User Manual

for

INDIA GEC Software

(Automation of Estimation of Dynamic Ground Water Resources using GEC-2015 methodology and Related Research work to improve GEC Assessment)

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1.0 Introduction

Ground Water is the backbone of India's agriculture and drinking water security in urban and rural areas. However, it is important to realize that groundwater is not a resource that could be utilized indiscriminately. India being a home to more than 1.3 billion people, the increasing population, urbanization and non-uniform extraction have accelerated depletion of ground water resources. This is reflected in falling ground water levels trends and contamination of aquifers. A serious groundwater crisis prevails currently in India due to excessive over-extraction and groundwater contamination covering nearly 60 percent of all districts in India and posing a risk to drinking water security of the population. In addition to over-extraction and biological/chemical contamination of water, excess groundwater and water logging is also a serious problem in many regions, impacting livelihood security of large sections of society.

Groundwater estimation committee (GEC) 2015 gives guidelines to classify assessment units (largely administrative units such as blocks/talukas/mandals/firkas, and in some cases hydrological units such as watersheds/aquifers) into SAFE, SEMI-CRITICAL, CRITICAL AND OVEREXPLOITED categories for a region. This classification is based on the amounts of Ground Water Recharge, Draft, Flux happened in a particular year.

India GEC system will take Data Input through Excel as well as through Forms, compute various Ground water components (recharge, draft, flux, etc.), classify assessment unit into appropriate categories, develop visibility dashboards for each of the components. System allows user to view the data in both MIS as well as GIS view. User can also download the reports in formats like CGWB, etc.

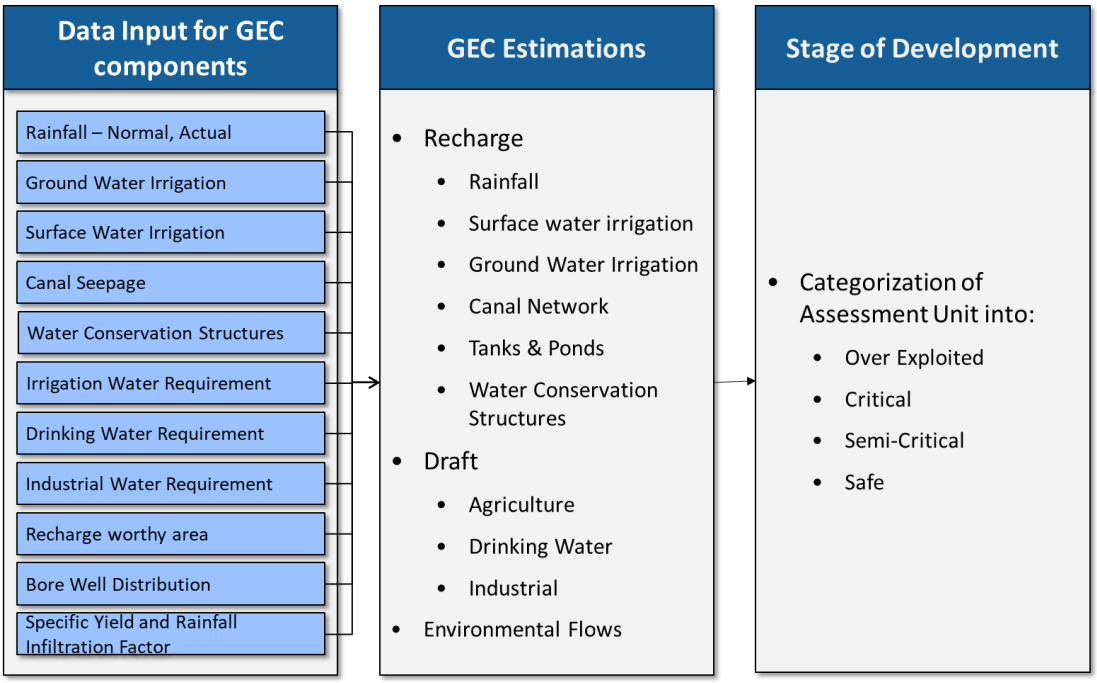


Figure 1: Overview of Ground Water Resource Estimation Platform – GEC 2015

2.0 Methodology Used

The system is based on GEC 2015 methodology for ground water resources estimation for 3 types of Aquifers: Unconfined Aquifer, Semi-Confined Aquifer and Confined Aquifer. The resource estimation for an Unconfined Aquifer is based on the principle of water balance:

Inflow – Outflow = Change in Storage (of an aquifer)

This equation can be further elaborated as:

$$\Delta S = R_{RF}+R_{STR}+R_{C}+R_{SWI}+R_{GWI}+R_{TP}+R_{WCS}\pm VF \pm LF - GE - T - E - B$$

Where,

ΔS – Change is storage

R_{RF} – Rainfall recharge

R_{STR} – Recharge from stream channels

R_{C} – Recharge from canals

R_{SWI} – Recharge from surface water irrigation

R_{GWI} – Recharge from ground water irrigation

R_{TP} – Recharge from tanks & ponds

R_{WCS} – Recharge from water conservation structures

VF – Vertical inter aquifer flow

LF – Lateral flow along the aquifer system (throughflow)

GE – Ground Water Extraction

T – Transpiration

E – Evaporation

B – Base flow

India GEC system is divided into 3 modules – Input, Computation and Output.

1. **Input module** – Input Module refers to the Data Entry module at an Assessment Unit level. Data Input is done via 2 methods i.e.

    a. **Excel based input** – In this, the user needs to download District level data sheet template where he/she can fill the data at an Assessment Unit level. User now needs to upload their fully filled excel sheet into the system.

    b. **Form based input** – In this, the user is shown a form and he/she can fill/edit the data in data sheet in an online mode. Once user is done with editing online, he/she can Submit the data file.

2. **Computation module** – Computation Module refers to the ground water calculations for an assessment unit. These computations are based on GEC 2015 methodology and are used to calculate Annual Extractable Ground Water Resource, Total Current Annual Ground Water Extraction (utilization) and the percentage of ground water utilization with respect to recharge (stage of Ground Water Extraction) for an assessment unit. Based on these percentages an assessment unit is categorized into SAFE, SEMI-CRITICAL, CRITICAL AND OVEREXPLOITED categories.

3. **Output module** Once categorized the data is shown in two views:

    a. **MIS Dashboard** – MIS dashboard shows the results of the assessment for the entire India, and also State wise in tabular form. The MIS dashboard shows all type of recharges, extractions, inflows and outflows computed for both monsoon and non-monsoon periods of the year and then reflect the overall stage of extraction at the selected Geo-Zoom Level.

    b. **GIS Dashboard** – GIS dashboard shows the data in Web Geo-Server format, implemented in interactive GIS platform allowing user to all GEC related information in the map itself. GIS view represents the data on India map and color codes each District/Assessment unit based on the categorization.

2.1 Ground Water Recharge

The Ground Water Recharge for an Unconfined Aquifer is calculated as:

$$Recharge = R_{RF}+R_{STR}+R_{C}+R_{SWI}+R_{GWI}+R_{TP}+R_{WCS}$$

Where,

R_{RF} – Rainfall recharge

R_{STR} – Recharge from stream channels

R_{C} – Recharge from canals

R_{SWI} – Recharge from surface water irrigation

R_{GWI} – Recharge from ground water irrigation

R_{TP} – Recharge from tanks & ponds

R_{WCS} – Recharge from water conservation structures

2.1.1 Annual Rainfall Recharge

Introduction

Monsoon Rainfall is the major source of ground water recharge. About 58% of the annual replenishable resources are contributed by monsoon rainfall. This recharge is estimated using Ground Water Level Fluctuation method (for Monsoon season only) and Rainfall Infiltration Factor method (for both Monsoon and Non-Monsoon). User is allowed to enter data at Assessment Unit level, Rain Gauge level data, IMD Grid level, etc.

Data Elements Used

Component	Parameter	Unit
Rainfall Infiltration Factor Method	Rainfall	Millimeter
Water Table Fluctuation Method	Water Level	Meter

Data computation methodology

The Rainfall Recharge estimations based on Water Level Fluctuation method, reflects actual field conditions as it considers the response of ground water level. However, this estimation is often subject to uncertainties. In the regions, where adequate data on ground water level fluctuations is not available, ground water recharge is estimated using rainfall infiltration factor method. Therefore, it is recommended to compare the rainfall recharge obtained from water level fluctuation approach with that estimated using rainfall infiltration factor method.

Ground Water Level Fluctuation Method

The Ground Water Level Fluctuation method is to be used for assessment of rainfall recharge in the monsoon season only. It considers following factors for recharge calculation:

- Change in storage
- Rise/Fall in water level in the monsoon season
- Specified yield (based on Aquifer Norms)

R_{RF} (wtfm) = ((Change in Ground Water Storage + Gross Ground Water Extraction for all uses in Command/Non-Command Area during Monsoon) - Recharge from “Other Sources” during Monsoon Season))1000

Where,

Change in Ground Water Storage = Rise/Fall in water level in the monsoon season * Area * Specific Yield

Recharge from “Other Sources” = Recharge due to seepage from Canals + Recharge from Surface Water Irrigation + Recharge from Ground Water Irrigation + Recharge from Tanks and Ponds + Recharge from Water Conservation Structures

Rainfall recharge during monsoon season for normal monsoon rainfall condition, R_{RF} (Normal, wtfm) is calculated as:

R_{RF} (Normal, wtfm) = (Rainfall Recharge * Monsoon Normal Rainfall) / Monsoon Actual Rainfall

Rainfall Infiltration Factor Method

The Rainfall Infiltration Factor method is used for rainfall recharge assessment in both monsoon and non-monsoon season. It considers following factors for recharge calculation:

- Area
- RFIF - Rainfall Infiltration Factor (based on Aquifer Norms)
- Normal Monsoon Rainfall

R_{RF} (Normal, rifm) = (Area*(Normal Rainfall during Monsoon-Rainfall threshold) * Rainfall Infiltration Factor)/1000

Where

Rainfall Threshold = 10% of annual rainfall

Method selection for Monsoon

Once the rainfall recharge is estimated using both the methods, Percent Deviation (PD) is calculated. PD is the difference between the two methods i.e. R_{RF} (wtfm) and R_{RF} (rifm) expressed as a percentage of the R_{RF}(rifm)

PD = (R_{RF} (Normal, wtfm) - R_{RF} (Normal, rifm)) / R_{RF} (Normal, rifm) * 100

Where,

R_{RF} (wtfm) = Rainfall Recharge for normal monsoon season rainfall estimated using Water Table Fluctuation method

R_{RF} (rifm) = Rainfall Recharge for normal monsoon season rainfall estimated using Rainfall Infiltration Factor method

The criteria for adoption are:

- If -20% < PD < +20% Final Rainfall Recharge = R_{rf}(wtfm)
- If PD < -20% Final Rainfall Recharge = R_{rf}(rifm)* 0.8
- If PD > +20% Final Rainfall Recharge = R_{rf}(rifm)* 1.2

2.1.2 Recharge from Other Sources – Ground Water Irrigation

Introduction

In recharge through ground water irrigation, the ground water which was earlier extracted for agricultural irrigation purposes is now contributing to the ground water recharge. This recharge is calculated based on the return flow factor for paddy as well as non-paddy fields.

Data Elements Used

Component	Parameter	Unit
Recharge due to Ground Water Irrigation	Cropping Pattern	Acres

Data computation methodology

Recharge due to applied Ground Water Irrigation is estimated based on the following formula:

$$R_{GWI} = GD_I * RFF$$

Where:

R_{GWI} = Recharge due to applied ground water irrigation

GD_I = Gross Ground Water Draft for Irrigation

RFF = Return Flow Factor and is calculated as [(Irrigated Area Under Paddy * Return Flow Factor for Paddy) + (Irrigated Area Under Non-Paddy * Return Flow Factor for Non-Paddy)] / (Irrigated Area Under Paddy + Irrigated Area Under Non-Paddy)

2.1.3 Recharge from Other Sources - Surface Water Irrigation

Introduction

Surface Water Irrigation is done to irrigate crops through the canal water. This water also contributes to ground water recharge and is calculated using Return Flow Factor and number of days the water was discharged to fields.

Data Elements Used

Component	Parameter	Unit
Recharge due to Surface Water Irrigation	Design Discharge of the Outlet	Cusecs
	Number of Days	Number
	Cropping Pattern	Acres

Data computation methodology

Recharge due to Applied Surface Water Irrigation: Recharge due to applied surface water irrigation is estimated based on the following formula:

R_{SWI} = AD * Days * RFF

Where:

R_{SWI} = Recharge due to applied surface water irrigation

AD = Average Discharge

Days = Number of days water is discharged to the Fields

RFF = Return Flow Factor

In case discharge data is not available below formula is used to calculate R_{SWI}:

R_{SWI} = [((Irrigation Area Under Paddy * Crop Water Requirement for Paddy) + (Irrigation Area under Non-Paddy * Crop Requirement for Non-Paddy)) * RFF

Where,

RFF = [(Irrigated Area under Paddy * Return Flow Factor for Paddy) + (Irrigated Area under Non-Paddy * Return Flow Factor for Non-Paddy)] / (Irrigated Area under Paddy + Irrigated Area under Non-Paddy)

2.1.4 Recharge from Other Sources - Canal Seepage

Introduction

Canals store water till the time it is disbursed for irrigation, industrial and domestic purposes. During this time the water seeps down the ground, contributing to the ground water recharging. Canals are of two types – Lined and Unlined.

Data Elements Used

Component	Parameter	Unit
Recharge from Canal Seepages	Reach Length	Meters
	Full Supply Length	Meters
	Side Angle	Degrees
	Base Width	Meters
	Number of Days	Number

Data computation methodology

Recharge due to canals is estimated based on the following formula:

$$R_C = WA * SF * Days$$

Where:

R_C = Recharge Due to Canals

WA = Wetted Area (calculated as Wetted Perimeter X Length of Canal Reach)

SF = Seepage Factor

Days = Number of Canal Running Days

2.1.5 Recharge from Other Sources - Tanks and Ponds

Introduction

During monsoon season, water get stored in Tanks and Ponds. This stored water contributes to the ground water recharge based on the amount of water stored and number of days water is stored in these structures.

Data Elements Used

Component	Parameter	Unit
Recharge from Tanks and Ponds	Water Spread Area	Hectares
	Number of Days	Numbers

Data computation methodology

Recharge due to Tanks & Ponds is estimated based on the following formula:

$$R_{TP} = AWSA * R * RF$$

Where:

R_{TP} = Recharge due to Tanks & Ponds

AWSA= Average Water Spread Area

N = Number of days Water is available in the Tank/Pond

RF = Recharge Factor (As per GEC 2015, recommended RF = 1.4 mm / day)

2.1.6 Recharge from Other Sources - Water Conservation Structures

Introduction

Similarly, like Tanks and Ponds, Artificial Structures for Water Conservation, stores water in monsoon season which then contributes to ground water recharge.

Data Elements Used

Component	Parameter	Unit
Recharge due to Water Conservation Structure	Gross Storage	Hectare Meters
	Number of Refills	Number

Data computation methodology

Recharge due to Water Conservation Structures is estimated based on the following formula:

$$R_{WCS} = GS * RF$$

Where:

R_{WCS} = Recharge due to Water Conservation Structures

GS = Gross Storage = Storage Capacity * No. of Fillings

RF = Recharge Factor (As per GEC 2015 recommendations, RF = 40% of Gross Storage during a year which means 20% during monsoon season and 20% during non-monsoon Season)

2.1.7 Recharge from Other Sources – Stream Channels

Introduction

Streams following through an area also contributes to the Ground Water recharge.

Data computation methodology

Recharge from Stream Channels is estimated using Darcy's Law.

$$Q = K * [(h2-h1)/L] * A$$

Where:

K = Coefficient of Permeability / Hydraulic Conductivity

h1 = Head of the river

h2 = Head at the Ground Water level

L = Length of the river which contribute to recharge

A = Area of cross-section

2.1.8 Recharge from Other Sources - Pipelines

Introduction

Because of the water supply schemes, Pipelines are used for transporting water for domestic and industrial purpose in Urban area. Leakages from these pipelines are huge in some areas and contribute to ground water recharge.

Data Elements Used

Component	Parameter	Unit
Pipelines	Water supply through pipeline	Hectare Meters
	Number of days water is supplied	Number

Data computation methodology

Recharge from pipelines ($P_{ipelines}$) is estimated based on the description given in GEC 2015:

$R_{Pipelines}$ = 0.5 * (Water Supply through pipelines * Percentage losses/100) * Weighted Infiltration factor * Number of Days water is supplied through pipelines

2.1.9 Recharge from Other Sources - Sewage/Flash floods

Introduction

Seepages from the sewerages also contribute to recharge. Water which gets logged due to flash floods (happening due to heavy rainfall in a short period of time) also contribute to ground water recharge.

Data computation methodology

Recharge from Sewage/Flash Floods ($R_{Sewage/Flash\ Floods}$) is estimated based on the description given in GEC 2015:

$$R_{Sewage/Flash\ Floods} = WP * SF * Length * Days$$

Where:

WP = Wetted Perimeter

SF = Seepage Factor

Days = Number of Days

2.2 Inflows and Outflows

Environmental Flows consists of Vertical inter Aquifer Flow, Lateral Flow along the aquifer system, Transpiration, Evaporation and Baseflow.

2.2.1 Vertical Inter Aquifer Flow

Introduction

In areas where more than one aquifer is present, there is a possibility that either of ground water flow between the aquifers which is known as Vertical Inter Aquifer Flow. Vertical aquifer interflow is calculated using Darcy's law

Data computation methodology

This is calculated using Darcy's Law:

$$Q = HC * [\Delta h/T] * A$$

Where,

HC = Hydraulic Conductivity

Δh = Average Change in Head

T = Thickness of Aquitard

A = Area of the zone

2.2.2 Lateral flow along the aquifer system (throughflow)

Introduction

In Unless and until the assessment unit is a hydrological unit with sealed boundaries, there is always a possibility of ground water movement across the boundaries. Wherever the assessment unit are blocks, there will be a ground water flow across the boundaries. This flow of ground water between the aquifers is known as Lateral Flow Lateral Flow is calculated using Darcy's law.

Data computation methodology

This is calculated using Darcy's Law:

$$Q = T * [\Delta h/Distance] * L$$

Where,

T = Transmissivity

Δh = Up Contour - Down Contour

Distance = Distance between two contours on ground

L = Length of the section

2.2.3 Transpiration

Introduction

Transpiration normally takes place from the ground water reservoir if the roots reach the ground water table. If the water table is deep below, ground water cannot be lost through transpiration. But in situations where the roots extend up to the capillary rise of ground water levels, it will lead to transpiration.

Data computation methodology

This is calculated as:

$$Transpiration = A * TR * Days * (RD + CR - GWL) / (RD + CR)$$

Where,

A = Area

TR = Transpiration Rate

RD = Average Root Depth

CR = Capillary Rise

GWL = Ground Water Level

2.2.4 Evaporation

Introduction

Evaporation normally takes place from surface water bodies. As the ground water is not exposed to surface, there is a less possibility for evaporation from ground water bodies. But in situations where the ground water levels are less than the capillary rise of the aquifer material, it will lead to evaporation.

Data computation methodology

This is calculated as:

Evaporation = A * ER * Days * (CR - GWL)/CR

Where,

A = Area

ER = Evaporation Rate

CR = Capillary Rise

GWL = Ground Water Level

2.2.5 Evapotranspiration

Introduction

Sometimes it will be difficult to get evaporation and transpiration rates separately. It may be possible to get a single rate of evapotranspiration which is the cumulative effect of evaporation and transpiration. In these situations, instead of using two terms viz. evaporation and transpiration in the equation only one term is used i.e. Evapotranspiration.

Data computation methodology

This is calculated as:

Evapotranspiration = A * ETR * Days * (RD + CR - GWL) / (RD + CR)

Where,

A = Area

ETR = Evapotranspiration Rate

RD = Average Root Depth

CR = Capillary Rise

GWL = Ground Water Level

2.2.6 Baseflow

Introduction

Even though the aquifers are underdeveloped, the water levels will not rise to ground level. The reason for this is base flow.

Data computation methodology

Baseflow is calculated at Stream Gauge discharge:

If Spell Number is 0, then.

Baseflow = Stream Discharge

Else

Baseflow = Discharge at Start day in the spell + Day Number in the Spell * Slope of Discharge Straight line of the Spell

Where,

Stream Discharge = Average of 5 years of Daily Stream Discharge data

Slope of Discharge Straight line of the Spell = (Discharge at End day – Discharge at State day) / (Number of Days)

2.2.7 Environmental Flows

Introduction

The Unaccounted Natural Discharges are estimated based on the method used for calculating rainfall recharge in monsoon season. If the rainfall recharge is computed using water table fluctuation method,5% of the Total Annual Ground Water Recharge is taken as unaccounted Natural discharges else it is 10%of the Total Annual Ground Water Recharge.

2.3 Annual Extractable Ground Water Resource

Introduction

The Total Annual Ground Water Recharge cannot be utilized for human consumption as there are some ecological commitments to be fulfilled before the extractable resources is defined. Therefore, ground water base flow contribution limited to the ecological flow of the river should be determined which will be deducted from Annual Ground Water Recharge to determine Annual Extractable Ground Water Resources (AEGR).

Data computation methodology

$$AEGR = TGWR - ND$$

Where,

AEGR = Annual Extractable Ground Water Resources

TGWR = Total Ground Water Recharge

ND = Natural Discharges

2.4 Ground Water Extraction

Ground water draft or extraction can be assessed as follows:

$$GE_{ALL} = GE_{DOM} + GE_{IRR} + GE_{IND}$$

Where,

GE_{ALL} = Ground water extraction for all uses

GE_{DOM} = Ground water extraction for domestic uses

GE_{IRR} = Ground water extraction for irrigation uses

GE_{IND} = Ground water extraction for industrial uses

2.4.1 Extraction for Domestic Use

Introduction

Ground water which is extracted for domestic use can be estimated based on well census method or requirement method.

Data Elements Used

Component	Parameter	Unit
Ground Water Extraction	Well Census	Number
	Number of days	Number
	Population	Number
	Consumptive Requirement	Litres per capita per day

Data computation methodology

Ground Water Extraction for Domestic Use can be calculated in 2 ways:

Unit Draft Method: Formula for Unit Draft Method is:

$$GE_{DOM} = \text{Unit Draft} * \text{Wells}$$

Where,

Unit Draft = Draft per well

Wells = Number of Wells used for domestic purpose

Consumptive Use Method: Formula for Consumptive Use Method is:

$$GE_{DOM} = \text{Population} * \text{Consumptive Requirement} * Lg$$

Where,

Consumptive Requirement = Per Capita Daily Water Requirement (lpcd)

Lg = Fractional Load on Ground Water for Domestic Water Supply

2.4.2 Extraction for Irrigation Use

Introduction

One of the main sources of water is ground water on which many farmers depends for irrigation. This can be estimated based on Well Census Method, Crop Water Requirement Method or Power Consumption Method.

Data Elements Used

Component	Parameter	Unit
Ground Water Extraction	Well Census	Number
	Number of days	Number
	Cropping Pattern	Acres
	Power Consumed	Kilo Watt Hours

Data computation methodology

Ground Water Extraction for Irrigation Use can be calculated in 3 ways:

Unit Draft Method: Formula for Unit Draft Method is:

$$GE_{IRR} = \text{Unit Draft} * \text{Wells}$$

Where,

Unit Draft = Unit Draft per well

Wells = Number of Wells used for irrigation purpose

Crop Water Requirement Method: Formula for Crop Water Requirement Method is:

$$GE_{IRR} = (\text{Crop Water Requirement} * \text{Crop Area}) / 1000$$

Power Consumption Method: Formula for Power Consumption Method is:

$$GE_{IRR} = \text{Extraction} * \text{Power Units}$$

Where,

Extraction = Extraction per unit power consumption

Power Units = Number of units of power consumed for agricultural pump

2.4.3 Extraction for Industrial Use

Introduction

Most industries, especially in the manufacturing field require a significant amount of water to produce goods. Due to the continuous flow of water, ground water provides ongoing functioning of the industries for a sustainable production.

Data Elements Used

Component	Parameter	Unit
Ground Water Extraction	Well Census	Number
	Number of days	Number
	Number of Industrial Units	Number

Data computation methodology

Ground Water Extraction for Industrial Use can be calculated in 2 ways:

Unit Draft Method: Formula for Unit Draft Method is:

$$GE_{IND} = \text{Unit Draft} * \text{Wells}$$

Where,

Unit Draft = Unit Draft per well

Wells = Number of Wells used for industrial purpose

Consumptive Use Method: Formula for Consumptive Use Method is:

$$GE_{IND} = \text{Number of industrial units} * \text{Unit Water Consumption} * Lg$$

Where,

Lg = Fractional Load on Ground Water for Domestic Water Supply

2.5 Stage of Ground Water Extraction (%)

Introduction

To define a particular area in terms of Ground Water, we use stage of extraction. It defines the amount of water extracted from total extractable ground water resources and is expressed in percentage.

Data computation methodology

The stage of ground water extraction is calculated as follows:

Stage of Extraction (%) = (GE)/(AEGR)*100

Where,

GE = Existing Gross Ground Water Extraction from all uses

AEGR = Annual Extractable ground Water Resources

2.6 Categorization of the Assessment Unit

Introduction

Based on Stage of Extraction we categorize the area into 4 categories SAFE, SEMI-CRITICAL, CRITICAL and OVER EXPLOITED. The purpose of this categorization is to find out over exploited and non-exploited areas for planning actions regarding ground water resources.

Data computation methodology

Based on Stage of Ground Water Extraction, assessment units into 4 categories:

- SAFE
- SEMI-CRITICAL
- CRITICAL
- OVER-EXPLOITED

The criteria for categorization of Assessment units will be:

Stage of Extraction (%)	Categorization
0 to <= 70	SAFE
>70 to <=90	SEMI-CRITICAL
>90 to <= 100	CRITICAL
>100	OVER-EXPLOITED

2.7 Allocation of Ground Water Resource for Utilization

Introduction

The Annual Extractable Ground Water Resources are to be apportioned between domestic, industrial and irrigation uses. This requirement has to be based on population as projected for the year 2025, per capita requirement of water for domestic use, and relative load on ground water for urban and rural water supply.

Data computation methodology

The Annual Extractable Ground Water Resources follow the following empirical relation:

$$Alloc = 22 \times N \times Lg \text{ (mm/year)}$$

Where,

Alloc = Allocation for domestic water requirement

N = population density in the unit in thousands per sq. km.

Lg = fractional load on ground water for domestic water supply (<1.0)

It is assumed that the requirement of water for domestic use is 60 lpcd per head.

2.8 Net Annual Ground Water Availability

Introduction

The water available for future use is obtained by deducting the allocation for domestic use and current extraction for Irrigation and Industrial uses from the Annual Extractable Ground Water Recharge. The resulting ground water potential is termed as the Net Annual Ground Water Availability for future use.

Data computation methodology

Net Annual Ground Water Availability is computed as:

Net Annual Ground Water Availability = Total Annual Ground Water Recharge – Unaccounted Natural Discharges

2.9 In-Storage Unconfined Ground Water Resources

Introduction

Static Ground Water Resources of an area are the resources which remain available below the dynamic zone of water table fluctuation. This is not replenished every year and extracting this water is called ground water mining.

Data Elements Used

Component	Parameter	Unit
In Storage Resources of Unconfined Aquifer	Area	Hectares
	Bottom of Dynamic Zone	Meters
	Bottom of unconfined Aquifer	Meters

Data computation methodology

In-Storage Ground Water Resources can be expressed as follows:

$$SGWR = A * (Z2 - Z1) * SY$$

Where,

SGWR = Static or In-Storage Ground Water Resources

A = Area of the Assessment Unit

Z2 = Bottom of Unconfined Aquifer

Z1 = Pre-monsoon water level

SY = Specific Yield in the Zone of static ground water resources

2.10 In-Storage Confined Aquifer Water Resources

Introduction

Confined aquifers consist of an impermeable dirt/rock layer which prevents water from seeping into the aquifer from the ground surface located above. Instead, water seeps into confined aquifers from place where the impermeable layer does not exist. Assessment of ground water resources for confined aquifers assumes crucial importance since over-exploitation of these aquifers may lead to far more detrimental consequences than to those of shallow unconfined aquifers.

Data Elements Used

Component	Parameter	Unit
In Storage Resources of Confined Aquifer	Area	Hectares
	Pre monsoon Piezometric head	Meters
	Post monsoon Piezometric head	Meters
	Bottom of Top Confining Layer	Meters

Data computation methodology

Confined Aquifer Water Resources can be expressed as follows:

$$Q_{Confined} = A * S * \Delta h = A * S * (hPRE - h0)$$

Where,

$Q_{Confined}$ = In storage Ground Water Resource of Confined Aquifer

A = Areal extent of the confined aquifer

S = Storativity

Δh = Change in Piezometric head

h0 = Bottom level of the top confining layer

hPRE = Piezometric head during pre-monsoon period

If the confined aquifer is not being exploited for any purpose, the dynamic and static resources of the confined aquifer need not be estimated separately. Instead, the in storage of the aquifer can be computed using the following formula.

$$Q_{Confined} = A * S * \Delta h = A * S * (hPOST - h0)$$

Where,

$Q_{Confined}$ = In storage Ground Water Resource of Confined Aquifer

A = Areal extent of the confined aquifer

S = Storativity

Δh = Change in Piezometric head

hPOST = Piezometric head during post-monsoon period

h0 = Bottom of the Top Confining Layer

2.11 Dynamic Confined Aquifer Water Resources

Data Elements Used

Component	Parameter	Unit
Dynamic Resources of Confined Aquifer	Area	Hectares
	Pre monsoon Piezometric head	Meters
	Post monsoon Piezometric head	Meters

Data computation methodology

Confined Aquifer Water Resources can be expressed as follows:

$$Q_{Confined} = A * S * \Delta h = A * S * (hPOST - hPRE)$$

Where,

$Q_{Confined}$ = Dynamic Ground Water Resource of Confined Aquifer

A = Areal extent of the confined aquifer

S = Storativity

Δh = Change in Piezometric head

hPOST =Piezometric head during post-monsoon period

hPRE = Piezometric head during pre-monsoon period

2.12 In-Storage Semi-Confined Aquifer Water Resources

Introduction

An aquifer which is partially confined by soil layers of low permeability through which recharge and discharge can still occur. Unless and until, it is well studied that the recharge to this is not computed either in the over lying unconfined aquifer or underlying/overlying semi confined aquifers, it should not be assessed separately.

Data Elements Used

Component	Parameter	Unit
In Storage Resources of Semi-Confined Aquifer	Area	Hectares
	Pre monsoon Piezometric head	Meters
	Post monsoon Piezometric head	Meters
	Bottom of Top Confining Layer	Meters

Data computation methodology

Semi-Confined Aquifer Water Resources can be expressed using the same formula as in Confined Aquifer Water Resources:

$$Q_{Semi - Confined} = A * S * \Delta h = A * S * (ht – h0)$$

Where,

$Q_{Semi - Confined}$ = In storage Ground Water Resource of Semi - Confined Aquifer

A = Areal extent of the semi-confined aquifer

S = Storativity

Δh = Change in Piezometric head

h0 = Bottom level of the top confining layer

hPRE = Piezometric head at any particular time

2.13 Dynamic Semi-Confined Aquifer Water Resources

Data Elements Used

Component	Parameter	Unit
Dynamic Resources of Semi-Confined Aquifer	Area	Hectares
	Pre monsoon Piezometric head	Meters
	Post monsoon Piezometric head	Meters

Data computation methodology

Semi-Confined Aquifer Water Resources can be expressed as follows:

$$Q_{Semi - Confined} = A * S * \Delta h = A * S * (hPOST – hPRE)$$

Where,

$Q_{Semi - Confined}$ = Dynamic Ground Water Resource of Semi – Confined Aquifer

A = Areal extent of the semi-confined aquifer

S = Storativity

Δh = Change in Piezometric head

hPOST = Piezometric head during post-monsoon period

hPRE = Piezometric head during pre-monsoon period

2.14 Quality Tagging

Quality assessment of ground water is equally important as the quantity assessment. The major sources of quality concern are salinity, fluoride, and arsenic. It can vary depending on the area also. If the particular parameter is influencing an area in mappable units then the parameter should be tagged to the assessment subunit. Apart from salinity, fluoride and arsenic, if there is any other parameter, that is also captured in this.

2.15 Additional Potential Resource

2.15.1 Spring Discharge

Introduction

Spring discharge constitutes an additional source of ground water in hilly areas which emerges at the places where ground water level cuts the surface topography.

Data computation methodology

Potential ground water resource due to springs can be expressed as follows:

Potential Resources (Springs) = Q * No of days

Where,

Q = Spring Discharge

No of days = Number of days spring yields

2.15.2 Waterlogged areas and shallow water table

Introduction

In the area where the ground water level is less than 5 m below ground level or in waterlogged areas, the resources up to 5 m below ground level are potential and are used in addition to the annual recharge in the area.

Data Elements Used

Component	Parameter	Unit
Waterlogged and shallow water table	Depth to water table below ground surface	Meters
	Area of shallow water table zone	Hectares
	Specific Yield	Fraction

Data computation methodology

Potential ground water resource in shallow water table areas can be expressed as follows:

Potential Resources (Waterlogged/Shallow Water Table) = (5-D) * A * SY

Where,

D = Depth to water table below ground surface in pre-monsoon period in shallow aquifers

A = Area of shallow water table zone

SY = Specific Yield

2.15.3 Flood Prone

Introduction

Ground water recharge from a flood plain is calculated considering areal extent of flood plain, Retention period of flood and Type of sub-soil strata and silt charge in the river water which gets deposited and controls seepage.

