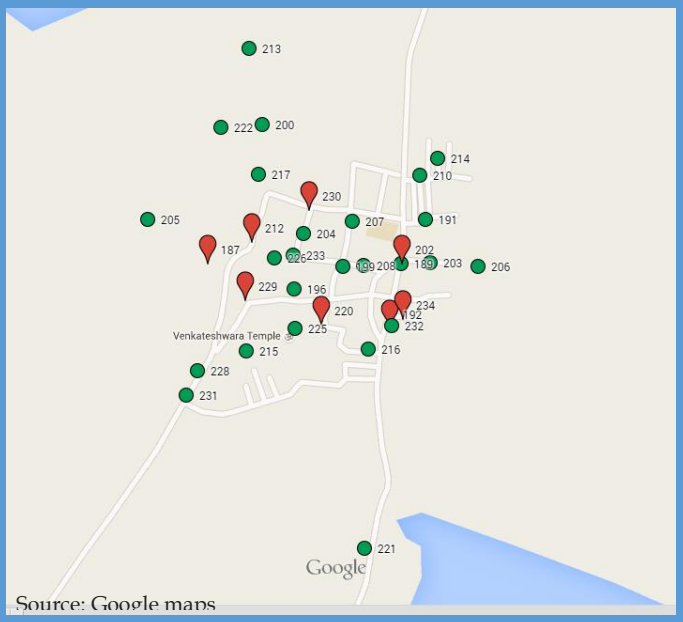
WATER QUALITY GIS REPORT



Source: Google maps


Source: Sai Kiran, SaciWATERs

SaciWATERs
2014-15

Suchita Jain

Contents

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, this small part particularly intents

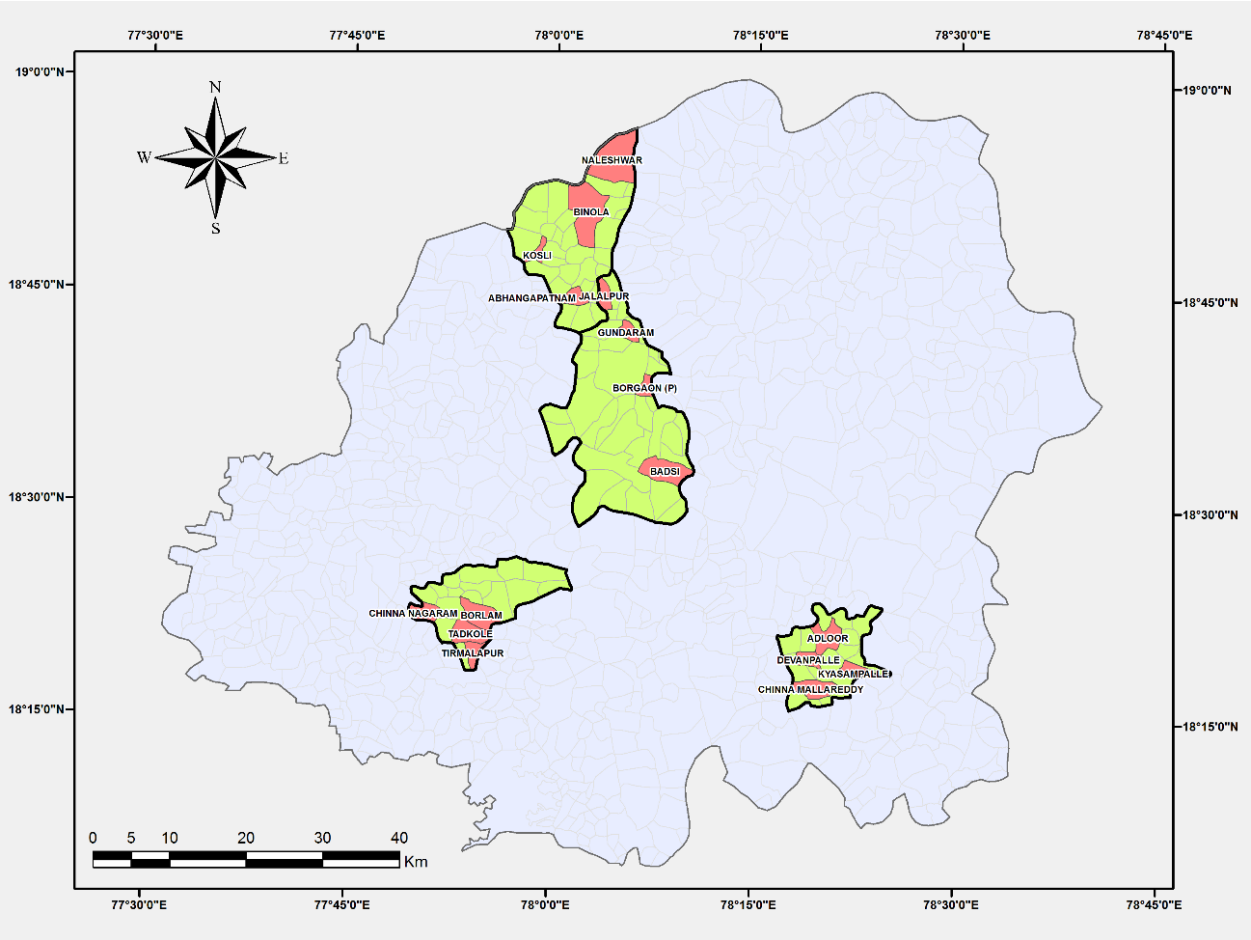
1. Visualization the GPS data on water quality testing data and parameters in GIS platform for the entire state of Telangana.
2. Identifying gaps and doing a comparative analysis of government data and cross verification of the same from the ground.

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 know as spatial data. For this exercise we have used point GPS data with water quality parameters and polygon 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 was to map and display all the secondary data available under the NRDWQMSP. Constant efforts were made to get spatial data along with the water quality parameters for the point sources from government department as the secondary data was not available. There were delays in obtaining this data due to the bifurcation of the state and the reconciliation of the data. The RWS&S department was formally requested for data, as well as the state

laboratory. The Latitude and longitude values of GPS data over the NRDWP website was shown as 0.000, 0.000 as shown below in the print screen image of the website:

Navipet Mandal - Binola

Banswada Mandal - Kollur- Ch. Nagaram village

The first set of data was received (from the Nizamabad district lab) only with water quality parameters 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.

The water quality data have been collected by local labs of the RWS&S department while the GPS surveying task had been outsourced to a third party agency called "Bluefrog mobile technologies". The total source points in all sixteen villages are 549. Out of these 549 sources the GPS co-ordinates are available for only 362 points. The GPS survey had been conducted during mid-2013 and early 2014. The remaining points have been marking as "not surveyed" in the spatial database. The responsible agency have justified the query as:

1. The asset details might have been not entered in NIC Database so it couldn't being surveyed.
2. The field assistant was not able to show the asset, therefore the surveyor might have missed it

2. Village boundary shape-file:

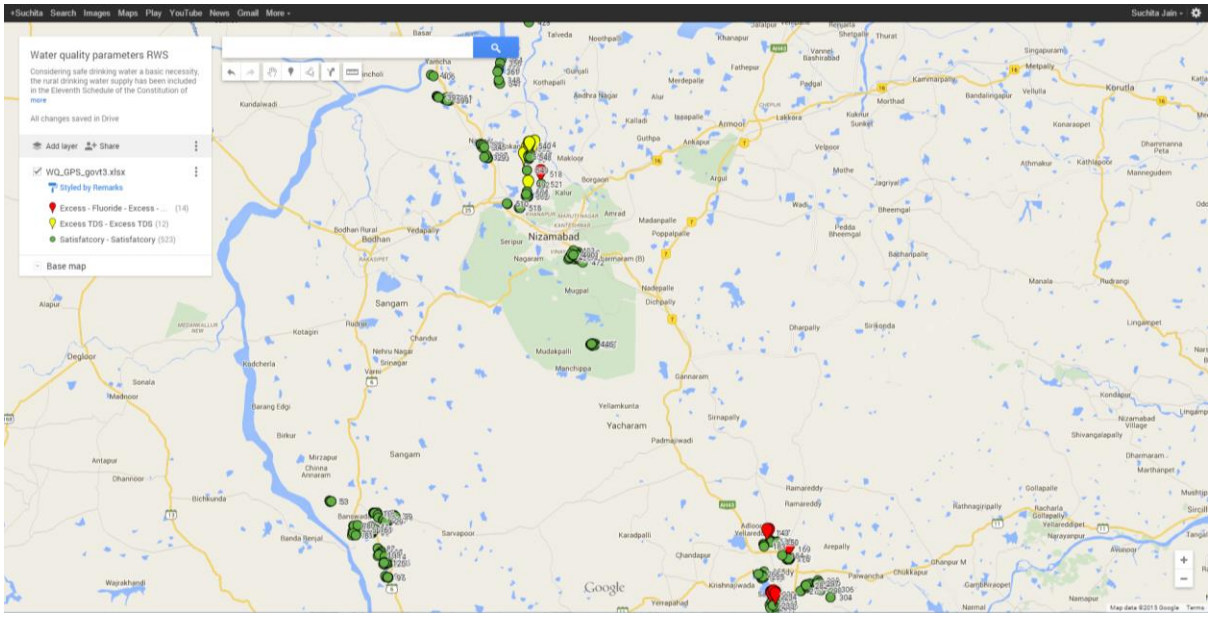
Shape-files are geospatial vector data format used for geographic Information system (GIS) Software. These village boundary shape-files (unverified on ground) have been procured from Survey of India, Dehradun to visually display the GPS point data. The same time this was also helpful to identify the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

4. Methodology:

The GPS data along with parameters had been spatially projected over google maps as well as village boundary shape-files from Survey of India.

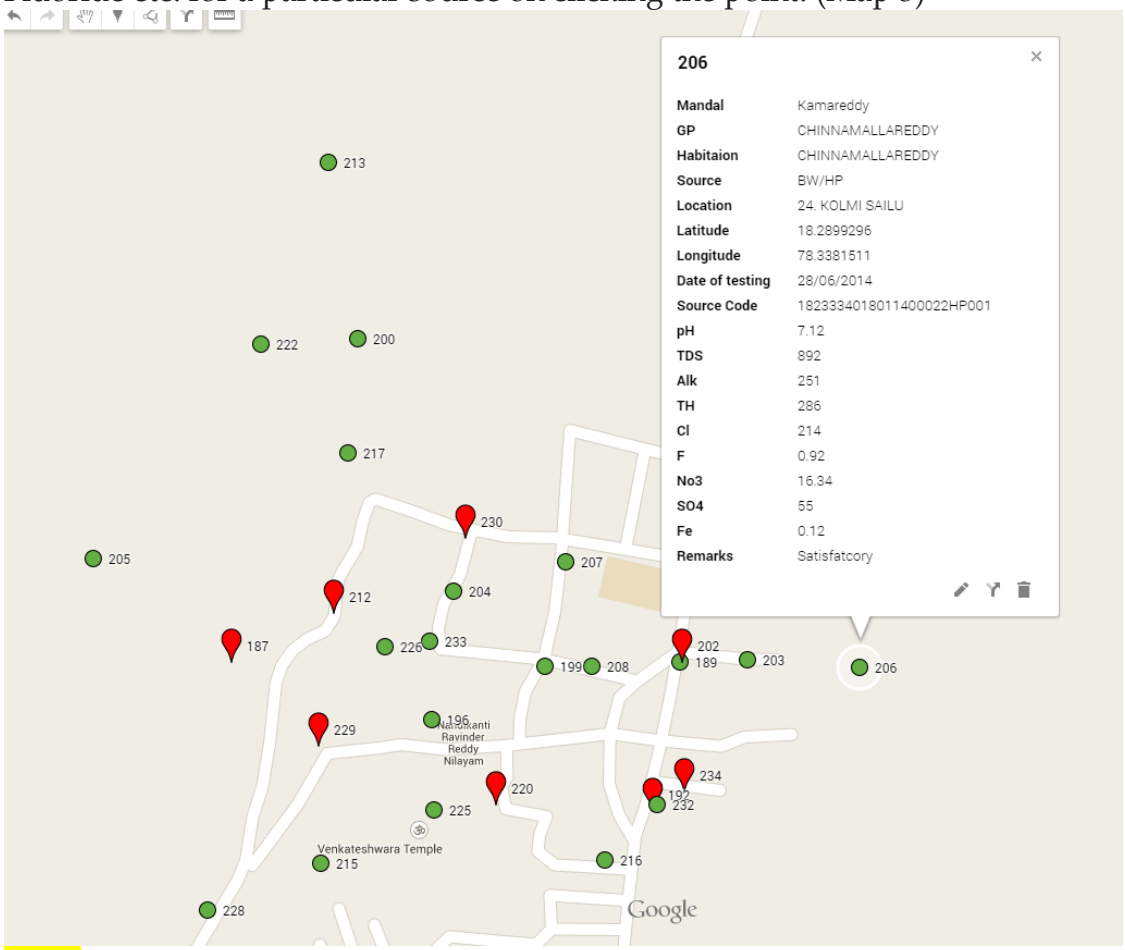
1. Google maps:

Google maps (https://www.google.co.in/maps) is a freely available platform to transform the non-spatial data to spatial based on corresponding geo-spatial co-ordinates. 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 adjoining data would also be displayed as per requirement. Google maps have been useful to validate the accuracy of spatial co-ordinates at particular location level. Google maps are also more user friendly and will enable a better interaction between the user and the data.



(*Map 2: location of GPS sources over Google maps*) *The map can be seen at* https://www.google.com/maps/d/edit?mid=z-FLEYgPDwLE.kFtkkheSsFeE

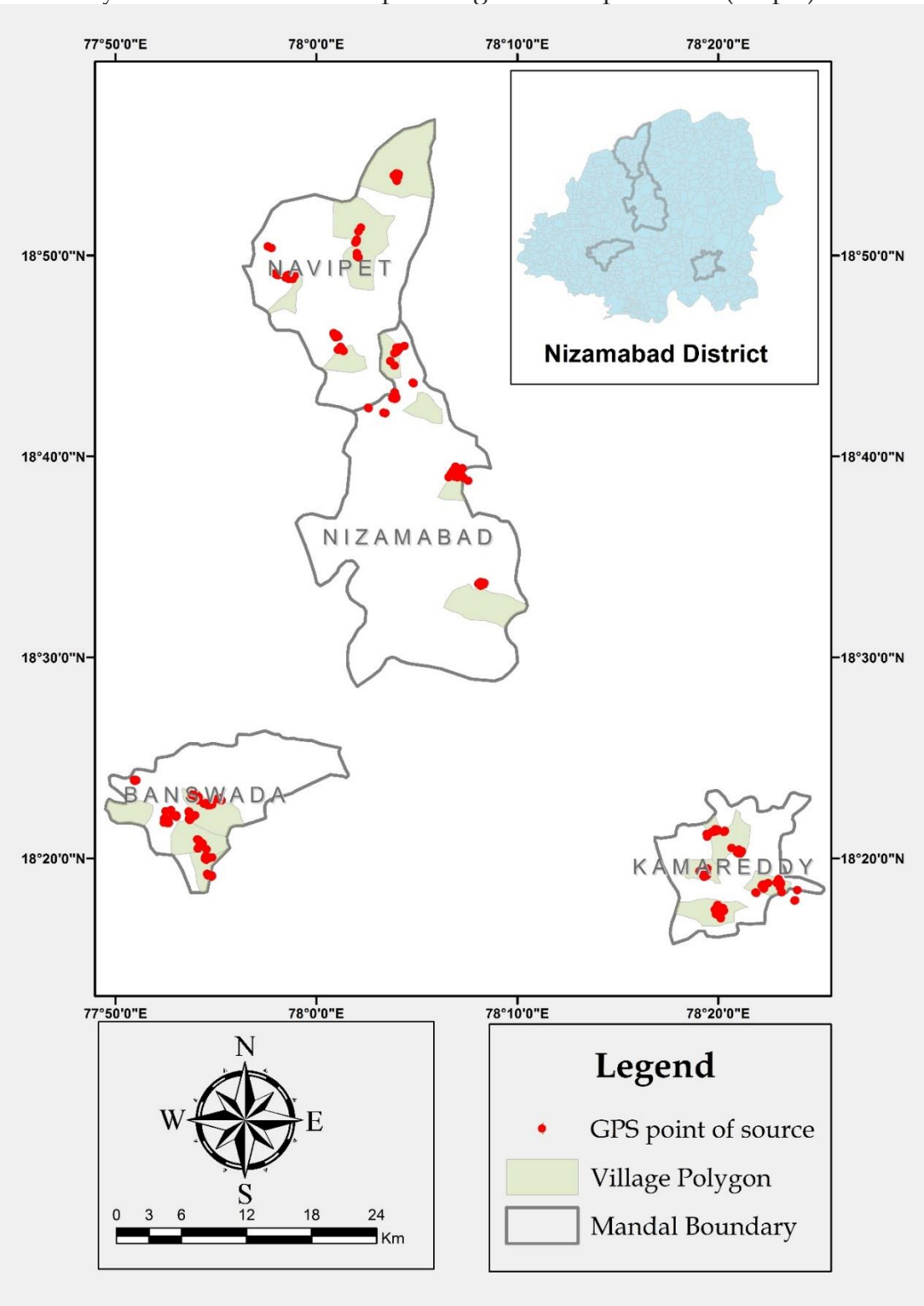
The interactive map will also allow to display the detailed location of the point and date of testing along with values for each parameter like pH, TDS, Chloride and Fluoride etc. for a particular source on clicking the point. (Map 3)



Map 3: GPS Point location of Water source on base-map showing the linked values for water quality parameters

2. Village boundary Shape-files:

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)



Map 4: 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 362 points. For rest 187 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 2: 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	Sulphate	150	400
9	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 values and source id numbers has been used for labelling purpose. The data values has been classified to three classes for all parameters except *p*H and the colour codes for each class are as follows (Table 3):

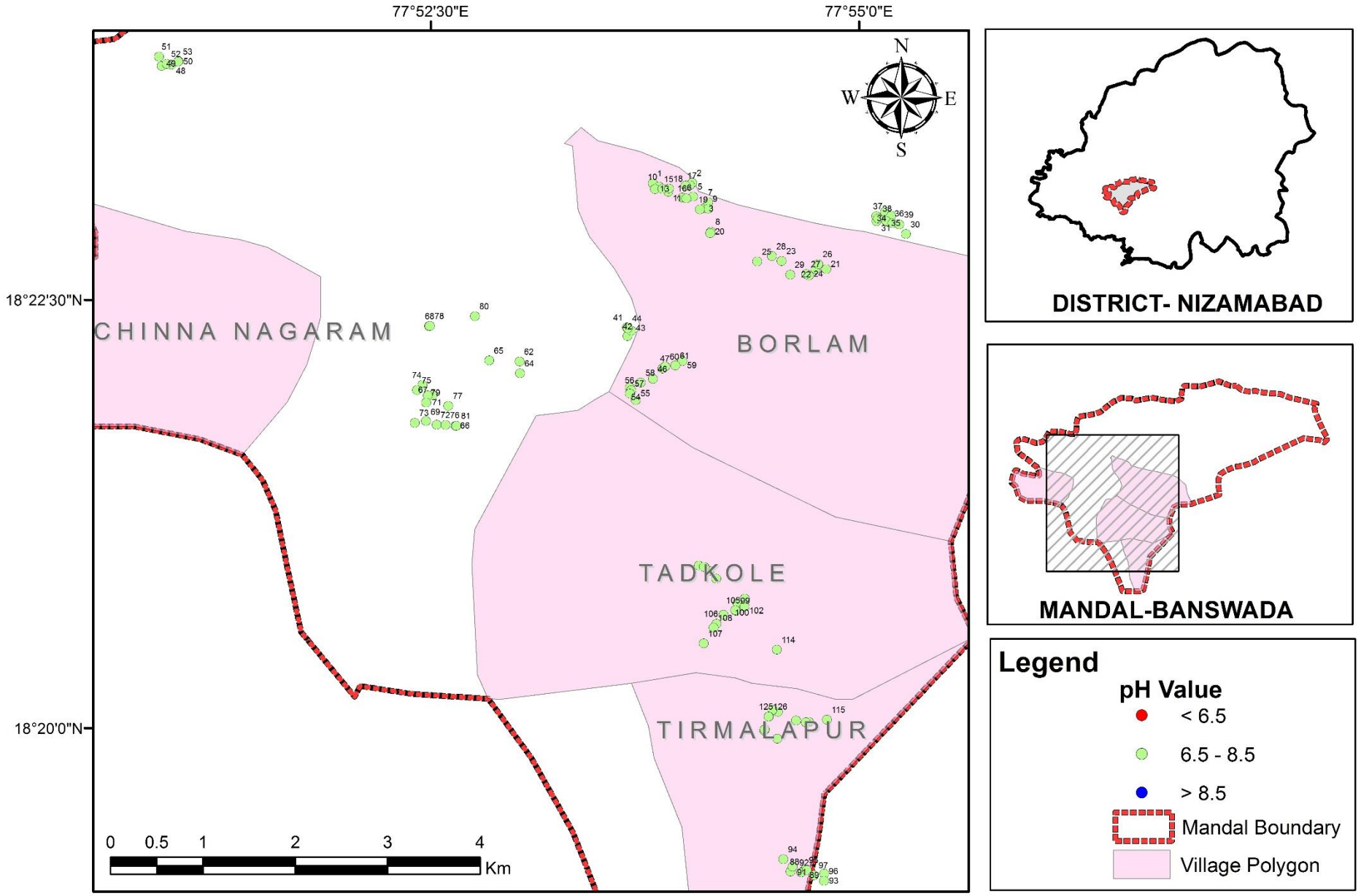
Table 3: Colour scheme for water quality parameters except for pH

