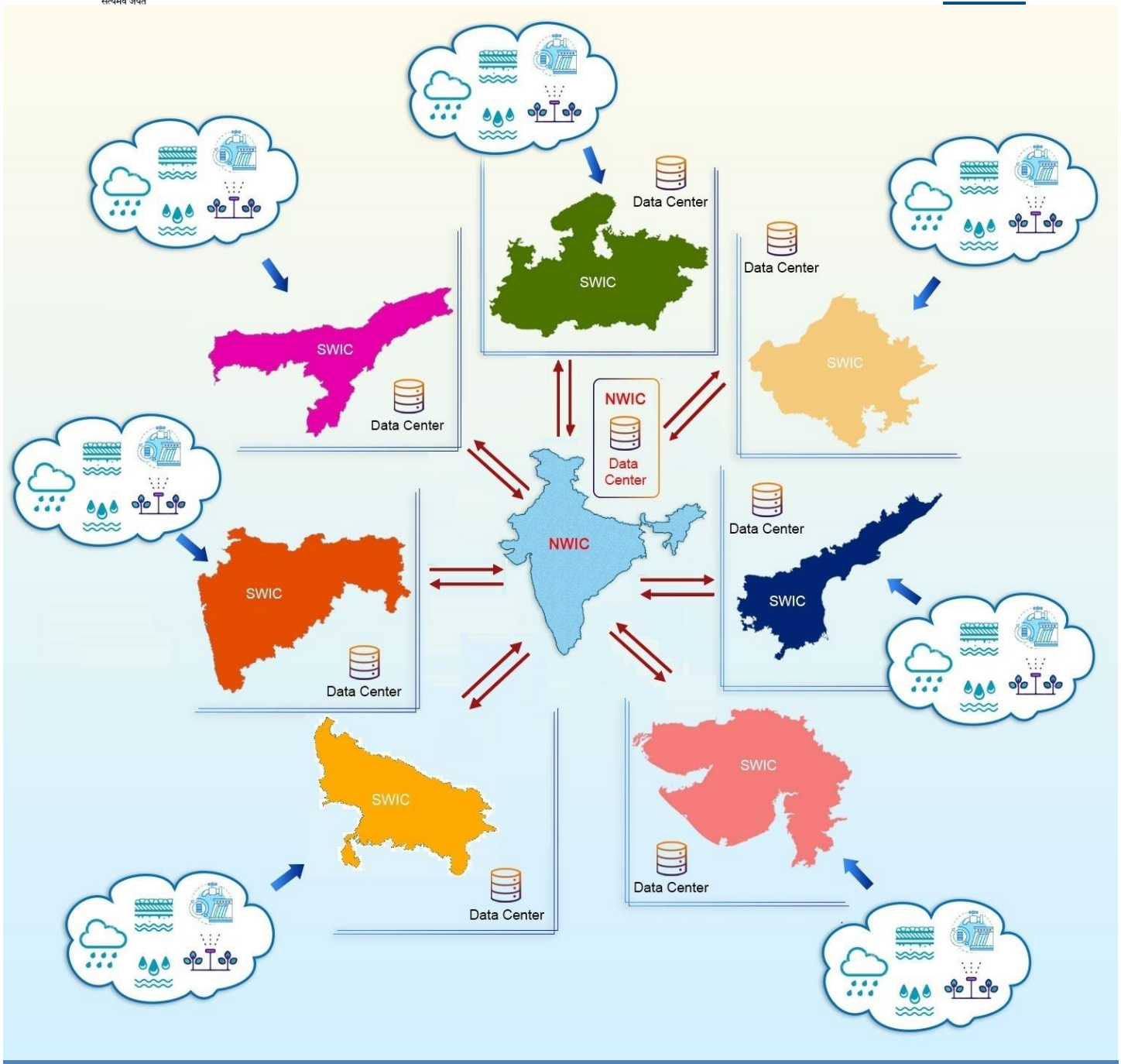

Framework for Setting up of State Water Informatics Centre(SWIC)

Contents

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EXECUTIVE SUMMARY

We are well aware that our water resources are very precious. These resources are increasingly under pressure due to factors like population growth, economic development, urbanization and climate change etc. Effective and efficient management of these resources backed up by informed decision making through seamless availability of historical and real time data both at the state and national level is, thus, of critical importance.

Due to multiplicity of data producing agencies collecting their domain specific data-the same is often fragmented, incomplete, dispersed and heterogeneous making it difficult for policy makers to process it into useful information to support decision making. To overcome these challenges, NWIC had been set up by the Government of India in 2018 to act as central repository of data on water resources and allied themes. Though, NWIC is maintaining nationwide digital water database and associated spatial data for the country and disseminates it through a digital platform **(India-WRIS**), there is state specific micro level & demand side data which can be better collected and maintained by the states themselves. This has led to the concept of establishment of **State Water Informatics Centres (SWIC)** at state/UT level.

The major role expected to be performed by SWIC is to collect data from different state departments/agencies, digitization as per standard formats, validation and populating the same in state specific data base. NWIC would be hand holding states in this much needed endeavour by arranging requisite hardware and software, preparation of data-base, development of analytical tools, generic products and decision support system for SWIC to operate at nominal budgetary support from states.

The entire concept and framework of SWIC has been logically explained briefly in the following paragraphs:

1. Need and scope of SWIC

As we know what cannot be measured cannot be managed. Therefore, availability of water resources data is critical for management of water resources of the country. In India, water being a state subject, the data fields required for water resources planning & management at local and micro level are available with respective states. A dedicated body as State Water Informatics Centre (SWIC) is needed as a state data repository entrusted with collecting, collating and updating the data and to act on policy towards uniform data acquisition, standardization, analysis and dissemination. The SWIC will be responsible for collection of water data of the state by setting up regular mechanism for collection of periodic data from different state departments/organizations, primary and secondary data validation, customization of applications developed in NWIC to suit state requirements and developing tools & applications specific to their respective state.

The basic objective of establishing SWIC is, thus, to empower states with digital, validated, on-line water resources information system required for better planning and management of water resources at State level and simultaneously to feed the central system for basin and regional level policy planning and taking

strategic decisions based on authentic data analytics. In coordination with NWIC, the SWIC shall act as a single point solution for regional and micro level data amalgamation and its dissemination.

2. Benefits expected from SWIC:

The establishment of SWIC will help states in:

- Policy formulation for scientific management of water resources and related aspects of the state
- Strategic Decision making
- Modelling activities and development of analytical tools
- Development of decision support systems and other knowledge products related to water.
- Overall water resources management and planning in the respective states.

3. State-WRIS and the data/parameters to be captured

Along with the **Time-series Source side data** being monitored by states viz. rainfall, river level, discharge, reservoir levels, Ground water level, Surface water and ground water quality, silting, the **Time-series data on Utilization and demands side** like releases into canals, water levels and discharges incanals and distribution network, ground water utilization will be brought on a single platform by SWIC as **State-Water Resource Information System (State-WRIS)** of the State/UT**.**

In addition, the **Spatial data** relating to crop coverage, location of river gauging sites, ground water level/qualitymonitoring sites, surface water quality monitoring sites along with the meta data of the sites, command area maps, aquifer mapping, geological maps, detailed land use land cover, soil maps and **Other associated data** such as river cross sections, G&D rating curves, Area Elevation Capacity curves of reservoirs, litho logs, geo-electrical logs, aquifer parameters, and data pertaining to demography will also be brought on the State-WRIS platform. Any other data being captured or proposed to be captured by the state may also brought on the platform. Thus, all state specific data on water and related themes may be brought on the platform (State-WRIS) to help the state in developing knowledge products, analytical tools and decision support system for better water management.

4**. Stakeholders for SWIC:**

All line departments of the states dealing with water such as Irrigation, Water Resources Department, Minor Irrigation department, Agriculture department. Rural Department, Planning department, Water Supply Department, Academicians and researchers etc. will be the stakeholders for SWIC.

5. Users of SWIC:

The respective state government organizations, Central Govt organizations, co-basin states, Academicians, Researchers, Water resources professionals, residents of the co-

basin states are expected to benefit hugely from SWIC.

6. Role of NWIC in establishment and Management of SWIC:

NWIC shall handhold the states in implementation of SWIC and development of State-Water Resources Information System (State-WRIS). NWIC shall guide States/SWIC during all the stages of implementation of SWIC & State-WRIS. NWIC shall provide the technical guidance and support for all the developments related to geo-spatial & time-series data aggregation, standardization and database management Software & Hardware Technologies including Development & Production Environment Setup (i.e. servers/cloud for testing and hosting the platform) etc. The major roles of NWIC are listed below: -

I. Standardization of data and GIS layers
II. Sharing & Integration of data with states
III. Common validation tools
IV. Production Environment Hosting platforms (servers and cloud requirement)
V. Development of generic reports,Visualization and Dashboards
VI. Common licenses, software for GIS and databases
VII. Development of generic applications and DSS

7. Technical framework of SWIC:

For the purpose of implementation of the framework, states have been grouped into **two** categories based on current progress made by different states in setting up centralized geo-spatial IT platform for collection and dissemination of water data:

Model-I States which are in the process developing IT systems/ State-WRIS, and

Model -II States which are already online i.e. the States which have already established fullyfeatured WRIS platform

Model-I States: NWIC would provide end to end support to the states falling in Model-I category. Such states will develop SWIC with extensive support from NWIC including availability of IT platform for hosting, database management, GIS layer development and creation of state specific dashboards. Guiding principles have been proposed with regard to database set up, software selection and hosting platform for setting up of SWIC by these states in the framework document.

States already online i.e. Model-II states: These states can continue with their existing setup for the State-WRIS, however data/information integration with NWIC in seamless manner would be ensured by means of APIs, Map services (WMS/WFS), and other modes of data sharing mechanisms, as needed from time to time.

The establishment of SWIC with this technical framework will have benefits in terms of standardized data schema, ease of data sharing, improvement in data

quality and validation with proper metadata. The data will be reusable and interoperable and accessible to all states along with ease of access to all stakeholders/ users working in different organisations within and beyond the state boundary. The approach will be cost effective as there will be minimal need for investing money in setting separate data centers, purchasing software and IT infrastructure and its O&M at the state end.

8. Proposed administrative set up of SWIC:

A lead department may be decided by the Chief Secretary of state for separate establishmentof SWIC. In case of smaller states having only one water resources department, the same may be declared as the lead department. The lead Department will take all necessary approvals required viz. SWIC mandate, organizational setup, location, reporting relationship and necessary budget provisions. The head of SWIC would report to Chief Secretary/PrincipalSecretary or Head of the lead department. A Chief Engineer level officer may head SWIC in case of large states and in case of small states a Superintendent Engineer level officer may head the SWIC. Other officers may be drawn from various concerned departments/organisations of the states on deputation to allow fast implementation by experienced Water Resources Managers. The IT professionals (RS and GIS experts, software developers, data base expert and hardware and networking experts) required locally may be hired for required period. NWIC will also help states in hiring experts in terms oftheir number, qualification and experience.

9. Approach towards implementation to setup the SWIC:

SWIC may be located at the Data Centre established under HP1/HP2/NHP, wherein requisite infrastructure has already been provided under these schemes. This would save and minimize the expenditure on establishment of SWIC at State/UT level. Funding for development of basic infrastructure such as furnishing data Centre, local servers, work stations and software have already been made available to the states under the **National Hydrology Project**. NHP funds may also be utilized for initial deployment of local IT resources and contractual IT & GIS experts in the newly set up SWIC.

Although immediate action on establishment of SWIC is possible utilizing the resources under NHP towards infrastructure, however, a formal arrangement would essentially be required subsequently through approval of the cabinets of the respective states through which specific mandate would be entrusted to the SWIC with annual budgetary support.

This framework document for State Water Informatics Centre (SWIC) aims to provide a clear understanding about the need, importance and the procedure envisaged for establishment of State Water Informatics Centre by states, its operation and maintenance with hand-holding support by the National Water Informatics Centre (NWIC).

Chapter 1

Introduction

1. Introduction

The National Water Policy (2002) and (2012) recognizes that the development and the management of water resources need to be governed by national perspectives and aims to develop and conserve the scarce water resources in an integrated and environmentally sound way. The policy emphasizes the need for effective and economical management of our water resources by intensifying research efforts in the use of remote sensing technologies and developing an information system.

The National Water Policy 2002, para 2 on Information System states:

"2.1 A well-developed information system, for water related data in its entirety, at the national/ state level, is a prime requisite for resource planning. A standardized national information system should be established with a network of data banks and databases, integrating and strengthening the existing central and state agencies and improving the quality of data and the processing capabilities.

2.2 Standards for coding, classification, processing of data and methods / procedures for its collection should be adopted. Advances in information technology must be introduced to create a modern information system promoting free exchange of data among various agencies. Special efforts should be made to develop and continuously upgrade technological capability to collect, process and disseminate reliable data in the desired time frame.

2.3 Apart from the data regarding water availability and actual water use, the system should also include comprehensive and reliable projections of current and future demands of water for diverse purposes at different time and spatial scales. The ultimate objective is to achieve sustainable water security at the scales of towns and villages."

The National Water Policy 2012 in its section 14 for Database & Information System stipulates:

"14.1 All hydrological data, other than those classified on national security consideration, should be in the public domain. However, a periodic review for further declassification of data may be carried out. A National Water Informatics Centre should be established to collect, collate and process hydrologic data regularly from all over the country, conduct the preliminary processing, and maintain in an open and transparent manner on a GIS platform.

14.2 In view of the likely climate change, much more data about snow and glaciers, evaporation, tidal hydrology and hydraulics, river geometry changes, erosion, sedimentation, etc. needs to be collected. A programme of such hydro-meteorological data collection needs to be developed and implemented.

