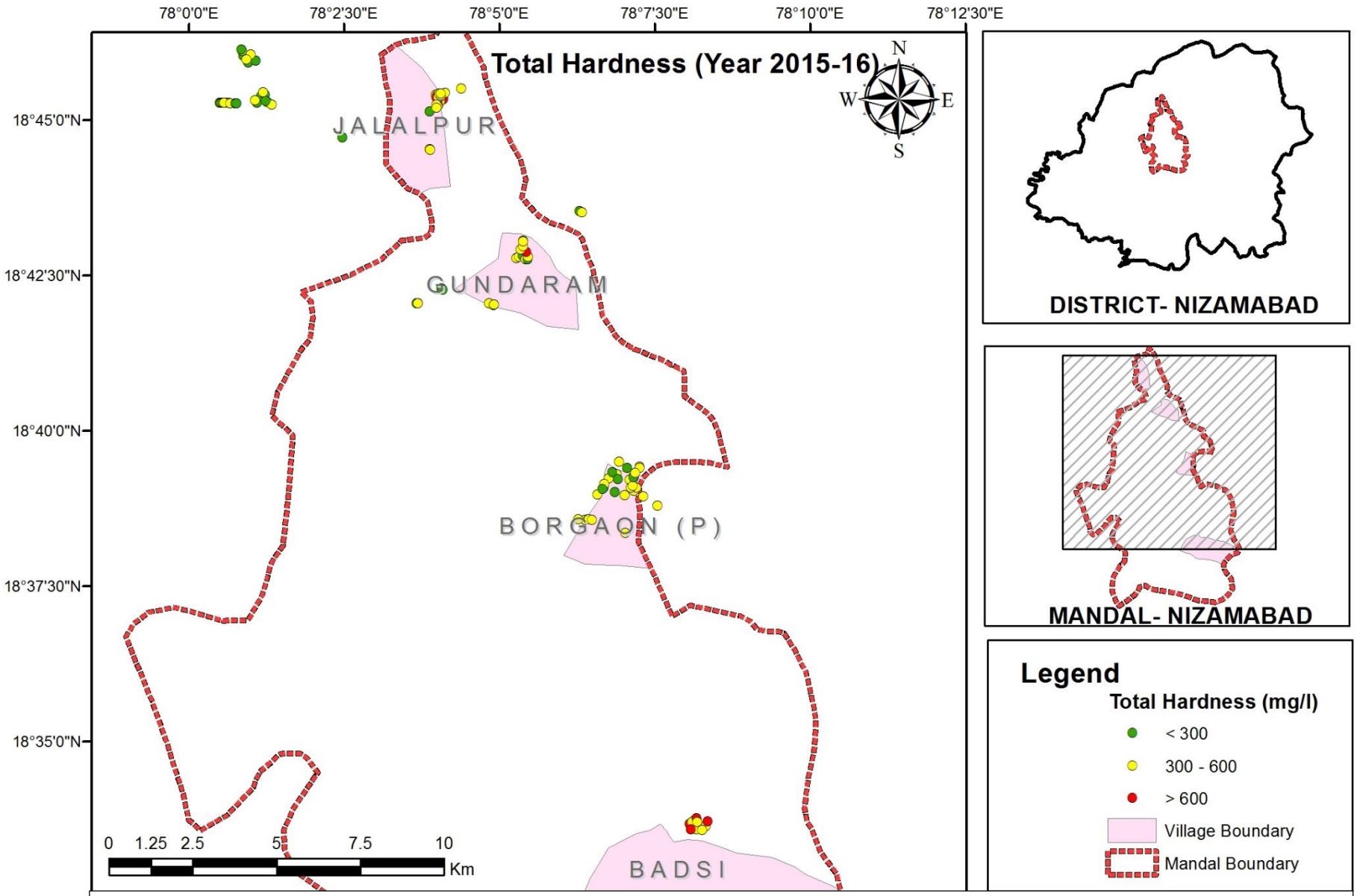
Map 16.2 showing Total Hardness values of Water sources points - Kamareddy Mandal
Note- Maximum source values shows within desirable limit (Green), some values are within maximum permissible limit (Yellow) and 2-3 values shows above permissible limit (Red).



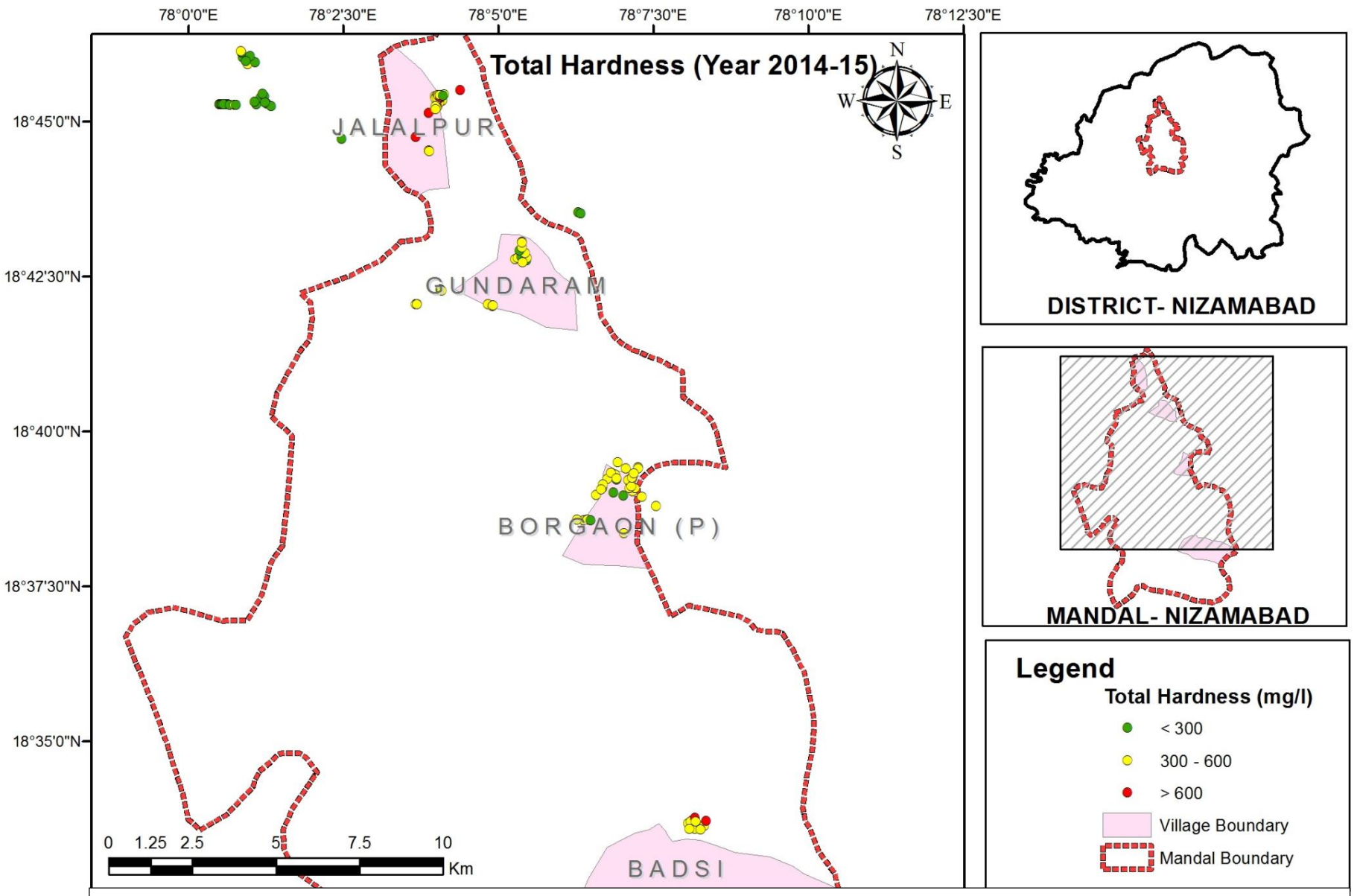
Map 17.1 showing Total Hardness values of Water sources points - Navipet Mandal
Note- maximum given GPS points shows the Total hardness values within the desirable limit (Green). 2-3 values shows above permissible limit (Red), remaining are within the maximum permissible limit (Yellow)



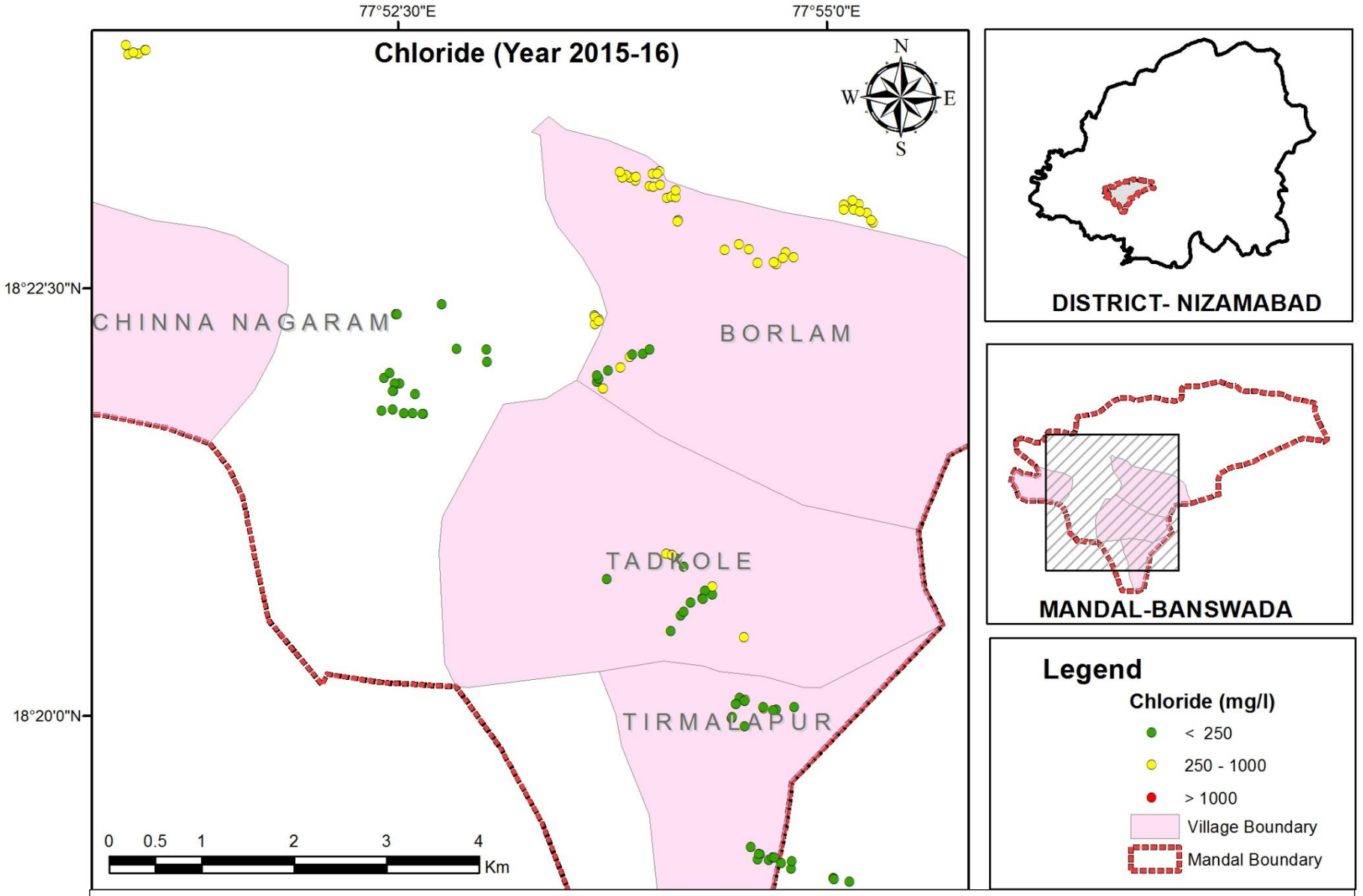
Map 17.2 showing Total Hardness values of Water sources points - Navipet Mandal
Note- Maximum given GPS points shows the Total hardness values within the desirable limit (Green). 4-5 values shows above permissible limit (Red), remaining are within the maximum permissible limit (Yellow)



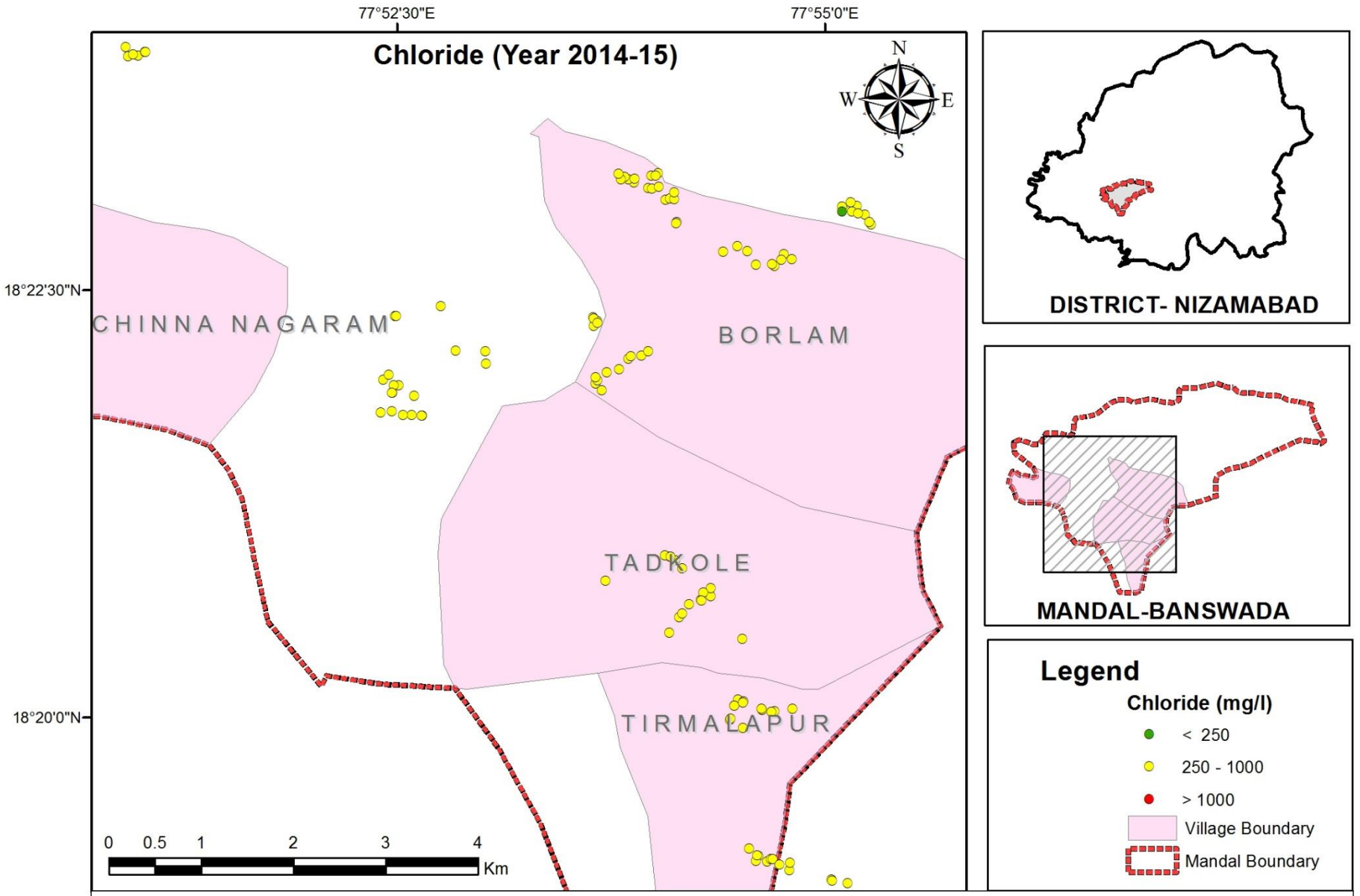
Map 18.1 showing Total Hardness values of Water sources points - Nizamabad Mandal
Note- Few sources in Badsi, Jalalpur and Gundaram showing total hardness values above permissible limit (Red), some values within desirable limit (Green) and some values for the given GPS points showing values within maximum permissible limit (Yellow)



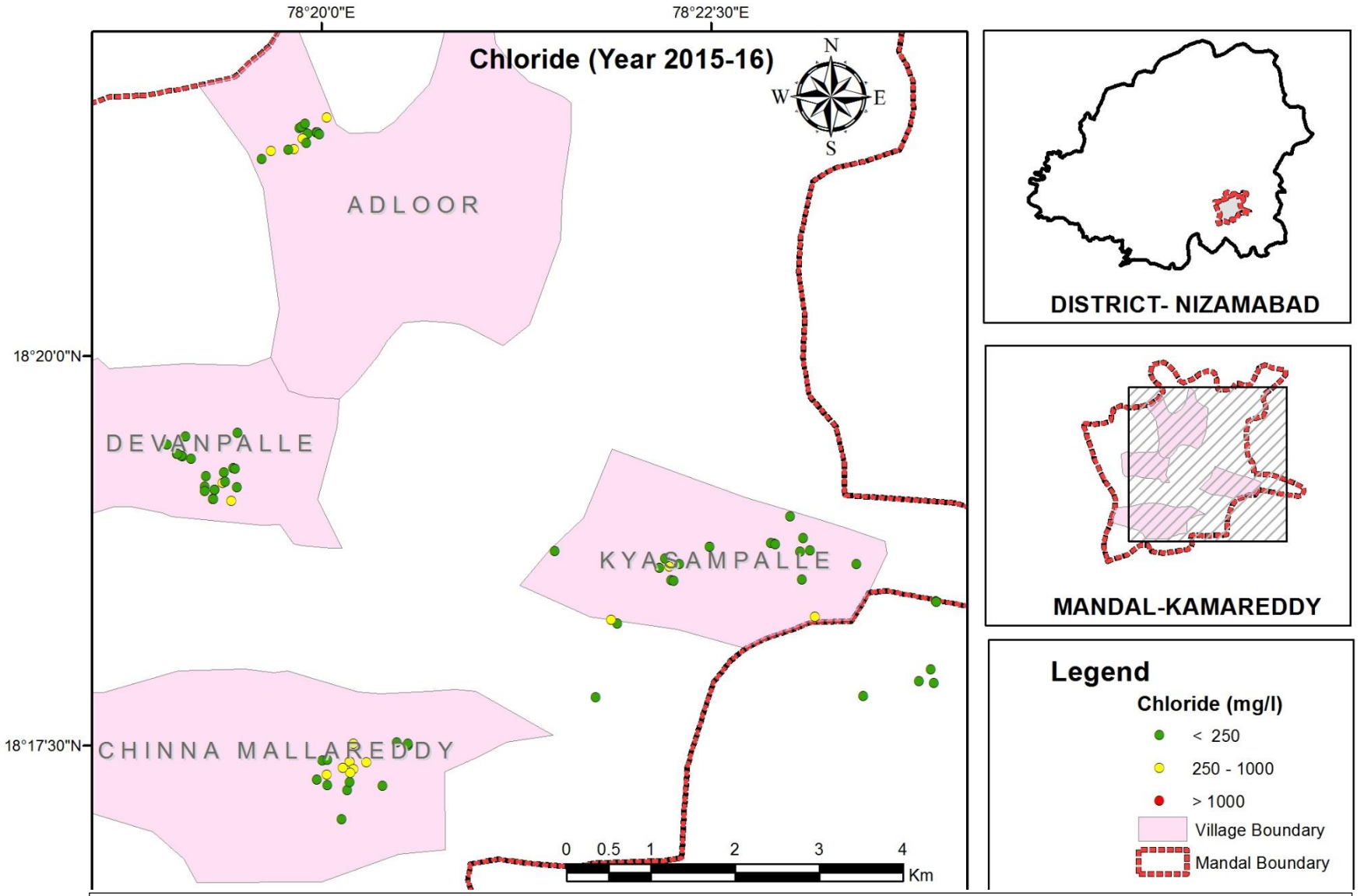
Map 18.2 showing Total Hardness values of Water sources points - Nizamabad Mandal
Note- Few sources in Badsi, Jalalpur showing total hardness values above permissible limit (Red), some values within desirable limit (Green) and some values for the given GPS points showing within maximum permissible limit (Yellow)