Data Elements Used

Component	Parameter	Unit
Flood Prone	Number of Days	Number
	Flood Prone Area	Hectare

Data computation methodology

Potential ground water resource in flood prone areas can be expressed as follows:

$$\text{Potential Resources (Flood Prone)} = 1.4 * N * A/1000$$

Where,

N = No of Days Water is Retained in the Area

A = Flood Prone Area

2.16 Coastal Areas

Data computation methodology

Coastal Area resources can be expressed as follows:

$$\Delta S = A * (\text{PostWT} - \text{PreWT}) * SY$$

Where,

ΔS = Change in Ground water Storage

A = Area of Coastal Zones

PreWT = Water table during Pre-monsoon = RL of GL – water level during pre-monsoon season in mbgl

PostWT = Water table during Post-monsoon = RL of GL – water level during post-monsoon season in mbgl

SY = Specific Yield

In-storage Coastal Area resources can be expressed as follows:

$$\text{In-Storage Resources} = A * (\text{PreWT} - \text{Bottom of Aquifer}) * SY$$

Where,

A = Area of Coastal Zones

PreWT = Water table during Pre-monsoon = RL of GL – water level during pre-monsoon season in mbgl

Bottom of the Aquifer is to be limited to 40*(pre monsoon water table

above mean sea level)

SY = Specific Yield

2.17 Water Depletion Zones

Data computation methodology

Water Depletion zone resources can be expressed as follows:

$$\Delta S = A * (Pre - Post) * SY$$

Where,

ΔS = Change in Ground water Storage

A = Area of Water Depletion Zones

Pre = Pre - monsoon Ground water level

Post = Post - monsoon Ground water level

SY = Specific Yield

2.18 Validation using GW

2.18.1 Introduction

Ground Water assessment is based on the Stage of Extraction which has inherent uncertainties. The estimation of ground water extraction is based on indirect assessment using factors such as electricity consumption, well census and area irrigated from ground water. Thus, it is very important to validate the 'Stage of Ground Water Extraction' with long term trend of ground water levels. Long term water level trends are needed for a minimum period of 10 years for both pre-monsoon and post-monsoon period. This data will help in getting the Trend of Ground Water over the years. Following table is used for validation:

Stage of Extraction	Ground Water Level Trend Observed	Remarks
<= 70%	Significant decline in trend in both pre-monsoon and post-monsoon	Not acceptable and needs reassessment
>100%	No significant decline in both pre-monsoon and post-monsoon long term trend	Not acceptable and needs reassessment

This validation is shown on Dashboard with a small green tick besides the Categorization of an assessment unit. Red tick indicates that the particular assessment unit needs reassessment.

2.18.2 Mockups

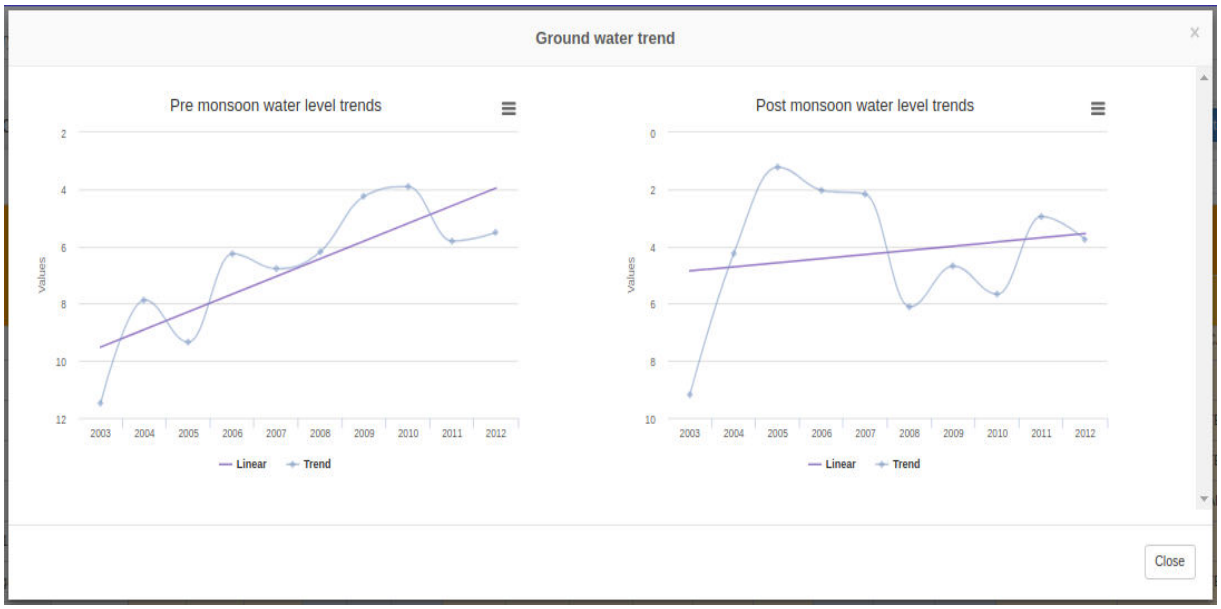


Figure 2: Validation using Ground Water Trend result

3.0 Input Sheets and Shape File formats

3.1 Excel Download and Upload Templates

In order to compute data for GEC, 11 excel templates are provided for the user to fill and submit the data in the system for an Assessment Unit

3.1.1 Basic Data File

Basic Data Sheet comprises of 2 sub sheets:

a) Basic Data which captures the information related to Recharge Worthy Area, Non-Recharge Worthy Area, Type of Soil, Specific Yield, Rainfall Infiltration Factor.

"Basic Data" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers should not be changed. They are taken from the shapefile.
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	*Total Geographical Area (ha)	*Hilly Area (ha)	*Total Recharge Worthy Area (ha)				Static/In-Storage Unconfined Ground Water Resources		If Assessment Unit is Urban					
						*Command	*Non Command	*Poor Quality	Total	Bottom of the Unconfined aquifer (m)	Specific Yield in Static/In-Storage zone	Command		Non Command		Poor Quality	
												Paved	UnPaved	Paved	UnPaved	Paved	UnPaved

Figure 3: Basic Data Template

b) Aquifer Data which captures aquifer information of the assessment unit i.e. Principal Aquifer, Major Aquifer and its code.

"Aquifer Data" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers should not be changed. They are taken from the shapefile.
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Principal Aquifer	Major Aquifer	*Major Aquifer Code	Command			Non Command			Poor Quality		
							*Percentage of geographical area	* Recommended Specific Yield for assessment (%)	* Recommended Infiltration Factor for assessment (%)	*Percentage of geographical area	* Recommended Specific Yield for assessment (%)	Recommended Infiltration Factor for assessment (%)	*Percentage of geographical area	* Recommended Specific Yield for assessment (%)	* Recommended Infiltration Factor for assessment (%)

Figure 4: Aquifer Data Template

3.1.2 Rainfall Data File

In this sheet user can input either assessment unit wise data, Rain gauge data, IMD Grid data or Time series data. Based on user selection the respective sheet will be downloaded.

a) Rainfall – Assessment Unit Data

"Rainfall Data at Assessment unit level" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	*Year	Monsoon		Non-Monsoon	
						*Actual (mm)	*Normal (mm)	*Actual (mm)	*Normal (mm)

Figure 5: Rainfall – Assessment Unit Data Template

b) Rainfall – Rain Gauge Data

"Rainfall Data at Rain Gauge level" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) Only the raingauge station data of the state are considered to compute rainfall values.Neighbouring state's rainguage data is not considered in the interpolation method.
(4) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Name of Raingauge	*Latitude	*Longitude	*Year	Monsoon		Non-Monsoon	
					*Actual (mm)	*Normal (mm)	*Actual (mm)	*Normal (mm)

Figure 6: Rainfall – Rain Gauge Data Template

c) Rainfall – IMD Grid Data

"Rainfall Data at IMD Grid level" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) Only the IMD Grid in the state are considered to compute rainfall values. Neighbouring state's grid data is not considered in the interpolation method.
(4) All columns will be pre-populated from the values entered in the previous assessment year

S.No	GRID ID	*Latitude	*Longitude	*Year	Monsoon		Non-Monsoon	
					*Actual (mm)	*Normal (mm)	*Actual (mm)	*Normal (mm)

Figure 7: Rainfall – IMD Grid Data Template

d) Rainfall – Time Series Data

"Rainfall Data at Time Series level" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year
(4) This data can be given via an API

S.No	Station Name	Station ID	*Latitude	*Longitude	Date	Time	Value (mm)

Figure 8: Rainfall – Time Series Data Template

e) Rainfall – Threshold Data

"Rainfall Data Threshold Value" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Threshold Value (mm)	
					Minimum	Maximum

Figure 9: Rainfall – Threshold Data Template

3.1.3 Ground Water Well Data File

In this sheet user can input data either assessment unit wise data, Well wise data or Time series data. Based on user selection the respective sheet will be downloaded.

a) Ground Water Well – Assessment Unit Data

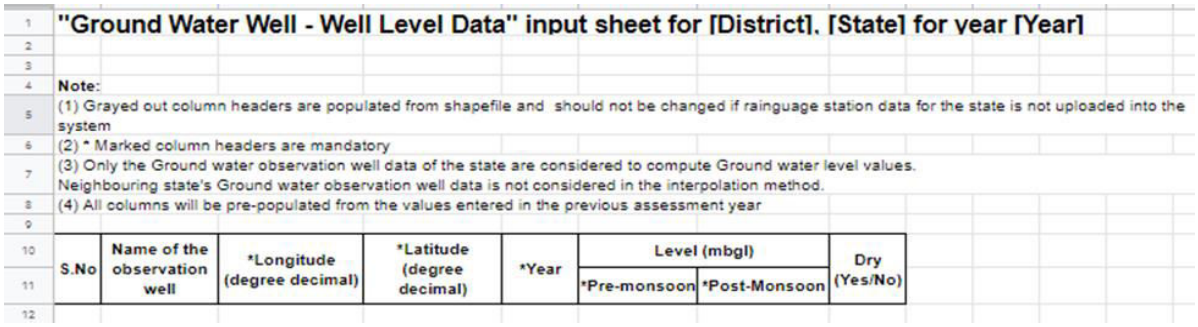
"Ground Water Well - Assessment Unit Level" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed if rainguage station data for the state is not uploaded into the system
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	* Year	Level (m)	
						*Pre-monsoon	*Post-Monsoon

Figure 10: Ground Water Well – Assessment Unit Data Template

b) Ground Water Well – Well Data



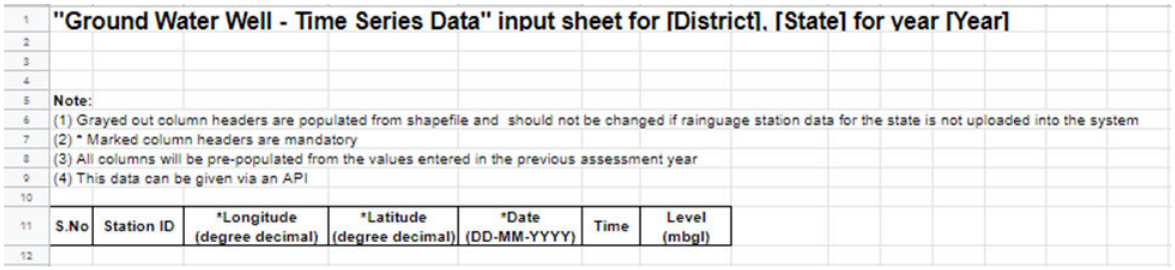
"Ground Water Well - Well Level Data" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed if rainguage station data for the state is not uploaded into the system
(2) * Marked column headers are mandatory
(3) Only the Ground water observation well data of the state are considered to compute Ground water level values. Neighbouring state's Ground water observation well data is not considered in the interpolation method.
(4) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Name of the observation well	*Longitude (degree decimal)	*Latitude (degree decimal)	*Year	Level (mbgl)		Dry (Yes/No)
					*Pre-monsoon	*Post-Monsoon	

Figure 11: Ground Water Well – Well Data Template

c) Ground Water Well – Time Series Data



"Ground Water Well - Time Series Data" input sheet for [District], [State] for year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed if rainguage station data for the state is not uploaded into the system
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year
(4) This data can be given via an API

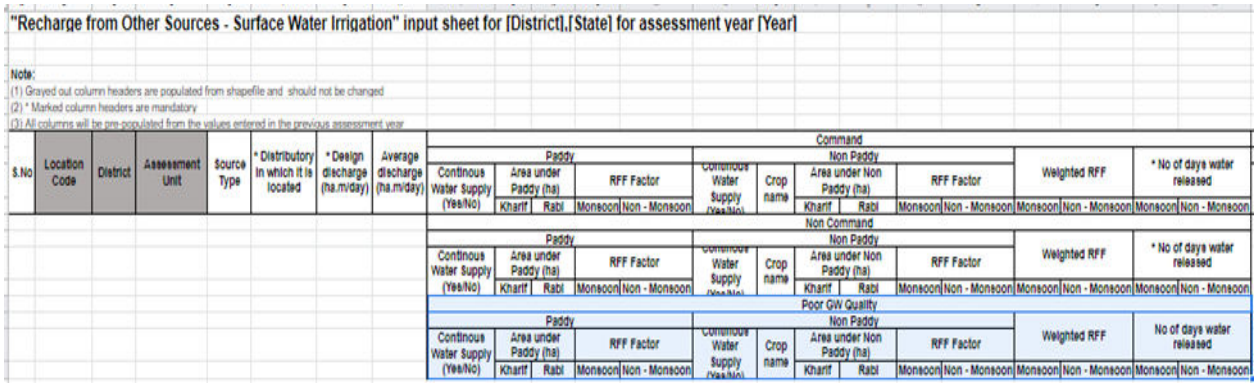
S.No	Station ID	*Longitude (degree decimal)	*Latitude (degree decimal)	*Date (DD-MM-YYYY)	Time	Level (mbgl)

Figure 12: Ground Water Well – Time Series Data Template

3.1.4 Recharge Data File

Recharge Data file captures the data related to various recharge components. This file consists of 7 sub sheets (a to g):

a) Surface Water Irrigation – Canal Outlet



"Recharge from Other Sources - Surface Water Irrigation" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Source Type	* Distributory in which it is located	* Design discharge (ha.m/day)	Average discharge (ha.m/day)	Command / Non Command / Poor GW Quality	Paddy: Continous Water Supply (Yes/No)	Paddy: Area under Paddy (ha) Kharif	Paddy: Area under Paddy (ha) Rabi	Paddy: RFF Factor Monsoon	Paddy: RFF Factor Non - Monsoon	Non Paddy: Continous Water Supply (Yes/No)	Non Paddy: Crop name	Non Paddy: Area under Non Paddy (ha) Kharif	Non Paddy: Area under Non Paddy (ha) Rabi	Non Paddy: RFF Factor Monsoon	Non Paddy: RFF Factor Non - Monsoon	Weighted RFF Monsoon	Weighted RFF Non - Monsoon	* No of days water released Monsoon	* No of days water released Non - Monsoon
								Command															
								Non Command															
								Poor GW Quality															

Figure 13: Recharge – Surface Water Irrigation – Canal Outlet Template

b) Surface Water Irrigation – Crop Water Requirement

"Recharge from Other Sources - Surface Water Irrigation" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Command Area													
				Paddy						Non-Paddy							
				Continous Water Supply (Yes/No)	* Estimated Crop Water Requirement (mm)		* Area under crop (ha)		RFF Factor		Continous Water Supply (Yes/No	* Crop Name	* Estimated Crop Water Requirement		* Area under crop (ha)		RFF Factor	
					Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon
				Non-Command Area														
				Paddy						Non-Paddy							
				Continous Water Supply (Yes/No)	* Estimated Crop Water Requirement (mm)		* Area under crop (ha)		RFF Factor		Continous Water Supply (Yes/No	* Crop Name	* Estimated Crop Water Requirement (mm)		* Area under crop (ha)		RFF Factor	
					Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon
				Poor GW Quality Area														
				Paddy						Non-Paddy							
				Continous Water Supply (Yes/No)	* Estimated Crop Water		* Area under crop		RFF Factor		us Water Supply (Yes/No	* Crop Name	* Estimated Crop		* Area under crop		RFF Factor	
					Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Kharif	Rabi	Monsoon	Non - Monsoon

Figure 14: Recharge – Surface Water Irrigation – Crop Water Requirement Template

c) Canal Seepages

"Recharge from Other Sources - Canal Seepage" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year
(4) It is mandatory to fill either (J or K , L & M) or N
(5) It is mandatory to enter I or O

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Poor Quality)	* Name of the canal Segement	Canal Type (Main/Minor)	Type (Lined/Unlined)	Length of Canal (m)	Design depth of flow (m)	Average Supply Depth (m)	Bed width (m)	Side Slope (degrees)	Wetted Perimeter (m)	Wetted Area (million sq m)	Canal seepage factor (ha.m/d/million sq.m)		* No.of canal running days	
															Monsoon	Non-Monsoon	Monsoon	Non-Monsoon

Figure 15: Recharge – Canal Seepage Template

d) Tanks & Ponds

"Recharge from Other Sources - Tanks & Ponds" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year
(4) Either Design Water Spead Area or Average Water Spread Area or Both Should be given

S.No	Location Code	District	Assessment Unit	*Name of Tank/Pond	Command area						
					Number of Tanks/Ponds	Recharge Factor (mm/day)	Design water spread area of single tank (ha)	Average Water Spread area of single tank (ha)		* No. of days water is available	
								Monsoon	Non monsoon	Monsoon	Non monsoon
					Non Command area						
					Number of Tanks/Ponds	Recharge Factor (mm/day)	Design water spread area of single tank (ha)	* Average Water Spread area of single tank (ha)		* No. of days water is available	
								Monsoon	Non monsoon	Monsoon	Non monsoon
					Poor GW Quality area						
					Number of Tanks/Ponds	Recharge Factor (mm/day)	Design water spread area of single tank (ha)	* Average Water Spread area of single tank (ha)		* No. of days water is available	
								Monsoon	Non monsoon	Monsoon	Non monsoon

Figure 16: Recharge – Tanks and Ponds Template

e) Water Conservation Structures

"Recharge from Other Sources - Water Conservation Structures" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	* Name of the Structure	Recharge Factor of Structure		Structure information								
							Command			Non Command			Poor Quality		
					Monsoon	Non-Monsoon	* Number of Structures	* Storage Capacity (ha.m)	* No. of Fillings	* Number of Structures	* Storage Capacity (ha.m)	* No. of Fillings	* Number of Structures	* Storage Capacity (ha.m)	* No. of Fillings

Figure 17: Recharge – Water Conservation Structure Template

f) Ground Water Irrigation

"Recharge from Other Sources - Ground Irrigation " input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Command													
				Paddy				Non Paddy						Weighted RFF		* No of days water released	
				Continous Water Supply (Yes/No)	Area under Paddy (ha)		RFF Factor		Continous Water Supply (Yes/No)	Crop name	Area under Non Paddy (ha)		RFF Factor				
					Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Monsoon	Non - Monsoon	Monsoon	Non - Monsoon	Monsoon	Non - Monsoon
				Non Command													
				Paddy				Non Paddy						Weighted RFF		* No of days water released	
				Continous Water Supply (Yes/No)	Area under Paddy (ha)		RFF Factor		Continous Water Supply (Yes/No)	Crop name	Area under Non Paddy (ha)		RFF Factor				
					Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Monsoon	Non - Monsoon	Monsoon	Non - Monsoon	Monsoon	Non - Monsoon
				Poor GW Quality													
				Paddy				Non Paddy						Weighted RFF		No of days water released	
				Continous Water Supply (Yes/No)	Area under Paddy (ha)		RFF Factor		Continous Water Supply (Yes/No)	Crop name	Area under Non Paddy (ha)		RFF Factor				
					Kharif	Rabi	Monsoon	Non - Monsoon			Kharif	Rabi	Monsoon	Non - Monsoon	Monsoon	Non - Monsoon	Monsoon	Non - Monsoon

Figure 18: Recharge – Ground Water Irrigation Template

3.1.5 Draft Data File

Draft file collects ground water extraction data for various uses. This file consists of 6 sub sheets (a to f):

a) Domestic Unit Draft

"Domestic (Unit Draft)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year
(4) Actual number of wells in use (column H) is considered to be 80% of number of wells (column G)

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	* Type of Structure	* No. of wells in assessment year	Actual No. of wells in use	* Estimated draft per well (ha.m)	
								Monsoon	Non-Monsoon

Figure 19: Draft – Domestic Unit Draft Template

b) Domestic Consumptive Use Method

"Domestic (Consumptive Use)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Command									
				Population Details					* Per capita Requirement (lpcd - litres per capita per day)		* Fractional load on ground water Lg		No. of Days	
				* Reference Year	* Population as on Reference Year		* Growth Rate (%)						Monsoon	Non Monsoon
					Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban		
				Non Command										
				Population Details					* Per capita Requirement (lpcd - litres per capita per day)		* Fractional load on ground water Lg		No. of Days	
				* Reference Year	* Population as on Reference Year		* Growth Rate (%)						Monsoon	Non Monsoon
					Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban		
				Poor GW Quality										
				Population Details					* Per capita Requirement (lpcd - litres per capita per day)		* Fractional load on ground water Lg		No. of Days	
				* Reference Year	* Population as on Reference Year		* Growth Rate (%)						Monsoon	Non Monsoon
					Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban		

Figure 20: Draft – Domestic Consumptive Use Template

c) Irrigation Unit Draft

"Irrigation (Unit Draft)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	* Type of Structure	* No. of wells in assessment year	Actual No. of wells in use	* Estimated draft per well (ha.m)	
								Monsoon	Non-Monsoon

Figure 21: Draft – Irrigation Unit Draft Template

d) Irrigation Power Consumption

"Irrigation (Power Consumption)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Command Area			
				Monsoon		Non Monsoon	
				* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)	* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)
				Non-Command Area			
				Monsoon		Non Monsoon	
				* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)	* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)
				Poor GW Quality Area			
				Monsoon		Non Monsoon	
				* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)	* Estimated power requirement For 1 ham of water lift (kilo watt hours kWh)	* Total power consumed (kilo watt hours kWh)

Figure 22: Draft – Irrigation Power Consumption Template

e) Industrial Unit Draft

"Industrial (Unit Draft)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	* Type of Industries	* Type of Structure	* No. of wells in assessment year	Actual No. of wells in use	* Estimated draft per well (ha.m)	
									Monsoon	Non-Monsoon

Figure 23: Draft – Industrial Unit Draft Template

f) Industrial Consumptive Use Pattern

"Industrial (Consumptive Use Pattern)" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Command Area					
				* Type of Industry	* No of Such Industries	* Estimated Consumptive Requirement (ha.m/day)	* Fractional load on ground water Lg	No. of days water is being extracted	
								Monsoon	Non Monsoon
				Non Command Area					
				* Type of Industry	* No of Such Industries	* Estimated Consumptive Requirement (ha.m/day)	* Fractional load on ground water Lg	No. of days water is being extracted	
								Monsoon	Non Monsoon
				Poor Quality Area					
				* Type of Industry	* No of Such Industries	* Estimated Consumptive Requirement (ha.m/day)	* Fractional load on ground water Lg	No. of days water is being extracted	
								Monsoon	Non Monsoon

Figure 24: Draft – Industrial Consumptive Use Template

3.1.6 Inflows and Outflows Data File

This file includes data related to Vertical inter Aquifer Flow, Lateral Flow along the aquifer system, Transpiration, Evaporation and Baseflow:

a) Base Flow

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	River Gauge name	Day	Average Stream Discharge (cumecs)	Direct Runoff Spells					
								Spell No.	Start day	End Day	Day Number in the Spell	Discharge at Start Day (cumecs)	Discharge at End Day (cumecs)

Figure 25: Environmental Flows – Base Flow Template

b) Additional Base Flow

"Fluxes : Additional Base Flow" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	No. of stream gauges	Name of up stream river gauge	Catchment area of upstream river gauge	Name of down stream river gauge	Catchment area of downstream river gauge

Figure 26: Environmental Flows – Base Flow Template

c) Vertical inter Aquifer flow

"Fluxes : Vertical Inter Aquifer Flow" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Graved out column headers are ocoulated from shaoefile and should not be chanoed
(2) * Marked column headers are mandatorv
(3) All columns will be ore-ocoulated from the values entered in the orevious assessment vear

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Zone No	Hydraulic Conductivity of the Aquitard	Thickness of Aquitard (m)	Monsoon		Non Monsoon	
								Average Change in Head (m)	Area of the Zone (ha)	Average Change in Head (m)	Area of the Zone (ha)

Figure 27: Environmental Flows – Vertical Inter Aquifer Flow Template

d) Lateral Aquifer flow

"Fluxes : Lateral Aquifer Flow" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Graved out column headers are ocoulated from shaoefile and should not be chanoed
(2) * Marked column headers are mandatorv
(3) All columns will be ore-ocoulated from the values entered in the orevious assessment vear

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Section No.	Transmissivity	Monsoon					Non Monsoon				
							Length of the section (m)	Up Contour (m)	Down Contour (m)	Distance between two contours on ground in (m)	InFlow/ OutFlow	Length of the section (m)	Up Contour (m)	Down Contour (m)	Distance between two contours on ground in (m)	InFlow/ OutFlow

Figure 28: Environmental Flows – Lateral Aquifer Flow Template

e) Evapotranspiration

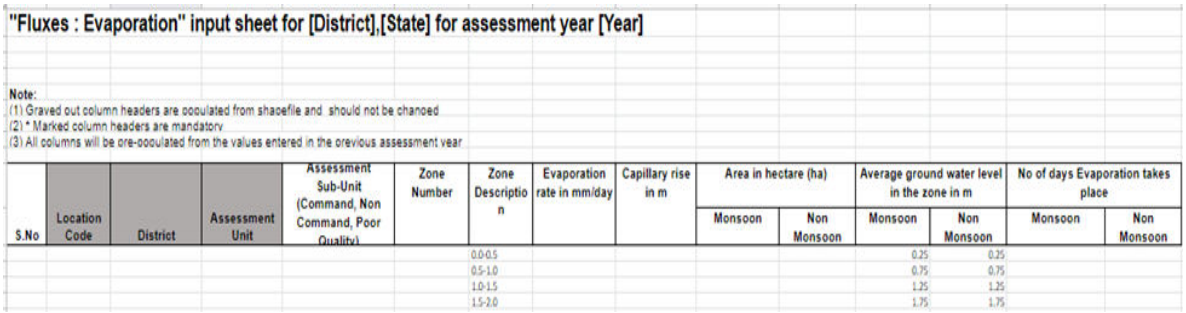
"Fluxes : Evapotranspiration" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Graved out column headers are ocoulated from shaoefile and should not be chanoed
(2) * Marked column headers are mandatorv
(3) All columns will be ore-ocoulated from the values entered in the orevious assessment vear

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Zone Number	Zone Description	Evapotranspiration rate in mm/day	Average Root Depth in m	Capillary rise in m	Area in hectare		Average ground water level in the zone in m		No of days Evapotranspiration takes place	
										Monsoo	Non	Monsoo	Non	Monsoo	Non
						0.0-0.5						0.25	0.25		
						0.5-1.0						0.75	0.75		
						1.0-1.5						1.25	1.25		
						1.5-2.0						1.75	1.75		
						2.0-2.5						2.25	2.25		
						2.5-3.0						2.75	2.75		
						3.0-3.5						3.25	3.25		
						3.5-4.0						3.75	3.75		
						4.0-4.5						4.25	4.25		
						4.5-5.0						4.75	4.75		

Figure 29: Environmental Flows – Evapotranspiration Template

f) Evaporation



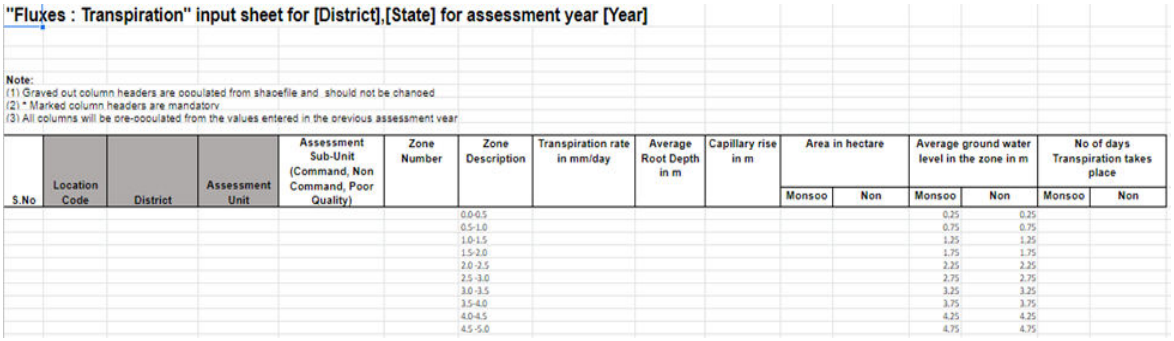
"Fluxes : Evaporation" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Zone Number	Zone Description	Evaporation rate in mm/day	Capillary rise in m	Area in hectare (ha)		Average ground water level in the zone in m		No of days Evaporation takes place	
									Monsoon	Non Monsoon	Monsoon	Non Monsoon	Monsoon	Non Monsoon
						0.0-0.5					0.25	0.25		
						0.5-1.0					0.75	0.75		
						1.0-1.5					1.25	1.25		
						1.5-2.0					1.75	1.75		

Figure 30: Environmental Flows – Evaporation Template

g) Transpiration



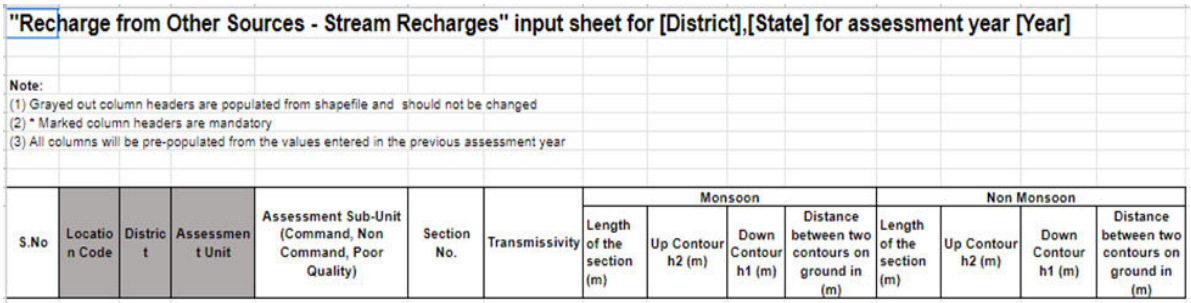
"Fluxes : Transpiration" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Zone Number	Zone Description	Transpiration rate in mm/day	Average Root Depth in m	Capillary rise in m	Area in hectare		Average ground water level in the zone in m		No of days Transpiration takes place	
										Monsoo	Non	Monsoo	Non	Monsoo	Non
						0.0-0.5						0.25	0.25		
						0.5-1.0						0.75	0.75		
						1.0-1.5						1.25	1.25		
						1.5-2.0						1.75	1.75		
						2.0-2.5						2.25	2.25		
						2.5-3.0						2.75	2.75		
						3.0-3.5						3.25	3.25		
						3.5-4.0						3.75	3.75		
						4.0-4.5						4.25	4.25		
						4.5-5.0						4.75	4.75		

Figure 31: Environmental Flows – Transpiration Template

g) Stream Channels



"Recharge from Other Sources - Stream Recharges" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Section No.	Transmissivity	Monsoon				Non Monsoon			
							Length of the section (m)	Up Contour h2 (m)	Down Contour h1 (m)	Distance between two contours on ground in (m)	Length of the section (m)	Up Contour h2 (m)	Down Contour h1 (m)	Distance between two contours on ground in (m)

Figure 32: Environmental Flows – Stream Channels Template

3.1.7 Additional Potential Resources Data File

a) Shallow Water Areas

"Shallow Water Table Zone" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Shallow Water Table Zone	
				* Pre-Monsoon DTWL (m bgl)	* Area (ha)
				0.0-0.5	
				0.5-1.0	
				1.0-1.5	
				1.5-2.0	
				2.0 -2.5	
				2.5 -3.0	
				3.0 -3.5	
				3.5-4.0	
				4.0-4.5	
				4.5 -5.0	

Figure 33: Additional Potential Resources – Shallow Water Area Template

b) Flood Prone Areas

"Flood Prone Area" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Flood Prone Area		
				* Flood Prone Area (ha)	* Flood Impound Days in a year	Seepage Factor (m)

Figure 34: Additional Potential Resources – Flood Prone Area Template

c) Spring Discharges

"Spring Discharge" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Name of Spring	Spring Discharge (lph)		Number of Days Spring	
					* Monsoon	* Non-Monsoon	* Monsoon	* Non-Monsoon

Figure 35: Additional Potential Resources – Spring Discharge Template

3.1.8 Resources of Confined and Semi-Confined Aquifer Data File

Resources of Confined and Semi-Confined Aquifer data file captures data related to Confined Aquifer and Semi-Confined Aquifer

Confined Aquifer

"Confined Aquifer Piezometer Data" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	* Name of the Confined Aquifer	* Area of Confined Aquifer (Sq. m)	* Storativity (Fraction)	* Bottom of top confining layer (m)	Being Extracted or Not (Yes/No)	* Average Piezometric head (m amsl)	
									Pre-Monsoon	Post-Monsoon

Figure 36: Resources of Confined and Semi-Confined Aquifer – Confined Aquifer Template

Semi-Confined Aquifer

"Semi-Confined Aquifer Piezometer Data" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	* Name of the Semi-Confined Aquifer	Recommended Specific Yield for assessment (%)	* Area of Semi-Confined Aquifer (Sq. m)	* Storativity (Fraction)	* Bottom of top confining layer (m)	Being Extracted or Not (Yes/No)	* Average Piezometric head (m amsl)	
										Pre-Monsoon	Post-Monsoon

Figure 37: Resources of Confined and Semi-Confined Aquifer – Semi-Confined Aquifer Template

3.1.9 Urban Area Resource – Pipelines and Sewages

"Pipelines and Sewages" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Per capita water requirement (lpcd)	Pipelines				Sepage through Sewages/Flash floods				
						Water Supply (ham/day)	(%) Loss	No. of days of flow		Wetted Perimeter (m)	Length (m)	No of days of flow		Seepage factor
								Monsoon	Non-monsoon			Monsoon	Non-monsoon	

Figure 38: Urban Area Resource – Pipelines & Sewage Template

3.1.10 Unconfined Dynamic Aquifer Other Details

"Unconfined Dynamic and Other Detail" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed if Monitoring station data for the state is not uploaded into the system
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Quality Tagging		Environmental Flows in ham/year	Population Details				* Per capita Requirement (lpcd - litres per capita per day)		* Fractional load on ground water Lg	
					Major parameter present in mappable areas (Salinity/Fluoride/Arsenic)	Other Parameters present in mappable areas		* Reference Year	* Population as on Reference Year		* Growth Rate (%)				
									Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban

Figure 39: Unconfined Dynamic Aquifer Other Details Template

3.1.11 Coastal Areas

"Coastal Areas" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment y

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor Quality)	Name of the Coastal Area	* Area of Coastal Area(ha)	* Specific Yield (Fraction)	* Bottom of the Aquifer (m above MSL)	* Reduced Level of Ground Level	Pre-Monsoon Water Level (mbgl)	Post-Monsoon Water Level (mbgl)

Figure 40: Coastal Areas Template

3.1.12 Water Depletion Zones

"Water Depleted Zones" input sheet for [District],[State] for assessment year [Year]

Note:
(1) Grayed out column headers are populated from shapefile and should not be changed
(2) * Marked column headers are mandatory
(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code	District	Assessment Unit	Assessment Sub-Unit (Command, Non Command, Poor	Name of the Water Depleted Zone	* Area of Water Depleted Zone(ha)	* Specific Yield (Fraction)	Pre-Monsoon Water Level (mbgl)	Post-Monsoon Water Level (mbgl)

Figure 41: Water Depletion Zones Template

3.2 Form Inputs

User can also submit the data using form inputs for a particular Assessment unit.

