

**CENTRAL GROUND WATER BOARD  
DEPARTMENT OF WATER RESOURCES,  
RIVER DEVELOPMENT AND GANGA REJUVENATION,**

**MINISTRY OF JAL SHAKTI  
GOVERNMENT OF INDIA**



**INCEPTION REPORT  
IMPACTS OF URBANISATION ON THE GROUNDWATER  
REGIME OF MUNICIPAL CORPORATION,  
THIRUVANANTHAPURAM  
(NAQUIM-2.0)**

**AAP: 2023-24**

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Scientist-D (Hydrogeology)**

## INCEPTION REPORT

### Introduction

The Aquifer Mapping and Management programme (NAQUIM) was launched by CGWB in the year 2012 as per the recommendations of the Report of the Steering Committee on Water Resources and Sanitation for Twelfth Five Year Plan (2012-2017), Planning Commission. NAQUIM was taken up with the objectives of delineating aquifers, characterizing aquifers and preparing aquifer management plans. National level mapping of Aquifers on 1:50,000 scales was considered sufficient for planning requirements up to block level.

Though the NAQUIM outputs have been useful for sustainable ground water management in numerous ways as enumerated above, large scale implementation of its recommendations at ground level by the user agencies is lacking. As per the feedback received from the agencies using the NAQUIM outputs, major limitations of the on-going studies include **i)** non availability of printed maps at usable scales and **ii)** lack of site specific recommendations for implementation at Panchayat or village level.

Keeping the above limitations in mind and considering the future requirements, broad objectives of NAQUIM 2.0 studies will be **i)** providing information in higher granularity with a focus on increasing density of dynamic data like ground water level, ground water quality etc. **ii)** providing issue based scientific inputs for ground water management up to Panchayat level, **iii)** providing printed maps to the users and **iv)** putting in place a strategy to ensure implementation of the recommended strategies. Involving state agencies in the studies for a sense of ownership.

The NAQUIM 2.0 studies are envisaged to be multidisciplinary. The study 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 one of the main identified issue is Urban Agglomerate.

The proposed urban study area of Port Blair under NAQUIM 2.0 covers an area of 42 Sq. km. The proposed area is to be mapped in 1:10,000 scales. Considering the urban agglomeration, constant growth of population and urbanization in Port Blair town, it is very difficult and challenging task to manage the fresh ground water resource in the island condition where there is a constant threat of saline sea water intrusion. The Trivandrum urban has been selected under the pre-defined priority type of “**Urban Agglomerate**” out of 11 Priority areas as per Central Ground Water Board national mandate.

## ABOUT STUDY AREA

Thiruvananthapuram city is located along the south west coast of India (Fig 1). It spreads over an area 215 km<sup>2</sup> and houses 9.57 lakh people (2011 census). From the coastal plain the city extend over undulating lateritic midlands. Settlements occupies the ridges and upper slopes, whereas the valleys, given for agriculture, function as water cushioning areas during heavy monsoon showers. Average annual rainfall in Thiruvananthapuram city is around 1700mm. Both the monsoons, active in the city account for 76% of annual rainfall. There is rain in Trivandrum city almost in every month. The river Karamana, its tributary Killi Ar and couple of small streams drain the city. Trivandrum city expanded from 75km<sup>2</sup> in 1966 to 215 km<sup>2</sup> by 2012 and now has 100 Wards.

Sl No.	CGWB Studies	Findings
1.	<b>The SIDA assisted Coastal Kerala Ground Water Project of CGWB</b>	<ul style="list-style-type: none"> <li>Carried out detailed hydrogeological studies with exploration in the district</li> <li>during the period 1983-88. Aquifer Units and characteristics deciphered. Zones of groundwater potential identified. Development prospects formulated through the studies.</li> </ul>
2.	<b>Hydrogeological Studies Along The Coastal Tracts With Special Emphasis On Vulnerability To Sea Water Ingress Trivandrum District, Kerala (2009-10)</b>	<ul style="list-style-type: none"> <li>Areas affected by Sea water intrusion demarcated and management options elaborated like optimising the pumping rate and duration.</li> </ul>
3.	<b>Base Line Data On Ground Water Regime And Quality In The Proposed Vizhinjam Harbour And Container Terminal/Other Allied Infrastructure Areas In Trivandrum District (2011)</b>	<ul style="list-style-type: none"> <li>The main objective of the study was to carry out micro level hydrogeological survey in the area of the proposed Vizhinjam International Terminal and to find out the impact of this project in the ground water regime of the area, which included both quantitative and qualitative study.</li> </ul>
4.	<b>Groundwater Scenario in Major Cities of India (2011)</b>	<ul style="list-style-type: none"> <li>City has the highest population density in Kerala resulting in more built up area which reduce the groundwater recharge. In order to tackle the declining water level trend in urban area, groundwater management techniques such as roof top ran water harvesting system and artificial recharge structures should be</li> </ul>