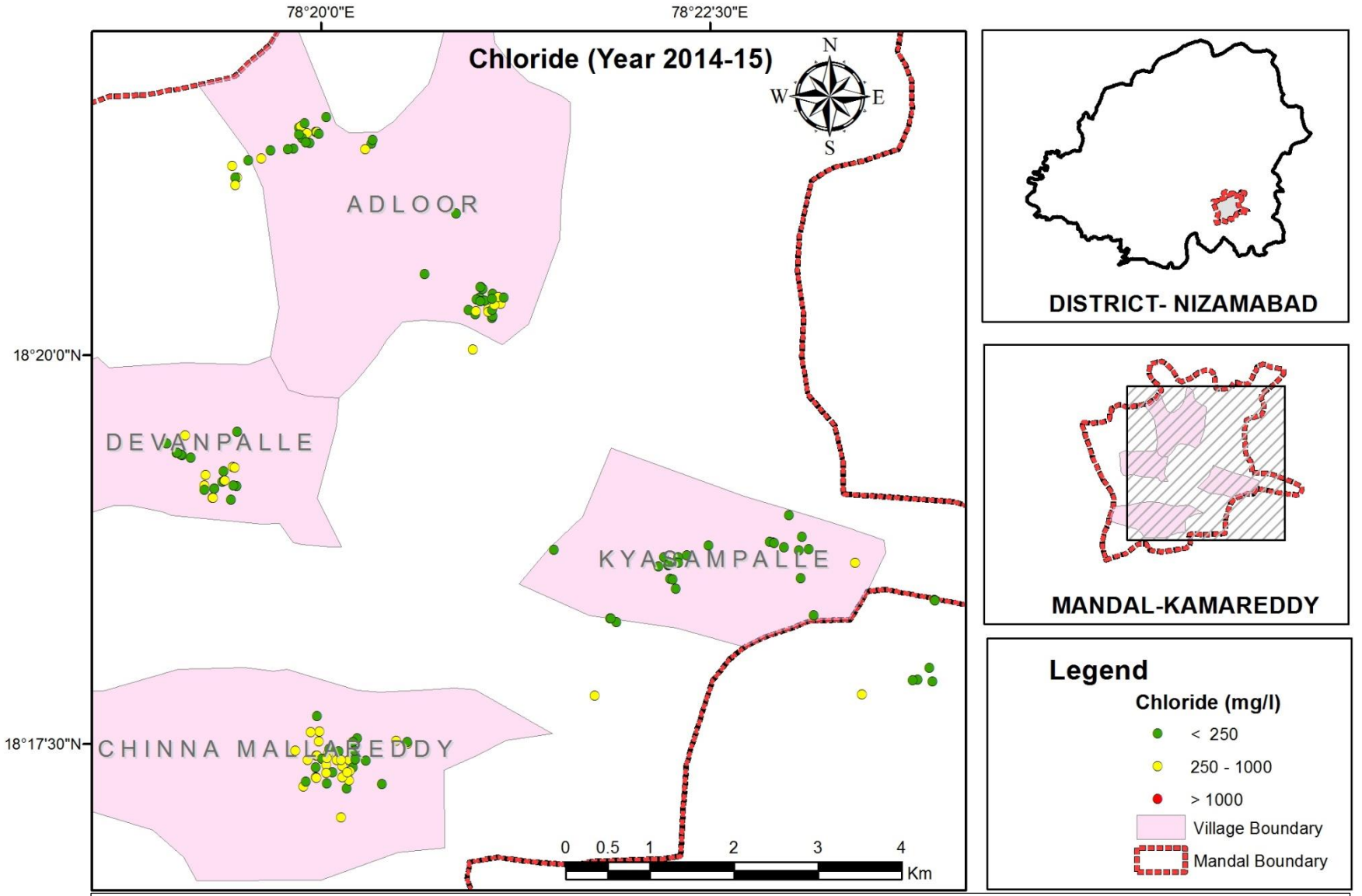
Map 19.1 showing Chloride values of Water sources points - Banswada Mandal
Note- some sources for the given GPS points showing chloride values within maximum permissible limit (Yellow) some showing values less than desirable limit (Green).



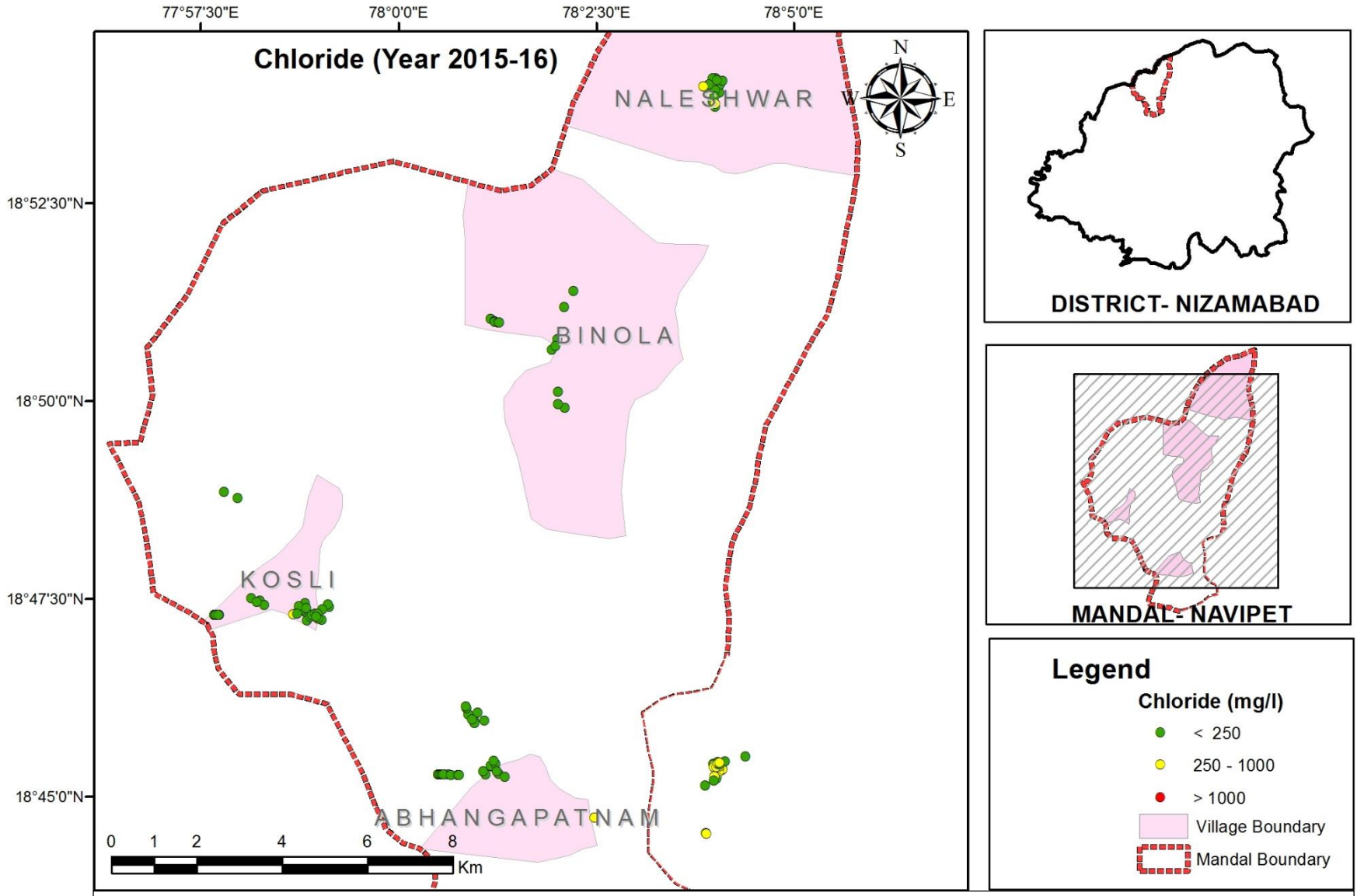
Map 19.2 showing Chloride values of Water sources points - Banswada Mandal
Note- some sources for the given GPS points showing chloride values within maximum permissible limit (Yellow) some showing values within desirable limit (Green).



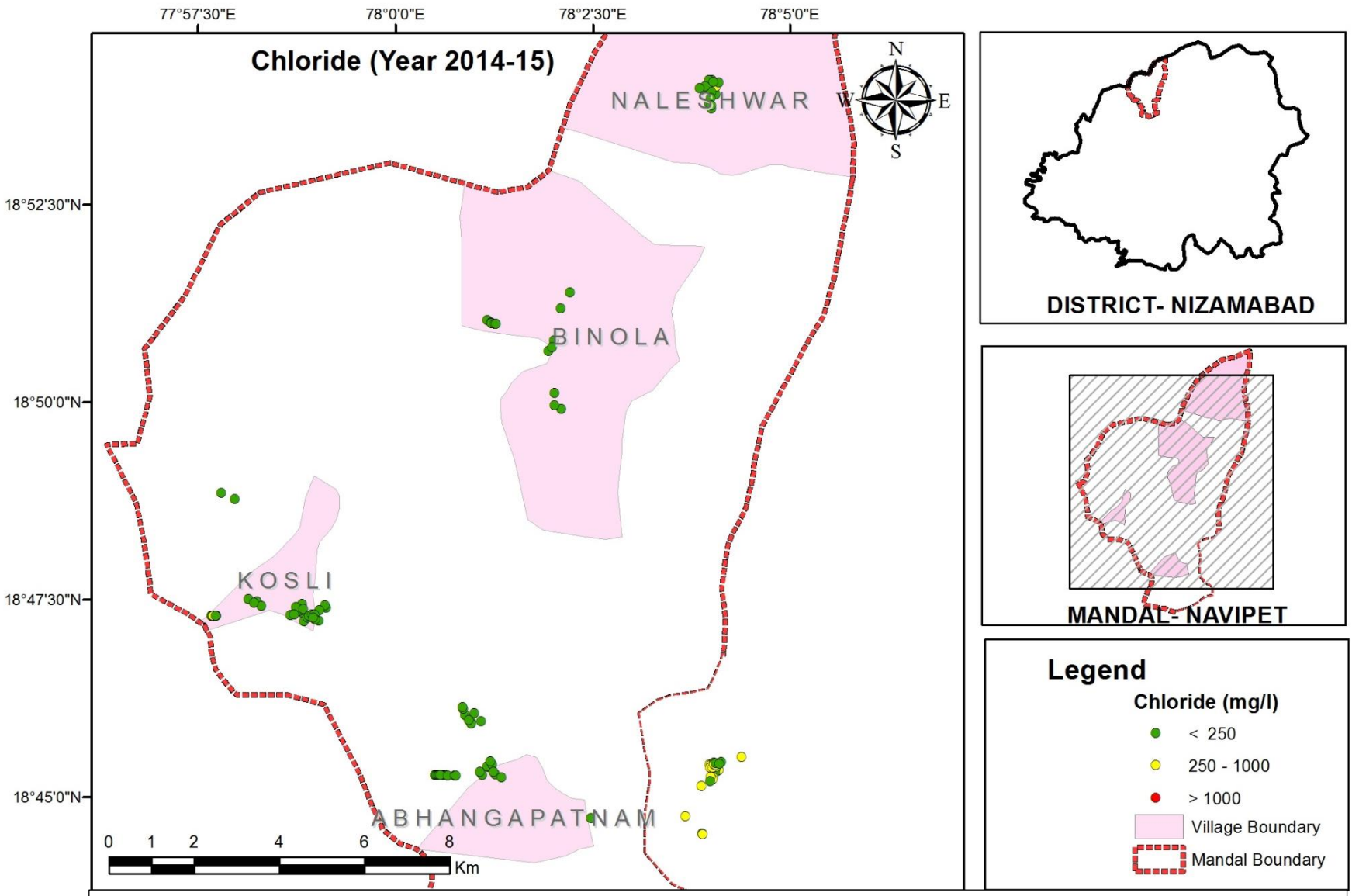
Map 20.1 showing Chloride values of Water sources points - Kamareddy Mandal
Note- A mixed pattern where around 60% values for chloride are within the desirable limit (Green) while rest 40%, mostly in Chinna Mallareddy shows values within maximum permissible limit (Yellow).



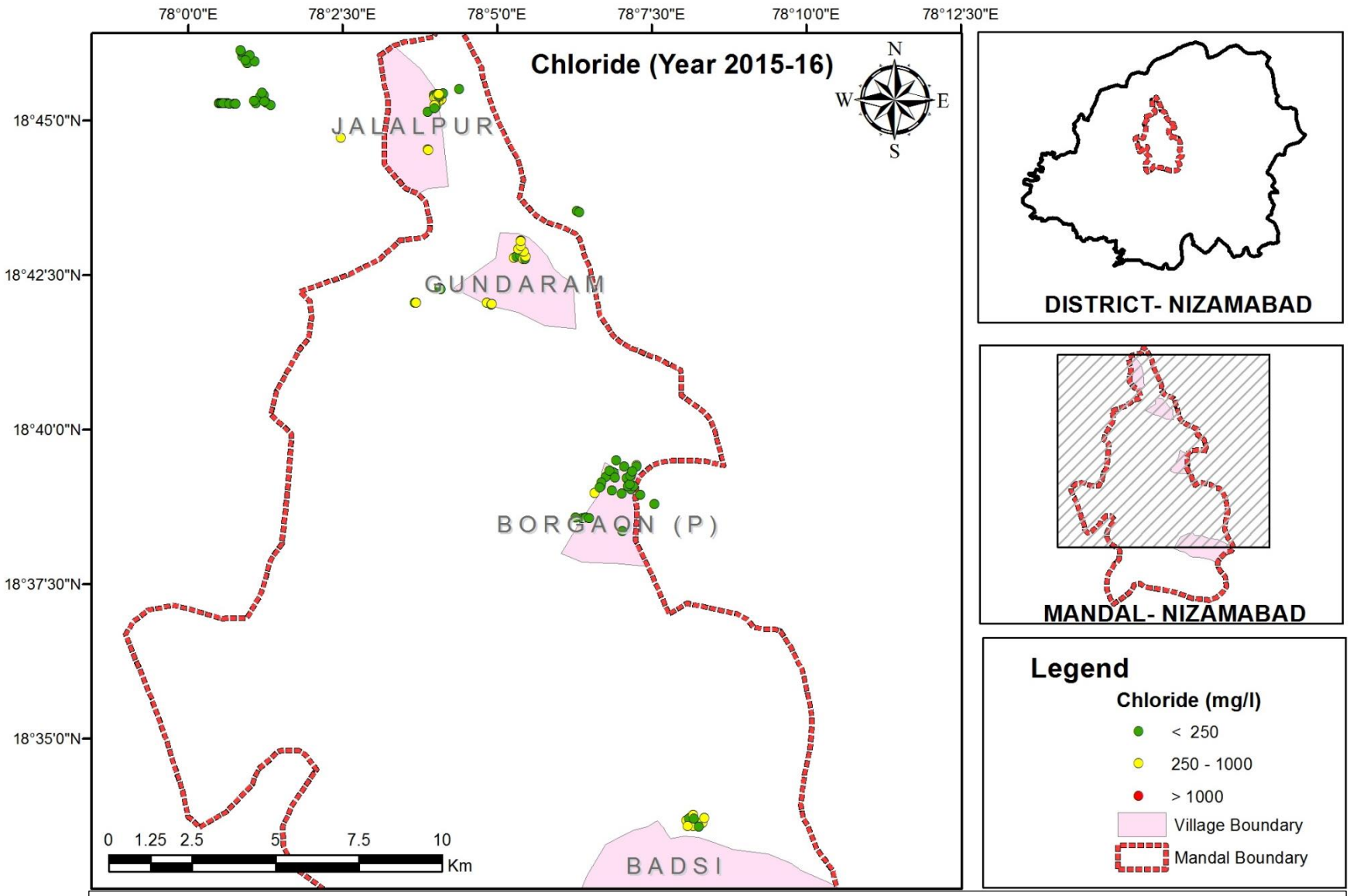
Map 20.2 showing Chloride values of Water sources points - Kamareddy Mandal
Note- A mixed pattern where around 50% values for chloride are within the desirable limit (Green) and other 50% values within maximum permissible limit (Yellow).



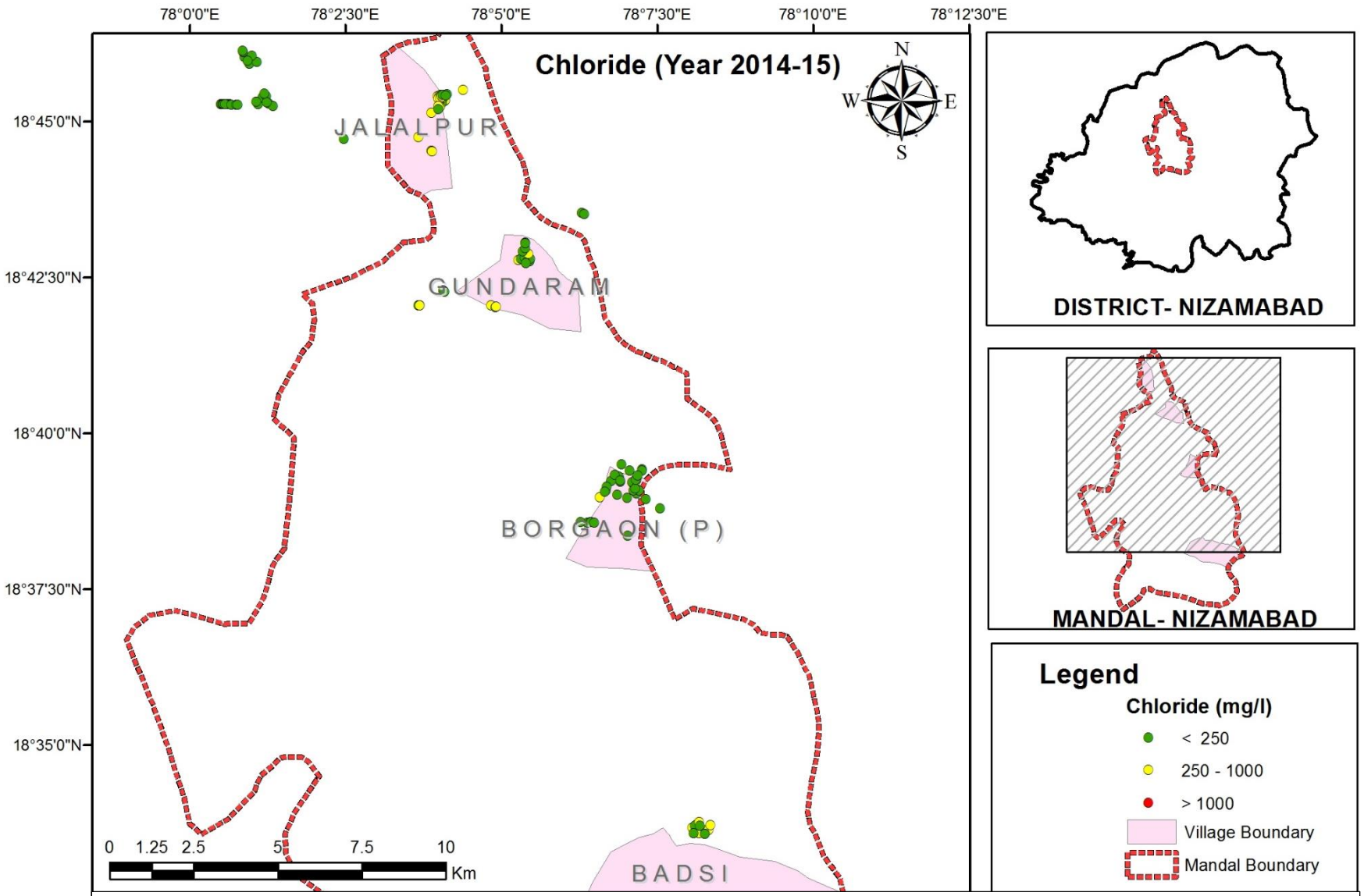
Map 21.1 showing Chloride values of Water sources points - Navipet Mandal
Note - All values for the given GPS points showing chloride within desirable limit (Green), only few of them are in desirable and maximum permissible limit (Yellow)