14.3 All water related data, like rainfall, snowfall, geo-morphological, climatic, geological, surface water, ground water, water quality, ecological, water extraction and use, irrigated area, glaciers, etc., should be integrated with well-defined procedures and formats to ensure online updating and transfer of data to facilitate development of database for informed decision making in the management of water."

The vision of a pan-India Water Resources Information System is also in line with the Hydro-Meteorological Data Dissemination Policy, formulated by the Ministry of Jal Shakti in November 2018, which has the objective to make non-sensitive data collected through the use of public funds available for legitimate use, enabling better decision making and meeting society's needs.

1.1. Existing Organization Setup - NWIC

The National Water Informatics Centre was established to collect, collate and process Hydrologic data regularly from all over the country, conduct the preliminary processing, and maintain in an open and transparent manner on a GIS platform. National Water Informatics Centre (NWIC) was set up by the Government on 28th March, 2018 under the Ministry of Jal Shakti, Department of Water Resources, RD & GR, to provide value added products and services to all stakeholders for its management and sustainable development.

Objectives of NWIC

- Collection of available data from varied sources, generate new database, organize in standardized GIS format and provide scalable web-enabled information systems.
- Maintaining, updating, collating and disseminating water data and information.
- Sharing of hydro-meteorological data amongst central and state government organisations and other stakeholders as well as the general public.
- Providing tools to create value added maps by way of multilayer stacking of GIS database so as to provide integrated view of the water resources scenarios to the policy planners.
- Collaboration with national/ international research institutes and
- Providing technical support to organizations dealing with water emergency response for hydrological extremes.
- Maintaining and updating India Water Resources Information System (India-WRIS) and Water Information Management System (WIMS).

The current organizational structure at NWIC is as depicted in Figure 1. NWIC is headed by a Joint Secretary level officer. In the Technical head, 3 Joint Directors are heading three groups namely, Data Team, Service Team and System Team. The Joint Directors are further supported by Deputy Directors & Assistant Directors in the team. The Administrative section is led by one Under-secretary supported by 1 Section Officer and 1 Assistant Section Officer. Additionally, the three verticals of NWIC have hired professionals to perform works

related to GIS, Software Development, Hardware & networking and Database and few administrative supports staff such as accounts clerks, office assistants, PS/PA, MTS etc.

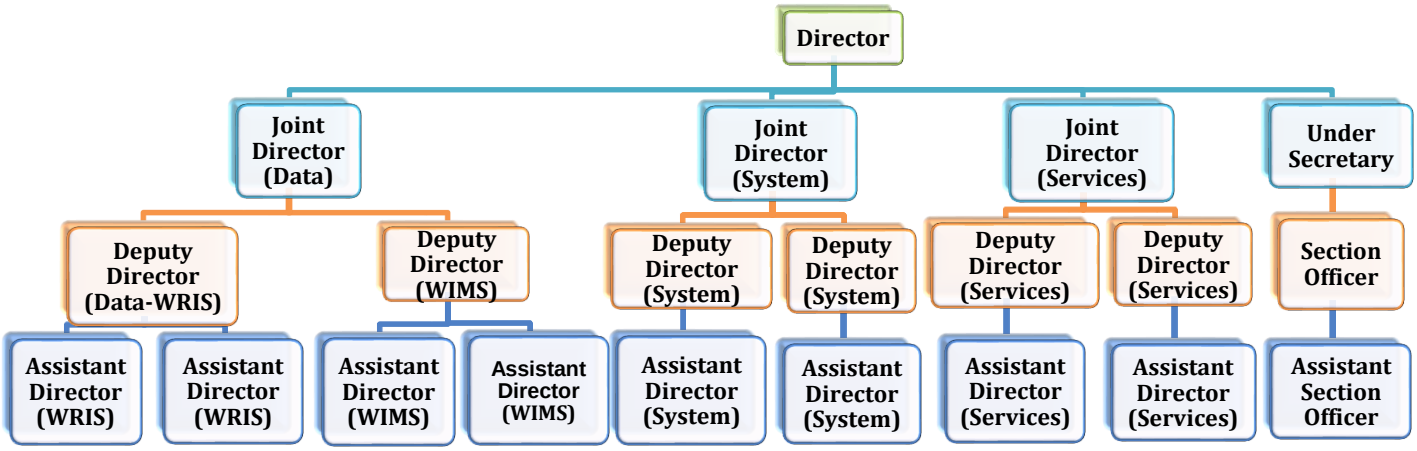

Figure 1: NWIC Organogram

1.2. System Overview - India-WRIS & WIMS

NWIC under its purview is managing two IT Platforms – India-WRIS and WIMS.

I. India-WRIS

The National Water Informatics Centre (NWIC) manages India WRIS portal (www.indiawris.gov.in), a single window solution for all water resources data and information in a standardized national GIS framework. It allows users to Search, Access, Visualize, Understand and Analyse comprehensive and contextual water data for the assessment, monitoring, planning and development of water resources in the context of Integrated Water Resources Management (IWRM). Utilities like Online Web Editor, Data/Report download, Data availability facilitates users to browse through the available data, download the required information and update the state specific data. Some of the major modules offered with their features are given in **Annexure-1**

II. WIMS

(https://india-water.gov.in/wims)

NWIC is handling operation & maintenance of WIMS (Water Information Management system), a web enabled water resources data entry, storage and management system for both surface and ground water resources. The data are being collected through web-based

data entry, mobile-app and also by automated methods through telemetry sensors. WIMS is conceived as an internal application to be used by the technical staff of Central and State water departments. The time-series information available with WIMS is automatically updated on a daily basis and disseminated to all other users through India WRIS portal. Salient features of WIMS are:

- Real time Data Acquisition System (telemetry) modules for configuration and receiving of water related parameters for Surface, ground and hydro-meteorological data.
- Information management system for time series historical and manual data for central and state agencies working on surface and groundwater monitoring.
- Water Quality labs information along with sample data entry system.
- User based access system with defined set of roles and privileges for data entry, view and validation.
- Various reporting and import / export utilities for authorized users.
- Free access to IAs under NHP. Can extend to other departments on purpose basis.

Details of different modules available on WIMS and their features are given in **Annexure- I.**

Flood Forecasting
(http://ffs.india-water.gov.in)

From WIMS database for Flood forecasting, a map based public portal for Central Water Commission's Flood Monitoring and Flood Dissemination has also been created for exploring 'Current Flood Forecast', 'Site' or 'Hydrograph'.

Map based tool to find information of 325 CWC Flood Forecasting Stations consisting of 197 Level Forecasting stations for towns/important villages and 128 Inflow Forecasting Stations for Dams/Reservoirs. Individual station's static information and latest available dynamic information such as water level and flood forecast issued are also displayed.

Current Flood Forecast or Site or Hydrograph provided information for all flood monitoring stations including Flood forecasting Stations. The Colour of any point signifies the basic characteristics of the station. Green is for Flood Level Forecast Station basically important towns/ villages and Blue is for Inflow forecast station basically a dam/reservoir/barrage/weir etc. These colours will be dynamically changing for Flood Level Forecast Stations as per the river water level with respect to Warning Level (WL), Danger Level (DL), and Highest Flood Level (HFL). Normally latest dynamic information is available during flood period 1st May/1st June to 31st October/31st December.

- "Yellow" when the river is flowing Above Normal Flood Level: When river water level is at or above WL but below DL.
- "Orange" when the river is flowing in Severe Flood: When river water level is at or above DL but below HFL.

- "Red" when the river is flowing in Extreme Flood: When river water level is at or above HFL.

HFL is updated on a yearly basis before start of the flood season. Newly attained HFL during the flood season of a particular year in any station will be updated in the next year before start of the flood season.

Chapter 2

State Water Informatics Centre (SWIC)

2. SWIC

2.1 Need for SWIC

India as a subcontinent has a wide variety of geological landforms e.g., hills/mountains, valleys, plains, volcanic plateaus, desserts, coastal plains etc. which led to development of various fluvial geomorphological features guiding the modern drainage systems. The rivers of India undergo large seasonal fluctuations in terms of its flow and sediment load. These large seasonal fluctuations are due to diversified climate which varies from a tropical monsoon climate in the south to a temperate climate in the north. The climate also varies from region to region because of onset and withdrawal of monsoon at different times at different part of India which is the most important source of water.

The Himalayan rivers are different in many respects from those of the Indian Peninsula. The former has a highly dynamic environment with extreme variability in discharge and sediment load. In comparison, the adjustments in Peninsular rivers are less frequent and of a much smaller magnitude. These wide variability in the fluvial, geomorphological and climatological aspects over different parts of India makes the study and assessment more complex.

Further, India as a country is union of 28 states and 8 UTs and as most of the rivers in the country are inter-State, the regulation and development of waters of these rivers, is a source of inter-State differences and disputes.

In the Constitution of India, water is a matter included in Entry 17 of List-II i.e., State List. Referring Water as a State Subject, except for very few major schemes, states manage all water resources data including that on demands. However, data available with state is fragmented and stored in various forms across many departments/ organisations/ establishments of the concerned State.

For proper planning of water resources in terms of demand and supply side management, developing advance analytical tools and models, applications and Decision Support System, a centralized data platform integrated with geo-spatial data is the minimum requirement, along with adoption of uniform practice of data acquisition and storage.

States collect enormous micro level data for water and allied themes and as data collection is carried out by different departments, a dedicated body is needed as data repository and to formulate policy towards uniform data acquisition, standardization, validation, analysis and dissemination. This dedicated body at State level would establish a mechanism for coordination among data generating organizations, users, planners, academicians and all other stake holders. Achieving real improvement in water resources

management will only be possible when data from all over the region is available to all the stakeholders at a single platform.

The IT platforms of compiled data on water and allied themes would help in development of various applications and analytics for informed decision making. The standardization will make data and workflow interoperable and co-operable between the states and national-level bodies. This will ensure seamless integration and consumption of data by the various applications for better water resources management at national, basin and local level.

2.2 Challenges in Setting up of SWIC

The major challenges in setting up the SWIC will be:

1. In states, there are domain specific bodies e.g., WRD for surface water, GWRD for ground water, minor irrigation department, agriculture, state disaster management authority etc. collecting, monitoring, consolidating the data related to their respective jurisdictions.
2. There is lack of coordination among the domain specific bodies and getting data from these different organizations for aggregation becomes a humongous task.
3. Every state has different set of organisations depending upon its size, climatic conditions, type of geomorphological setup etc. which results in non-uniformity in data collection, data format, attribute identification, frequency of data collection etc. thus causing difficulties for data conversion, validation, integration and consolidation at one platform.
4. Due to some overlapping of jurisdictions, the data collection may sometimes overlap with other organization also.
5. There are number of organisations at central as well as state level, who are collecting data on water resources and allied themes generating enormous datasets. To compile and maintain these data at single platform requires set of diverse technical and administrative skills. Since development of IT enabled GIS platforms have not been the core functions of water resources department conventionally, there is lack in the technical expertise and professional experts/ resources at State level for developing the State-WRIS like
    i. Water resources expert/ hydrologist and ground water specialist for validation of the collected data and its conversion and compilation into products for use by various IT applications
    ii. RS & GIS experts for creating, updating and quality check of geo-spatial data.
    iii. Software Developers for coding, UI designing, development of tools etc.
    iv. Database Expert for the handling and management of database
    v. Hardware & Networking expert for regular operation and maintenance of IT Infrastructure.

vi. Team Leads for guiding the team, assessment of work, managing tasks and defining timelines etc.

6. A defined funding requirement and funding mechanism is not in place for creating and sustaining such dedicated body at the state level.
7. Lacking of state level strategy for integrated water resources management aimed at achieving local level water security.

2.3 Benefits

The establishment of SWIC will have benefits in the following aspects:

a) **Standards & Policy**: Policies will be in place for schema, data exchange/ sharing, data quality, validation rules, metadata and reporting.
b) **Reusable and Interoperable**: Base data, Schema, infrastructure, application architecture, APIs/Webservices licenses will be interoperable and accessible to all states.
c) **Ease of Access**: Common and strong user management and access control will ensure data security and access to all stakeholders/ users through the internet. Further, through its connectivity to the national portal, the states will be able to easily access the information available with the other co-basin riparian states.
d) **Cost-Effectiveness**: The approach is cost effective as there will be minimal need of investing money in setting separate data centres, purchasing software and IT infrastructure, its O&M at the state end.
e) **Knowledge Centre**: Experts with domain knowledge with a cohesive team will be in place for the States/ Centre for the water sector as a whole.
f) **Quick Deployment**: Since states would be able to share infrastructure and program codes already developed by the Centre or the other states, State-WRIS can be quickly rolled in with less efforts.

2.4 Proposed Solution

Based on the progress of various states in setting up of centralized geo-spatial IT Platform with integration of database & development of applications, they are divided into two groups (Table 1).