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

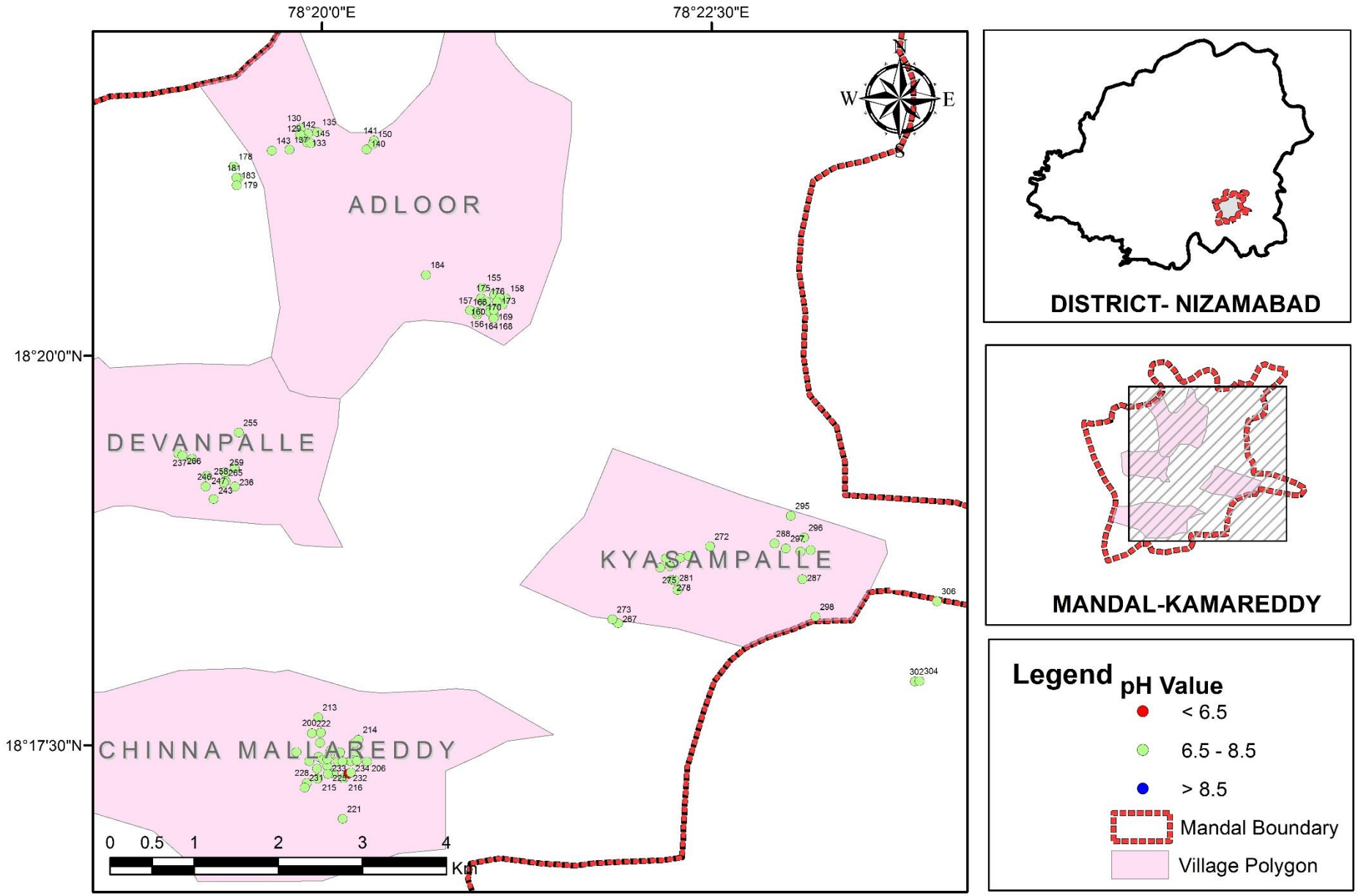
To display pH values

Table 4 : Colour scheme for pH values

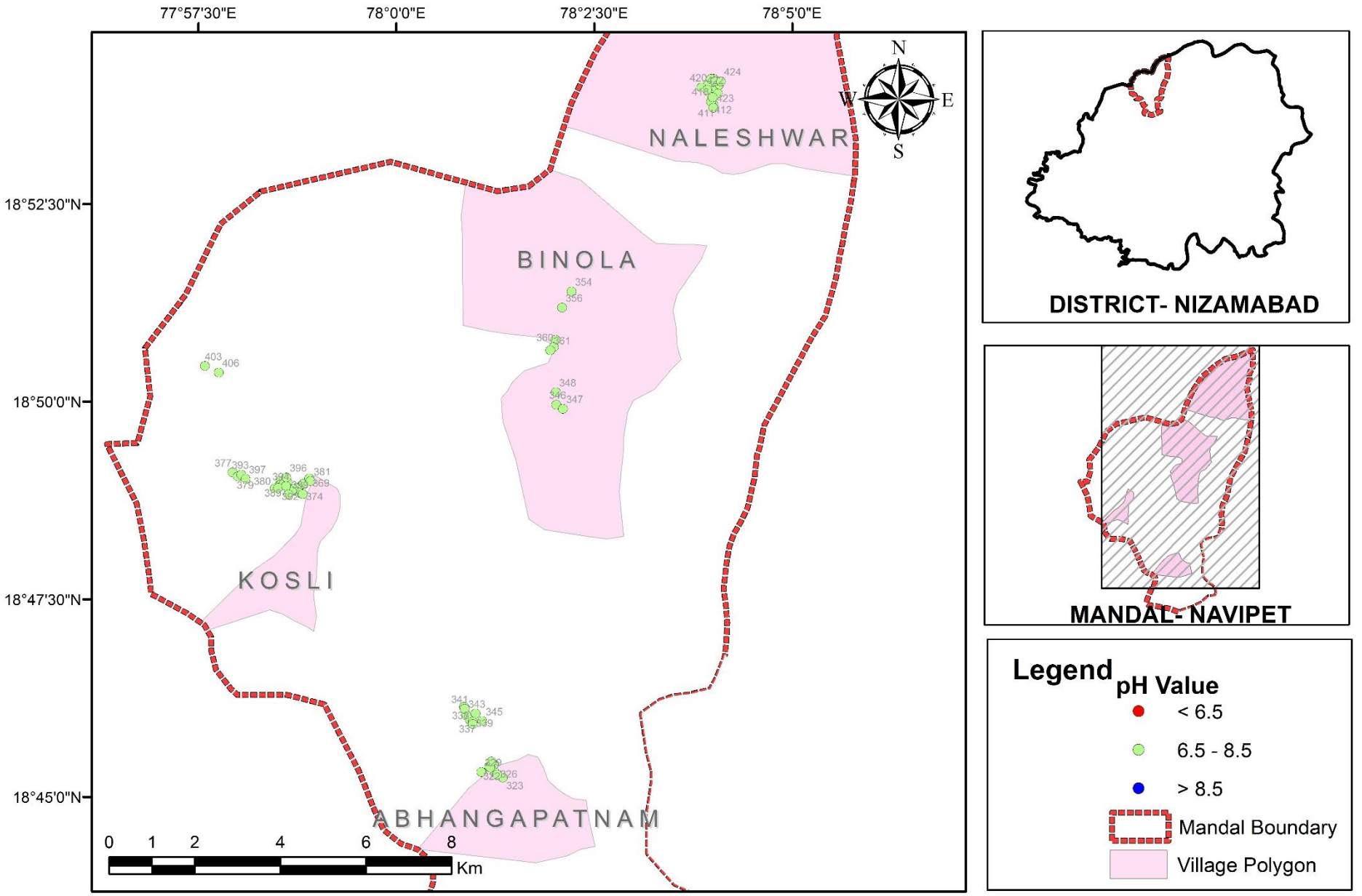
Symbol	Colour	Class
●	Red	Displaying values below desirable limit
●	Green	Displaying values between desirable and maximum permissible limit
●	Blue	Displaying values beyond permissible limit



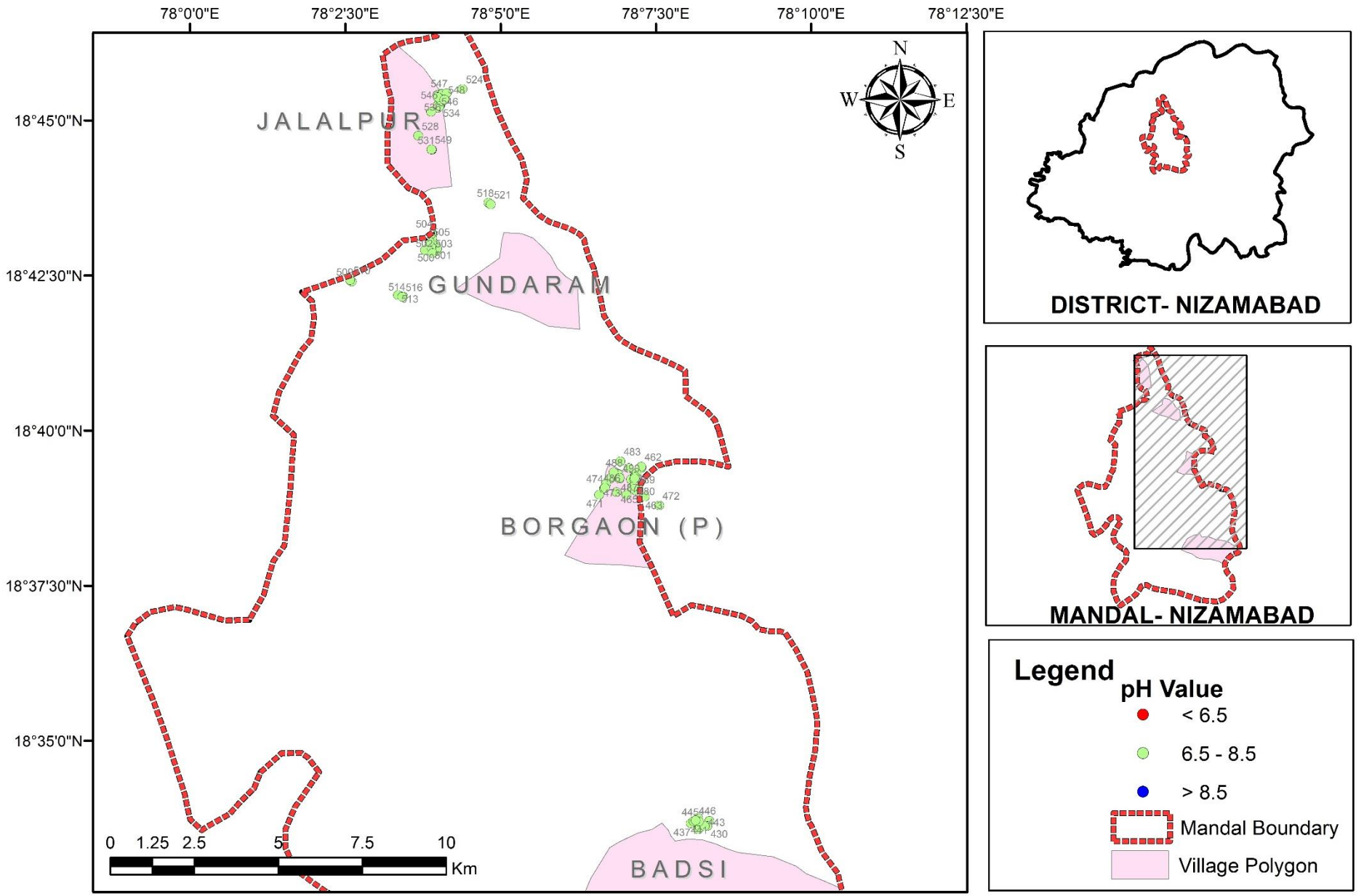
Map 5 showing *p*H values of Water sources points- Banswada Mandal
Note-All values for the given GPS points are within permissible limits (green)



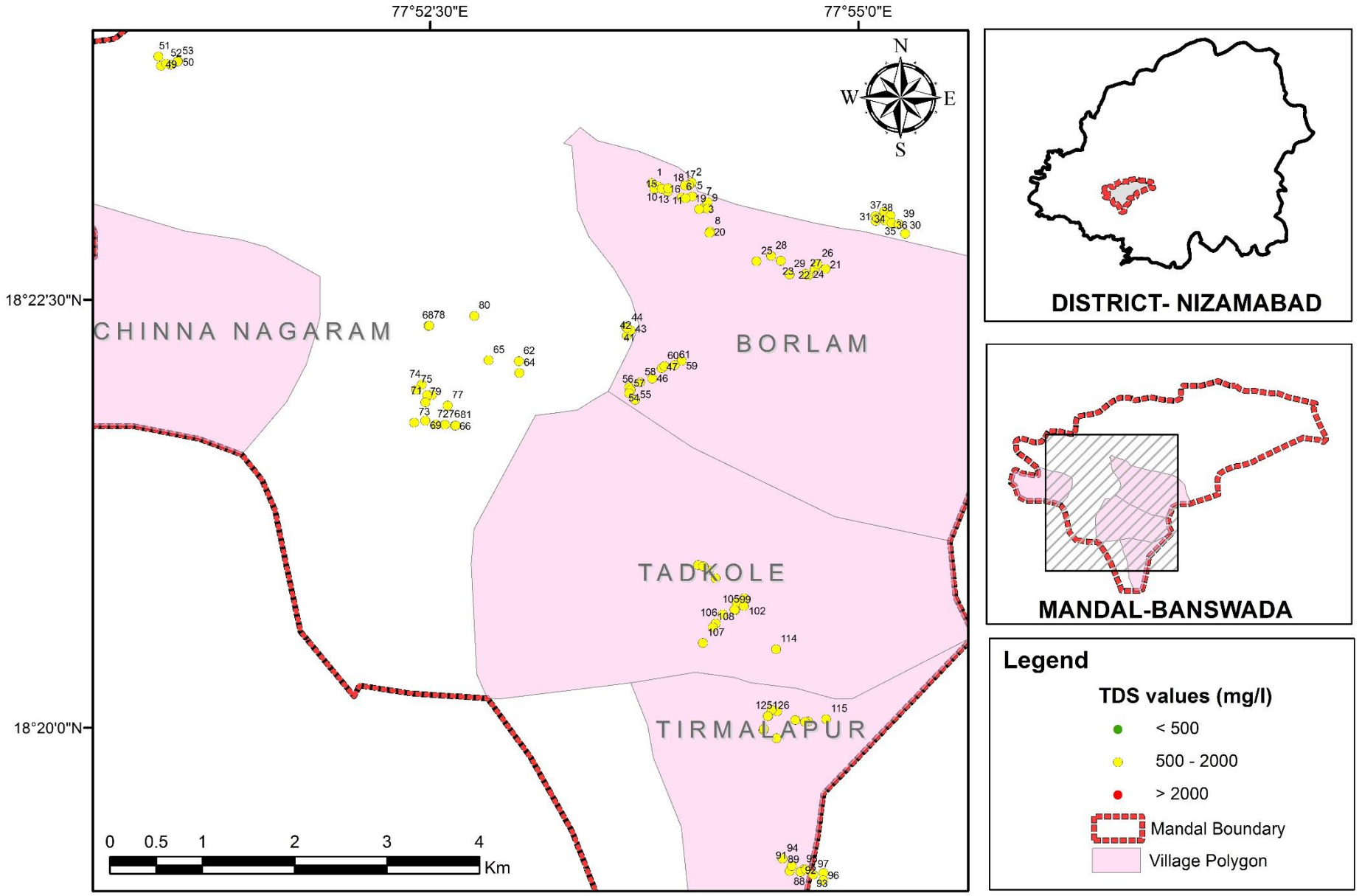
Map 6 showing pH values of Water sources points- Kamareddy Mandal
Note-All values for the given GPS points are within permissible limits (green) except less than one showing acidic nature of water (red in chinnamallareddy)



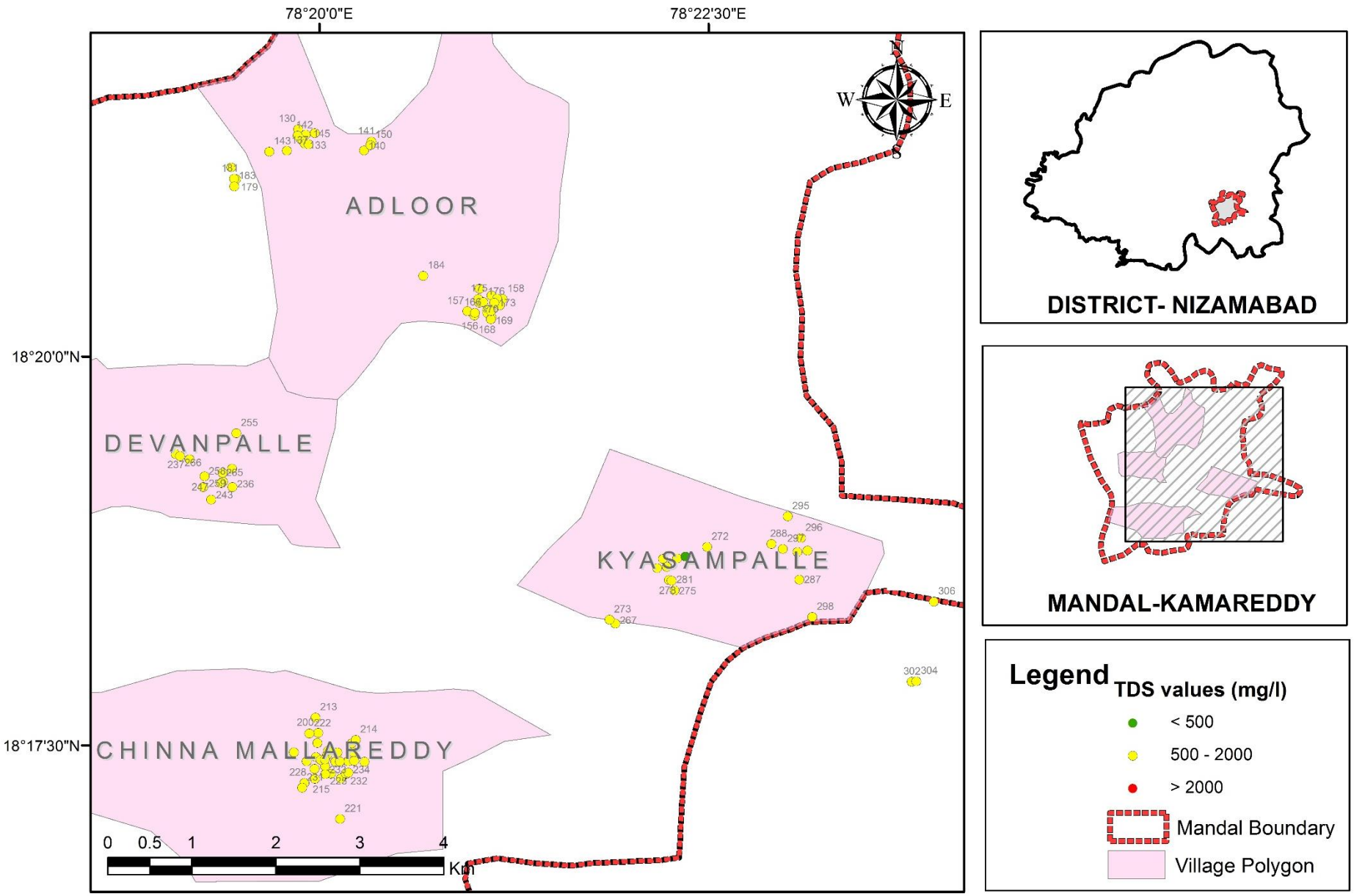
Map 7 showing pH values of Water sources points - Navipet Mandal
Note-All values for the given GPS points are within permissible limits (green)



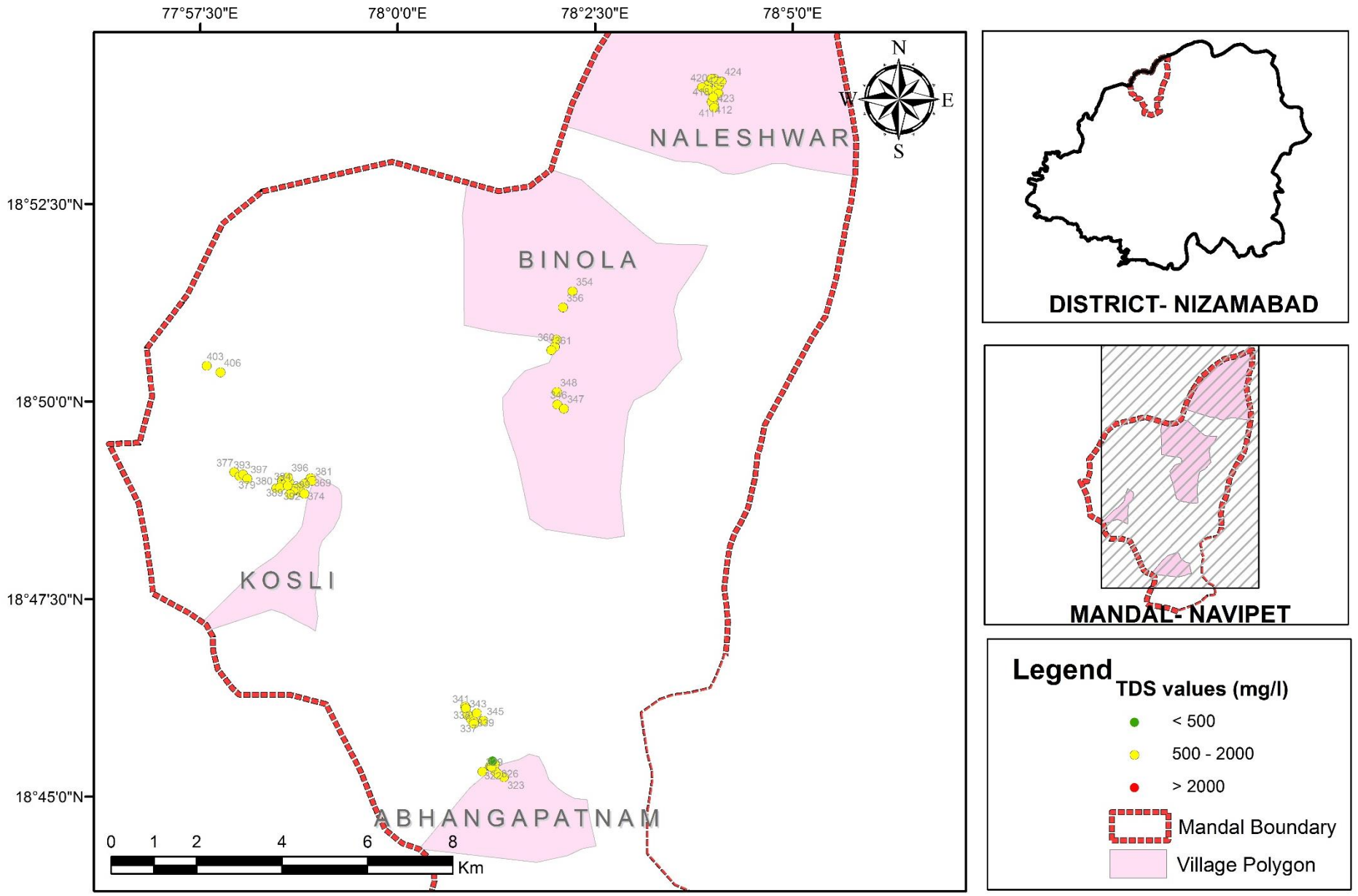
Map 8 showing pH values of Water sources points- Nizamabad Mandal
Note-All values for the given GPS points are within permissible limits (green)