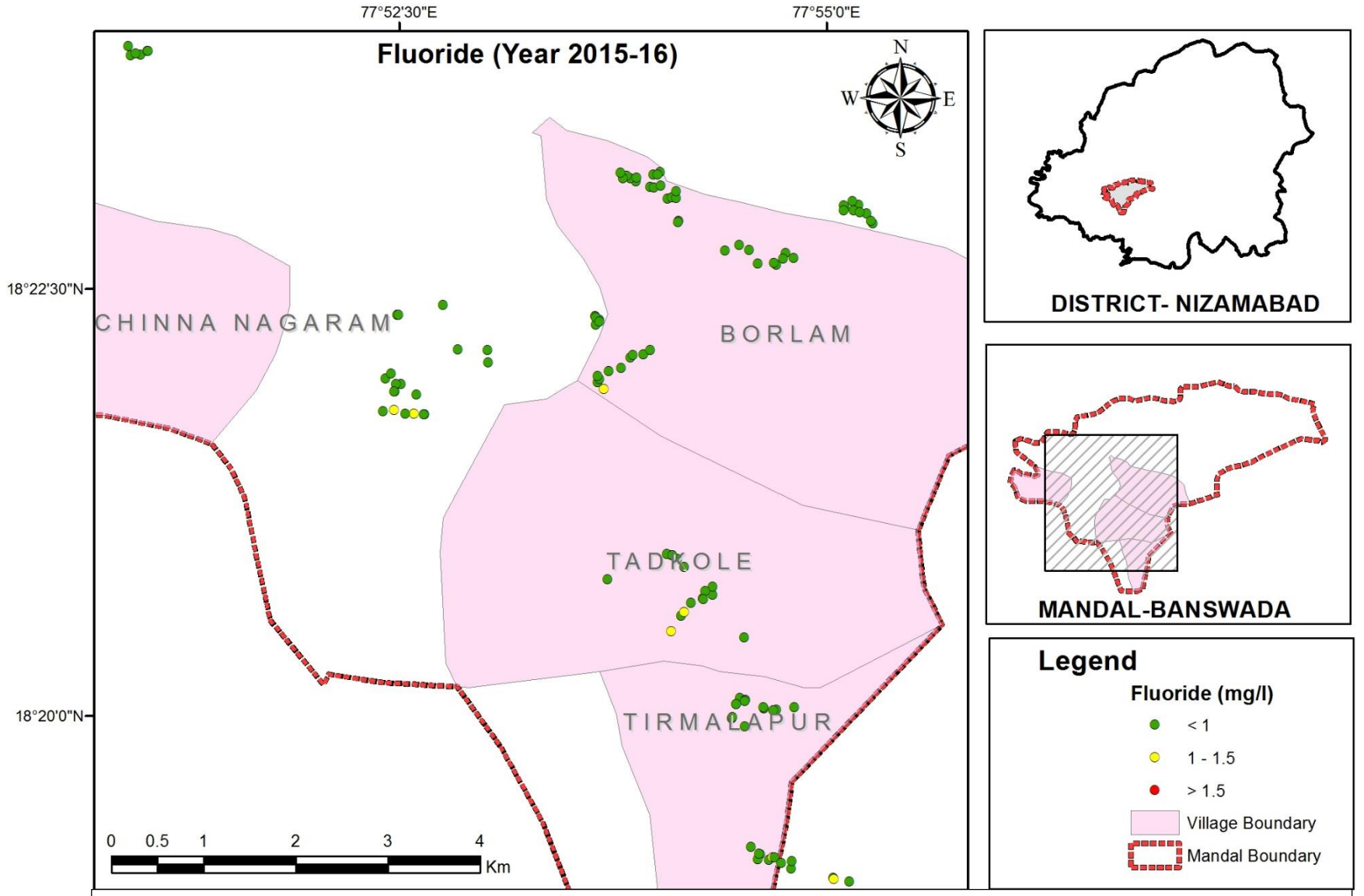
Map 21.2 showing Chloride values of Water sources points - Navipet Mandal
Note - All values for the given GPS points showing chloride within desirable limit (Green).



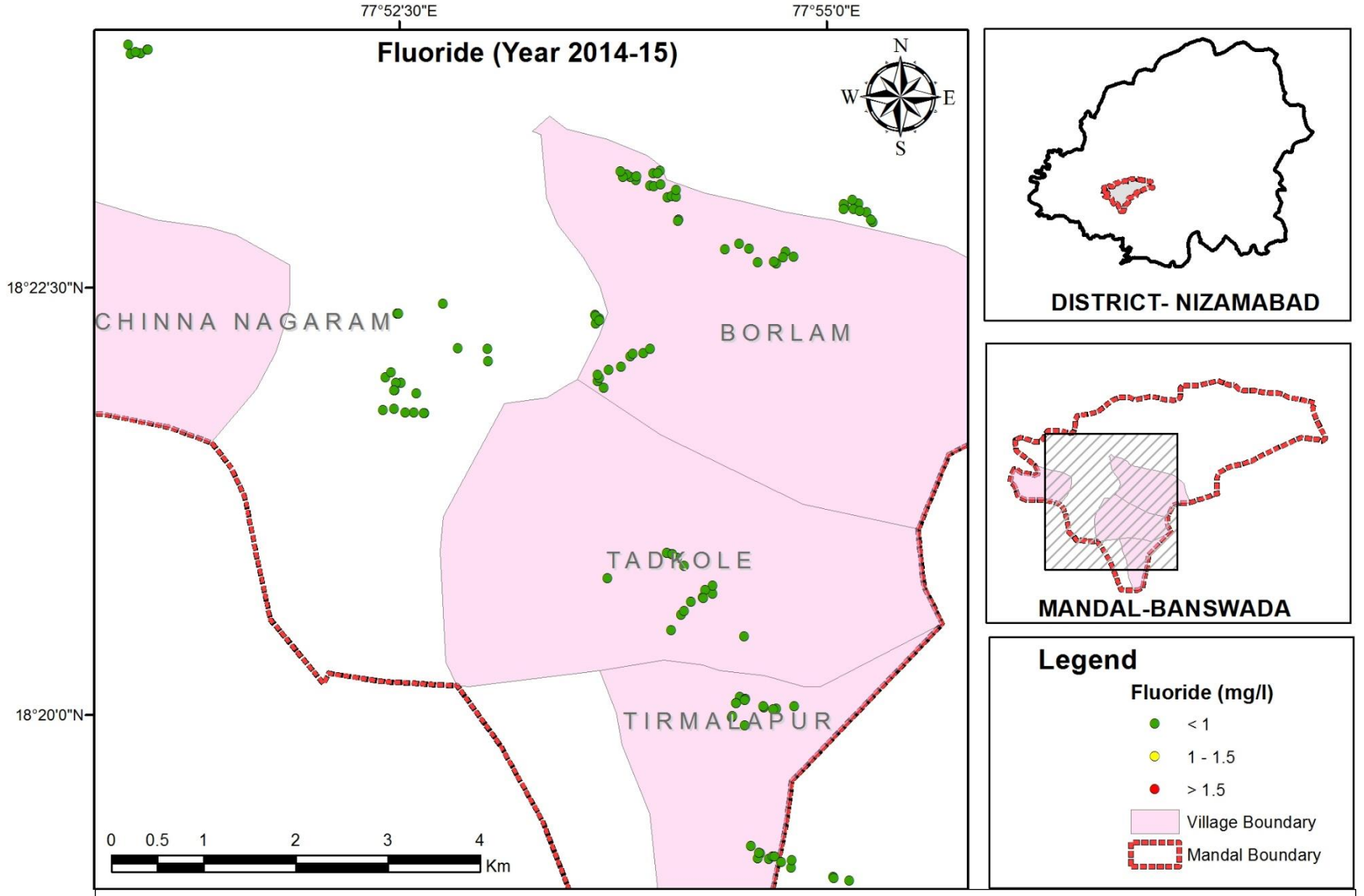
Map 22.1 showing Chloride values of Water sources points - Nizamabad Mandal
Note – For the given GPS points most values for chloride are within the desirable limit (Green) other sources showing chloride values within maximum permissible limit (Yellow).



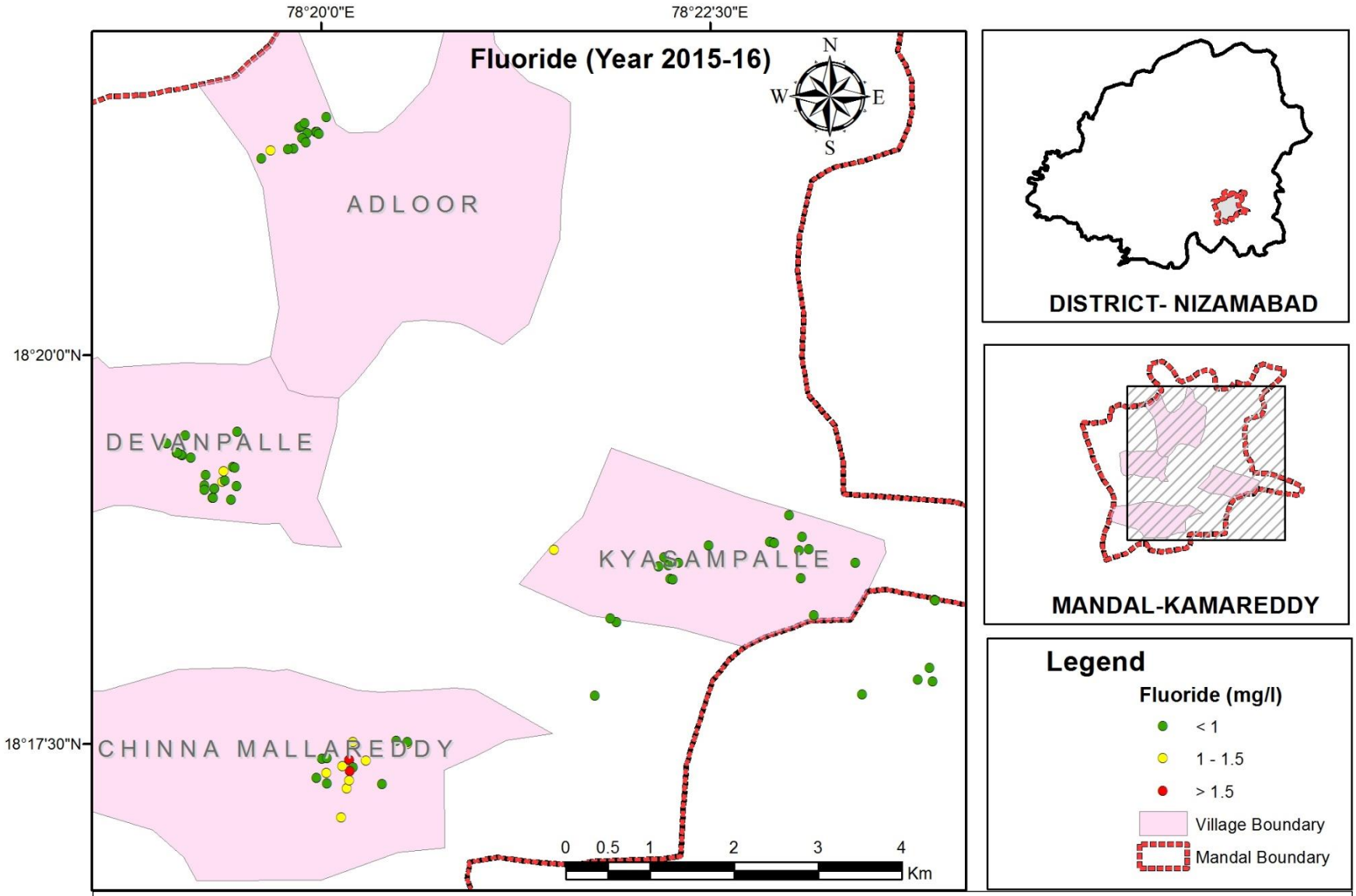
Map 22.2 showing Chloride values of Water sources points - Nizamabad Mandal
Note – For the given GPS points most values for chloride are within the desirable limit (Green) other sources showing chloride values within maximum permissible limit (Yellow).



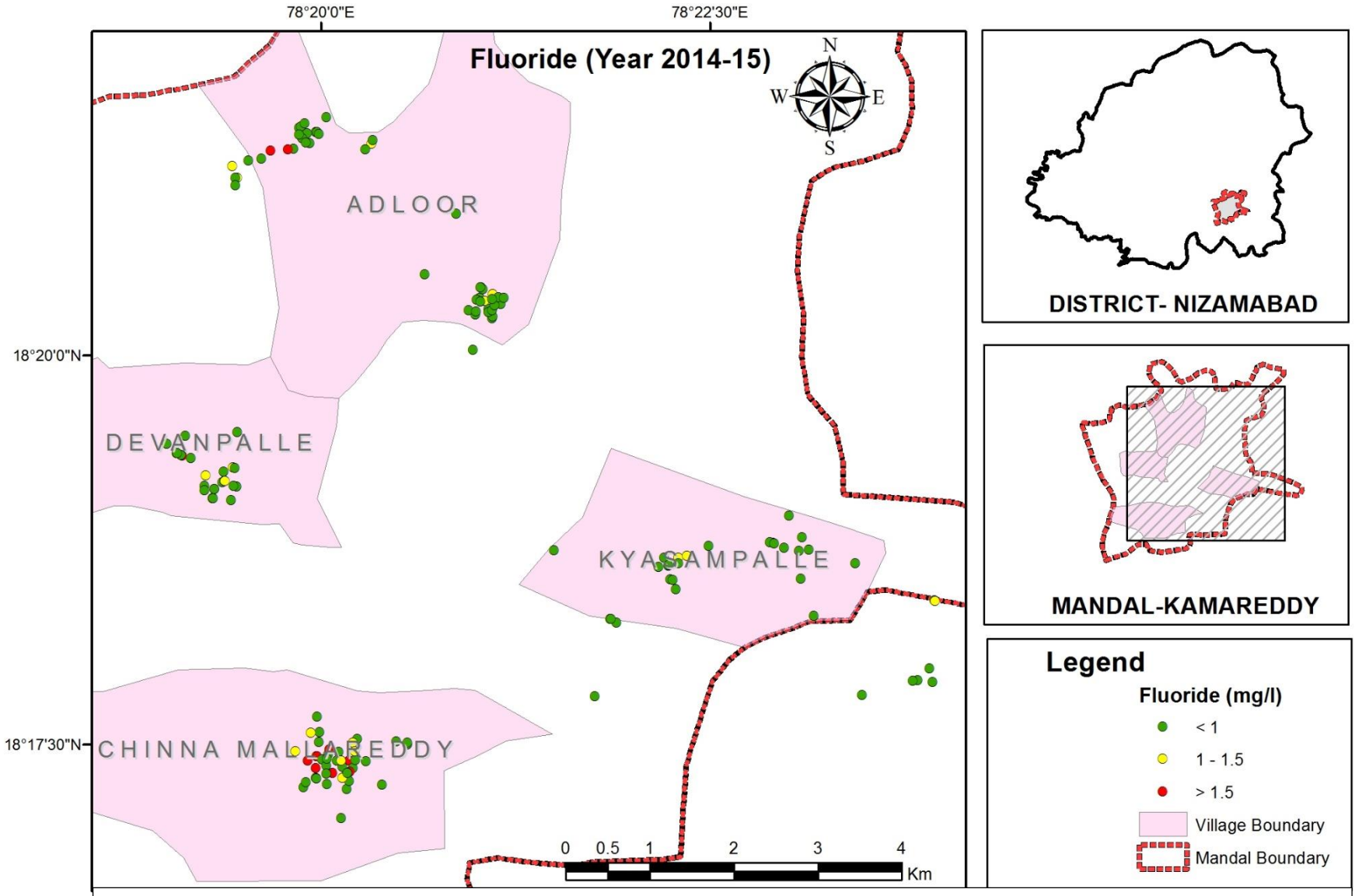
Map 23.1 showing Fluoride values of Water sources points - Banswada Mandal
Note- Most of the values for the given GPS points showing fluoride within desirable limit (Green), few of them are between desirable and maximum permissible limit (Yellow)



Map 23.2 showing Fluoride values of Water sources points - Banswada Mandal
Note- All the values for the given GPS points showing fluoride within desirable limit (Green).

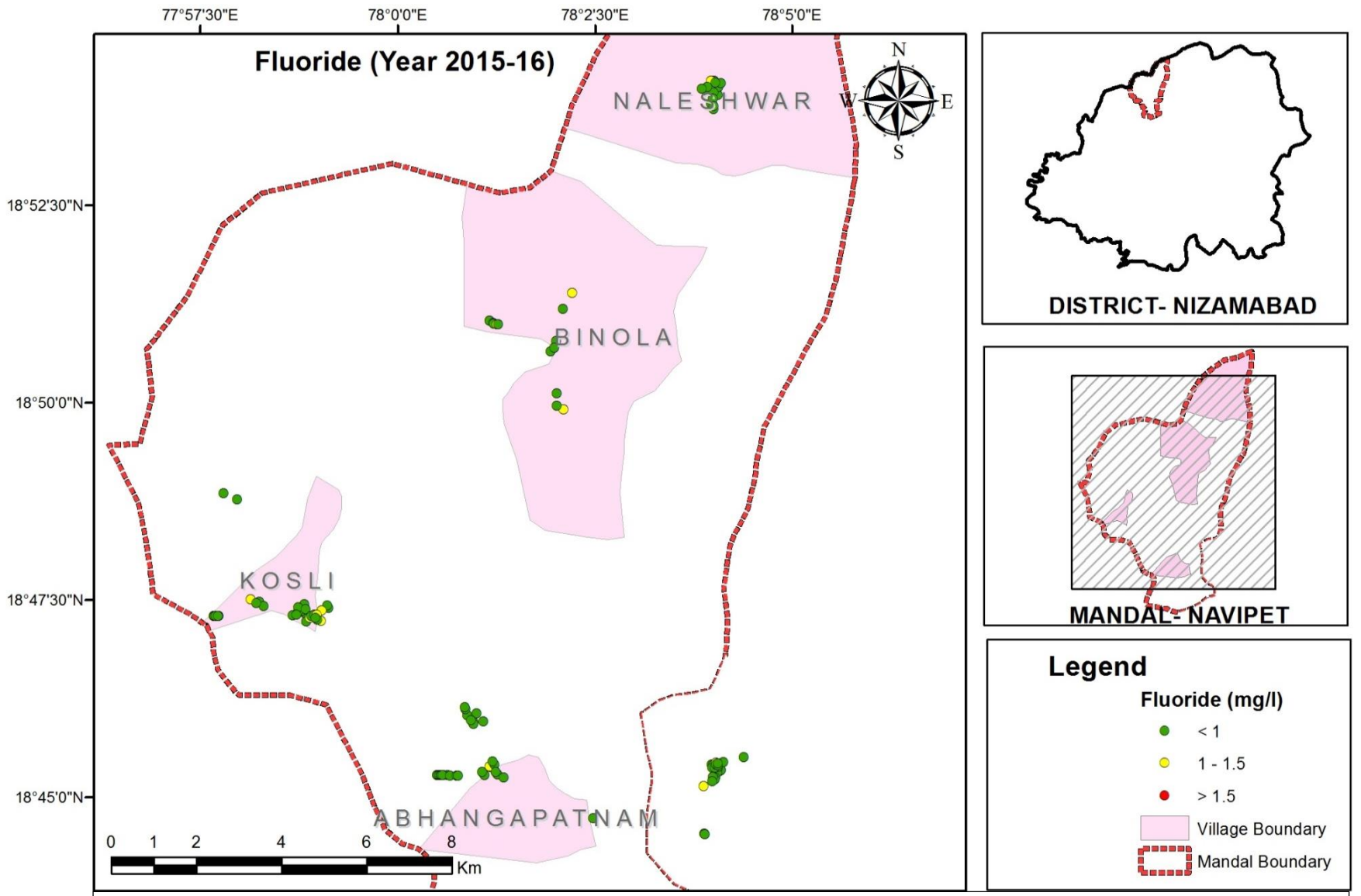


Map 24.1 showing Fluoride values of Water sources points - Kamareddy Mandal
Note- Few noticeable sources in Chinna Mallareddy shows fluoride values above maximum permissible limit (Red), other values are within desirable limit (Green), rest are within maximum permissible limit (Yellow).

