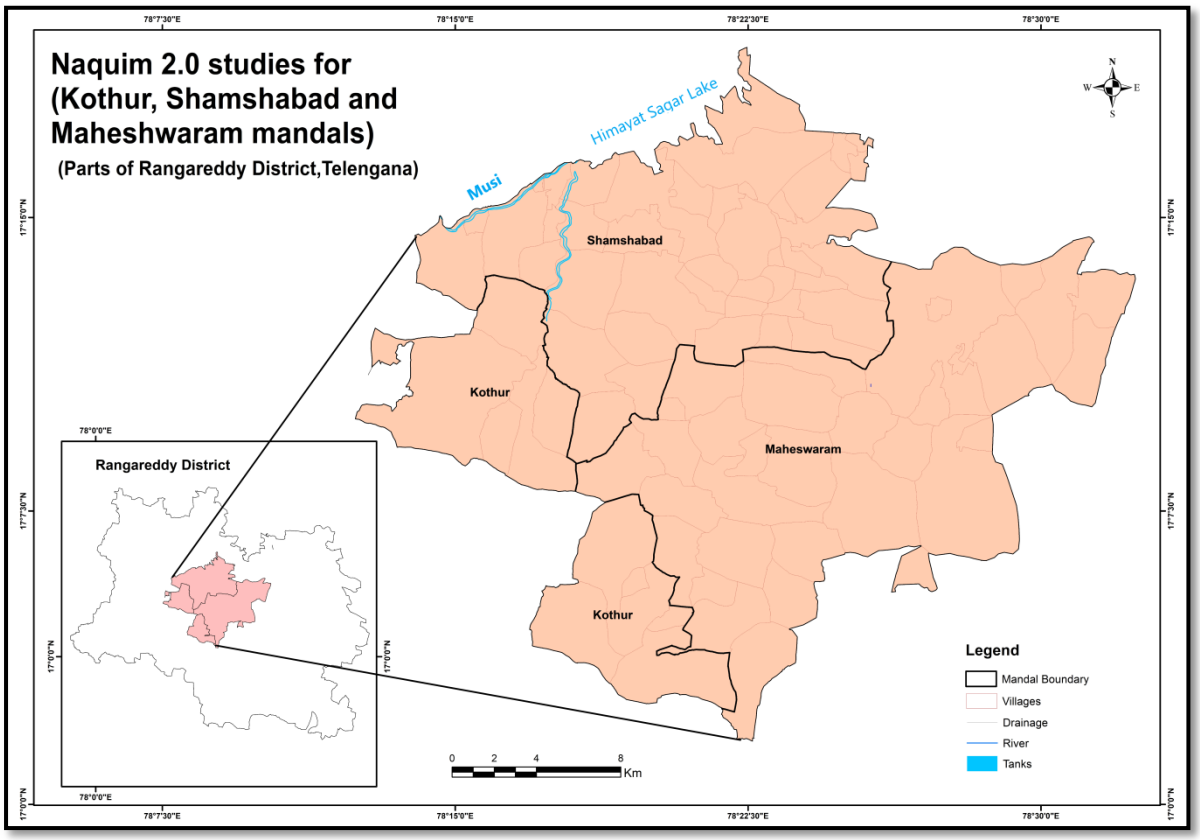
GOVERNMENT OF INDIA
MINISTRY OF JAL SHAKTI
DEPARTMENT OF WATER RESOURCES
RIVER DEVELOPMENT & GANGA REJUVENATION
CENTRAL GROUND WATER BOARD

Inception Report: NAQUIM 2.0 Studies

Effects of Urbanization on Ground Water Systems in Kothur, Maheshwaram, Shamshabad Mandals of Rangareddy district Telangana`

(AAP 2023-24)



CGWB, SR, HYDERABAD
April 2023

Effects of Urbanization on Ground Water Systems in Kothur, Maheshwaram, Shamshabad Mandals of Rangareddy district Telangana

Contents

1. Introduction

The National Aquifer Mapping and Management programme (NAQUIM) launched by CGWB in the year 2012 with the objectives of delineating and characterizing aquifers and preparing aquifer management plans on 1:50,000 scale. In this programme, mapping the Aquifers in 1: 50,000 scale was considered sufficient for planning requirements up to mandal level. The findings of NAQUIM studies are being utilized by many agencies, especially the State government agencies involved in ground water management and water supply but large-scale implementation at ground level by the user agencies has been lacking. As per the feedback received from the agencies using the NAQUIM outputs, major limitations include non-availability of printed maps at usable scales and lack of site-specific recommendations for implementation at village level. Keeping the above limitations in mind and considering the future requirements, now NAQUIM 2.0 has been taken up with broad objectives.

This inception report is prepared in accordance with the requirements of the NAQUIM 2.0 programme. It provides an overview of the studies to be taken-up and contains a description of the generation of a preliminary knowledge base, the detailed work plan, methodologies, deliverables, list of activities, targets and an estimate of the time allocation for involved personnel in the study.

Major areas where NAQUIM 2.0 outputs will be used includes,

1. Drinking water source sustainability
2. Sites for Artificial Recharge
3. Safe Drinking water sources in quality affected areas
4. Assured irrigation through ground water in areas that have adequate ground water potential.
5. Implementation of water conservation and AR schemes
6. Ground Water Regulations
7. Participatory Ground Water Management