3.2.1 Basic Form Input

Basic Data Form Input comprises of 2 sub forms:

a) Basic Data which captures the information related to Recharge Worthy Area, Non-Recharge Worthy Area, Type of Soil, Specific Yield, Rainfall Infiltration Factor.

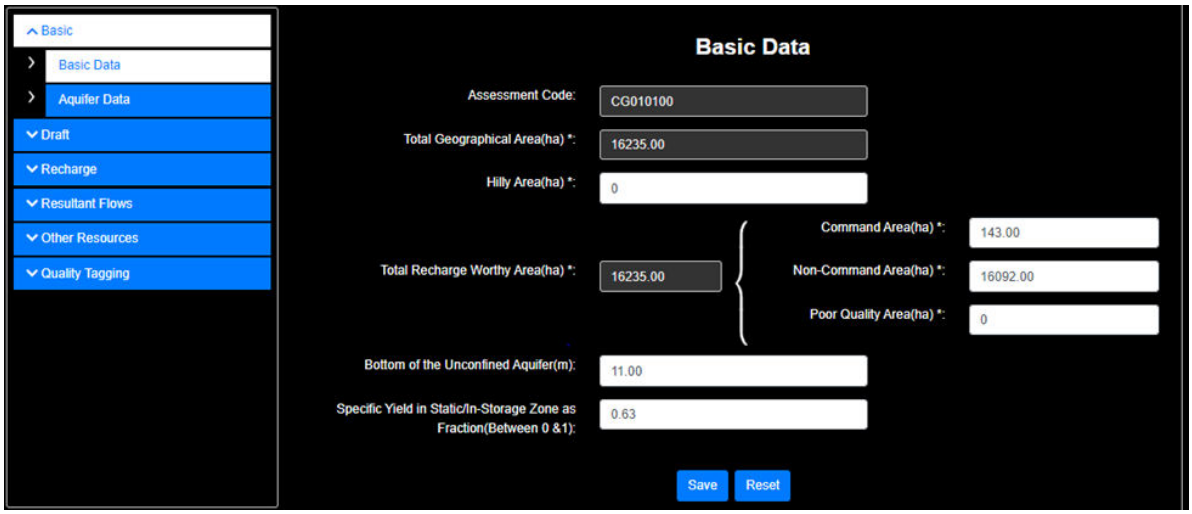


Figure 42: Basic Data Form Input

b) Aquifer Data which captures aquifer information of the assessment unit i.e. Principal Aquifer, Major Aquifer and its code.

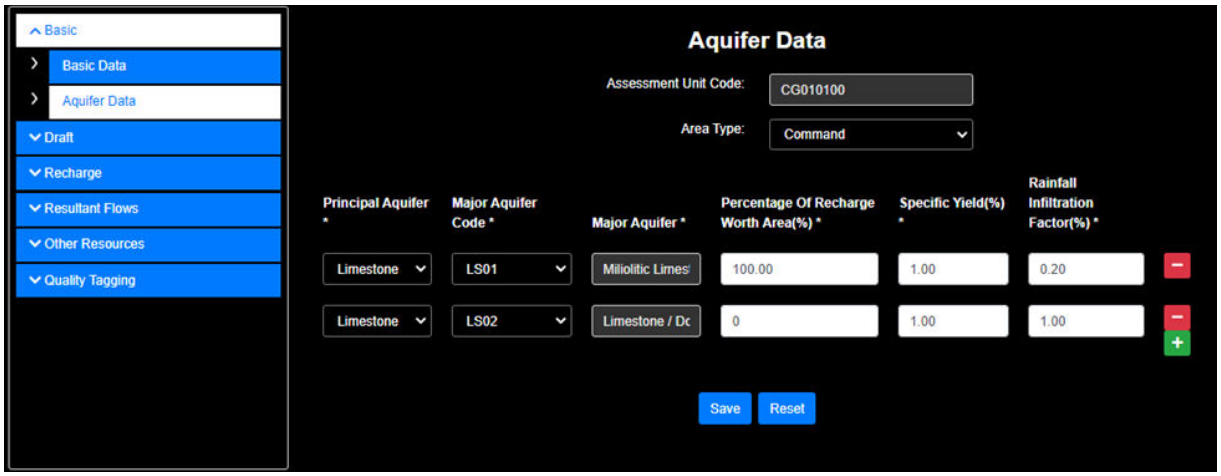


Figure 43: Aquifer Data Form Input

3.2.2 Recharge Form input

Recharge Form Input captures the data related to various recharge components. This file consists of 7 sub sheets (a to g):

a) Surface Water Irrigation – Canal Outlet

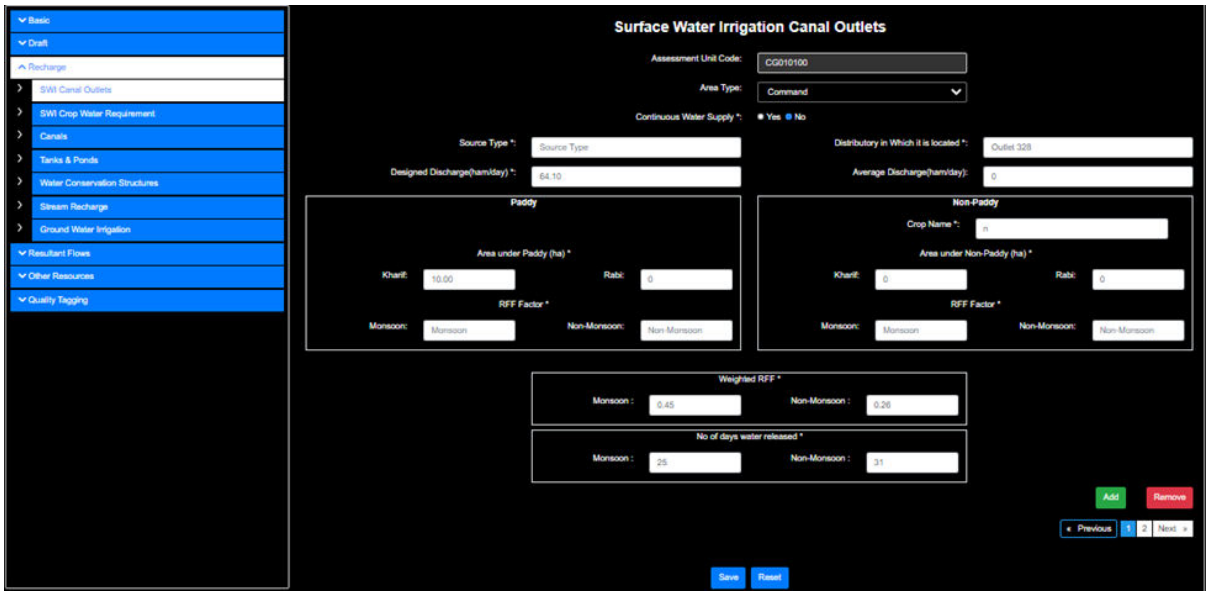


Figure 44: Recharge – Surface Water Irrigation – Canal Outlet Form Input

b) Surface Water Irrigation – Crop Water Requirement

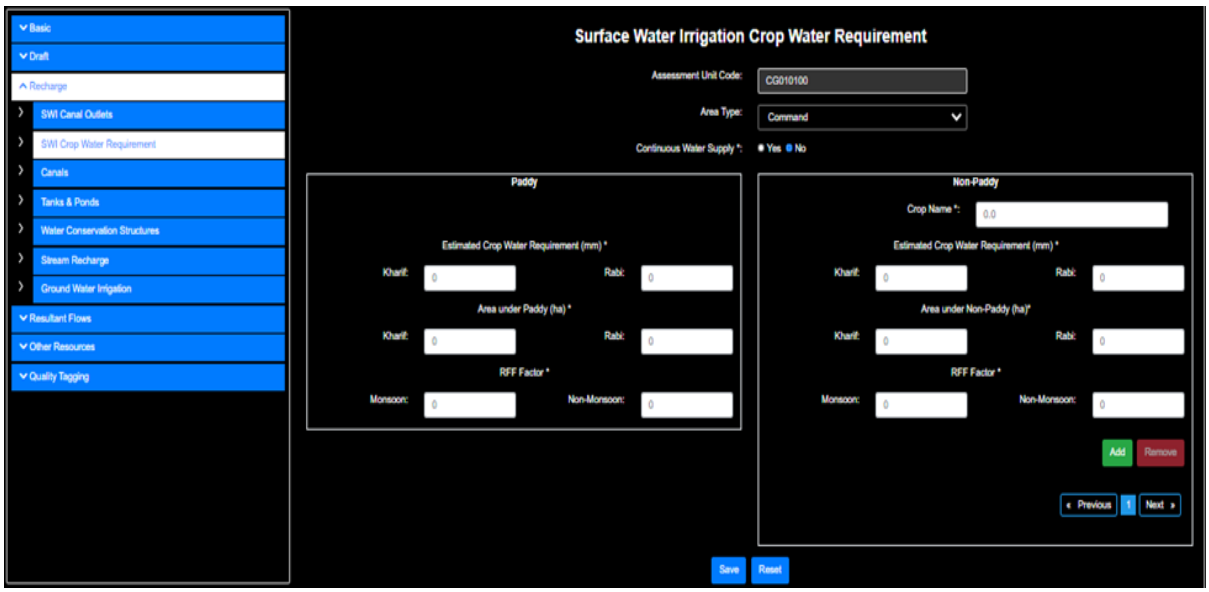


Figure 45: Recharge – Surface Water Irrigation – Crop Water Requirement Form Input

c) Canal Seepages

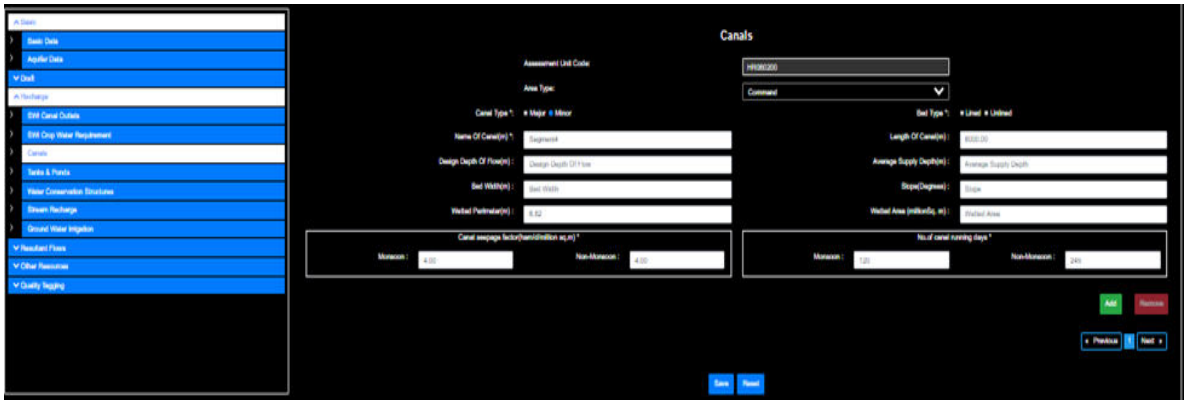


Figure 46: Recharge – Canal Seepage Form Input

d) Tanks & Ponds

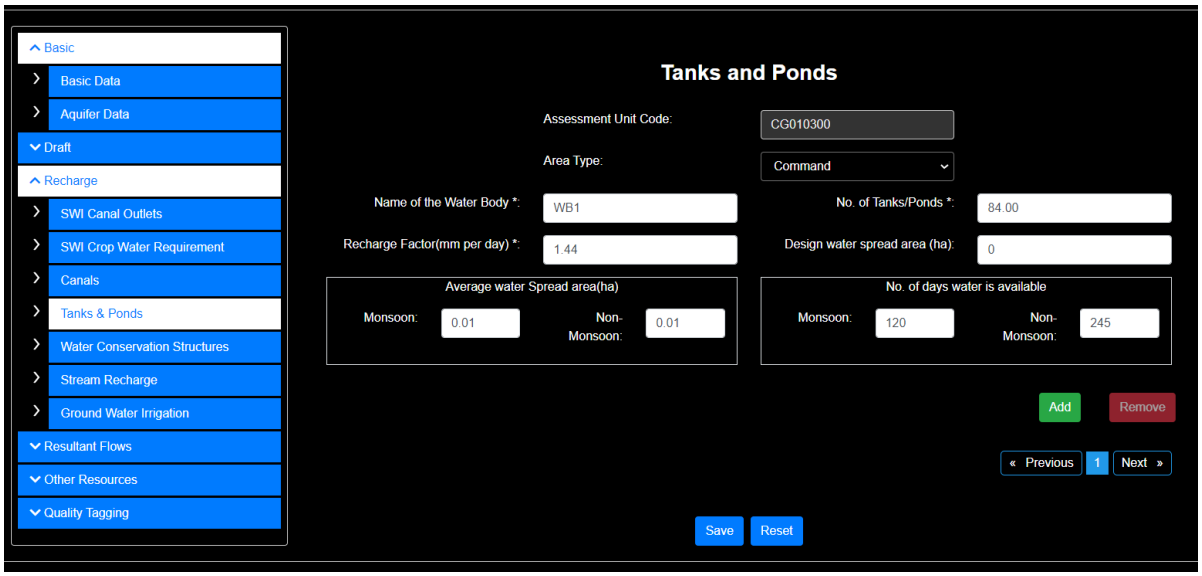


Figure 47: Recharge – Tanks and Ponds Form Input

e) Water Conservation Structures

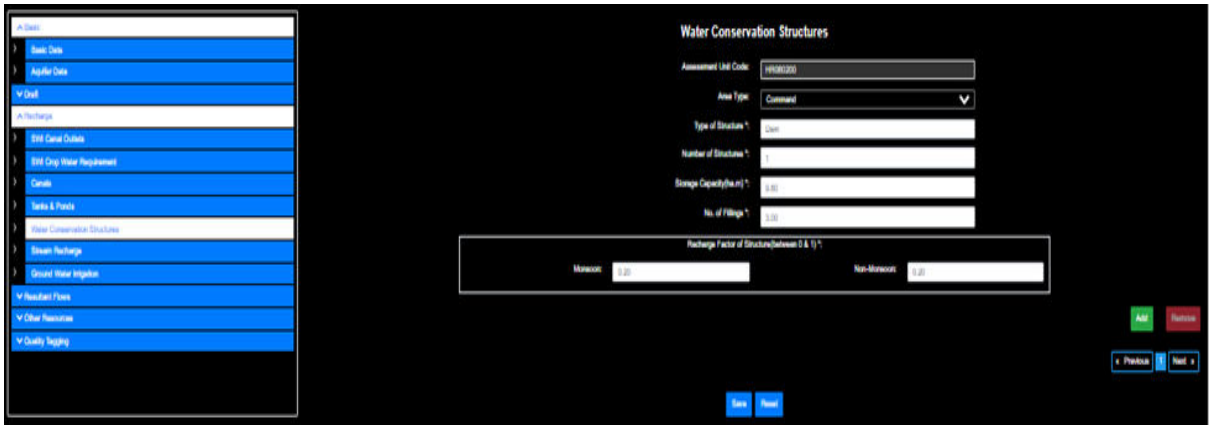


Figure 48: Recharge – Water Conservation Structure Form Input

f) Stream Channels

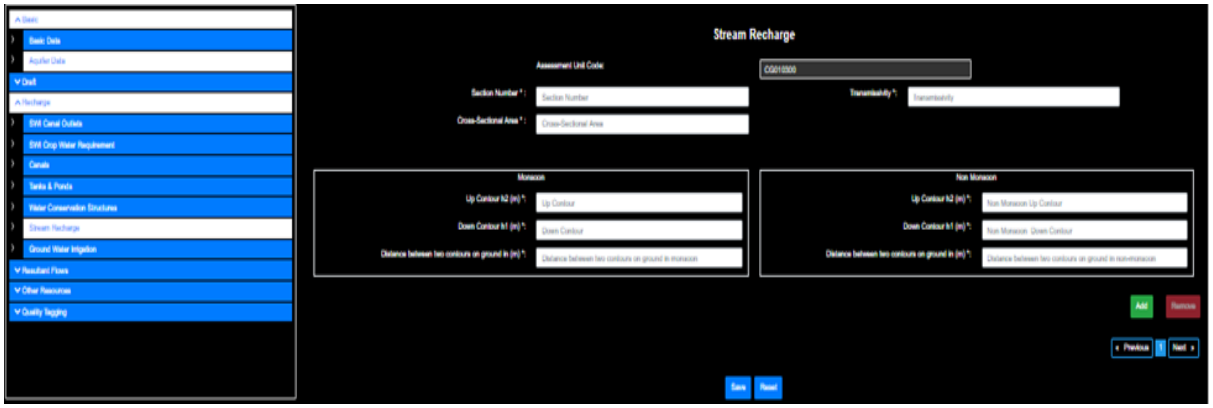


Figure 49: Recharge – Stream Channels Form Input

g) Ground Water Irrigation

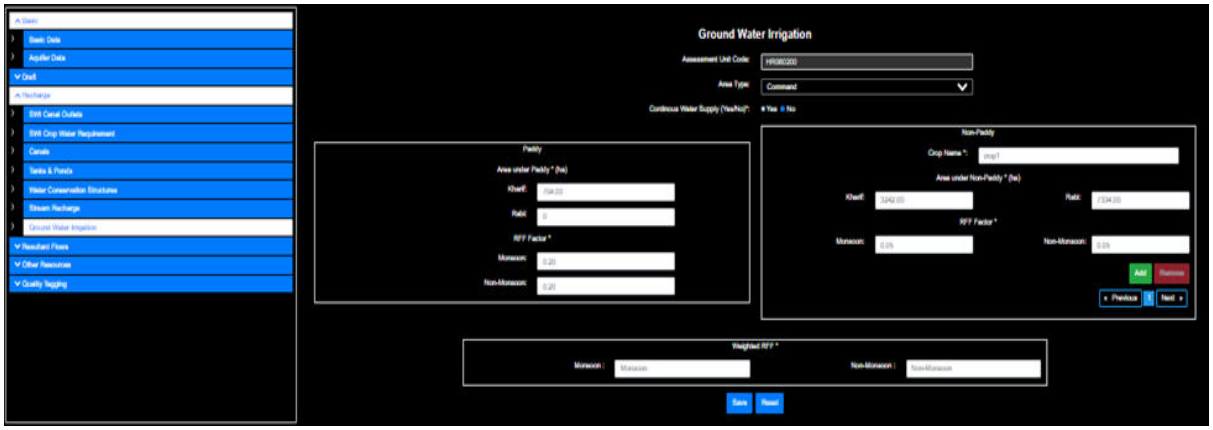


Figure 50: Recharge – Ground Water Irrigation Form Input

3.2.3 Draft Form Input

Draft Form Input collects ground water extraction data for various uses. This file consists of 4 sub forms (a to d):

a) Domestic / Industrial / Irrigation Unit Draft

This form input allows user to submit the data for all the unit drafts i.e. Domestic, Industrial and Irrigation Unit Draft with the help of a drop down.

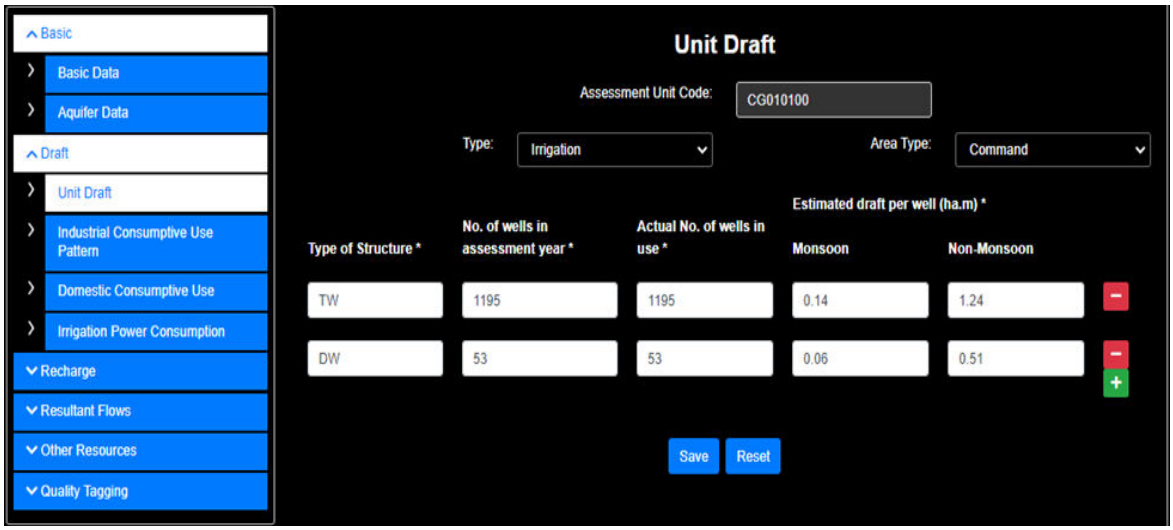


Figure 51: Draft – Unit Draft Form Input

b) Domestic Consumptive Use Method

Figure 52: Draft – Domestic Consumptive Use Form Input

c) Irrigation Power Consumption

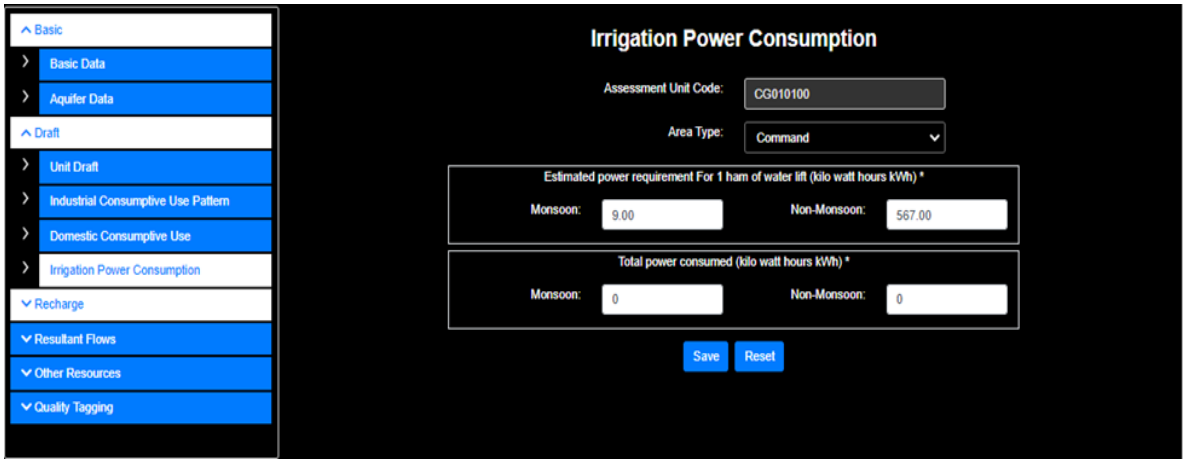


Figure 53: Draft – Irrigation Power Consumption Form Input

d) Industrial Consumptive Use Pattern

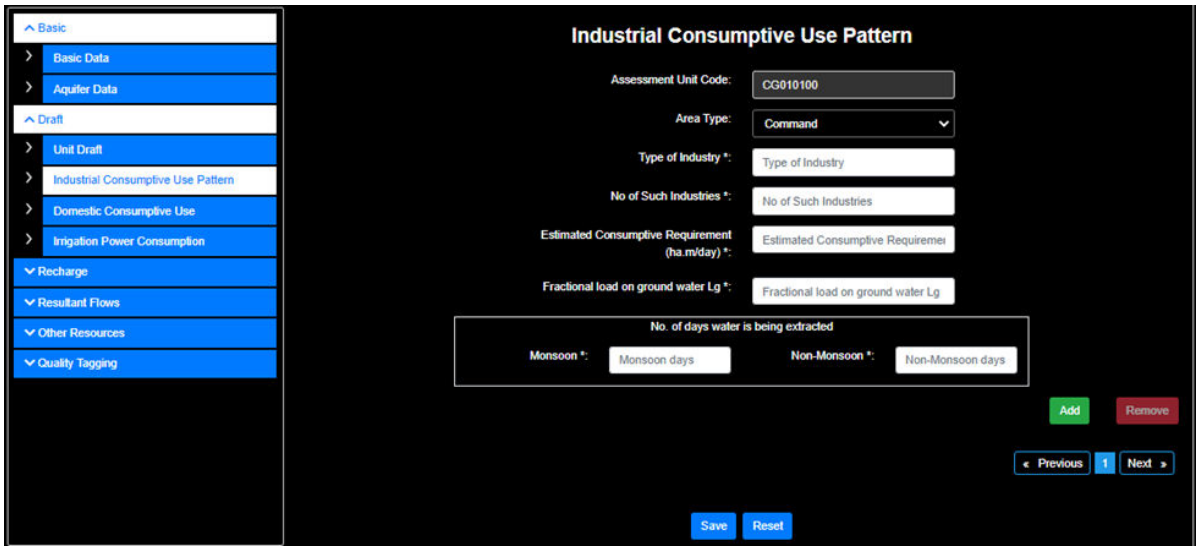


Figure 54: Draft – Industrial Consumptive Use Form Input

3.2.4 Inflows and Outflows Data File

This file includes data related to Vertical inter Aquifer Flow, Lateral Flow along the aquifer system, Transpiration, Evaporation and Baseflow:

a) Base Flow

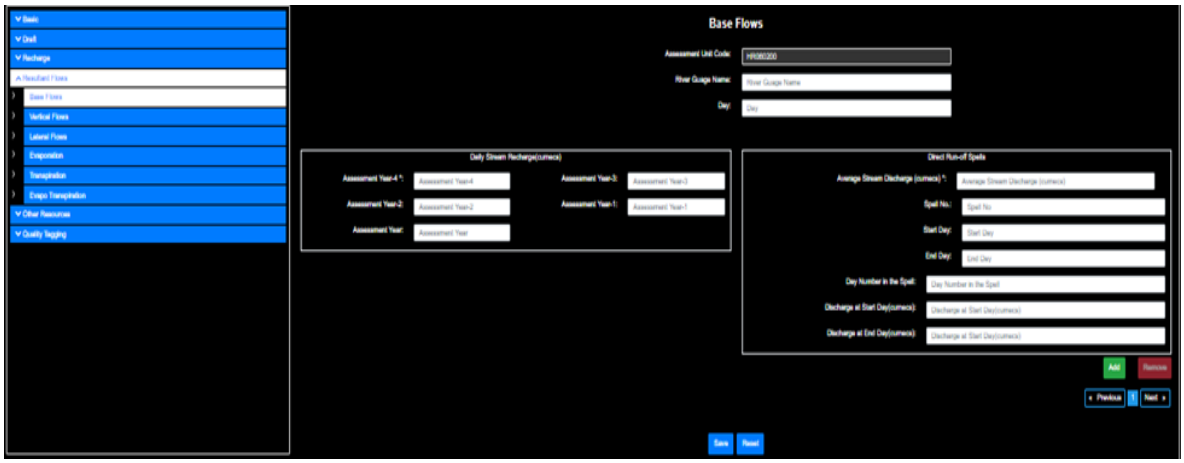


Figure 55: Environmental Flows – Base Flow Form Input

b) Vertical inter Aquifer flow

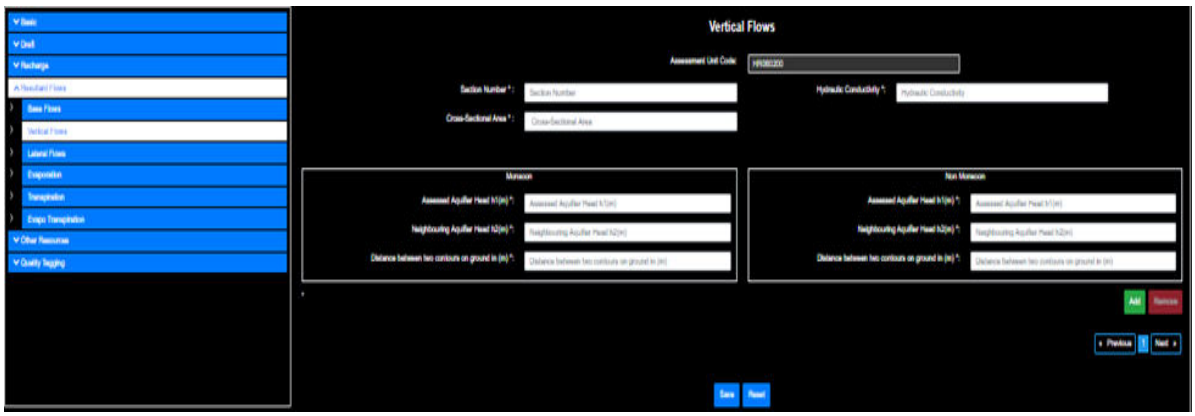


Figure 56: Environmental Flows – Vertical Inter Aquifer Flow Form Input

c) Lateral Aquifer flow

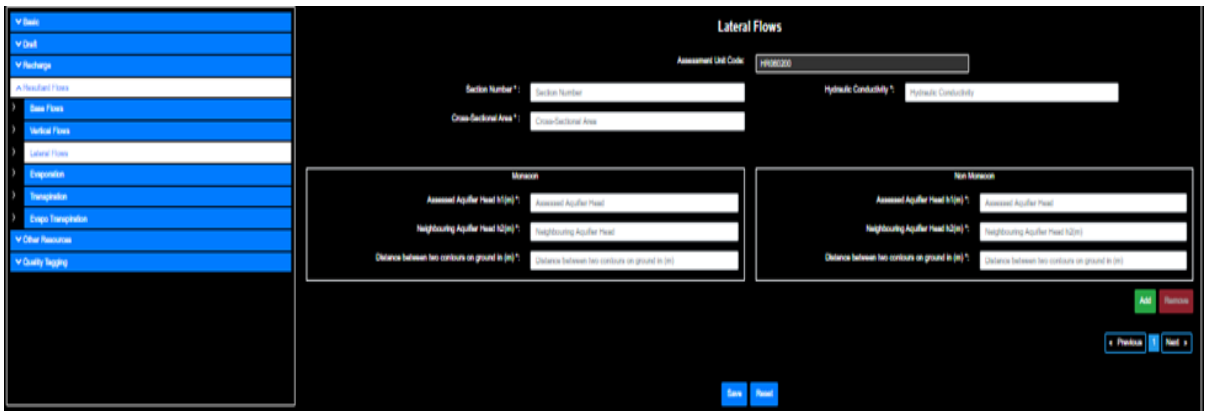


Figure 57: Environmental Flows – Lateral Aquifer Flow Form Input

d) Evapotranspiration

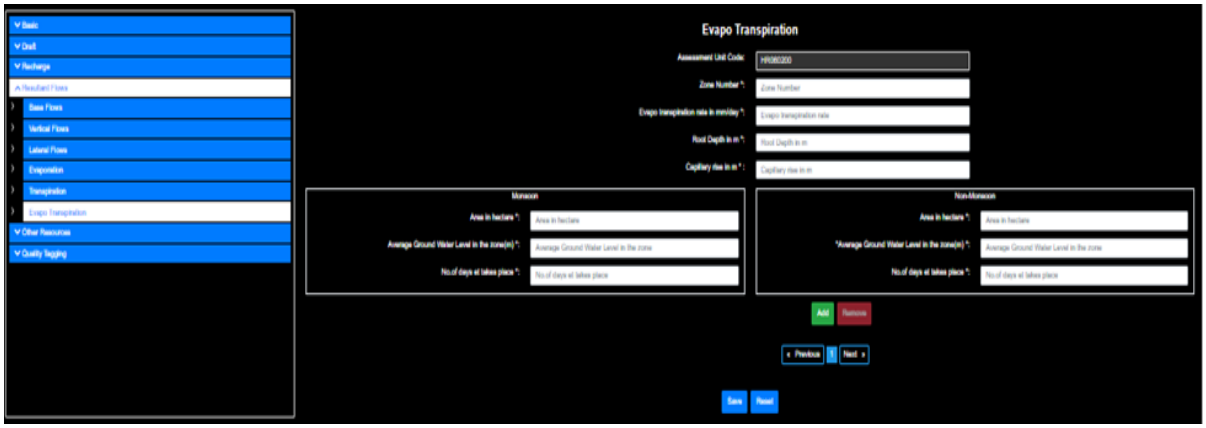


Figure 58: Environmental Flows – Evapotranspiration Form Input

e) Evaporation

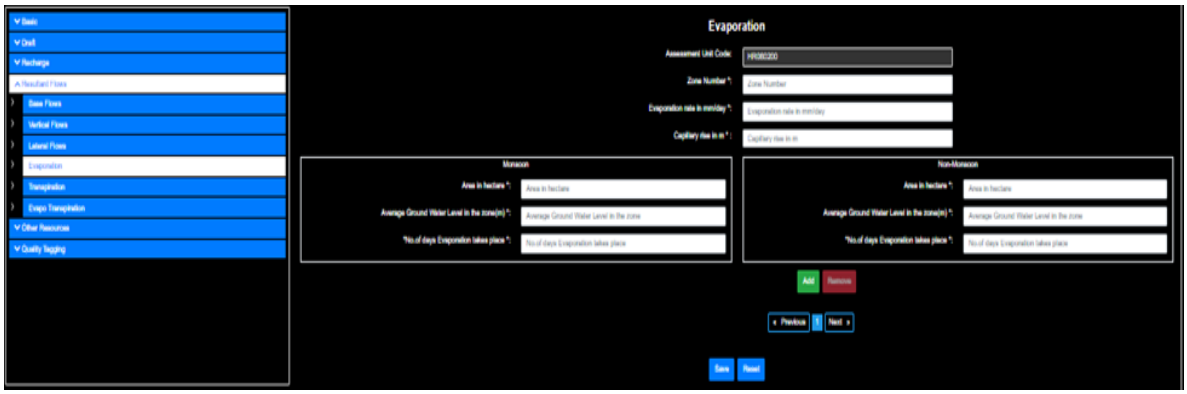


Figure 59: Environmental Flows – Evaporation Form Input

f) Transpiration

Figure 60: Environmental Flows – Transpiration Form Input

3.2.5 Additional Potential Resources Form Input

a) Shallow Water Areas

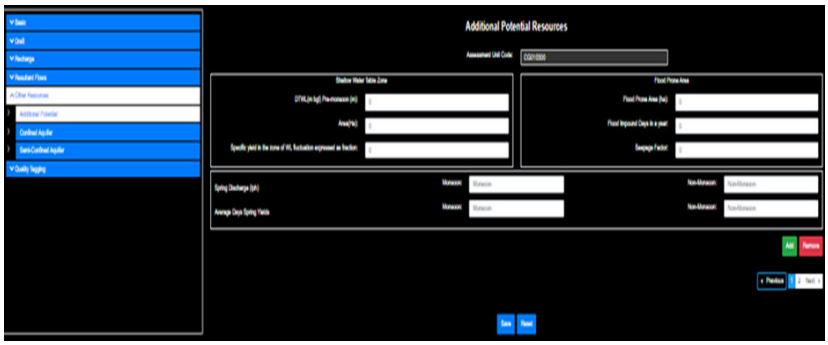


Figure 61: Additional Potential Resources – Shallow Water Area Form Input

b) Flood Prone Areas

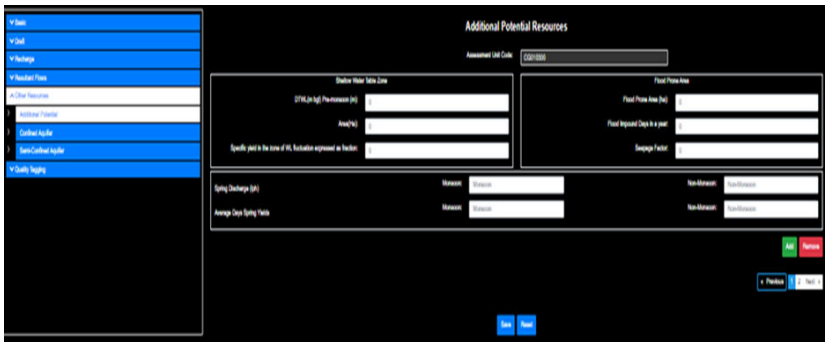


Figure 62: Additional Potential Resources – Flood Prone Area Form Input

a) Spring Discharges

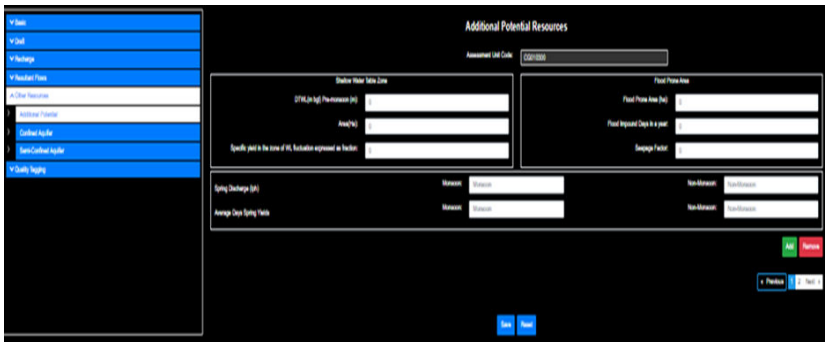


Figure 63: Additional Potential Resources – Spring Discharge Form Input

3.2.6 Resources of Confined and Semi-Confined Aquifer Form Input

Resources of Confined and Semi-Confined Aquifer Form Input captures data related to Confined Aquifer and Semi-Confined Aquifer