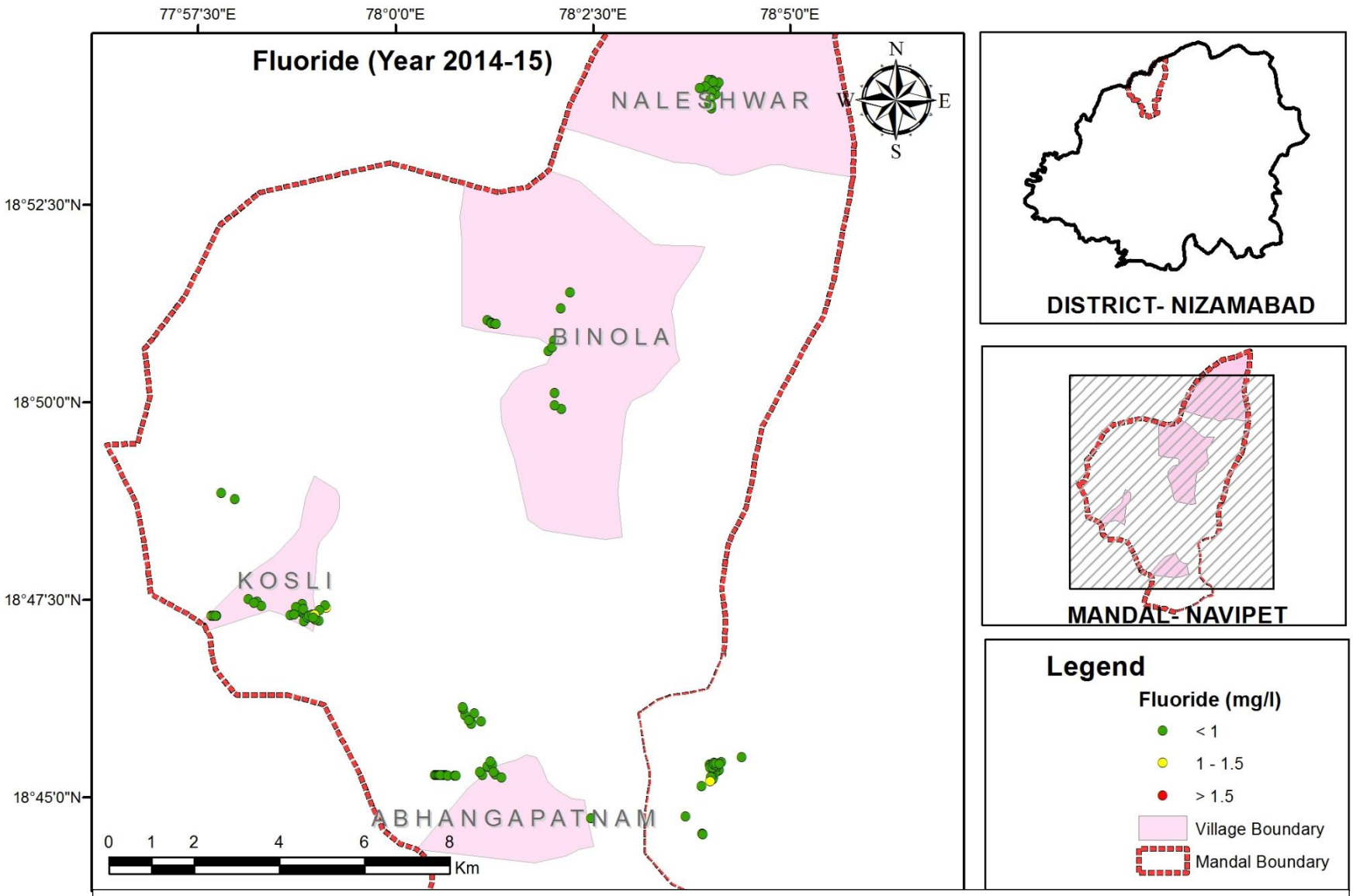


Map 24.2 showing Fluoride values of Water sources points - Kamareddy Mandal

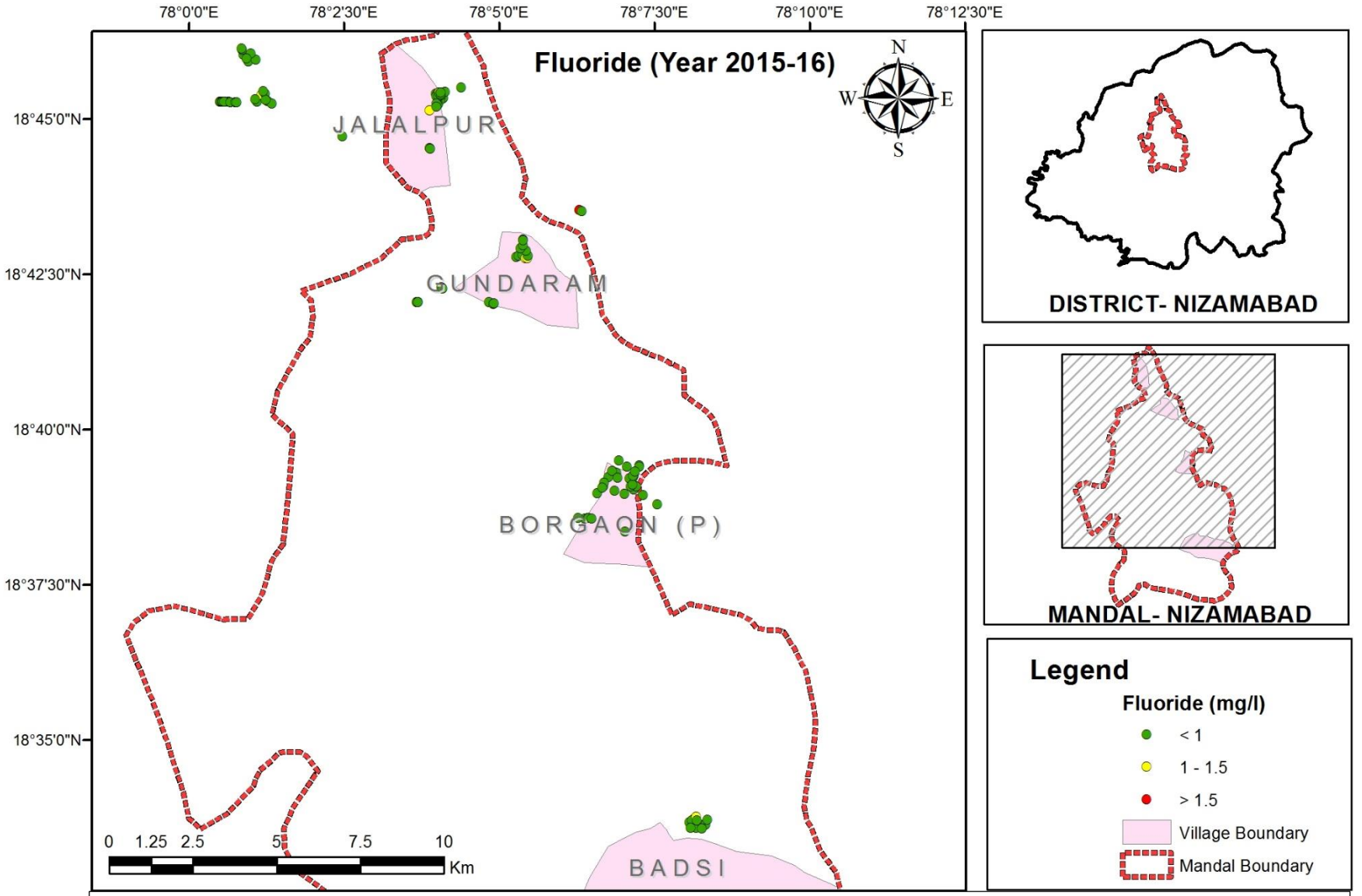
Note- Few noticeable sources in Chinna Mallareddy and adloor shows fluoride values above maximum permissible limit (Red), most of the other values are within desirable limit (Green), few points are within maximum permissible limit (Yellow).



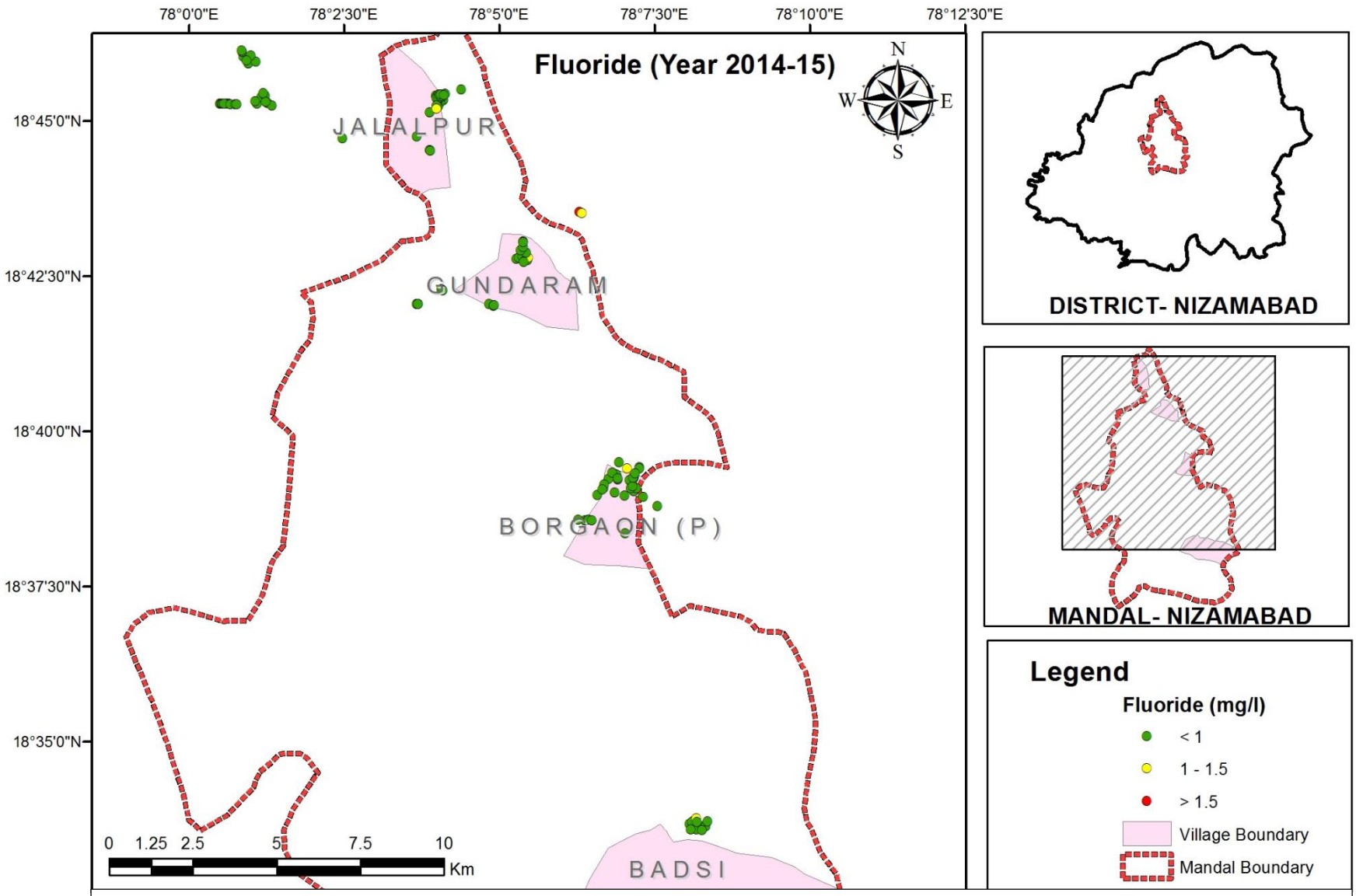
Map 25.1 showing Fluoride values of Water sources points - Navipet Mandal
Note- Most of the values for the given GPS points showing fluoride within desirable limit (Green) except few points near Kosli and Binola are within maximum permissible limit(Yellow).



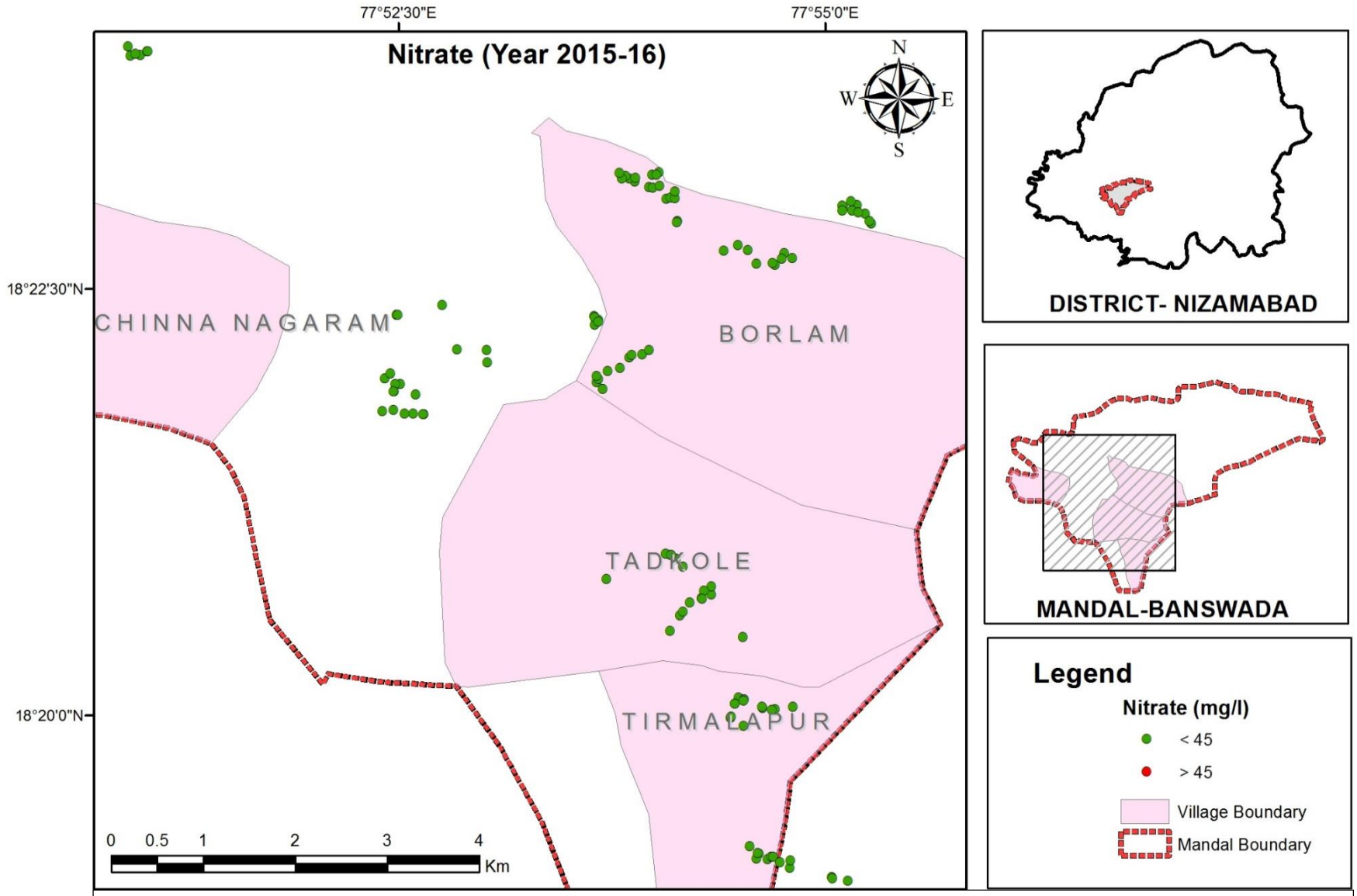
Map 25.2 showing Fluoride values of Water sources points - Navipet Mandal
Note- All the values for the given GPS points showing fluoride within desirable limit (Green) except few points near Kosli is within maximum permissible limit(Yellow).



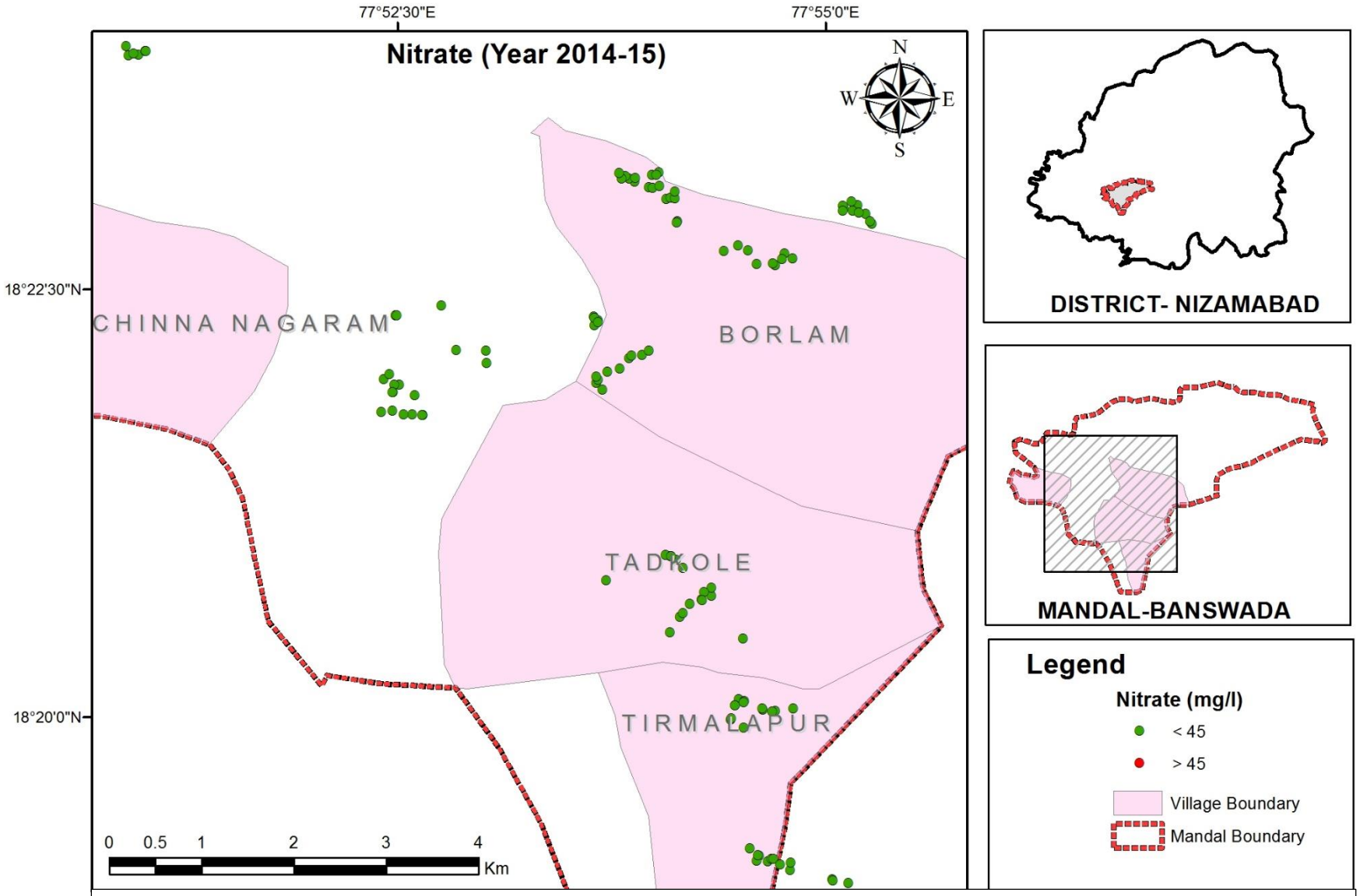
Map 26.1 showing Fluoride values of Water sources points - Nizamabad Mandal
Note- Most sources for given GPS points showing fluoride values under desirable limit (Green), very few within the maximum permissible limit (Yellow).