2. Study area

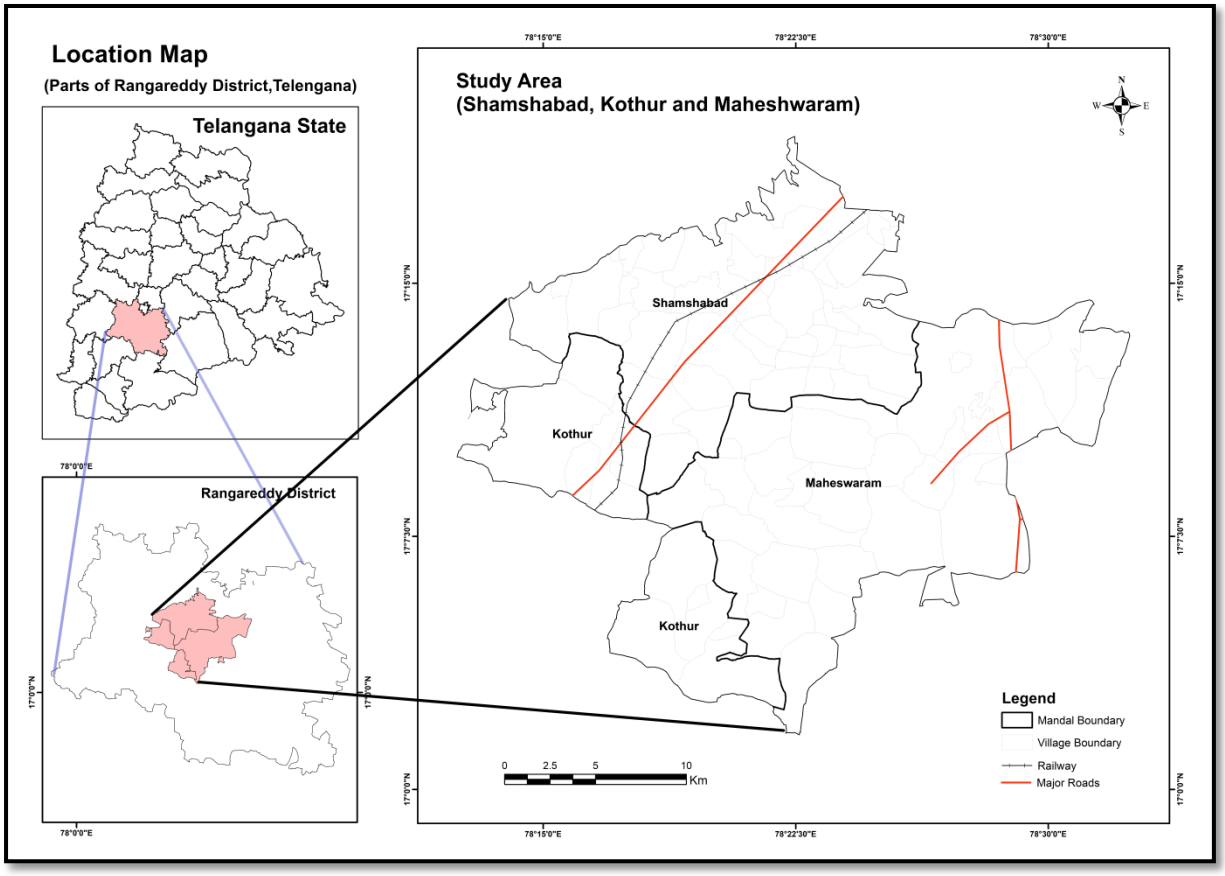
During the AAP 2023-24, an area of 556 sq. km. covering 85 villages of three mandals namely Kothur, Maheshwaram and Shamshabad of Rangareddy district in Telangana State has been selected based on the priority areas identified under NAQUIM 2.0 (Figure 1). The area falls on SOI toposheets No. 56/K/8 1:50,000 scale. The study area is bordered by Hyderabad and Medchal-malkajgiri district in the north and Mahabubnagar district in the south. The eastern and western parts are bordered by mandals of Rangareddy district. The study area falls in Musi drainage basin and is drained by Musi River, a tributary of Krishna River, which flows in almost E-W direction and possess two main lakes - Osman Sagar and Himayat Sagar. The drainage system in the area is sub-dendritic to rectangular type indicating poor permeability of the soils/formations. Almost all the tanks were disappeared due to increasing urbanization. Area is shallow to moderately weathered pediplain gently undulating and is

gently sloping area with isolated hills. The details of the mandals are given in Table 1 and the location of the study area is shown in Fig. 1

Table 1: Basic Information of the Study area

Particulars	Mandal			Study Area
	Kothur	Maheshwaram	Shamshabad	
Area (Sq.km)	83.49	255	201.90	540
Villages	12	32	41	85
Population (2011 Census)	83508	65125	87837	236470
Households	11776	11850	19660	43286
Altitude	582	581	581	581
Rainfall (mm)	643	735	836	738
Basin-Sub basin	Krishna-Musi	Krishna-Musi	Krishna-Musi	Krishna-Musi
Aquifer	Banded gneissic Complex	Banded gneissic Complex	Banded gneissic Complex	Banded gneissic Complex

Fig 1: Index map of the Study area



3. Priority Types

NAQUIM 2.0 is designed to provide detailed information to support groundwater management decisions at ground level. Since the issues are different in different areas, the studies under NAQUIM 2.0 are proposed as issue specific and will be undertaken in prioritized focus areas. Broadly 11 Priority areas are identified based on ground water related issues and the present study deals with specific priority area i.e. under "Urban agglomerate" where emphasis is to be placed on the effects of urbanization on ground water system in the study area.

The detailed study is planned to cover following topics,

1. Aquifer Dispositions in the area
2. Aquifer-wise Ground water levels
3. Delineation of Recharge Areas
4. Estimation/Refinement of parameters used for resource assessment
5. Assessment of ground water resources
6. Ground Water Quality
7. Ground Water Quality Management Interventions including demarcation of safer aquifers
8. Artificial Recharge Plan
9. Identification of potential aquifers for drinking water supply
10. A plan for drinking water source sustainability
11. Plan for Conjunctive use of surface water and ground water
12. Recommendations for tackling water logging
13. Demand driven studies like- Source Finding, Development of new cities, Waste disposal sites etc.
14. Other measures

4. Previous studies

A number of studies has been taken up earlier in the area and the details of referred reports are listed in Table 2.

Table 2: Details of earlier studies taken-up in Study area

SN	Report	Year
1	Ground Water Iinformation Booklet Rangareddy district	2007
2	GW Management studies in Rawirala watershed, Rangareddy district	2014
3	Geoelectrical investigations for mapping weathered zone of Ravirala watershed area, in Maheshwaram mandal, Rangareddy district	2009-10
4	Hydrogeological framework & development prospects, Rangareddy district	1999
5	Hydrogeological environment near Surana oil industries, around Shapur village, Shamshabad Mandal, Rangareddy district	March 1999

6	GW Management studies in parts of Rangareddy District	2003-04
7	GW Management studies in southern parts of Rangareddy District	2003-04
8	Reappraisal hydrogeological surveys in Eastern parts Rangareddy District	Jan 1999
9	GW brochure , Rangareddy district	2015
10	Basic Data report, Maheshwaram	1999
11	Basic Data report, Shamshabad	1999
12	Basic Data report, Emulnare	1999
13	Basic Data report, Rawiral	1999
14	Basic Data report, Sri nagar	1999
15	Basic Data report, Maisaram	1999
16	Basic Data report, Uppuguda tanda	1999
17	Basic Data report, Kambamena tanda	1999
18	Basic Data report, Pendyal	1999
19	Basic Data report, Ameerpet	1999
20	Basic Data report, Pinjerla	1999
21	Basic Data report, Subhanpur	1999
22	Basic Data report, Kolla padkal	1999
23	Basic Data report, Madanpalli	1999
24	Basic Data report, Tallaguda	1999
25	Basic Data report, Kothur	1999
26	Basic Data report, Gudur	1999

Earlier studies reveal that the depth of fracture zone is increasing towards south-eastern part in Shamshabad and Kothur mandal while it is increasing towards western part of Maheswaram mandal. Similarly, weathered thickness is maximum on the western part of Shamshabad and Kothur mandal. But in Maheswaram mandal, weathered thickness is maximum on the Northeastern part. Higher NO_3 - concentrations (> 45 mg/L) is reported in weathered zone and is due to sewage contamination while higher concentration of F- (>1.5 mg/L) in weathered zone and fractured zone is due to local geology (granite/gneiss rock), high weathering, longer residence time and alkaline nature of groundwater. In all the mandals, sustainability of bore wells are low. Mandal-wise summary of various parameters are given in Table 3.