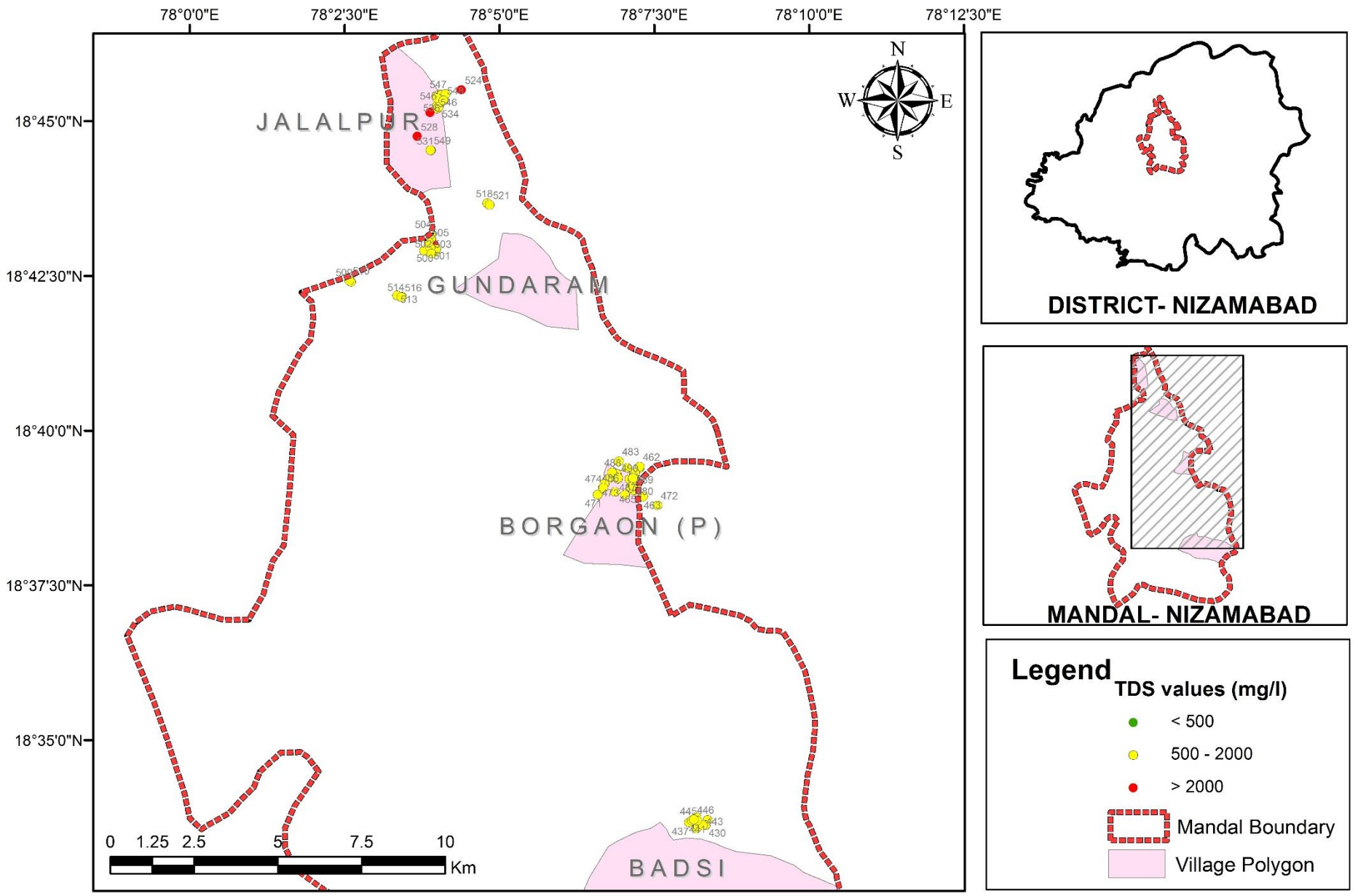
Map 9 showing TDS values of Water sources points - Banswada Mandal
Note-All values for the given GPS points showing total dissolved solids within the maximum permissible limit (yellow)



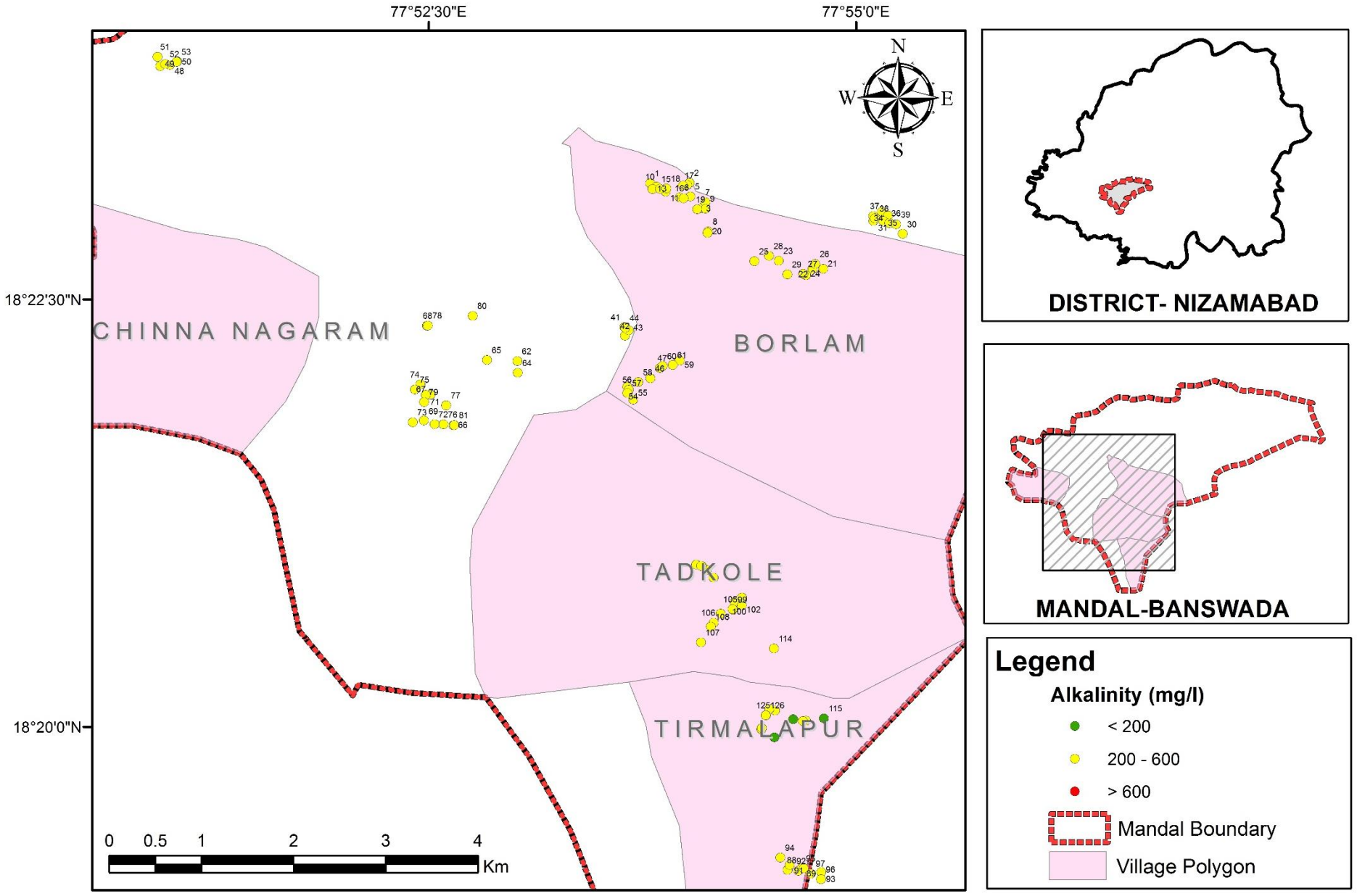
Map 10 showing TDS values of Water sources points - Kamareddy Mandal
Note-Only one source (green) shows values within desirable limit while all other values for the given GPS points showing total dissolved solids within maximum permissible limit (yellow)



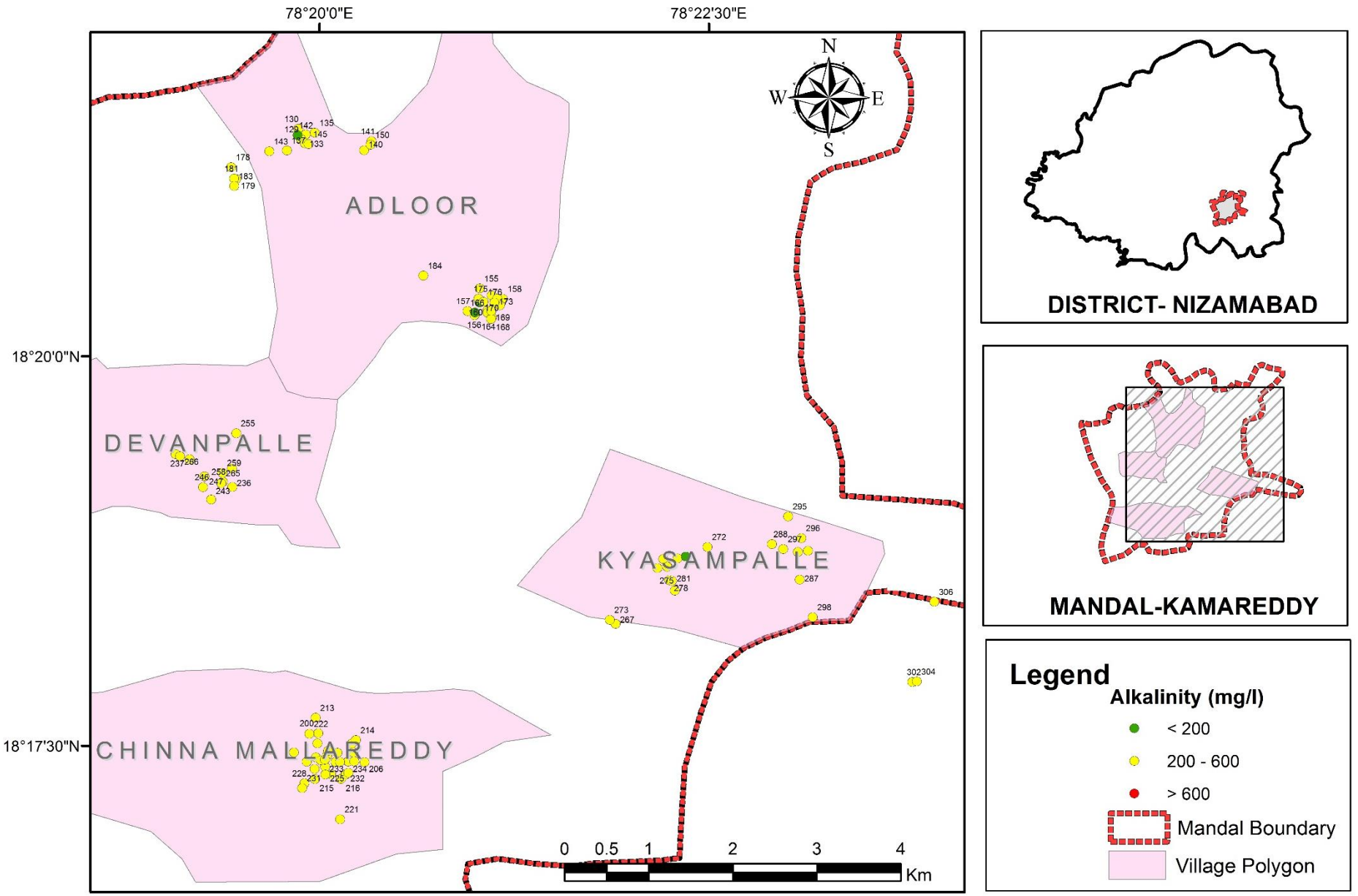
Map 11 showing TDS values of Water sources points - Navipet Mandal
Note-Only one source shows values within desirable limit (green) while all other values for the given GPS points showing total dissolved solids within maximum permissible limit (yellow)



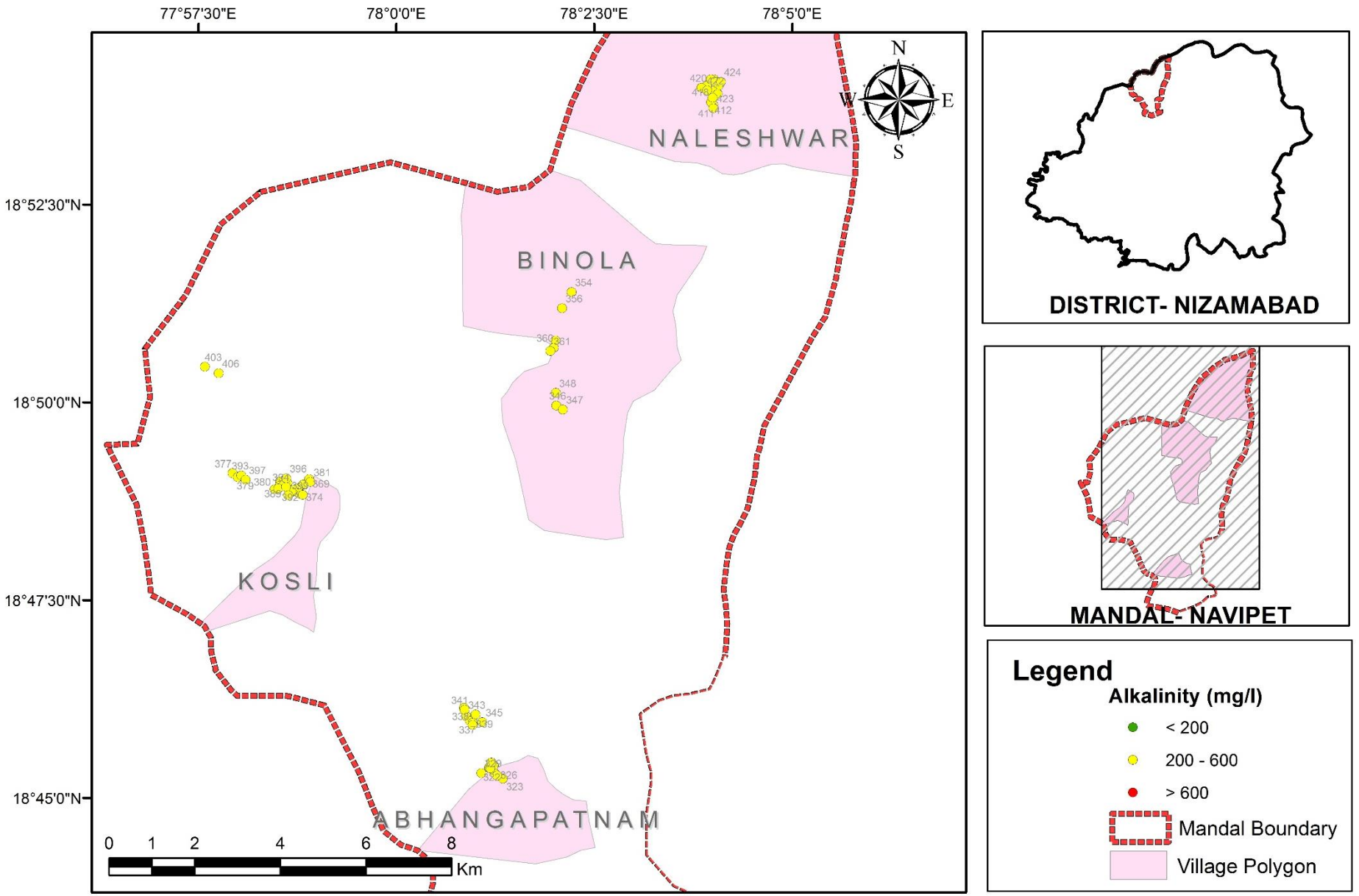
Map 12 showing TDS values of Water sources points - Nizamabad Mandal
Note-Few source near Jalalpur shows values above permissible limit (red) while all other values for the given GPS points showing total dissolved solids within maximum permissible limit (yellow)



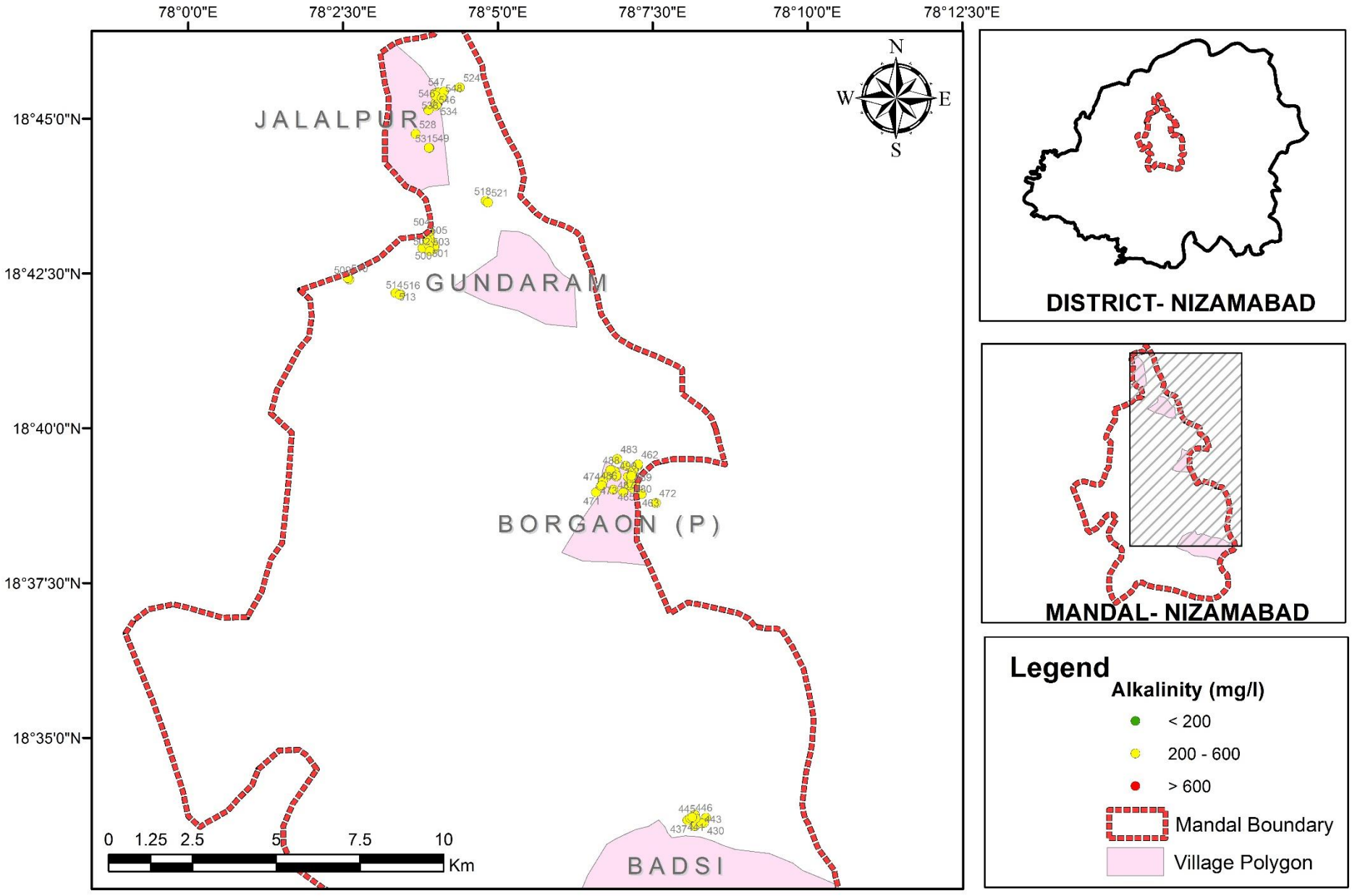
Map 13 showing Alkalinity values of Water sources points - Banswada Mandal
Note- Few source near Tirmalapur shows values within desirable limit (green) while all other values for the given GPS points showing alkalinity within maximum permissible limit (yellow)



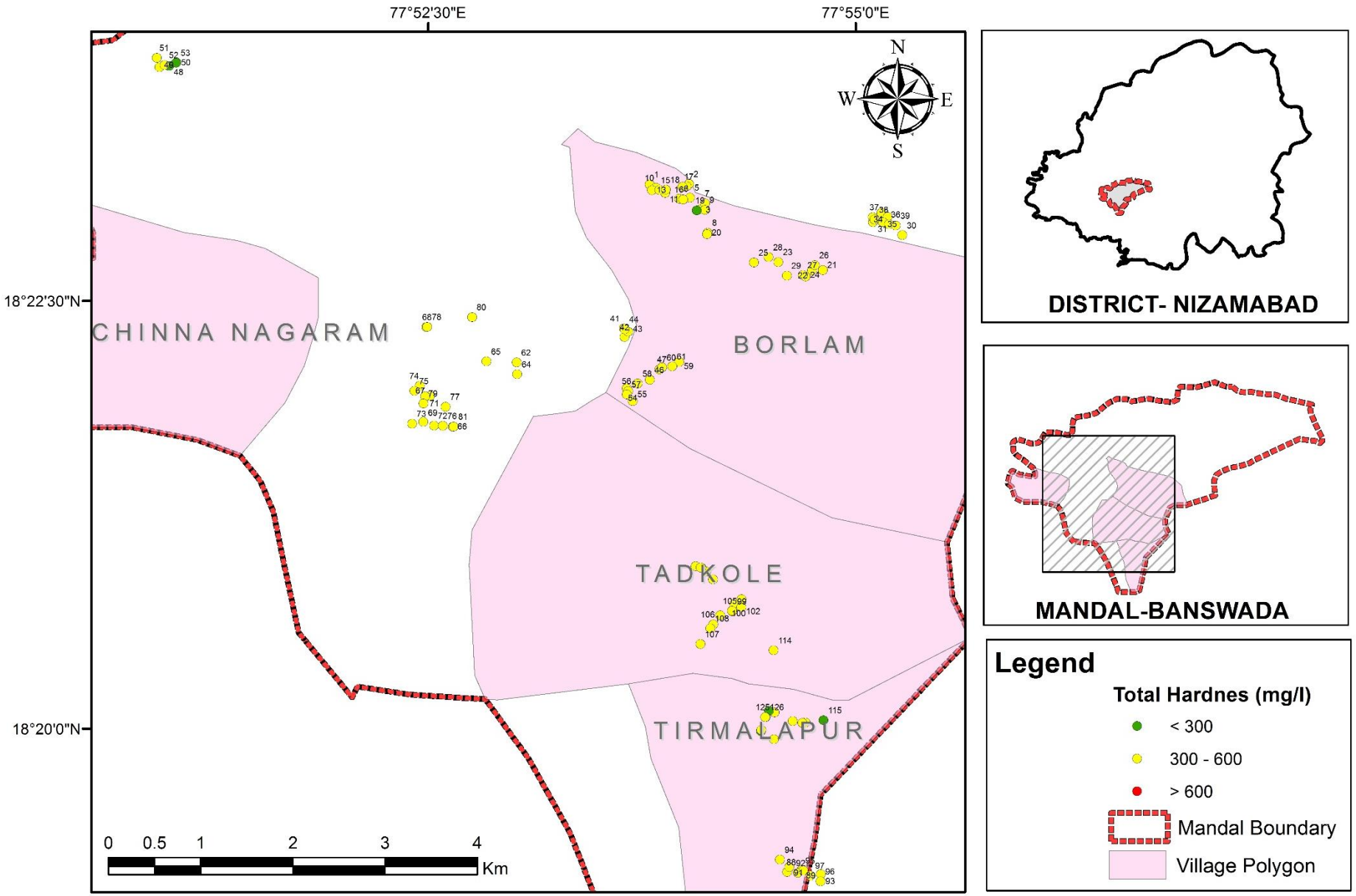
Map 14 showing Alkalinity values of Water sources points - Kamareddy Mandal
Note- Few source near Tirmalapur shows values within desirable limit (green) while all other values for the given GPS points showing alkalinity within maximum permissible limit (yellow)