		constructed to augment the groundwater reservoir.
5.	<b>Aquifer Mapping and Management Plan for Trivandrum District (2012)</b>	<ul style="list-style-type: none"> <li>Under NAQUIM programme study has been taken up where different aquifer units were identified. Aquifer characteristic and disposition delineated. Issues identified as low yield in parts of the district and contamination issues were highlighted. Under supply side intervention 525 Sq Km area identified for artificial recharge to arrest the huge non-committed run-off and augment the ground water storage in the district.</li> </ul>

The study area forms a part of coastal tract in Thiruvananthapuram district stretching from Vizhinjam in the south to Edava in the north. Along the Thiruvananthapuram coast, tourism is a major activity mainly because of its picturesque setting. Moreover, population density is high all along the coast resulting in heavy extraction of groundwater and the coastal area, being a narrow stretch of land sandwiched between the sea and kayals where it has a highly fragile balance between the salt water and fresh water.

Physiographically, the area is characterized by coastal plains flanked by gently sloping upland on the east. The width of the coastal plain ranges upto 5 km. Geomorphologically, the landforms in the study area are carved out by a combination of marine, fluvial and denudational activities which can be grouped into erosional and depositional landforms. The study area is studded with a number of backwater channels and estuaries. Moreover, the area is well drained by the tributaries of Karamana and Vamanapuram rivers, dissecting the entire area before they debouche into the Lakshadweep Sea. Hydrogeologically, the area is underlain by geologic formations ranging in age from Precambrian to Recent. The eastern upland is represented by Khondalite, Migmatite and Charnockite group of rocks of Archaean age. Sedimentary formations of Tertiary age and Coastal sand and alluvium of Recent age occur all along the western coastal fringe area.

**Priority types:**

Trivandrum Urban area has been selected under the pre-defined priority type (Priority Area 2) of “Urban Agglomerate” out of 11 Priority areas as per Central Ground Water Board national mandate under NAQUIM 2.0.

**Objectives of the present study:**

Groundwater has been used everywhere in the world for a long time because of its easy accessibility and good quality. In urban areas, groundwater as a source of domestic, commercial and industrial water has greatly contributed to the development of cities. Groundwater in urban areas can suffer from many kinds of contamination from both natural and anthropogenic sources. Anthropogenic

contamination, the key contributor in urban areas industrial wastewater, domestic waste water and leaky sewage, septic tanks are sources of nitrogen, heavy metals, volatile organic compounds, pathogenic microorganisms and pharmaceuticals. These contaminants are either discharged to the ground by factories, warehouses and households, and then migrate to the subsurface together with rainwater infiltration, or they can be directly discharged into subsurface soil layers through leaking sewer pipes. These sources of nitrate can also become sources of other hazardous substances or health-related microorganisms. Other than nitrogen, there are many contaminants in urban groundwater including heavy metals, volatile organic carbons and pharmaceutical.

The present objective is to prepare detail map of the study area of Trivandrum Urban Area in 1:10,000 scale. To assess the Ground Water Management & Development of the study area along with Aquifer disposition, aquifer delineation, etc. as per NAQUIM 2.0 guideline. The study is defined with following objectives in **Table 1:**

**Table 1: Objectives of NAQUIM 2.0 study**

<b>S. No</b>	<b>Objectives</b>
1.	Aquifer Mapping on Watershed basis (identified as the AMU)
2.	Demand Supply Study
3.	Aquifer Dispositions
4.	Aquifer-wise ground Water Levels
5.	Delineation of Recharge Areas
6	Estimation/Refinement of parameters used for resource assessment
7.	Assessment of ground water resources
7	Ground Water Quality
8	Areas showing signs of subsidence
9	Ground Water Quality Management Interventions including demarcation of safer aquifers
10	Artificial Recharge Plan
11	Other measures
12	Identification of potential aquifers for drinking water supply
13	A plan for drinking water source sustainability
14	Recommendations for tackling water logging