Table 3: Mandal-wise summary of Aquifer parameters

Parameters	**Shamshabad Mandal**	**Kothur Mandal**	**Maheshwaram Mandal**
Aquifer	Granitic Gneiss	Granitic Gneiss	Granitic Gneiss
Weathered Zone, m	0-13	0-36	0-29.1
Fractured zone, m	21-43	12-55	5.0-47.5
Yield, lps	<1	<0.1 to 8	<1
Depth to water level, mbgl Pre-monsoon Post-monsoon	9.05-33.08 2.94-34.45	1.71–22.05 6.58 – 35.44	19.80 – 24.89 14.00 – 24.07
Transmissivity (m^2/day)	up to 240	Upto 240	Upto 0.1925
Specific yield	0.01-0.02	0.01-0.02	0.01-0.02
Storativity	0.0001 to 0.00001	0.0001 to 0.00001	0.0001 to 0.00001
Annual GW recharge, MCM	28.15	11.35	19.23
Annual extractable GW resource, MCM	25.37	10.28	18.27 h
Total GW extraction, MCM	15.18	9.18	13.47
Stage of GW extraction	59.84 % (safe)	89.29 (Semi critical)	74% (Semi critical)

5. Objectives of the present study

To tackle the above issues, following objectives for the present study has been finalised.

1. To provide information in higher granularity with a focus on increasing density of dynamic data like ground water level, ground water quality as well as on aquifer disposition.
2. To determine the effects of urbanization on ground water regime in terms of quantity and quality.
3. To demarcate areas which are highly prone to ground water quality issues due to urbanization and industrialization in terms of quantity and quality.
4. To estimate the actual urban recharge considering the underground leakage, which provide insight into the extent of ground water contamination.
5.
6. Water budgeting along with source sustainability measures specifically for each village.
7. To provide issue based scientific inputs for ground water management up to village level.

8. Estimate grey water production of Industrial and Domestic sector. Recommend ETP/STP and proper site for utilisation
9. Explore the possibility of Managed Aquifer Recharge in each urban area and standardise the quality of grey water for Irrigation and green belt.
10. Cost – benefit ratio to be included based on existing standard norms of respective states.
11. Include future plan based on Smart City project report.
12. To provide printed maps to the users.
13. To envisage a strategy to ensure implementation of the recommended strategies.
14. To involve state agencies in the studies for a sense of ownership.

6. Methodology

The brief series of steps and activities to be followed during the study is as below,

1. Inception report
2. Pre-monsoon field work
3. Base map preparation (Data analysis and interpretation, Chemical analysis of samples, Mid-term appraisal presentation)
4. Post monsoon field visit
5. Field visit for verification and ground truthing
6. Report finalization
7. Sharing the report and findings

7. Existing data and Data gap analysis

All the existing data available is collected and compiled and is given in Table 4 and annexure I to V.

Table 4: Status of Existing data

SN	Particulars	Data Points	Proposed
1	Exploration	18 nos (EW :16 & OW 02)	30nos. (EW-20, Industrial cluster-10)
2	Geophysical Studies	VES:12 TEM:0	101
3	G W Monitoring	22 Nos. (CGWB – DW:10, Pz:11,01 SGWD:)	107 (Keywells)
4	Water Quality	03	107
5	Hydrogeological Tests	Infiltration Test : nil Pumping Tests 02	

The study area for NAQUIM 2.0 in parts of Rangareddy districts includes mandals of Maheshwaram, Shamshabad and Kothur. This area include 18 geo-exploration data points, however 04 data points are falling just outside the study which can be also be used to make data base more authentic. The proposed exploration sites is around 30 nos, out of which 10 sites will be specifically focus on industrial clusters and remaining 20 will cover the data gaps. The proposed 101 geophysical sites for TEM/VES are mentioned on map attached below. The proposed 107 keywells will be used to monitor ground water 2 times in pre and post monsoon along with water sampling for quality analysis.

Major Issues identified from Previous Studies

The following major issues as an effect of Urbanization are primarily identified for the present study.

1. Groundwater recharge processes in an urban area are different than in non-urban areas. There are various new components that must be considered in the case of urban groundwater recharge in addition to the natural recharge from precipitation. Impervious cover and urban drainage systems increase runoff. Leakages from water supply network and sewage networks exists in the area, which has to be calculated.
2. Water marketing is present in almost all over the area and people are buying bottled water from the market for drinking purposes as there is no sufficient supply of surface water.
3. Change in land use from agricultural land to residential purposes and cropping pattern from traditional crops to cash crops (spices, cotton) is reported.
4. Geo-genic pollution (Fluoride) in ground water is reported, which can be attributed to source rock, rock water interaction where acid-soluble fluoride bearing minerals (fluorite, fluoro-apatite) gets dissolved under alkaline conditions and also due to higher residence time of ground water in deeper aquifer.
5. Anthropogenic pollution (Nitrate) in ground water is reported and is due to unscientific sewage disposal of treated and untreated effluents in urban and rural areas.
6. Use of NPK fertilizers and nitrogen fixation by leguminous crops is reported.
7. Over-exploitation and Deeper water levels, over-extraction for paddy cultivation during Rabi season (32 % to total crops of rabi) and ground water mining is also reported.
8. Sustainability issues reported from all the three mandals, which is manifested as desaturation of weathered zone.
9. The sustainability of existing groundwater structures, food and drinking water security are challenging tasks in the preparation of management plan.

The required data density for the study based on instructions/ Norms as mentioned in tool kit is as below,

1. Exploratory Drilling: At least two for each principal aquifer type in the area
2. Pumping Test: At least one for each principal aquifer type in the area

3. Water Level Monitoring: At least 3 for each GMU (Ground Water Management Unit). A GMU could be a village, a ward, aquifer unit, geomorphology, LULC class or as relevant to the study. Deeper aquifers if available are to be treated as separate GMUs.
4. Sampling for Water Quality: At least 3 for each GMU (village). At least one for each habitation in areas with ground water contamination
5. VES/TEM/Imaging: At least 05 for each principal aquifer type in the area
6. Feedback and Sample survey: At least 1for each village. OR At least 3 for each GMU (aquifer type or land use as relevant to the study).