Confined Aquifer

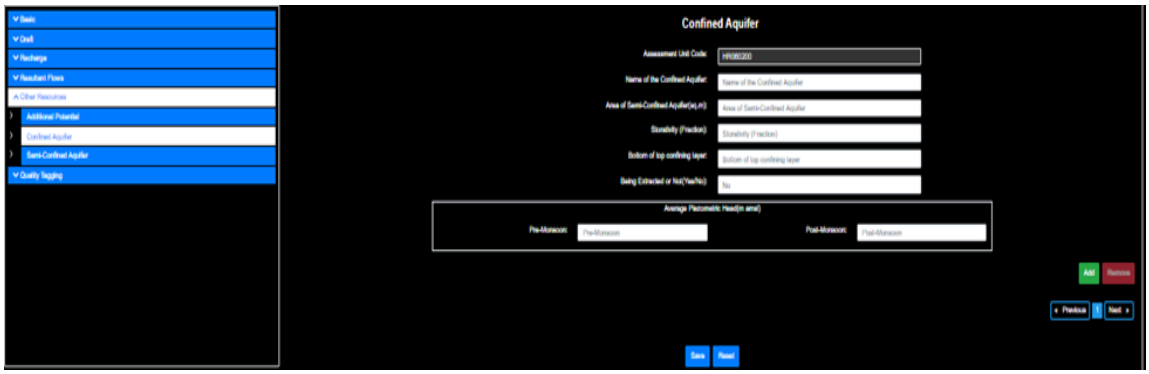


Figure 64: Resources of Confined and Semi-Confined Aquifer – Confined Aquifer Form Input

Semi-Confined Aquifer

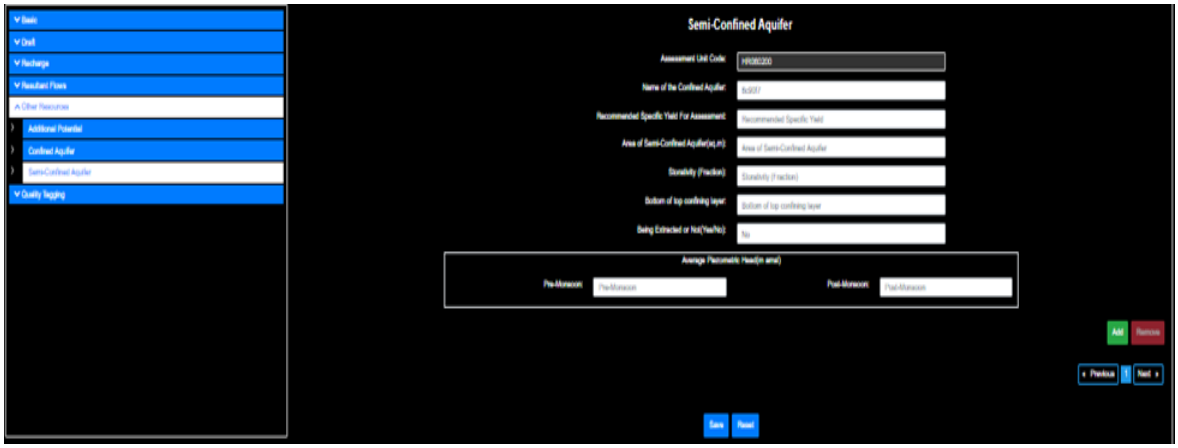
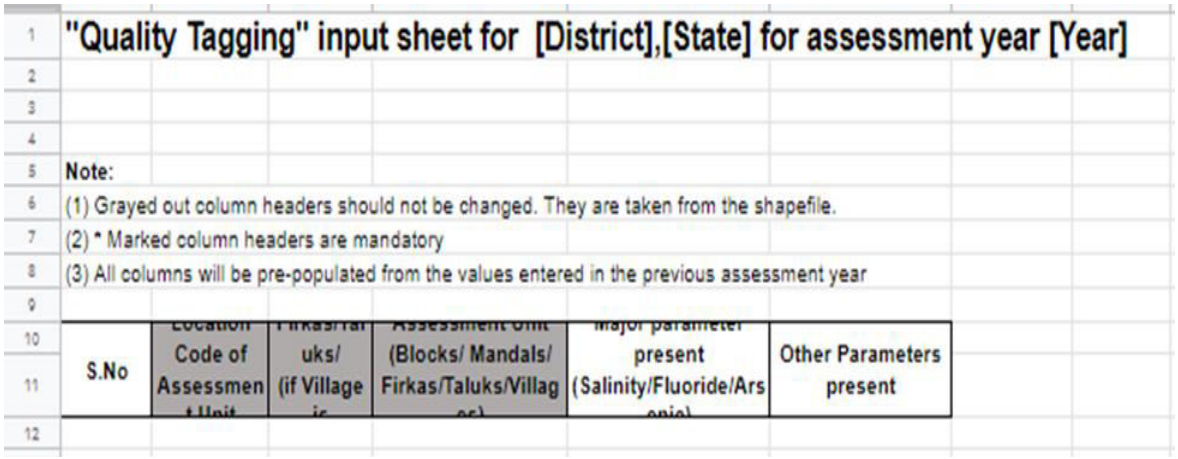


Figure 65: Resources of Confined and Semi-Confined Aquifer – Semi-Confined Aquifer Form Input

3.2.7 Unconfined Dynamic Aquifer Other Details



"Quality Tagging" input sheet for [District],[State] for assessment year [Year]

Note:

(1) Grayed out column headers should not be changed. They are taken from the shapefile.

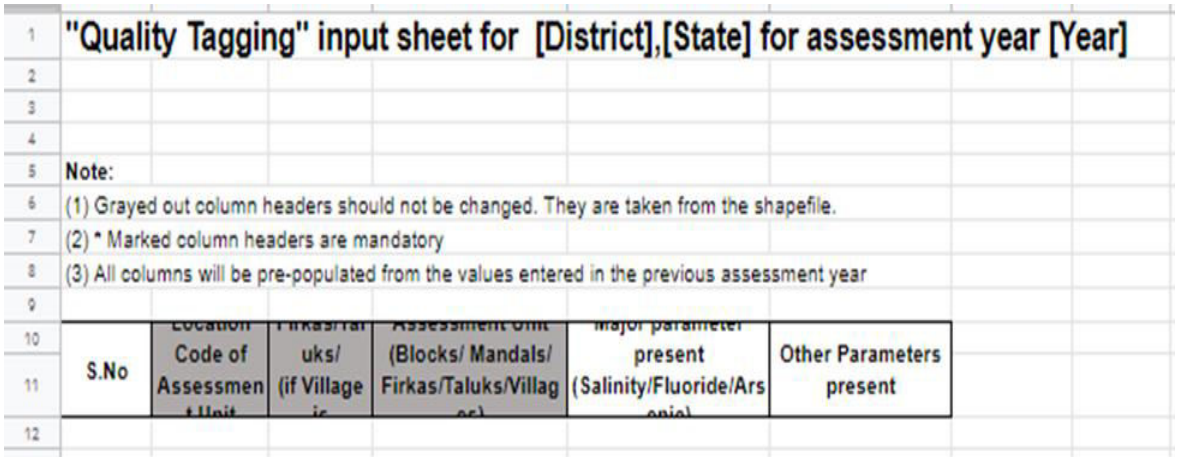
(2) * Marked column headers are mandatory

(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code of Assessment Unit	Firkas/Taluks/ (if Village ic	Assessment Unit (Blocks/ Mandals/ Firkas/Taluks/Villag es)	Major parameter present (Salinity/Fluoride/Arsenic)	Other Parameters present

Figure 66: Unconfined Dynamic Aquifer Other Details Form Input

3.2.8 Coastal Areas



"Quality Tagging" input sheet for [District],[State] for assessment year [Year]

Note:

(1) Grayed out column headers should not be changed. They are taken from the shapefile.

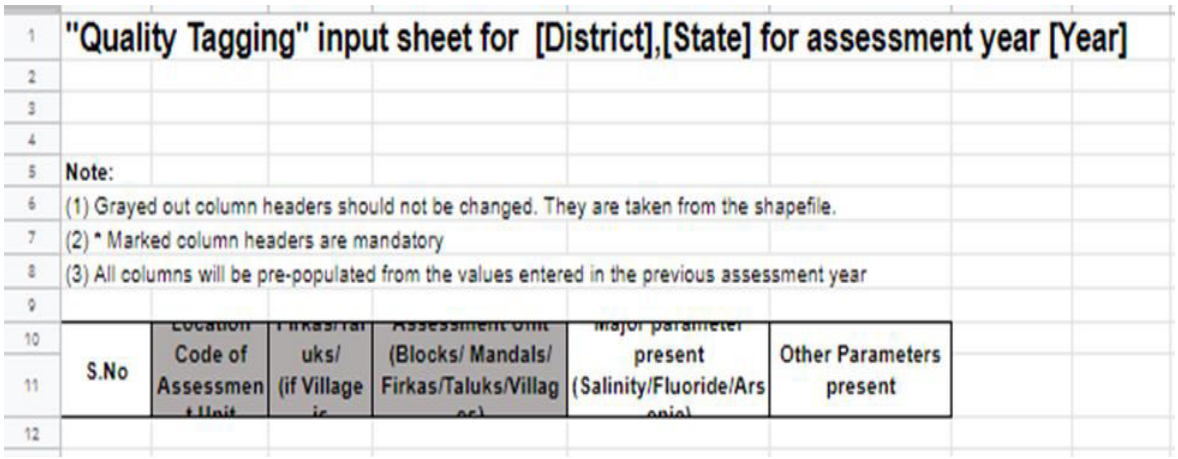
(2) * Marked column headers are mandatory

(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code of Assessment Unit	Firkas/Taluks/ (if Village is	Assessment Unit (Blocks/ Mandals/ Firkas/Taluks/Villag es)	Major parameter present (Salinity/Fluoride/Arsenic)	Other Parameters present

Figure 67: Coastal Areas Form Input

3.2.9 Water Depletion Zones



"Quality Tagging" input sheet for [District],[State] for assessment year [Year]

Note:

(1) Grayed out column headers should not be changed. They are taken from the shapefile.

(2) * Marked column headers are mandatory

(3) All columns will be pre-populated from the values entered in the previous assessment year

S.No	Location Code of Assessment Unit	Firkas/Taluks/ (if Village is	Assessment Unit (Blocks/ Mandals/ Firkas/Taluks/Villag es)	Major parameter present (Salinity/Fluoride/Arsenic)	Other Parameters present

Figure 68: Water Depletion Zones Form Input

3.3 Shape File format - Pending

User needs to upload a State shape file with Assessment unit, hierarchy and geometry. This information needs to be embedded into the shape file's attribute table. The shape file should be in .shp format consisting of 6 files: cpg, .dbf, prj, qpj, .shp, .shx. All the 6 files should be there in one folder. This folder should now be placed into another folder and then zipped with .zip extension. User needs to then upload this .zip file into the system.

The Attribute Table of the shape file should be in the following format:

p0_id	p0_name	p0_type	p1_id	p1_name	p1_type	ur_type
ML050100	RI-BHOI	DISTRICT	b967d23e-68c8-492c-a372-9623441f7d24	ML	STATE	R
ML010100	EAST GARO HILLS	DISTRICT	b967d23e-68c8-492c-a372-9623441f7d24	ML	STATE	R
ML040100	NORTH GARO HILLS	DISTRICT	b967d23e-68c8-492c-a372-9623441f7d24	ML	STATE	R
ML020100	EAST JAINTIA HILLS	DISTRICT	b967d23e-68c8-492c-a372-9623441f7d24	ML	STATE	R
ML030100	EAST KHASI HILLS	DISTRICT	b967d23e-68c8-492c-a372-9623441f7d24	ML	STATE	R
ML060100	SOUTH GARO HILLS	DISTRICT	b967d23e-68c8-492c-a372-9623441f7d24	ML	STATE	R
ML070100	SOUTH WEST GARO HIL	DISTRICT	b967d23e-68c8-492c-a372-9623441f7d24	ML	STATE	R
ML080100	SOUTH WEST KHASI HI	DISTRICT	b967d23e-68c8-492c-a372-9623441f7d24	ML	STATE	R
ML090100	WEST GARO HILLS	DISTRICT	b967d23e-68c8-492c-a372-9623441f7d24	ML	STATE	R
ML100100	WEST JAINTIA HILLS	DISTRICT	b967d23e-68c8-492c-a372-9623441f7d24	ML	STATE	R
ML110100	WEST KHASI HILLS	DISTRICT	b967d23e-68c8-492c-a372-9623441f7d24	ML	STATE	R

Figure 69: Shape File Attribute Table format

P0 will always correspond to the Assessment unit – in the above case it is District

P0_ID will always be the Assessment Unit code

P0_NAME will always be the Assessment Unit name

P0_TYPE will always be the Assessment Unit type (District/Block/Village, etc.)

P1 corresponds to the next higher level of hierarchy – in this case it is State

And so on….

UR_TYPE gives information regarding the type of assessment unit i.e. Urban or Rural. In this column user should enter U for Urban Assessment Units and R for Rural Assessment Units.

Note: In any case the State ID should never be changed.

4.0 GIS Dashboard / Homepage

4.1 Dashboard – GIS View

4.1.1 Introduction

The GIS view of India GEC let the user visualize the Assessment Unit categorization geographically on top of other map layers. Each assessment unit is color coded based on the categorization (SAFE, SEMI-CRITICAL, CRITICAL and OVER-EXPLOITED). This view also shows data for each of the GEC component in the information panel at the right side. By default, the view starts at India level map with all the states showing the latest categorization of the assessment units.

4.1.2 Map Layers

Layers	**Base Layers** ▪ **Open Street Maps** **Administrative Layers** ▪ **State** ▪ **Assessment Unit** **Hydrological Layers** ▪ **Basin** ▪ **Sub-Basin** **Heatmaps** ▪ **Categorization** ▪ **Annual Normal Rainfall** ▪ **Annual Ground Water Recharge (Unit Map)** ▪ **Annual Ground Water Extraction (Unit Map)** ▪ **Aquifer Map**

4.1.3 Features

Legends	Legends provides categorical and break values of the data.
Map Tools	Tools to zoom in and out of the map
Information Panel	Shows the Rainfall, Recharge, Draft, Losses, Stage of Extraction, DTW (bgl) and Categorization for Command Area, Non-Command Area and Total Area
Map Download	Downloads the current selected map

Filters	▪ Geo View (Admin/Basin) ▪ Assessment Year ▪ Computation Type (Actual/Normal) ▪ Period (Annual/Monsoon/Non-Monsoon)

4.1.4 Mockups

GIS View / Homepage

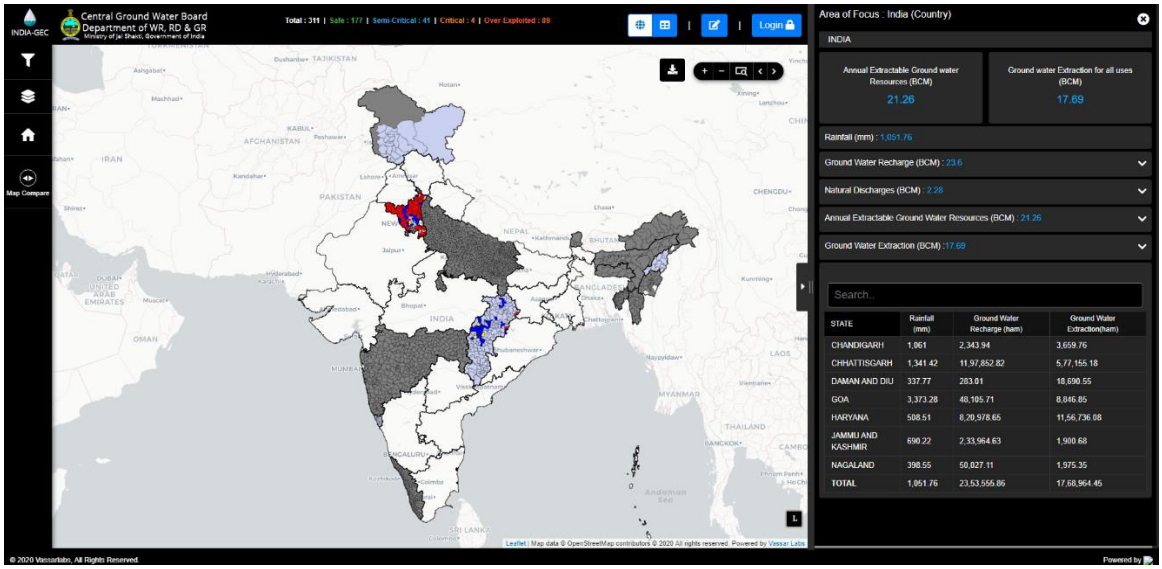


Figure 70: GIS Home Page mockup

Map Layers

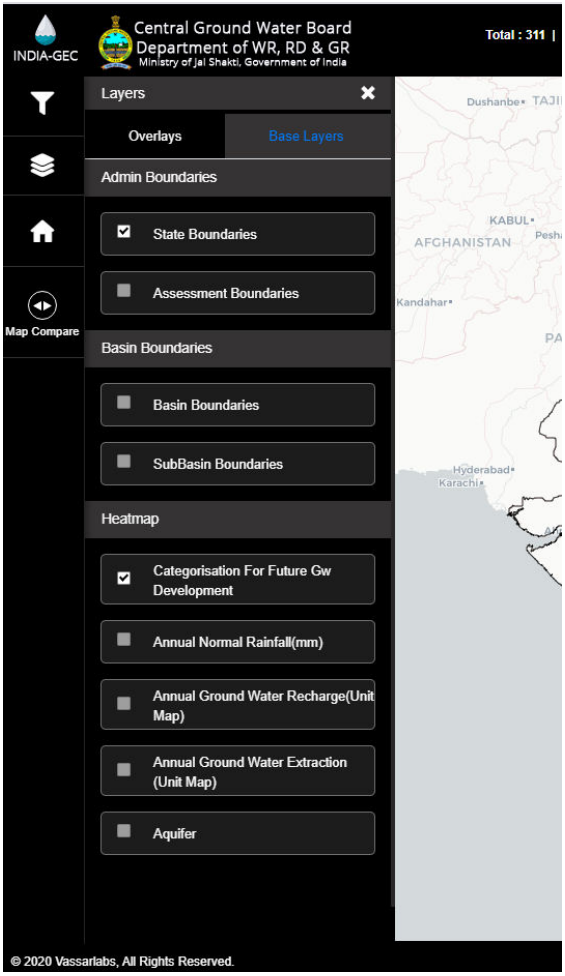


Figure 71: GIS View – Map Layers mockup

Filters

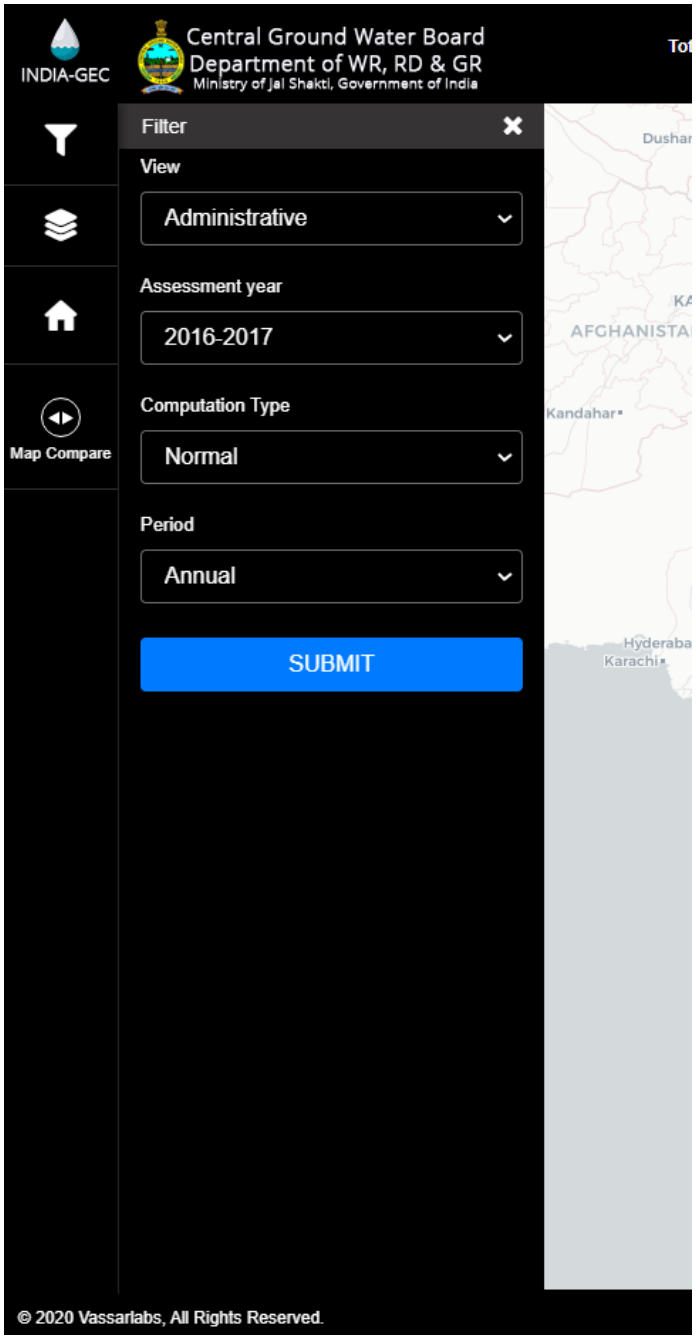


Figure 72: GIS View – Filters mockup

Information Panel

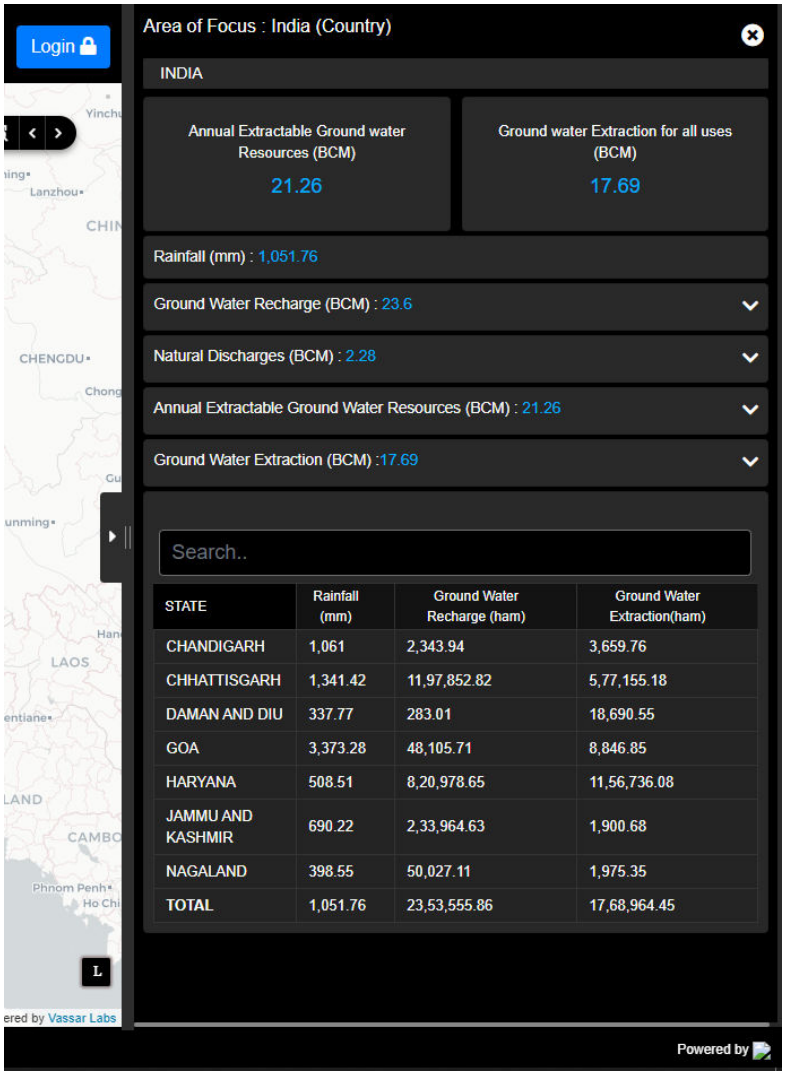


Figure 73: GIS View – Information Panel mockup

4.2 Heatmap

The Heatmaps or Choropleth maps in GIS view lets you see the various information layers including Categorization, Rainfall, etc. India GEC system provides 5 different heatmaps for visualization.

4.2.1 Categorization

The Categorization Heatmap shows the categorization for each assessment unit.

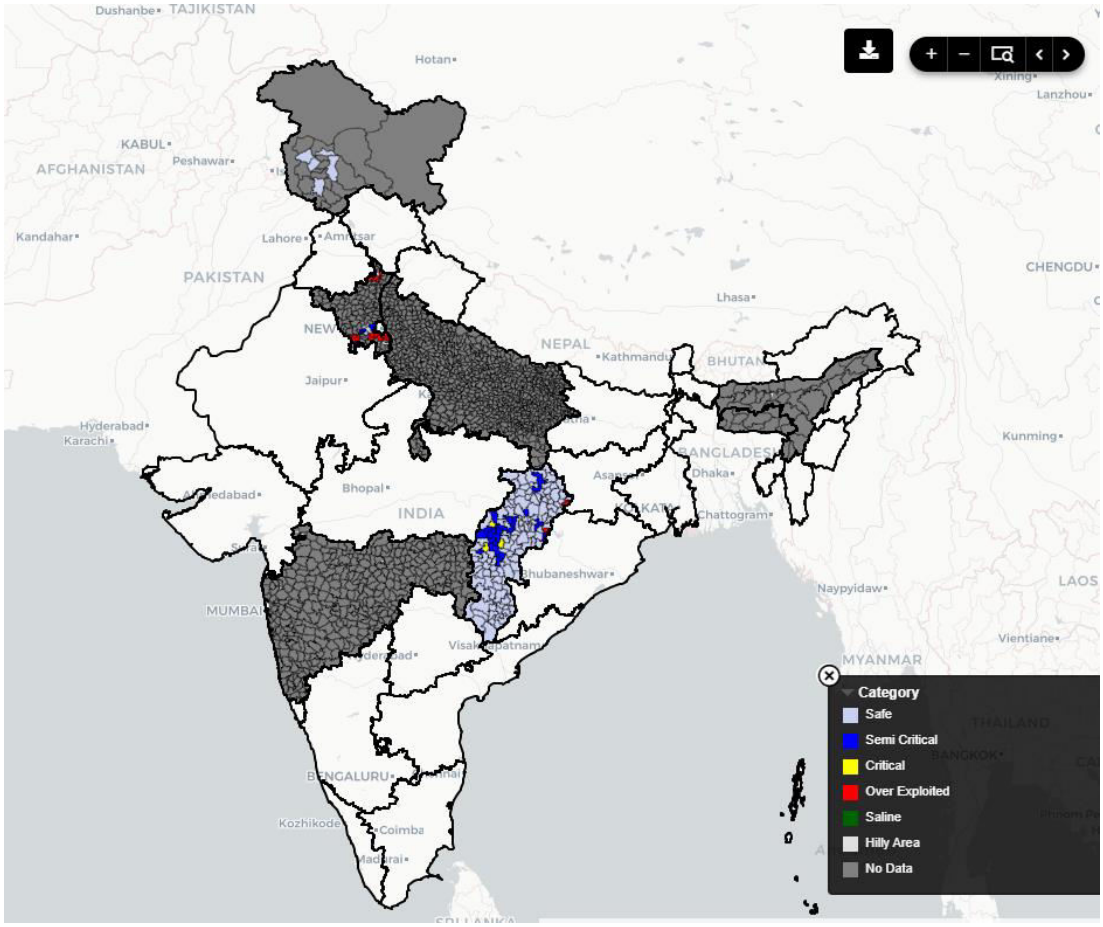


Figure 74: GIS View – Categorization Heatmap

4.2.2 Annual Normal Rainfall

The Annual Normal Rainfall Heatmap allows user to see the Normal Rainfall of an Assessment Unit in a year.

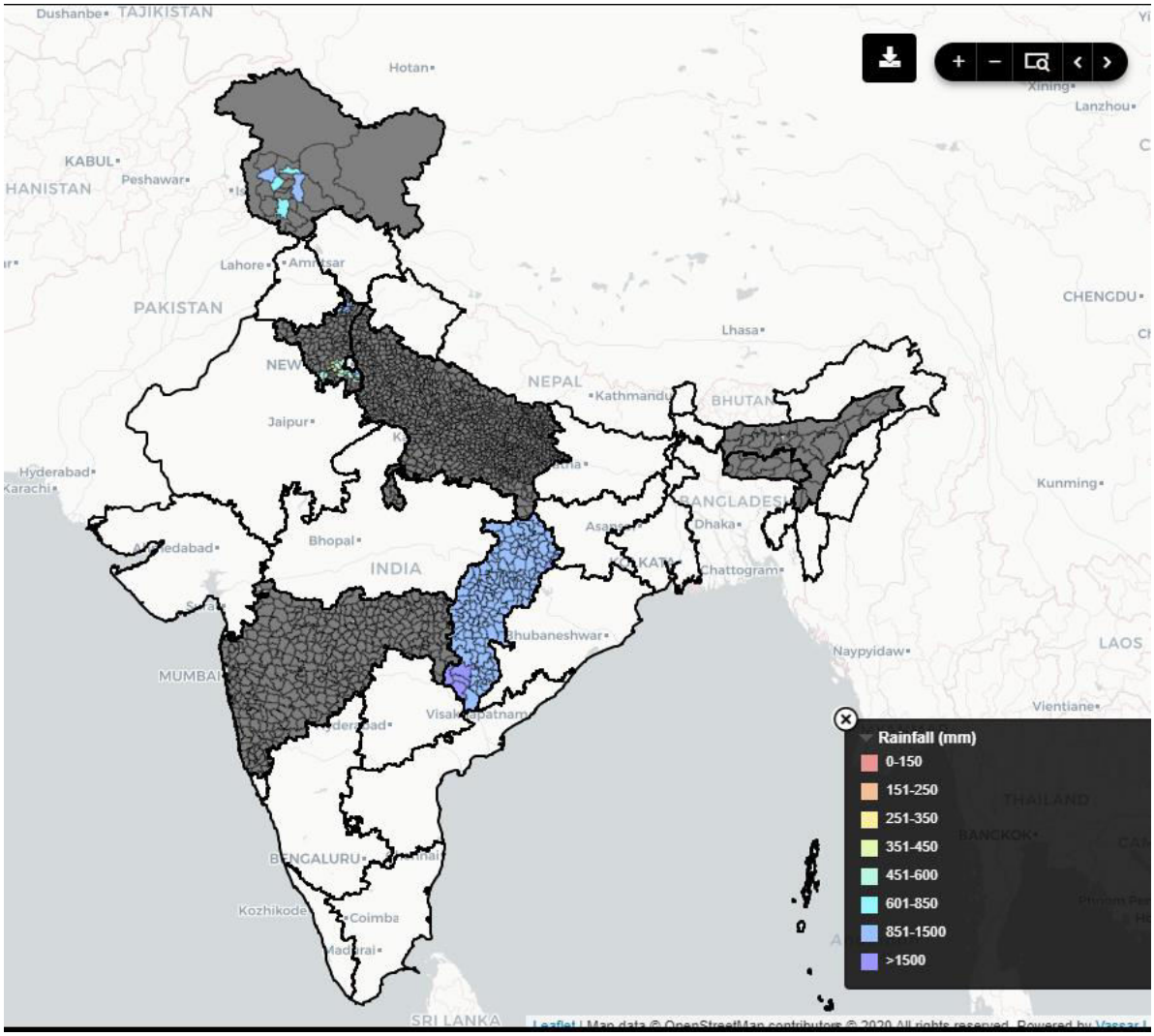


Figure 75: GIS View – Annual Normal Rainfall Heatmap

4.2.3 Annual Ground Water Recharge (Unit Map)

The Annual Ground Water Recharge Heatmap is a Unit Map showing user Assessment Unit wise Recharge divided by Recharge Worthy Area.