Table 1: Proposed Solution

Status of Establishment at States					Time Series		Spatial data		Software Selection		Telemetry Data	IT-Platform	
	Case	DBMS	GIS	Portal	Parameters in WIMS	Parameters not in WIMS	Layers in NWIC	Layers not in NWIC	Database	GIS	Sensor Integration	Development & Staging Environment	Production Environment
Model 1 (States in the process of developing IT Systems/ State-WRIS)	I	×	×	×	Station management and data entry in NWIC-WIMS.	Creation of standard schema by NWIC and storage of the same in NWIC-WIMS. Station management and data entry in NWIC-WIMS	Use India-WRIS layers.	NWIC will create new layer with standardize schema	Postgres (Free & open-source software)	ESRI-ArcGIS NWIC shall procure additional ArcGIS Enterprise licenses as per need. However, ArcGIS desktop licenses shall be procured by States	Telemetry sensors shall be integrated with NWIC-WIMS	Shall be provided by NWIC	Shall be provided by NWIC on the same cloud as being used by NWIC for hosting of India-WRIS & NWIC-WIMS
	II	✔	×	×									
	III	✔	×	✔									
	IV	×	✔	×			Integrate State data in India-WRIS layers and use India-WRIS GIS data						
	V	✔	✔	×									
Model 2 (States Online)	VI	✔	✔	✔	Station management and data entry in NWIC-WIMS	Station management and data entry in State platform. Align schema as per National standards	Can use India-WRIS layers through API whenever required	Follow the schema by NWIC.	As per State policy	As per State policy	State to use their own platform for collection of data from tele-sensors to be hosted on State platform. Telemetry data to NWIC-WIMS would continue as it is.	State shall arrange its own	As per State policy

Note: DBMS, GIS Suite, Front-end & Back-end software may change as per Govt. policy, technological advances & requirement of the system

Model 1: States in the process of developing IT Systems/State-WRIS (Case I-V of table 1)

States which are yet to begin or have made some progress but are yet to reach the level of full featured WRIS platform are in this group (Table 1: Case I-V). By implementing SWIC in coordination with NWIC, the states will have following advantages:

- A uniform and standard format in terms of database, software/ development technologies and hosting would be available.
- This will ensure the interoperability amongst states and the Centre.
- The process of implementing and developing State WRIS will become faster and cost effective.
- The state would be able to focus on "Core Activities" like data generation, data analysis and its utilization for developing DSS.
- This will also remove the duplicity of resources, hosting platform, data centre infrastructures, purchasing of commercial software and tools, development cost etc. as all of them is available with NWIC and same will be made available to the State with authorized access to their own database.
- The IT setup at NWIC will be used by pooling of servers, licensed software and will expand the configuration as per the requirement when the load increases.

To achieve the stated, following guiding principles are proposed for Database setup, Software selection and Hosting platform.

A. Database Setup (DBMS)

I. Temporal Data

Presently, at national level NWIC-WIMS is handling time series data for the parameters mentioned in Table 2 along with station management. This platform is used by all central and state agencies for data entry, validation and reporting purposes. Data is received through web-based manual entry system, mobile app, file transfers & Telemetry sensors using GPRS and satellite. There can be following scenarios for capturing temporal data (Figure 2).

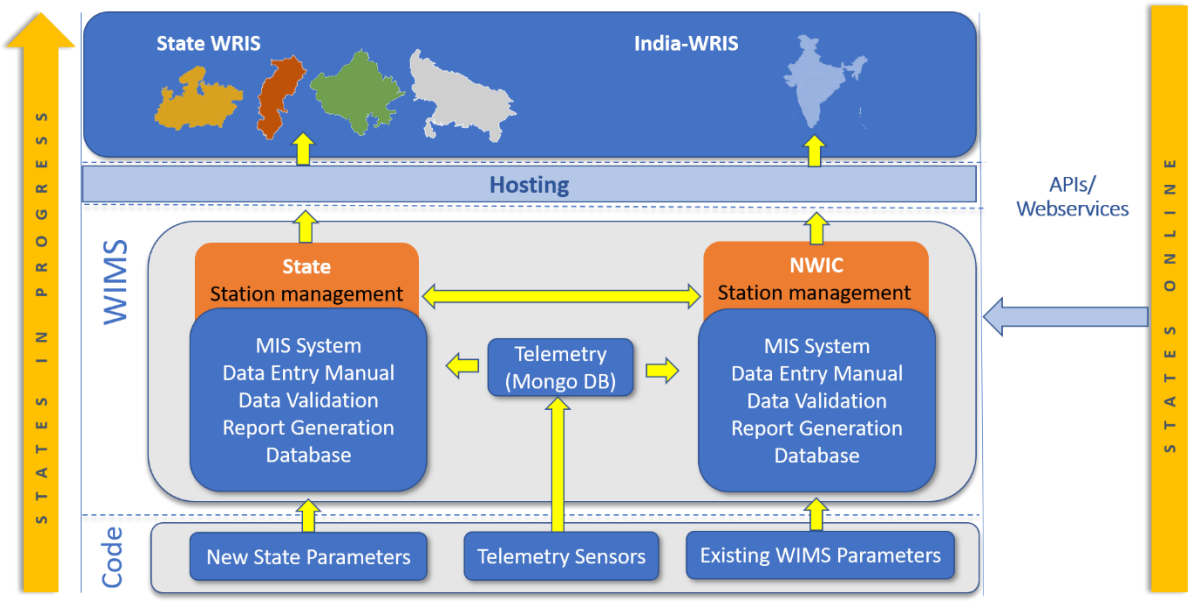

Figure 2: Proposed WIMS Solution

The collection mechanism of telemetry data to the WIMS-Database is complex & requires high level of networking technology. The telemetry data is collected by two means i.e., either through Mobile GPRS mode or through Earth Receiving Stations (ERS) mode. The data aggregated through Mobile GPRS is sent by FTP Server. For sites, where mobile coverage doesn't exist, data captured through telemetry sensors is transmitted to Earth Receiving Stations and then to FTP servers. CWC has set up ERS at 3 locations namely Jaipur, Burla & Delhi. The data transmitted by sensors through mobile network or satellite is required to be formatted into a standard structure before sending to FTP server of NWIC-WIMS to enable telemetry decoder to function efficiently. This system is already in place and functional, hence, shall continue to be used for all telemetry-based data collection.

In future, when the amount of data received through telemetry sensors become huge and too voluminous, the current mechanism may be reviewed for changes as per need.

a) Parameters hosted in NWIC-WIMS

i. Following parameters are presently being captured in NWIC-WIMS for all Implementing Agencies sharing data under NHP (Table 2).

Table 2: List of WIMS parameters

S. No.	Parameter	S. No.	Parameter
1	Evaporation	11	River & Spring discharge
2	Humidity	12	Ground water level

S. No.	Parameter	S. No.	Parameter
3	Atmospheric Pressure	13	Reservoir Evaporation
4	Rainfall	14	Reservoir Water level
5	Solar Radiation & Sunshine	15	Reservoir Storage
6	Atmospheric Temperature	16	Reservoir Inflow
7	River Sedimentation	17	Reservoir Outflow
8	Snow parameters (Snow Stake, Snow water equivalents & Snowfall	18	Diff. inflow & losses
9	Surface Water Quality parameters	19	Ground Water Quality parameters
10	Wind direction & speed	20	River water Level

ii. All data either collected manually or by telemetry stations (received through FTP) for parameters of Table 2 (historical, current & in future) would continue to be hosted on WIMS irrespective of whether data generation cost is funded by Centre/State or nature of data generating agency i.e., central/State Government.

b) Parameters presently not in NWIC-WIMS

i. For parameters which are presently not captured in NWIC-WIMS, States would inform such parameters to NWIC for creating a standard schema (with all relevant fields, format of data, unit of measurement, etc.,). These parameters, shall be stored in NWIC-WIMS database, which shall be expanded as per data growth.
ii. Each state would have station management, MIS system, manual data entry, validation and report generation etc., with all functionalities as available now in NWIC-WIMS.
iii. The schema for these parameters as prepared by NWIC, shall be shared across all States to maintain uniformity of standards. It will help in interoperability and reusability of applications developed by all the states.

II. Spatial data

The spatial data are features representing different set of information mapped in GIS standard format (Figure 3). In NWIC (India-WRIS), 114 GIS layers are available which are standardized and compiled for entire India (Annexure A).

i. Spatial data residing on NWIC (India-WRIS) database falls under this class.
ii. The States/UTs, who doesn't have the Geo-spatial data or the available Geo-spatial layers are not yet enriched fully, would use Geo-Spatial data available at NWIC (India-WRIS) platform. State need not to develop a separate GIS platform for the

same and may use the layers available with NWIC (India-WRIS) to populate their additional data.

iii. If new set of spatial features are available with States (presently not available in any layer of NWIC (India-WRIS), additional GIS layer(s) shall be created by NWIC following the standard schema for the use of State.

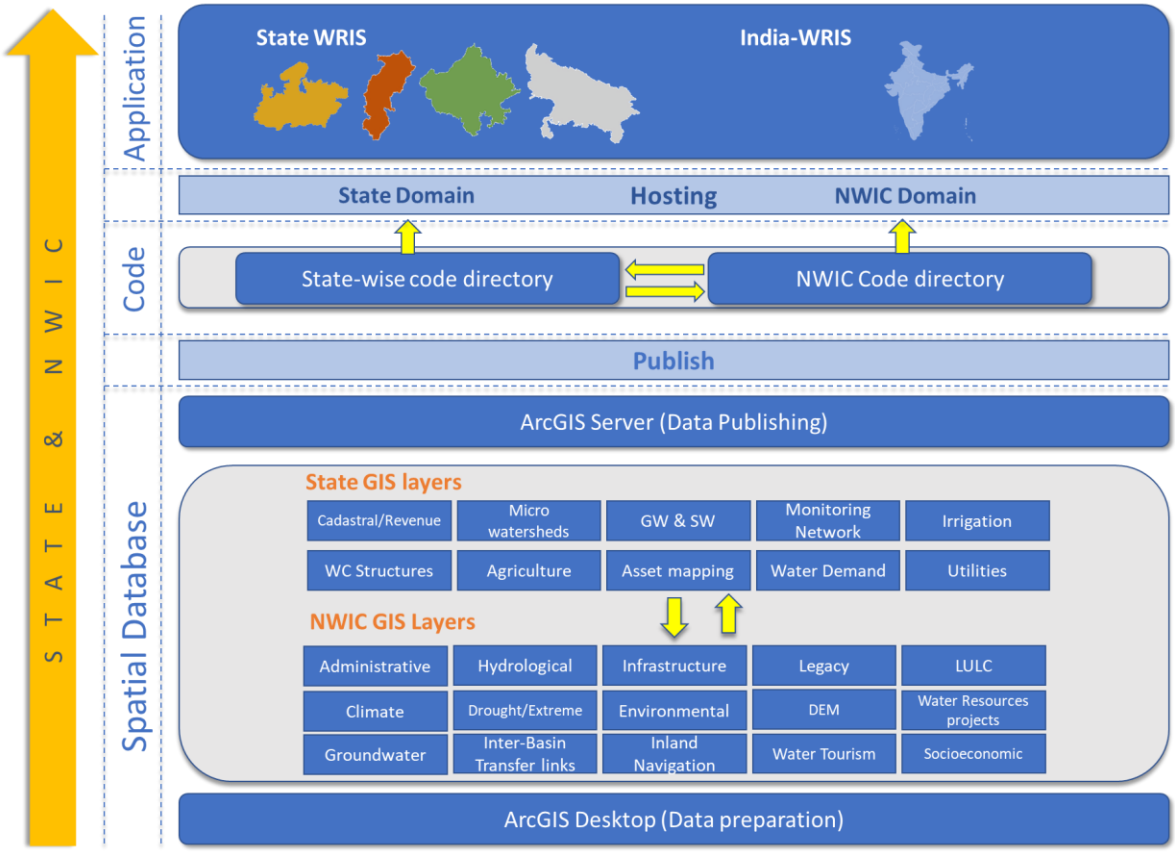

Figure 3: Proposed India-WRIS Solution

B. Software Selection

The software used for the database and GIS layer management would be key for implementation of uniform mechanism across state and centres:

a. Database: Software same as NWIC in Case I-V of States in progress (Table 1). Presently, NWIC is using Postgres (free and open-source software) for hosting time series data and spatial layer data.

b. GIS: Software for creation and updating of GIS layers, standards enterprise version ArcGIS-ESRI is being used at NWIC. Number of licenses as per user load shall be managed by NWIC centrally. Desktop version of ESRI ArcGIS shall be procured by State/ UTs, if required by their local development team in Case I-V of Table 2.

c. The selection of database management package or GIS suite and other software for Front-end & Back-end integration changes with evolution of newer technologies & relevancy of various options fulfilling our changing needs. Whenever, changes are decided in software, technologies, NWIC shall take into account upgradation of SWIC setup & smooth changeover across country.

C. Hosting Platform

For hosting of State-WRIS, the IT platform and domain are to be considered:

a. IT platform: Servers and storage for production environment for State-WRIS shall be provided by NWIC on the same cloud where India-WRIS is hosted. (case I-V of Table 1).

b. Website: States have to register themselves for domain name in the format <statename>-wris.gov.in and website shall be hosted in same cloud where indiawris.gov.in is presently hosted by NWIC. NWIC shall help in registration, wherever necessary.

D. Development environment:

NWIC shall provide access to SWIC of its own physical infrastructure of Development Environment setup at NWIC office (New Delhi) and create a development environment for the states to develop the code at state end if required during development and upgradation of State-WRIS. The development environment allows developers to test their code and check whether the application is functioning properly with the implementation of their code.