Based on data gap analysis the proposed sites are given in Fig. 2, 3 and 4 as below.

Geophysical Data: VES/TEM:

As 12o VES data is available within the study area, considering the exiting exploration database, 101 locations have been identified and given for recommendations and details are given in Table and Figure 2.

Sl No	Particulars	Existing	Proposed
1.	Geophysical Studies	VES:12 TEM:0	101
2.	G W Monitoring	22 Nos. (CGWB –22, SGWD:)	107 (Keywells)
3.	Exploration	18 nos (EW :16 & OW 02)	30 nos. (EW-20, Industrial cluster-10)
4.	Hydrogeological tests	Nil	Pumping Tests : 02

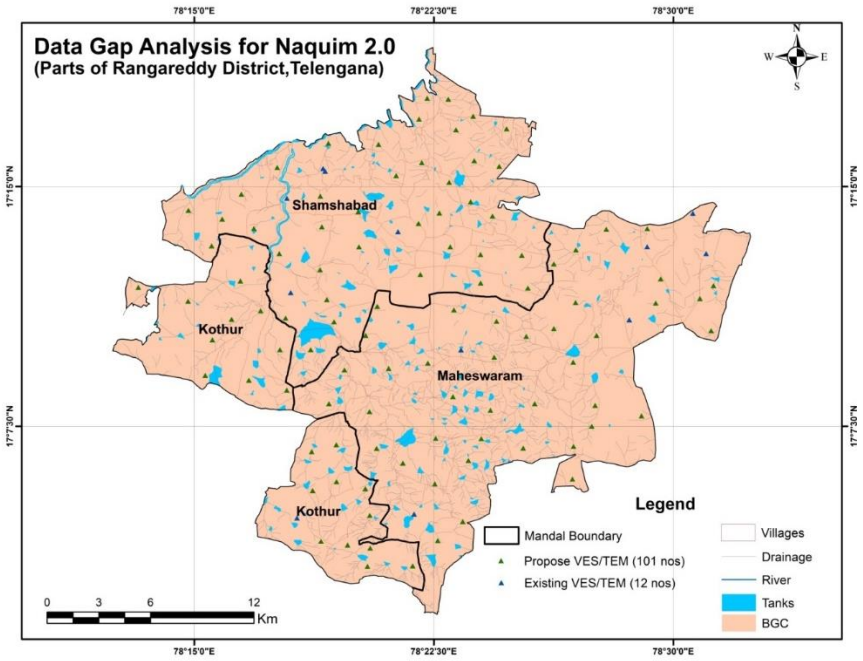


Fig.2. Data gap analysis for Geophysical survey

Exploration: The available CGWB in-house Exploration data in different mandals within the study area have been compiled. CGWB has constructed 18 wells within the study area. The data insufficiency within the study area is thereby identified and 30 locations have been recommended for exploration and details are given in Figure 3.

Ground Water Level & Quality Monitoring:

To identify the requirement of key wells for micro-level study, the existing monitoring stations of CGWB and SGWD has been considered. In order to meet the objective of the present study, a grid of 0.5*0.5 km has been drawn and identified the data gap. Moreover, minimum 3 wells per urban unit was also taken care off and details are given in Figure 4.