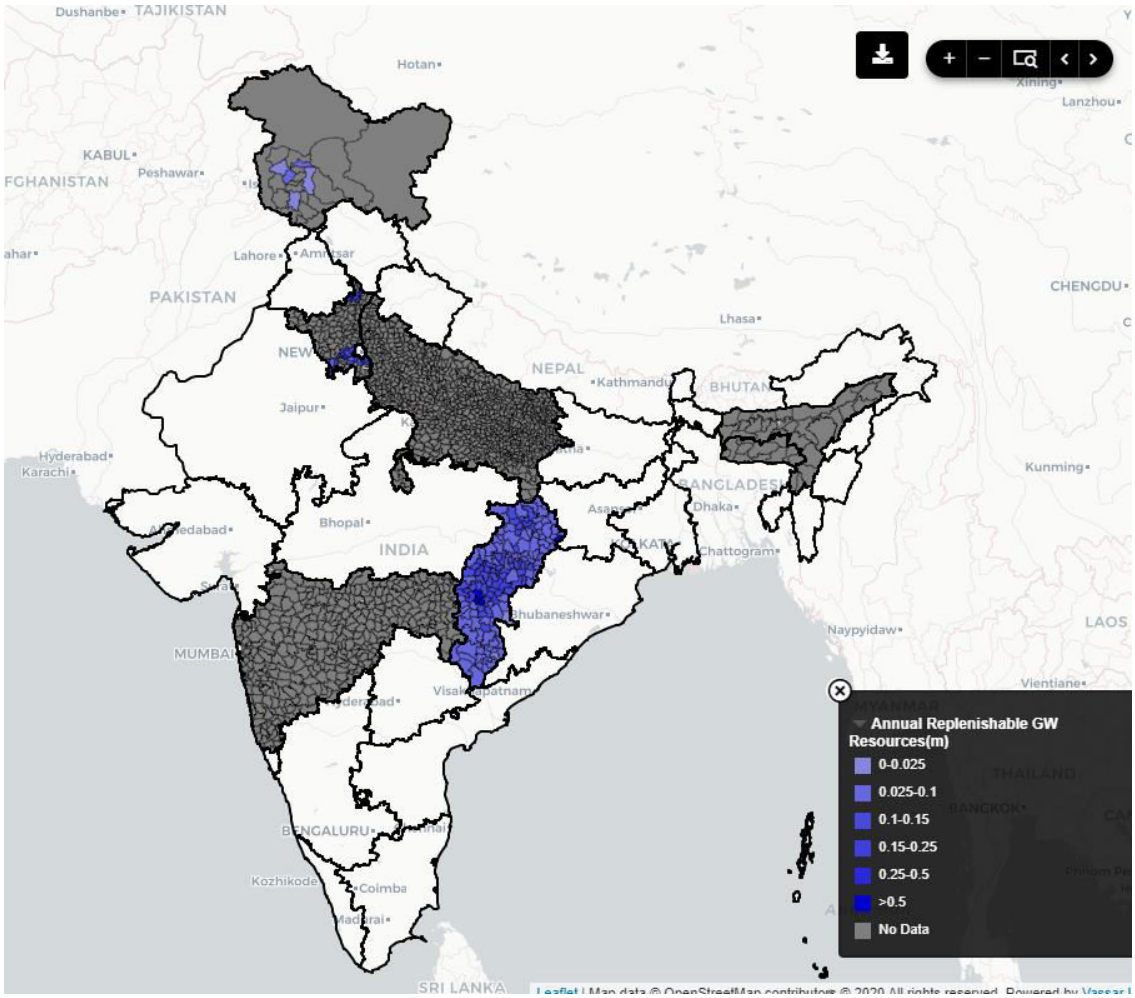


Figure 76: GIS View – Annual Ground Water Recharge (Unit Map) Heatmap

4.2.4 Annual Ground Water Extraction (Unit Map)

The Annual Ground Water Extraction Heatmap is a Unit Map showing user Assessment Unit wise Extraction divided by Recharge Worthy Area.

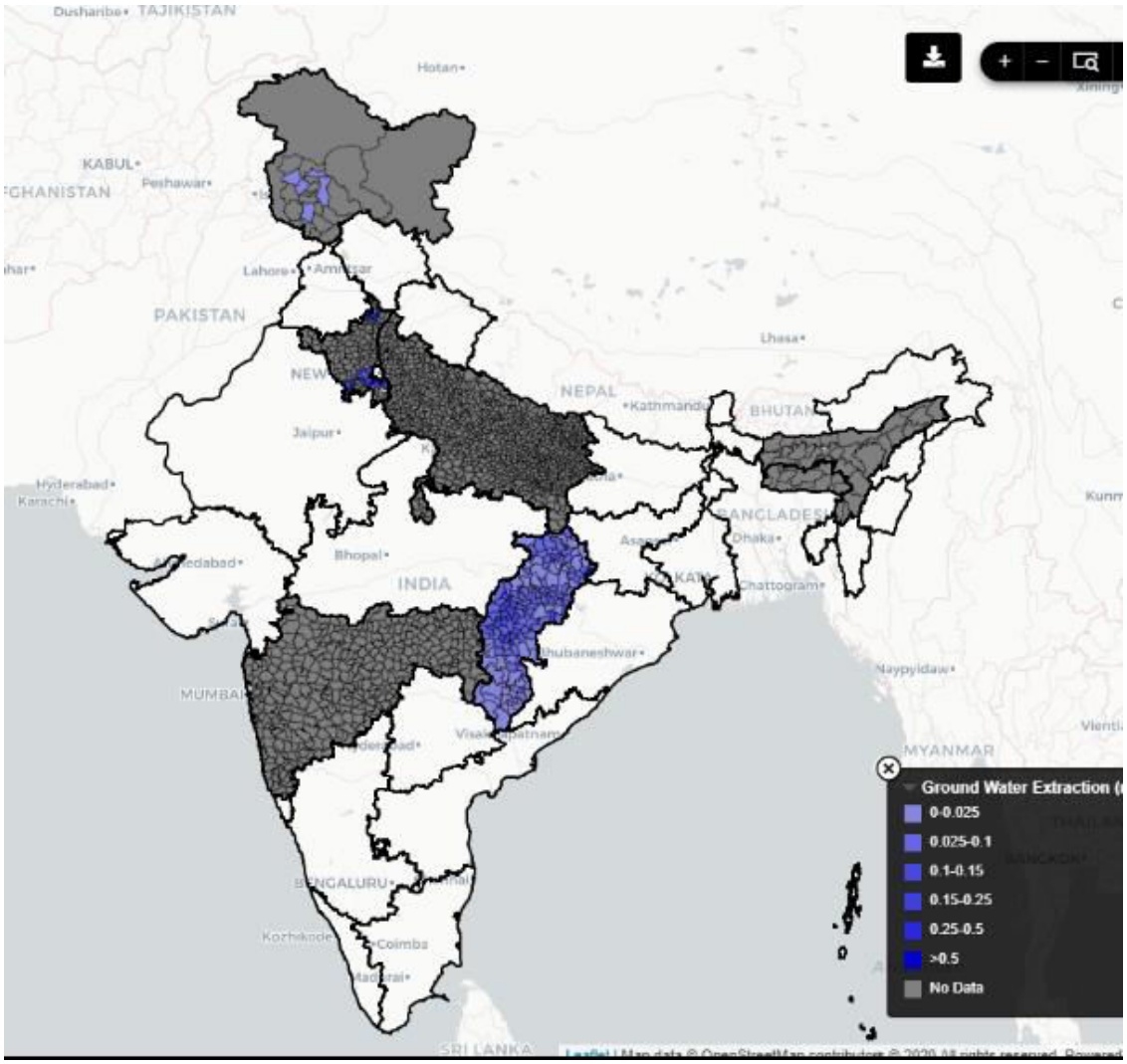


Figure 77: GIS View – Annual Ground Water Extraction (Unit Map) Heatmap

4.2.5 Aquifer Map

The Aquifer Map shows various aquifer distribution across whole of India.

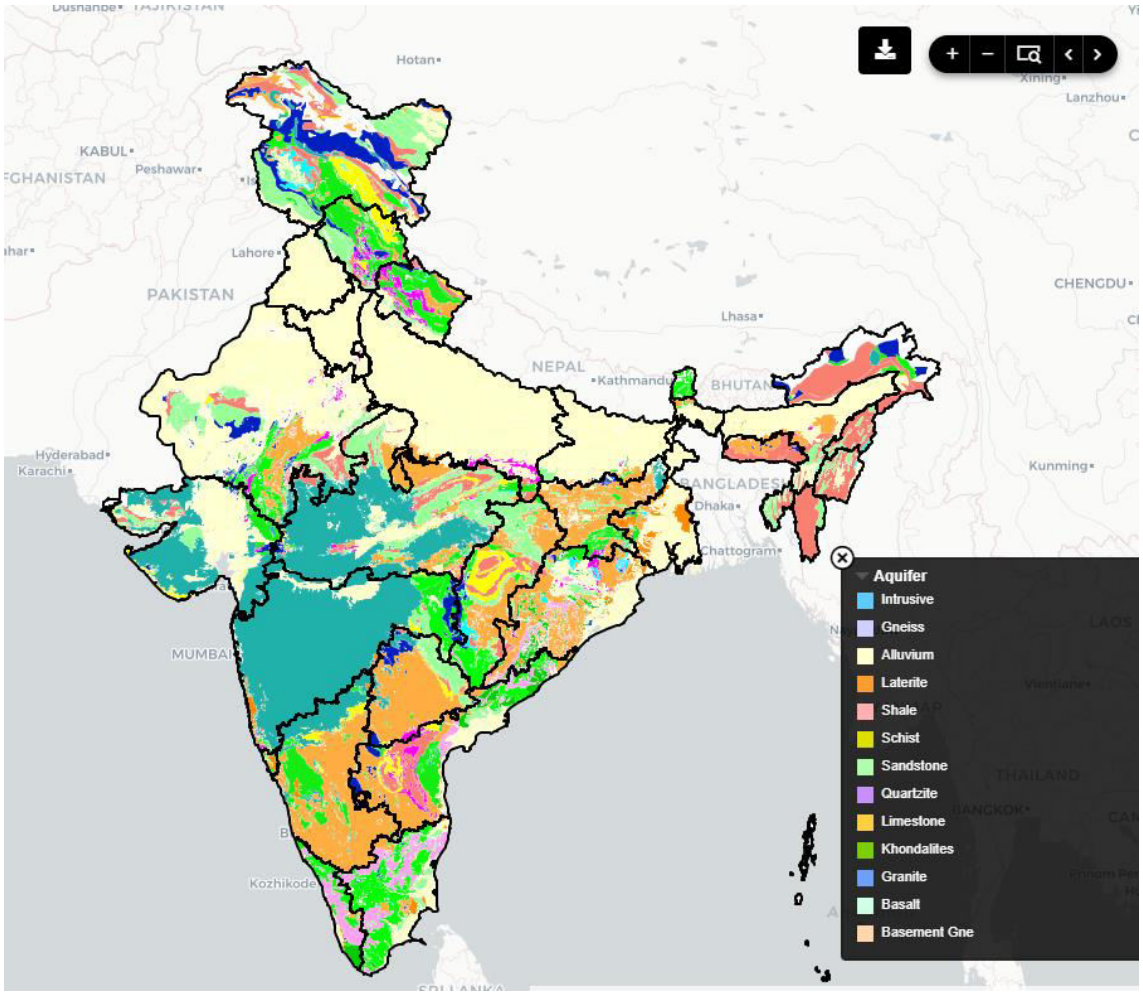


Figure 78: GIS View – Aquifer Heatmap

5.0 MIS Dashboard

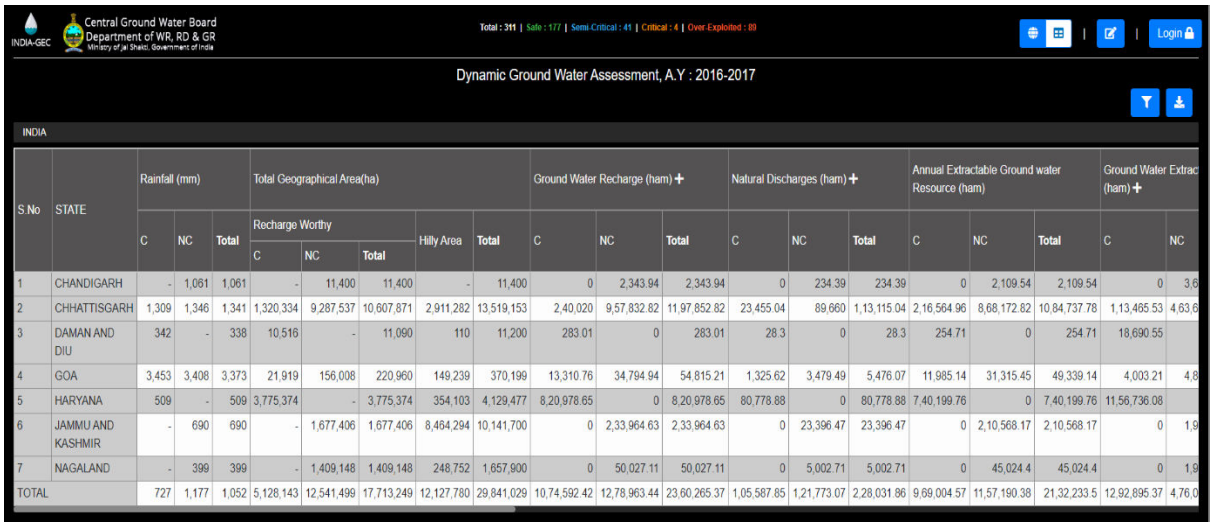
5.1 Dashboard – MIS View

5.1.1 Introduction

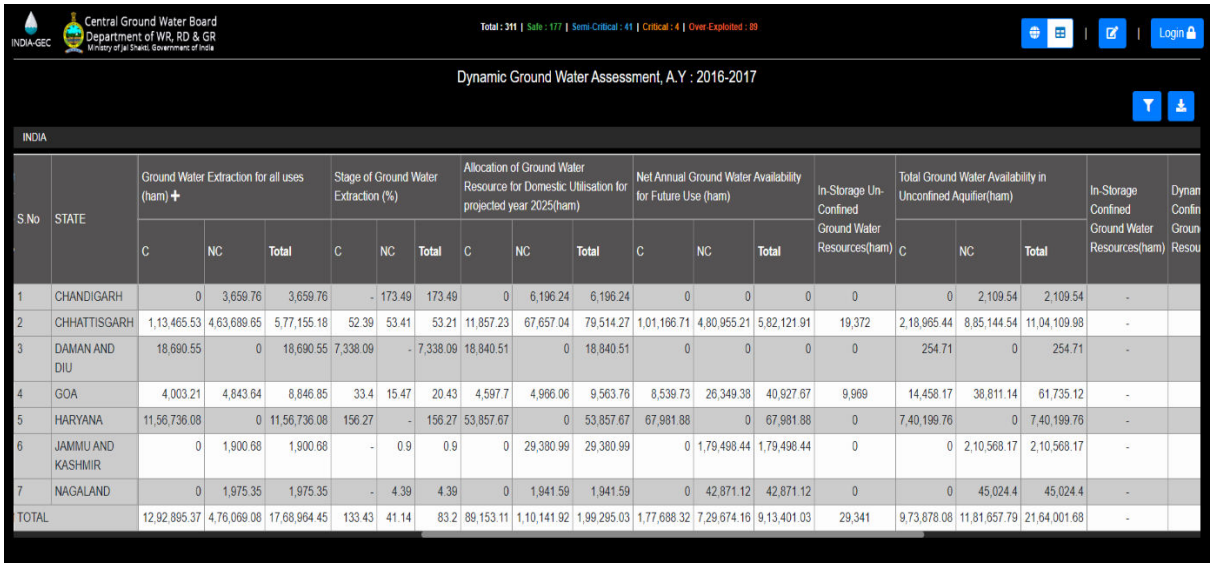
The MIS view of India GEC let the user visualize the data for Rainfall, Recharge, Draft, Losses, State of Ground Water Extraction, Assessment Unit categorization in tabular format distributed across Command and Non-Command areas in an assessment unit. All the values calculated are in ha.m.

Data Items	▪ Command Area ▪ Non-Command Area ▪ Total Area
Filters	▪ Assessment Year ▪ Time Period (Annual/Monsoon/Non-Monsoon) ▪ Geo View (Administrative/Hydrological) ▪ Category (Safe/Semi-Critical/Critical/Overexploited)

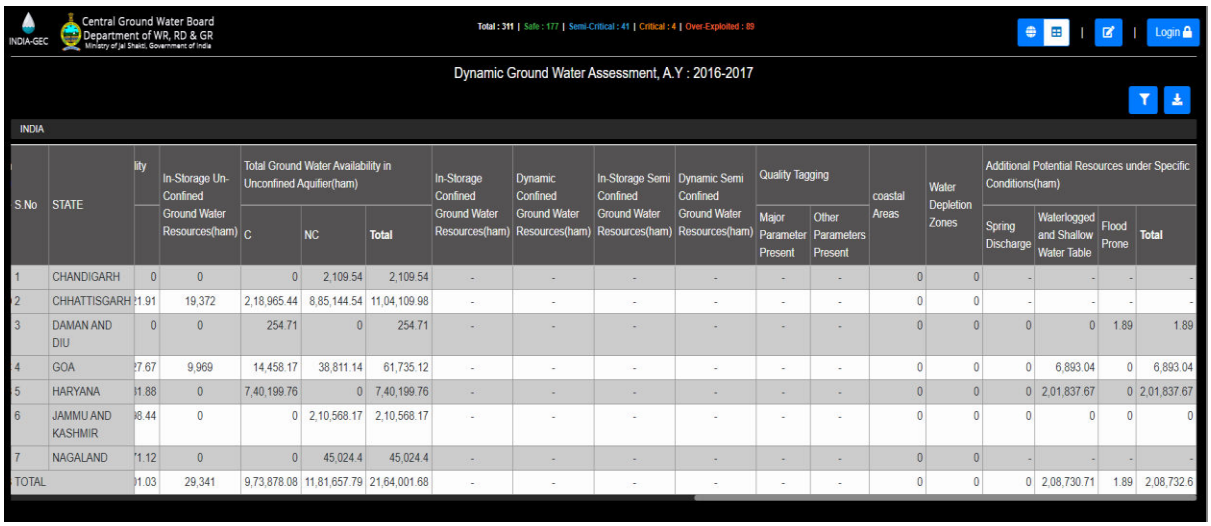
5.1.2 Mockups



S.No	STATE	Rainfall (mm)			Total Geographical Area(ha)					Ground Water Recharge (ham) +			Natural Discharges (ham) +			Annual Extractable Ground water Resource (ham)			Ground Water Extrac (ham) +	
					Recharge Worthy			Hilly Area	Total											
		C	NC	Total	C	NC	Total			C	NC	Total	C	NC	Total	C	NC	Total	C	NC
1	CHANDIGARH	-	1,061	1,061	-	11,400	11,400	-	11,400	0	2,343.94	2,343.94	0	234.39	234.39	0	2,109.54	2,109.54	0	3,6
2	CHHATTISGARH	1,309	1,346	1,341	1,320,334	9,287,537	10,607,871	2,911,282	13,519,153	2,40,020	9,57,832.82	11,97,852.82	23,455.04	89,660	1,13,115.04	2,16,564.96	8,68,172.82	10,84,737.78	1,13,465.53	4,63,6
3	DAMAN AND DIU	342	-	338	10,516	-	11,090	110	11,200	283.01	0	283.01	28.3	0	28.3	254.71	0	254.71	18,690.55	
4	GOA	3,453	3,408	3,373	21,919	156,008	220,960	149,239	370,199	13,310.76	34,794.94	54,815.21	1,325.62	3,479.49	5,476.07	11,985.14	31,315.45	49,339.14	4,003.21	4,8
5	HARYANA	509	-	509	3,775,374	-	3,775,374	354,103	4,129,477	8,20,978.65	0	8,20,978.65	80,778.88	0	80,778.88	7,40,199.76	0	7,40,199.76	11,56,736.08	
6	JAMMU AND KASHMIR	-	690	690	-	1,677,406	1,677,406	8,464,294	10,141,700	0	2,33,964.63	2,33,964.63	0	23,396.47	23,396.47	0	2,10,568.17	2,10,568.17	0	1,9
7	NAGALAND	-	399	399	-	1,409,148	1,409,148	248,752	1,657,900	0	50,027.11	50,027.11	0	5,002.71	5,002.71	0	45,024.4	45,024.4	0	1,9
TOTAL		727	1,177	1,052	5,128,143	12,541,499	17,713,249	12,127,780	29,841,029	10,74,592.42	12,78,963.44	23,60,265.37	1,05,587.85	1,21,773.07	2,28,031.86	9,69,004.57	11,57,190.38	21,32,233.5	12,92,895.37	4,76,0



S.No	STATE	Ground Water Extraction for all uses (ham)			Stage of Ground Water Extraction (%)			Allocation of Ground Water Resource for Domestic Utilisation for projected year 2025(ham)			Net Annual Ground Water Availability for Future Use (ham)			In-Storage Un-Confined Ground Water Resources(ham)	Total Ground Water Availability in Unconfined Aquifier(ham)			In-Storage Confined Ground Water Resources(ham)	Dynan Confin Groun Resou
		C	NC	Total	C	NC	Total	C	NC	Total	C	NC	Total		C	NC	Total		
1	CHANDIGARH	0	3,659.76	3,659.76	-	173.49	173.49	0	6,196.24	6,196.24	0	0	0	0	0	2,109.54	2,109.54	-	
2	CHHATTISGARH	1,13,465.53	4,63,689.65	5,77,155.18	52.39	53.41	53.21	11,857.23	67,657.04	79,514.27	1,01,166.71	4,80,955.21	5,82,121.91	19,372	2,18,965.44	8,85,144.54	11,04,109.98	-	
3	DAMAN AND DIU	18,690.55	0	18,690.55	7,338.09	-	7,338.09	18,840.51	0	18,840.51	0	0	0	0	254.71	0	254.71	-	
4	GOA	4,003.21	4,843.64	8,846.85	33.4	15.47	20.43	4,597.7	4,966.06	9,563.76	8,539.73	26,349.38	40,927.67	9,969	14,458.17	38,811.14	61,735.12	-	
5	HARYANA	11,56,736.08	0	11,56,736.08	156.27	-	156.27	53,857.67	0	53,857.67	67,981.88	0	67,981.88	0	7,40,199.76	0	7,40,199.76	-	
6	JAMMU AND KASHMIR	0	1,900.68	1,900.68	-	0.9	0.9	0	29,380.99	29,380.99	0	1,79,498.44	1,79,498.44	0	0	2,10,568.17	2,10,568.17	-	
7	NAGALAND	0	1,975.35	1,975.35	-	4.39	4.39	0	1,941.59	1,941.59	0	42,871.12	42,871.12	0	0	45,024.4	45,024.4	-	
TOTAL		12,92,895.37	4,76,069.08	17,68,964.45	133.43	41.14	83.2	89,153.11	1,10,141.92	1,99,295.03	1,77,688.32	7,29,674.16	9,13,401.03	29,341	9,73,878.08	11,81,657.79	21,64,001.68	-	



S.No	STATE	lity	In-Storage Un-Confined Ground Water Resources(ham)	Total Ground Water Availability in Unconfined Aquifier(ham)			In-Storage Confined Ground Water Resources(ham)	Dynamic Confined Ground Water Resources(ham)	In-Storage Semi Confined Ground Water Resources(ham)	Dynamic Semi Confined Ground Water Resources(ham)	Quality Tagging		coastal Areas	Water Depletion Zones	Additional Potential Resources under Specific Conditions(ham)			
				C	NC	Total					Major Parameter Present	Other Parameters Present			Spring Discharge	Waterlogged and Shallow Water Table	Flood Prone	Total
1	CHANDIGARH	0	0	0	2,109.54	2,109.54	-	-	-	-	-	-	0	0	-	-	-	-
2	CHHATTISGARH	1.91	19,372	2,18,965.44	8,85,144.54	11,04,109.98	-	-	-	-	-	-	0	0	-	-	-	-
3	DAMAN AND DIU	0	0	254.71	0	254.71	-	-	-	-	-	-	0	0	0	0	1.89	1.89
4	GOA	7.67	9,969	14,458.17	38,811.14	61,735.12	-	-	-	-	-	-	0	0	0	6,893.04	0	6,893.04
5	HARYANA	1.88	0	7,40,199.76	0	7,40,199.76	-	-	-	-	-	-	0	0	0	2,01,837.67	0	2,01,837.67
6	JAMMU AND KASHMIR	8.44	0	0	2,10,568.17	2,10,568.17	-	-	-	-	-	-	0	0	0	0	0	0
7	NAGALAND	1.12	0	0	45,024.4	45,024.4	-	-	-	-	-	-	0	0	-	-	-	-
TOTAL		1.03	29,341	9,73,878.08	11,81,657.79	21,64,001.68	-	-	-	-	-	-	0	0	0	2,08,730.71	1.89	2,08,732.6

Figure 79: MIS View – Dashboard

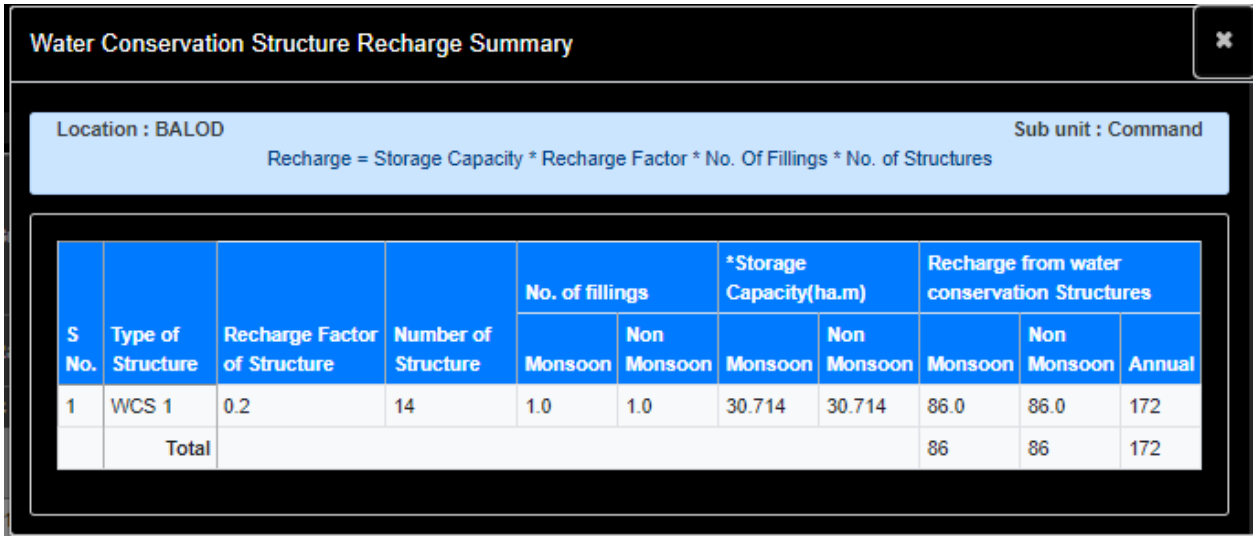
5.2 Computational Popup

User can see the calculations for each component by drilling down to the Assessment Unit level. Some of the popup are given below:

Irrigation Draft Popup:

Figure 80: MIS View – Computation Popup Sample 1

Water Conservation Structure Popup:



S No.	Type of Structure	Recharge Factor of Structure	Number of Structure	No. of fillings		*Storage Capacity(ha.m)		Recharge from water conservation Structures		
				Monsoon	Non Monsoon	Monsoon	Non Monsoon	Monsoon	Non Monsoon	Annual
1	WCS 1	0.2	14	1.0	1.0	30.714	30.714	86.0	86.0	172
	Total							86	86	172

Figure 81: MIS View – Computation Popup Sample 2

6.0 Other System Features

6.1 Live Ground Water Dashboard

6.1.1 Introduction

Live Ground Water Dashboard shows the live Change in Ground Water Storage for a specific assessment unit. The live ground water level is fetched from the India WRIS website via an API.

Change in Ground Water Storage can be expressed as follows:

$$\Delta S = A * (Pre – Current) * SY$$

Where,

ΔS = Change in Ground water Storage

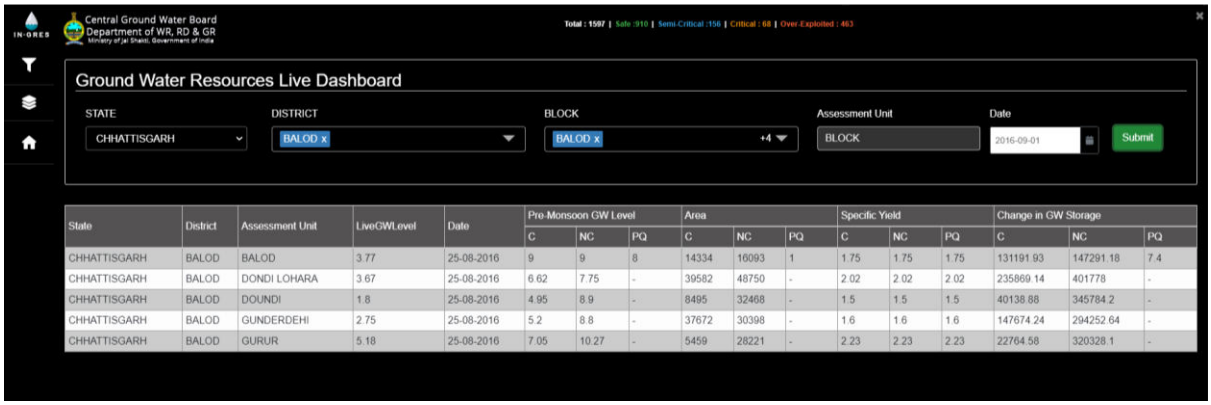
A = Area of Water Depletion Zones

Pre = Pre - monsoon Ground water level

Current = Current Ground water level

SY = Specific Yield

6.1.2 Mockups



State	District	Assessment Unit	LiveGWLevel	Date	Pre-Monsoon GW Level			Area			Specific Yield			Change in GW Storage		
					C	NC	PQ	C	NC	PQ	C	NC	PQ	C	NC	PQ
CHHATTISGARH	BALOD	BALOD	3.77	25-08-2016	9	9	8	14334	16093	1	1.75	1.75	1.75	131191.93	147291.18	7.4
CHHATTISGARH	BALOD	DONDI LOHARA	3.67	25-08-2016	6.62	7.75	-	39582	48750	-	2.02	2.02	2.02	235869.14	401778	-
CHHATTISGARH	BALOD	DOUNDI	1.8	25-08-2016	4.95	8.9	-	8495	32468	-	1.5	1.5	1.5	40138.88	345784.2	-
CHHATTISGARH	BALOD	GUNDERDEHI	2.75	25-08-2016	5.2	8.8	-	37672	30398	-	1.6	1.6	1.6	147674.24	294252.64	-
CHHATTISGARH	BALOD	GURUR	5.18	25-08-2016	7.05	10.27	-	5459	28221	-	2.23	2.23	2.23	22764.58	320328.1	-

Figure 82: Live Ground Water Dashboard mockup

6.2 Map comparison

6.2.1 Introduction

Map comparison allows user to compare the Ground water estimation done for two years. The GIS view shows the categorization at an assessment unit level. At the bottom there is an MIS View table showing the data for year 1, year 2 and also the percentage difference in the value between these two years. The header shows the summary of the assessment unit categorizations.

6.2.2 Mockups

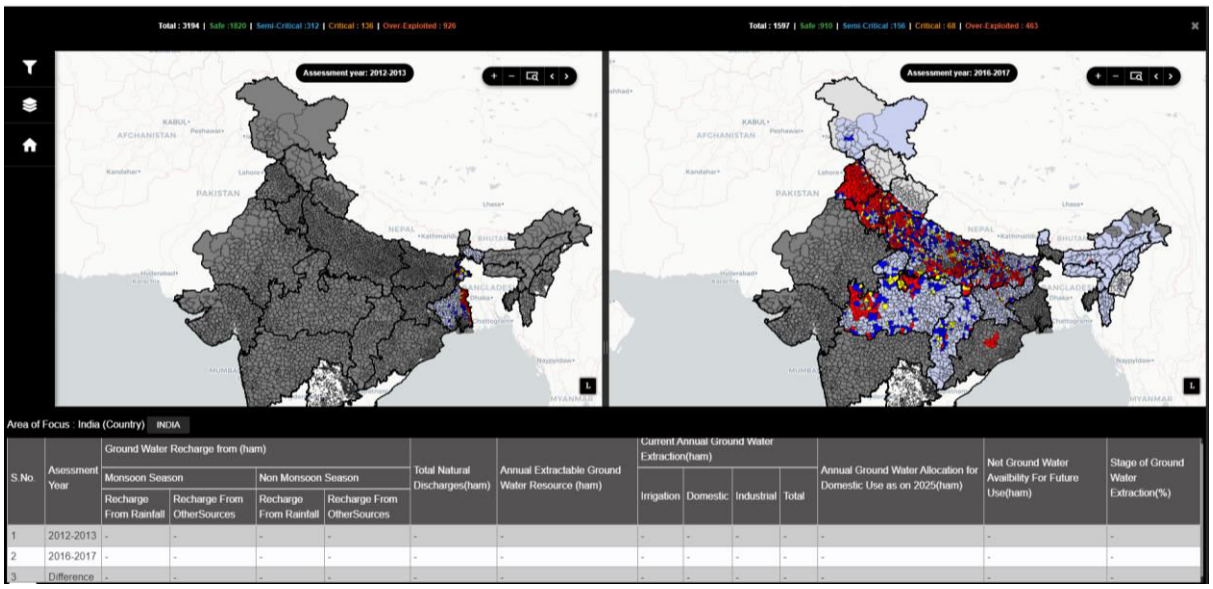


Figure 83: Map Comparison mockup

7.0 Reports

The download option in MIS View allows user to download reports in 6 formats:

7.1 Central Level Report

Central Level Report option allows user to download the state-wise district level data for an assessment year, computation type and view. The data is downloaded in MIS table format. All the calculated values are shown in ha.m.