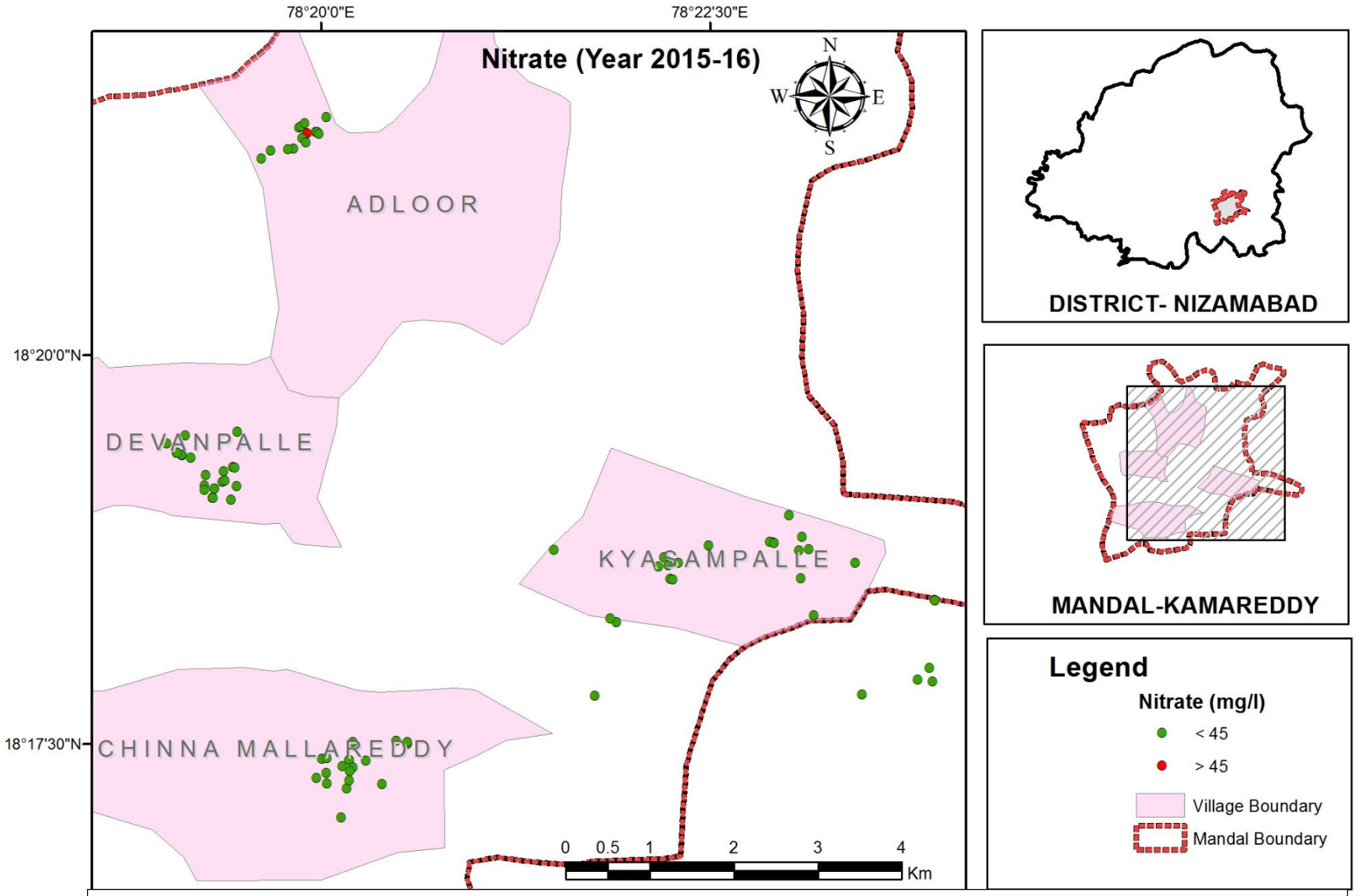
Map 26.2 showing Fluoride values of Water sources points - Nizamabad Mandal
Note- Most sources for given GPS points showing fluoride values under desirable limit (Green), very few within the maximum permissible limit (Yellow).



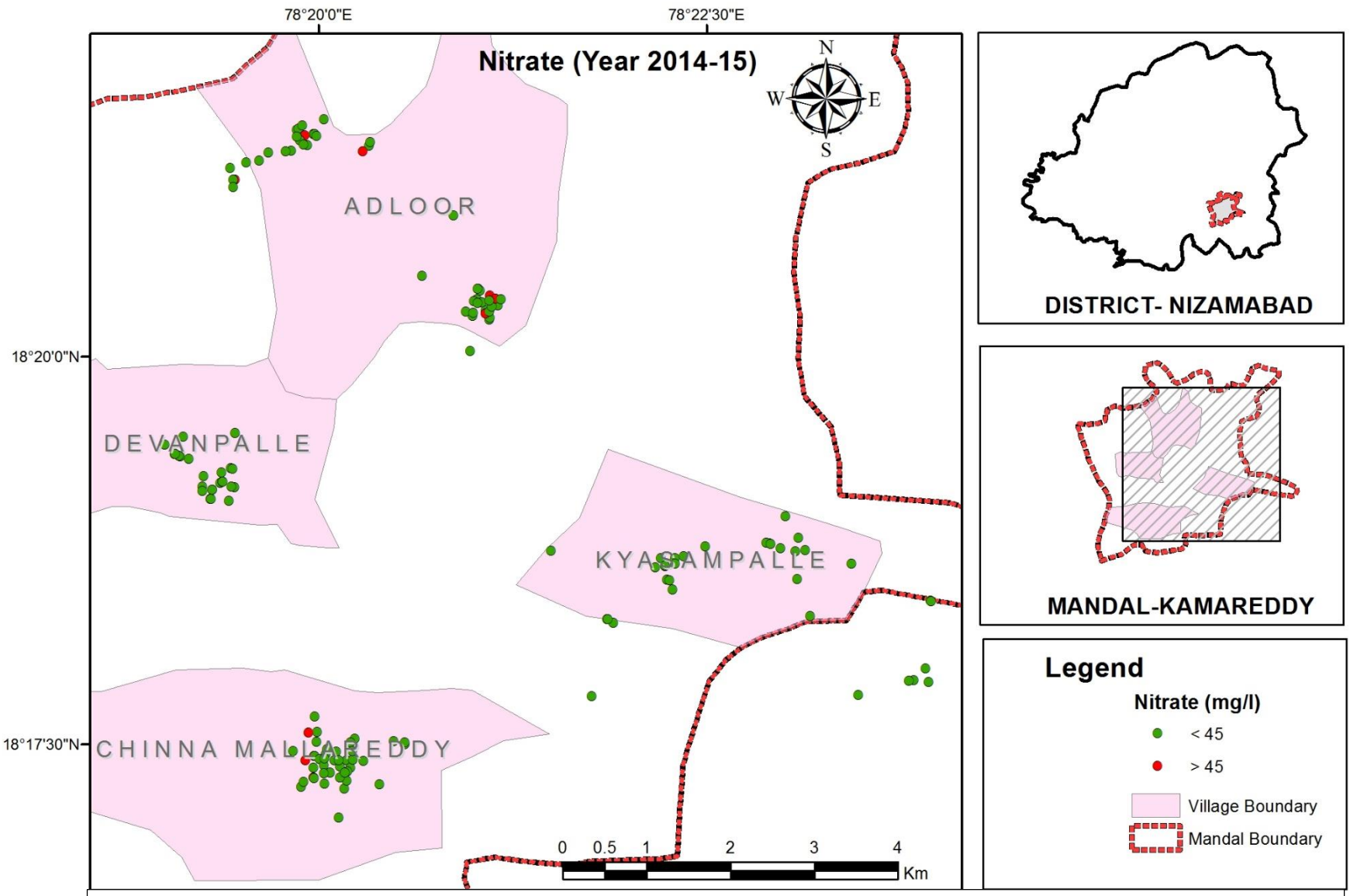
Map 27.1 showing Nitrate values of Water sources points - Banswada Mandal
Note - All values for the given GPS points showing Nitrate within desirable limit (Green).



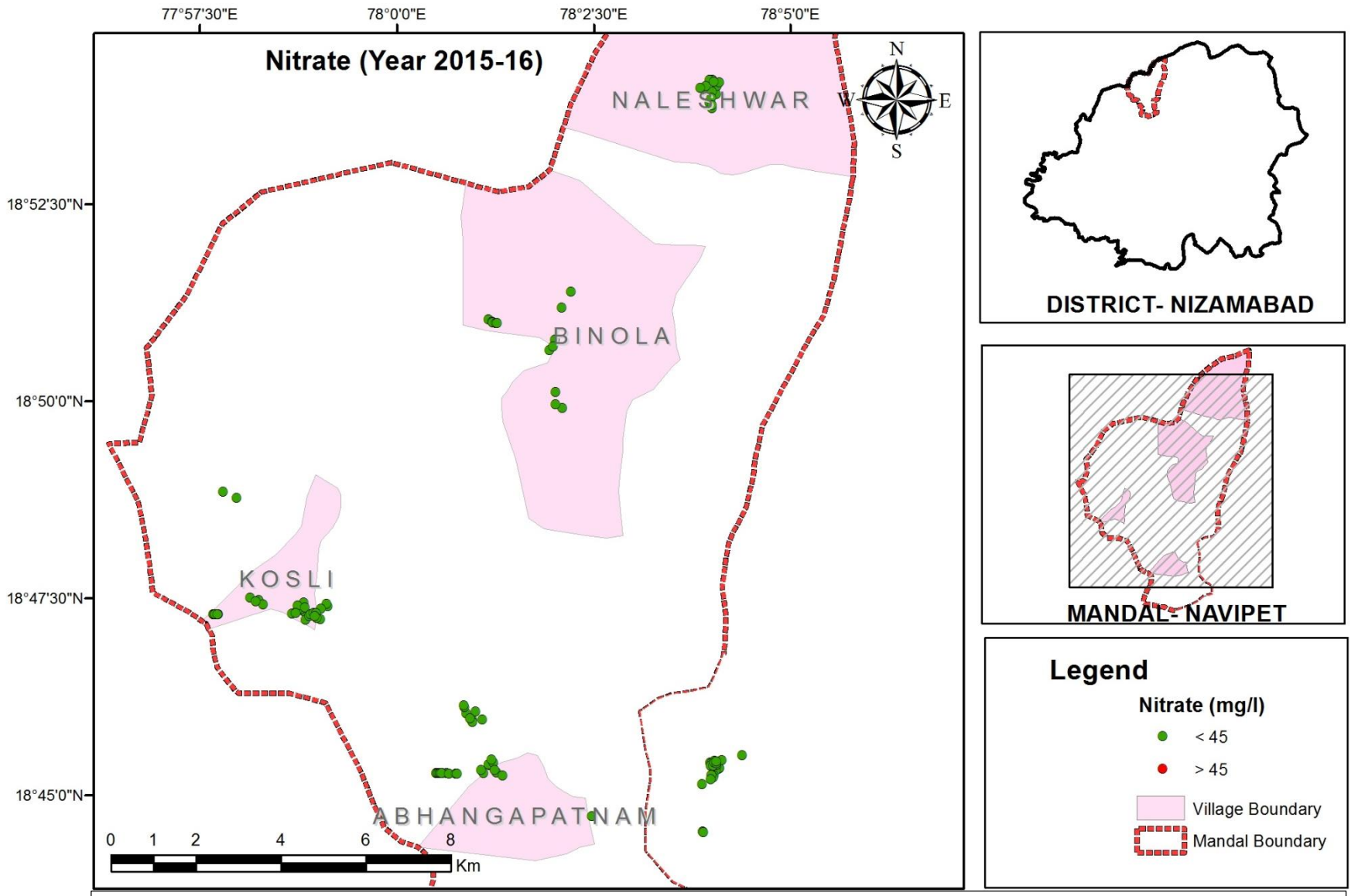
Map 27.2 showing Nitrate values of Water sources points - Banswada Mandal
Note - All values for the given GPS points showing Nitrate within desirable limit (Green).



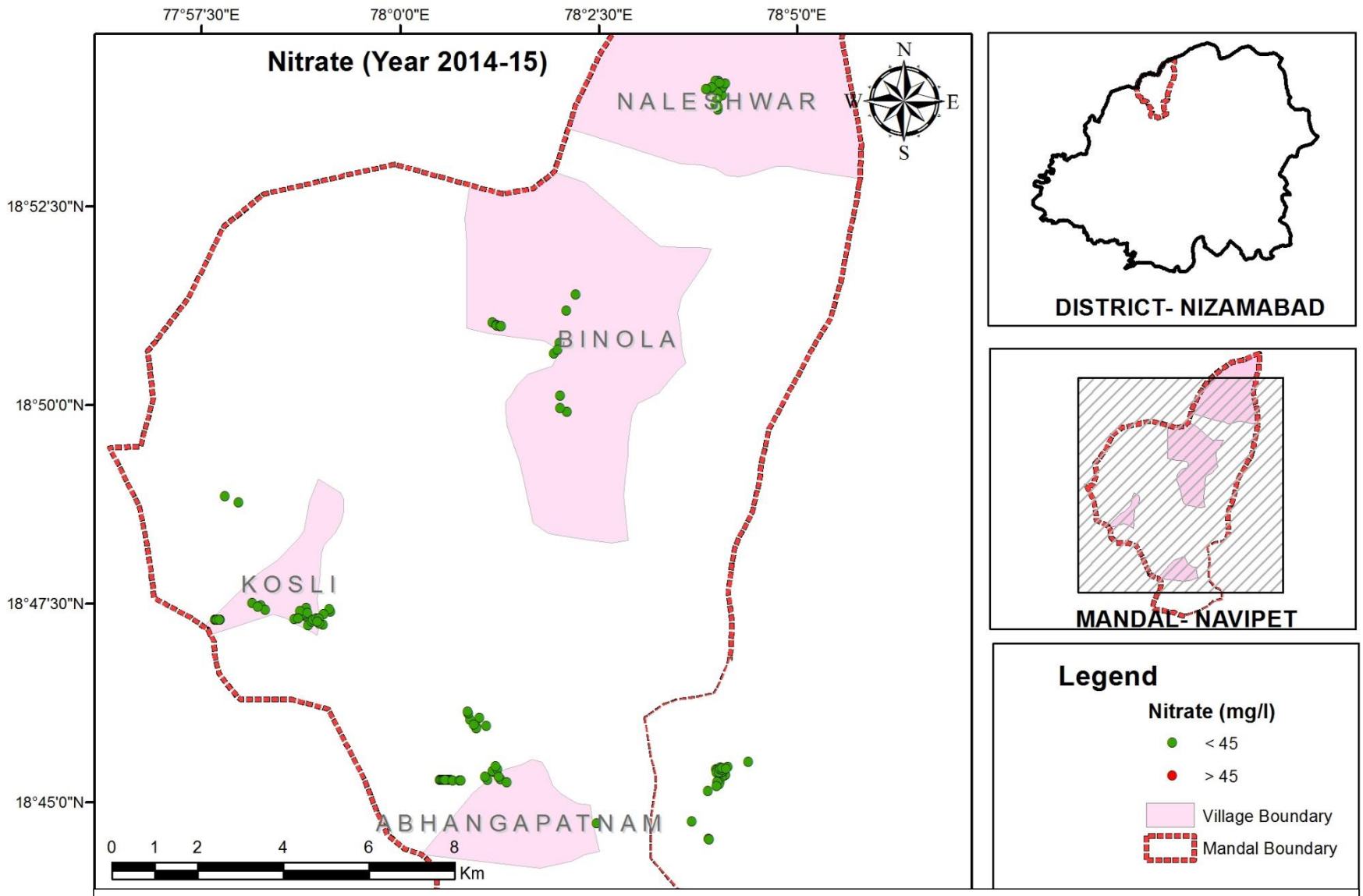
Map 28.1 showing Nitrate values of Water sources points - Kamareddy Mandal
Note – Most values for the given GPS points showing Nitrate within desirable limit (Green). Few of them are above permissible limit (Red).



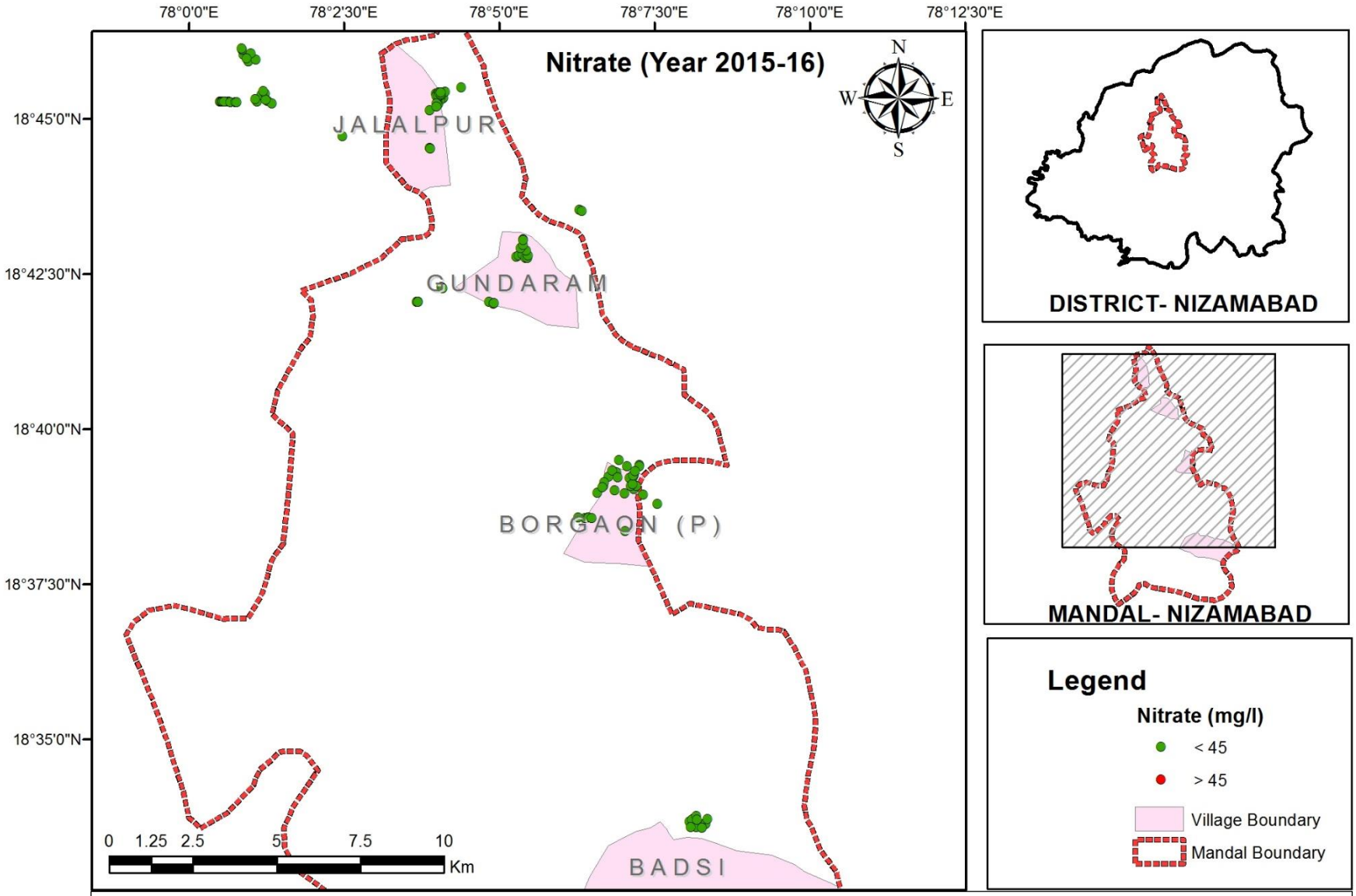
Map 28.2 showing Nitrate values of Water sources points - Kamareddy Mandal
Note – Most values for the given GPS points showing Nitrate within desirable limit (Green). Some of them in Adloor and Chinna mallareddy are above permissible limit (Red).



