[1]P Kishor Kumar

[2]L Priyanka

[3]K Saritha

[4]S Deepika

[5]R Suma

GIS Constructed Water Monitoring Network System Via IOT

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Abstract: Monitoring the quality of water plays a vital role in the advancement towards intelligent and smart agriculture. It also facilitates the seamless transition to automated monitoring of essential components of human daily needs, as new technologies continue to be developed and adopted in both agricultural and human daily life, particularly in relation to water. Assessing water stress requires accurate measurement of water usage [1]. The objective of this study is to optimize the distribution strategy and achieve more efficient and rapid distribution, while also making better use of technology to address the urgent need for water conservation. One of the criteria for the second filtering phase, which utilized a realtime data collection system, focused on the implementation of water quality monitoring and characterization methods. Water measurement sensors and the Internet of Things (IoT) can provide immediate information on water flow and pressure rates. This information is crucial for the analysis and surveillance of water [2]. At the RCEW campus, online smart water monitoring is imperative to ensure a more efficient and sustainable use of water. By combining the Internet of Things and geographic information systems (GIS), an online smart water monitoring prototype was developed specifically for RCEW [3]. This cutting-edge technology has proven to be highly successful in providing real-time information on water parameters, saving both time and money, while enabling the continuous study of water consumption patterns. This innovative technology seamlessly integrates IoT and GIS for effective water surveillance [4,5].

Keywords: Geographic Information System (GIS); Internet of Things; Sensors

I. INTRODUCTION

Water represents one of the planet's greatest resources. It has significant effects on the existence of humans and civilization's long-term survival [7]. Any individual respects water-based, consequently preserving its purity and ensuring access to it are essential. Therefore, measuring water use is crucial to determining water stress. Water is necessary for all living organisms [6]. The execution of the urbanization and industrialization plan is the cause of the public's serious worries concerning an upward trend in substances in waterways. More flexibility and more cost-effective processes are provided through the use of new digital technologies, like the Internet of Things (IoT), to generate higher-quality water network monitoring data [8]. Additionally, they facilitate data collection and analysis from distribution networks and smart water sensors. Geographic Information Systems (GIS) are becoming used on an increasing basis to map and analyze geospatial data by utilities, like storm drains, treatment facilities for wastewater, and water systems. Everything becomes connected when GIS and IoT come together, including sensors, geodatabases, analysis, and apps that water utilities can use [9]. It is an assessment of the water's state for use by humans or even for the requirements of different types of land. "A determination of water on its acceptability for a given use based on predefined physical, chemical, and biological parameters"[10]. Conventional methods of monitoring water quality call for the responsible farmer or health society to physically inspect and control the water quality by traveling to the designated areas or fonds [11]. The idea put forward additionally provides an intelligent sensor-based rainwater harvesting mechanism at the plot level.

The emergence of wireless sensor networks and the internet of things occurred simultaneously with the progress in data collection, facilitating the optimal features of water and air quality monitoring systems [12]. The latest

[1 1] *Corresponding author: Assistant Professor, Department of Electronics and Communication Engineering, Ravindra College of Engineering for Women, Kurnool, Andhra Pradesh, Email ID: pobbathi123@gmail.com

[2,3,4,5]Student, Department of Electronics and Communication Engineering, Ravindra College of Engineering for Women, Kurnool, Andhra Pradesh

[2]lagusanipinkygoud45@gmail.com, [3]sarithakashepogu@gmail.com, [4]sdeepikadece050@gmail.com, [5]sumaremata2002@gmail.com

advancements in water quality monitoring systems encompass the utilization of multiple sensors, automated control, wireless data collection, and uninterrupted sensing. Additionally, cutting-edge technologies such as artificial intelligence, machine learning, deep learning, fuzzy logic, and the Internet of Things are acknowledged as effective approaches to monitor water quality [13].

The phrase "Internet of Things" (IoT) is frequently utilized in various contexts. many contexts, but broadly speaking, we can define it as a global network of individually addressable networked things that are dependent on widely agreed communication protocols [14]. Healthcare and wellness, automation of homes and buildings, improved energy efficiency, industrial automation, asset management, logistics, smart metering and smart grid infrastructures, precision agriculture, smart shopping, the aquaculture sector, and water quantity and quality assessment are only a few of the use cases for the Internet of Things (IoT) has proven to be advantageous due to its ability to connect various devices and systems. In the realm of water quality management, IoT has emerged as a valuable platform for monitoring and evaluating water quality [15]. This study seeks to assess the current research trends in water quality management through an extensive literature review. The culmination of this effort is the integration of ongoing research on water quality management with the latest advancements in IoT technology [16].