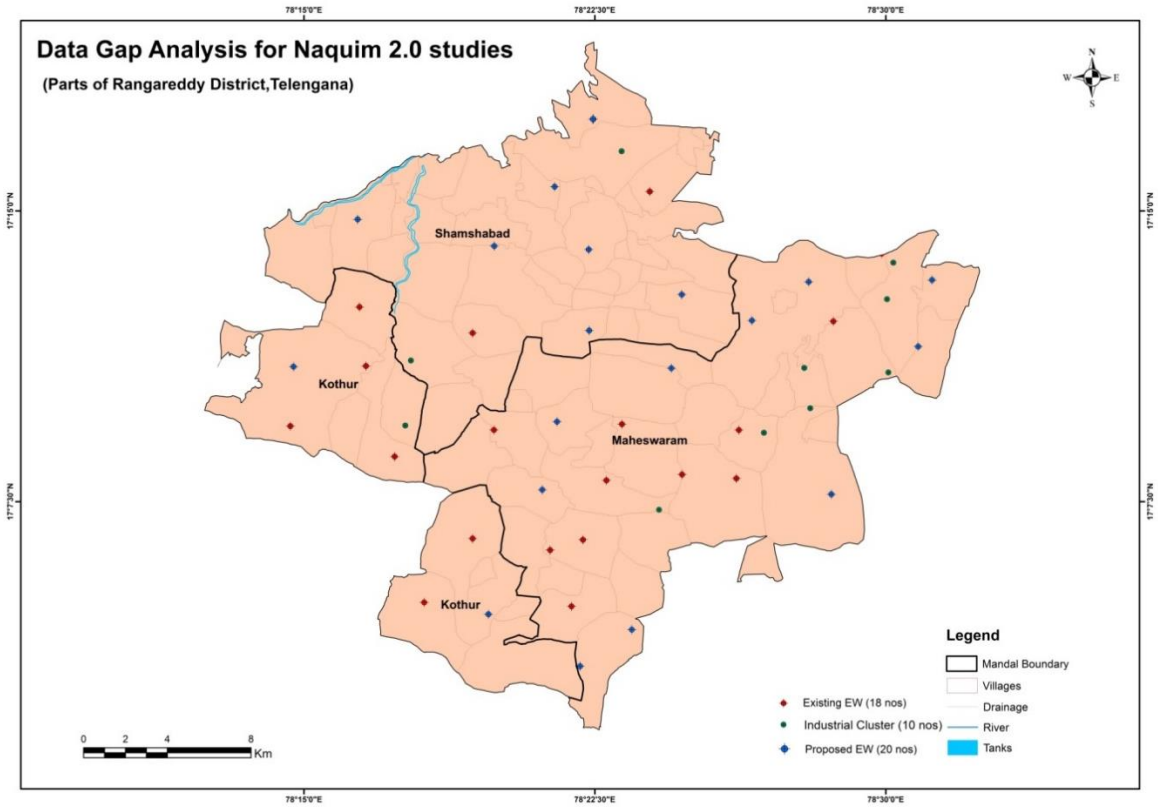


Fig.3. Data gap analysis for Exploratory drilling

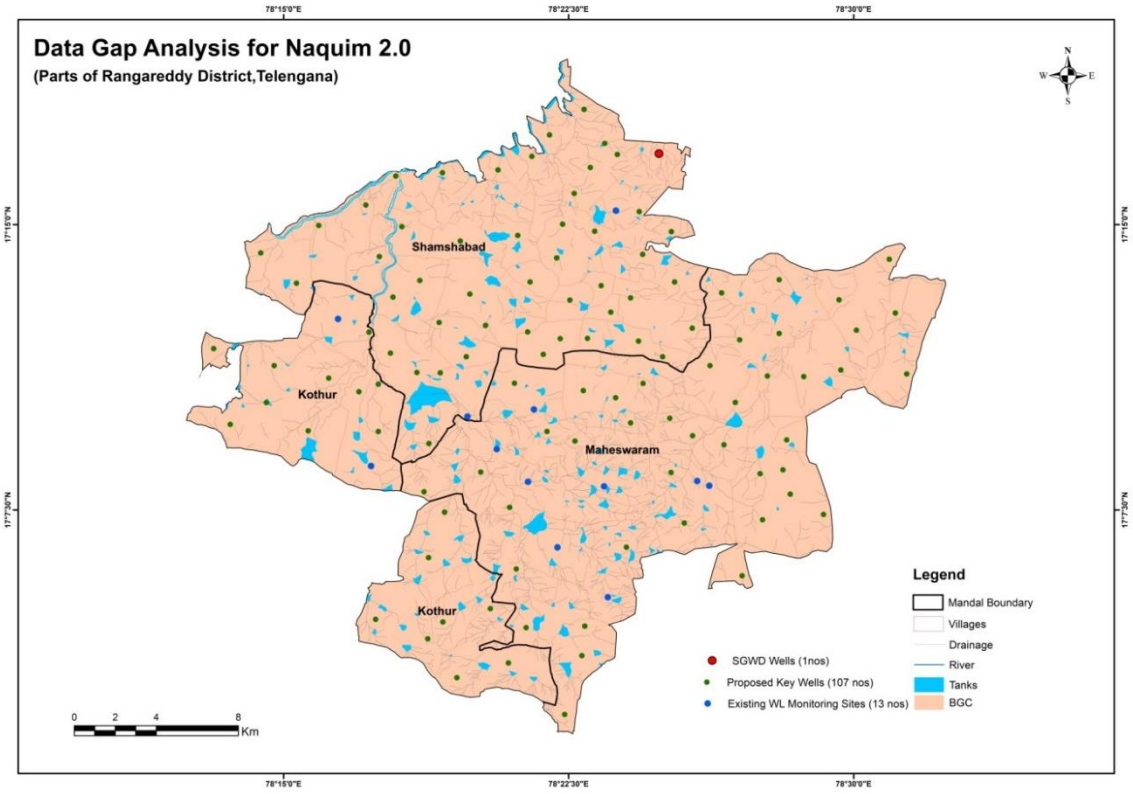


Fig.4. Data gap analysis for Establishment of Key wells

8. Month Wise Activity Plan

40 to 50 days of field work is required for generating sufficient data in desired granularity for this study area of 556 Km^2. The deliverables and deadlines during the assignment is given in table 5.

SN	Period	Assignment
1	1st to 3rd week of April	**Base map Preparation:** - Area map showing communication network, drainage, important places, existing NHS, existing EW, OW, Pz & DW, Data generated during previous NAQUIM studies and proposed locations for establishment of key wells. - The RF (Reproduction Factor) of the admin basemap is 1:10,000 or more. **Preparation of the Inception Report:**
2	4th week of April 2nd week of June **(20-25 days fieldwork)**	**Field Data Collection** - Key well establishment;Water level measurement including geo-coded locations (if not done earlier). & Water sample collection - Density of one key well per 5 - 10 Km^2, collect aquifer wise data wherever possible. Rigorous monitoring of deeper aquifer if they are commonly being used for agriculture & Industrial purposes. If they are less frequently used, coarser sampling and monitoring is considered sufficient. - Specific studies -Infiltration, Slug test, Pumping test - Aprising Block level Authorities about the Work Item. Presentation of Inception Report. **Sample Surveys and User Feedback:** - Discussions with farmers and other users at ground level. Collection of information from local agencies or well owners about well depth, slotted zone/fracture zone, discharge (can be measured by the officer, if possible),

		static water level and random drawdown data, Irrigation Practices, cropping pattern and related information. - Instantaneous discharge measurements along with data on, pump working hour for estimating unit draft. **Other ongoing field activities** Exploratory drilling, geophysical studies, data entry in WIMS
3	15th June to 15 October	**Data Analysis and Interpretation** - Compilation & analysis of data collected during pre-monsoon field work - Completion of chemical analysis of samples collected and data validation - Preparation of thematic maps such as pre-monsoon DTW, EC, Cl maps and identification of areas with quantity (deeper water level, declining trend, drying of wells/reduction of discharge) & Quality issues (F, NO_3, Fe, As) - Preparation of Location, LULC, Physiography & drainage, DEM, Hydrogeomorphic, Basin, rainfall histogram, Geological maps etc - Preparation of relevant chapters on the themes like Introduction, Physiography &drainage, Hydrometeorology, Hydrology, Landuse Landcover, Geology etc. - Tabulation and correlation of hydrogeological and geophysical data of existing EW, OW, PZ & DW, VES, TEM - Preparation of Cross sections (2D) showing aquifer disposition by correlating lithologs - Conceptual 3D Model (which will be modified after getting more data during post-monsoon studies) - Analysis of lithologs and aquifer properties data of previous studies and their incorporation - Mapping of water bodies from Satellite Imagery and its comparison with toposheet for preparation of RWH & AR Plan - Collection of drilling & other related data from State Govt agencies, Drilling companies & NGOs **Workshops and mid-term review by NLEC** - Regional Workshops of officers involved in NAQUIM 2.0 studies to exchange experiences, field data collection strategies, new findings etc. - Mid-term review and guidance by the NLEC. - Communication and/or Presentation (preferably) before District Administrative Authorities
4.	15th October to 15th December (**20 to 25 days field work**)	**Field Data Collection** - Post-monsoon water level monitoring - Monitoring of additional wells in areas identified with some issues based on level & quality monitoring data of pre-monsoon - Conducting pumping tests at field in irrigation wells, discharge vs drawdown measurement, quality checking with hand-held EC & pH meter, collection of drilling data from the pump/land owner etc. **Sample Surveys and User Feedback:** - Discussion with farmers and other users at ground level. Collection of information from local agencies or well owners about well depth, slotted zone/fracture zone, discharge (monitored wherever possible), static water level and random drawdown data, Irrigation Practices, cropping pattern, traditional water conservation and management practices and related information. - Instantaneous discharge measurements, along with pump working hour information for estimating unit draft. - Similarly, feedback of the local users will form an important input for