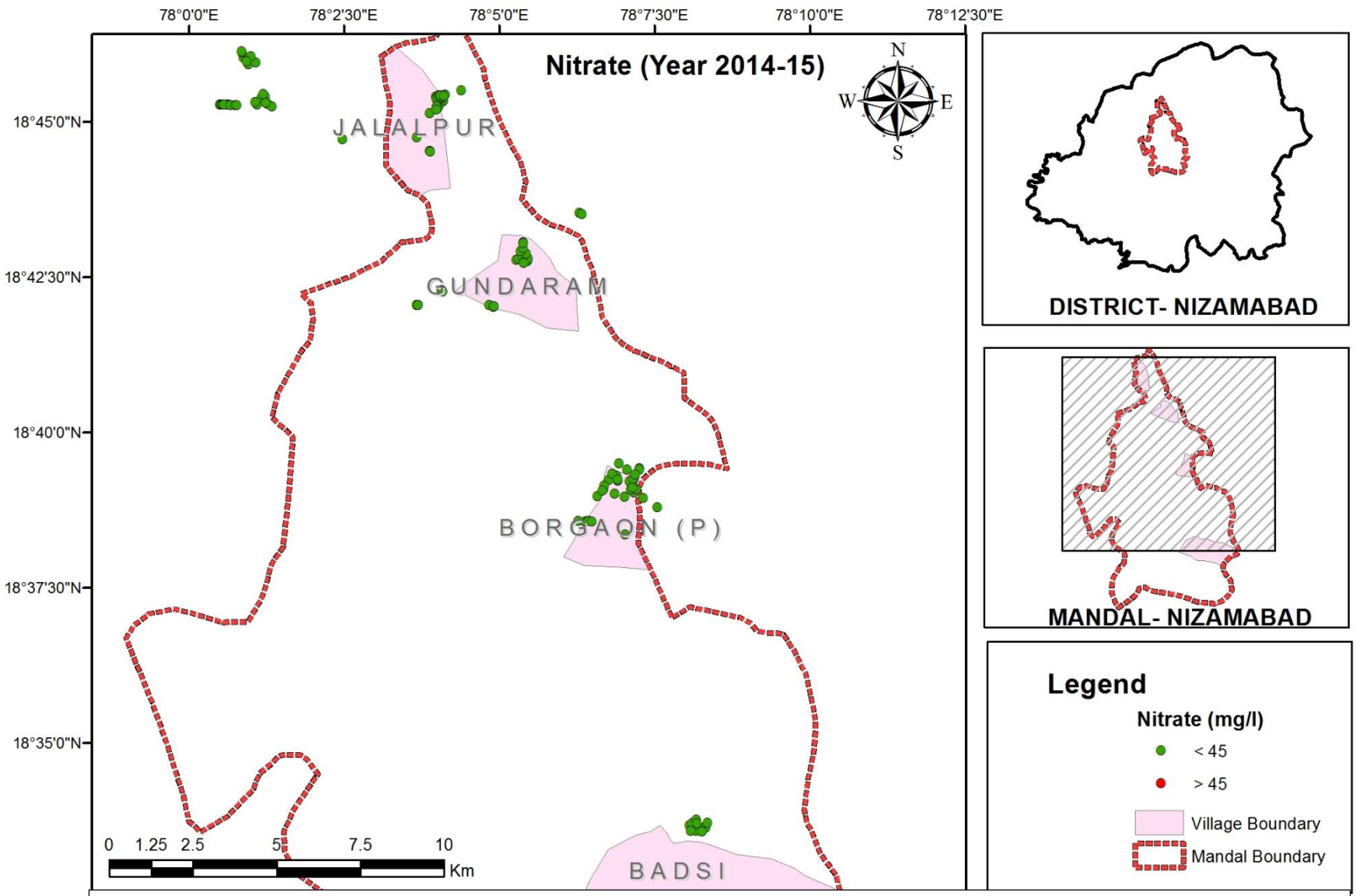
Map 29.1 showing Nitrate values of Water sources points - Nizamabad Mandal
Note – Most values for the given GPS points showing Nitrate within desirable limit (Green).



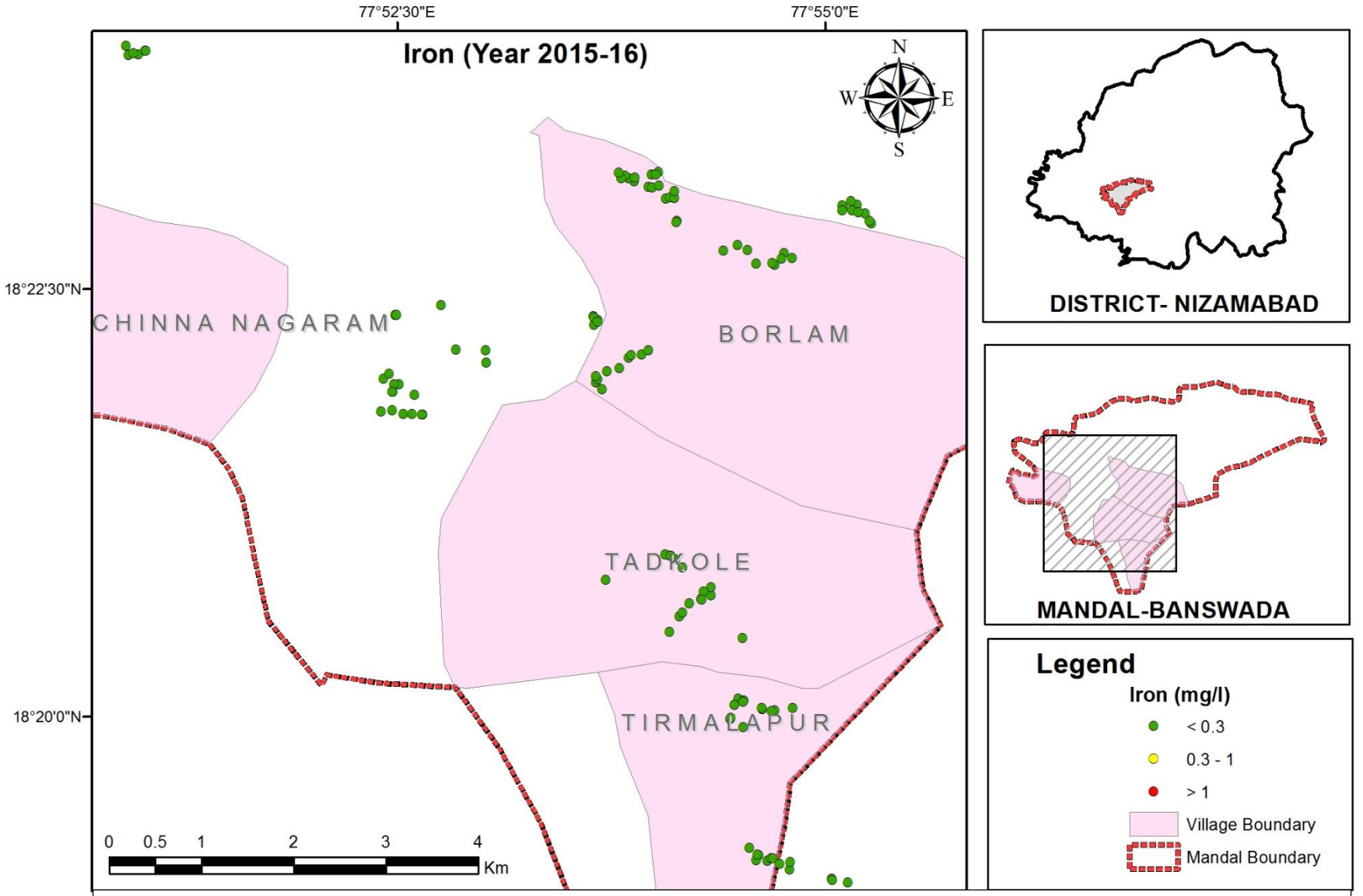
Map 29.2 showing Nitrate values of Water sources points - Nizamabad Mandal
Note – Most values for the given GPS points showing Nitrate within desirable limit (Green).



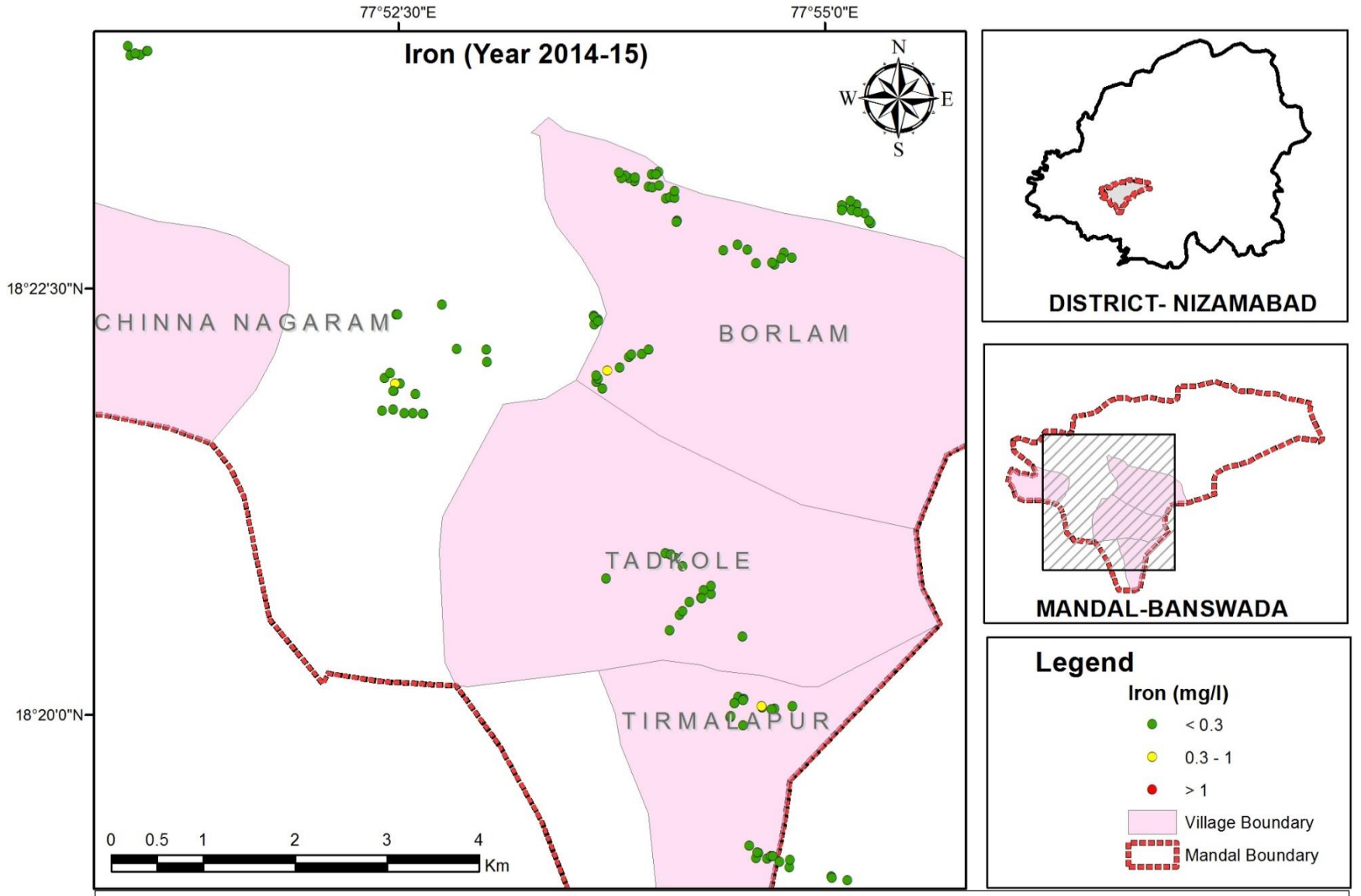
Map 30.1 showing Nitrate values of Water sources points - Nizamabad Mandal
Note – All values for the given GPS points showing Nitrate within desirable limit (Green).



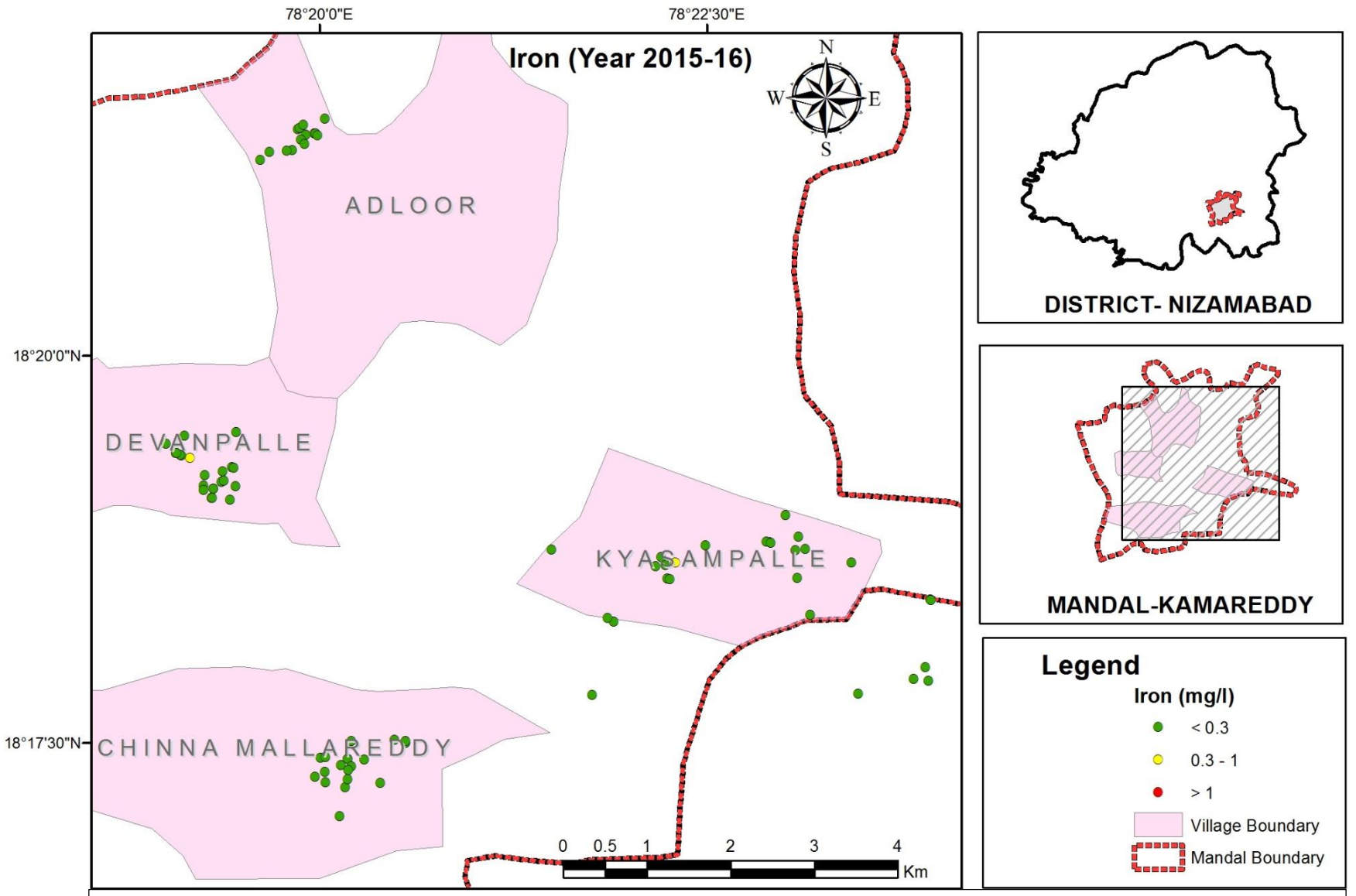
Map 30.2 showing Nitrate values of Water sources points - Nizamabad Mandal
Note – All values for the given GPS points showing Nitrate within desirable limit (Green).



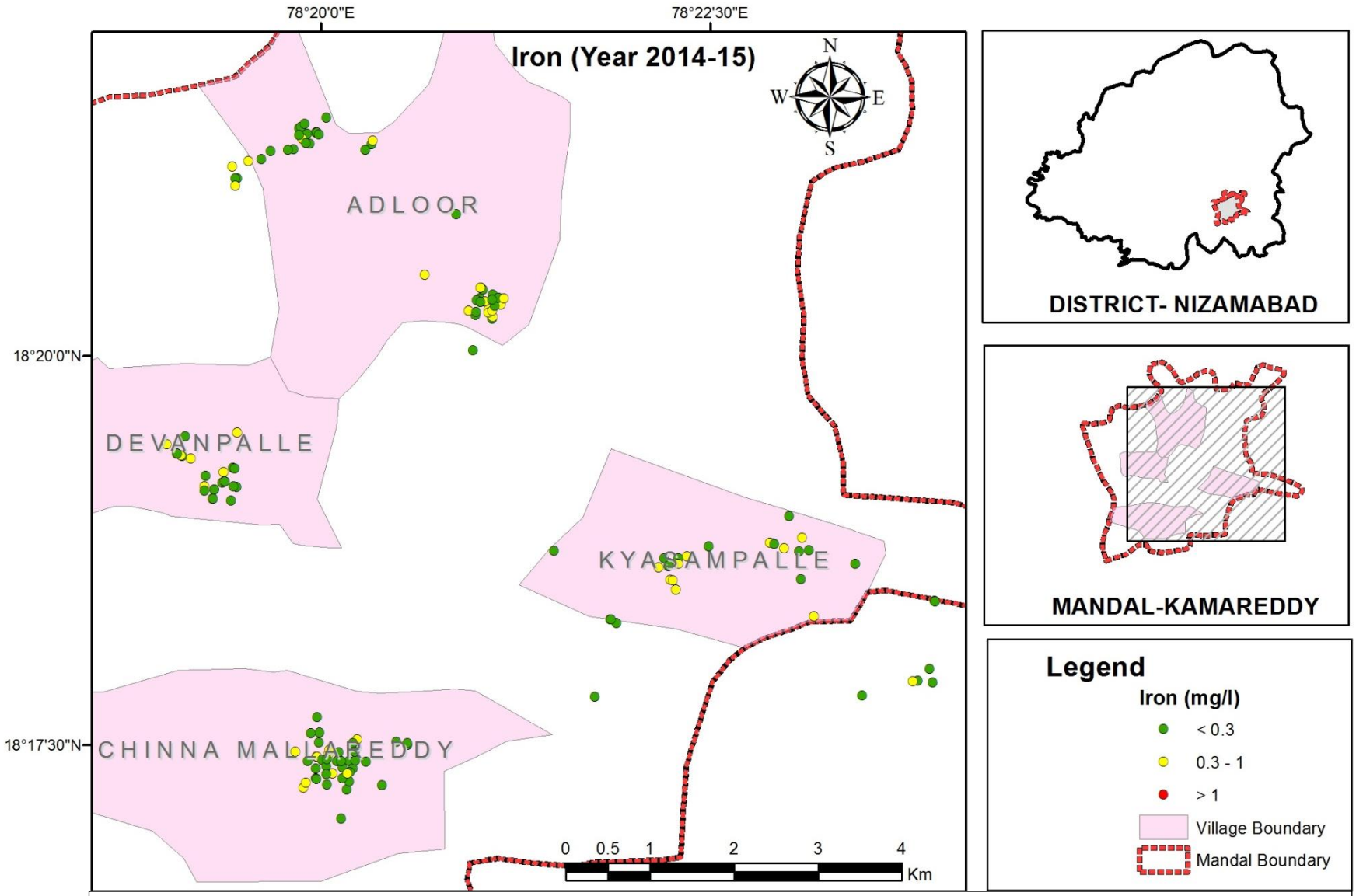
Map 31.1 showing Iron values of Water sources points - Banswada Mandal
Note – All the values for the given GPS points showing Iron within desirable limit (Green).