II. METHODOLOGY

The preliminary version of a virtual water monitoring platform for RCEW that integrates to The Internet of Things (IoT) and GIS consists of four layers:

- physical layer
- network layer
- processing layer
- application layer

A. Physical Layer:

Physical layer refers to any IoT device that detects and collects information about the physical characteristics of the study region's water network [17]. Network and application layers refer to sensors and other devices that convert analog impulses into digital ones. In this prototype development, different types of sensing sensors were used to collect information on the location of the sensors, as well as information on water pressure, water flow, and water consumption. Examples of sensors include the water flow sensors (WSG-20 model), water pressure sensors (PSG-380 model), and sensor nodes (RSG-100 model). Figure 1 shows the locations of the sensors on RCEW's campus [18].

Figure 1: The RCEW campus can be found at Nandikotkur Road in Kurnool.

B. Network Layer:

The Internet of Things (IoT) gateway at the edge of the network links the cloud services to a local water sensor network, typically moving data directly from the local device to the cloud were Web apps process and display data to consumers [19]. IoT devices are connected to the Internet wirelessly by LoRa WAN (also known as low power wide-area network, or LPWAN), which enables bi-directional communications between the nodes and servers. You can think of the LoRa gateway as a bridge that connects a server to a sensor. Even when the gateway can't process data, it compiles all the information it gets from the nodes and sends it to the server, where it can be processed. Data collection tools collect location data, water pressure data, water flow data, and consumption data.

Sensors can produce either a voltage or a current-based signal based on the physical event they're monitoring.

C. Processing Layer:

A centralized system collects and analyses data on water parameters to improve efficiency. The primary purpose of the data center system is to manage and monitor the water monitoring system (WMS). Data is collected by the WMS monitoring system and sent to the data centre in real-time [20]. The user interface allows for real-time monitoring of the water pressure and water flow rate. At the same time, the data is analysed and the results are used to approximate the water consumption pattern.

D. Application Layer:

Using cloud computing technologies, the data and storage for the water parameters have been combined in this application layer. Data can be distributed and stored on this cloud system at any time and from any location [21]. A sizable amount of water parameter data is accessible for monitoring via the website and mobile app after being saved in the cloud. Figure 5 illustrates how cloud computing is employed in smart monitoring of water for RCEW.

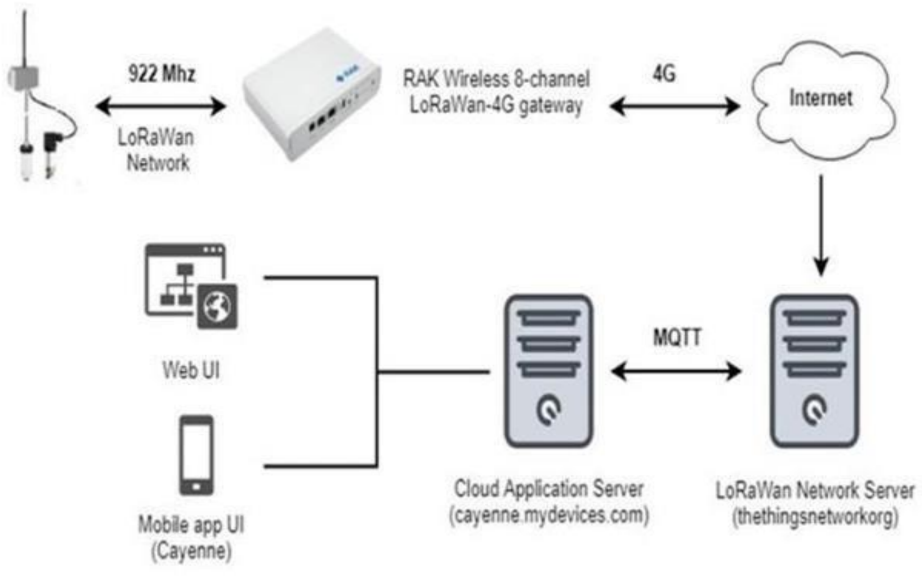

Figure 2: Water Monitoring Network system for RCEW

Users have the ability to search for sensor nodes and retrieve information from the online database that contains such data. The process of designing the database involves two steps: conceptual design and logical design. This study incorporates two geographical components: land use and sensor node data. Figure 3 illustrates an Entity Relationship (ER) diagram, which aids in comprehending the connections between various entities by representing the real world [22]. The logical design is employed to convert the entity name, attribute name, description, and data type from an ER diagram into a relational database schema (which includes table descriptions).