Centralized Code Directory: A central directory stores everything in one place. In a centralized model, multiple resources work simultaneously on the code while connected to the server itself. This maintains a single source of truth. Hence, a centralized code directory shall be created and shared with States for the coding purpose. The changes, commitment of the codes and information of state and central developers shall be sent and received from the central code directory only (Figure 4). A version control system like SVN, GIT etc. will be used for tracking changes in computer files and coordinating work on those files among multiple people. These tools enable each user to keep his own working copy and can check out the recent changes with the latest up to date files. The procedure for committing, pushing and pulling the code from the directory is given below:

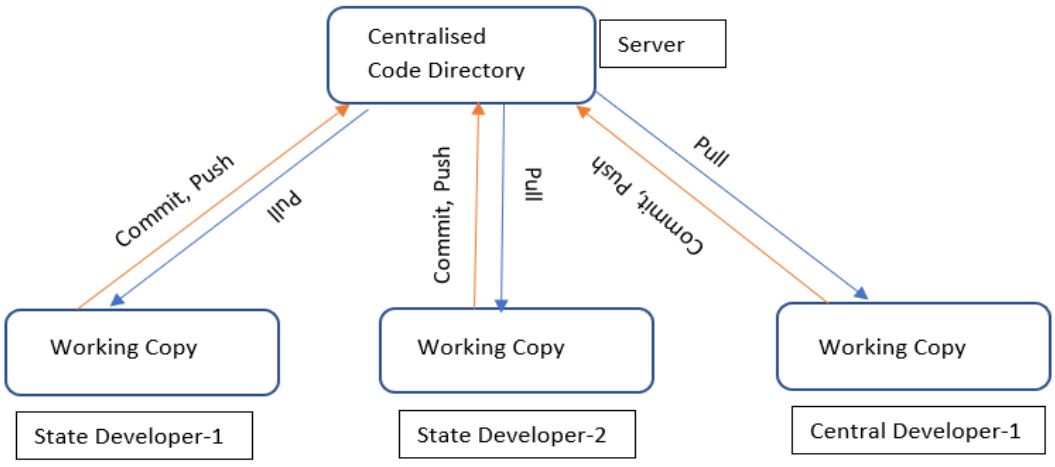

Figure 4: Centralized Code Directory Mechanism

The advantages of creating a centralized code directory are:

- It allows multiple developers to work simultaneously on the same project and may share the changes in the code with rest of the team. Thus, temporary or partial edits by one developer shall not interfere with other developers work.
- It will provide the access to historical coding script versions of the project and who has done the changes and when.
- It also allows the integration of edits without loss of any change. In rare cases, when two developers made conflicting edits to the same line of a script, then the version control system requests human assistance for decision making of keeping the code.
- The updates will be made directly on the server.
- Consistent file name and directory structures will be maintained.
- Once the application runs successfully, it will be moved to the staging environment.

After the testing of code, each build of state WRIS will be published with state domain name by NWIC team. The application will be tested on the development server to check for reliability and to make sure it will not fail on the actual production server. NWIC team & SWIC team shall test the system before the final deployment of State WRIS on the production server.

Model 2: States Online

This group comprises of the States with an already established, full featured working WRIS platform with Database, GIS layers, Web-based multi-user & public access platform, Visualization, and Reports, Data collection & validation systems and hosting platform (own or cloud) (Table 1: Case VI).

The state can continue with their setup for the State-WRIS. Sharing of information across NWIC and SWIC shall be by means of APIs, Map services (WMS/WFS), and other modes of data sharing mechanisms, as needed from time to time. These states have the option to switch over to Model 1 anytime in future.

2.5 Summary of Status of State Water Resources Information System of States

The draft concept note/framework on SWIC was shared with NHP implementing states/UTs to give them an overview of the SWIC setup and to explain the role of NWIC and states in establishing a well-integrated water resources management system in the country. NWIC has also organized training sessions and interacted extensively with NHP implementing states/UTs (IAs) to understand their existing water resources information systems and requirement in terms of infrastructure, technology and manpower for

setting up SWIC. NWIC has been consistently in touch with IAs and has been providing them guidance and support in terms of knowledge & technology-sharing.

Based on the information gathered from IAs through e-mail & telephonic conversation, it has been deduced that most of the IAs are yet to establish a functional state water information portal to disseminate all hydro-meteorological information in a GIS framework and hence would need support from NWIC towards availability of IT platform for hosting, software for database management, GIS layer development and creation of state-specific dashboards etc. (These states/UTs have been considered as likely Model-I states/UTs)

It is mentioned that out of the 29 IAs (27 states and 2 UTs), 20 states had given the feedback. For the remaining 9 IAs (7 states 2 UTs) and the non-NHP implementing States/UTS [1 state and 6 UTs], websites of their water resources departments were surveyed for assessment of their water information system. It is understood from the information gathered that only 2 states (**Kerala & Andhra Pradesh)** are in advanced state in setting up their GIS based platforms independently and have developed sufficient infrastructure to continue developing their systems by aligning with national standards & incorporating new features with the help of NWIC. These two states have thus been considered as likely **Model-2 States** and rest all states & UTs are suitable for **Model-1**. The categorisation of all states/UTs is tabulated below:

	Model-1	**Model-2**
(A1) **NHP implementing states**		
	1. Uttar Pradesh	1.Kerala
	2.Maharashtra	2.Andhra Pradesh
	3.Madhya Pradesh	
	4.Tamil Nadu	
	5.Rajashthan	
	6.Karnataka	
	7.Gujarat	
	8.Telengana	
	9.Haryana	
	10.West Bengal	
	11.Jharkhand	
	12.Aasam	
	13.Himachal Pradesh	
	14.Tripura	
	15.Meghalaya	
	16.Mizoram	
	17.Sikkim	

	18.Goa	
	19.Punjab	
	20.Uttarakhand	
	21.Nagaland	
	22.Odisha	
	23.Bihar	
	24.Manipur	
	25.Chhatisgarh	
(A2) **NHP implementing UTs**		
	1.Delhi	
	2.Pudducherry	
[B1] **Non-NHP implementing States**		
	1.Arunachal Pradesh	
(B2) **Non-NHP implementing UTs**		
	1.Chandigarh	
	2.Dadra, Nagar Haveli, Daman &Diu	
	3.Jammu & Kashmir	
	4.Lakshyadeep	
	5.Laddakh	
	6.Andman & Nicobar Islands	

The detailed information about the status of existing water information system of all the 36 states and UTs is given in **Annexure-II**

Chapter 3

Scope of SWIC

3. Scope of SWIC

SWIC shall act as a as a nodal agency for integration of water resources data within the state. It shall act as a repository for state-wide water resources data and will be responsible for maintaining, updating, collation and dissemination of data and information. In co-ordination with NWIC, the SWIC shall act as a single-point solution for regional and micro-level water resources data amalgamation and its dissemination. SWIC shall work on the following aspects for two proposed models as mentioned in table 3 .

Table 3: List of activities for Model 1 & Model 2

S. No.	Activities	Model 1	Model 2
1.	Preparation of inventory for water resources parameters and units available with state departments	By concerned States	By concerned States
2.	Collection of available water resources data from various state departments and academic institutions, all across the state	By concerned States	By concerned States
3.	Creation of database	By NWIC	By concerned States
4.	Monitoring, consolidation and organisation of data from state level departments	By concerned States	By concerned States
5.	Collection and compilation of Geo-spatial data available with different state departments/ institutions/ State Remote Sensing Centres/ Environmental Information System (ENVIS)	By concerned States	By concerned States
6.	Framing of Policy towards uniform data acquisition, standardization, validation, analysis and dissemination	Adopt NWIC & coordinate for new data set	Align policy towards national standards
7.	Establishment of a mechanism for coordination among state/ other organizations generating and using data	By concerned States	By concerned States
8.	IT infra management: Hardware/Software/Geo-spatial data except Office desktops and peripherals	By NWIC	By concerned States
9.	Providing technical support to state level organizations	By concerned States	By concerned States
10.	Coordination with the State agencies and NWIC	By concerned States	By concerned States

S. No.	Activities	Model 1	Model 2
11.	Coordination with any central & state level organization for geo-spatial data on allied themes e.g., SOI, NRSC, SRSC SLUSI, ENVIS etc.	Mainly by NWIC	By concerned States
12.	Sharing information by means of APIs, Map services (WMS/WFS), and other modes, as needed from time to time	By concerned States	By concerned States

3.1 Collection of Water Data (local Level)

3.1.1 Consolidation of the existing data

States are monitoring the water asset and the information is available with various departments in multiple formats and modes like hardcopy reports, CD/ DVD, spreadsheets with maximum data in digital form and is stored in PC of various branches/field offices/ planning wing offices etc. The micro level information i.e., village level inventory is captured at further administrative levels and is mostly stored in hard copy form. All these data need to be harmonized for themes, with a defined schema and format in digital format as per the schema proposed by NWIC. The collection of these data and standardizing it into defined schema would be the major task to be carried out by SWIC.

3.1.2 Setting of regular mechanism

A regular mechanism shall be setup for collection of periodic data generated by the multiple state departments. The following things to be done for setting up a regular mechanism at SWIC:

- Creation of a data entry form or data input screen on web portal for entering the manual data collection
- Integration of telemetry data with telemetry module of NWIC-WIMS
- User Management shall be created for authorizing field officers for data entry the data through web-portal

3.2 Data Validation

The data validation shall be under the work scope of SWIC and NWIC. There should be two level of validation i.e., primary and secondary. The primary validation parameters shall be defined by SWIC based on the minimum and maximum value of any parameter and maximum rate of change normally observed/ expected for any particular observation site. In case of large catchments spread across the boundaries of the states, there would be some stations where the input data is required from the nearby stations falling outside the boundary of the concerned states, the secondary validation in such cases shall be done

by NWIC and for rest of the cases, where the decision can be taken by the states, secondary validation shall be done by states itself.

Secondary validation can be done by the SWIC using the available tools developed by NWIC team for parameters of NWIC-WIMS. Customization required as per the State needs shall be done in coordination with NWIC and if there is a unique requirement or any new parameter for state, the state concerned may develop the tool under the guidance of NWIC.

3.3 Additional Database & Geo-Spatial data creation as per state specific needs

The State shall follow the same database schema for all the time-series and geo-spatial data which is currently collected and maintained by NWIC for establishing the standardization of the data. States may also share the additional time-series or geospatial data along with the attributes to NWIC which are currently not captured by NWIC, for the creation of standard schema which shall be followed by all other states in case of future additions.

3.4 State-specific reports, Visualization & Dashboards

In NWIC (India-WRIS) & NWIC-WIMS, data analysis and visualization tools in the form of maps, chart, graphs etc., and standard report generation functionality have been developed. These scripts will be shared with States / SWIC and same may be utilized for creation of state-specific reports, data visualization and dashboards thus saving time, resources and money on the fresh development of these features. For any additional state-specific customization request, NWIC shall mentor and guide states to implement the same with the experts engaged by SWIC.

3.5 State-specific Application & DSS

The applications developed in NWIC (India-WRIS) & NWIC-WIMS can be customized with State-specific requirements for implementation of State-WRIS on the similar lines of India-WRIS. The scripts developed by NWIC for multiple applications shall be shared with States/ SWIC for further customization of State-specific representation and development at State end. The new development of applications and DSS at NWIC shall have provision for customization at State level as well.

Chapter 4

Role of NWIC

4. Role of NWIC

4.1 Support

NWIC shall handhold the states for effortless establishment and implementation of SWIC and development of State-WRIS. NWIC shall guide States/SWIC during all the stages of implementation of SWIC, State-WRIS. NWIC shall provide the technical guidance and support for all the developments related to geo-spatial & time-series data aggregation and standardization, Software & Hardware Technologies including Development & Production Environment Setup, Hosting etc. The SWIC team will be in direct coordination with NWIC for monitoring and managing the process of implementation of State-WRIS.

4.2 Standardization of Data and GIS Layers

NWIC, shall play a key role in standardization of data attributes capturing time series and geo-spatial data.

- NWIC, shall maintain and share the usage of common country schema for similar themes and made available to all states.
- SWIC shall request to NWIC for creation of schema for data integration and standardization of any new parameter currently not available in NWIC. This shall be commonly used by all states as well.
- The geo-spatial layer data available in NWIC (India-WRIS) shall also be utilised by States. If states have any additional information pertaining to the existing geo-spatial layer at NWIC (India-WRIS), same shall be populated in the respective layer to avoid duplicity of information and creation of multiple copies.
- SWIC shall request NWIC for schema preparation and creation of new / additional geo-spatial layer in State-WRIS if so required.

4.3 Sharing & Integration of data with states

The data available in NWIC (India-WRIS) & NWIC-WIMS shall be shared with States following the hydro-meteorological data dissemination policy 2018. Presently, viewing rights are open to all whereas, editing is limited to the respective state jurisdiction. Downloads are also permitted as per the dissemination policy. Data of SWIC hosted on NWIC-WIMS shall be available to co-basin states, if any application being developed requires so.

4.4 Common Validation Tools

NWIC, shall take up the development of validation tools for the existing data parameters of NWIC-WIMS which shall be commonly consumed across states. NWIC shall help SWIC team to develop validation tools for new parameters available with States & these tools shall also be shared with all other states.

NWIC shall guide, train and handhold the states for validating of huge data collected/ to be collected on the different aspects of meteorology and water resources,

4.5 IT Hosting platform

Since in Model 1, data of additional parameters of State (presently not available in NWIC-WIMS) shall be stored on NWIC-WIMS by suitably expanding it, the state data would continue on NWIC-WIMS hosting cloud platform. Model 2, States can continue on their hosting platform or they have an option to migrate to the NWIC hosting platform. NWIC shall have more cloud space progressively as per requirement and expenditure on hosting platform and internet connectivity for State-WRIS website shall be fully borne by the NWIC.

SWIC shall arrange to procure internet connection for their establishment and field offices at their own cost. Local PC/ Printers /LAN network and other IT infra cost for the establishment of SWIC shall be borne by States.

4.6 Common licenses, software for GIS and databases

The cost of licenses (other than those which are required by client-end side team like ArcGIS desktop) deployed on common platform and used by Central & State Agencies in shared mode shall be borne by NWIC for States falling in Model 1 category. Some licenses for ArcGIS Desktop shall also be arranged temporarily on pool basis, till the states are able to arrange their own.

The States falling in Model 2 category, may continue with their setup for the State-WRIS and shall purchase the licenses if required any.

4.7 Development of generic reports, Visualization and Dashboards

The drafting, development and standardization of reports, visualization and dashboards which are to be commonly used by the States shall be done by NWIC. States can replicate the same for their jurisdiction and further customize as per requirement.