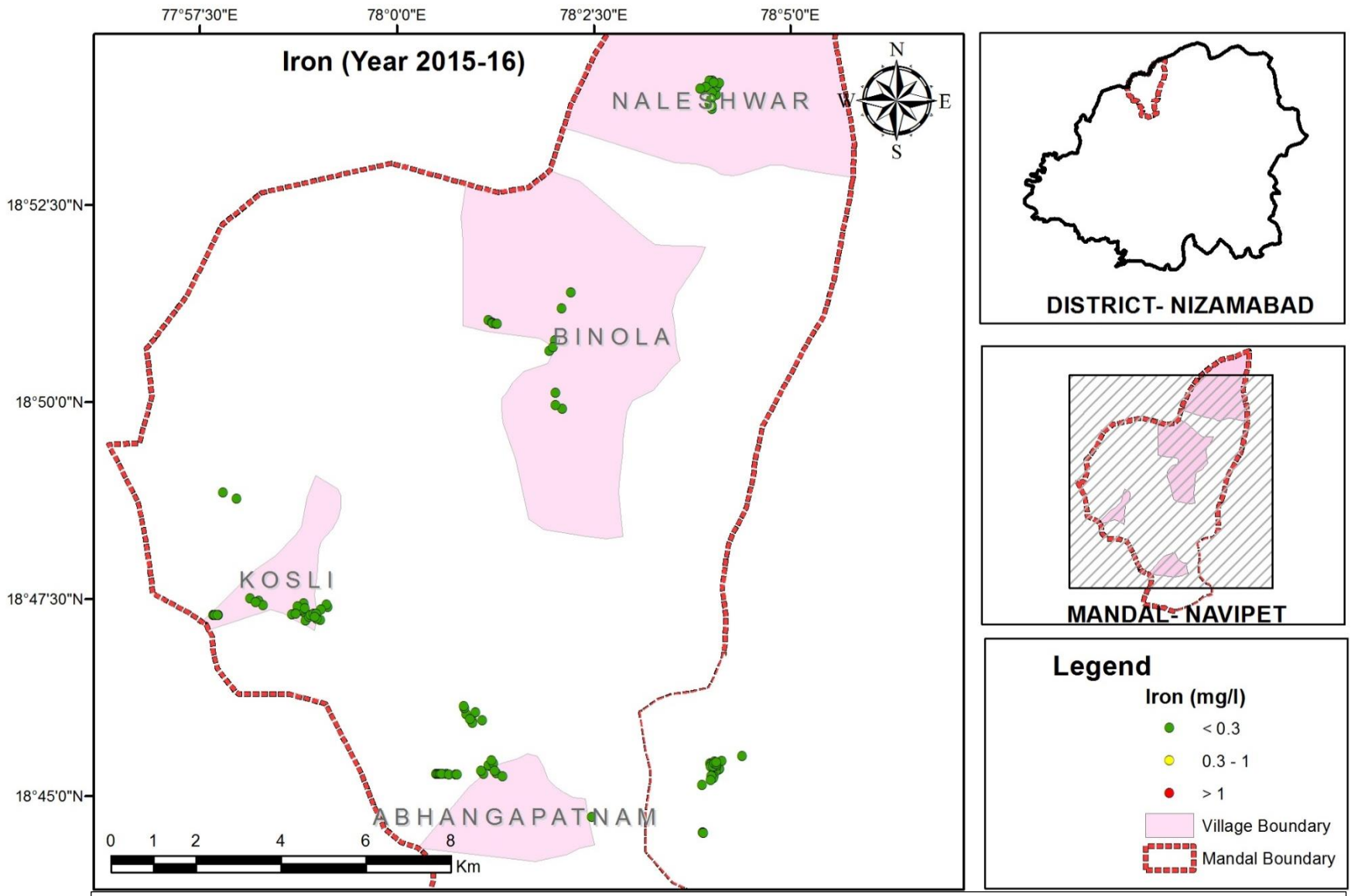
Map 31.2 showing Iron values of Water sources points - Banswada Mandal
Note – Most of the values for the given GPS points showing Iron within desirable limit (Green). Some points showing between desirable and maximum permissible limit (Yellow).



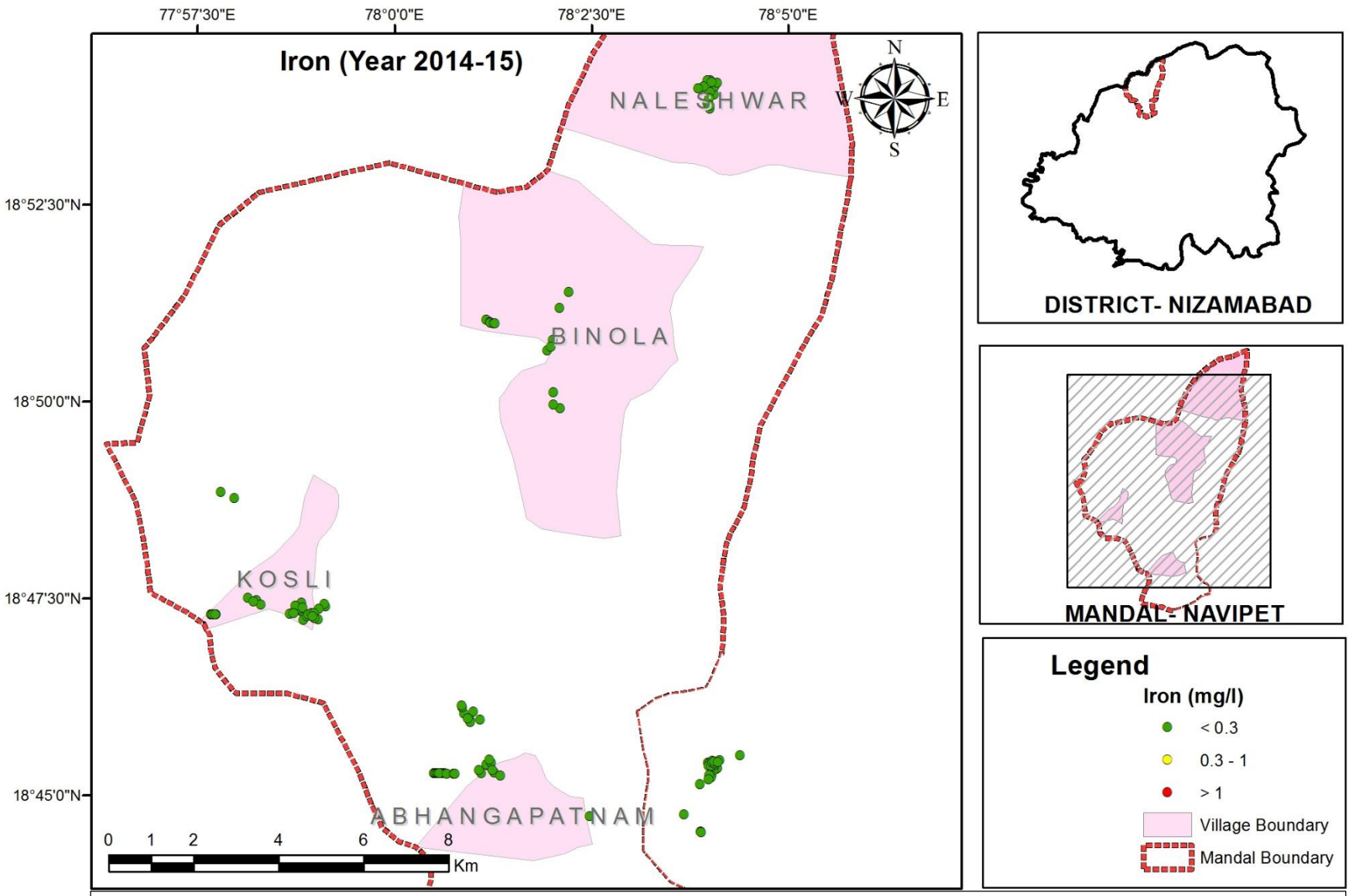
Map 32.1 showing Iron values of Water sources points - Kamareddy Mandal
Note – Most of the values for the given GPS points showing Iron within desirable limit (Green). Few points showing between desirable and maximum permissible limit (Yellow).



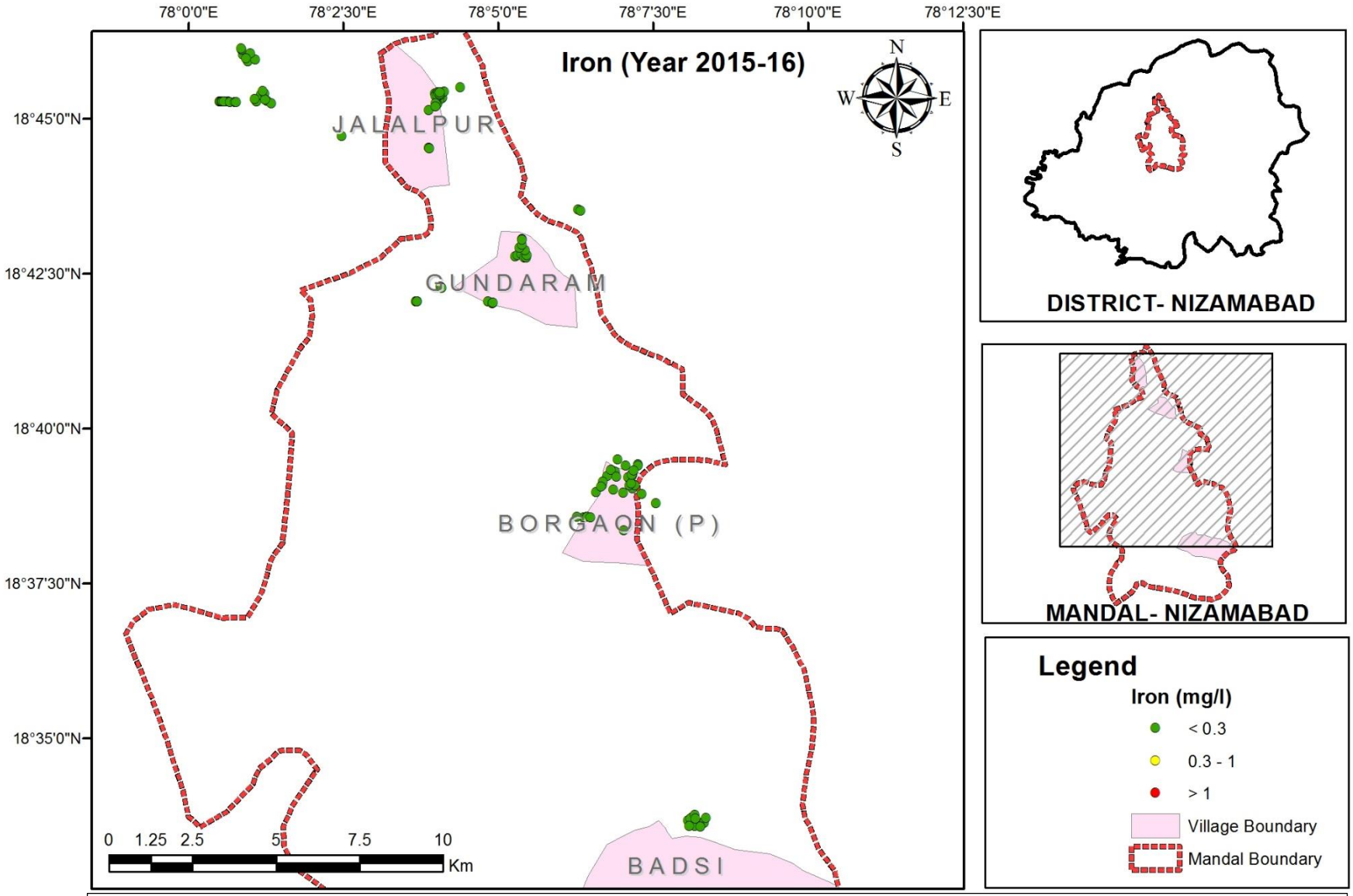
Map 32.2 showing Iron values of Water sources points - Kamareddy Mandal
Note – Most of the values for the given GPS points showing Iron within desirable limit (Green). Some points showing between desirable and maximum permissible limit (Yellow).



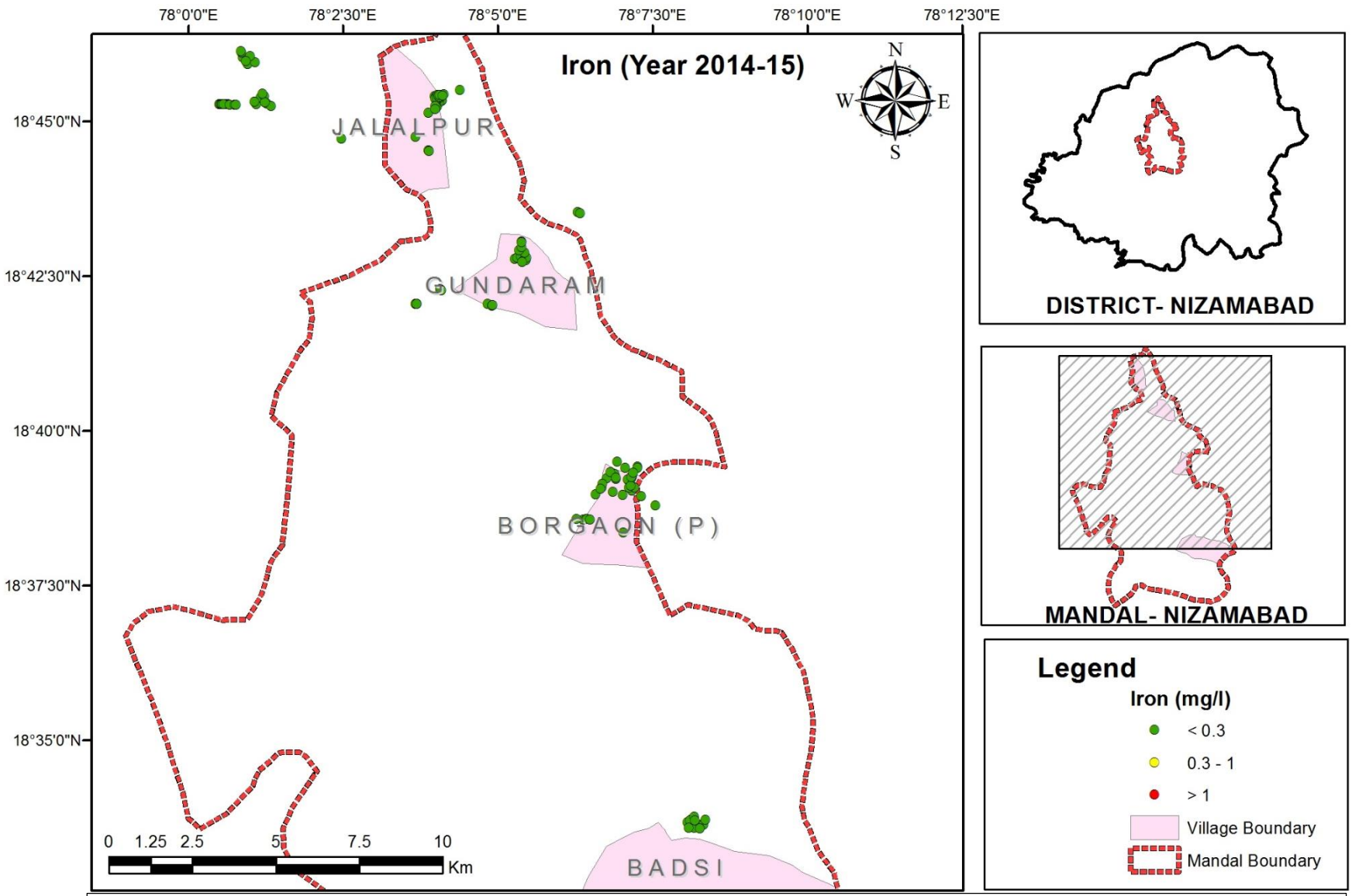
Map 33.1 showing Iron values of Water sources points - Navipet Mandal
Note – All sources for the given GPS points showing Iron within desirable limit (Green).



Map 33.2 showing Iron values of Water sources points - Navipet Mandal
Note – All sources for the given GPS points showing Iron within desirable limit (Green).



Map 34.1 showing Iron values of Water sources points - Nizamabad Mandal
Note – All sources for the given GPS points showing Iron within desirable limit (green).



Map 34.2 showing Iron values of Water sources points - Nizamabad Mandal
Note – All sources for the given GPS points showing Iron within desirable limit (green).

6. Results and discussion

As we collected data from Government of Telangana for year 2014-15 and 2015-16, we carried out temporal analysis to compare status of water quality for the mentioned years. Since all points were not matching so we combined both data-sets using source code so overall 473 source points were taken for analysis purpose. Out of those 473 points only 45 were showing values beyond maximum permissible limit.

Table 5: Table showing classified number of source points based on data availability

Year	Number of source points	Points with values above maximum permissible limit
2014-15	*463*	*37*
2015-16	*396*	*24*
Combined points (source points value beyond max. permissible limit for any year)	473	*45*
Common points (source points value beyond max permissible limit in both years)	386	*16*

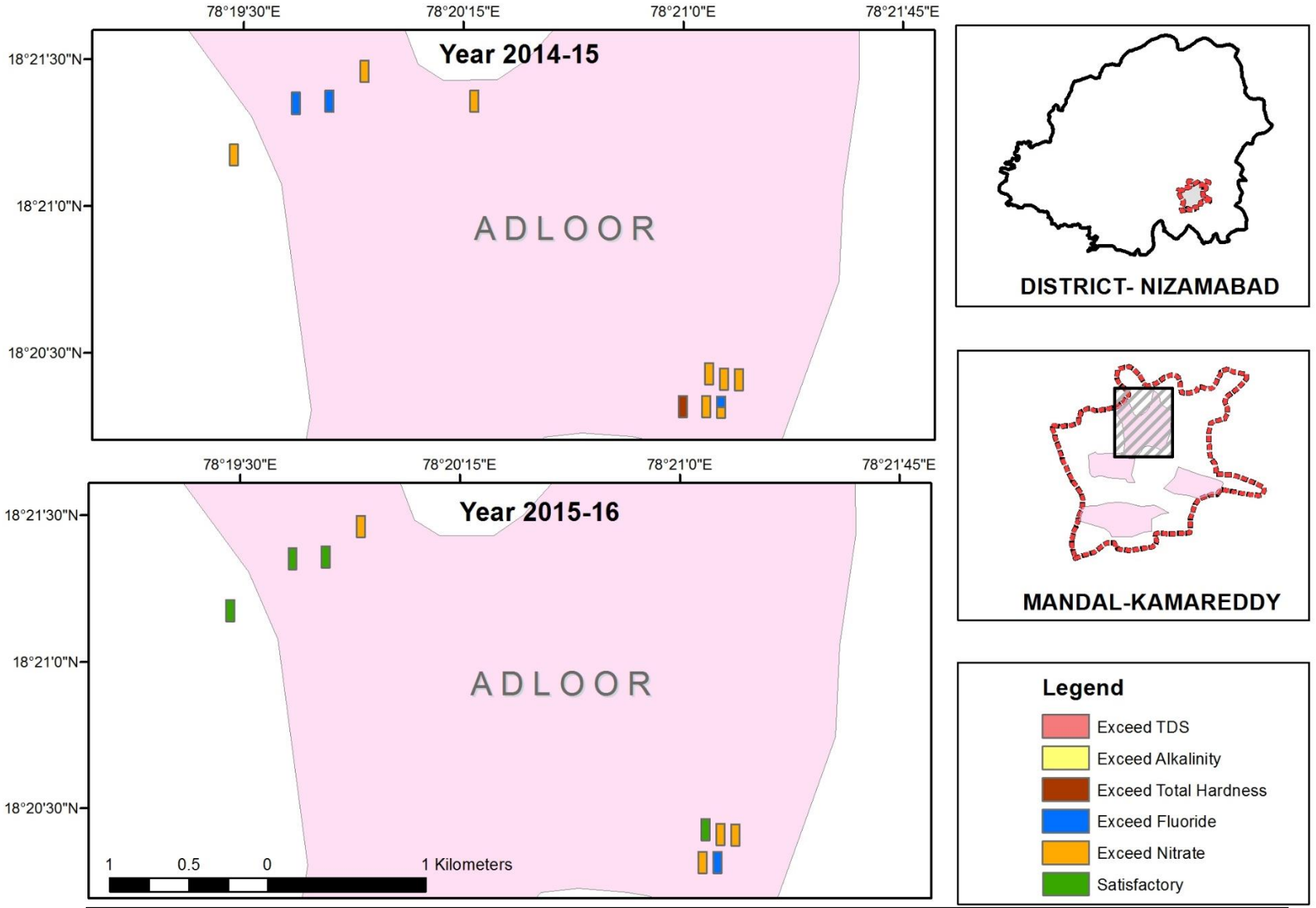
The source points with values beyond permissible limit were 37 in 2014-15 and 24 in subsequent year. The combined points for both years are 45, which are either unsatisfactory in 2014-15 or in 2015-16, and the number of common points are only 16. Remaining all points were found satisfactory. The 45 points are falling under six villages viz. Adloor, Devanpally and Chinnamallareddy from Kamareddy mandal and Gundaram, Jalalpur and Badsi from Nizamabad mandal.

The water quality of the source points was either contaminated by one or multiple contaminants. The below table is a classification matrix showing parameter-wise contamination in each village.