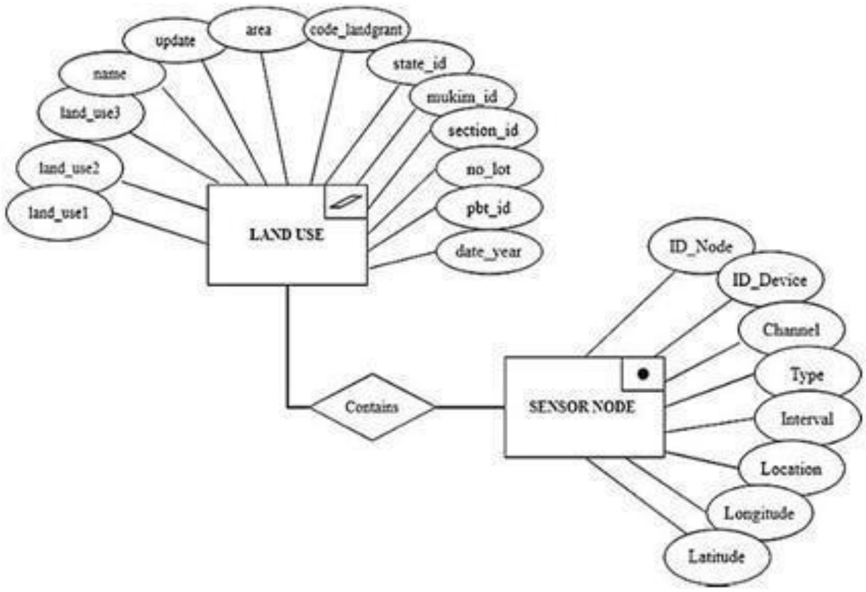

Figure 3: Entity Relationship Diagram (ERD) for Web-Based GIS in Water Monitoring Network System

To ensure that every aspect of the internet address to be displayed accurately, the application interface is essential. The website consists of several components, including the Homepage (main page), Real-time Data, Data, the Map in Figure 7, and Contact information.