4.8 Development of generic applications and DSS

The applications and DSS development to be commonly used by all States shall be done by NWIC. States can replicate the same and may customize further as per their specific need.

4.9 Assistance to States for State-specific reports, applications and DSS

NWIC shall guide, assist and mentor states for customization and development of State-specific reports, applications and DSS.

Chapter 5

Information Sharing & Security

5. Information Sharing & Security

5.1 Data Sharing Mechanism

The data available with NWIC (India-WRIS) & NWIC-WIMS is shared with States, Institutions & public following the hydro-meteorological data dissemination policy 2018. The database schema maintained by NWIC shall be followed by the states for all the existing and future addition of time-series and geo-spatial data to establish the standardization of the data across states and ease of sharing.

State level data shall be accessible to other co-basin states, if any application being developed needs this data and States shall follow the data sharing policy on the similar lines to NWIC (described below):

1. Through State-WRIS, visualization dashboards & download facilities shall be provided to all users without login
2. Supply of bulk data to other central & state agencies, Academicians, Research Institutions, other stake holders and public through an established mechanism like helpdesk.
3. Sharing of data on continuous basis between two GIS platform (Central & Model-2 States) shall be done through API or FTP.

5.2 Access Control Mechanism

The Access Control Mechanism shall be set up to control the access of the data/ information by the authorized users. This will allow the authentication and authorization of the concerned authorities to access the data for edit, view and download. The data owners shall have the complete right to grant or decline the access and the data shall be accessed by the user after the approval from the data owners. This will help to minimize the security risk of unauthorized access or improper modifications (integrity) to the data, while at the same time ensuring their availability to legitimate personnel.

For NWIC – WIMS database (Central DB), full access control shall be with NWIC and for State-level data, respective SWIC shall also have full access rights. SWIC shall also be provided with user management rights for creating role-based users within their jurisdiction.

The details of the data sharing and access control mechanism is described in table 4.

Table 4: Data Sharing and Access Control Mechanism for Model-1

Data Centre	Agency	Roles	Edit	View	Download
NWIC (India-WRIS)	NWIC	Owner	✓	✓	✓
	Concerned State	User	✓	✓	✓
	Other States, Public Institutions & General Public	User	×	✓	✓
State-WRIS	NWIC	User	×	✓	✓
	Concerned State	Owner	✓	✓	✓
	Other States, Public Institutions & General Public	User	×	✓	✓
NWIC-WIMS	NWIC	Owner	✓	✓	✓
	Concerned State	Owner	✓	✓	✓
	Other State	User	×	✓	✓

Note:

1. There is no editing facility for telemetry as the data flows into the system automatically.
2. Classified data of NWIC-WIMS is shared following the policy defined in Hydrometeorological Data Dissemination Policy 2018.

Chapter 6

Way Forward

6. Way Forward

The Chief Secretary of the State may have the prerogative to decide the lead department for setting up of SWIC where there are multiple departments dealing with water management. However, in case of small states having only one water resources department, the same may be declared as lead department for setting up of SWIC.

6.1 Approach towards implementation

To setup the SWIC, following things are to be considered and finalized:

i. Location of SWIC: SWIC may be located at the Data Centre established under HP1/HP2/NHP, wherein requisite infrastructure has already been provided under these schemes. This would save and minimise the expenditure on establishment of SWIC at State/UT level. For deployment of local IT resources and contractual IT & GIS experts in the newly set up SWIC, funds already allocated under NHP may also be utilised.
ii. Type of organization – separate department or attached office/ subordinate office of lead water resources department.
iii. Office Infrastructure- Space and other office infrastructure.

6.2 Organization Composition

The proposed organization composition is only a recommendation, the actual composition may vary as per the local requirement and states will have the flexibility to modify. It is recommended to have Chief Engineer level officer as head of SWIC in case of large states and Superintendent Engineer level officer as head of SWIC in case of small states. The officers shall be on deputation from departments/ organisations of State Government working in Water Resources & related fields to facilitate effective coordination. The officers reporting to the head of SWIC at the level of Superintending Engineer, Executive Engineer & Assistant Engineer shall be drawn from each major department related to water resources & allied themes. In case officers with requisite qualification and experience in surface/ ground water resource management/ hydrology is not available with the state, they may be hired as per requirement.

Apart from the technical officials, some administrative staff may also be required for proper functioning of the office. The administrative staff may comprise of Under Secretary, Section Officer, Assistant Section Officer, PS/PA, DEOs, Clerks/MTS etc. Gazetted or officers up to Group 'B' level may be posted on deputation & other staff may be either posted on deputation or recruited or hired as per the policy of the state concerned.

The team of IT experts would comprise RS & GIS Experts, Software Developers (Front-end & Back-end knowledge), Database Experts & Hardware-Networking Experts. The team should preferably have hired professionals as the Information Technologies are advancing quickly and therefore, it is advisable that the resources equipped with latest technologies are engaged for a defined period as per changing requirement from time to time. The numbers of hired professionals may be reviewed and revised based on the change in the requirement with time. SWIC may consult NWIC for hiring of professionals and NWIC shall guide in terms of numbers of professionals required along with the essential qualifications and experience required by each set of professionals.

6.3 Reporting Relationship

The head of SWIC shall report to Additional Chief Secretary/ Principal Secretary / head of the lead department.

6.4 Cabinet approval for constitution of SWIC

Lead Department shall initiate and follow up for the approval of establishment of SWIC. Note for approval of State Cabinet shall essentially contain:

1. Mandate of SWIC i.e., To provide value added products and services to all states' stake holders for management and sustainable development of water resources.
2. Roles & Responsibilities of SWIC
    a. Collection of available data from domain specific bodies, generate new database, organize in standardized GIS format and provide scalable web-enabled information system.
    b. Maintain, validate, update, collate and disseminate water data and information.
    c. Sharing of hydro-meteorological data amongst central and other state government organisations, stakeholders of water & general public.
    d. Provide tools to create value added maps by way of multilayer stacking of GIS database so as to provide integrated view to the water resources scenarios.
    e. Development of applications & decision support systems.
3. Organization Composition
4. Place of Setup
5. Head of Organization
6. Reporting Relationship
7. Budgetary provision

6.5 Monitoring & maintaining of SWIC for initial few years

During the initial phase of the establishment of SWIC, the monitoring and mentoring of SWIC shall be done by lead department of the state.

- Staffing: The requirement of staff for proper functioning of SWIC
- Co-ordination issues with other water resources related state departments.
- Infrastructure, office space, budget etc.

6.6 Works pertaining to development of State WRIS

All the state implementing Agencies under NHP have proposed activities pertaining to development of State WRIS. Before taking up any activity under this initiative, it would be prudent that the states discuss their requirement and plan of action with NWIC to ensure standardization, seamless integration with India WRIS and to remove duplication of efforts.

Annexure-I

Details of modules available on INDIA-WRIS & WIMS

I. Major modules offered on India-WRIS & WIMS with their features

A. Surface Water

The surface-water resources of a nation are the water in the rivers, streams, creeks, lakes, tanks, ponds, wetlands and reservoirs which is vitally important to our everyday life. It is an important source of drinking water and is used for irrigation, industrial and as well as other public uses. The availability of surface water varies depending upon the precipitation, storage capacity (lakes, wetlands and artificial reservoirs), permeability of the soil, runoff characteristics of the land, timing of precipitation and the local evaporation rates etc.

Information of surface water and availability in a single platform is a prerequisite for resources planning. India-WRIS web portal collects data regarding surface water from varied sources, stores and manages the data and also makes it available to download in a report format for easy access to users. This information is also used for derived information in the Water Audit module.

The modules containing surface water data are:

- *Reservoir level*: The information of live daily data on reservoir level and storage capacity of monitoring reservoirs is available.
- *Minor irrigation tanks*: The information of live daily data on the total capacity and total storage of minor irrigation tanks is available. The data is pulled from APWRIMS and currently only available for AP state.
- *Reservoir Sediment Study*: It offers the result of sediment study done using remote sensing method and hydrographic survey in different reservoirs spread across India.
- *Surface Water Bodies*: It offers the visualization of mapped water bodies across nation and State-District and Basin-Subbasin wise number of waterbodies under different area classes.
- *Rivers Monitoring*: The live daily data of river water level and river flow time series data is available.
- *Snow-Glacial Lakes*: It contains information of glacial lakes and water bodies of Himalayan regions for the years 2011 to 2019 covering the major river basins namely, Indus, Ganga and Brahmaputra. The glacial lakes/water bodies have been mapped based on the visual interpretation of AWiFS satellite images.

- *Wetlands*: It provides the spatial extent of wetland and its sub categories for pre-monsoon and post-monsoon comparisons of two years i.e., 1994 and 2005.
- *Surface water quality*: The data on 66 parameters measured for water quality is available on a monthly level from aug-1963 to march,2020.
- *Discharge Measuring Stations on Canals:* For improving efficiency of the canal irrigation system, checking quantity and timing of water released is necessary. It is being implemented at many places in the country and will be incorporated as a module in future.

B. Ground Water

Groundwater, water that occurs below the surface of Earth, where it occupies all or part of the void spaces in soils or geologic strata. It is also called subsurface water to distinguish it from surface water. Groundwater is a secure source of water availability. India is among the highest groundwater extracting country in the world. Groundwater has always been used by most of the economic activities, major activities being agriculture, rural supply and industrial use. As farmers, industries and households invest in individual water supply, groundwater becomes a preferred resource option.

Understanding and managing groundwater resources requires the integration of large amounts of high-quality data from different sources. India-WRIS platform serves the purpose of data collection, storage and dissemination of ground water resources status through an integrated approach. This data on ground water is also used for derived information in Water Audit module.

The modules containing ground water data are:

- *Ground water level*: Station wise data populated by central and state ground water departments (CGWB, State-GW and other central agencies) through manual data entry/ telemetric sensors/ Mobile app is available. The data is sub-categorized into State-District-Station wise level report, Seasonal – Annual – Decadal Fluctuation, and trends of water level. The live data is updated via telemetry stations. Data is accessed and made available in an integrated approach with WIMS.
- *Ground water quality*: Data on quality of ground water assessed with 17 parameters and is available on a yearly basis for a period of 2000-2016.
- *Groundwater Resources*: Data shows the estimates of dynamic ground water resources in terms of annual replenishable ground water resources (recharge), annual groundwater draft (utilization) and the percentage of utilization with respect to recharge (stage of development). The assessment units (blocks/watersheds/mandals/firkas) are categorized as Over Exploited, Critical, Semi critical, Safe based on Stage of Ground Water Development (Utilization) and

the long-term water level trend and available for the period 2009, 2011, 2013 and 2017.

- *Groundwater Prospects*: Maps generated on 1:50000 scale, showing information regarding potential areas in terms of GW availability (both quantity and quality) is available.
- *Litholog*: The lithology data of 2740 bore locations over the country with 26 parameters is available.
- *Aquifer systems*: Aquifer is the geological formation which contains water and the water in these porous formations is known as groundwater. The hydrogeological information of the country is available with classification of 14 Principal aquifer and 42 Major aquifers.
- *Artificial Recharge structure- Viewer*: this module is created to disseminate the data pertaining to existing artificial recharge structures in a structured manner.

C. Hydro-Meteorological Data

The modules containing hydrological and meteorological data are:

- *Rainfall*: Rainfall live time-series data is available from varied sources in a common dashboard since 1901.
- *Evapotranspiration*: The live daily data on Evapotranspiration is available on a grid basis till district level for a given time period. The data is an output of grid-wise, water balance components using VIC hydrological model by NRSC.
- *Soil Moisture*: The live daily data on Soil moisture (volumetric Soil Moisture content %) is available on a grid basis till district level for a given time period. The data is an output of grid-wise, water balance components using VIC hydrological model by NRSC.
- *Agro-Climatic/ecological zones*: Major climatic zones (Planning commission) and agro-ecological zones (ICAR,2001) are available with specific attributes for each zone.

D. Land Resources

Land resources available in the form of thematic layers provides a theme-wise information over a given area and the modules containing land resources information are:

- *Land use/Land cover*: The spatial layer shows the areas under 24 sub-classes of LULC. Data is available for 2005-06, 2011-12 & 2017-18 for pan India.
- *Soil*: Spatial variation of soil resources in terms of texture, depth, slope, erosion and productivity is available in the form of raster layer.

- *Land Degradation*: The data is satellite derived layers of degraded lands in the country for 8 states. It represents areas under various forms of land degradation processes, its type and severity level.
- *Waterlogging/Soil Salinity*: It contains the statistical area of waterlogging and soil salinity under major and medium commands in different State's India along with chart view. It provides results of a project named 'Assessment of Waterlogging and Salt and/or Alkaline affected Soils in the Commands of all Major and Medium Irrigation Projects in the Country using Satellite Remote Sensing (LISS-III data).
- *Wasteland*: Spatial maps of distribution of wasteland for the entire country under 36 sub-classes is available for the period of 2005-06.

E. Allied Themes

The modules containing information on allied themes are:

- *Inland Navigation Waterways*: Provides a brief summary of all inland waterways along with the maps as well as all relevant information. It is available for 5 navigation waterways namely, (a)the Ganga (NW-1), (b)the Brahmaputra (NW-2), (c)the West Coast Canal (NW-3), (d)Kakinada-Puducherry Canals system along with Godavari and Krishna rivers (NW-4) and (e)East Coast Canal with Brahman River and Mahanadi delta (NW-5). The sixth proposed navigation waterway (The Barak – NW-6) has also now been recommended by the Inland Waterways Authority of India (IWAI).
- *Storm Surge Study:* Information related to oceanographic and meteorological data for the entire coast of India is available. The oceanographic and meteorological variables considered includes Storm surge, Cyclone, Wave and Sea-Level Rise. For all these variables, data is generated for three scenarios - baseline (present) and 2040 and 2080 (climate change scenarios).
- *Socio-economic Census*: Information on the hierarchy of Administrative boundaries along with settlement information for urban and rural sets is available which provides details regarding cities and towns of the country with additional administrative classification.
- *Flood Inundation & Drought Affected areas*: It contains flood inundated area maps which is a satellite derived product for three years viz., 2008, 2009 and 2010 generated under Disaster Management Programme. Drought sub module provides the information of reported drought affected areas for the whole country under two main themes: Areas under Drought Prone Development and Desertification Development and Tribal Sub-Plan Areas.
- *Reported Extreme Temperature, rainfall and earthquake events*: Provides information of all destructing events caused due to water in its various forms and seismic activity. The major categories of extreme events data which display in this

module are Flood, Drought, Earthquake, Extreme rainfall and Extreme temperature.