		problem identification and characterization. Feedback are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. **Other ongoing field activities** Exploratory drilling, geophysical studies, data entry in WIMS
5	15th December to 15th January	**Data Analysis and Draft Report Preparation** - Compilation & Analysis of Post-monsoon data (Statistical analysis based on geology, physiography, etc. can also be attempted) - Chemical Analysis of the post monsoon water samples (collected from selected wells for confirmation of issues) - Preparation of maps and tables- please refer priority area wise deliverables and outputs - Preparation of ground water management plan, analysis of existing practices and proposed measures under Supply side and Demand side measures with the expected impact on ground water system. - Draft Report writing work **Other ongoing field activities** Exploratory drilling, geophysical studies, data entry in WIMS
6.	15th January to 15th February(2**0 to 25 days 2fieldwork**)	- Field truthing of Management plan & RWH & AR Plan - Final Stage field visit for various field data collection & generation based on the requirement (data gap filling) as observed during draft report preparation **Other ongoing field activities** Exploratory drilling, geophysical studies, data entry in WIMS
7.	15th February to 15th March	- Modification of draft report with additional information collected by the above mentioned field checks - Scrutiny and Finalisation of the Report **Other ongoing field activities** - Exploratory drilling, geophysical studies, data entry in WIMS -
8.	15th to 31st March	- Sharing of the reports with CHQ, SGWCC and DM/DC **Other ongoing field activities** - Exploratory drilling, geophysical studies, data entry in WIMS

Composition of Team

Roles and Responsibilities during NAQUIM 2.0 studies are envisaged to be multidisciplinary. Thus, it is proposed to have a team of experts in place for carrying out the activities proposed. The following team will work under the overall guidance of Sh. J. Siddhardha kumar, Regional Director.

Composition of the Team:		
	Team Leader	**Ms. Rani V. R.** Scientist D (Hg)
	Hydrogeologist-1	**Sh. Upendra Dhonde** Scientist C (Hg)
	Hydrogeologist-2	**Sh. Atharva Pawar** Scientist B (Hg)
	Geophysicist	**Smt. Akoju Ramadevi** Asst. Geophysicist
	Chemist	**Smt. Swati Dhenkula** Asst. Chemist

9. Team member-wise responsibilities

The team taking up this study have the following composition with specific responsibilities as given below,

Table 6 : Roles and Responsibilities

Role	Responsibilities
Team Leader	Planning, Supervision Work distribution and monitoring of activities Preparation of the inception report Timely Delivery of the envisaged Outputs Finalisation of the management plan Sharing of the outputs and Presentations at different forums Preparation of the draft report as per the approved Quality Standards and its Final Submission
Hydrogeologist-1	Field Data Collection (Exploration, Pz construction, Water Level, Water Quality, Pumping Tests, Infiltration tests, demand/supply data, sample surveys and others) Sample collection for quality studies Secondary Data collection Entering data in database (WIMS) Integration of data, preparation of thematic maps, preparation cross sections etc. Consultation with allied experts like agriculture, irrigation, agro-economics etc. Preparation of Management Plan Assisting the Team Leader in preparing maps and reports
Hydrogeologist-2	
As Geophysics	Field Geophysical Surveys Interpretation of field data Entering data in database (WIMS) Integration with existing geophysical and lithology data Preparation of inferred lithologs Suggesting potential sites for construction of water wells/artificial recharge Preparation of Tables, graphs and maps for reports Assisting the Team Leader in preparing the Report
As Expert Hydrochemistry	Sample collection for quality studies Analysis of samples. Integration with existing data Validation and interpretation of data Entering data in database (WIMS) Preparation of Tables, graphs and maps for reports Assisting the Team Lead in preparing the reports

10. Monthly targets

Period	Assignments to be carried out	Team Member
4th week of April	• Base map Preparation • Preparation of the Inception Report	Team Leader
4th week of	• Field Data Collection (Pre-Monsoon)	Expert Hydrogeologist I &II,

Period	Assignments to be carried out	Team Member
April to 3rd week of May	• Sample Surveys and User Feedback	Expert Geophysicist, Expert Chemist
June to October	• Data Analysis and Interpretation • Workshops and mid-term review by NLEC	Team Leader, Expert Hydrogeologist I &II, Expert Geophysicist, Expert Chemist
October to December	• Field Data Collection (Post Monsson) • Sample Surveys and User Feedback	Expert Hydrogeologist I &II, Expert Chemist
December to January	• Data Analysis and Draft Report Preparation • Other ongoing field activities	Team Leader, Expert Hydrogeologist I &II, Expert Geophysicist, Expert Chemist
January to February	• Field truthing of Management plan & RWH & AR Plan • Final Stage field visit for various field data collection & generation based on the requirement (data gap filling) as observed during draft report preparation	Team Leader, Expert Hydrogeologist I &II
February to March	• Modification of draft report with additional information collected by the above mentioned field checks • Scrutiny and Finalisation of the Report	Team Leader, Expert Hydrogeologist I &II, Expert Geophysicist, Expert Chemist
March	• Sharing of the reports with CHQ, SGWCC and DM/DC	Team Leader, Expert Hydrogeologist I &II, Expert Geophysicist, Expert Chemist

8.0 Monthly targets

Sr No.	Activity	Officer Deployed	Months (April to March)											
			Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
A	HYDROGEOLGY													
1	Compilation of available data	Ms. Rani V. R., Sh. U.V. Dhonde, Sh. A. Pawar												
2	Preparation of base maps	Ms. Rani V. R., Sh. A. Pawar												
3	Identification of data gap and planning for data generation	Sh. U.V. Dhonde, Sh. A. Pawar												
4	Preparation of Inception report	Ms. Rani V. R., Sh. U.V. Dhonde, Sh. A. Pawar												
5	Field work for establishment of key wells, pre-monsoon water level monitoring and groundwater sampling	Sh. U.V. Dhonde, Sh. A. Pawar												
6	Collection of data on existing water supply, sewerage network, industrial clusters	Ms. Rani V. R., Sh. U.V. Dhonde												
7	Collection of samples for GW Quality	Sh. U.V. Dhonde, Ms. Swati Dhenkula, ACH												
8	Field work for additional data and information	Sh. U.V. Dhonde, Sh. A. Pawar												
9	Post-monsoon WL monitoring from key wells and groundwater sampling	Sh. U.V. Dhonde, Sh. A. Pawar												
10	Final Stage field visit for various field data collection & generation based on the requirement (data gap filling) as observed during draft report preparation	Ms. Rani V. R., Sh. U.V. Dhonde, Sh. A. Pawar Smt. A. Rama Devi, AGP Ms. Swati Dhenkula, ACH												
B	GW EXPLORATION	GW EXPLORATION												
11	EW Data gap identification	Sh. U.V. Dhonde, Sh. A. Pawar,												
12	Site selection for drilling	Hydrogeologist												
13	Attending Drilling, preparation of lithologs, Conducting Pumping test	Hydrogeologist												
14	Preparation of Basic Data Report	Hydrogeologist												