**Existing data:**

Presently there are existing 26 Nos of Monitoring Stations present in the study area of Trivandrum Urban Area. Long Term Pre-monsoon & Post-Monsoon water level data Ground Water Quality Data are available of these monitoring stations. Presently 5 No of EW/BW is present in the study area. 15 Nos of VES has been already conducted in Trivandrum Urban Area.

**Data gap analysis:****Location:**

The study area comprises of 100 wards of Trivandrum Urban area, covering a total geographical area of 215 sq. km. It is bounded by the North latitudes of 8° 21' 45" and 8° 34' 49" and East longitudes of 76° 49' 39" - 77° 00' 25".

**Data Availability:**

The available CGWB in-house Exploration data and existing NHS wells for monitoring water level in different wards is compiled, tabulated and plotted. The data insufficiency within the study area is thereby identified and given for recommendations.

**Ground Water Monitoring Data:**

For 1st aquifer (un-confined/Phreatic), one open/dug well is recommended for each quadrant of a Base Map. For 2<sup>nd</sup> aquifer (fractured zone) the EW/OW constructed may be used as piezometers for GW monitoring. Base map at spatial scale of 3' X 3' grids have been considered for plotting and analysis of the gap in the study area.

Presently in Trivandrum there are 26 existing NHS wells which are monitored two times a year. **Table 2** show the distribution of NHS wells in the study area. A total of 40 wells tapping Aquifer-I are thereby recommended for bridging the data gap. A monthly monitoring of key wells is proposed during this study.

**Table 2: Existing Dug Well Locations**

Sl no	Location	Long	Lat
1	Azhakkulam (Kovalam)	76.99	8.39
2	Chakai (R1)	76.92	8.49
3	Kaimanam (R1)	76.97	8.47
4	Karyavattam	76.89	8.57
5	Kazhakoottam DCB	76.87	8.58
6	Kovalam	76.98	8.39
7	Kowdiar	76.96	8.52
8	Kudappanakunnu	76.96	8.56
9	Kulathur	76.88	8.54
10	Manacaud	76.95	8.47
11	Mannanthala (NHS)	76.94	8.54
12	Mukkolakkal	76.95	8.56
13	Paruthippara	76.95	8.54
14	Paudikonam	76.93	8.57
15	Poojappura	76.98	8.50
16	Poonkulam	76.98	8.42
17	Poonthura (NHS)	76.94	8.44
18	Sreekaryam	76.91	8.54
19	Statue	76.95	8.50
20	Thiruvallam	76.96	8.44

21	Thumba	76.85	8.56
22	Vattiyoorkavu	76.99	8.53
23	Vazhuthakkad	76.96	8.50
24	Veli	76.89	8.51
25	Shankhumugham /Vettukkad	76.90	8.49
26	Vizhinjam	76.99	8.38

**New Data generation plan:**

Presently the NAQUIM 2.0 study area of Portblair is divided in to 3’ X 3’ grid to establish new Key Observation Wells (KOWs), ground water sampling points, construction of EW (if feasible) to study the deeper aquifer parameters and also VES/ TEM Survey is required. The new data generation summarized as below in

**Table no 5**

**Table 5: New data Generation Plan in Trivandrum Urban Area**

<b>Key wells</b>	<b>Ward wise</b>	100
<b>Ward wise Data collection</b>	Water Demand Data	
	Population Data	
	Sewerage disposal system Data	
	No of structures GW abstraction structure	
	Well inventory Data	
<b>Hydrogeology</b>	Water Level	40
	VES Survey	15
	TEM	25
<b>GW Quality study</b>	Outsourcing BOD, SOD and other biological parameters.	50
	In-house Analysis	50 Basic/ 50 HM
<b>GW user feedback</b>	Interaction with GW users	

The work will be conducted with assistance of State Ground Water Department and other line departments working in Ground Water to get the details of check dam, Dug Well, Bore Well, water supply schemes, etc. Activity wise monthly targets for new data generation is to be set.