F. Projects

The modules containing water resources projects information are:

- *Water Resources Projects*: It provides information on irrigation, hydro-power and multi-purpose projects in India. It is a spatial inventory of the connected water resources structures, mapping the location of dams, barrages, weirs, anicuts, reservoirs, canals, lifts, command areas, hydropower plants, structure line etc.
- *Inter-basin Transfer Link*: Provides the detailed information and maps of the various components of the Inter Basin Transfer Links. The published maps of NWDA in .pdf format are available for Himalayan component.
- *Minor Irrigation Census*: It comprises Fourth MI (2006-07) and Fifth MI (2013-14) census to depict an overall view throughout the country which contains six layers of information at district level namely, absolute number of minor irrigation schemes, ground water and surface water schemes, number of five types of schemes, potential created, potential utilized and ultimate irrigation potential. The schemes have been categorized broadly into six major types: (1) Dug well (2) Shallow Tube well (3) Medium Tube well (4) Deep Tube well (5) Surface Flow Schemes and (6) Surface Lift Schemes.

II. Details of different modules available on WIMS

i. User Management

The module is for the admin user for the implementing agency to create further users along with providing roles and rights to them for data entry/validation. Also, the modules assignments are done through this section.

ii. Telemetry Management

Under WIMS the most important aspect added is the facility to configure Telemetry based sensor/data logger configuration. This includes both GPRS and INSAT based configuration for River/Reservoir monitoring stations. The module offers two applications:

a. *Sensor Hub Configuration:* Sensor Hub Configuration screen allows to create, view, edit and list the information for all the Sensor Hubs / Data Loggers connected to a station managed by the user agency. The module offers the following configurations:
   - Create Data Logger Configuration: The module is to attach the data logger detail to a station added in WIMS for the user agency.

- Edit Data Logger Configuration: The module is to edit the configuration for the data logger detail attached to a station added in WIMS for the user agency.
- Add Sensor Configuration: The module is to attach the sensor configuration details to a station added in WIMS for the user agency.
- Edit Sensor Configuration: The module is to edit the configuration for the sensor detail attached to a station added in WIMS for the user agency.

b. *Reservoir Sensor Hub Configuration* - Reservoir Sensor Hub Configuration screen allows to connect the sensor configuration for stations on Reservoirs. The module offers the following configurations:
   - Satellite ID Configuration: The module offers the configuration of sensors on reservoirs gates. Select reservoir station from the names list. Connect with the respective gate with the measured Data type (parameter measured).
   - Gates Configuration: The Gates on the reservoirs are configure here with sensors details.
   - Edit Gates Configuration: The module is to edit the configuration for the sensor detail attached to the gate sensor added for the reservoir.

iii. Network Monitoring Management

This section offers the main hub of modules related to the data entry, view, update for various aspects covered under WIMS. The modules under this section would be available based on the access provided to the user agency.

a. *Station Management:* Station Management Module enables users to provide an easy and fast access to all Monitoring Network information available at a glance. The network monitoring module contains and provides access to inventory information for sites (stations) at wells, springs, climatic, dams, gauge river stations. This module provides users a set of tools to make easy the maintenance of the network monitoring attributes to add new stations, to upgrade wrong data from the localization and description of existing stations and to delete an existing station if it is necessary. The user will use this module:
   - *add* new stations
   - delete stations
   - update or change some characteristics of the stations

b. *Manual Data Entry:* The module offers the data entry for the station for the mapped Data Type (measured parameters) in Station Management. The User will be able to view only the stations for which it is authorized.

c. *Data View:* This module offers the user to view multiple stations - multiple parameter's data based on various filters for the select duration, compare the data

in table and graph view. The time series data can be plot in graphs and the same can download in excel format.

d. *Data Validation*: The Module offers the user to edit/update the values stored for the measured parameter for the Station. Based on the provided Maximum, Minimum, Upper Limit and Lower Limit the values are highlight for the user for quick reference.

e. *Flow Measurement:* The module offers the different aspects information capture for flow measurement done for a station between a date duration.

f. *Summary Stage- Discharge Data:* The entry of primary stage-discharge is done mainly to re-compute and check the discharge computations carried out by the observer, to graphically observe the velocity and discharge profiles in the cross section, and thereby to have the data stored on magnetic media in an organised manner. For further use, only a summary information is needed out of this detailed information.

g. *Elevation Area Capacity Data*: The module offers to add / view / edit entry of Elevation Area Capacity Data for reservoirs.

h. *Reduced Level of Zero of Gauge*: To be able to compare the water level readings for different periods and for different stations it is very essential to properly store values of R L of gauge zero along with their respective validity periods.

i. *X-Section*: Cross-section data comprise of the pairs of distance and elevation of several points on the cross-sectional profile of the river gauging section. The distances are taken with respect to an origin on the gauging section and elevation is reported with respect to the mean sea level as the datum. The date of survey is always associated with the cross-sectional data. The Module offers the user to Add / View / Edit the information attached to the Station Code/Station Name for the Time duration – From Date and To Date.

j. *Current Meter*: This module is to view/edit existing current meters configured along with adding new current meters. There are attributes required for describing the current meters. These are the Current Meter Number, Type, Make, and Date of Manufacture, etc.

iv. Flood Forecast Module

The module offers the Flood monitoring related data entry, forecast, reports and communication related sub modules.

a. Forecast

- *Level Forecast Data:* The module offers the View / Add functionality for a station's Level forecast.
- *Inflow Forecast Data:* The module offers the View / Add functionality for a station's Inflow forecast.

b. Reports

The different sets of reports are provided under this section:

- *Old Reports (upto 2018)*
- *New Reports (From 2018)*
- *Bangladesh Reports*
- *Archived Reports*

c. *Data Entry – Flood Data Entry:* This module offers Flood data entry in four sections Rainfall, Water Level (Reservoir & River point), Inflow and Outflow.

d. *Connect:* The section provides alerts, email / SMS and Manage contact modules for Flood forecast sharing across the offices.

- *Alerts*
- *Email and SMS*
- *Manage Contacts*

v. Water Quality Module

The various modules offered in this section are:

a. *Laboratory Information:* In this data entry section, a laboratory can enter and edit all the relevant information necessary to describe the laboratory as per the form. An agency may enter information on multiple laboratories coming under its jurisdiction. This form also registers the number of parameters the laboratory can analyse along with the method of analysis.

b. *Parameter Information:* In this form, all the important information about the water quality parameters and the analytical methods available for each parameter are shown. All standard water quality parameters for HP laboratories, their analysis method(s) and their preferred (recommended) methods of analysis are provided upon installation of the software, as well as e.g., units, categories, level, no. of decimals, etc.

c. *Sample Data Entry:* For Station Type – Surface Water / Groundwater, further filter of samples based on Station Code/ Station Name and Laboratory in a time duration (From Date – To Date) for Sample data entry, view and edit is provided in this section.

d. *Graphs:* This module is to plot graphs for multiple parameters on a single chart based on user selection.

e. *Analytical Quality Control:* This module is for Add / View / Edit the Analytical Quality Control details.

f. *Water Quality Options:* The module is to provide, for a Lab Sample the Ion Balance %, Organization deciding Drinking Standard and reference Date in Trend Intercept.

The module is primarily for entering the analytical results for water quality parameters. In addition, the module has some extra functionality:

- Calculating certain water quality parameters based on results of other parameters
- Validating the water quality data
- Graphing water quality data
- Preparing reports of water quality results, including reports of customized parameters, stations or period and comparing water quality results with drinking water and irrigation water standards

vii. Sediment Module

Sediment module offer two sub modules:

a. Suspended Sediment Summary

b. Suspended Sediment Measurement

Suspended sediment observations form the part of sediment data and is normally associated with the amount of flow at any section. The observations are normally taken along with stage-discharge observations. However, they may also be taken with only stage measurement and later computing the corresponding discharges by using rating curves.

viii. Import/Export Tool

The purpose of this module is to have an online flow of data into or from the system in various formats. This includes Import and Export tools.

a. Import Tool: The module provides a simple format to upload data in excel format for a single parameter (data type) for a station.

b. Export Data to Excel

c. Export Analysis Data to Excel: In the Export analysis data to Excel, the different statistical functions can be performed on Hydrometeorological data namely: Daily Discharge Sheet, Daily Discharge sheet [Report WL], Total Annual Ten-Daily discharge, Total Annual Ten-Daily.

d. Export Data to Water Yearbook Format: The module offers to generate Water Year book Volume 1, 2 and 3 for mentioned Station Code / Name and Water Year. After Selection click on Generate Excel to download the report.

e. Export to IMD Format

f. Export Data to Mike-11

ix. Ground Water Exploration

The Modules is for user to *Add / View /Edit*, structure specific details. It includes:

a. Drilling details

b. Drill Time Log: This module is to specify the Drill Time Log information for the Structure at the time of Drilling activity.

c. *Litholog*
d. *Well Assembly*
e. *Development Details*
f. *Water Bearing Zones*
g. *Grouting/Sealing/Gravel Packing*
h. *Geophysical Logging*
i. *DWLR Details (will be added)*

x. *Geophysical investigation*
a. *Investigation details*
b. *Interpreted results of geophysical investigation*
c. *Profile data*
d. *Miss Masse Profiling*
e. *Dipole sounding*
f. *Axial profile*
g. *Hlem sounding*
h. *Vlf exploration*

xi *Pumping Test*

The Module offers various aspects under the Aquifer Performance test activity. They are:

a. *Aquifer-performance Test*
b. *Dug well pumping test*
c. *Preliminary-Yield Test*
d. *Step Draw Drawn Test*
e. *Dynamic Aquifer Performance Test*

xii. *Master Module*

The Module is to *View / Edit / Add* hierarchy of following*:*

a. *Administrative hierarchy:* This is for the Agency hierarchy:
AGENCY ---- > REGIONAL ----- > CIRCLE OFFICE ----- > DIVISIONAL OFFICE ------- > SUB DIVISIONAL OFFICE ---- > SECTION OFFICE
b. *Geographic hierarchy:* This is for the Basin hierarchy:
BASIN ---- > RIVER ----- > TRIBUTARY ----- > SUB TRIBUTARY ------- > SUB SUB TRIBUTARY ---- > LOCAL RIVER
c. *Geographic division:* This is for the Admin hierarchy:
STATE ---- > DISTRICT ----- > TEHSIL ----- > BLOCK ------- > VILLAGE

xiii. Personal Information

The module is as the profile detail of the registered Login user. It includes the Login (non-edit), Name, Email, Phone, Designation, Reset Password Panel. The password reset functionality is available for the user.

Annexure-II

Details of Water Resources Information Systems set up at State level

2.5 Status of water resources information dissemination setup at state level

The table 1 represents the current status of water resources information dissemination setup at state level.

Table 1: State-wise status of Water Resources Information Dissemination Setup

S. No.	State Name	Organization / Department	Level of Consolidation of Data	Name of the GIS Application Software for mapping	Name of the GIS Application Software for web-hosting	Name of the Database (time series) Software	Public Access through web		Hosting Platform	Development	Maintenance
			Centralized (Server Based) Or Distributed among various wings (PC based)				Yes/No	Domain Name	Cloud or In house data centre	Inhouse/Outsourced	Inhouse/ Outsourced
1	Uttar Pradesh	Information System Organisation, Irrigation & Water Resources Department,	Centralized	Arc GIS 10.5	No	My SQL (GWD)	Yes	http://upgwd.gov.in/ & https://idup.gov.in/en	Windows 10 Server, Inhouse & Cloud	Outsourced	Outsourced

2	Maharashtra	Planning and Hydrology, Jalvidyan Bhavan	Centralised			Wisdom	No		Inhouse	Outsource	Outsource
		GSDA	Pc based	MapInfo	No	Oracle, GEMS	No	http://gsda.maharashtra.gov.in/	Inhouse data centre	Outsourced	Inhouse
3	Madhya Pradesh	Water Resources	Centralised	ArcGIS		SWDES (for Surface water) /GWDES for Ground water	Yes	http://www.mpwrd.gov.in/	Inhouse	Outsourced	Inhouse
		MAPIT (Science & Technology	Centralised	Geoserver		Postgres	Yes	https://geoportal.mp.gov.in/wrd/	Inhouse	Inhouse	Inhouse
4	Tamil Nadu	Water Resources Department/State Ground Surface Water Resources Data Centre (SG & SWRDC)	Centralised	Arc GIS Version 10.8.1	Nil	1. Ground Water Data-GWDES 2.4	Yes, Only Ground Water Level data & meterological data	http://www.groundwatertnpwd.org.in/indexnew.htm	Cloud	outsourced	Inhouse
						2. Surface Water					