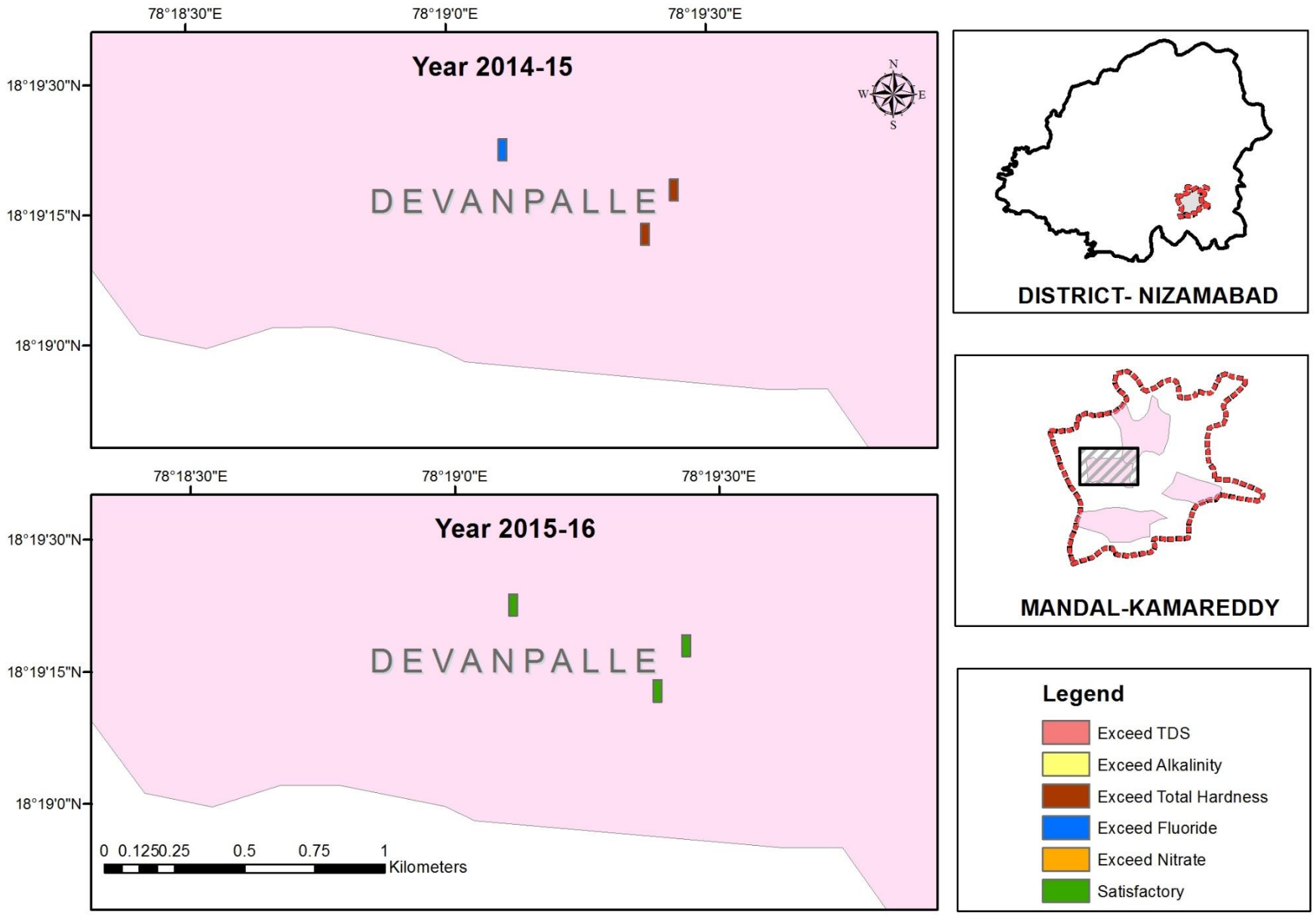
Table 6: Table showing parameter wise contamination matrix

Mandal	Villages	Year	Total Dissolved Solids	Alkalinity	Total Hardness	Fluoride	Nitrate
Kamareddy	Adloor	2014-15			1	3	8
		2015-16				1	4
	Devanpally	2014-15			2	1	
		2015-16			1	4	
	Chinnamallareddy	2014-15			1	8	4
		2015-16					
Nizamabad	Gundaram	2014-15	1			1	
		2015-16	1		1	1	
	Jalalpur	2014-15	8	1	7		
		2015-16	6	5	4		
	Badsi	2014-15			2		
		2015-16			4		

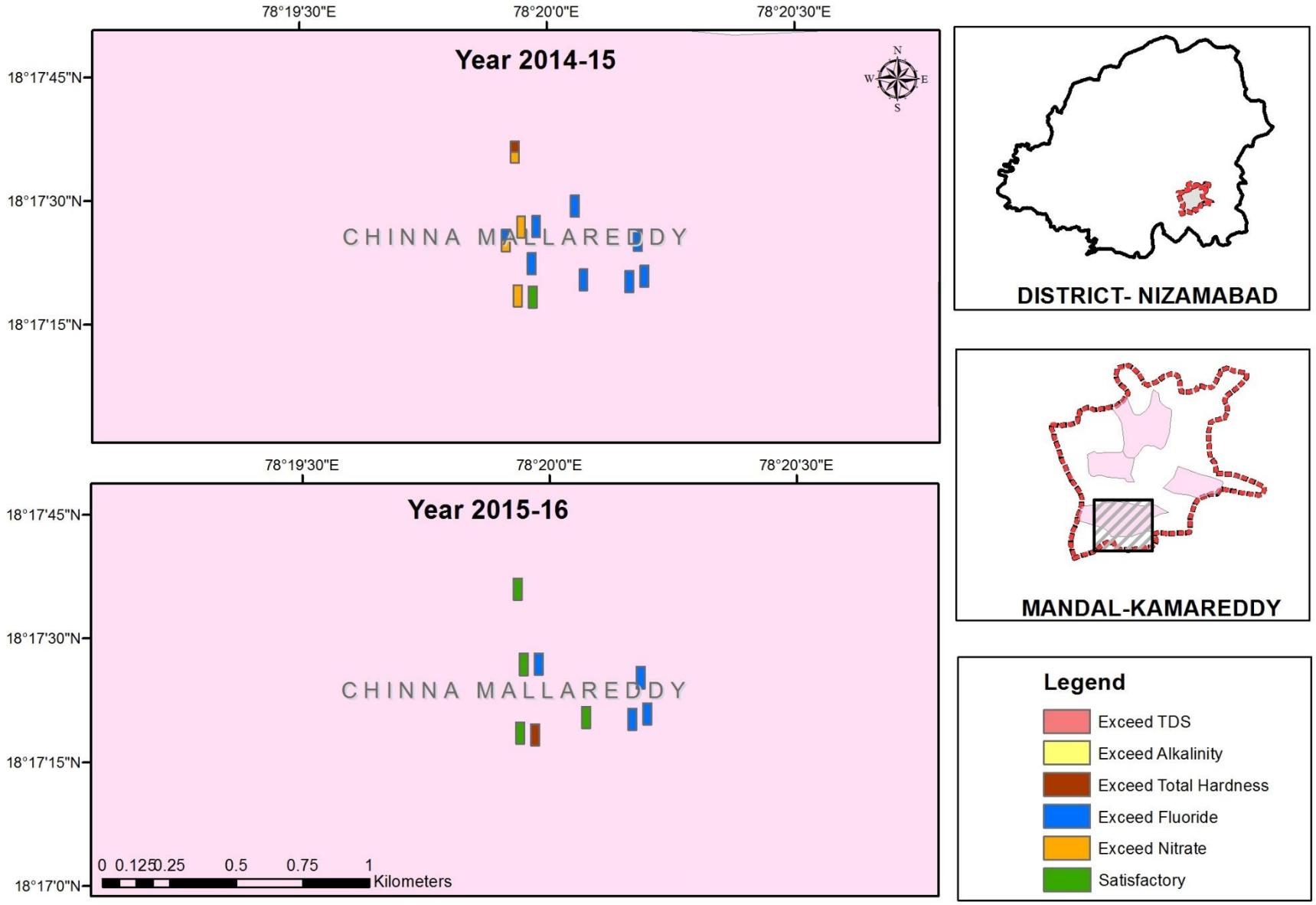
There were no sources found contaminated with Chloride and Iron. *p*H was also within desirable limit. Village-wise comparative layouts for all other contaminants are shown for each year.



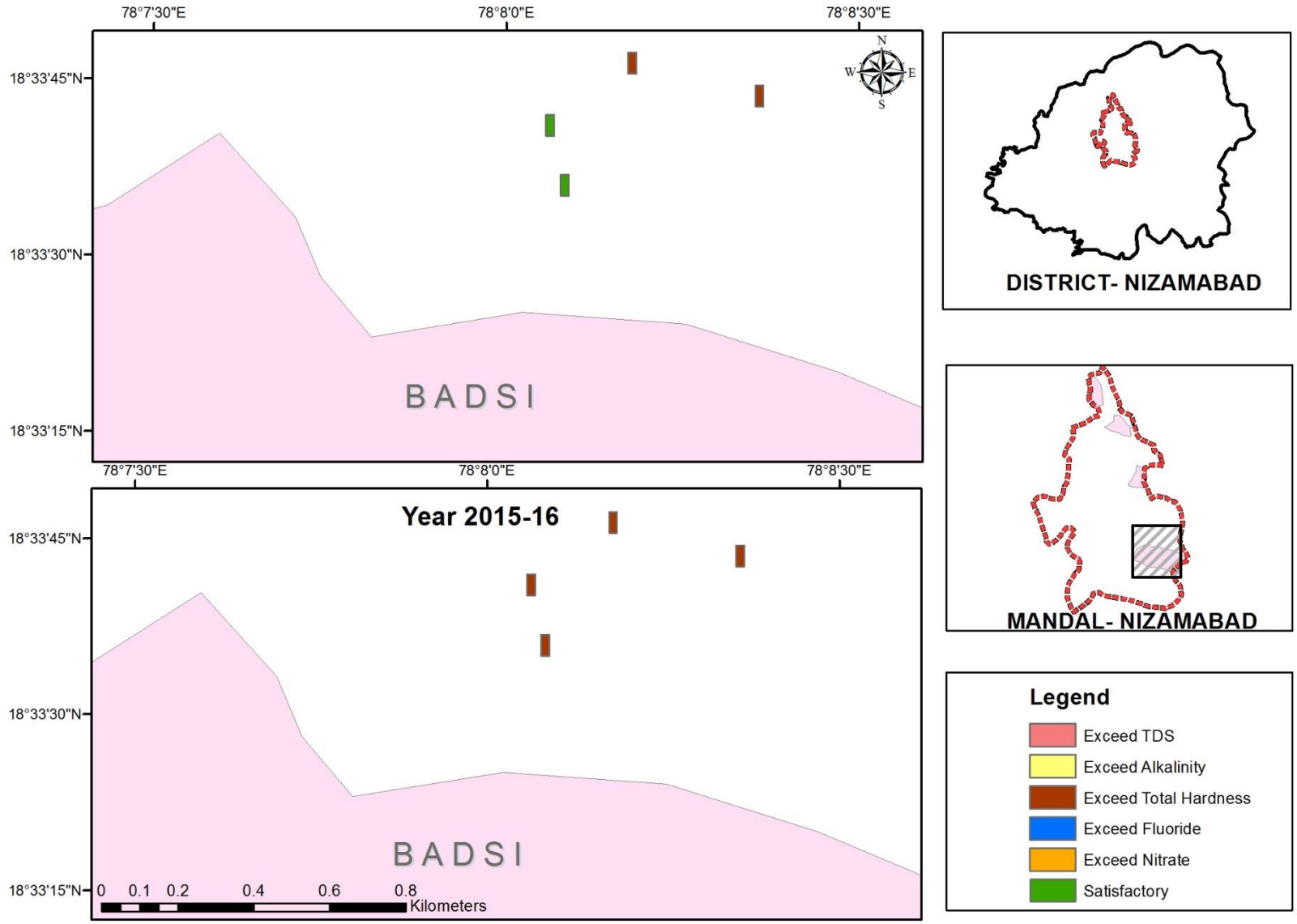
Map 35: Temporal analysis map of Adloor village in Kamareddy Mandal showing some points in 2014-15 data set have exceeding limits are changed into satisfactory in the year 2015-16.



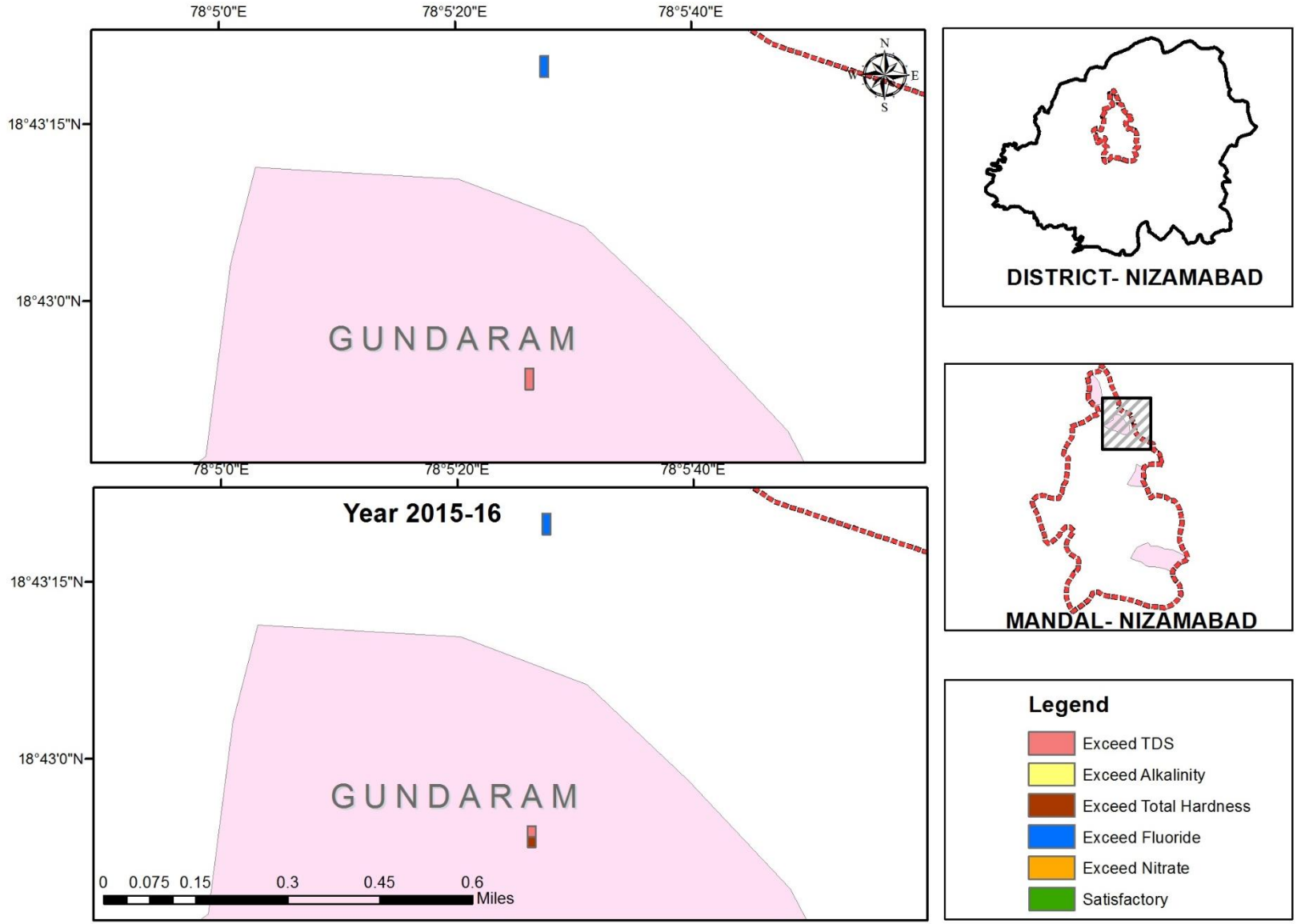
Map 36: Temporal analysis map of Devanapalle village in Kamareddy Mandal showing all points in 2014-15 data exceded limit, has changed into satisfactory in the year 2015-16



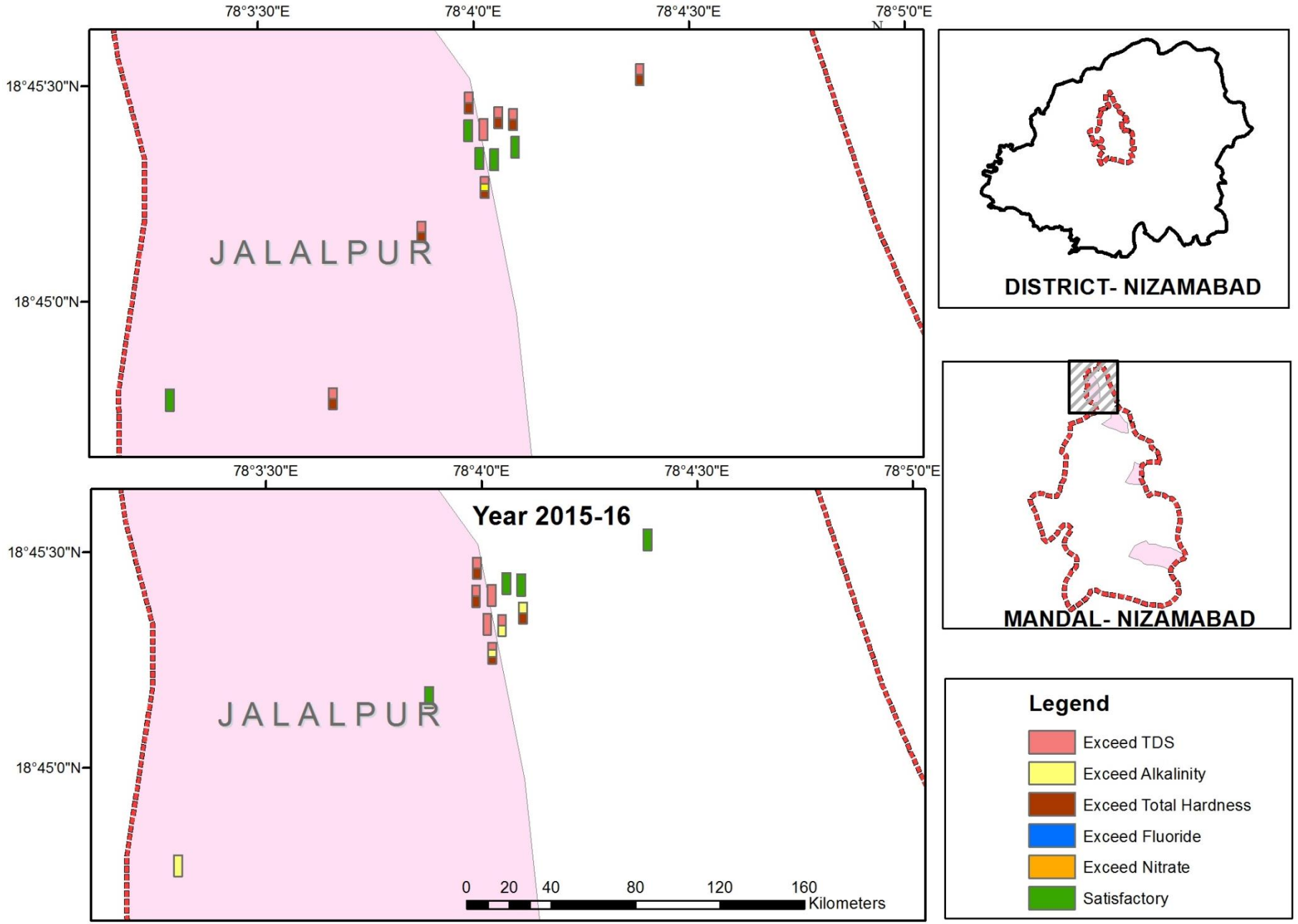
Map 37: Temporal analysis map of Chinna mallareddy village in Kamareddy Mandal showing one point in 2014-15 data set have exceeding limit has changed into satisfactory in the year 2015-16. Unfortunately we could not find data for some points in 2015-16.



Map 38: Temporal analysis map of Badsi village in Nizamabad Mandal showing points in 2014-15 are increased in the year 2015-16.



Map 39: Temporal analysis map of Gundaram village in Nizamabad Mandal showing points in 2014-15 are same but the intensity of the parameters are increased in the year 2015-16.



Map 40: Temporal analysis map of Jalapur village in Nizamabad Mandal showing most of the problematic points are from this village and there is no much change in this village based on the points in 2014-15 data and year 2015-16.

1. There are 45 points falling under 6 villages of two mandals have been identified with exceeding of the maximum permissible limit. Out of 45 points from the two data sets there is no data available for 6 points in 2015-16 dataset.

2. We strongly recommend that the GPS surveying should be done at the time of monitoring only. This will definitely fill the spatial gap in the database.

3. There should be consistency in data collection process. Monitoring should be done for all points once chosen.

4. The department should procure their own GPS devices and should provide a short orientation training to concerned staff or to recruit new staff for this exercise. This will reduce the dependency, time and cost and also will enhance the accuracy of data-set and capacity of individual and institution.

5. In case the source is Bore-well it is also very crucial to measure depth at which the water sample is being collected and to include this with the data will give a detailed picture of under-ground scenario and contamination and will strengthen the ability to produce good quality hydro-geological maps.