**Month-wise activity plan:**

Field visits and visits to local offices for data collection in the study area are required, Conducting Public Awareness training programmes. Data compilation report writing. Sharing of data with the concerned departments and entering data in WIMS. Subsequent Progress Reporting in MIS, uploading of reports and media in publications warehouse.

**Composition of the team:**

Team Leader Mini Chandran, Scientist-D, Hydrogeologist-1: Saritha S, Scientist D, Hydrogeologist-2: Bindhu J Viju, Scientist D, Chemist, Dr VST Gopinath, Scientist C, GP:



**Team-member-wise responsibilities and monthly targets for entering in the MIS:**

**Table6: NAQUIM 2.0 Work Distribution Table (Month-Wise) for Trivandrum Urban Area**

NAQUIM 2.0 Work Distribution Table (Month-Wise) for Trivandrum Urban Area														
Team members:		Mini Chandran (Scientist-D & Team Leader), Saritha S (Scientist D), Bindhu J Viju (Scientist D-Chemist ), VST Gopinath, Scientist C (GP)												
Sl.	WORK ITEMS	Assignments to be carried out by officers	Assignments to be carried out by officers											
			APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
1	Base map Preparation	Mini Chandran, Saritha S												
2	Preparation of the Inception Report:	Mini Chandran, Saritha S												
2	Ist Review	Mini Chandran,												
3	Pre-Monsoon Field Data Collection	Mini Chandran, Saritha S Bindhu J Viju VST Gopinath												
4	Pre-Monsoon Sample Surveys and User Feedback	Saritha S Bindhu J Viju												
5	Pre-Monsoon Other on-going field activities geophysical studies, data entry in WIMS	Saritha S Bindhu J Viju VST Gopinath												
6.	II Review	Mini Chandran												
6	Data Analysis and Interpretation	Mini Chandran, Saritha S Bindhu J Viju VST Gopinath												
7	Workshops and mid-term review by NLEC	Mini Chandran,												
8	Post-monsoon	Mini Chandran,												

NAQUIM 2.0 Work Distribution Table (Month-Wise) for Trivandrum Urban Area															
Team members:		Mini Chandran (Scientist-D & Team Leader), Saritha S (Scientist D), Bindhu J Viju (Scientist D-Chemist ), VST Gopinath, Scientist C (GP)													
Sl.	WORK ITEMS	Assignments to be carried out by officers	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	
				Field Data Collection	Saritha S Bindhu J Viju VST Gopinath										
9	Post-monsoon Sample Surveys and User Feedback	Mini Chandran, Saritha S Bindhu J Viju VST Gopinath													
10	Post-Monsoon Other on-going field activities, geophysical studies, data entry in WIMS	Saritha S Bindhu J Viju VST Gopinath													
	IV Review	Mini Chandran													
11	Data Analysis and Draft Report Preparation	Mini Chandran, Saritha S Bindhu J Viju VST Gopinath													
12	Other ongoing field activities geophysical studies, data entry in WIMS	Saritha S Bindhu J Viju VST Gopinath													
13	Ground Water Management Plan;Field truthing of Management	Mini Chandran, Saritha S Bindhu J Viju VST Gopinath													

NAQUIM 2.0 Work Distribution Table (Month-Wise) for Trivandrum Urban Area															
Team members:		Mini Chandran (Scientist-D & Team Leader), Saritha S (Scientist D), Bindhu J Viju (Scientist D-Chemist ), VST Gopinath, Scientist C (GP)													
Sl.	WORK ITEMS	Assignments to be carried out by officers	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	
				plan & RWH & AR Plan											
	V review	Mini Chandran													
14	Other ongoing field activities - data entry in WIMS	Saritha S Bindhu J Viju VST Gopinath													
	Vith Review	Mini Chandran,													
15	Modification of draft report with additional information collected by the above mentioned field checks - Scrutiny and Finalisation of the Report	Mini Chandran, Saritha S Bindhu J Viju VST Gopinath													
16	Other ongoing field activities - geophysical studies, data entry in WIMS	Saritha S Bindhu J Viju VST Gopinath													
17	Sharing of the reports with CHQ, SGWCC and DM/DC - Brochure to be prepared by 31st March.	Mini Chandran													