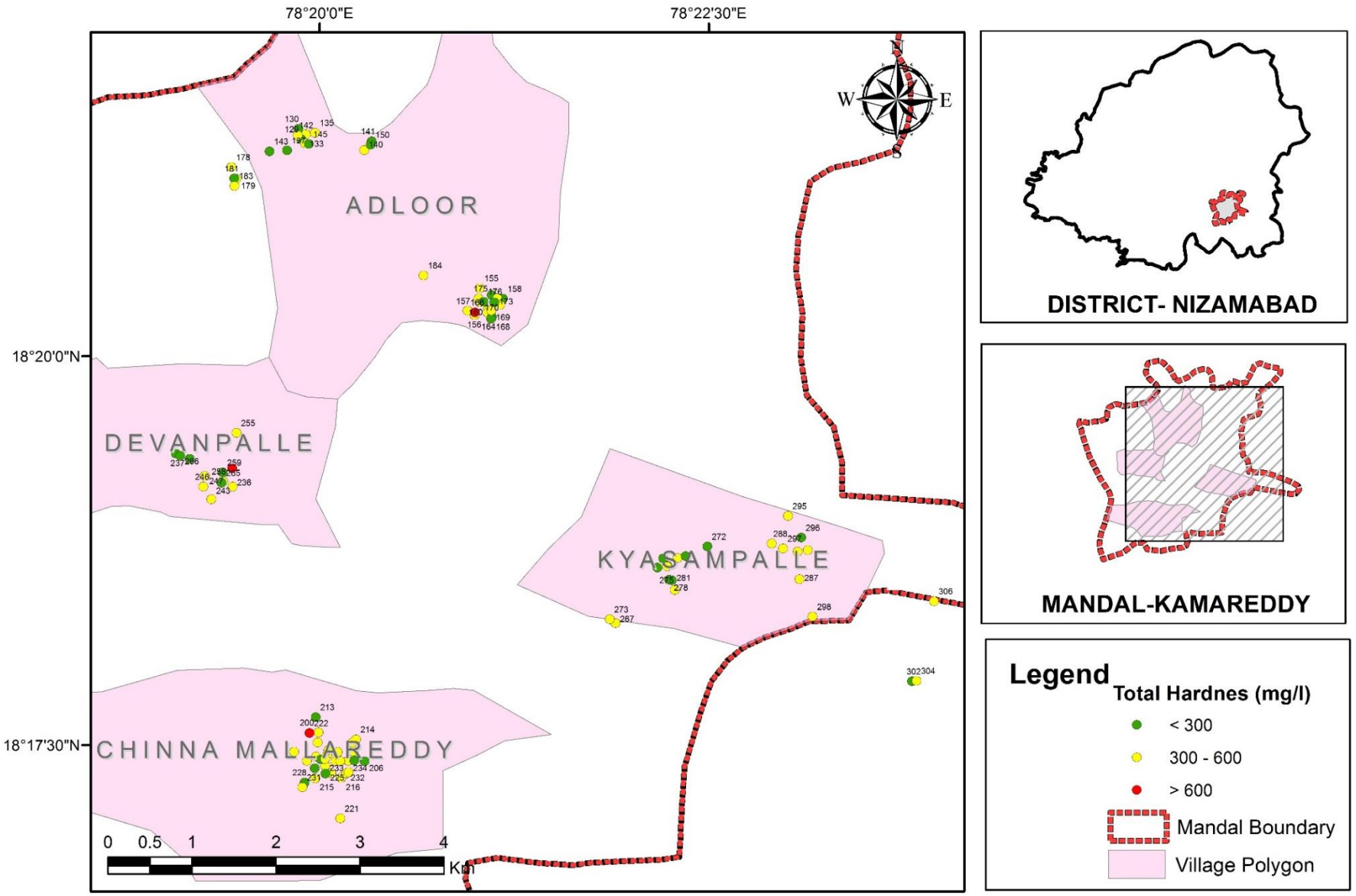
Map 15 showing Alkalinity values of Water sources points – Navipet Mandal
Note-All values for the given GPS points showing alkalinity within maximum permissible limit (yellow)



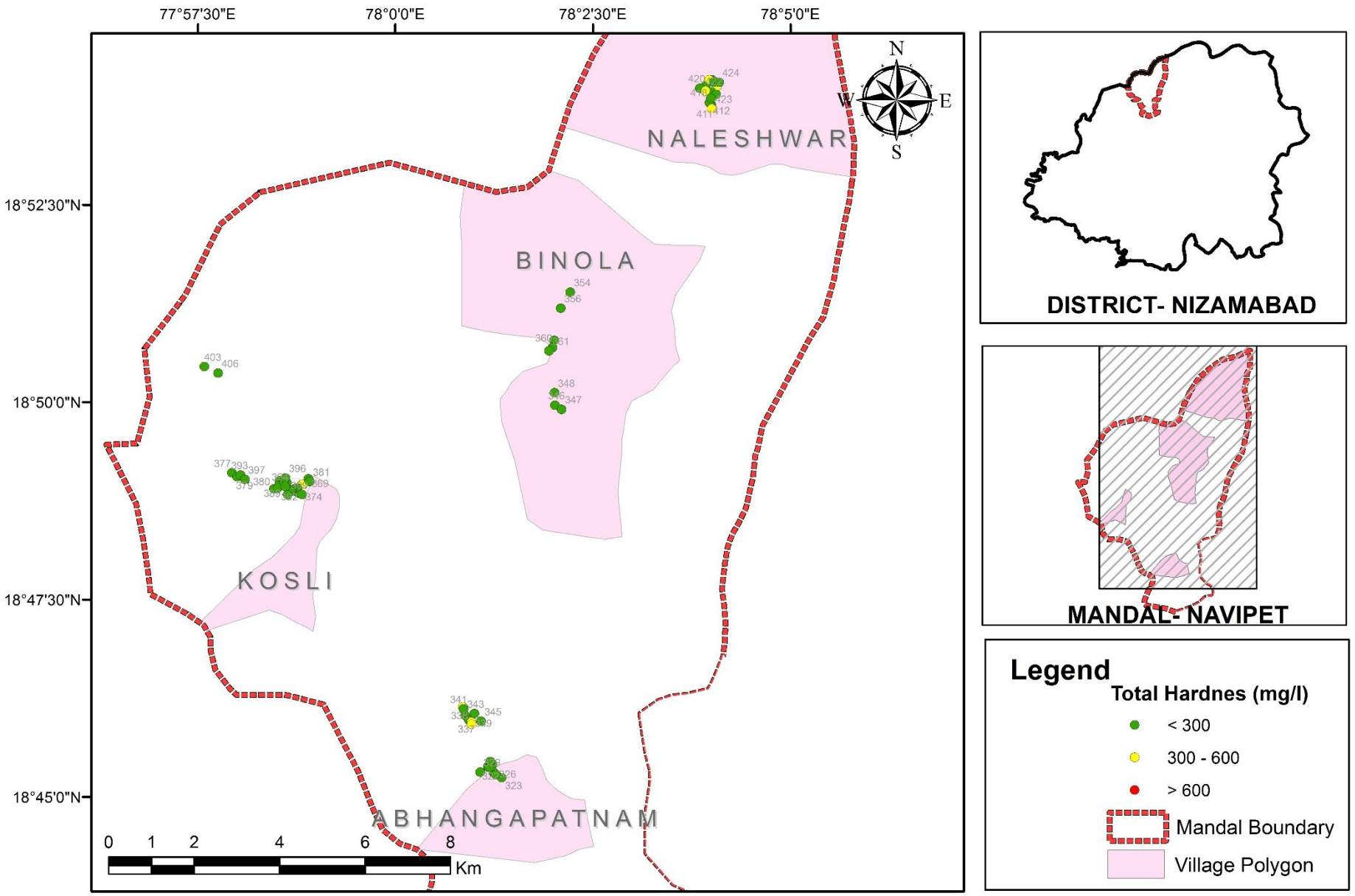
Map 16 showing Alkalinity values of Water sources points - Nizamabad Mandal
Note-All values for the given GPS points showing alkalinity within maximum permissible limit (yellow)



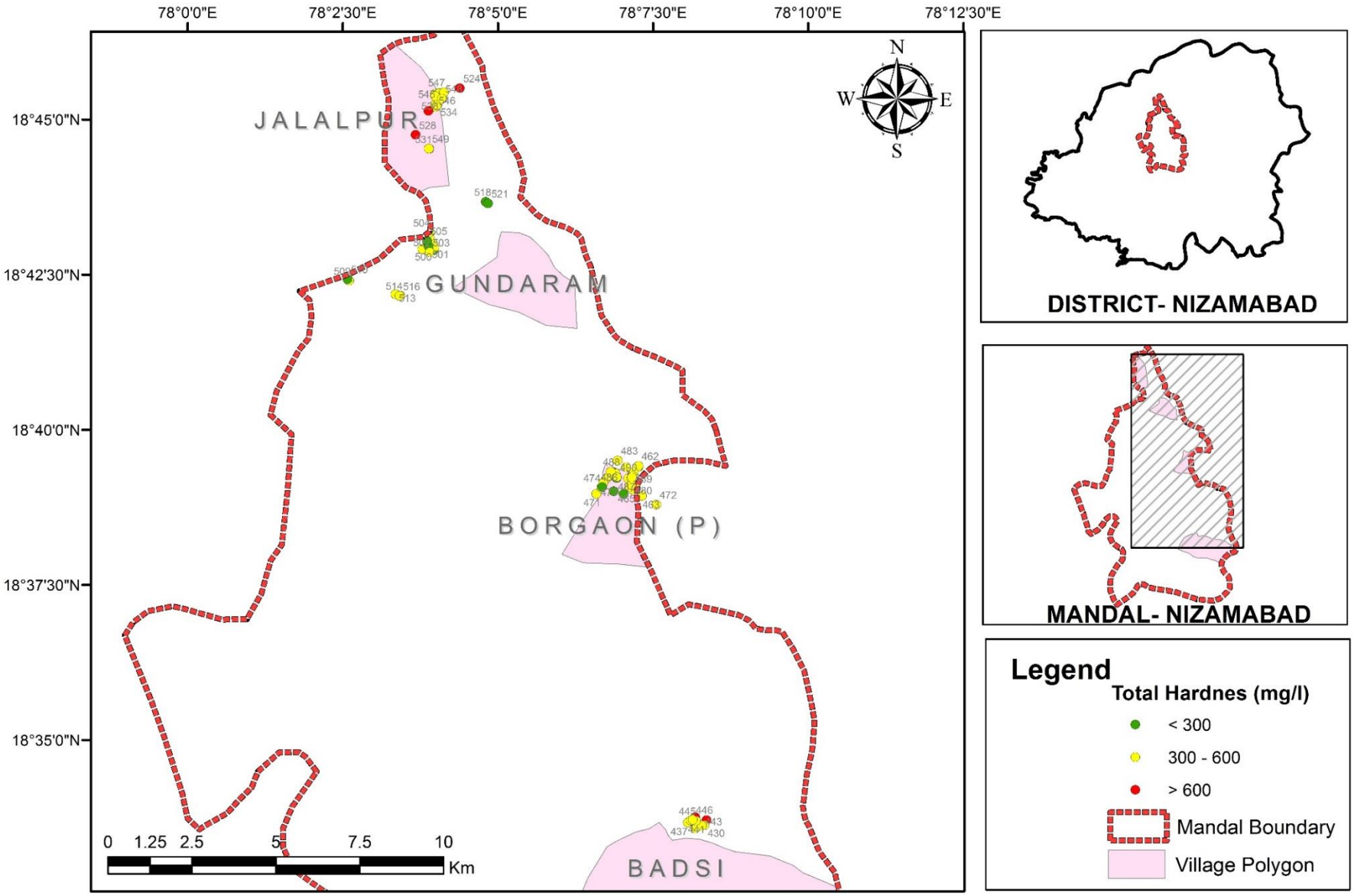
Map 17 showing Total Hardness values of Water sources points - Banswada Mandal
Note- Few sources in Tirmalapur and Borlum showing total hardness values within desirable limit (green) while all other values for the given GPS points showing values within maximum permissible limit (yellow)



Map 18 showing Total Hardness values of Water sources points - Kamareddy Mandal
Note- A mixed picture appears for Kamareddy mandal where around 30% sources shows total hardness values within desirable limit (green). Only 2-3 shows values above permissible limit (red). Rest others are within maximum permissible limit (yellow)

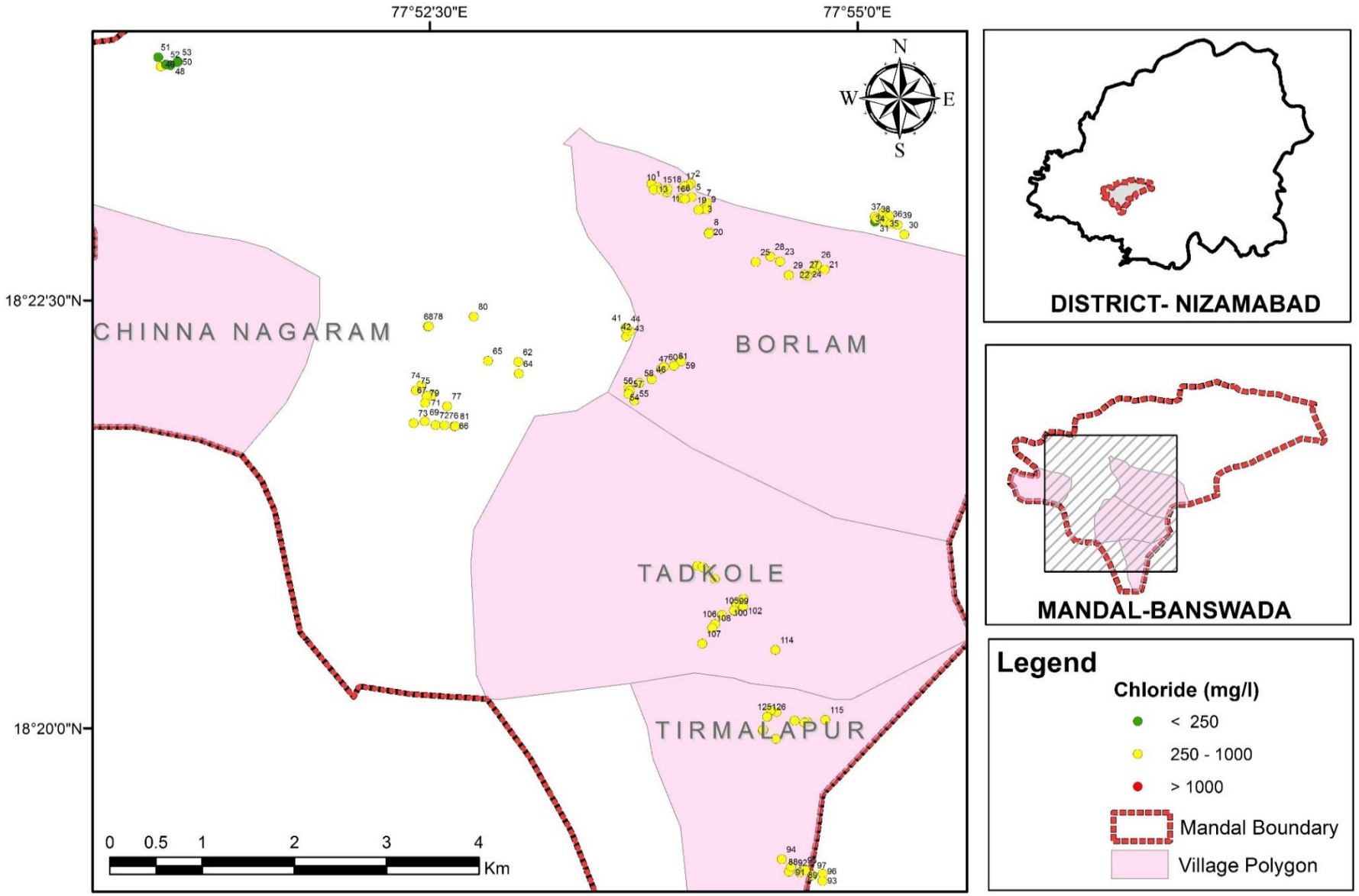


Map 19 showing Total Hardness values of Water sources points - Navipet Mandal
Note- Around 90% sources from the given GPS points shows the Total hardness values within the desirable limit (green). Remaining 10% are within the maximum permissible limit (yellow).

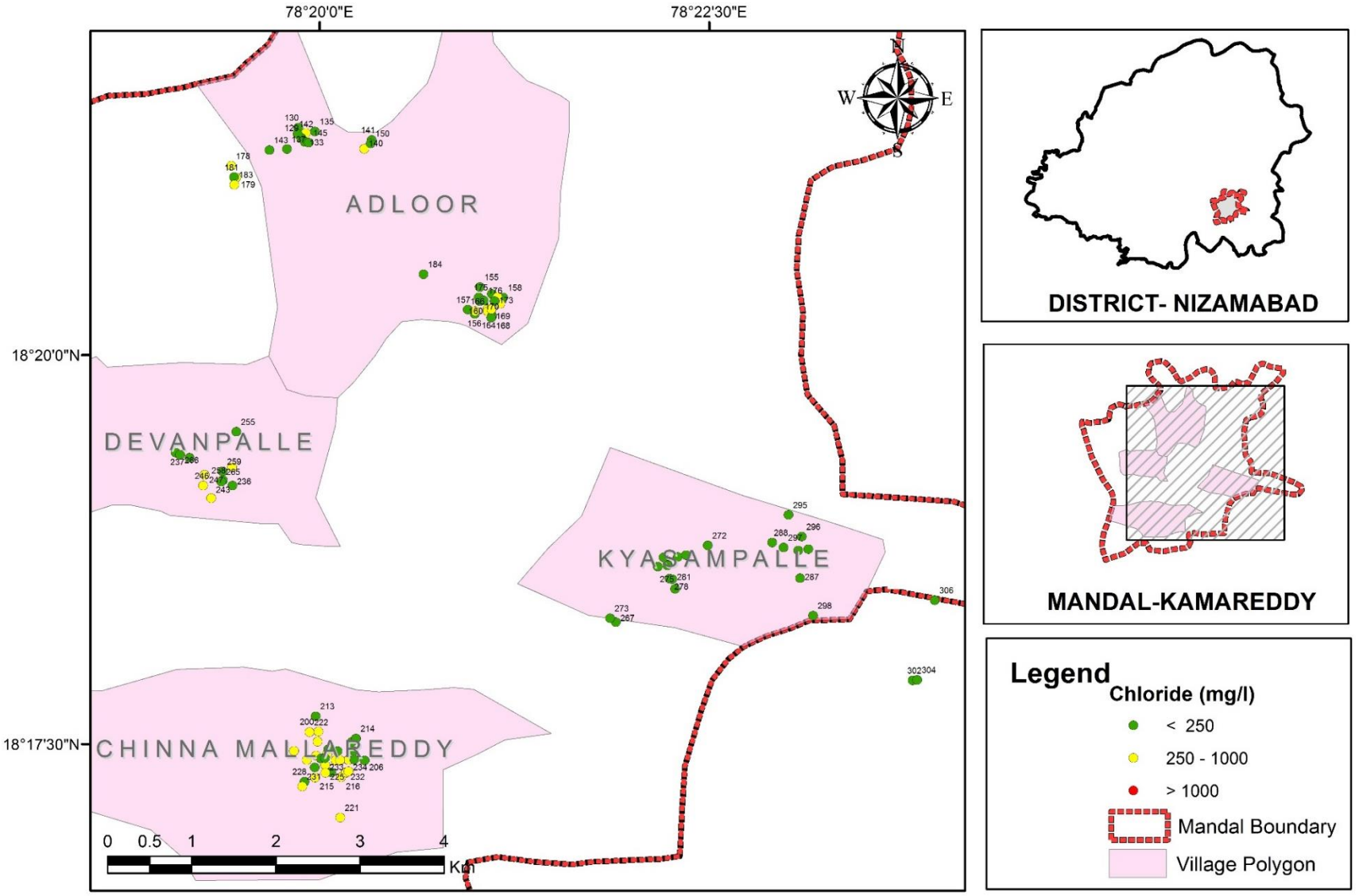


Map 20 showing Total Hardness values of Water sources points - Nizamabad Mandal

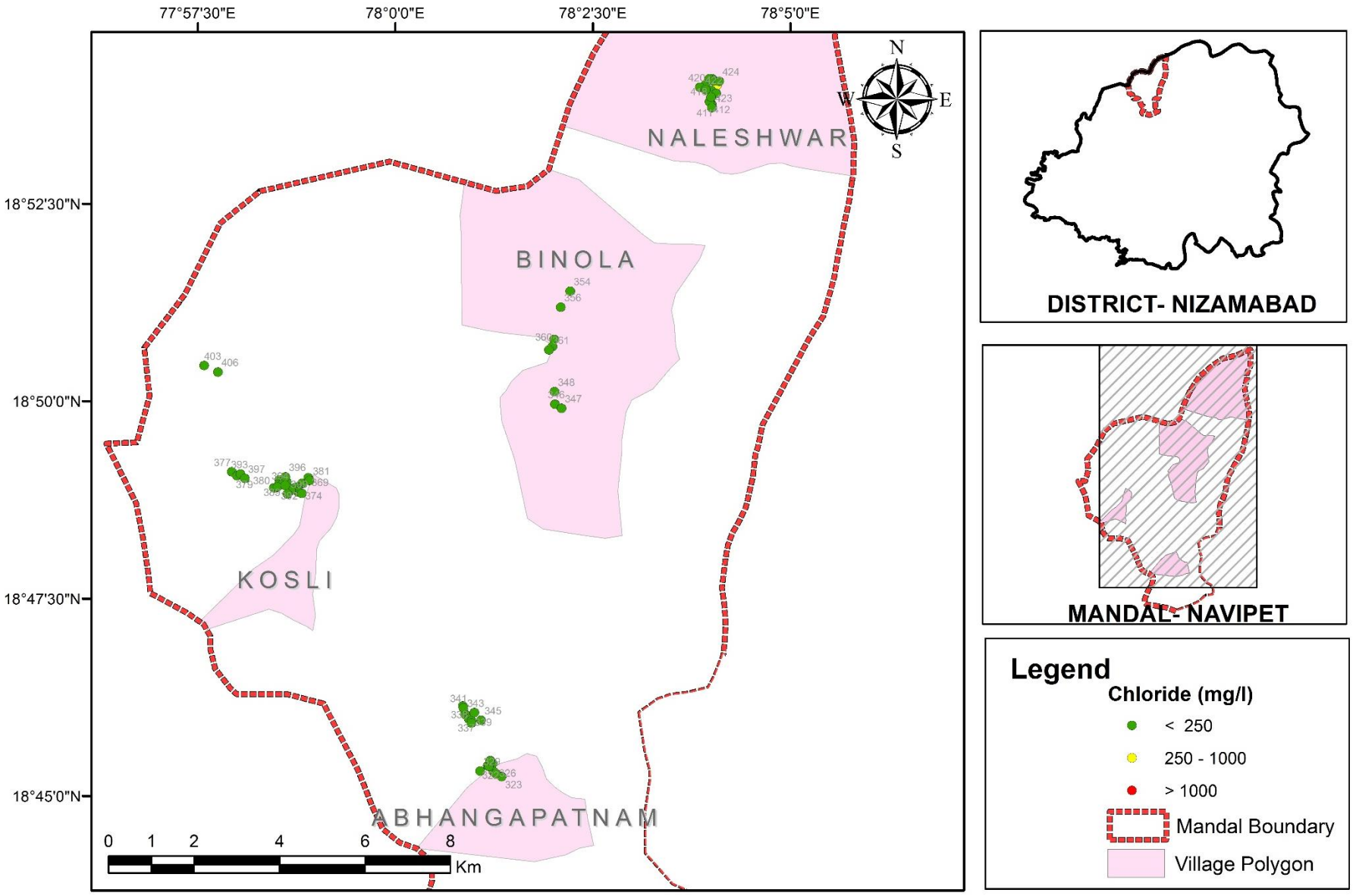
Note- Few sources in Badsi and Jalalpur showing total hardness values above permissible limit (red), few more showing values within desirable limit (green) while most other values for the given GPS points showing values within maximum permissible limit (yellow)