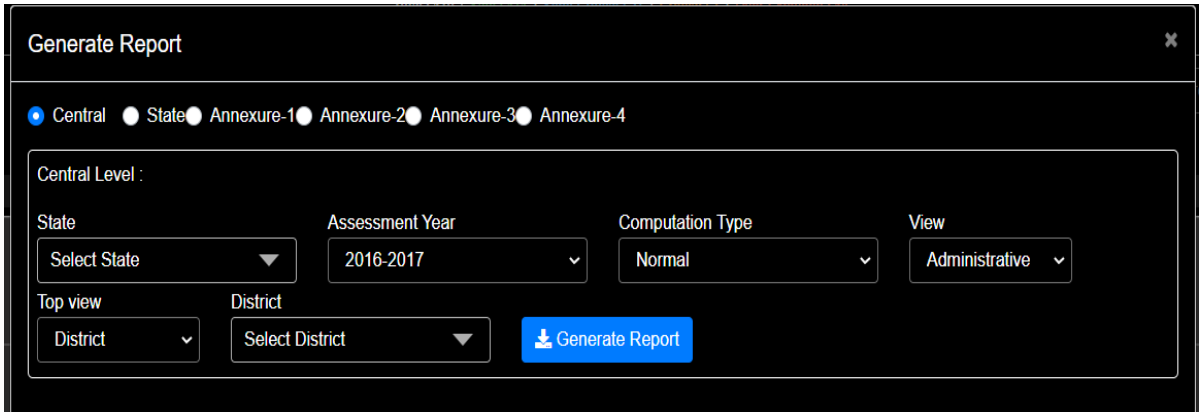


Figure 84: Central Level Report – Mockup

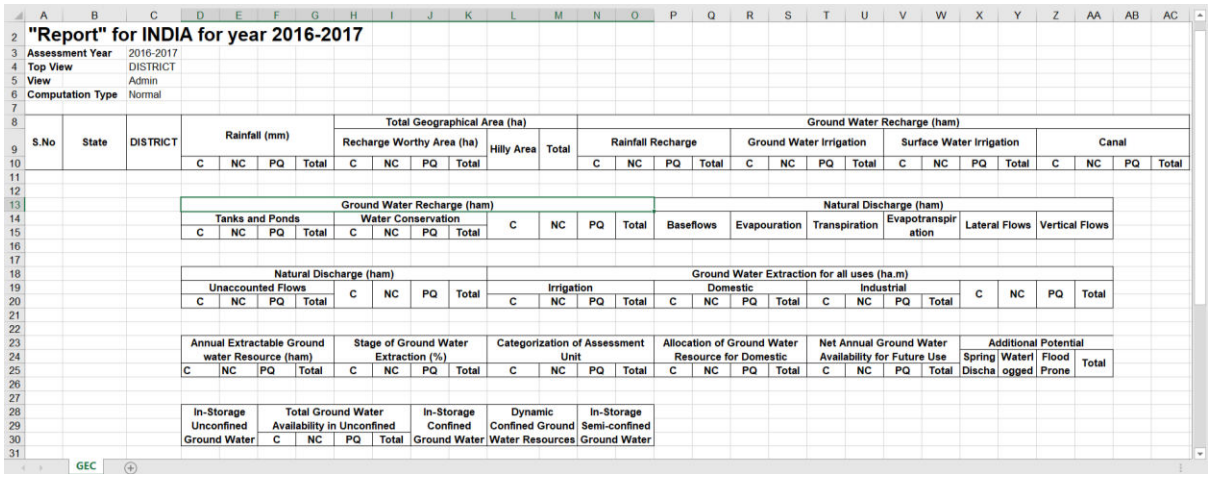


Figure 85: Central Level Report – Report Format

7.2 State Level Report

State Report option allows user to download the Assessment Unit-wise data for the selected state for an assessment year, computation type and view. The data is downloaded in MIS table format. All the calculated values are shown in ha.m.

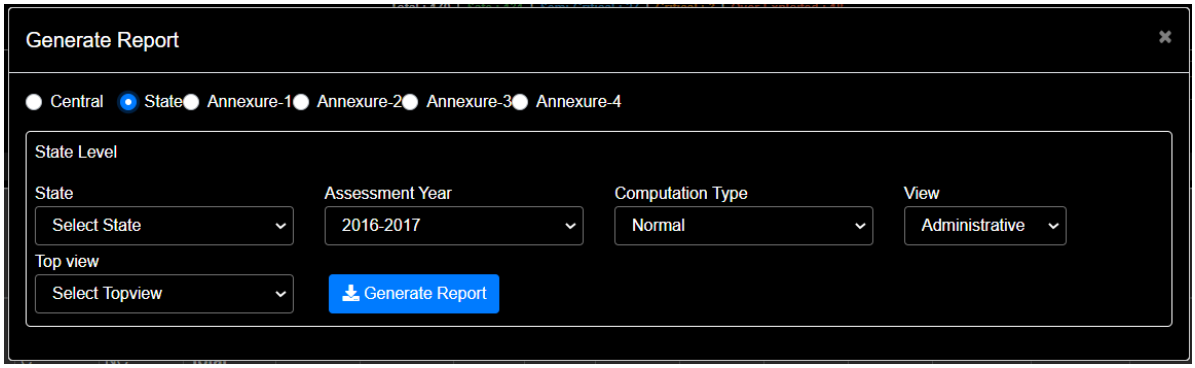


Figure 86: State Level Report – Mockup

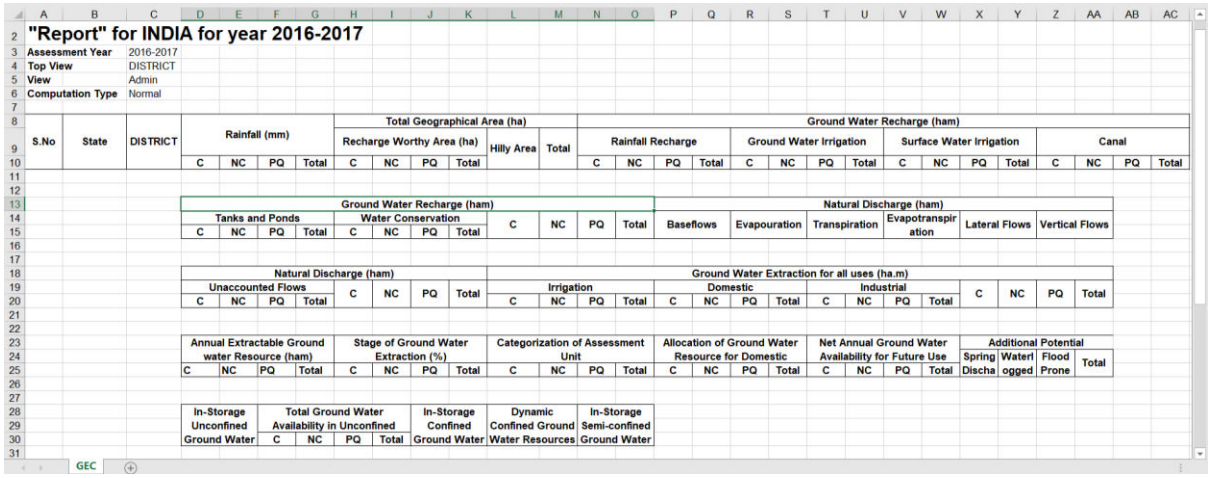


Figure 87: State Level Report – Report Format

7.3 CGWB Format – Annexure 1 – State-wise Resources

User can download the data in CGWB Annexure 1 format.

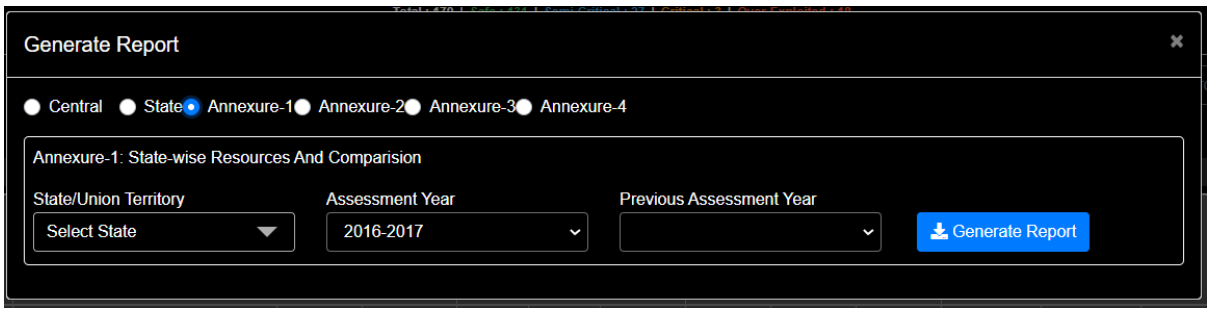


Figure 88: Annexure 1 – Mockup

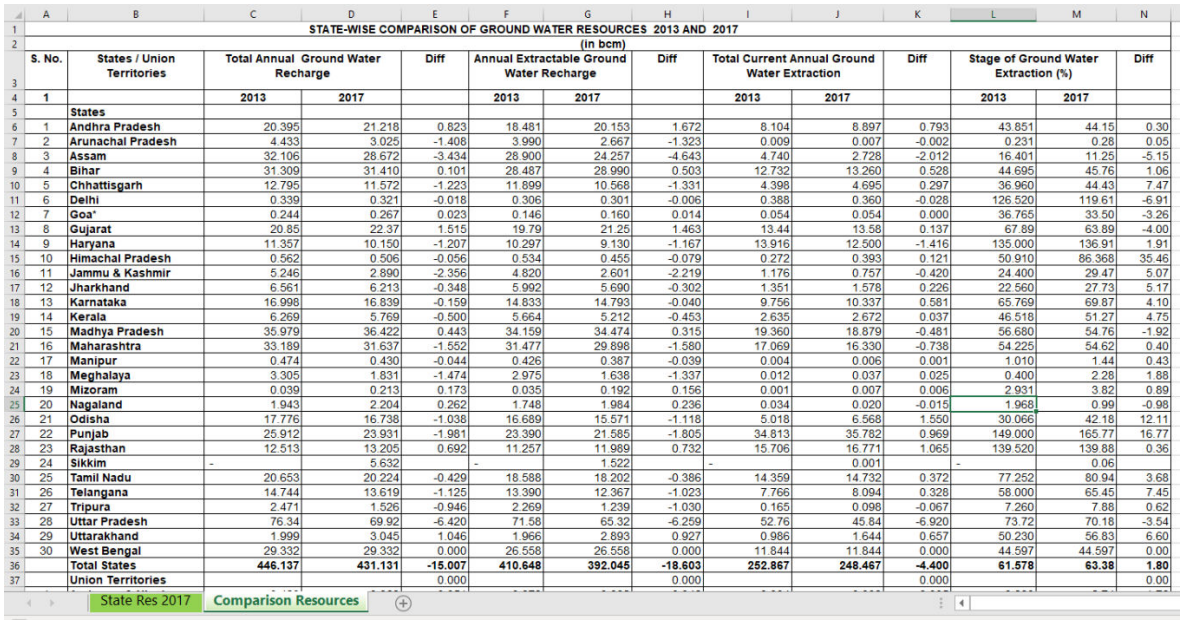
STATE-WISE DYNAMIC GROUND WATER RESOURCES OF INDIA, 2017

(in bcm)

S. No.	States / Union Territories	Ground Water Recharge					Total Natural Discharges	Annual Extractable Ground Water Resource	Current Annual Ground Water Extractio				Annual GW Allocation for for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)
		Monsoon Season		Non-monsoon Season		Total Annual Ground Water Recharge			Irrigation	Industrial	Domestic	Total			
		Recharge from rainfall	Recharge from other sources	Recharge from rainfall	Recharge from other sources										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	States														
1	Andhra Pradesh	9.96	5.62	1.21	4.42	21.22	1.07	20.15	7.85	0.14	0.90	8.90	1.48	12.31	44.15
2	Arunachal Pradesh	1.89	0.18	0.95	0.01	3.02	0.36	2.67	0.00	0.00	0.01	0.01	0.03	2.64	0.28
3	Assam	20.22	0.43	7.28	0.74	28.67	4.42	24.26	1.97	0.06	0.69	2.73	0.79	21.43	11.25
4	Bihar	19.83	3.95	3.14	4.50	31.41	2.43	28.99	10.78	0.66	1.83	13.26	1.83	15.78	45.76
5	Chhattisgarh	7.82	1.36	0.76	1.64	11.57	1.00	10.57	3.98	0.05	0.67	4.70	0.79	5.76	44.43
6	Delhi	0.13	0.06	0.03	0.11	0.32	0.02	0.30	0.09	0.02	0.24	0.36	0.29	0.02	119.61
7	Goa	0.19	0.03	0.01	0.05	0.27	0.11	0.16	0.02	*	0.03	0.05	0.04	0.07	33.50
8	Gujarat	15.95	3.40	0.00	3.02	22.37	1.12	21.25	12.84	0.11	0.63	13.58	0.90	7.98	63.89
9	Haryana	3.56	2.55	1.03	3.00	10.15	1.01	9.13	11.53	0.34	0.63	12.50	0.72	0.87	136.91
10	Himachal Pradesh	0.34	0.02	0.11	0.04	0.51	0.05	0.46	0.20	0.00	0.19	0.39	0.34	0.16	86.37
11	Jammu & Kashmir	1.00	0.50	0.88	0.51	2.89	0.29	2.60	0.20	0.07	0.50	0.76	0.50	1.84	29.47
12	Jharkhand	5.25	0.13	0.41	0.42	6.21	0.52	5.69	0.80	0.22	0.56	1.58	0.56	4.13	27.73
13	Karnataka	6.59	4.36	2.67	3.22	16.84	2.05	14.79	9.39	*	0.95	10.34	1.14	5.41	69.87
14	Kerala	3.91	0.04	0.68	1.13	5.77	0.56	5.21	1.22	0.01	1.44	2.67	1.57	2.41	51.27
15	Madhya Pradesh	27.10	1.51	0.82	6.99	36.42	1.95	34.47	17.43	0.22	1.24	18.88	1.72	15.84	54.76
16	Maharashtra	20.59	2.29	0.53	8.23	31.64	1.74	29.90	15.10	0.003	1.22	16.33	2.28	12.91	54.62
17	Manipur	0.23	0.01	0.17	0.02	0.43	0.04	0.39	0.00	0.00	0.00	0.01	0.04	0.34	1.44
18	Meghalaya	1.37	0.01	0.43	0.02	1.83	0.19	1.64	0.03	0.00	0.01	0.04	0.02	1.59	2.28
19	Mizoram	0.16	0.00	0.05	0.00	0.21	0.02	0.19	0.00	0.00	0.01	0.01	0.01	0.18	3.82
20	Nagaland	1.65	0.03	0.52	0.00	2.20	0.22	1.98	0.00	0.00	0.02	0.02	0.02	1.96	0.99
21	Odisha	10.53	2.34	1.50	2.37	16.74	1.17	15.57	5.28	0.14	1.15	6.57	1.30	8.85	42.18
22	Punjab	5.54	11.83	1.31	5.25	23.93	2.35	21.58	34.56	0.20	1.01	35.78	1.41	1.09	165.77
23	Rajasthan	9.74	0.78	0.24	2.44	13.21	1.22	11.99	14.85	0.00	1.92	16.77	2.67	0.88	139.88
24	Sikkim	5.20	0.00	0.43	0.00	5.63	4.11	1.52	0.00	0.00	0.00	0.00	0.01	1.51	0.06
25	Tamil Nadu	6.67	9.41	1.89	2.26	20.22	2.02	18.20	13.06	0.00	1.67	14.73	1.85	5.66	80.94
26	Telangana	7.56	1.42	1.88	2.76	13.62	1.25	12.37	7.09	*	1.00	8.09	1.39	4.26	65.45
27	Tripura	0.80	0.06	0.40	0.26	1.53	0.29	1.24	0.02	0.00	0.08	0.10	0.11	1.11	7.88
28	Uttar Pradesh	37.73	11.67	1.59	18.93	69.92	4.60	65.32	40.89	*	4.95	45.84	5.96	20.36	70.18
29	Uttarakhand	1.15	0.93	0.09	0.87	3.04	0.15	2.89	1.30	0.13	0.22	1.64	0.22	1.25	56.83
30	West Bengal**	18.71	1.51	5.26	3.85	29.33	2.77	26.56	10.84	*	1.00	11.84	1.53	14.19	44.60
	Total States	251.36	66.41	36.30	77.06	431.13	39.09	392.04	221.33	2.38	24.77	248.47	31.52	172.82	63.38
	Union Territories														

State Res 2017 | Comparison Resources

Figure 89: Annexure 1 – State Resources – Report Format



STATE-WISE COMPARISON OF GROUND WATER RESOURCES 2013 AND 2017

(in bcm)

S. No.	States / Union Territories	Total Annual Ground Water Recharge		Diff	Annual Extractable Ground Water Recharge		Diff	Total Current Annual Ground Water Extraction		Diff	Stage of Ground Water Extraction (%)		Diff
1		2013	2017		2013	2017		2013	2017		2013	2017	
	States												
1	Andhra Pradesh	20.395	21.218	0.823	18.481	20.153	1.672	8.104	8.897	0.793	43.851	44.15	0.30
2	Arunachal Pradesh	4.433	3.025	-1.408	3.990	2.667	-1.323	0.009	0.007	-0.002	0.231	0.28	0.05
3	Assam	32.106	28.672	-3.434	28.900	24.257	-4.643	4.740	2.728	-2.012	16.401	11.25	-5.15
4	Bihar	31.309	31.410	0.101	28.487	28.990	0.503	12.732	13.260	0.528	44.695	45.76	1.06
5	Chhattisgarh	12.795	11.572	-1.223	11.899	10.568	-1.331	4.398	4.695	0.297	36.960	44.43	7.47
6	Delhi	0.339	0.321	-0.018	0.306	0.301	-0.006	0.388	0.360	-0.028	126.520	119.61	-6.91
7	Goa*	0.244	0.267	0.023	0.146	0.160	0.014	0.054	0.054	0.000	36.765	33.50	-3.26
8	Gujarat	20.85	22.37	1.515	19.79	21.25	1.463	13.44	13.58	0.137	67.89	63.89	-4.00
9	Haryana	11.357	10.150	-1.207	10.297	9.130	-1.167	13.916	12.500	-1.416	135.000	136.91	1.91
10	Himachal Pradesh	0.562	0.506	-0.056	0.534	0.455	-0.079	0.272	0.393	0.121	50.910	86.368	35.46
11	Jammu & Kashmir	5.246	2.890	-2.356	4.820	2.601	-2.219	1.176	0.757	-0.420	24.400	29.47	5.07
12	Jharkhand	6.561	6.213	-0.348	5.992	5.690	-0.302	1.351	1.578	0.226	22.560	27.73	5.17
13	Karnataka	16.998	16.839	-0.159	14.833	14.793	-0.040	9.756	10.337	0.581	65.769	69.87	4.10
14	Kerala	6.269	5.769	-0.500	5.664	5.212	-0.453	2.635	2.672	0.037	46.518	51.27	4.75
15	Madhya Pradesh	35.979	36.422	0.443	34.159	34.474	0.315	19.360	18.879	-0.481	56.680	54.76	-1.92
16	Maharashtra	33.189	31.637	-1.552	31.477	29.898	-1.580	17.069	16.330	-0.738	54.225	54.62	0.40
17	Manipur	0.474	0.430	-0.044	0.426	0.387	-0.039	0.004	0.006	0.001	1.010	1.44	0.43
18	Meghalaya	3.305	1.831	-1.474	2.975	1.638	-1.337	0.012	0.037	0.025	0.400	2.28	1.88
19	Mizoram	0.039	0.213	0.173	0.035	0.192	0.156	0.001	0.007	0.006	2.931	3.82	0.89
20	Nagaland	1.943	2.204	0.262	1.748	1.984	0.236	0.034	0.020	-0.015	1.968	0.99	-0.98
21	Odisha	17.776	16.738	-1.038	16.689	15.571	-1.118	5.018	6.568	1.550	30.066	42.18	12.11
22	Punjab	25.912	23.931	-1.981	23.390	21.585	-1.805	34.813	35.782	0.969	149.000	165.77	16.77
23	Rajasthan	12.513	13.205	0.692	11.257	11.989	0.732	15.706	16.771	1.065	139.520	139.88	0.36
24	Sikkim	-	5.632		-	1.522		-	0.001		-	0.06	
25	Tamil Nadu	20.653	20.224	-0.429	18.588	18.202	-0.386	14.359	14.732	0.372	77.252	80.94	3.68
26	Telangana	14.744	13.619	-1.125	13.390	12.367	-1.023	7.766	8.094	0.328	58.000	65.45	7.45
27	Tripura	2.471	1.526	-0.946	2.269	1.239	-1.030	0.165	0.098	-0.067	7.260	7.88	0.62
28	Uttar Pradesh	76.34	69.92	-6.420	71.58	65.32	-6.259	52.76	45.84	-6.920	73.72	70.18	-3.54
29	Uttarakhand	1.999	3.045	1.046	1.966	2.893	0.927	0.986	1.644	0.657	50.230	56.83	6.60
30	West Bengal	29.332	29.332	0.000	26.558	26.558	0.000	11.844	11.844	0.000	44.597	44.597	0.00
	Total States	**446.137**	**431.131**	**-15.007**	**410.648**	**392.045**	**-18.603**	**252.867**	**248.467**	**-4.400**	**61.578**	**63.38**	**1.80**
	Union Territories			0.000			0.000			0.000			0.00

State Res 2017 | Comparison Resources

Figure 90: Annexure 1 – Comparison Resources – Report Format

7.4 CGWB Format – Annexure 2 – District-wise Resources

User can download the data in CGWB Annexure 2 format.

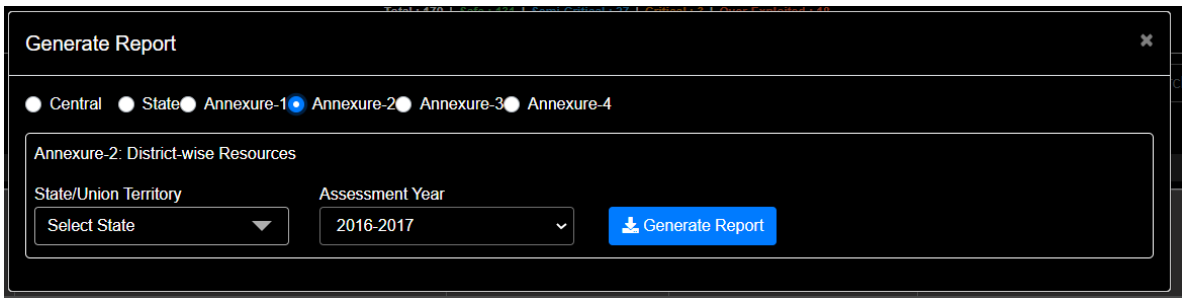


Figure 91: Annexure 2 – Mockup

DYNAMIC GROUND WATER RESOURCES OF INDIA, 2017

ANDHRA PRADESH

S. No.	District	Ground Water Recharge					Total Natural Discharges	Annual Extractable Ground Water Resource	Current Annual Ground Water Extraction				Annual GW Allocation for for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)
		Monsoon Season		Non-monsoon Season		Total Annual Ground Water Recharge			Irrigation	Industrial	Domestic	Total			
		Recharge from rainfall	Recharge from other sources	Recharge from rainfall	Recharge from other sources										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	States														
1	Anantapur	89200.23	46136.12	1013.97	50415.31	186765.62	9338.31	177427.31	142953.85	612.86	14272.07	157838.79	21623.75	59410.09	88.96
2	Chittoor	115718.55	32389.60	1204.19	38028.60	187340.94	9367.06	177973.88	95256.50	838.80	8758.49	104853.79	13528.83	80858.36	58.92
3	East Godavari	104140.05	95383.56	3714.55	50847.53	254085.69	12704.33	241381.36	41688.32	6101.44	3316.71	51106.47	4226.85	193656.03	21.17
4	Guntur	52942.86	57011.90	2547.96	18800.39	131303.10	6565.15	124737.95	39174.72	119.02	8823.34	48117.07	14159.10	79051.91	38.57
5	Kadapa	93311.68	15869.52	2048.53	11177.61	122407.34	6120.40	116286.94	74888.06	1240.70	3733.71	79862.47	6110.25	56568.63	68.68
6	Krishna	52891.68	70806.39	21641.60	17375.91	162715.57	8135.80	154579.78	47223.03	3360.60	6412.20	56995.83	7402.78	98790.07	36.87
7	Kurnool	90024.09	43892.80	1203.46	26774.23	161894.57	8094.75	153799.81	53291.48	510.30	10498.38	64300.17	16377.90	94278.99	41.81
8	Nellore	128089.98	46637.76	5.16	93668.83	268401.73	13420.14	254981.59	90301.92	221.04	6187.09	96710.05	11024.36	159531.34	37.93
9	Prakasam	39372.56	26669.85	56344.85	36593.00	158980.26	7949.05	151031.21	54372.39	467.91	9789.35	64629.64	17557.06	94941.54	42.79
10	Srikakulam	34847.68	35719.34	17837.37	19681.53	108086.91	5404.34	102681.56	40762.37	302.49	8445.49	49510.36	17007.28	63919.93	48.22
11	Visakhapatnam	61906.83	10809.63	6823.31	2690.68	82230.45	4538.54	77691.90	12608.08	201.48	6296.00	19104.57	7980.54	59560.86	24.59
12	Vizianagaram	59226.39	21945.67	6795.38	17486.23	105453.67	5272.77	100180.90	20595.54	47.68	463.74	21106.97	4922.00	77587.51	21.07
13	West Godavari	74662.56	58478.66	48.11	58931.01	192120.35	9606.03	182514.32	71924.15	381.24	3261.65	75567.04	6028.80	113241.04	41.40
	Total (Ham)	996335.139	561750.790	121228.409	442470.837	2121785.174	106516.652	2015268.516	785040.421	14405.5630	90257.225	889703.213	147949.501	1231396.289	44.15
	Total (Bcm)	9.963	5.618	1.212	4.425	21.218	1.065	20.153	7.850	0.144	0.903	8.897	1.479	12.314	44.15

DYNAMIC GROUND WATER RESOURCES OF INDIA, 2017

ARUNACHAL PRADESH

S. No.	District	Ground Water Recharge					Total Natural Discharges	Annual Extractable Ground Water Resources	Current Annual Ground Water Extraction				Annual GW Allocation for for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)
		Monsoon Season		Non-monsoon Season		Total Annual Ground Water Recharge			Irrigation	Industrial	Domestic	Total			
		Recharge from rainfall	Recharge from other sources	Recharge from rainfall	Recharge from other sources										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Anjaw	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area
2	Changlang	12375.64	696.00	13629.49	71.16	26772.29	2849.44	23922.85	0.00	0.00	174.00	174.00	671.87	23350.98	0.73
3	Dibang Valley	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area
4	East Kameng	7281.63	233.00	2413.44	0.00	9928.07	992.81	8935.26	0.00	0.00	25.00	25.00	169.06	8766.20	0.28
5	East Siang	56206.01	5327.00	20135.02	670.93	82338.96	13307.12	69031.84	0.00	0.00	65.00	65.00	176.16	68855.68	0.09
6	Kurung Kumey	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area
7	Lohit	55018.30	2311.00	31078.96	0.00	88408.26	8840.83	79567.43	0.00	0.48	218.00	218.48	666.00	78900.96	0.27
8	Lower Dibang Valley	39162.24	1749.00	20240.30	0.00	61151.54	6115.15	55036.39	0.00	0.00	32.00	32.00	62.40	54973.98	0.06
9	Lower Subansiri	1358.90	1227.00	729.69	78.74	3394.33	738.65	2655.68	0.00	0.00	18.00	18.00	105.20	2550.48	0.68
10	Papum Pare	6076.25	1950.00	3165.94	3.53	11195.72	1449.26	9746.46	0.00	14.40	85.00	99.40	492.34	9239.72	1.02

State Res 2017 | Sheet3

Figure 92: Annexure 2 – Report Format

7.5 CGWB Format – Annexure 3 – Categorization

User can download the data in CGWB Annexure 3 format.

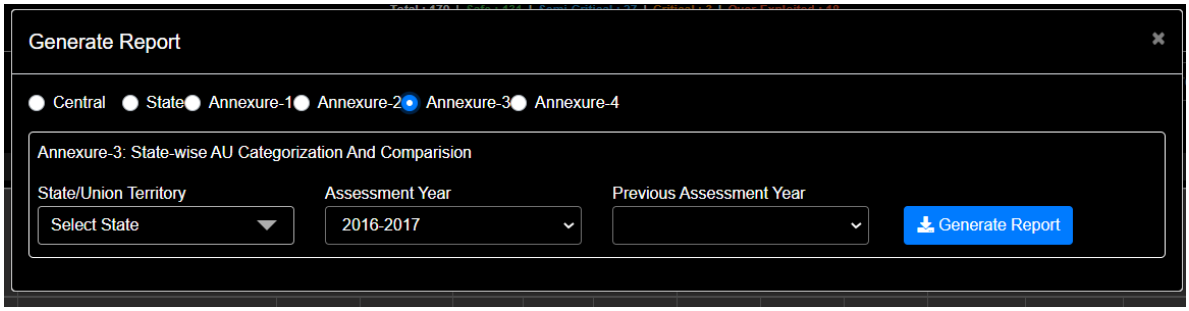


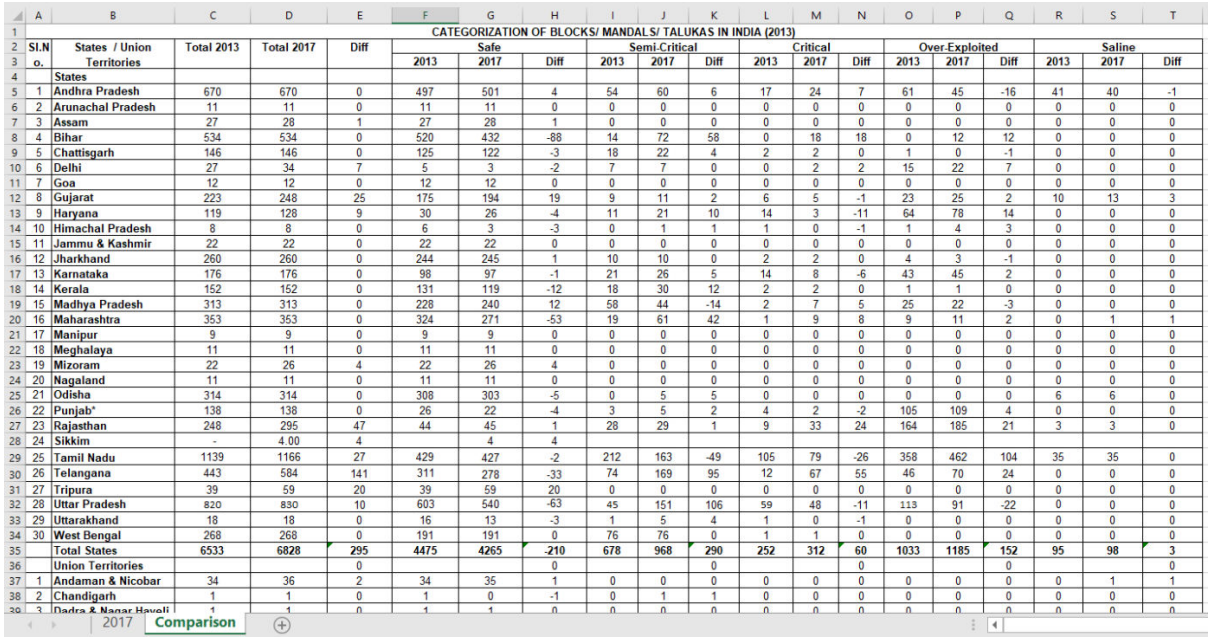
Figure 93: Annexure 3 – Mockup

CATEGORIZATION OF BLOCKS/ MANDALS/ TALUKAS IN INDIA (2017)

S.No.	States / Union Territories	Total No. of Assessed	Safe		Semi-Critical		Critical		Over-Exploited		Saline	
			Nos.	%	Nos.	%	Nos.	%	Nos.	%	Nos.	%
	States											
1	Andhra Pradesh	670	501	75	60	9	24	4	45	7	40	6
2	Arunachal Pradesh	11	11	100	0	0	0	0	0	0	0	0
3	Assam	28	28	100	0	0	0	0	0	0	0	0
4	Bihar	534	432	81	72	13	18	3	12	2	0	0
5	Chattisgarh	146	122	84	22	15	2	1	0	0	0	0
6	Delhi	34	3	9	7	21	2	6	22	65	0	0
7	Goa	12	12	100	0	0	0	0	0	0	0	0
8	Gujarat	249	194	78	11	4	5	2	25	10	13	5
9	Haryana	128	26	20	21	16	3	2	78	61	0	0
10	Himachal Pradesh	8	3	38	1	13	0	0	4	50	0	0
11	Jammu & Kashmir	22	22	100	0	0	0	0	0	0	0	0
12	Jharkhand	260	245	94	10	4	2	1	3	1	0	0
13	Karnataka	176	97	55	26	15	8	5	45	26	0	0
14	Kerala	152	119	78	30	20	2	1	1	1	0	0
15	Madhya Pradesh	313	240	77	44	14	7	2	22	7	0	0
16	Maharashtra	353	271	77	61	17	9	3	11	3	1	0
17	Manipur	9	9	100	0	0	0	0	0	0	0	0
18	Meghalaya	11	11	100	0	0	0	0	0	0	0	0
19	Mizoram	26	26	100	0	0	0	0	0	0	0	0
20	Nagaland	11	11	100	0	0	0	0	0	0	0	0
21	Odisha	314	303	96	5	2	0	0	0	0	6	2
22	Punjab	138	22	16	5	4	2	1	109	79	0	0
23	Rajasthan	295	45	15	29	10	33	11	185	63	3	1
24	Sikkim	4	4	100	0	0	0	0	0	0	0	0
25	Tamil Nadu	1166	427	37	163	14	79	7	462	40	35	3
26	Telangana	584	276	48	169	29	67	11	70	12	0	0
27	Tripura	59	59	100	0	0	0	0	0	0	0	0
28	Uttar Pradesh'	830	540	65	151	18	48	6	91	11	0	0
29	Uttarakhand	16	13	72	5	28	0	0	0	0	0	0
30	West Bengal ''	268	191	71	76	28	1	0	0	0	0	0
	Total States	6828	4265	62	968	14	312	5	1185	17	98	1

2017 | Comparison

Figure 94: Annexure 3 – Categorization – Report Format



CATEGORIZATION OF BLOCKS/ MANDALS/ TALUKAS IN INDIA (2013)

Sl.No.	States / Union Territories	Total 2013	Total 2017	Diff	Safe			Semi-Critical			Critical			Over-Exploited			Saline		
					2013	2017	Diff	2013	2017	Diff	2013	2017	Diff	2013	2017	Diff	2013	2017	Diff
	States																		
1	Andhra Pradesh	670	670	0	497	501	4	54	60	6	17	24	7	61	45	-16	41	40	-1
2	Arunachal Pradesh	11	11	0	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Assam	27	28	1	27	28	1	0	0	0	0	0	0	0	0	0	0	0	0
4	Bihar	534	534	0	520	432	-88	14	72	58	0	18	18	0	12	12	0	0	0
5	Chattisgarh	146	146	0	125	122	-3	18	22	4	2	2	0	1	0	-1	0	0	0
6	Delhi	27	34	7	5	3	-2	7	7	0	0	2	2	15	22	7	0	0	0
7	Goa	12	12	0	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Gujarat	223	248	25	175	194	19	9	11	2	6	5	-1	23	25	2	10	13	3
9	Haryana	119	128	9	30	26	-4	11	21	10	14	3	-11	64	78	14	0	0	0
10	Himachal Pradesh	8	8	0	6	3	-3	0	1	1	1	0	-1	1	4	3	0	0	0
11	Jammu & Kashmir	22	22	0	22	22	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Jharkhand	260	260	0	244	245	1	10	10	0	2	2	0	4	3	-1	0	0	0
13	Karnataka	176	176	0	98	97	-1	21	26	5	14	8	-6	43	45	2	0	0	0
14	Kerala	152	152	0	131	119	-12	18	30	12	2	2	0	1	1	0	0	0	0
15	Madhya Pradesh	313	313	0	228	240	12	58	44	-14	2	7	5	25	22	-3	0	0	0
16	Maharashtra	353	353	0	324	271	-53	19	61	42	1	9	8	9	11	2	0	1	1
17	Manipur	9	9	0	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Meghalaya	11	11	0	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0
19	Mizoram	22	26	4	22	26	4	0	0	0	0	0	0	0	0	0	0	0	0
20	Nagaland	11	11	0	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0
21	Odisha	314	314	0	308	303	-5	0	5	5	0	0	0	0	0	0	6	6	0
22	Punjab*	138	138	0	26	22	-4	3	5	2	4	2	-2	105	109	4	0	0	0
23	Rajasthan	248	295	47	44	45	1	28	29	1	9	33	24	164	185	21	3	3	0
24	Sikkim	-	4.00	4		4	4												
25	Tamil Nadu	1139	1166	27	429	427	-2	212	163	-49	105	79	-26	358	462	104	35	35	0
26	Telangana	443	584	141	311	278	-33	74	169	95	12	67	55	46	70	24	0	0	0
27	Tripura	39	59	20	39	59	20	0	0	0	0	0	0	0	0	0	0	0	0
28	Uttar Pradesh	820	830	10	603	540	-63	45	151	106	59	48	-11	113	91	-22	0	0	0
29	Uttarakhand	18	18	0	16	13	-3	1	5	4	1	0	-1	0	0	0	0	0	0
30	West Bengal	268	268	0	191	191	0	76	76	0	1	1	0	0	0	0	0	0	0
	Total States	6533	6828	295	4475	4265	-210	678	968	290	252	312	60	1033	1185	152	95	98	3
	Union Territories			0			0			0			0			0			0
1	Andaman & Nicobar	34	36	2	34	35	1	0	0	0	0	0	0	0	0	0	0	1	1
2	Chandigarh	1	1	0	1	0	-1	0	1	1	0	0	0	0	0	0	0	0	0
3	Dadra & Nagar Haveli	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0

2017 Comparison

Figure 95: Annexure 3 – Comparison – Report Format

7.6 CGWB Format – Annexure 4 – List of Categorization

User can download the data in CGWB Annexure 4 format.