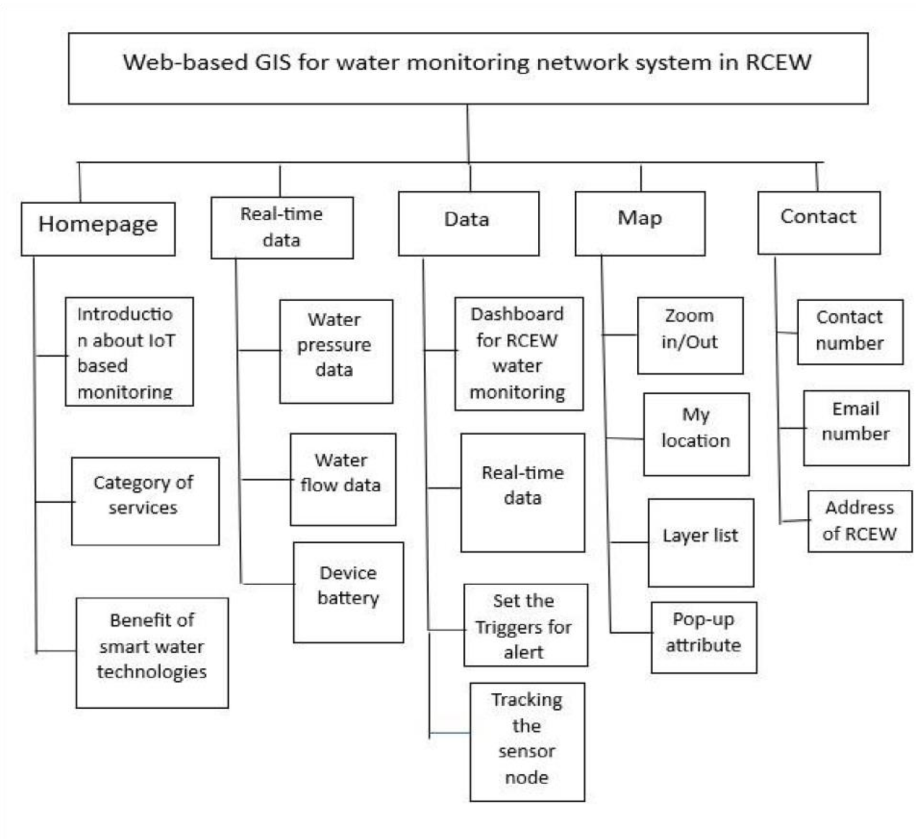

Figure 4: Design for the water monitoring network system's application interface

WEB MAP APPLICATION:

Essentially, web mapping allows GIS data to be uploaded online and shared with other users. Online maps that are equally as good as those created with a GIS can be created with the QGIS2Web application. Web mapping

QGIS data is fortunately made simple by available resources. With the Leaflet or Open Layers libraries, for example, your QGIS project might produce a web map via the QGIS2Web plugin. In QGIS, create a web map before proceeding to create an online mapping application.

III. RESULT

An option available is to utilize the Utility Network Analyst and Water Utility network modification. This involves assigning the water distribution tasks to the geographic information systems (GIS) software, which can effectively manage, analyse, and conduct comprehensive investigations on the existing water network assets.

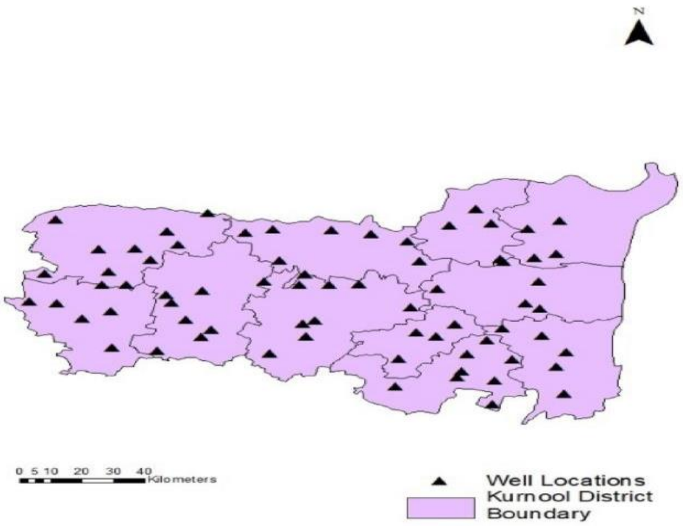

Figure 5: GIS based approach of water monitoring in Kurnool district

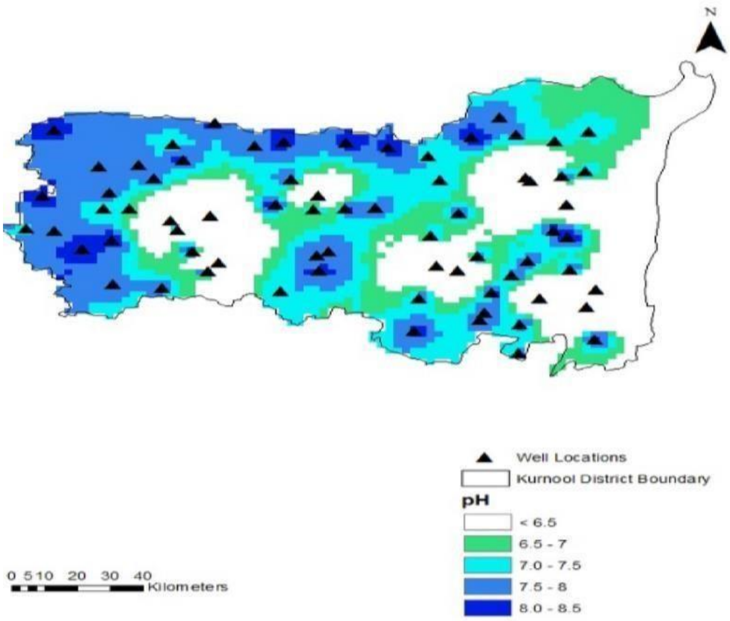

Figure 6: PH Value of Water on GIS mapping

In addition, these systems have the ability to respond to particular queries regarding network components like pipelines, pumps, valves, and so on. The utilization of GIS offers numerous advantages, such as facilitating the inspection, repair, replacement, and assessment processes. It also enhances the potential capabilities of the system and contributes to an increase in the revenue of the distributed water company.