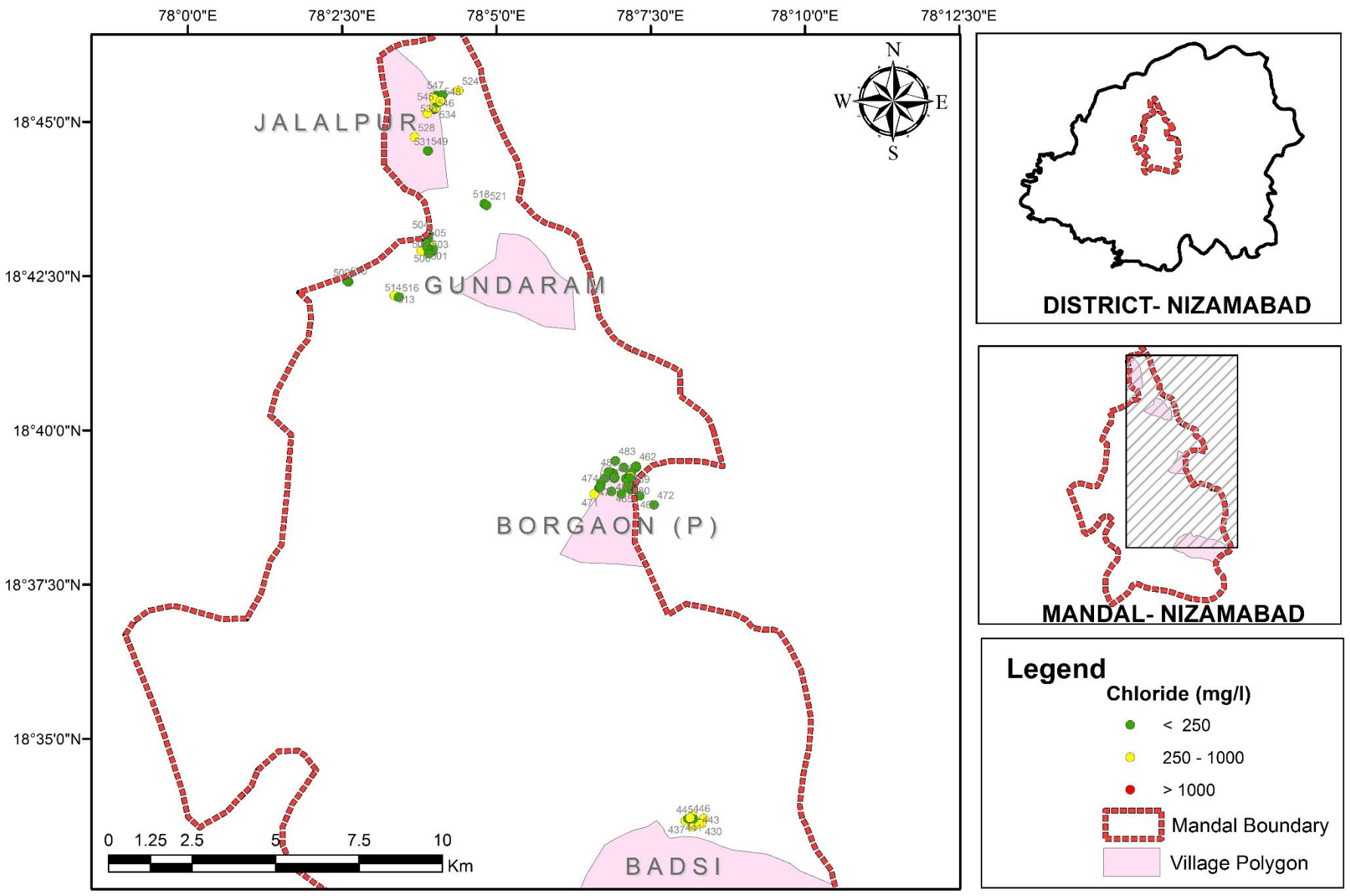
Map 21 showing Chloride values of Water sources points - Banswada Mandal
Note- All sources for the given GPS points showing chloride values within maximum permissible limit (yellow) except very few (3-4) showing values less than desirable limit (green).



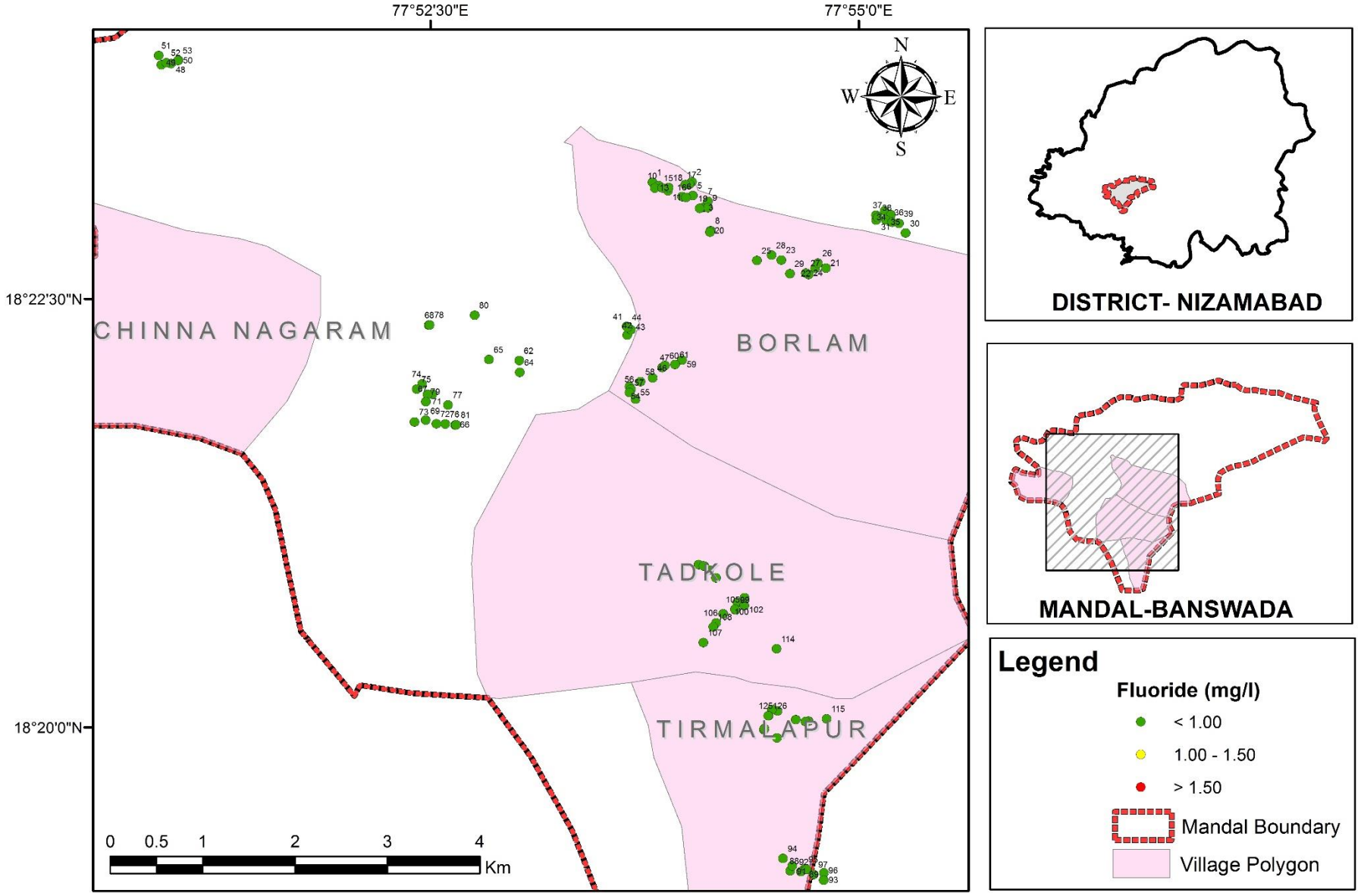
Map 22 showing Chloride values of Water sources points - Kamareddy Mandal
Note- A mixed pattern where around 60% values for chloride are within the desirable limit (green) while rest 40%, mostly in Chinna Mallareddy shows values within maximum permissible limit (yellow).



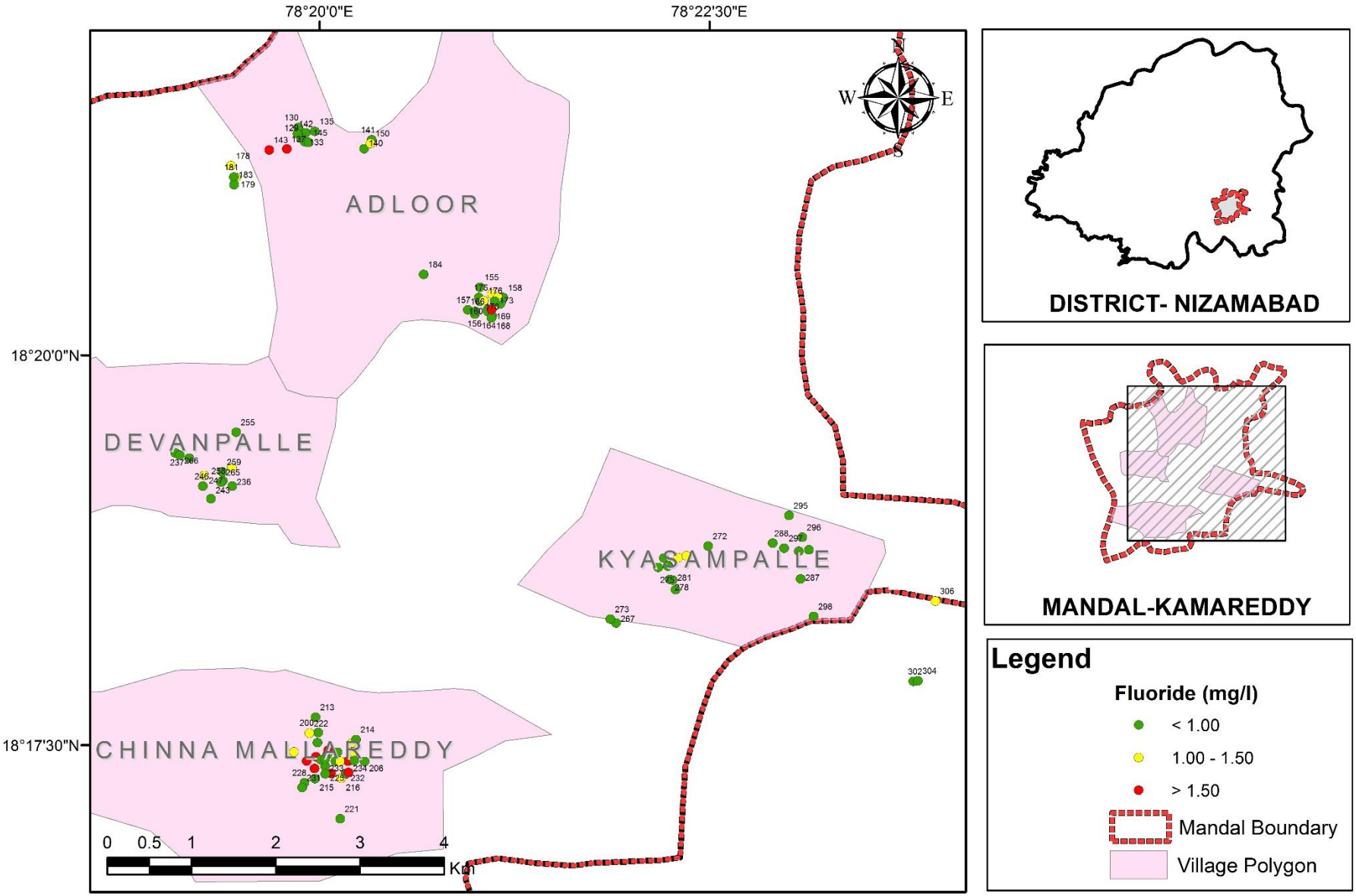
Map 23 showing Chloride values of Water sources points - Navipet Mandal
Note - All values for the given GPS points showing chloride within desirable limit (green)



Map 24 showing Chloride values of Water sources points - Nizamabad Mandal
Note – For the given GPS points most values for chloride near Borgaon and Gundaram are within the desirable limit (green) while in Badsi and Jalalpur most source shows chloride values within maximum permissible limit (yellow).

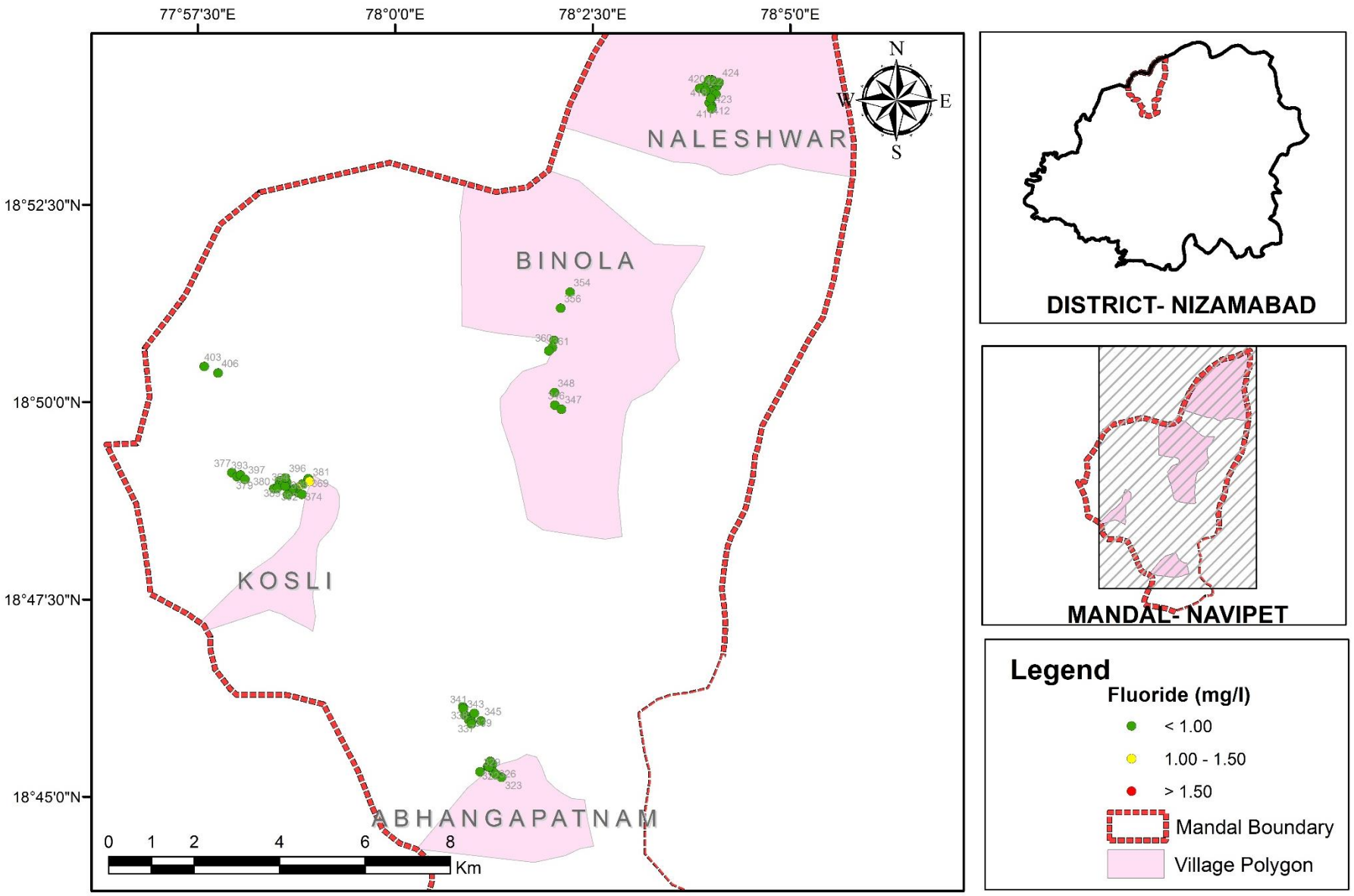


Map 25 showing Fluoride values of Water sources points - Banswada Mandal
Note- All values for the given GPS points showing fluoride within desirable limit (green)