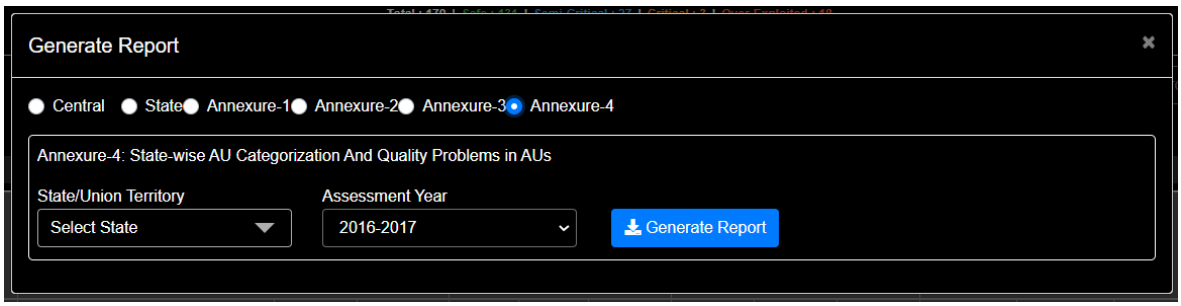


Figure 96: Annexure 4 – Mockup

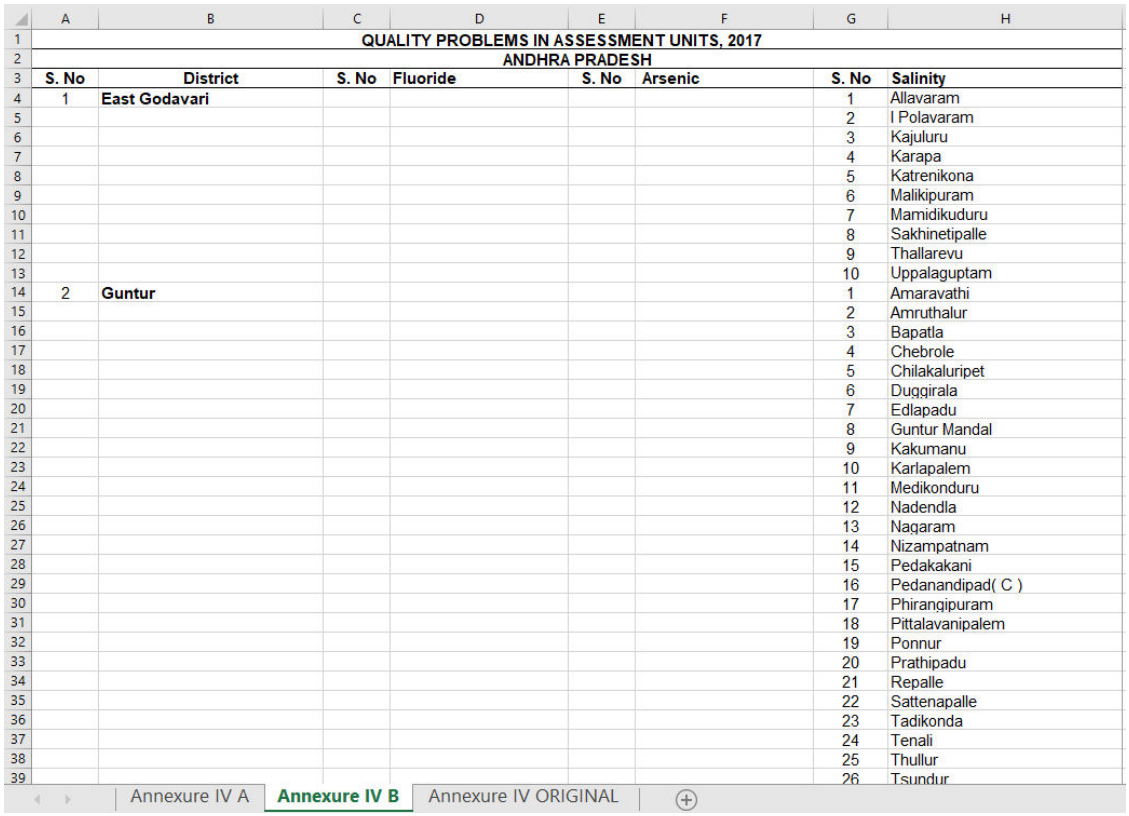
CATEGORIZATION of ASSESSMENT UNITS, 2017

ANDHRA PRADESH

S. No	District	S. No	Semi-Critical	S. No	Critical	S. No	Over-Exploited
1	Anantapur	1	Kudair	1	Puttaparthi	1	Tadpatri
		2	Kundurpi	2	Brahmasamudram	2	Kothacheruvu
		3	Somandepalle	3	Obuladevaracheruvu	3	Roddam
		4	Lepakshi	4	Nallacheruvu	4	Hindupur
		5	Tadimarri	5	Kambadur	5	Gudibanda
		6	Mudigubba			6	Amadagur
		7	Atmakur			7	Chilamathur
						8	Talupula
						9	Agali
						10	Tanakal
						11	Yadiki
						12	Putlur
						13	Yellanur
						14	Gandlapenta
						15	Rolla
						16	Madakasira
						17	Parigi
						18	Amarapuram
						19	Gorantla
						20	Nallamada
						21	Settur
2	Chittoor	1	Vadamalapeta	1	Pakala	1	Puthalapattu
		2	Chittoor Mandal	2	Pulicherla	2	Ramasamudram
		3	Kalikiri	3	Ramachandrapuram	3	Tirupati
		4	Guramkonda	4	Santhi Puram	4	Nindra
		5	Palasamudram	5	Srirangarajapuram	5	Gudi Palle
		6	Baireddi Palle	6	Venkatagiri Kota		
		7	Karvetinagar	7	Thavanampalle		
		8	Pileru	8	Penumuru		
		9	Gangadhara Nellore	9	Pedda Panjani		

Annexure IV A | Annexure IV B | Annexure IV ORIGINAL

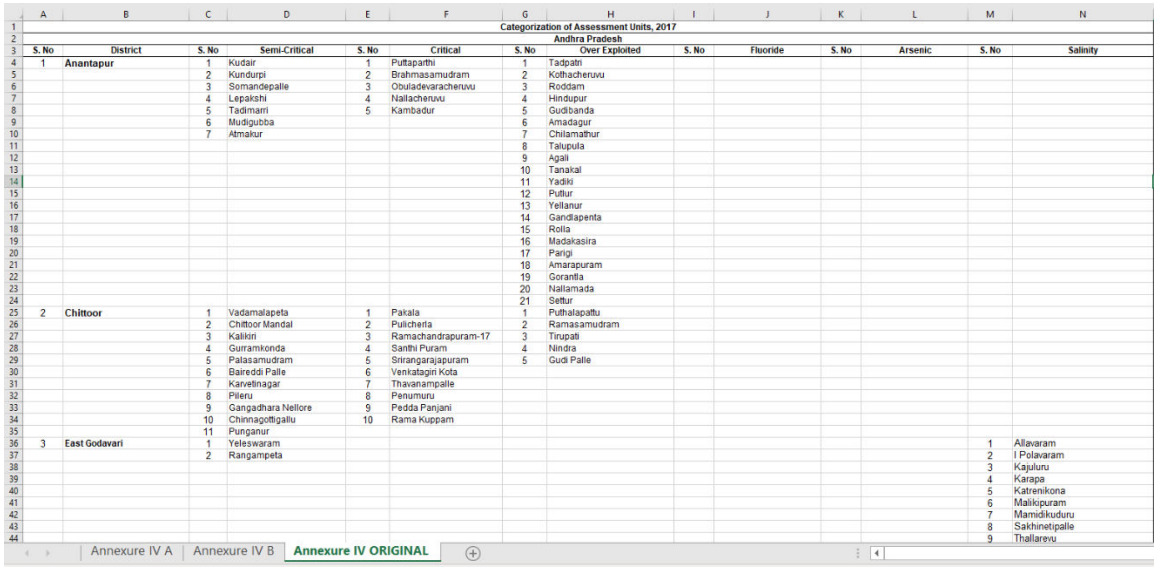
Figure 97: Annexure 4 – Annexure IV A – Report Format



	A	B	C	D	E	F	G	H
1	QUALITY PROBLEMS IN ASSESSMENT UNITS, 2017							
2	ANDHRA PRADESH							
3	S. No	District	S. No	Fluoride	S. No	Arsenic	S. No	Salinity
4	1	East Godavari					1	Allavaram
5							2	I Polavaram
6							3	Kajuluru
7							4	Karapa
8							5	Katrenikona
9							6	Malikipuram
10							7	Mamidikuduru
11							8	Sakhinetipalle
12							9	Thallarevu
13							10	Uppalaguptam
14	2	Guntur					1	Amaravathi
15							2	Amruthalur
16							3	Bapatla
17							4	Chebrole
18							5	Chilakaluripet
19							6	Duggirala
20							7	Edlapadu
21							8	Guntur Mandal
22							9	Kakumanu
23							10	Karlapalem
24							11	Medikonduru
25							12	Nadendla
26							13	Nagaram
27							14	Nizampatnam
28							15	Pedakakani
29							16	Pedanandipad(C)
30							17	Phirangipuram
31							18	Pittalavanipalem
32							19	Ponnur
33							20	Prathipadu
34							21	Repalle
35							22	Sattenapalle
36							23	Tadikonda
37							24	Tenali
38							25	Thullur
39							26	Tsundur

Annexure IV A | **Annexure IV B** | Annexure IV ORIGINAL

Figure 98: Annexure 4 – Annexure IV B – Report Format



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Categorization of Assessment Units, 2017													
2	Andhra Pradesh													
3	S. No	District	S. No	Semi-Critical	S. No	Critical	S. No	Over Exploited	S. No	Fluoride	S. No	Arsenic	S. No	Salinity
4	1	Anantapur	1	Kudair	1	Puttaparthi	1	Tadpatri						
5			2	Kundurpi	2	Brahmasamudram	2	Kothacheruvu						
6			3	Somandepalle	3	Obuladevaracheruvu	3	Roddam						
7			4	Lepakshi	4	Nallacheruvu	4	Hindupur						
8			5	Tadimarri	5	Kambadur	5	Gudibanda						
9			6	Mudigubba			6	Amadagur						
10			7	Atmakur			7	Chilamathur						
11							8	Talupula						
12							9	Agali						
13							10	Tanakal						
14							11	Yadiki						
15							12	Putlur						
16							13	Yellanur						
17							14	Gandlapenta						
18							15	Rolla						
19							16	Madakasira						
20							17	Parigi						
21							18	Amarapuram						
22							19	Gorantla						
23							20	Nallamada						
24							21	Settur						
25	2	Chittoor	1	Vadamalapeta	1	Pakala	1	Puthalapattu						
26			2	Chittoor Mandal	2	Pulicherla	2	Ramasamudram						
27			3	Kalikiri	3	Ramachandrapuram-17	3	Tirupati						
28			4	Gurramkonda	4	Santhi Puram	4	Nindra						
29			5	Palasamudram	5	Srirangarajapuram	5	Gudi Palle						
30			6	Baireddi Palle	6	Venkatagiri Kota								
31			7	Karvetinagar	7	Thavanampalle								
32			8	Pileru	8	Penumuru								
33			9	Gangadhara Nellore	9	Pedda Panjani								
34			10	Chinnagottigallu	10	Rama Kuppam								
35			11	Punganur										
36	3	East Godavari	1	Yeleswaram									1	Allavaram
37			2	Rangampeta									2	I Polavaram
38													3	Kajuluru
39													4	Karapa
40													5	Katrenikona
41													6	Malikipuram
42													7	Mamidikuduru
43													8	Sakhinetipalle
44													9	Thallarevu

Annexure IV A | Annexure IV B | **Annexure IV ORIGINAL**

Figure 99: Annexure 4 – Annexure IV Original – Report Format

7.7 Custom Report

Custom reports allow user to generate report for a specific assessment unit which fall under a certain criterion. User has an option to define ranges for Recharge Worthy Area, Annual Rainfall, Ground Water Recharge, Ground Water Extraction and Stage of Extraction. User also has an option to choose to download the report for a specific Category. Custom Report option is provided in the Report Download option in MIS View

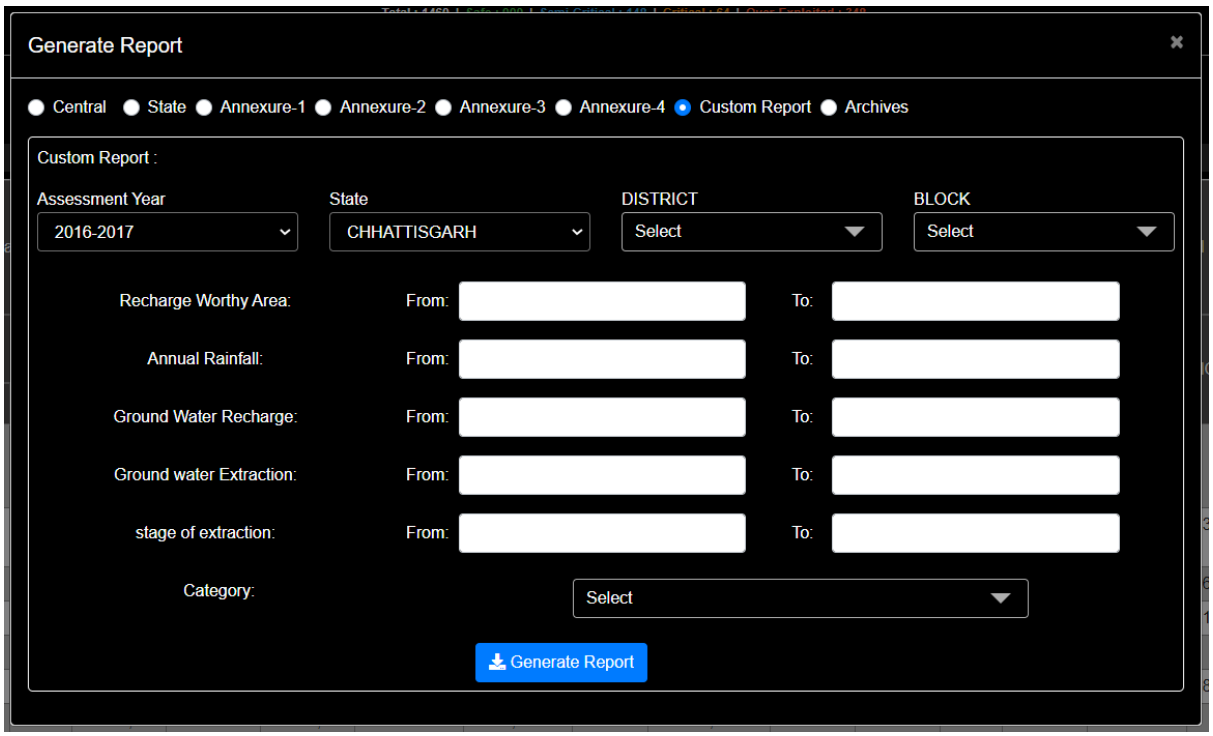


Figure 100: Customer Report – Mockup

8.0 User Logins

8.1 Introduction

India GEC has 7 different levels of users who can submit, view and approve the data submitted by the Field User.

Apart from Field User, all other users have an Approvals Tab. This tab gives the brief information about the Assessment Unit/State in approval process. Details such as assessment unit name, type and category are shown here.

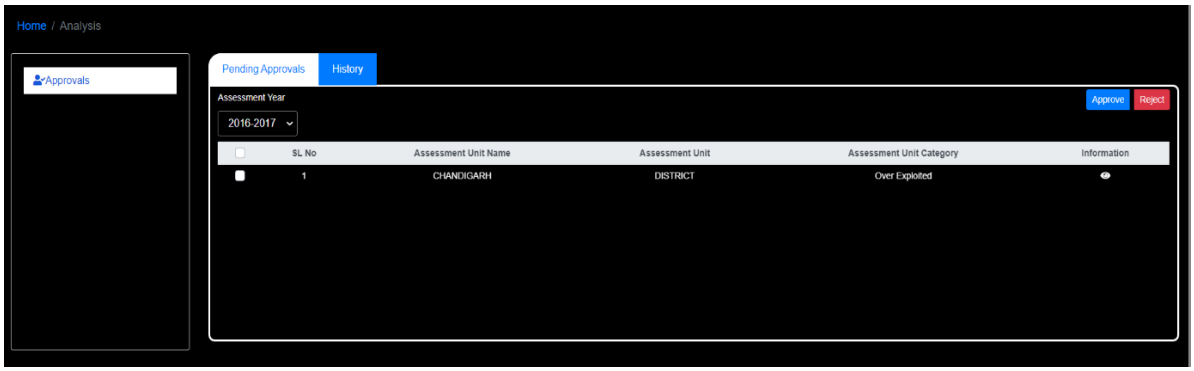


Figure 101: Pending Approvals Tab

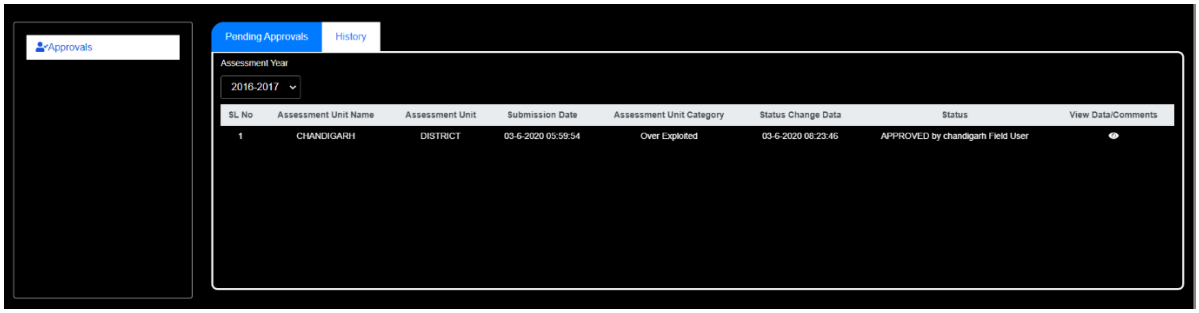


Figure 102: History Tab

On pressing the eye icon under “Information” user can see the following details:

a) **Uploaded Excel Sheets** – This shows the data sheets uploaded by the field user

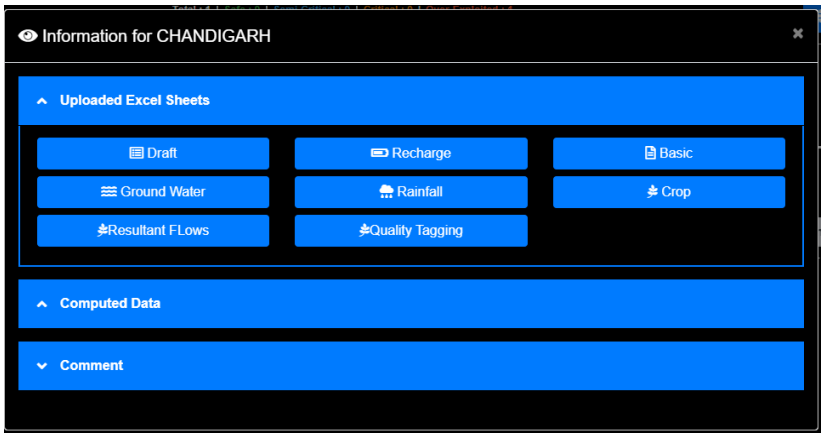


Figure 103: View Data – Uploaded Excel Sheets

b) **Computed Data** – This shows the computed data which after approval will be shown on GIS and MIS view

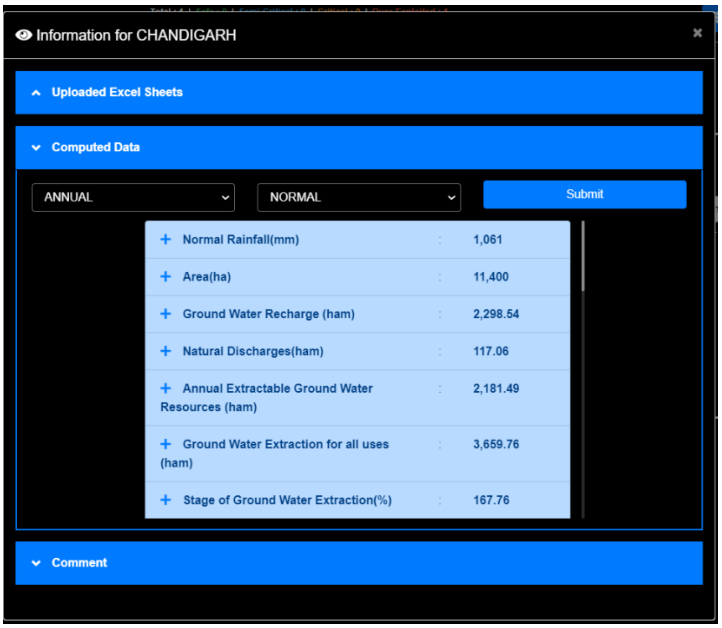


Figure 104: View Data – Computed Data

c) **Comments** – This shows the comments given by the users while approving or rejecting the data

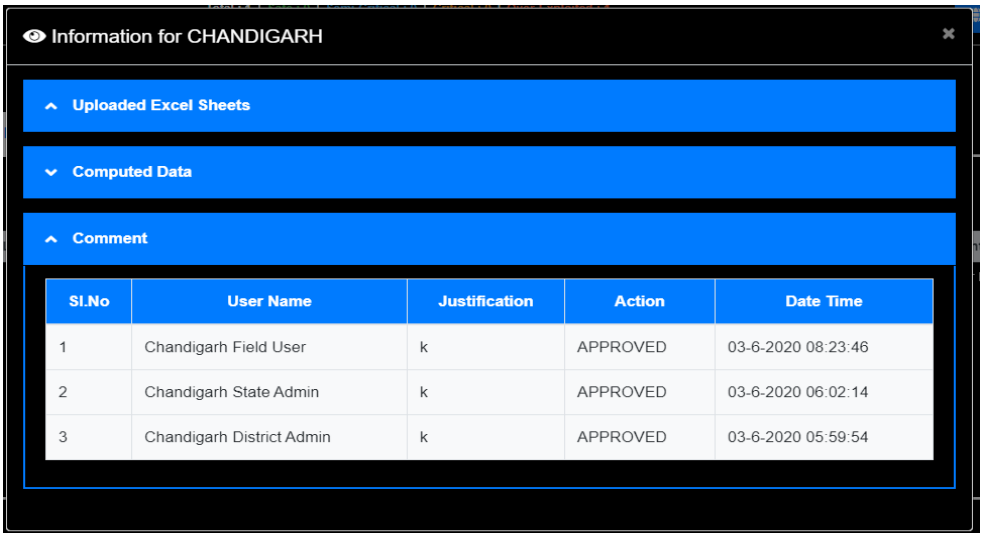


Figure 105: View Data - Comments

8.2 Field User Login

8.2.1 Approvals Tab

This tab shows the list of assessment unit for which the data computation is done and are ready for approvals.

Figure 106: Field User Login – Approvals Tab

8.2.2 Excel Download Tab

In this tab, user can download the templates for various data sheets.

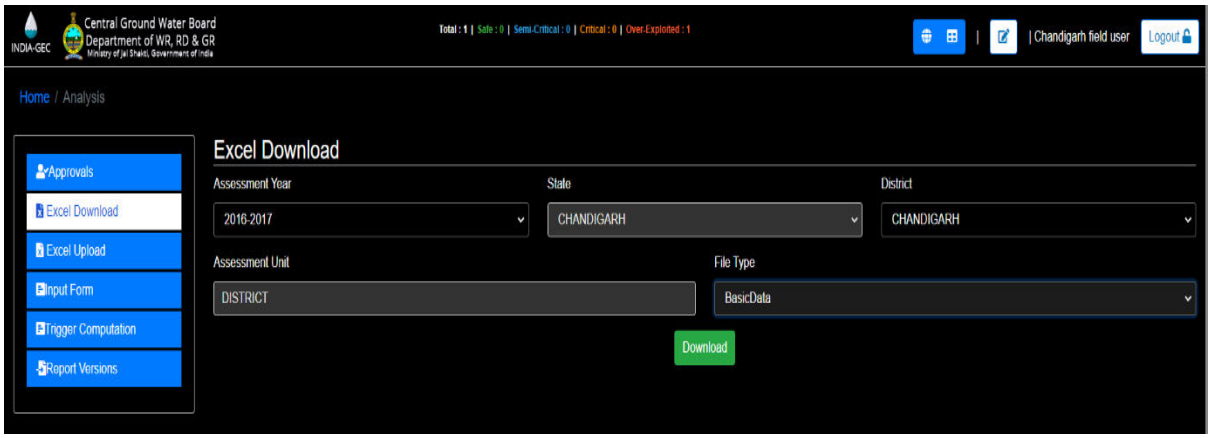


Figure 107: Field User Login – Excel Download Tab

8.2.3 Excel Upload Tab

In this tab, user can upload the filled data sheets.

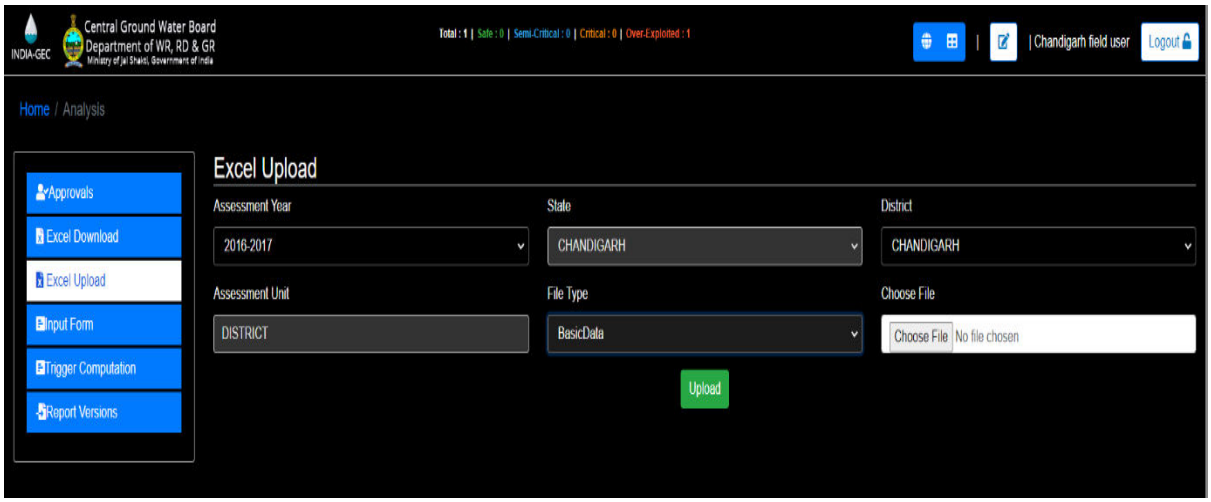


Figure 108: Field User Login – Excel Upload Tab

8.2.4 Input Form Tab

In this tab, user can submit the data using Input Forms.

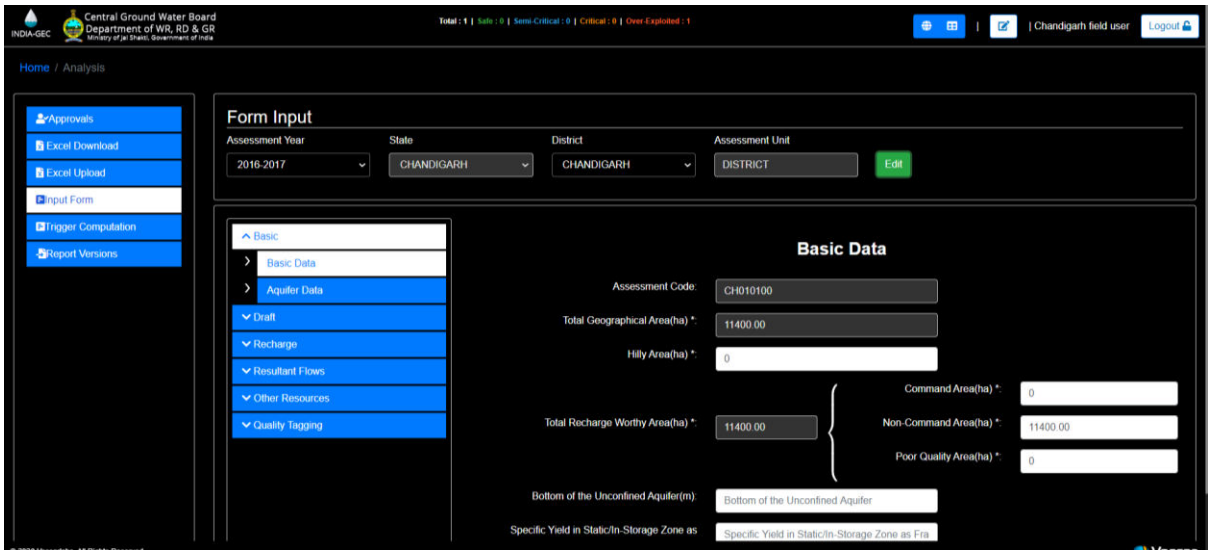


Figure 109: Field User Login – Input Form Tab

8.2.5 Trigger Computation Tab

Once user has submitted the data by either of the method, user needs to trigger the computations for the data. As soon as the trigger gets completed the assessment units along with computed will appear in Approvals tab.

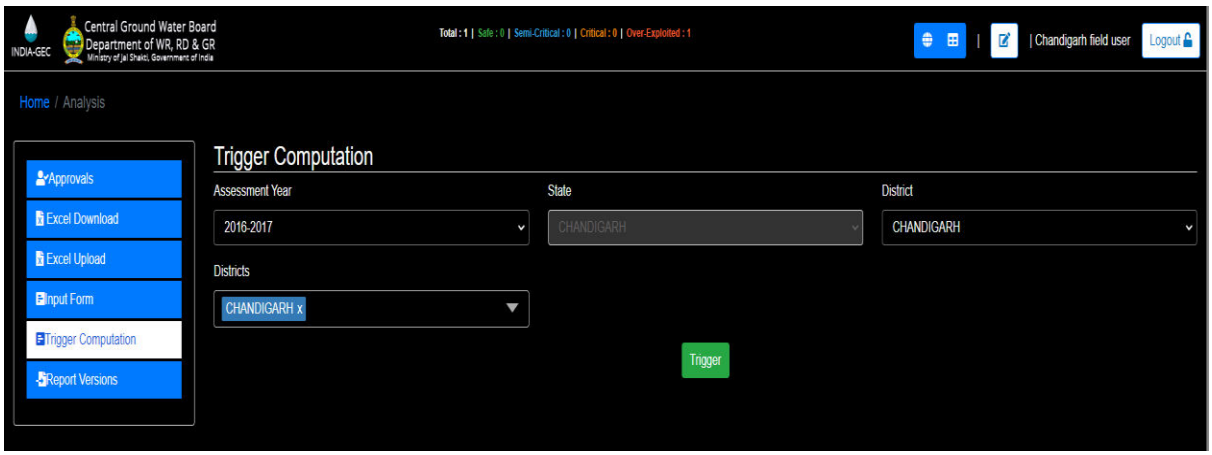


Figure 110: Field User Login – Trigger Computation Tab

8.2.6 Report Versions Tab

In this tab, user can see all the reports generated till date. User can also revert back to a previously generated report.