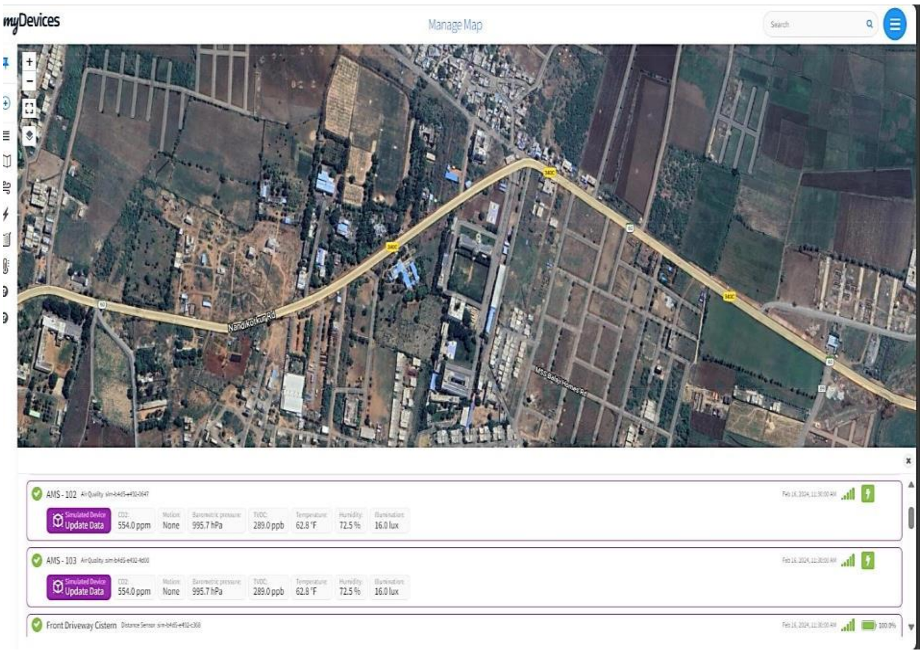

Figure 7: RCEW Water Monitoring Dashboard

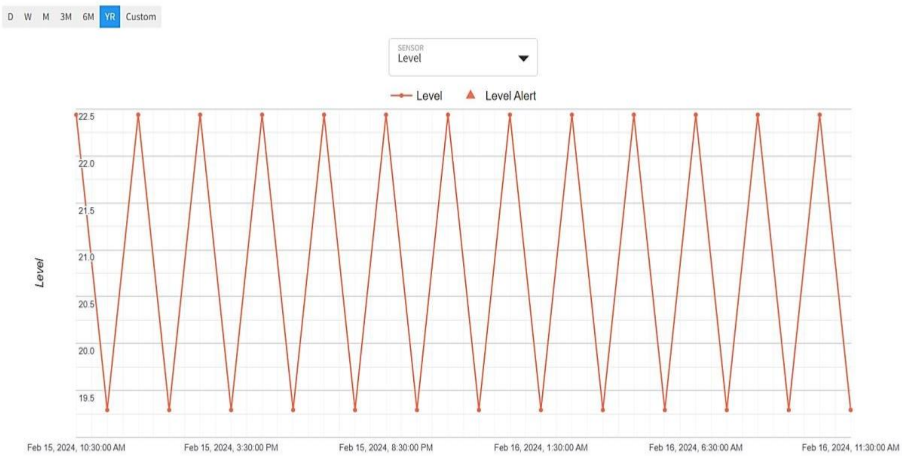

Figure 8: Data on the Daily Water Level

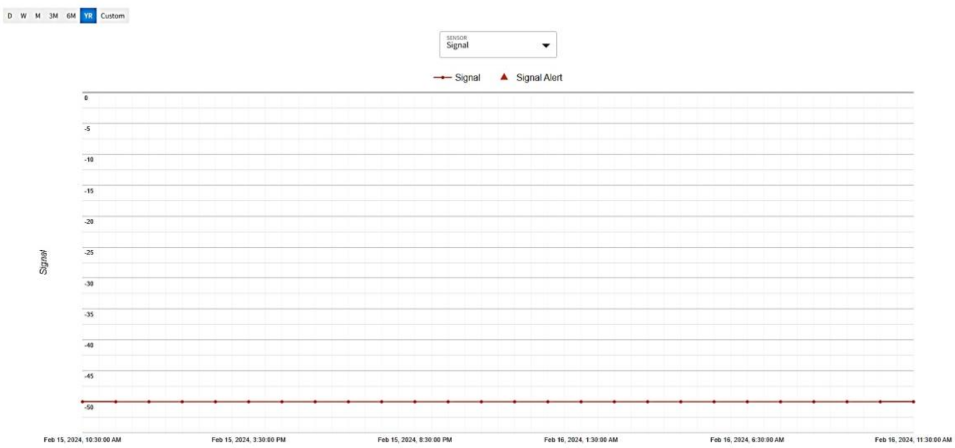

Figure 9: Water Signal

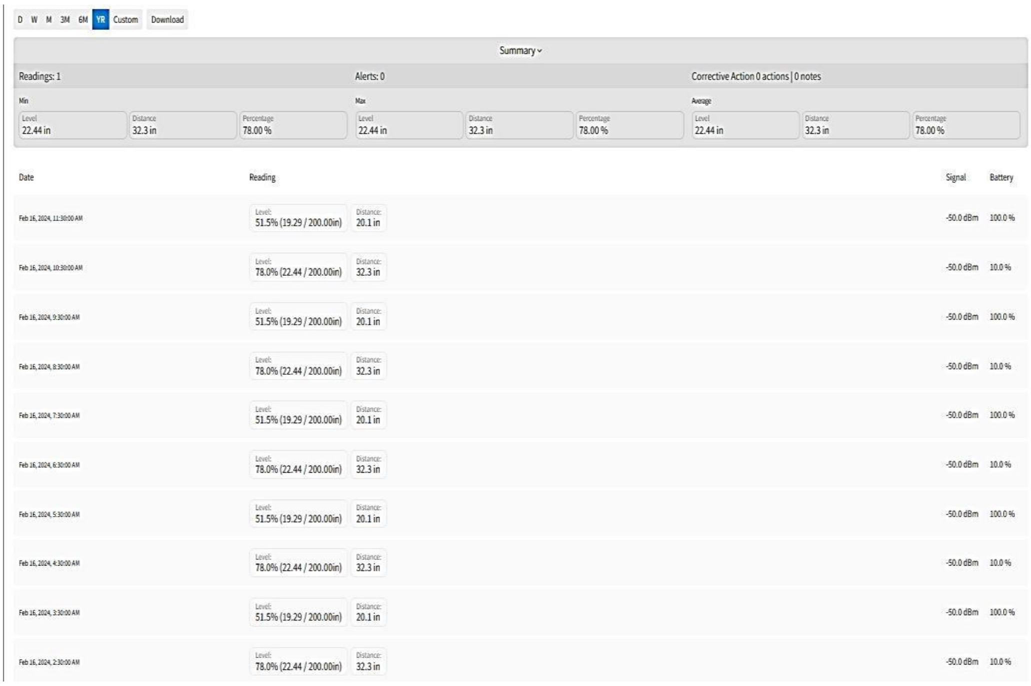

Figure 10: Measurements of the Water level on a specific day

IV. CONCLUSION

Geographic Information System that connects computerized databases that explain characteristics of a certain location to computerized maps, or location data. This connectivity makes it simple to access data and location at the same time. The newest technology for smart water monitoring has proven to be an exceptionally effective approach in providing up-to-the-minute data on water parameters. by integrating the IoT-GIS, which is also cost- and time-effective, and permitting ongoing analysis of water consumption with the use of cloud computing services. In addition, GIS facilitates swift and precise updates to maps and other forms of data. Modelling can be enhanced by utilizing information derived from the spatial data of GIS. One of the key strengths of GIS lies in its ability to process data sets using various numerical analysis techniques. The digital approach to storing and analysing spatial or image data significantly enhances data analysis. The applications of GIS are vast and diverse. Water Supply can utilize GIS to effectively protect different water supply systems in conjunction with source water assessments. If equipped with a comprehensive database, Geographic Information Systems (GIS) can serve as a powerful tool for analytical and decision-making purposes within the water supply system. Furthermore, it can be employed to evaluate the impacts of development and for effective management.

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