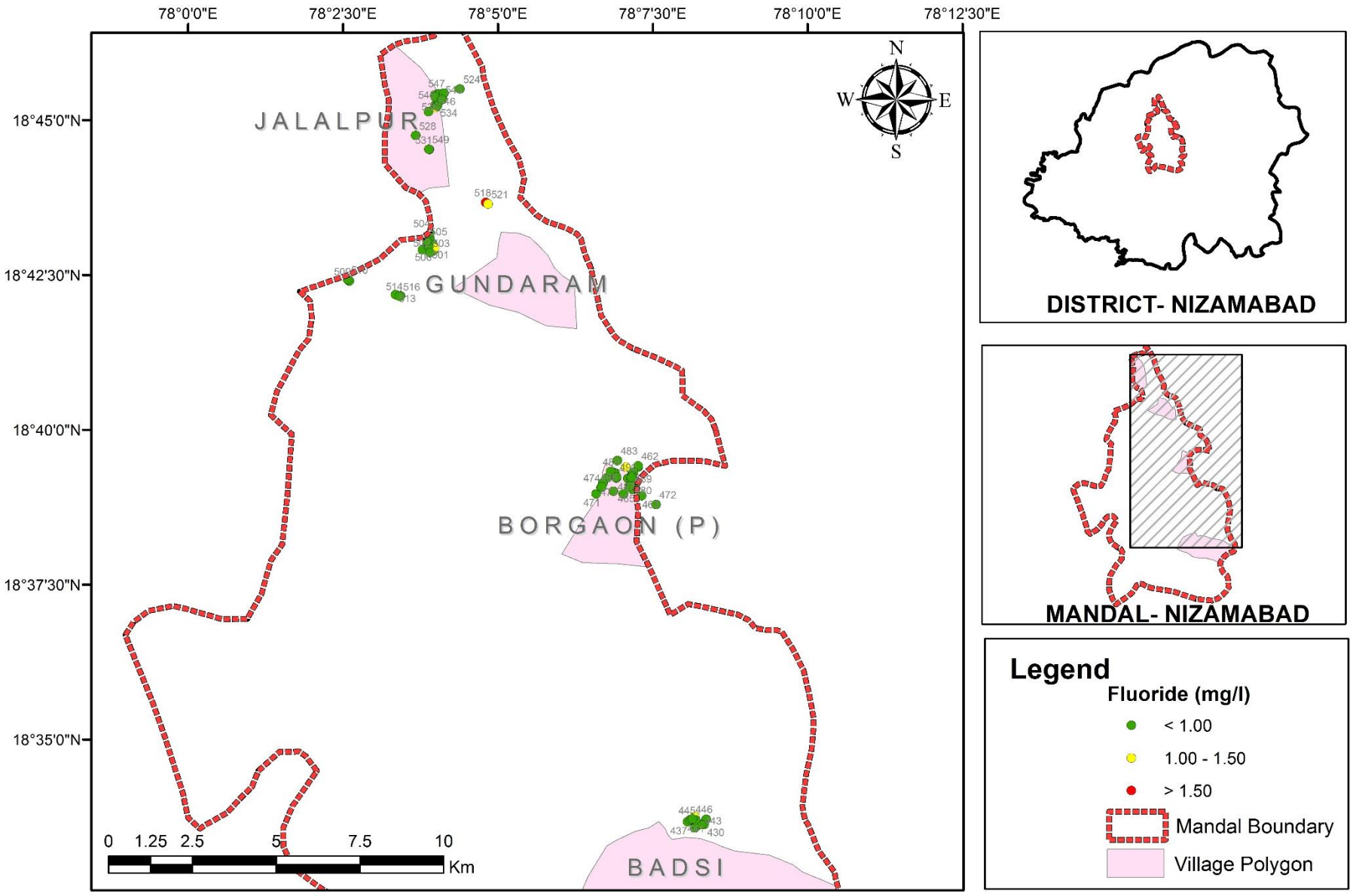


Map 26 showing Fluoride values of Water sources points - Kamareddy Mandal

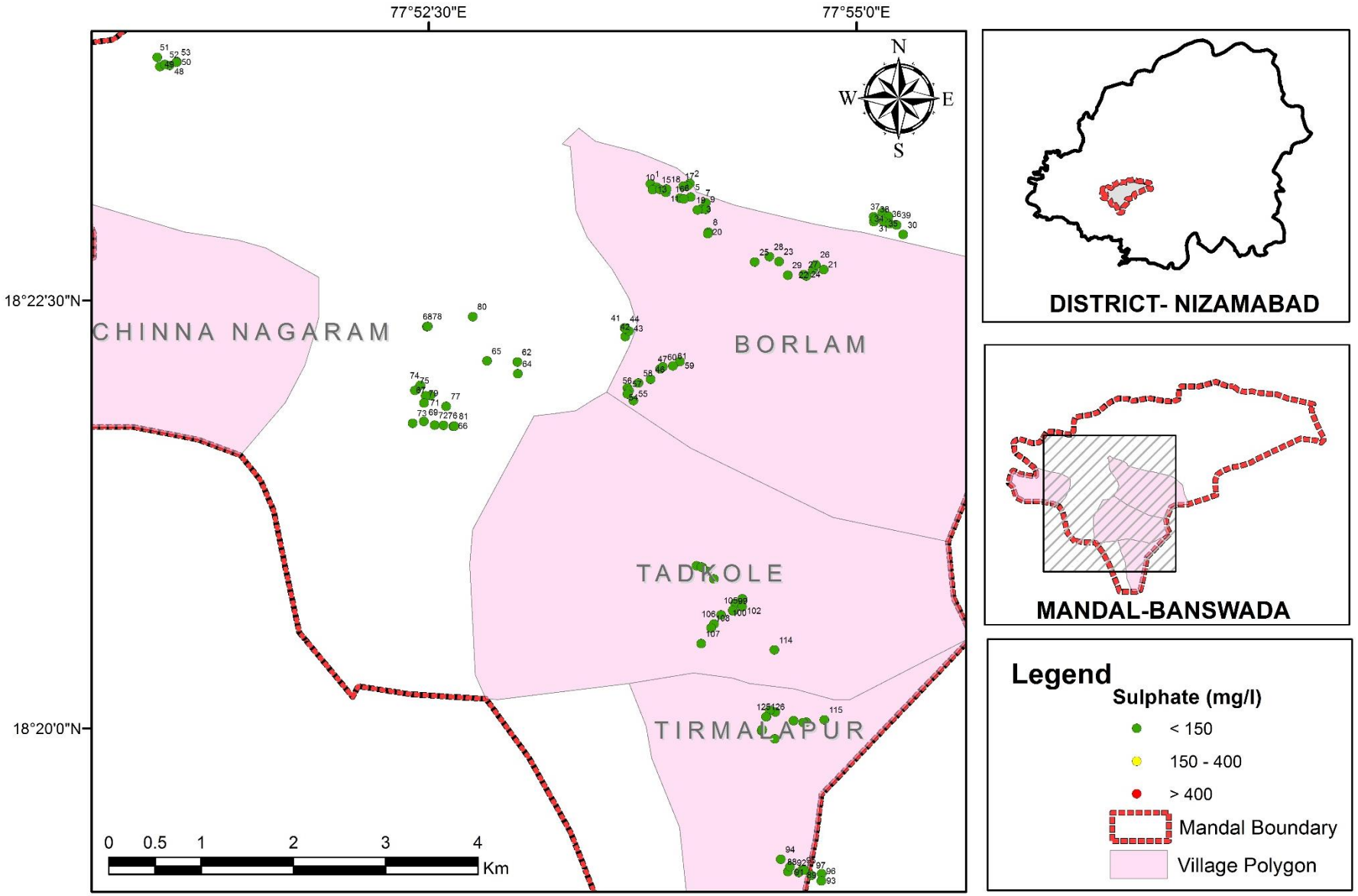
Note- Few noticeable sources (around 5%) in Chinna Mallareddy and Adloor shows fluoride values above maximum permissible limit (red), other 80% values are within desirable limit (green), rest are within maximum permissible limit (yellow).



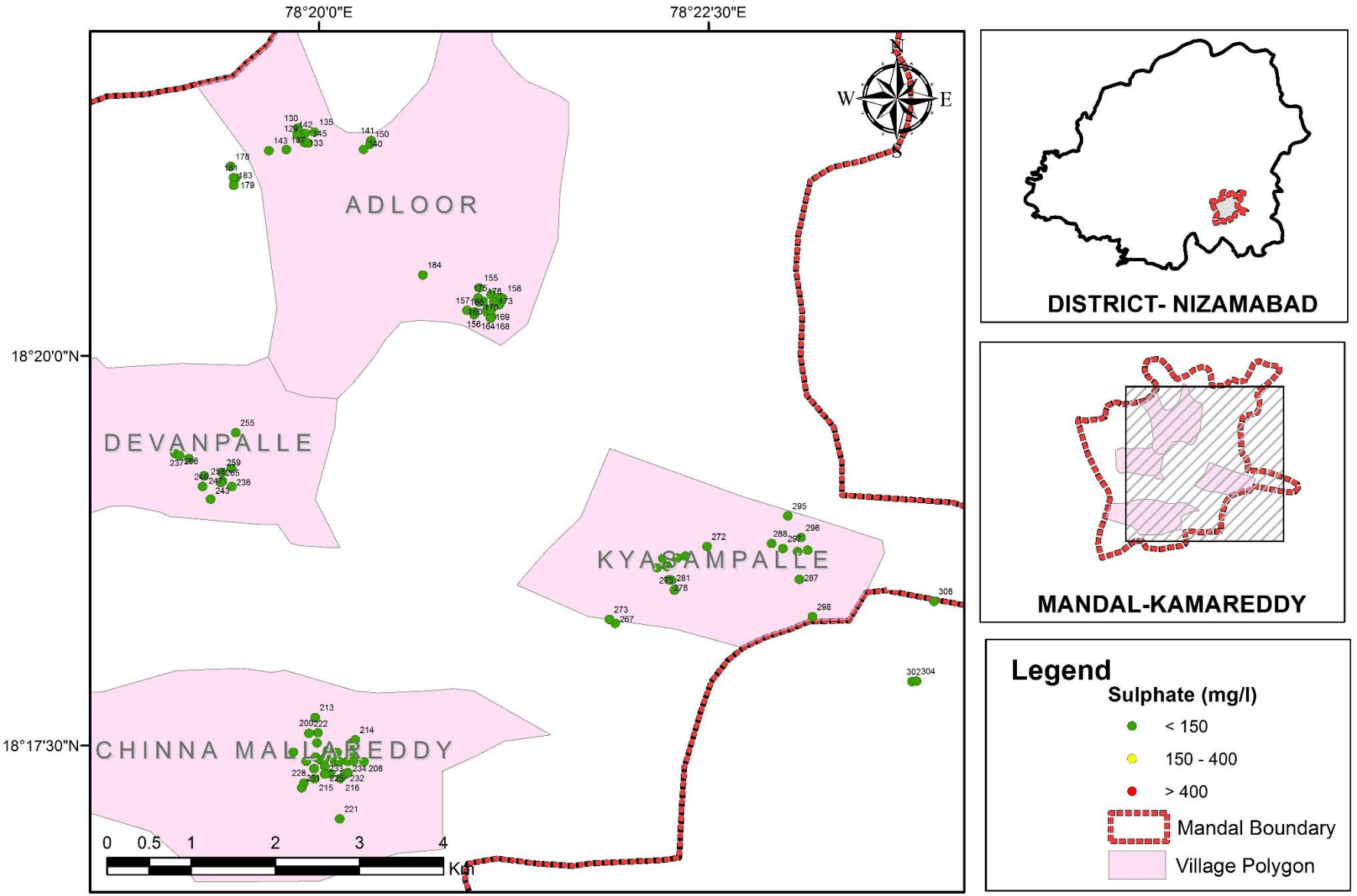
Map 27 showing Fluoride values of Water sources points - Navipet Mandal
Note- All values for the given GPS points showing fluoride within desirable limit (green) except one near Kosli is within maximum permissible limit.



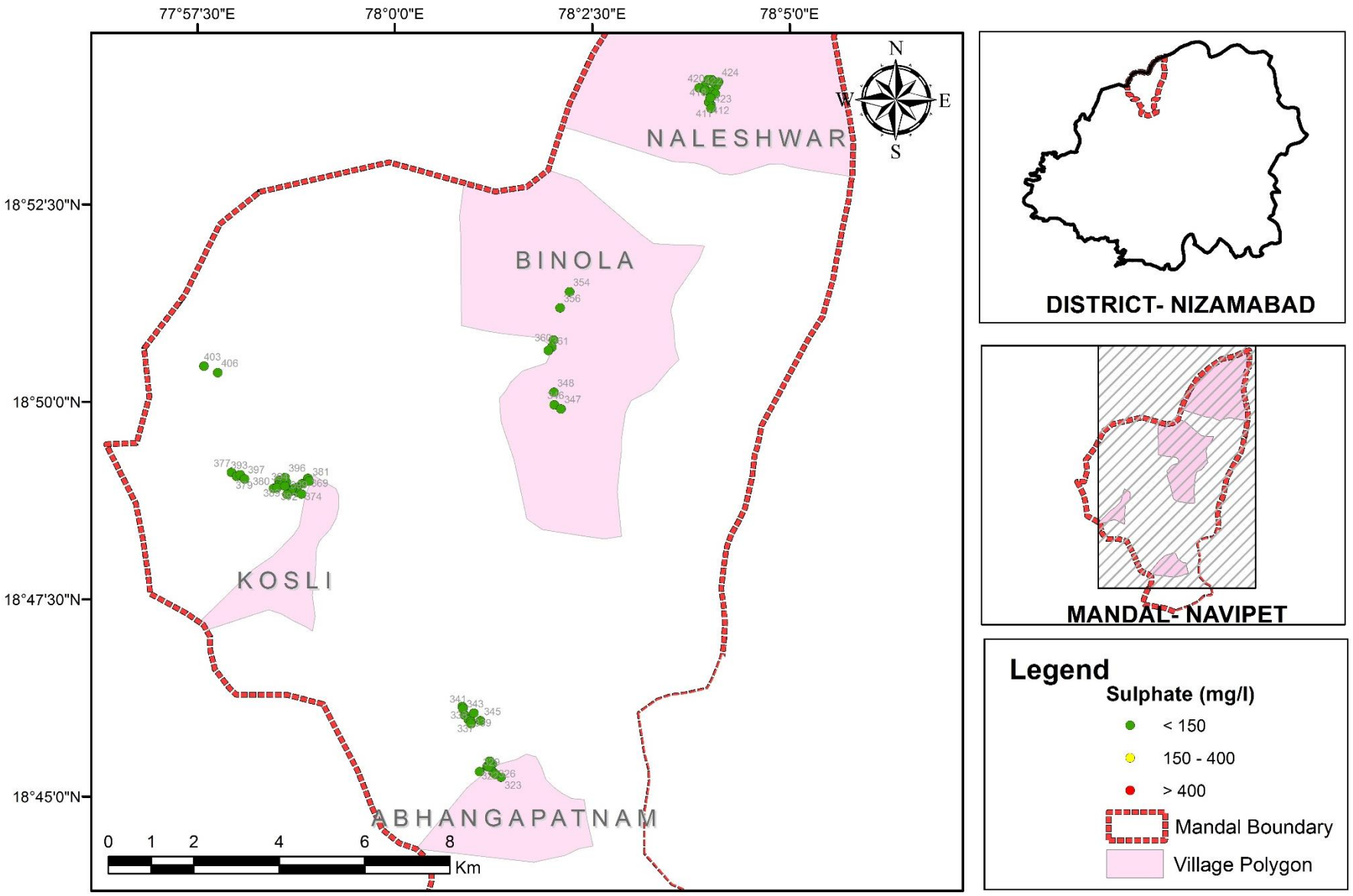
Map 28 showing Fluoride values of Water sources points - Nizamabad Mandal
Note- Most sources for given GPS points showing fluoride values under desirable limit (green), very few within the maximum permissible limit (yellow) while only one shows fluoride above permissible limit (red).



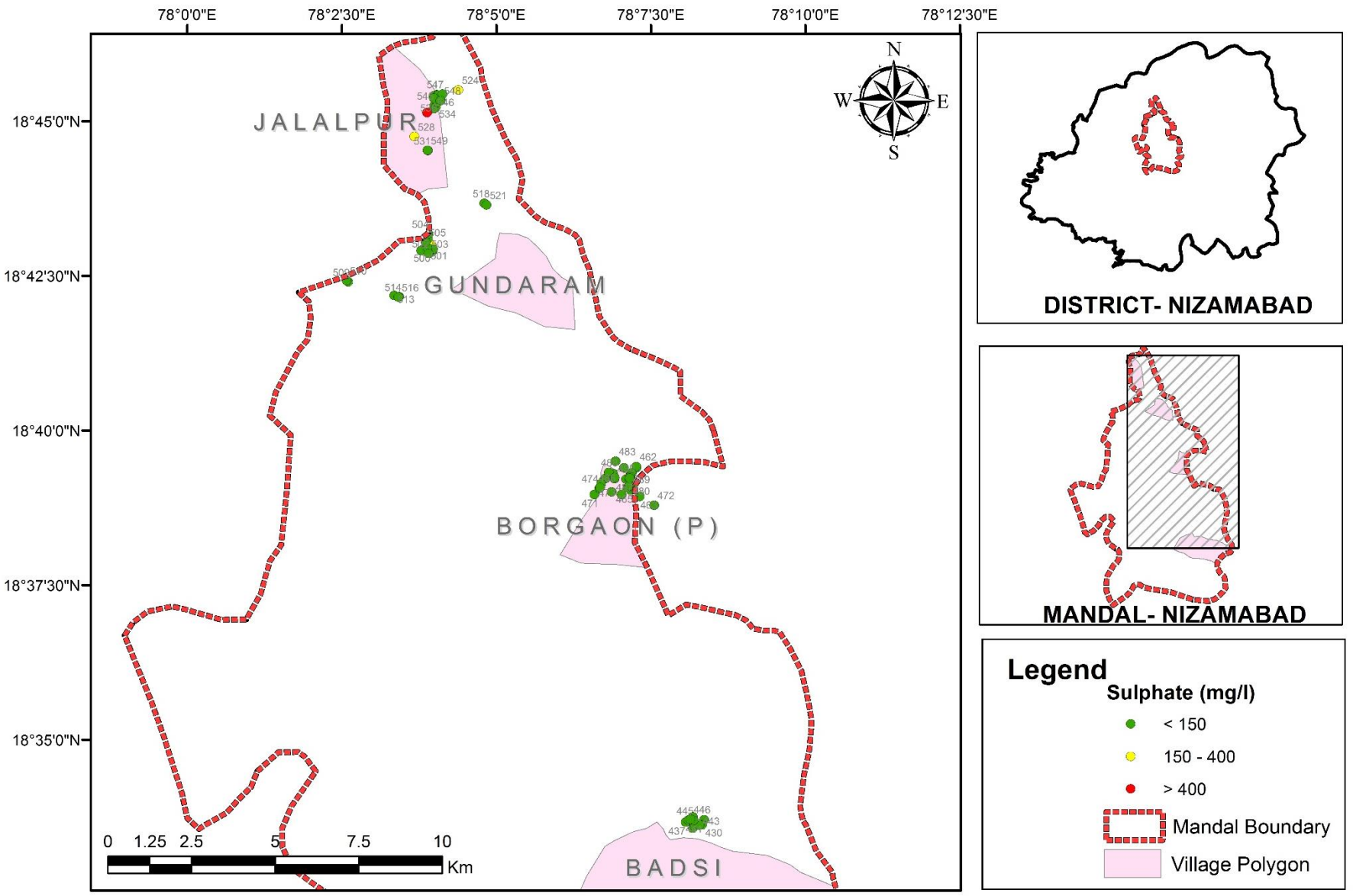
Map 29 showing Sulphate values of Water sources points - Banswada Mandal
Note- All values for the given GPS points showing Sulphate within desirable limit (green).



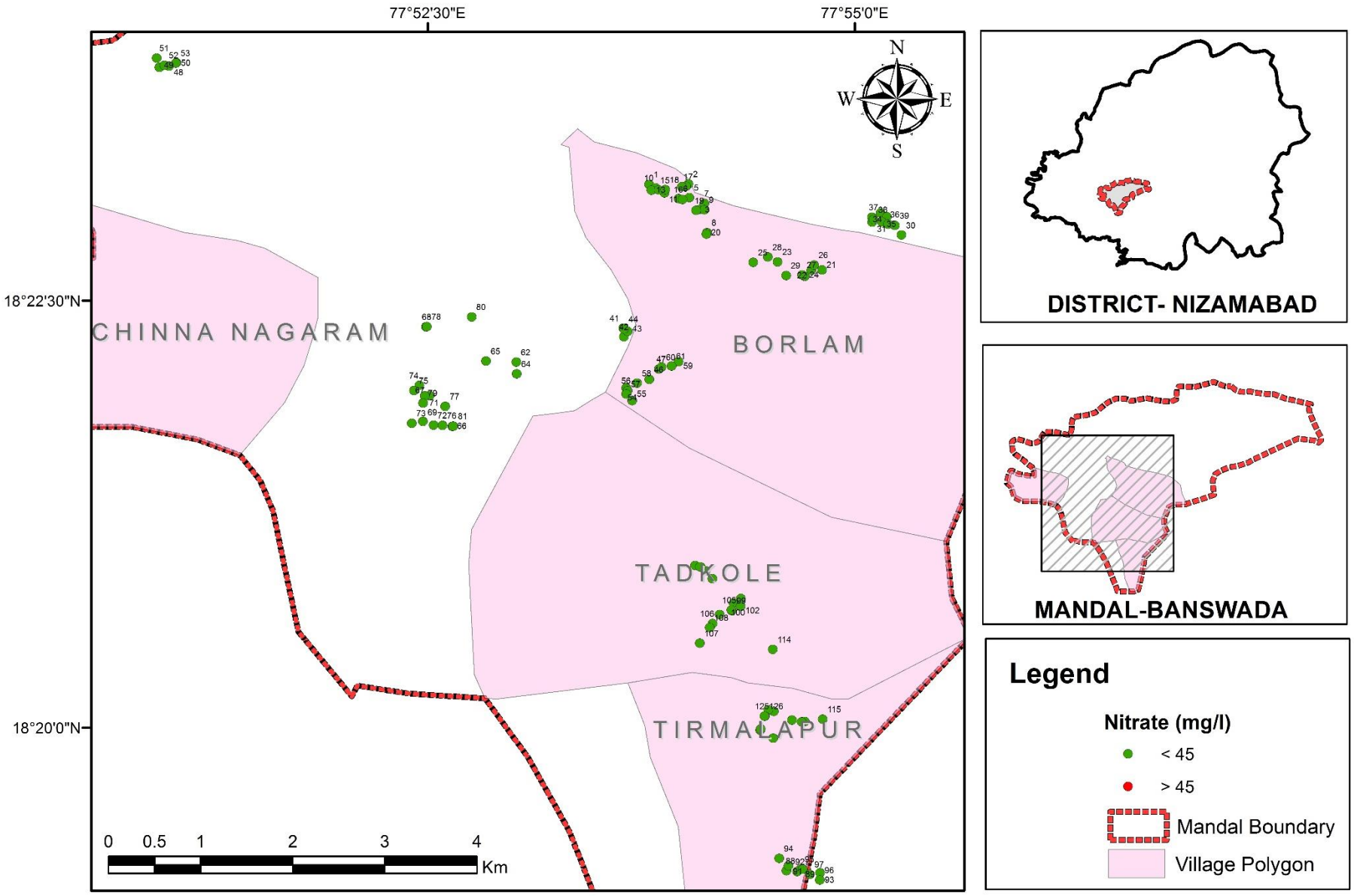
Map 30 showing Sulphate values of Water sources points - Kamareddy Mandal
Note- All values for the given GPS points showing Sulphate within desirable limit (green).



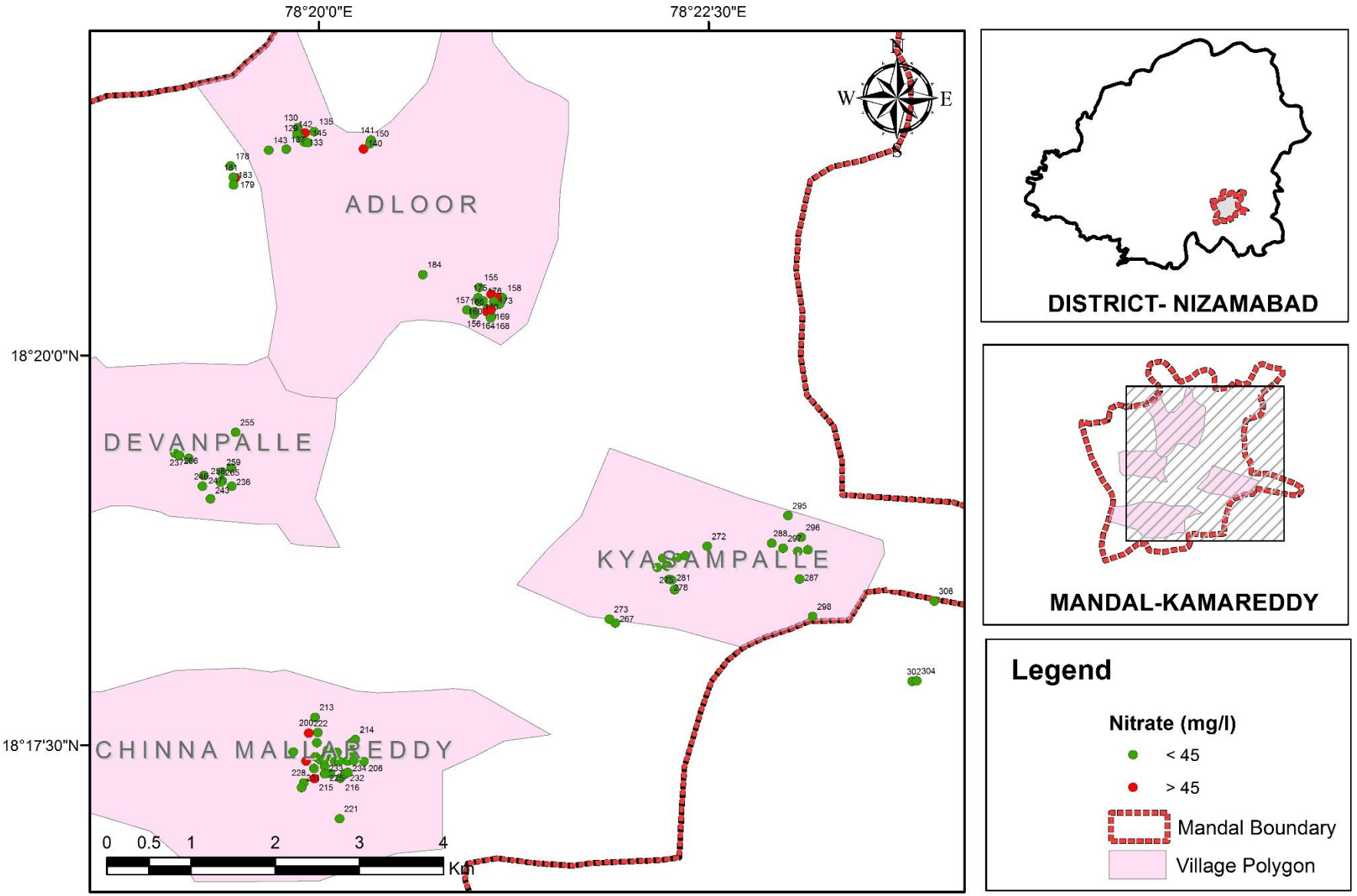
Map 31 showing Sulphate values of Water sources points - Navipet Mandal
Note- All values for the given GPS points showing Sulphate within desirable limit (green).