						Data-SWDES					
						3. Water Quality Data-WQDES					
5	Rajasthan	Water Resources Department	PC based	No		No	Yes	No	No	No	No
6	Karnataka	Water Resources Development Organisation	Centralised	NHP portal		No	No	No	No	No	No
7	Gujarat	Gujarat Water Resources Development Corporation Ltd	Centralised	Q GIS, Open street maps and Arc. GIS	No	Postgr eSQL	yes	https://wrd.guj.nic.in/	Cloud	Inhouse	inhouse
8	Odisha	Ground Water Department	No information available as per the state's official website								
9	Telangana	Irrigation & CAD Dept.	Centralised	Arc GIS	No	Postgr eSQL	yes, Twris and wims	https://bhuvan-app1.nrsc.gov.in/twris/dashboard	Cloud	Inhouse	Inhouse

								/#/dashboard			
10	Andhra Pradesh	Water Resources Department	Centralised	Arc GIS	Arc GIS	PostgreSQL	Yes	https://apwrims.ap.gov.in/	Cloud, State data centre	Inhouse	inhouse
11	Arunachal Pradesh	Water Resources Department	No information available as per the state's official website								
12	Chhattisgarh	Water Resources Department	No information available as per the state's official website								
13	Bihar	Water Resources Department	Partially Centralised, (gauge, discharge ,Rainfall ,GIS layers like drainage network, canal network, LULC, Admin boundaries, etc)	ArcGIS		Oracle	Partially Yes (through login)	fmiscwrdbihar.gov.in	Inhouse data centre	outsourced	Partially inhouse

14	West Bengal	Irrigation and Waterways Department	Pc based	RTDAS, ARC GIS	No	No	No	No	No	No	No
15	Kerala	Groundwater Department,	WIMS, NHP portal &Pc based	ArcGIS & Map info		GRAFP	No	No	No	No	No
16	Jharkhand	Water Resources Department	PC based	No		Excel	No	No	No	No	No
17	Assam	Assam Water Research And Management Institute	(1) Most of the historical data of the state are kept in manual registers etc. (2) Some data are digitised and kept in PCs. (3) Some data are uploaded in WIMS recently	Not yet created		So far no Database Management Software has been used for managing database at state level. However, under NHP	Dissemination of water resource data will be made after creation of State WRIS. So far under NHP historical data has been uploaded in WIMS. After setting up of RTDAS, realtime data will also be uploaded in WIMS. WIMS will be a part of State WRIS after creation of the WRIS		Not yet created	Not yet created	Not yet created

						historical data has been uploaded in WIMS.					
18	Punjab	Water Resources & GWSC Water Resources and Environment Directorate	Partially Centralized, Partially PC Based	ArcGIS		Excel	Yes	http://irrigation.punjab.gov.in/	Inhouse	Partially both	outsourced
19	Haryana	Irrigation and Water Resources Department	Centralized Server	ArcMap		MS-SQL	Yes	systems.hid.gov.in	Inhouse	Inhouse	Inhouse
20	Uttarakhand	Irrigation Department	No information available as per the state's official website								
21	Himachal Pradesh	IPH Department	PC based	ArcGIS		eswis	No	No	No	No	No
22	Tripura	PWD (WR)	PC based	ArcGIS		NHP portal	No	No	No	No	No
23	Meghalaya	Water Resources Department	Distributed among various	ArcGIS		No	Yes	https://megwaterresour	Cloud (NIC National	NIC	NIC

			wings (PC based)					ces.gov.in/	Data Centre)		
24	Manipur	Irrigation and Flood Control Department	Centralised	No			No	http://manenvis.nic.in/database/waterresources_2704.aspx			
25	Nagaland	Water Resources Department	No information available as per the state's official website								
26	Mizoram	Irrigation & Water Resources Department	Centralised				Yes	https://irrigation.mizoram.gov.in/#			
27	Sikkim	Water Resources Department	Proposed to be stored in centralized (Server Based)	ArcGIS		No software at present	Proposed to be accessible to the public	To be created	In-house Data Centre	Outsourced	Outsourced
28	Goa	Water Resources Department	Centralized and PC based			SWDES	No	No	No	No	No

29	Delhi	Irrigation & Flood Control Dept	Water data is not available								
30	Puducherry	Puducherry Water Resources Organisation	Pc based	ArcGIS		Geodata base	No	No	No	No	No
31	Andaman & Nicobar	PWD	No information available as per the state's official website								
32	Ladakh	Irrigation Department	No information available as per the state's official website								
33	Dadra & Nagar haveli, Daman & Diu	Irrigation Department	No information available as per the state's official website								
34	Lakshadweep	LPWD	No information available as per the state's official website								
35	Jammu & Kashmir	Jal Shakti department	No information available as per the state's official website								
36	Chandigarh	Irrigation Department	No information available as per the state's official website								

Annexure-III

GIS layers of India-WRIS

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
1	Canal Network	65537 nos. (78595 Updated) 368108.90 Km	Data of CWC & State WRDs digitized using IRS LISS IV + Cartosat merged Satellite data and SOI 50K Toposheets	2020	Polyline	1:5000	1:10000	In-House
2	State Boundaries	37	Survey of India (SOI), Govt. of India	2011 (Still updation of new states were incorporated inhouse)	Polygon	1: 2,00,000	1: 2,00,000	SOI
3	District Boundaries - 2011	640	Survey of India (SOI), Govt. of India	2011	Polygon	1: 1,00,000	1: 1,00,000	SOI
4	Surface Water Bodies	796588 (48963 sq km)	Digitized using IRS LISS IV + Cartosat merged Satellite data and Toposheets (SOI) (2011-2013 imagery)	2013	Polygon	1:5000	1:10000	Inhouse
5	River line	4.3 Million Km, 7764841 features	IRS LISS IV + Cartosat merged Satellite data (NRSC) and Toposheets (SOI)	2012	Polyline	1:10000	1:20000	Inhouse

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
6	Major Rivers	208 features, 36632Km	CWC (Central Water Commission) / Inhouse	2008	Polyline	1:1000000	1:3,000,000	CWC (Central Water Commission) / Inhouse
7	HE projects (& Powerhouse)	301	Data of CWC, Concerned State & Central Govt. Departments digitized using IRS LISS IV + Cartosat merged Satellite data and Toposheets (SOI)	2020	Point	1:4000	1:5000	Inhouse
8	Barrage/Weir/ Anicut	1062 (1075 Updated)	Data of CWC, Concerned State & Central Govt. Departments digitized using IRS LISS IV + Cartosat merged Satellite data and Toposheets (SOI)	2020	Point	1:4000	1:5000	Inhouse
9	Dam	4661 (4677 Updated)	Data of CWC, Concerned State & Central Govt. Departments digitized usingIRS LISS IV + Cartosat merged Satellite data and Toposheets (SOI)	2020	Point	1:4000	1:5000	Inhouse
10	Lift	735 (752 Updated)	Data of CWC, Concerned State & Central Govt. Departments digitized using IRS LISS IV +	2020	Point	1:4000	1:5000	Inhouse

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
			Cartosat merged Satellite data and Toposheets (SOI)					
11	Canal Off take locations (Hydro Structures)	23	Data of CWC, Concerned State & Central Govt. Departments digitized using IRS LISS IV + Cartosat merged Satellite data and Toposheets (SOI)	2010-2013	Polyline	1:4000	1:5000	In-house + NRSC
12	Structure Line	5467 nos. (5497 Updated) 4937Km (4962.76Km Updated)	Data of CWC, Concerned State & Central Govt. Departments digitized using IRS LISS IV + Cartosat merged Satellite data and Toposheets (SOI)	2020	Polyline	1:4000	1:5000	Inhouse
13	Command areas- Major & Medium	2645 (2495 Updated) 809218.05 Sq Km	Data of CWC, Concerned State & Central Govt. Departments digitized using IRS LISS IV + Cartosat merged Satellite data and Toposheets (SOI) and Project report on mapping of water logging and salt affected area in major & medium irrigation commands	2020	Polygon	1:10000	1:20000	Inhouse

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
14	Hydroelectric Regions	5	Central Electricity Authority	2010	Polygon	1: 2,00,000	1: 2,00,000	CEA
15	Seismic Zones	4	Indian Meteorological Department, IMD	2011	Polygon	1: 1,00,000	1: 1,00,000	IMD
16	Hydroelectric Basins	8	Central Electricity Authority	2010	Polygon	1: 1,00,000	1: 1,00,000	Central Electricity Authority
17	Minor Irrigation Schemes (4th & 5th MI)	Total Ground Water Schemes (4th MI) = 19757820 nos. Total Ground Water Schemes (5th MI) = 20521884 nos. Total Surface Water Schemes (4th MI) = 1248853 nos. Total Surface Water Schemes (5th MI) = 1192249 nos. CCA (4th MI) = 57224548, CCA (5th MI) =	DoWR	2006-07 (Fourth MI) & 2013-14 (Fifth MI)	Polygon	1: 1,00,000 (Data as field in State and District boundary)	1: 1,00,000	DoWR/Inhouse

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
		74496301.87ha IPC (4th MI) = 78887598, IPC (5th MI) = 87335262.12 ha IPU (4th MI) =63499683, IPC (5th MI) = 70823880.51 ha Water Distribution Devices (4th MI) = 21006673 nos. Water Distribution Devices (5th MI) = 20866215 nos.						
18	Inter Basin Transfer Links	1) 14 Himalayan components & 2) 16 Peninsular components (Detailed)	National Water Development Agency (NWDA)	2004	Links are polyline, associated/supporting layers in point, polygon and line	1:50,000	1:50,000	NWDA

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
19	Basin WRIS	27	Delineated from SRTM 90m DEM version 4 (http://srtm.csi.cgiar.org)	2011	Polygon	1:20000	1:25000	Inhouse
20	Sub Basin WRIS	101	SRTM 90m DEM version 4 (http://srtm.csi.cgiar.org), Carto DEM and Satellite data (NRSC) and Toposheets (SOI)	2013	Polygon	1:20000	1:25000	Inhouse
21	River Polygon	42387 features, 64587 Sq Km	IRS LISS IV + Cartosat merged Satellite data (NRSC) and Toposheets (SOI)	2013	Polygon	1:10000	1:20000	Inhouse
22	Inland Navigation Waterways	6	Inland Waterways Authority of India (IWAI) , Govt. of India	2006-2007	Waterways are polyline, associated/supporting layers in polygon, point and line	1: 10,000 (NW1,2,3) 1:50,000 (NW4,5,6)	1: 20,000 (NW1,2,3) 1:50,000 (NW4,5,6)	IWAI
23	Waterlogging area in major medium irrigation project	Total command area studied= 86484015.04 ha (Waterlogged area= 1525235.82	CWC/RRSC (W)	2003-05	Raster	1:24000	1:35000	NRSC

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
	command area	ha), 384862 Features						
24	Salt affected area in major medium irrigation project command area	Total command area studied= 86484015.04 ha (Salt affected= 1026442.01 ha), 443996 Features	CWC/RRSC (W)	2003-05	Raster	Raster	1:50000	NRSC
25	Soil samples for major medium irrigation projects	Soil sampling Sites=15623 nos.	CWC/RRSC (W)	2003-05	Point		1:50000	NRSC
26	Reservoir Hydrographic Survey	243	Data of CWC, digitized using IRS LISS IV + Cartosat merged Satellite data and Toposheets (SOI)	1798-2014	Polygon	1:10000	1:10000	Inhouse
27	Reservoir Remote Sensing Survey	129	Data of CWC, digitized using IRS LISS IV + Cartosat merged Satellite data and Toposheets (SOI)	1989- 2015	Polygon	1:10000	1:10000	Inhouse
28	Sedimentation Zone	9	CWC	2010	Polygon	1:100000	1:100000	CWC (Central Water Commission)

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
29	Meteorological Sub Divisions	36	IMD	2010	Polygon	1:100000	1:100000	IMD
30	Reservoir Basin	13	CWC	2010	Polygon	1:100000	1:100000	CWC (Central Water Commission)
31	Reservoir Region	5	CWC	2010	Polygon	1:100000	1:100000	CWC (Central Water Commission)
32	Basin CGWB	34	Central Ground Water Board, CGWB (digitized from A4 size map)	2006	Polygon	1: 20,000	1: 25,000	In-House
33	Aquifer Information (Principal & Major Aquifers)	Principal-14, Major- 42	Central Ground Water Board (CGWB)	2012	Polygon	1:50000	1:50000	CGWB
34	Aquifer Depth	6 states data (Punjab, Haryana, Madhya Pradesh, West Bengal, Kerala, Tamil nadu)	Central Ground Water Board (CGWB)	2013	Raster	Raster	1:50000	CGWB/ Inhouse

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
35	Aquifer Thickness	6 states data (Punjab, Haryana, Madhya Pradesh, West Bengal, Kerala, Tamil nadu)	Central Ground Water Board (CGWB)	2013	Raster	Raster	1:50000	CGWB/ Inhouse
36	Aquifer Material	6 states data (Punjab, Haryana, Madhya Pradesh, West Bengal, Kerala, Tamil nadu)	Central Ground Water Board (CGWB)	2012	Polygon	Raster	1:50000	CGWB/ Inhouse
37	Basin CWC	22	CWC (Central Water Commission)	2011	Polygon	1: 20,000	1: 25,000	In-House
38	Litholog well location	2740	Central Ground Water Board (CGWB)	1996-2005	Point	Plotted location point	1: 20,000	CGWB
39	State Boundary (GWR 2013,2017)	36	Central Ground Water Board (CGWB)	2013	Polygon	1:10K - 1:50K	1: 50,000	CGWB
40	District Boundary (GWR 2013)	697	Central Ground Water Board (CGWB)	2013	Polygon	1:10K - 1:50K	1: 50,000	CGWB