C	GEOPHYSICAL STUDIES	GEOPHYSICAL STUDIES												
15	Data gap identification for VES/TEM	Smt. A. Rama Devi, AGP												
16	Field work -VES/TEM	Smt. A. Rama Devi, AGP												
17	Analysis and interpretation of VES/TEM data	Smt. A. Rama Devi, AGP												
C	CHEMICAL ANALYSIS	CHEMICAL ANALYSIS												
18	Analysis of sample collected during pre-monsoon from key wells	Ms. Swati Dhenkula, ACH												
19	Analysis of sample collected during post-monsoon from key wells	Ms. Swati Dhenkula, ACH												
20	Analysis of samples collected during exploration	Ms. Swati Dhenkula, ACH												
D	FIELD TRUTHING AND PREPARATION OF AQUIFER MAPS, MANAGEMENT PLANS	FIELD TRUTHING AND PREPARATION OF AQUIFER MAPS, MANAGEMENT PLANS												
21	Compilation of data and preparation of GIS based maps and management plans	Ms. Rani V. R., Sh. A. Pawar												
22	Report Preparation	Ms. Rani V. R.												
23	Field Truthing of Management Plan	Ms. Rani V. R., Sh. U.V. Dhonde												
24	Modification of Draft report. Scrutiny and Finalisation of the report	Ms. Rani V. R.												
25	Sharing of the reports with CHQ, SGWCC and DM/DC	Ms. Rani V. R., Sh. U.V. Dhonde, Sh. A. Pawar												

Annexure I

Exploration Data

SN	Location/Village	Longitude	Latitude	Mandal/Block	WELL TYPE	Elevation (m amsl)	Depth Drilled (m bgl)	Casing	Major Lithology encountered	Zones From	Zones to	S.W.L (m.bgl)	Discharge (lps)
1	Gudur	78.2739	17.2087	Kothur	EW	490	200	5.87	GR	24	25	6.53	0.077
2	Kothur	78.2890	17.1444	Kothur	EW	512	200	16.68	GR	No promising zones		13.85	Traces
3	Maheshwaram	78.4369	17.1558	Maheshwaram	EW	495	200	29.75	GR	20.2	21.2	NIL	0.077
4	Narasappaguda	78.244167	17.1575	Kothur	EW		24		Granite	16		4.51	5
5	Tallaguda	78.276667	17.183333	Kothur	EW		43		Granite	8			0
6	Pinjerla	78.3225	17.109167	Kothur	EW		43		Granite	24			0.3
7	Enmulnare	78.301667	17.081667	Kothur	EW		43.5		Granite	8			0
8	Kambamena Tanda	78.386667	17.158333	Maheswaram	EW		32		Fr.GT	10			0
9	Uppuguda Tanda	78.4125	17.136667	Maheswaram	EW		40		Fr.GT	21			0
10	Kolla Padkal	78.365	17.08	Maheswaram	EW		33		Fr.GT	16			0.06
11	Sri Nagar	78.4775	17.2025	Maheswaram	EW		36.75		Fr.GT	13			2.85
12	Rawiral	78.498333	17.231667	Maheswaram	EW		40		Fr.GT	16			0.6
13	Maisaram	78.435833	17.135	Maheswaram	EW		39		Fr.GT	9			0
14	Amdapur	78.293333	17.275833	Shamshabad			41		Fr.GT	29			0.06
15	Madanpalli	78.3225	17.1975	Shamshabad	EW		48		Fr.GT	15			1.4
16	Ameerpet	78.331667	17.155833	Maheswaram	EW		45		Fr.GT	7			0
17	Subhanpur	78.355833	17.104167	Maheswaram	EW		43		Fr.GT	11			0.7
18	Pendyal	78.38	17.134167	Maheswaram	EW		40		Fr.GT	4			0
19	Shamshabad	78.398611	17.258333	Shamshabad	EW		26.5	14	Granite	20	20.2	16.57	0
20	Shamshabad	78.398611	17.258333	Shamshabad	EW		26.5	14	Granite	20	20.2	16.57	0
21	Shamshabad	78.398611	17.258333	Shamshabad	EW		26.5	11.2	Granite	20			0
22	Maheswaram	78.430556	17.066667	Maheswaram	EW		30		Granite	25.3	26.5		0.21

Annexure II

Hydrogeological tests data

SN	Location/Village	Longitude	Latitude	Mandal/Block	Well type	Depth Drilled (m bgl)	S.W.L (m.bgl)	Discharge (lpm)	Discharge (lps)	Drawdown (m)	Sp. Capacity	T	S
1	Gudur	78.2739	17.2087	Kothur	EW	200	6.53	4.62	0.077			0.4084	0.001
2	Kothur	78.2890	17.1444	Kothur	EW	200	13.85	#VALUE!	Traces			0.3308	1.00E-06
3	Maheshwaram	78.4369	17.1558	Maheshwaram	EW	200	NIL	4.62	0.077			NIL	NIL
4	Narasappaguda	78.244167	17.1575	Kothur	EW	24	4.51	300	5				
5	Tallaguda	78.276667	17.183333	Kothur	EW	43		0	0				
6	Pinjerla	78.3225	17.109167	Kothur	EW	43		18	0.3				
7	Enmulnare	78.301667	17.081667	Kothur	EW	43.5		0	0				
8	Kambamena Tanda	78.386667	17.158333	Maheswaram	EW	32		0	0				
9	Uppuguda Tanda	78.4125	17.136667	Maheswaram	EW	40		0	0				
10	Kolla Padkal	78.365	17.08	Maheswaram	EW	33		3.6	0.06				
11	Sri Nagar	78.4775	17.2025	Maheswaram	EW	36.75		171	2.85				
12	Rawiral	78.498333	17.231667	Maheswaram	EW	40		36	0.6				
13	Maisaram	78.435833	17.135	Shamshabad	EW	39		0	0				
14	Amdapur	78.293333	17.275833	Shamshabad	EW	41		3.6	0.06				
15	Madanpalli	78.3225	17.1975	Shamshabad	EW	48		84	1.4				
16	Ameerpet	78.331667	17.155833	Maheswaram	EW	45		0	0				
17	Subhanpur	78.355833	17.104167	Maheswaram	EW	43		42	0.7				
18	Pendyal	78.38	17.134167	Maheswaram	EW	40		0	0				
19	Shamshabad	78.398611	17.258333	Shamshabad	EW	26.5	16.57	0	0				
20	Shamshabad	78.398611	17.258333	Shamshabad	EW	26.5	16.57	0	0				
21	Shamshabad	78.398611	17.258333	Shamshabad	EW	26.5		0	0	0.78		36.57	
22	Maheswaram	78.430556	17.066667	Maheswaram	EW	30		12.6	0.21				