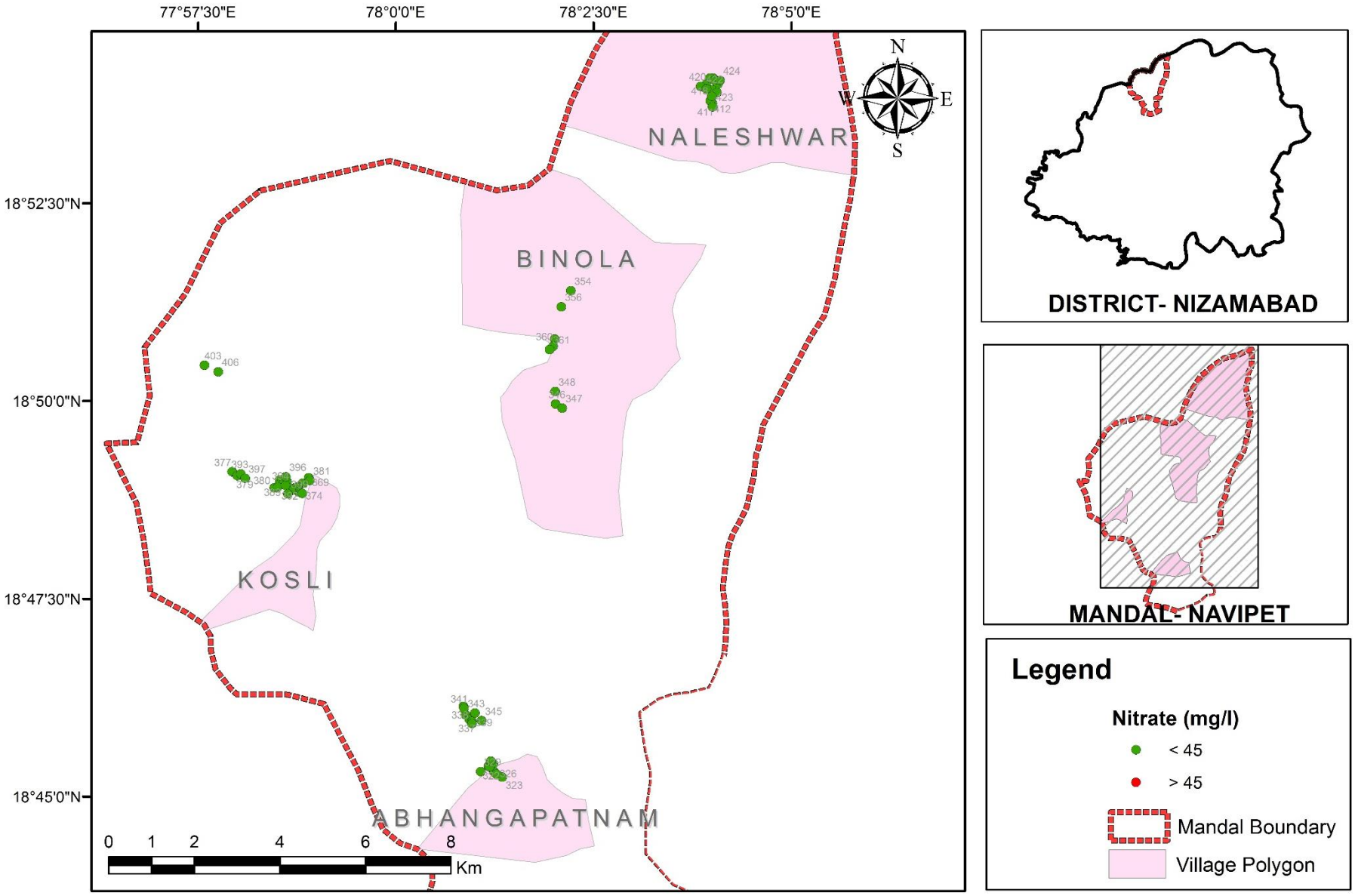
Map 32 showing Sulphate values of Water sources points - Nizamabad Mandal
Note- All values for the given GPS points showing Sulphate within desirable limit (green) except very few in Jalalpur showing sulphate within maximum permissible limit (yellow). Only one is above permissible limit (red).



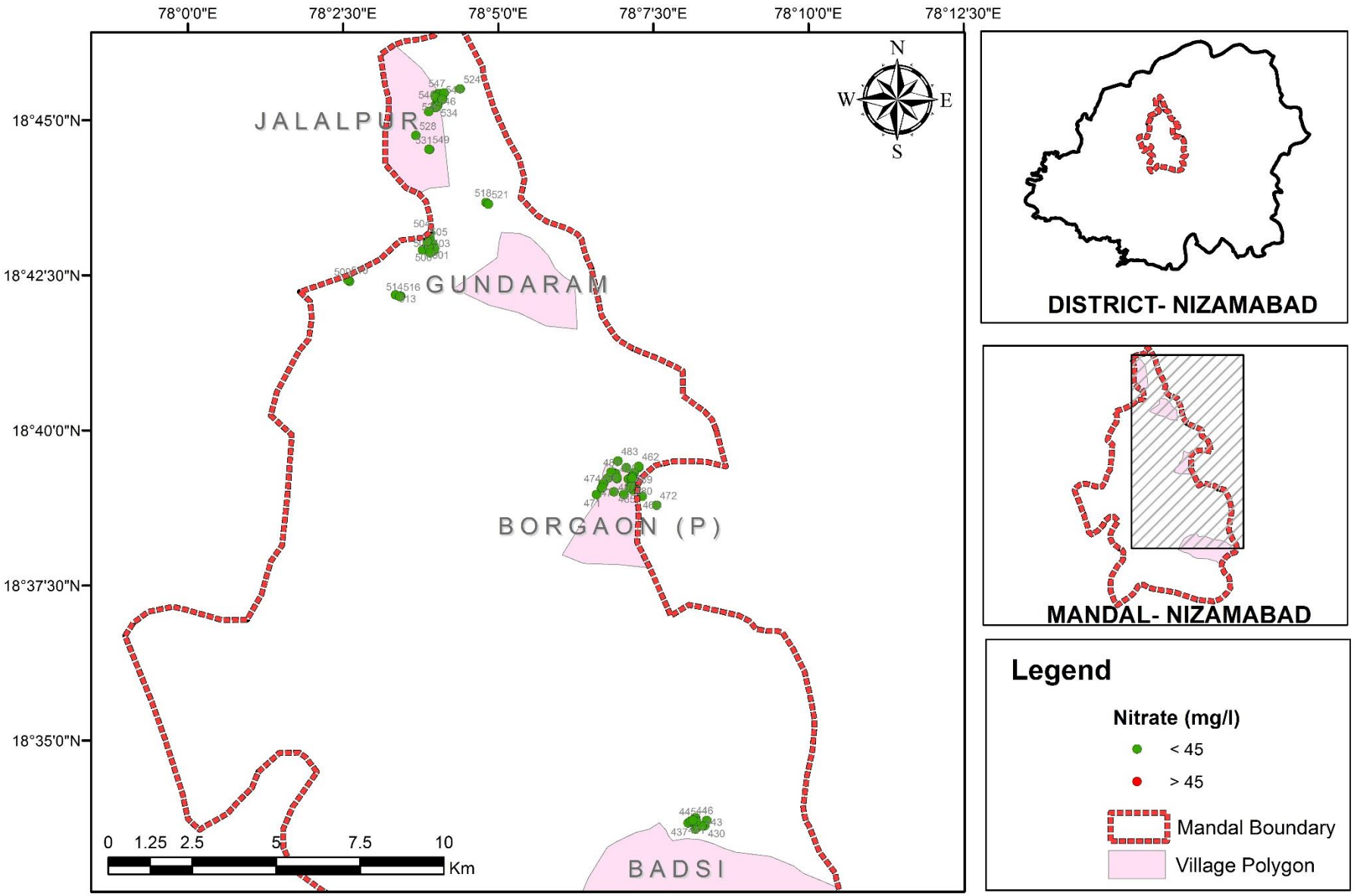
Map 33 showing Nitrate values of Water sources points - Banswada Mandal
Note - All values for the given GPS points showing Nitrate within desirable limit (green).



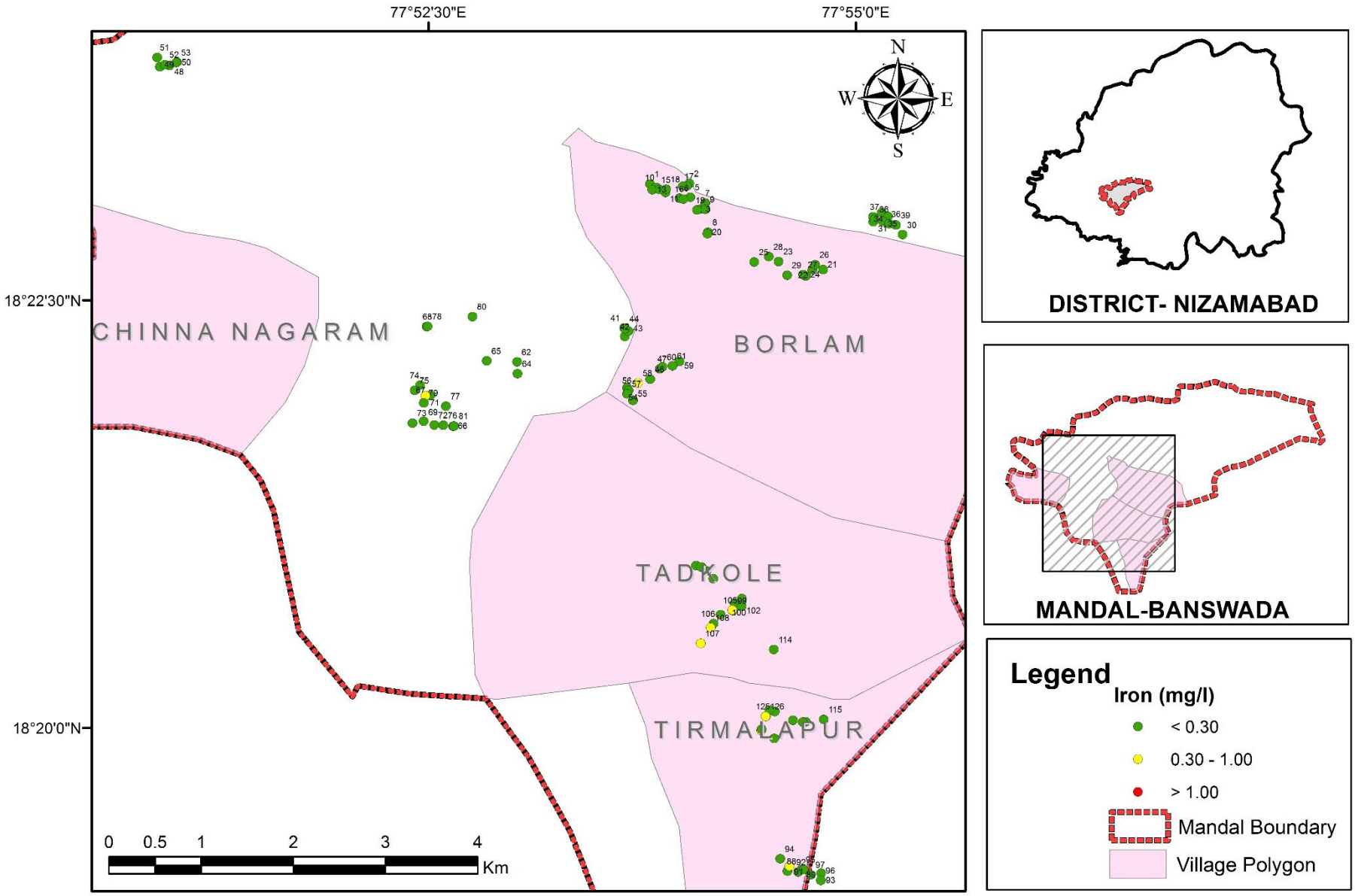
Map 34 showing Nitrate values of Water sources points - Kamareddy Mandal
Note – Most values for the given GPS points showing Nitrate within desirable limit (green). Few (5%) are above permissible limit (red).



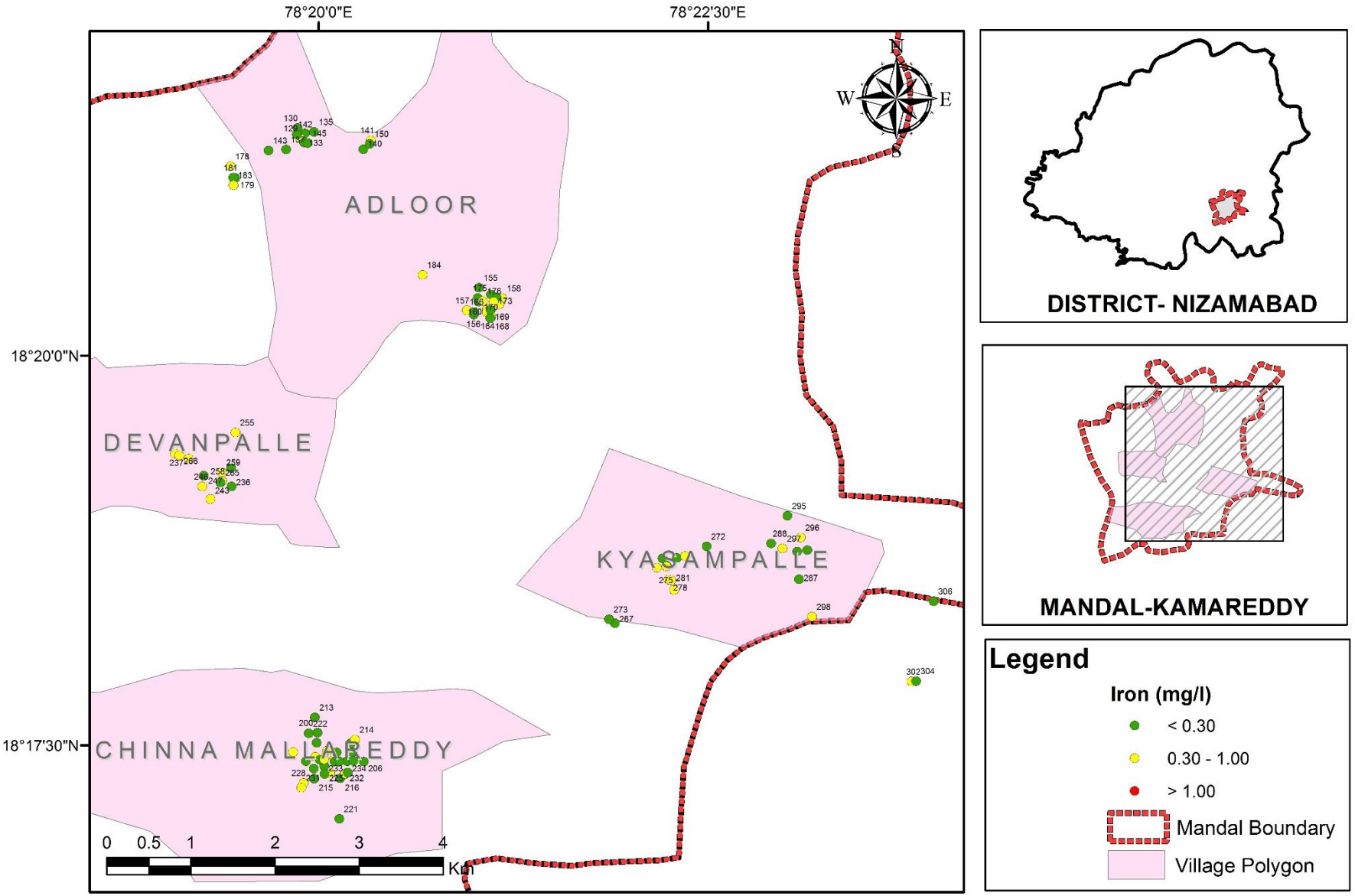
Map 35 showing Nitrate values of Water sources points - Nizamabad Mandal
Note – Most values for the given GPS points showing Nitrate within desirable limit (green).



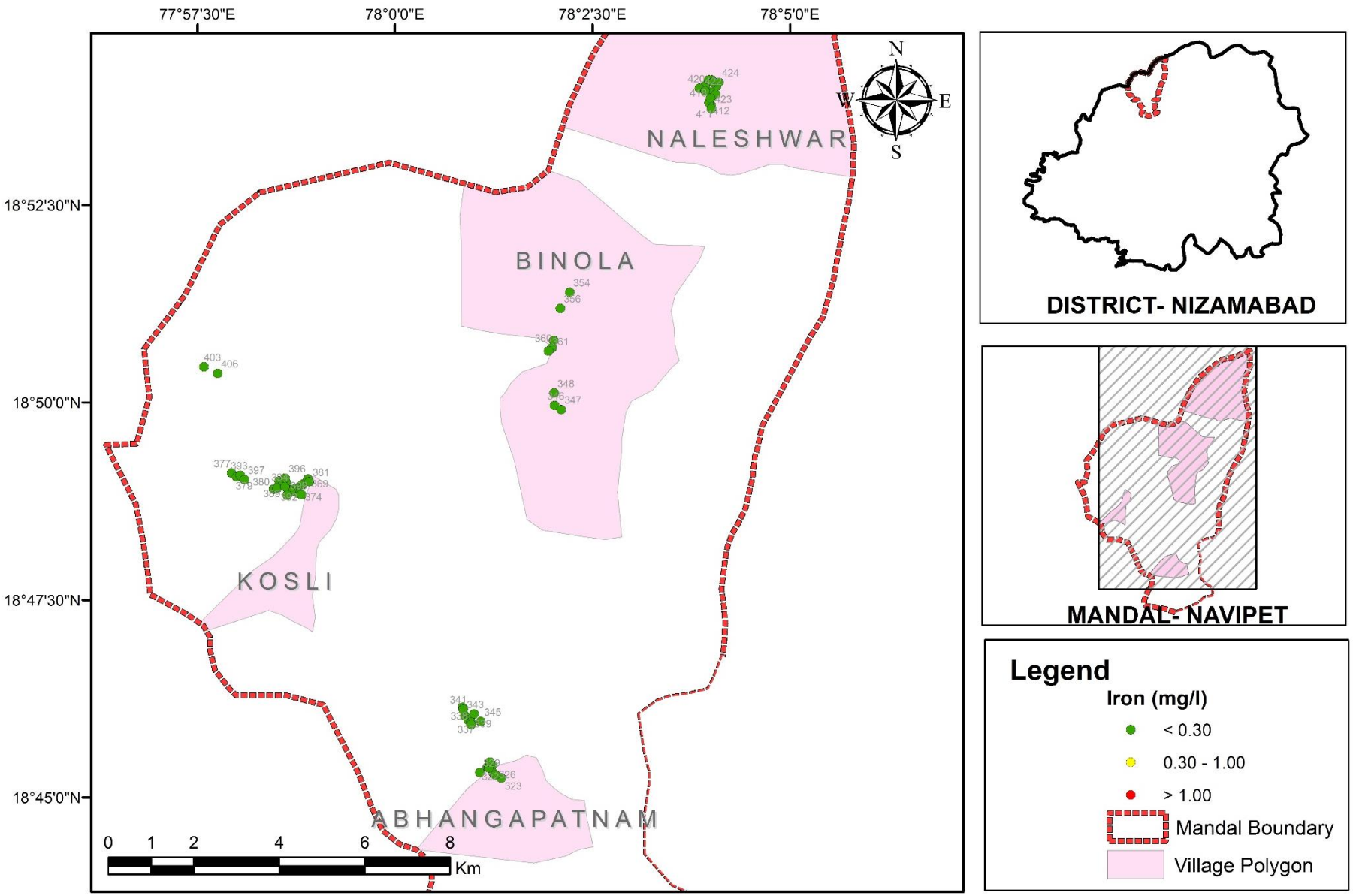
Map 36 showing Nitrate values of Water sources points - Nizamabad Mandal
Note – All values for the given GPS points showing Nitrate within desirable limit (green).



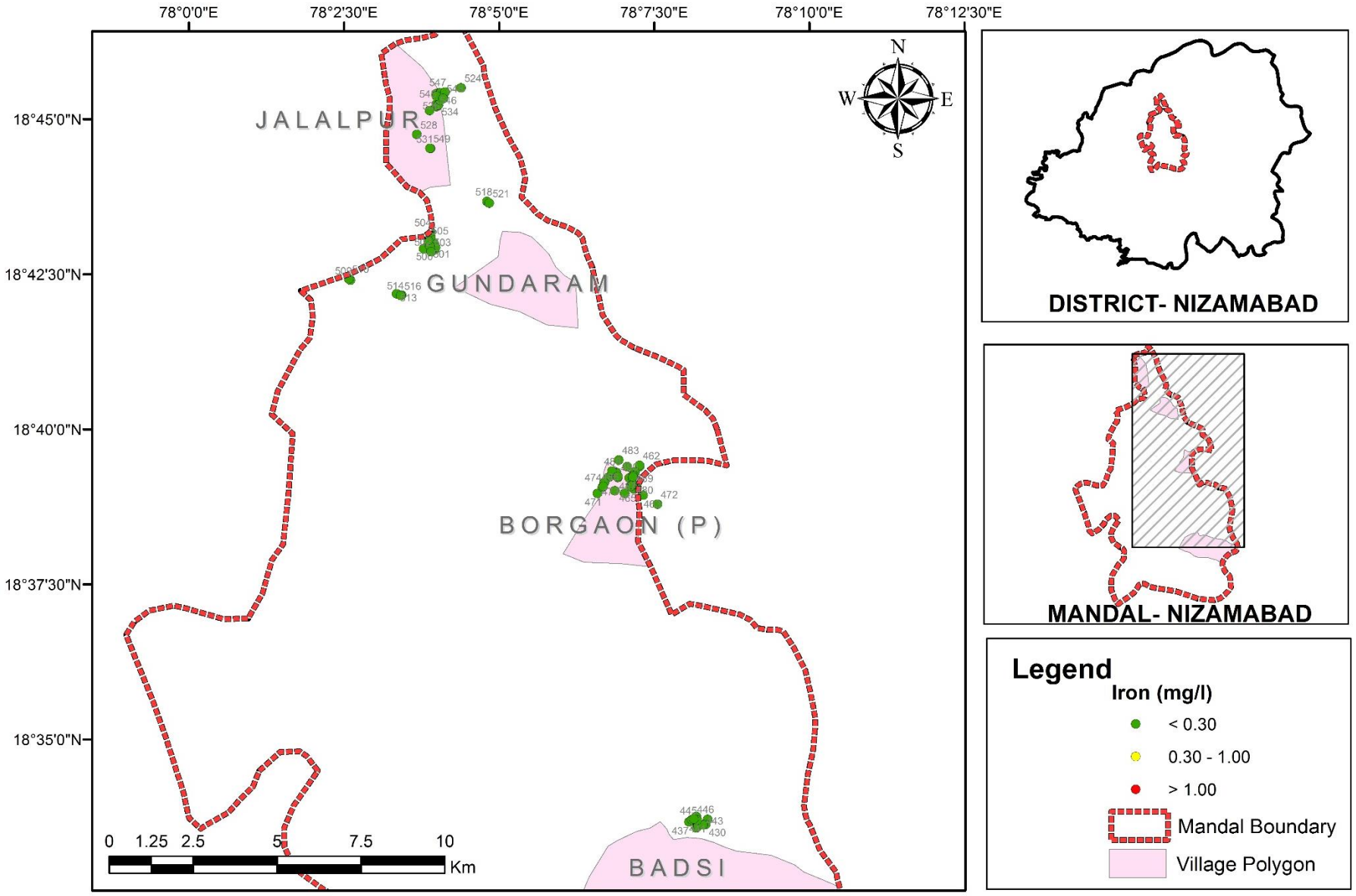
Map 37 showing Iron values of Water sources points - Banswada Mandal
Note – Most values for the given GPS points showing Iron within desirable limit (green). Other very few showing Iron contamination within maximum permissible limit (yellow).