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
41	District Boundary (GWR 2017)	701	Central Ground Water Board (CGWB)	2017	Polygon	1:10K - 1:50K	1: 50,000	CGWB
42	Block/Assessment Unit-2013 (Categorization of Blocks/Talukas/Mandals)	6471	Central Ground Water Board (CGWB)	2013	Polygon	1:10K - 1:50K	1: 50,000	CGWB
43	Block/Assessment Unit-2011 (Categorization of Blocks/Talukas/Mandals)	6552	Central Ground Water Board (CGWB)	2011	Polygon	1:10K - 1:50K	1: 50,000	CGWB
44	Block/Assessment Unit-2017 (Categorization of Blocks/Talukas/Mandals)	6861	Central Ground Water Board (CGWB)	2017	Polygon	1:10K - 1:50K	1: 50,000	CGWB
45	Towns	7944	Census of India, IRS LISS IV + Cartosat merged Satellite data (NRSC) and Toposheets (SOI)	2011	Point	1: 10,000	1: 10,000	SOI

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
46	Grid (RGDWM Sheets 250K)	2328 Grid of 50K scale out of 5104 Grids	CWC/NRSC (Rajiv Gandhi National Drinking Water Mission (RGNDWM) project)	1999-2010	Polygon	1: 50,000	1: 50,000	SOI (250k grid bounady)
47	Water Resource Region	6	Delineated from SRTM	2008	Point	1:20000	1:25000	Inhouse
48	Watershed	4566	SRTM 90m DEM version 4 (http://srtm.csi.cgiar.org), Carto DEM and Satellite data (NRSC) and Topo sheets (SOI)	2013	Polygon	1:10000	1:20000	Inhouse
49	Basin AISLUS	35	All India Soil and Land Use Survey	1990	Polygon	1: 20,000	1: 100,000	Inhouse
50	Basin NCIWRDP	24	NCIWRDP	1999	Polygon	1: 20,000	1: 100,000	Inhouse
51	Sub-Basin CWC	99	CWC (Central Water Commission)	2011	Polygon	1: 20,000	1: 25,000	Inhouse
52	Wet Lands Post-Monsoon2005	7270556.06 ha, 28315 Feature	SAC, Ahmedabad, NRSC	2005	Polygon	1:250,000	1:250,000	SAC, Ahmedabad, NRSC
53	Wet Lands Pre-Monsoon 2005	6216895.11 ha, 17509 Feature	SAC, Ahmedabad, NRSC	2005	Polygon	1:250,000	1:250,000	SAC, Ahmedabad,

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
								NRSC
54	Wet Lands Post Monsoon 1994	6263215.71 ha, 21999 Feature	SAC, Ahmedabad, NRSC	1994	Polygon	1:250,000	1:250,000	SAC, Ahmedabad, NRSC
55	Wet Lands Pre-Monsoon 1994	4123461.58 ha, 10227 Feature	SAC, Ahmedabad, NRSC	1994	Polygon	1:250,000	1:250,000	SAC, Ahmedabad, NRSC
56	Glacial Lakes/Waterbody	Total=522 Glacial Lakes=62; Waterbody=460	CWC (Central Water Commission)	2011-2019 (June)	Polygon	AWiFS data processed	1:100,000	CWC
57	Snow Cover (Minimum and Maximum Extent)	Minimum Cover (2009) =83733 Sq Km Maximum cover (2009) =208545 Sq Km	NRSC	2009	Raster	AWiFS data processed	1:100,000	NRSC
58	Storm Surge	1395 locations	RMSI, CWC	2011	Point	1:100000	1:100000	RMSI, CWC
59	NIO Observation Location	100 nos.	RMSI, CWC	2011	Point	1:100000	1:100000	RMSI, CWC
60	India Coastline	19060 Km	RMSI, CWC	2011	Polyline	1:100000	1:100000	RMSI, CWC

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
61	River Name	20457 features (470935.94 Km)	IRS LISS IV + Cartosat merged Satellite data (NRSC) and Toposheets (SOI)	2013	Polyline	1:10000	1:20000	Inhouse
62	Water Tourism	1036	State Tourism websites, Ministry of Tourism, Govt. of India, Different Publications, www.indiastats.com	2006-07	Point	1:5000	1:5000	Inhouse
63	Wild Life	292	State Tourism websites, Ministry of Tourism, Govt. of India, Different Publications, www.indiastats.com	2006-07	Point	1:5000	1:5000	Inhouse
64	LULC 2011-2012	9 land use/cover classes	NRSC, ISRO	2011-12	Raster	LISS-III data processed	1: 50,000	NRSC
65	LULC 2005-2006	24 land use /cover classes	NRSC, ISRO	2005-06	Raster	LISS-III data processed	1: 50,000	NRSC
66	Wasteland	36 class (45957735.59 ha)	NRSC, ISRO	2005-2006	Raster	LISS-III data processed	1: 50,000	NRSC
67	State Capitals	34	Survey of India (SOI), Govt. of India		Point	1:10000	1:10000	Survey of India (SOI), Govt. of India

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
68	District Headquarter	634	Census of India	2011	Point	1:10000	1:10000	Census of India
69	Block	7150	CGWB	2011	Polygon	1: 50,000	1: 50,000	CGWB
70	Village Boundary	607642	Census of India/ SOI	2001	Polygon	1:10000	1:10000	SOI
71	Road Multilane	8268 segments, 165407.4 Km	NHAI, NRDB, IRS LISS IV + Cartosat merged Satellite data (NRSC) and Toposheets (SOI)	2013	Polyline	1: 5,000	1: 10,000	NHAI & NRDB
72	Rail	3546 segments, 68986 Km	Indian Railways, IRS LISS IV + Cartosat merged Satellite data (NRSC) and Toposheets (SOI)	2013	Polyline	1: 5,000	1: 10,000	Indian Railways
73	Settlement Extent (Town, Village, Hamlet)	889676 nos., 80590 Area in Sq Km	IRS LISS IV + Cartosat merged Satellite data (NRSC) and Toposheets (SOI)	2013	Polygon	1: 24,000	1: 30,000	In-House
74	Parliament Constituencies - 2009	547	Election Commission of India	2004	Polygon	1: 1,00,000	1: 1,00,000	Election Commission of India
75	Parliament	543	Election Commission of	2004	Polygon	1: 1,00,000	1:	Election

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
	Constituencies - 2004		India				1,00,000	Commission of India
76	Assembly Constituencies	4111	Election Commission of India	2004	Polygon	1: 1,00,000	1: 1,00,000	Election Commission of India
77	International Boundary	1	Survey of India (SOI), Govt. of India	2001	Polygon	1:1,000,000	1:1,000,000	Survey of India (SOI), Govt. of India
78	Village Location	672909 nos.	SOI/Census of India	2010-13	Point	1:10000	1:10000	SOI
79	Hamlet Location	223232 nos.	SOI/Census of India	2010-13	Point	1:10000	1:10000	SOI
80	Tehsil	5924	SOI/Census of India	2011	Polygon	1:10000	1:10000	SOI
81	Land Degradation	31123303.5 ha (8 states data)	NRSC, ISRO	2005-2006	Raster	1:24000	1: 50,000	NRSC, ISRO
82	Soil Depth	Depth data of 298664571.42 ha area	NBSS & LUP	2004-2005	Raster	Raster	1: 50,000	NBSS & LUP
83	Soil Texture	Texture data of 298653161.32 ha area	NBSS & LUP	2004-2005	Raster	Raster	1: 50,000	NBSS & LUP

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
84	Soil Slope	Slope data of 298653152.41 ha area	NBSS & LUP	2004-2005	Raster	Raster	1: 50,000	NBSS & LUP
85	Soil Erosion	Erosion data of 298653217.71 ha area	NBSS & LUP	2004-2005	Raster	Raster	1: 50,000	NBSS & LUP
86	Soil Productivity	Productivity data of 281894262.85 ha area	NBSS & LUP	2004-2005	Raster	Raster	1: 50,000	NBSS & LUP
87	Agro Ecology Regions	20	Indian Council of Agricultural Research (ICAR)	1992	Polygon	1: 1,00,000	1: 1,00,000	ICAR
88	Agro Sub Region Ecology	60	ICAR NBSS&LUP	1994	Polygon	1: 1,00,000	1: 1,00,000	ICAR
89	Agro Climatic Regions	15	Planning Commission	1989	Polygon	1: 1,00,000	1: 1,00,000	Planning Commission
90	Flood 2008	Flood area 13225.72 sq km	NRSC, ISRO	2008	Raster	1:24000	1: 50,000	NRSC, ISRO
91	Flood 2009	Flood area 7059.75 sq km	NRSC, ISRO	2009	Raster	1:24000	1: 50,000	NRSC, ISRO
92	Flood 2010	Flood area 3579 sq km	NRSC, ISRO	2010	Raster	1:24000	1: 50,000	NRSC, ISRO

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
93	Block Drought	Desert Development program (DDP)-214, Drought Prone area program (DPAP)-854	MoRD	2002	Polygon	Data as a field in Block boundary	1: 50,000	MoRD
94	Drought District	DPAP - 185 (183 as per declaration) DDP- 40 (3 Common Blocks in Both DPAP&DDP)	MoRD	2002	Polygon	Data as a field in District boundary	1: 1,00,000	MoRD
95	Tribal Sub Plan Area MoRD 2002 (District Wise)	80 Districts	Ministry of tribal affairs	1983	Polygon	Data as a field in District boundary	1: 1,00,000	Ministry of tribal affairs
96	Tribal Sub plan area 1983(Pockets of Tribal Concentration)	236 Pockets	Ministry of tribal affairs	1983	Point	1: 50,000	1: 50,000	Ministry of tribal affairs

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
97	Predominantly Tribal Areas-1983	State/UTs having predominant tribal population= 137221 Sq Km Sub Plan Area = 520361.51 Sq Km	Ministry of tribal affairs	1983	Polygon	1: 50,000	1: 50,000	Ministry of tribal affairs
98	Earthquakes - IMD (1819-2011)	26 events detail	IMD	1819-2011	Point	Plotted location point	1: 10,000	IMD
99	Earthquakes - USGS (1594-1984)	617 events detail	USGS and National Earth quake Information Centre	1594-1984	Point	Plotted location point	1: 10,000	USGS and National Earth quake Information Centre
100	Extreme Temperature and Rainfall (WMO Recognized IMD Sites)	382 IMD stations Data	IMD	1828-2010	Point	Plotted location point	1: 10,000	IMD
101	Airport	194 nos.	Airport Authority of India	2020	Point	1: 5,000	1: 5,000	Airport Authority of India
102	Hillshade_90	Derived from SRTM 90m DEM	(http://srtm.csi.cgiar.org)	2008	Raster	Raster	1:100000	

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
		version 4						
103	PMP Grids	465	CWC, IMD	2014-15	Polygon	1:20000	1:25000	CWC, IMD
104	Storm Isohyetal Map	280 Isohyetal layers	CWC, IMD	2014-15	Polygon	1: 50,000	1: 50,000	CWC, IMD
105	Rainfall Station (PMP)	4206	IMD	2014-15	Point	1: 20,000	1: 20,000	IMD
106	PMP Basin	10	CWC, IMD	2014-15	Polygon	1:20000	1:25000	CWC, IMD
107	River Points (Level & Discharge)	4180 of All Agency (CWC-1748 nos)	24 Agencies	WDO (Station Count may vary)	Point	Plotted location point	1:125000	Respective agency/ Vassarlabs
108	Reservoirs	414 of All Agency (CWC Agency-138)	CWC, APWRIMS, Gujrat State Data	WDO (Station Count may vary)	polygon		1:125000	Respective agency/ Vassarlabs
109	River Points (Quality)- 66 parameters	Surface Water Quality - 441 Stations	CWC	WDO (Station Count may vary)	Point	Plotted location point	1:125000	Respective agency/ Vassarlabs

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
110	Rainfall sensor /station	1. State & Central agencies - 6848 Station data	A) State Agencies (WIMS) (35 Nos) & UT's (2) B) Central Agencies (WIMS) (CWC, Damodar Valley Corporation, National Institute of Hydrology, Bhakra Beas Management Board, etc)	WDO (Station Count may vary)	Point	Plotted location point	1:125000	Respective agency/ Vassarlabs
111	MI Tanks	37974	APWRIMS (Only Available for Andhra Pradesh State)	WDO (Station Count may vary)	Point	Plotted location point	1:125000	Respective agency/ Vassarlabs
112	GW Stations (GW Level)	54140	CGWB and State Agency (11 state data)	WDO (Station Count may vary)	Point	Plotted location point	1:125000	Respective agency/ Vassarlabs
113	GW Stations (GW Quality)- 17 parameters	18905	CGWB	WDO (Station Count may vary)	Point	Plotted location point	1:125000	Respective agency/ Vassarlabs
Choropleth Map	Soil moisture Heatmap	Country Level	NRSC VIC Model (Volumetric Soil Moisture content (%) till 15cm depth; Gridded (0.05 X0.05) data)	WDO	Raster	Raster	1:125000	Respective agency

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
Choropleth Map	Rainfall Heatmap	1.IMD -Gridded (0.25 X0.25) 2. NRSC - Gridded (0.05 X0.05)	A) IMD B) NRSC	WDO	Raster	Raster	1:125000	Respective agency
Choropleth Map	Evapotranspiration Heatmap	Country Level	NRSC (ET Level in mm; Gridded (0.05 x 0.05) data)	WDO	Raster	Raster	1:125000	Respective agency
Choropleth Map	Ground Water Level Heatmap		CGWB and State Agency		Raster	Raster	1:125000	Respective agency

S. No.	Layers List	(Total No., Length & Area)	Source	Data Year	Geometry	Mapping Scale	Display Scale	Developed & Managed
Choropleth Map	Water Audit	Computation of Total inflow (rainfall, and from other water bodies like streams), Change in Storage (Reservoirs, MI tanks, soil moisture, Ground water), Total Outflow (ET, outflow streams from the region, surface and subsurface outflow, Utilization (Domestic, Industrial, agriculture))	Several agencies					Respective agency