Annexure III

Geophysical Data

SN	Village	Longitude	Latitude	Typr_of_St	Year_of_St	R1	H1__m_	R2	H2__m_	R3	H3__m_	R4	H4__m_	R5	Inferred_L	aqu1_top	aq1_bot	aqu1_thick	fr1_from	fr1_to
1	Narkhoda	78.3183	17.258	VES	2015-16	153	0.6	72	3.9	124	23.2	VH	0		Banded gneissic	0.6	4.5	3.9	14	0
2	Narkhoda	78.3172	17.2594	VES	2015-16	111	1	71	5.4	207	41.5	5000	0		Banded gneissic	1	6.4	5.4	24	0
3	DRDO,Raviryala	78.4863	17.2186	VES	2021-22	27	1	17	6.83	VH	7.83		0		Banded gneissic	1	28	27	0	0
4	DRDO,Raviryala	78.5102	17.236	VES	2021-22	133	1.29	28	8.36	VH	9.65		0		Banded gneissic	1	8	7	0	0
5	Malikglamguda	78.477	17.1805	TEM	2021-22	123.35	1.11	330.71	5.78	432.43	0	0	0		Banded gneissic	0	0	6.89	0	0
6	Raviryala	78.5171	17.215	TEM	2021-22	48.283	5.974	265.38	43.532	413.26	0	0	0		Banded gneissic	0	0	49.51	0	0
7	Nagaram (Chinna Golkonda)	78.3892	17.1648	TEM	2021-22	0	0	0	0	0	0	0	0		Banded gneissic	0	0	0	0	0
8	Kollapadadal	78.3647	17.0792	TEM	2021-22	0	0	0	0	0	0	0	0		Banded gneissic	0	0	0	0	0
9	Samshabad	78.3563	17.2264	TEM	2021-22	0	0	0	0	0	0	0	0		Banded gneissic	0	0	0	0	0
10	Palamakula	78.3003	17.1947	TEM	2021-22	0	0	0	0	0	0	0	0		Banded gneissic	0	0	0	0	0
11	Enmulanara	78.3036	17.0772	TEM	2021-22	0	0	0	0	0	0	0	0		Banded gneissic	0	0	0	0	0
12	Kacharam	78.2983	17.2439	TEM	2021-22	0	0	0	0	0	0	0	0		Banded gneissic	0	0	0	0	0

Annexure IV

Water Quality Data : Monitoring Wells

Sl. No.	Location	pH	E C in □S/cm	TH	Ca	Mg	Na	K	Fe	Cl	SO_4	NO_3	F	Alkalinity	Turbidity (NTU)	CO_3	HCO_3	TDS	Cu	Zn	Cd	Cr	Mn	Pb	As	Uranium
				mg/L												mg/L										ppb
1	Shamshabad1	7.27	1500	470	138	30	127	1.2	N.A.	142	6.9	53	0.93	500	4.9	0	610	872	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	4.0
2	Maheswaram1	7.39	1060	510	128	46	8.1	1.8	N.A.	106	1.9	23	1.03	355	3.8	0	433	581	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	12
3	Ameerpelli	7.15	2330	740	92	124	192	2.3	N.A.	425	14	81	0.65	485	2	0	592	1293	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	36
4	Akanpalli	7.52	600	265	55	31	15	1.1	N.A.	32	13	2.1	0.85	240	3.7	0	293	328	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	2.9
5	Pulimakthal (Habibullaguda)	7.73	700	218	36	31	59	2.5	N.A.	39	5.7	4.8	1.05	285	2.4	0	348	391	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0.78
6	Kollapadkal	7.26	1740	550	120	61	145	1.6	N.A.	199	13	151	1.44	455	2	0	555	1030	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0.33
7	Pendyal	7.38	1020	245	64	21	121	1.2	N.A.	43	5.4	17	1.44	430	3.2	0	525	594	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	14
8	Mansanpallypz	7.32	800	205	36	28	80	15	N.A.	110	8.9	32	0.90	210	2.5	0	256	468	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7.1
9	Muchinthal	7.74	860	125	18	19	138	3.6	N.A.	32	6.6	3.4	3.40	375	2.4	0	458	503	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	19
10	Gudur	7.05	1700	550	160	36	134	5.5	N.A.	227	53	246	0.82	275	4.4	0	336	1068	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	61
11	Kothur	7.45	2100	520	112	58	241	2.8	N.A.	355	39	11	0.78	500	4.8	0	610	1192	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	11
12	Dubbacherla	7.47	1840	300	72	29	227	97	N.A.	241	40	139	0.35	425	2.6	0	519	1162	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7.8
13	Maheshwaram	7.91	860	125	14	22	129	19	N.A.	138	59	6.8	5.89	168	2.5	0	204	518	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	7.7

Annexure V

Water Quality Data : Exploration

SN	Location/Village	Longitude	Latitude	Mandal/Block	Well type	Depth Drilled (m bgl)	EC (Micro siemens/cm)	NO3 (ppm)	F (ppm)	As (ppb)	Fe	TDS	TH	C03	HCO 3	Ca	M g	Cl	Na	K	SO4	SiO2
1	Gudur	78.2739	17.2087	Kothur	EW	200	676	6	0.46		0.11	434	260	0	240	56	29	45	32	2.9	68	4.5
2	Kothur	78.2890	17.1444	Kothur	EW	200	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
3	Maheshwaram	78.4369	17.1558	Maheshwaram	EW	200	NIL	NIL	NIL	NIL	NIL	NIL	NI L	NIL	NIL	NI L	NI L	NI L	NIL	NIL	NIL	NIL
4	Narasappaguda	78.244167	17.1575			24	680											25				
5	Tallaguda	78.276667	17.183333			43	1350											121				
6	Pinjerla	78.3225	17.109167			43	714											28				
7	Enmulnare	78.301667	17.081667			43.5	787											30				
8	Kambamena Tanda	78.386667	17.158333			32	840											34				
9	Uppuguda Tanda	78.4125	17.136667			40	459											11				
10	Kolla Padkal	78.365	17.08			33	1550											223				
11	Sri Nagar	78.4775	17.2025			36.75	754											74				
12	Rawiral	78.498333	17.231667			40	810											21				
13	Maisaram	78.435833	17.135			39	638											46				
14	Amdapur	78.293333	17.275833			41	503											21				
15	Madanpalli	78.3225	17.1975			48	557											11				
16	Ameerpet	78.331667	17.155833			45																
17	Subhanpur	78.355833	17.104167			43																
18	Pendyal	78.38	17.134167			40	868											25				
19	Shamshabad	78.398611	17.258333			26.5	2100											115				
20	Shamshabad	78.398611	17.258333			26.5	2100											340				
21	Shamshabad	78.398611	17.258333			26.5																
22	Maheswaram	78.430556	17.066667			30	2000											240				