Map 38 showing Iron values of Water sources points - Kamareddy Mandal
Note – More than 50% sources for the given GPS points showing Iron within desirable limit (green). Remaining others showing Iron contamination within maximum permissible limit (yellow).



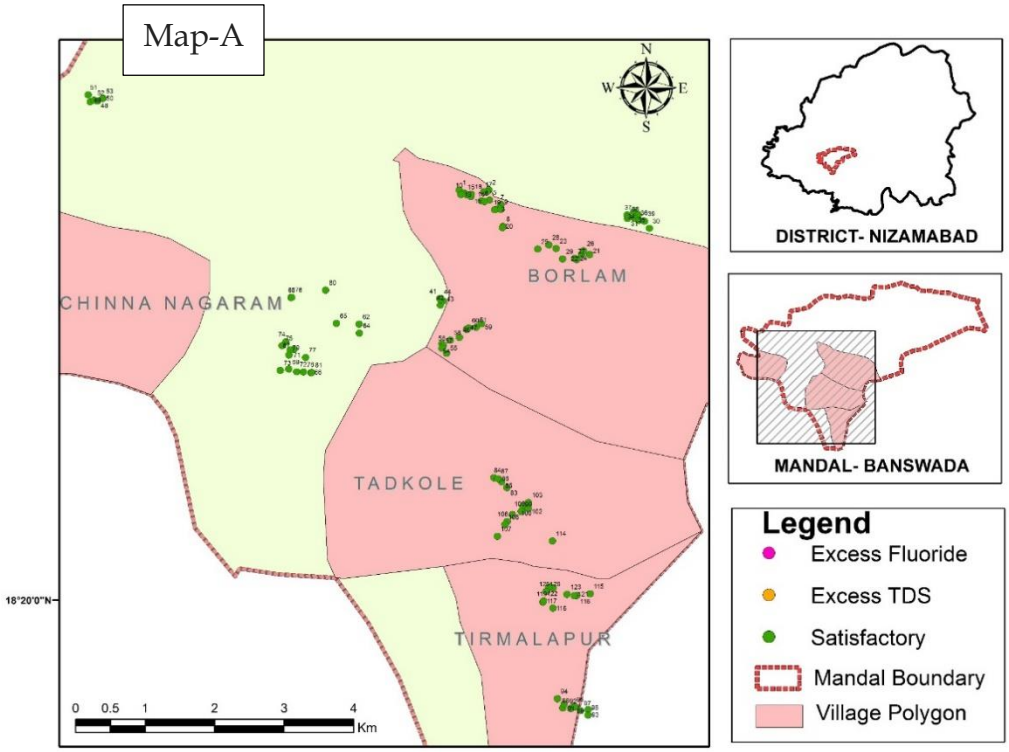
Map 39 showing Iron values of Water sources points - Navipet Mandal
Note – All sources for the given GPS points showing Iron within desirable limit (green).

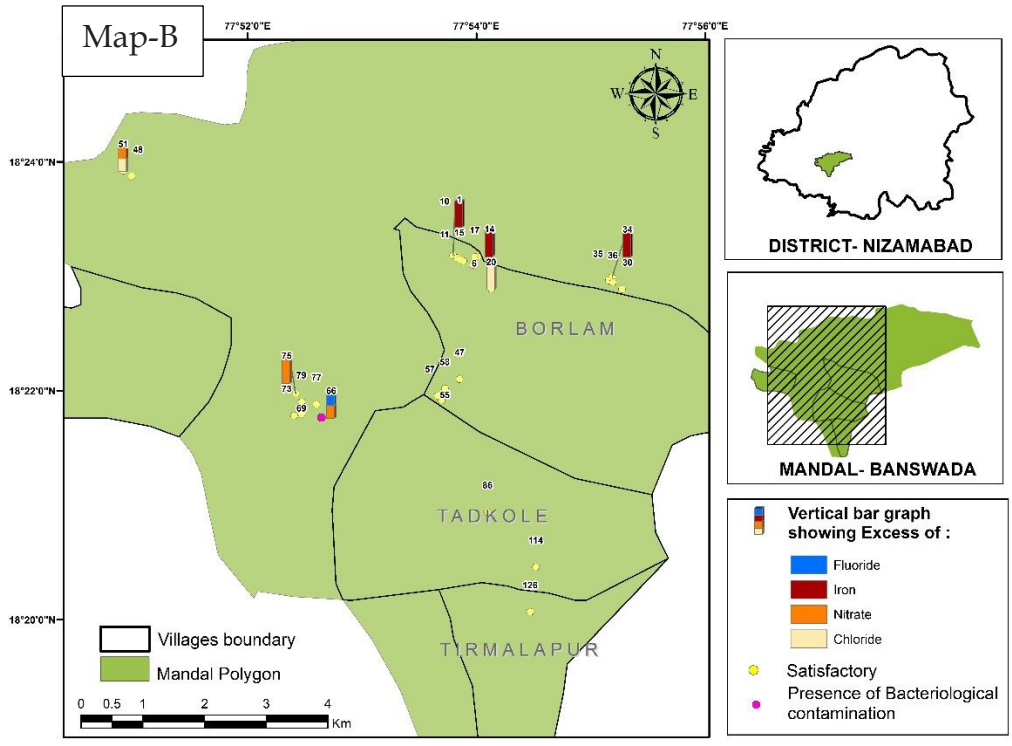


Map 40 showing Iron values of Water sources points - Nizamabad Mandal
Note – All sources for the given GPS points showing Iron within desirable limit (green).

6. Discussion and Recommandation:

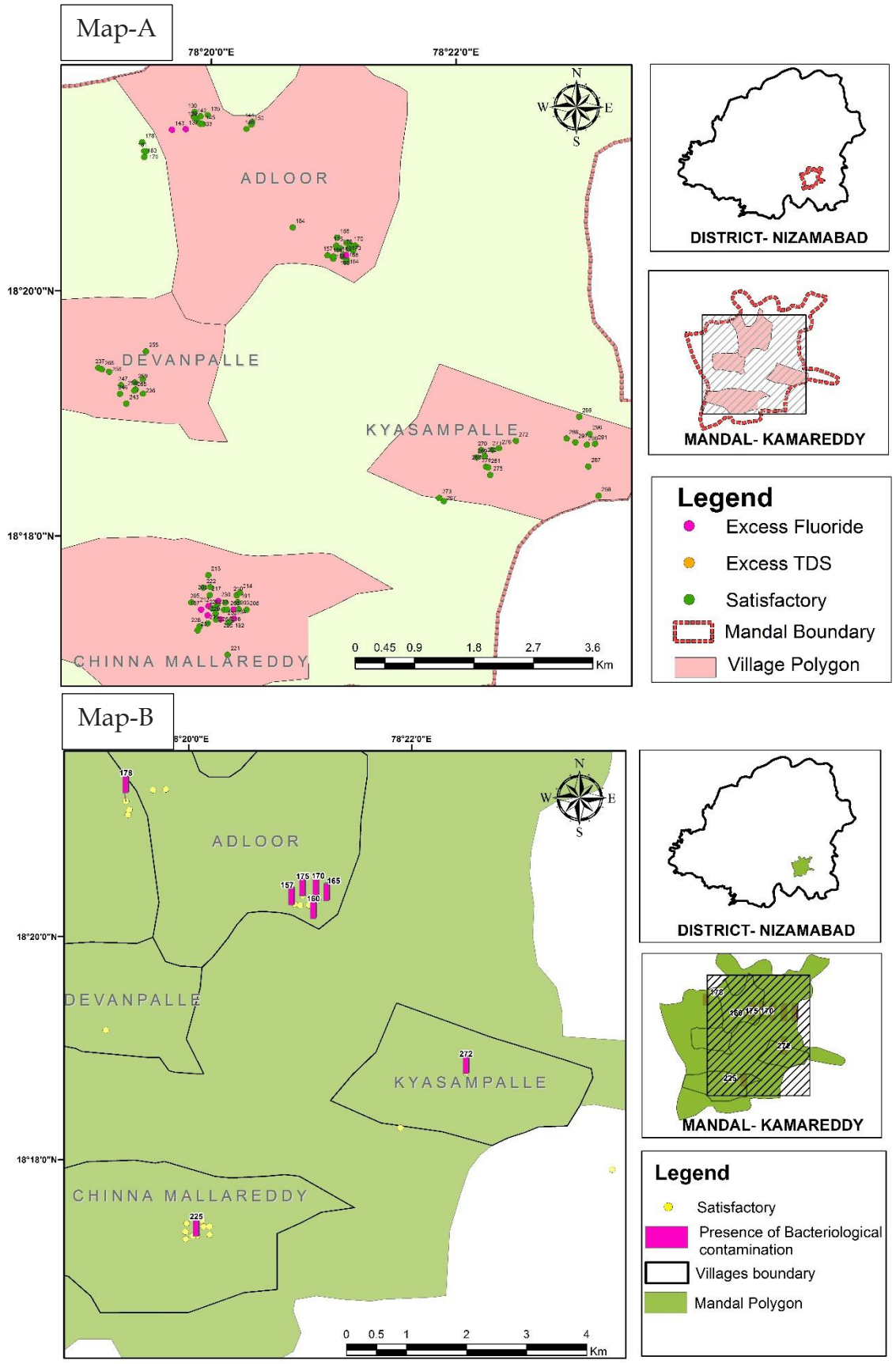
Ground-truthing exercise had been carried out to verify the status of water quality sources with limited random survey points. Though overall 220 points were visited but since the spatial co-ordinates were not available for many so only around 100 points have been shown in GIS.



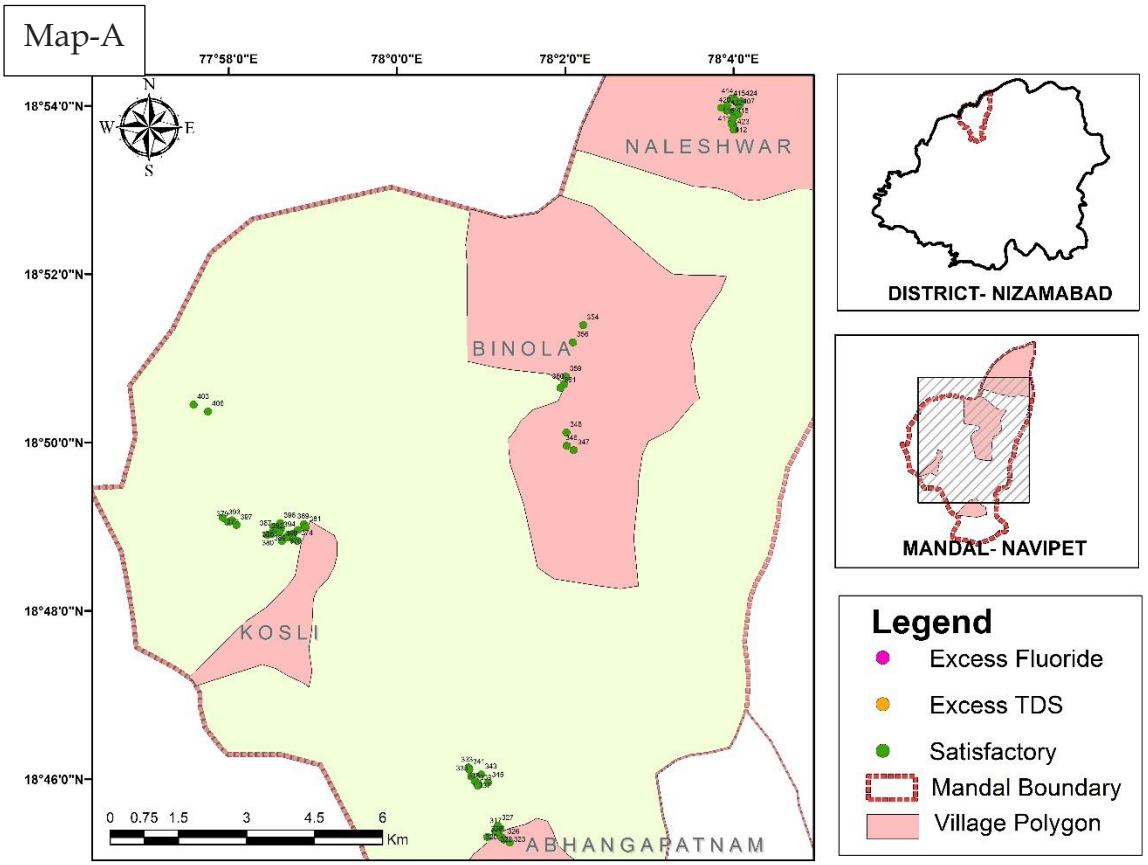


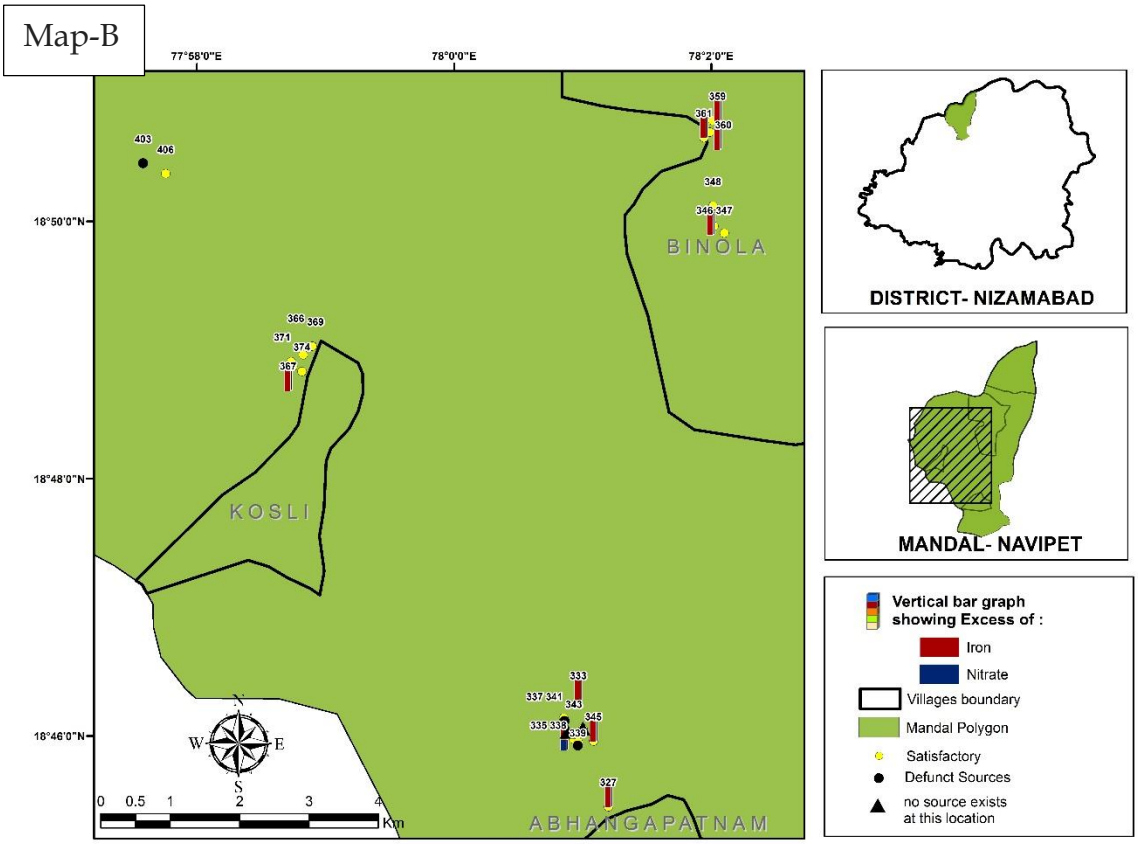
Map 41: Comparative maps of Banswada Mandal showing comparison of contaminants from government and field verification data

Note- The government data (Map A) shows all sources for given GPS points as satisfactory (green) while the field verification exercise (Map- B) for limited sources indicates excess of fluoride, iron, nitrate, chloride and also shows presence of bacteriological contamination (various colours as per legend).

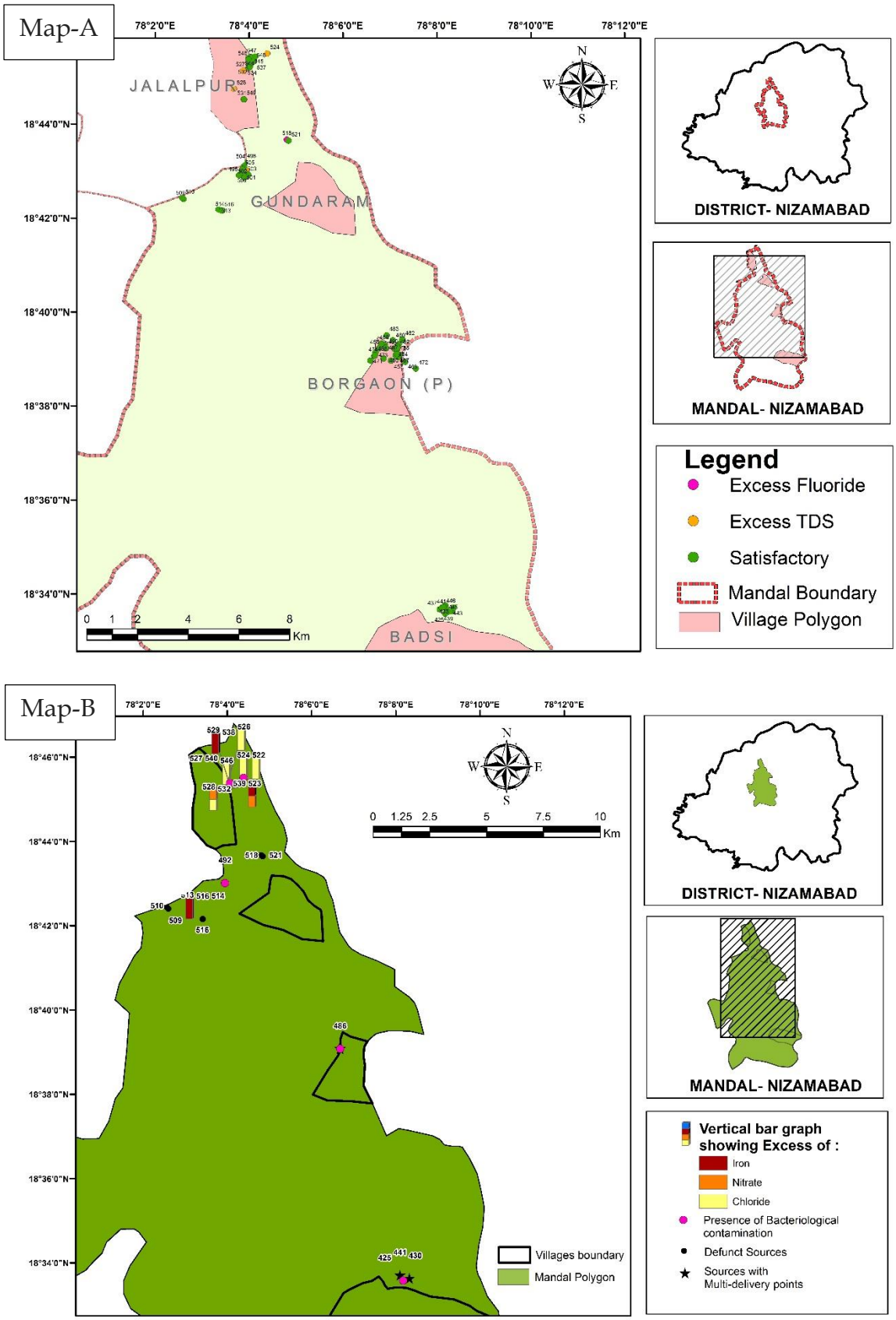


Map 42: Comparative maps of Kamareddy Mandal showing comparison of contaminants from government and field verification data.
Note- The government data (Map A) shows most sources for given GPS points as satisfactory (green) and few sources are showing excess fluoride (pink dot). The field verification exercise (Map-B) for limited sources indicates presence of bacteriological contamination.





Map 43: Comparative maps of Navipet Mandal showing comparison of contaminants from government and field verification data.
Note- The government data (Map A) shows all sources for given GPS points as satisfactory (green). The field verification exercise (Map-B) for limited sources indicates excess of Iron and Nitrate (colours as per legend). Also few sources found as defunct (black dots) and few could not been found at the location (black triangle)



Map 44: Comparative maps of Nizamabad Mandal showing comparison of contaminants from government and field verification data.
Note- The government data (Map A) shows most sources for given GPS points as satisfactory (green) only 1-2 shows excess TDS. The field verification exercise (Map-B) for limited sources indicates excess of Iron, Nitrate and Chloride along with presence of Bacteriological contamination (colours as per legend). Also few sources found as defunct (black dots) and few with multi-delivery points (black stars)

1. As the overall aim behind collecting the spatial data was to prepare the hydrological maps and to look for suitable drilling sites and recharge sites. Though the water quality parameter data is available but still the aim could not be achieved due to lack of spatial co-ordinates.

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. 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.

4. 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.