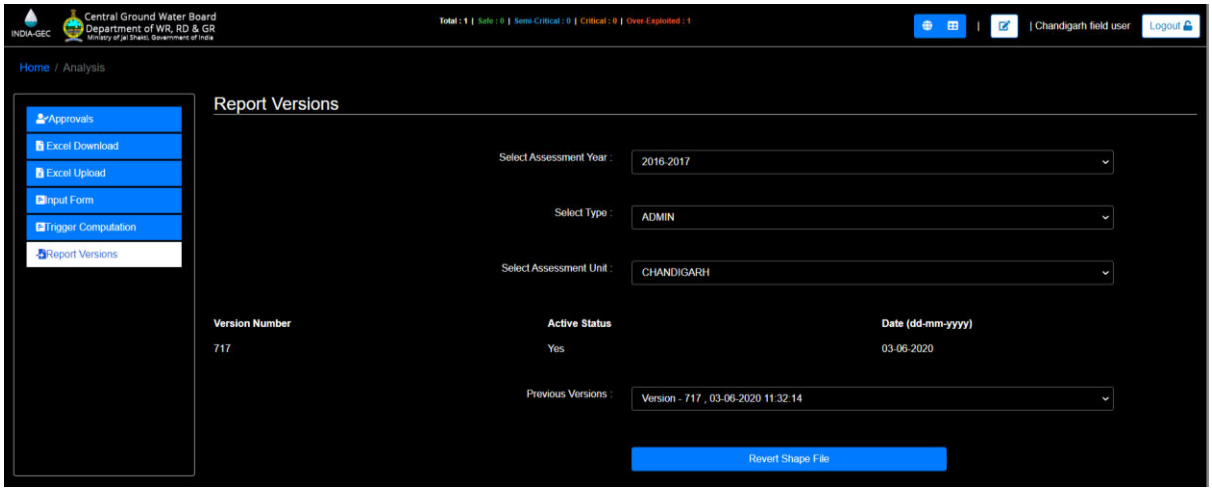


Figure 111: Field User Login – Report Versions Tab

8.3 District Admin Login

8.3.1 Approvals Tab

The role of District Admin is to verify and approve the data submitted by the Field User.

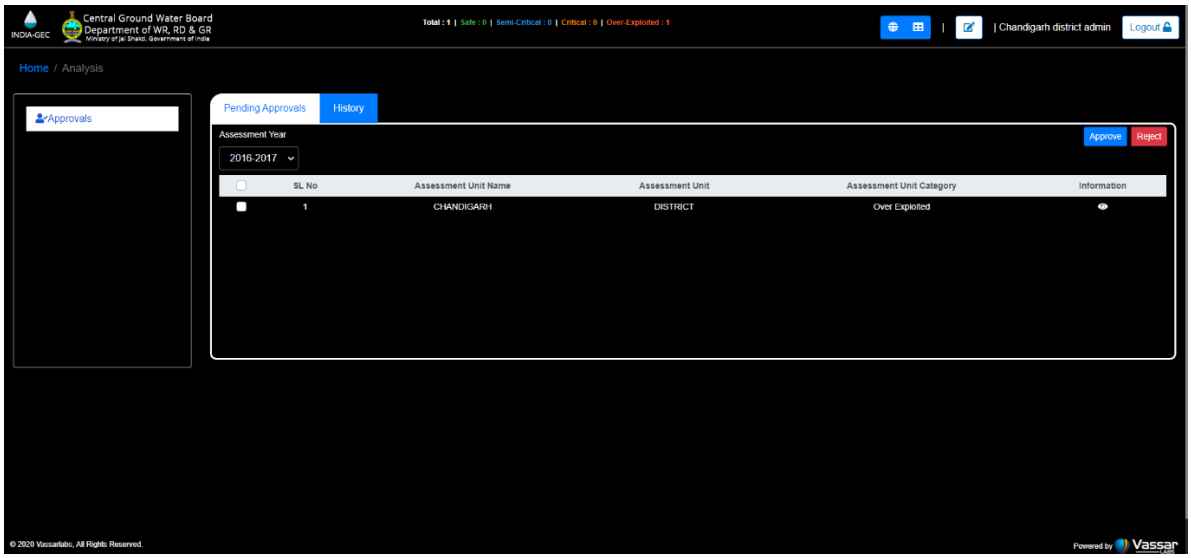


Figure 112: District Admin Login – Approvals Tab

8.4 State Admin Login

8.4.1 Approvals Tab

This tab shows the list of assessment unit for which the data computation is done and are ready for approvals.

Figure 113: State Admin Login – Approvals Tab

8.4.2 Submit to SLC - Approvals Tab

Once the data for each assessment unit is submitted and approved, state admin will send the data to SLC for further approval.

Figure 114: State Admin Login – Approvals Tab – Submit to SLC

8.4.3 State Basic Data Tab

This is the tab where State Admin will be initializing the state by uploading the shape file of the state.

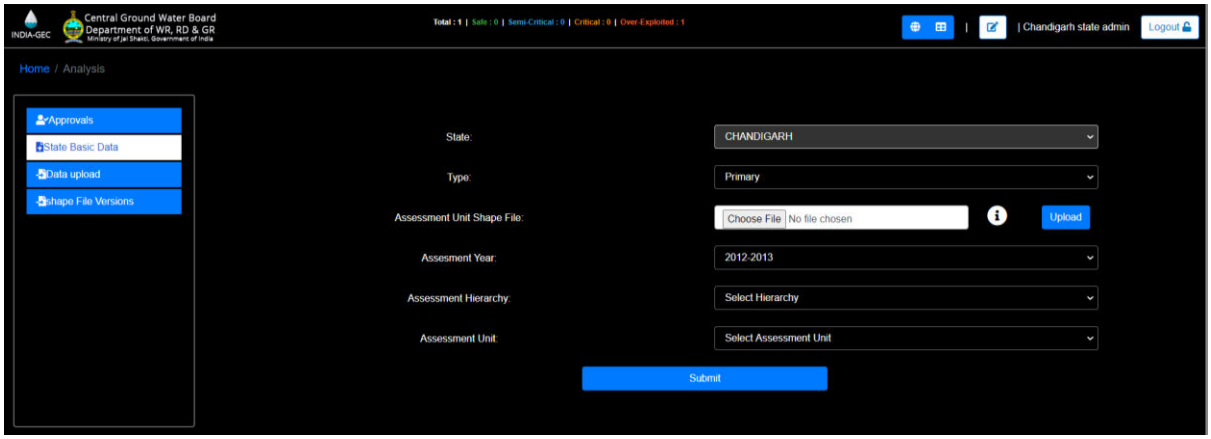


Figure 115: State Admin Login – State Basic Data Tab

8.4.4 Data upload Basic Data Tab

This is the tab where State Admin will be initializing the state by uploading the shape file of the state.

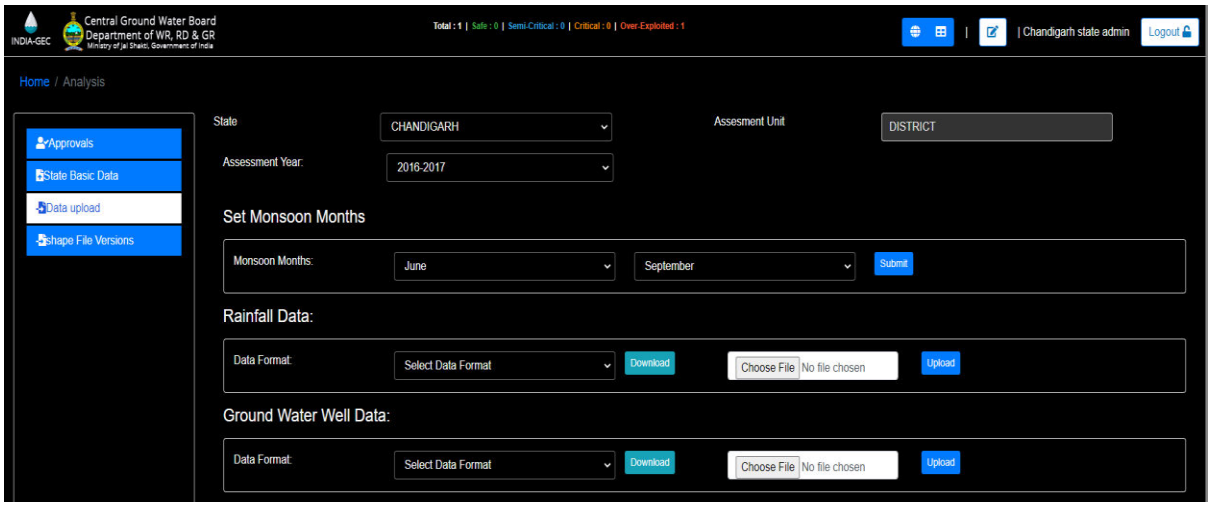


Figure 116: State Admin Login – Data Upload Tab

8.4.5 Shape File Version Tab

In this tab, user can revert back to a previously uploaded shape file.

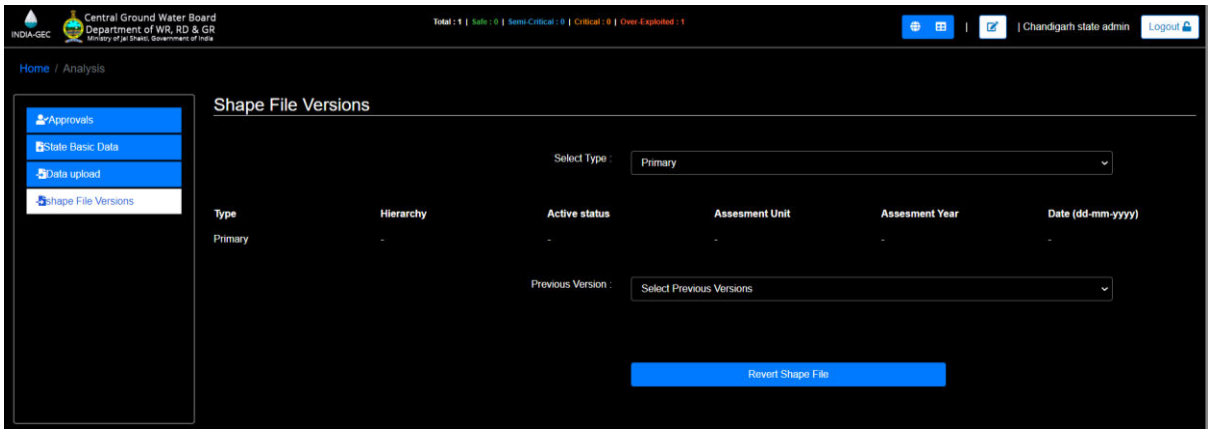


Figure 117: State Admin Login – Shape File Version Tab

8.5 SLC Admin Login

8.5.1 Approvals Tab

The role of SLC Admin is to verify and approve the report submitted by State Admin.

Figure 118: SLC Admin Login – Approvals Tab

SLC user has been given a provision to upload the proceedings file while approving the report.

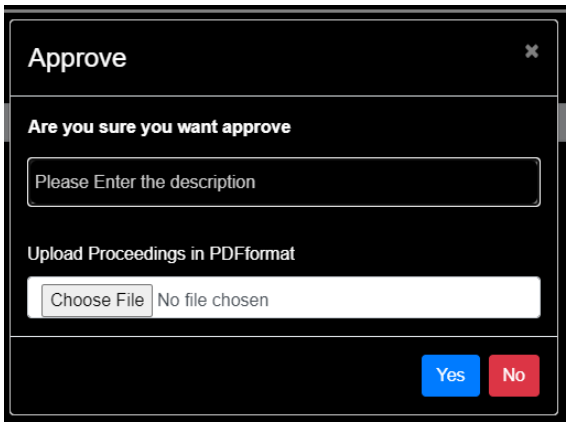


Figure 119: SLC Admin Login – Upload Proceedings Popup

8.6 CGWB Admin Login

8.6.1 Approvals Tab

The role of CGWB Admin is to verify and approve the report submitted by the SLC Admin.

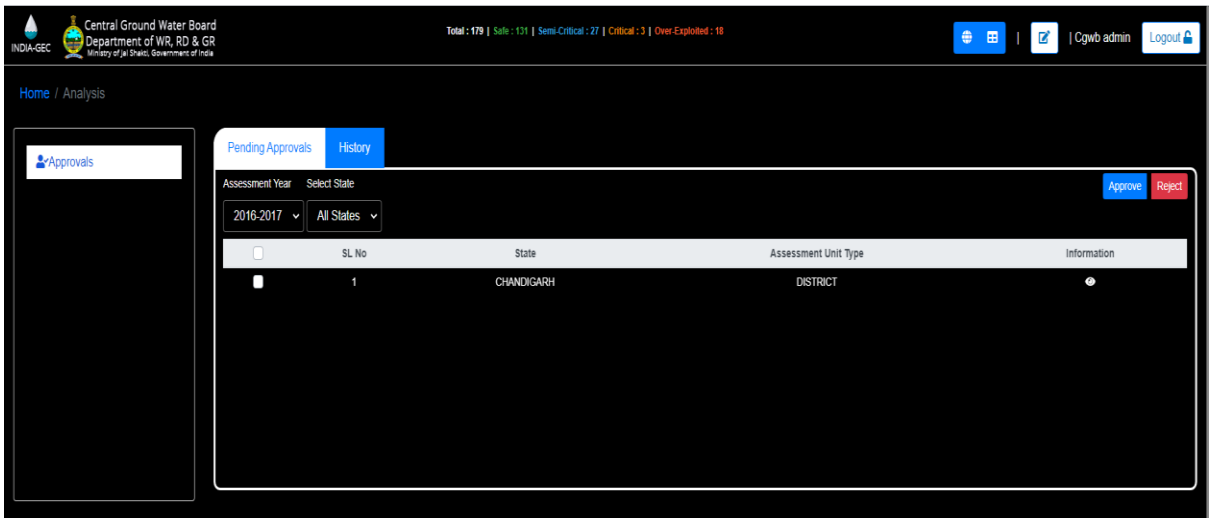


Figure 120: CGWB Admin Login – Approvals Tab

8.7 CLEG Admin Login

8.7.1 Approvals Tab

The role of CLEG Admin is to verify and approve the report submitted by the CGWB Admin.

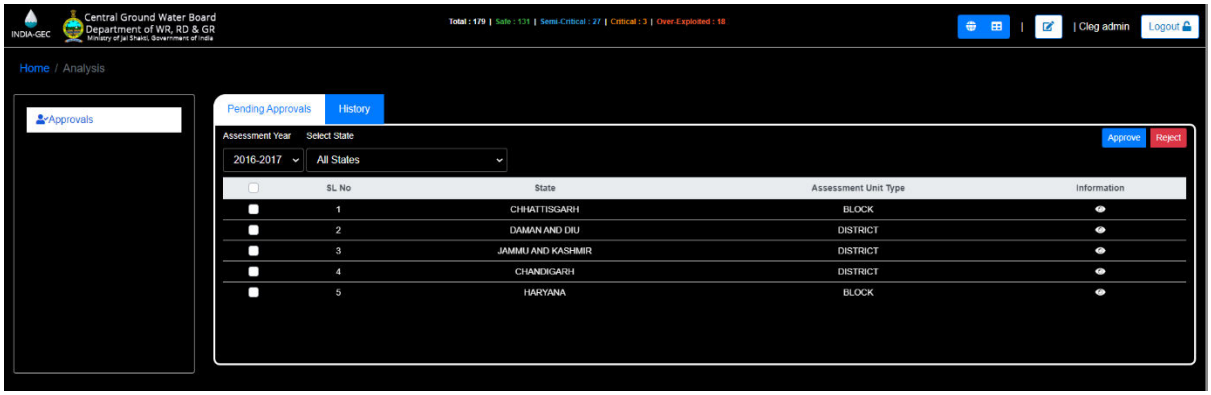


Figure 121: CLEG Admin Login – Approvals Tab

CLEG user has been given a provision to upload the proceedings file while approving the report.

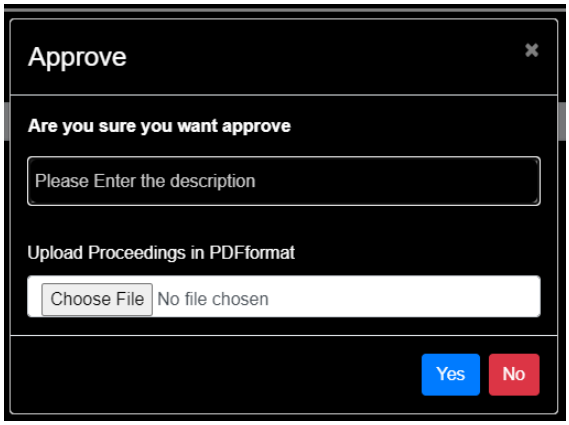


Figure 122: CLEG Admin Login – Upload Proceedings Popup

8.8 Ministry Admin Login

8.8.1 Approvals Tab

The role of Ministry Admin is to verify and approve the report submitted by the CLEG Admin.

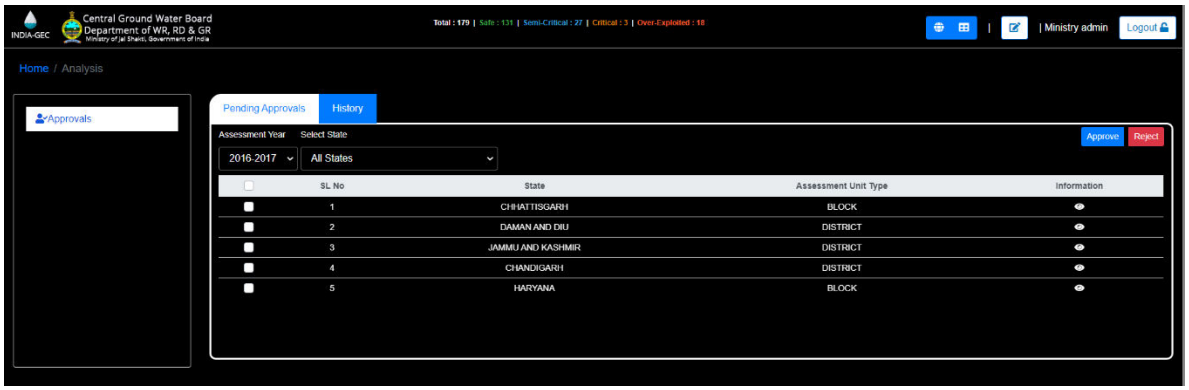


Figure 123: Ministry Admin Login – Approvals Tab

Ministry user has been given a provision to upload the proceedings file while approving the report.

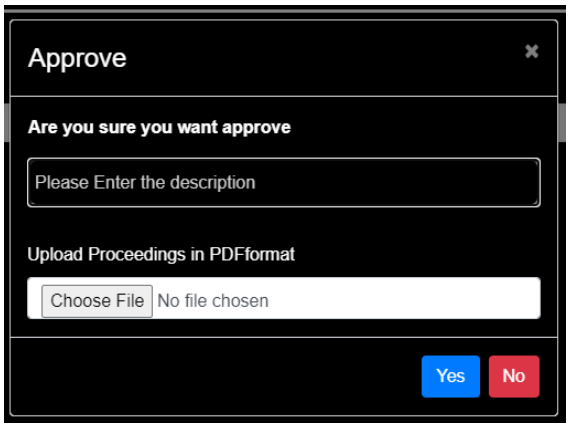


Figure 124: Ministry Admin Login – Upload Proceedings Popup

9.0 Approval Levels

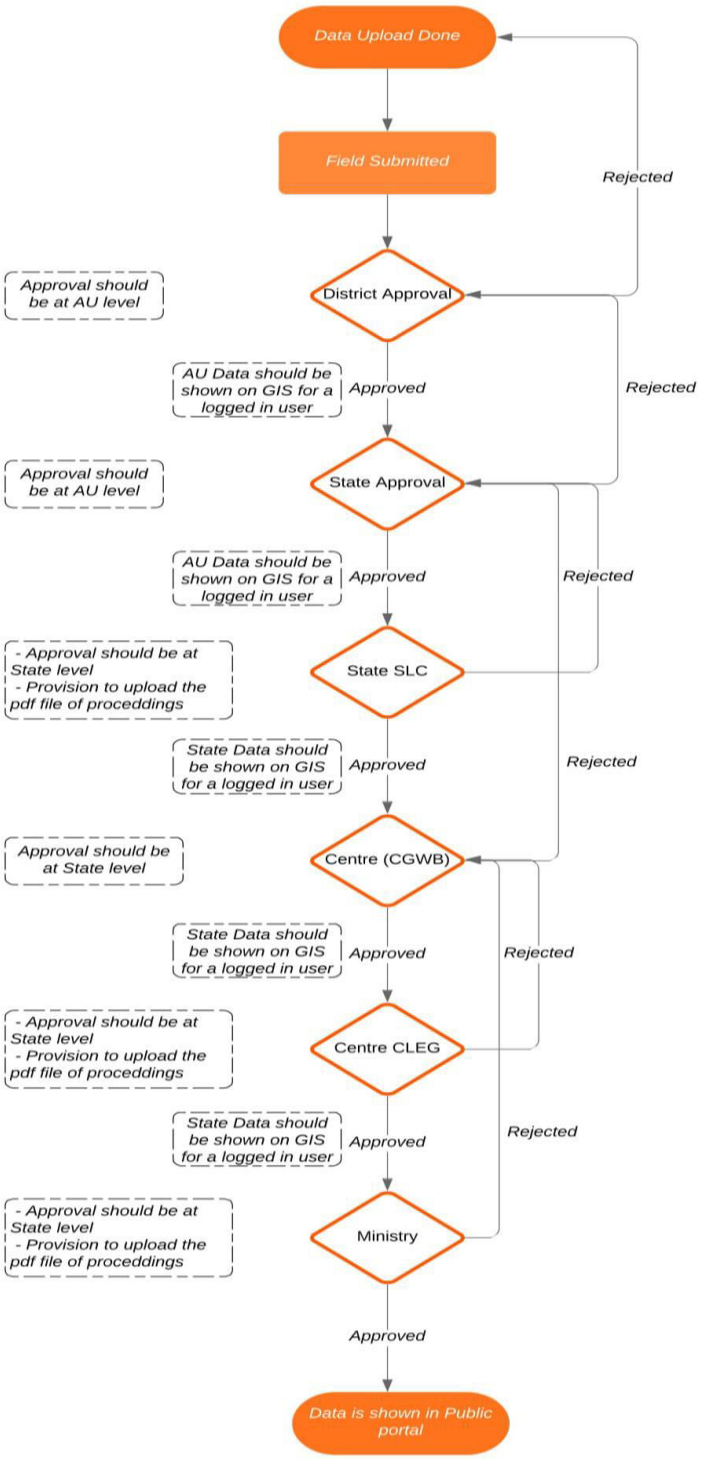


Figure 125: Approval Levels

10.0 User Journey

User journey can be divided into 4 stages:

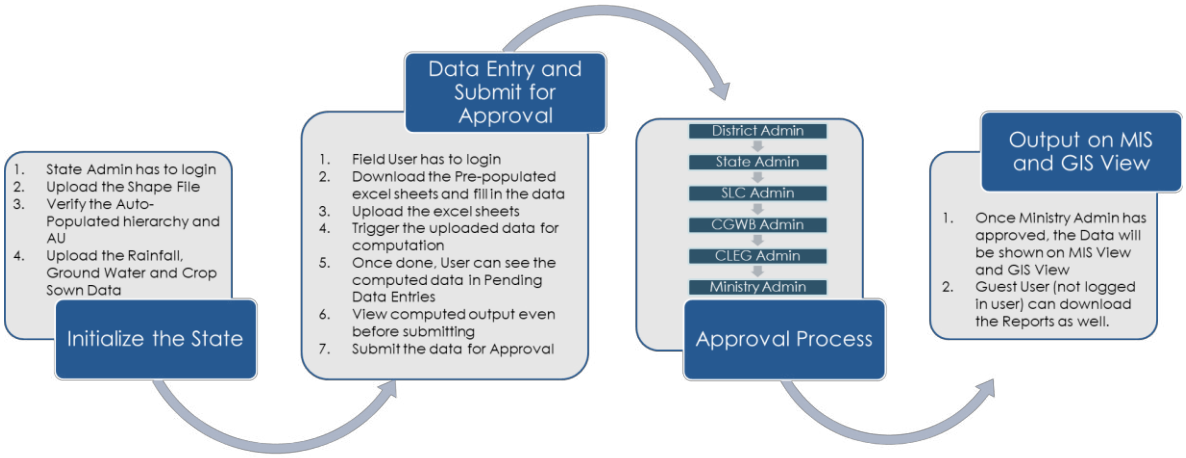


Figure 126: User Journey

10.1 Stage 1: Initialize the State

The first step to data submission process is to initialize the state. In this stage, “State Admin” has to login and upload the state shape file with all its Assessment units and hierarchies embedded into the attribute table of the shape file. The system will extract the hierarchy from the shape file and pre-populate district and assessment unit name and codes.

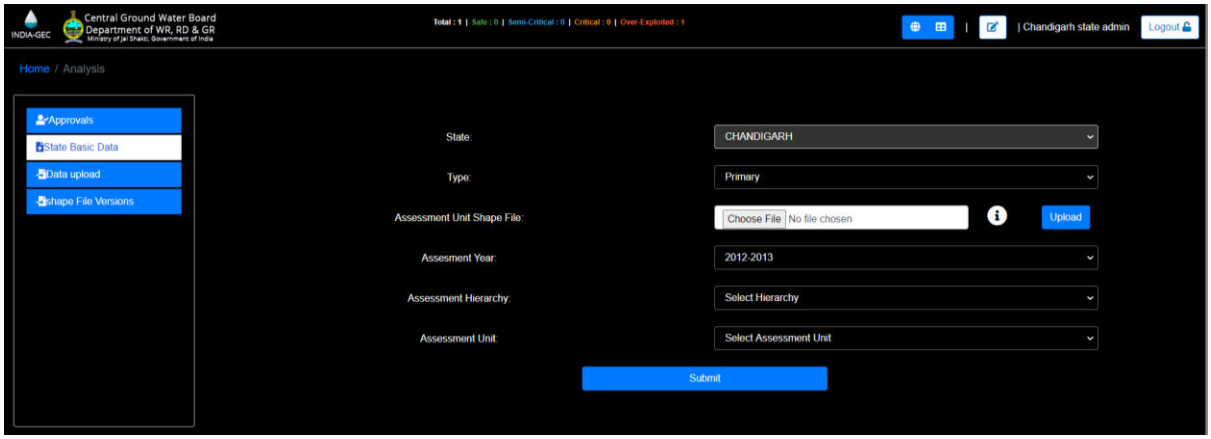


Figure 127: Shape file Upload

Once shape file upload is done, State user needs to upload Rainfall and Ground Water

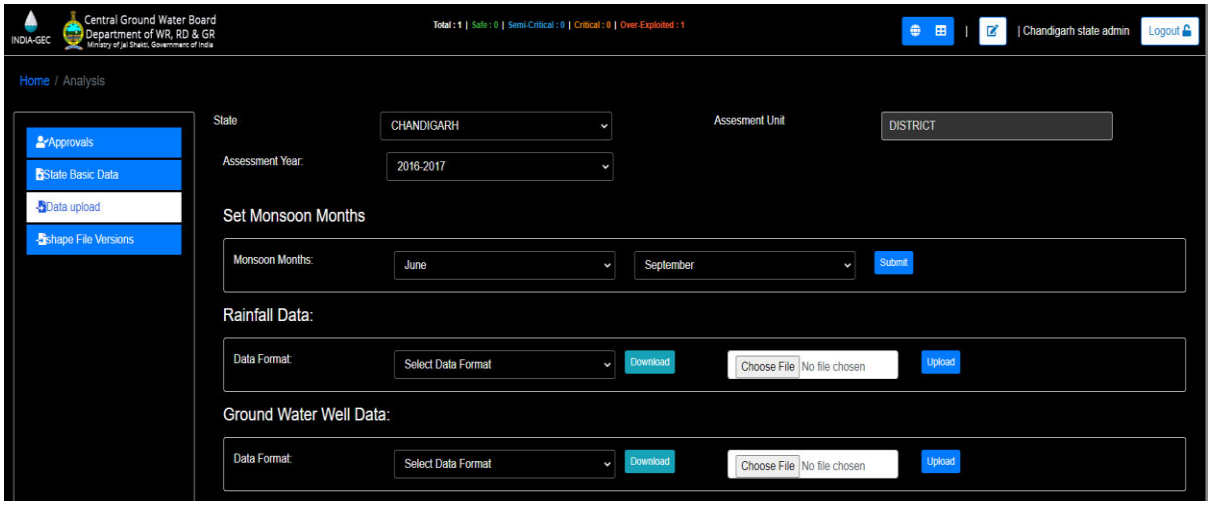


Figure 128: State Data Upload

10.2 Stage 2: Data Entry and Submit for Approval

In Stage 2, Field user has to login and submit the data. There are two ways to submit the data, one is using the excel file download and upload. Another way is through form input.

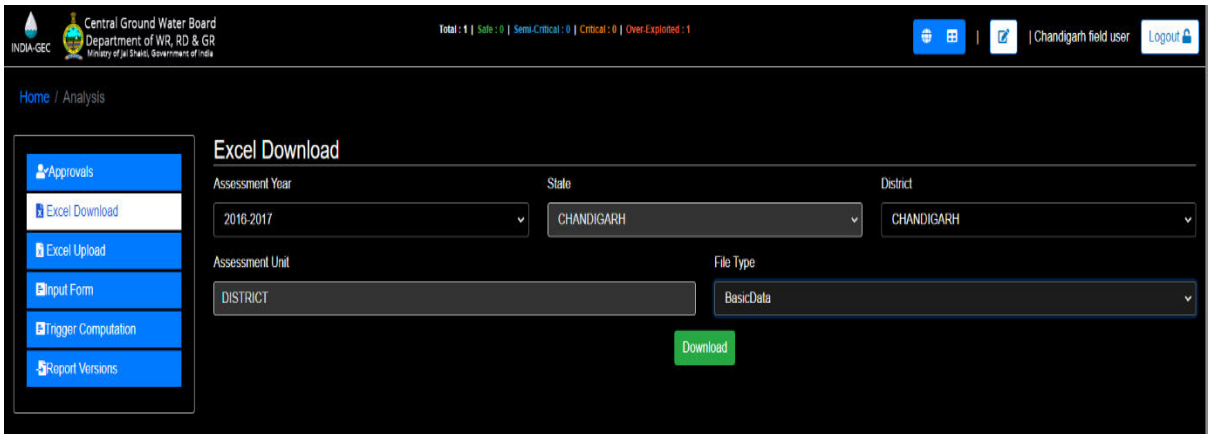


Figure 129: Excel Download

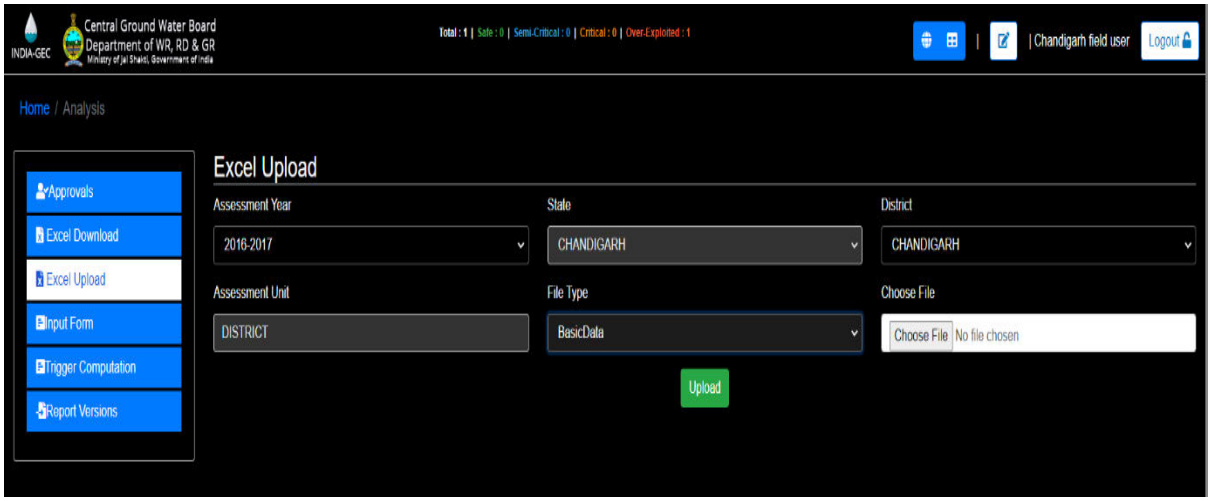


Figure 130: Excel Upload

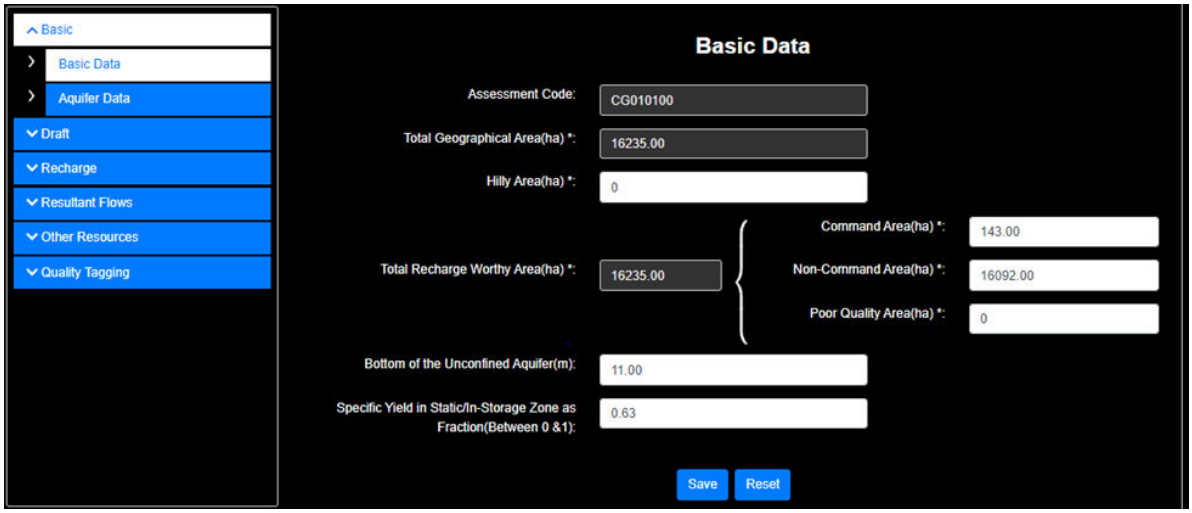


Figure 131: Form Input

Once done, Field user has to Trigger the data. User can either trigger for one assessment unit or he can trigger for the whole district at once.

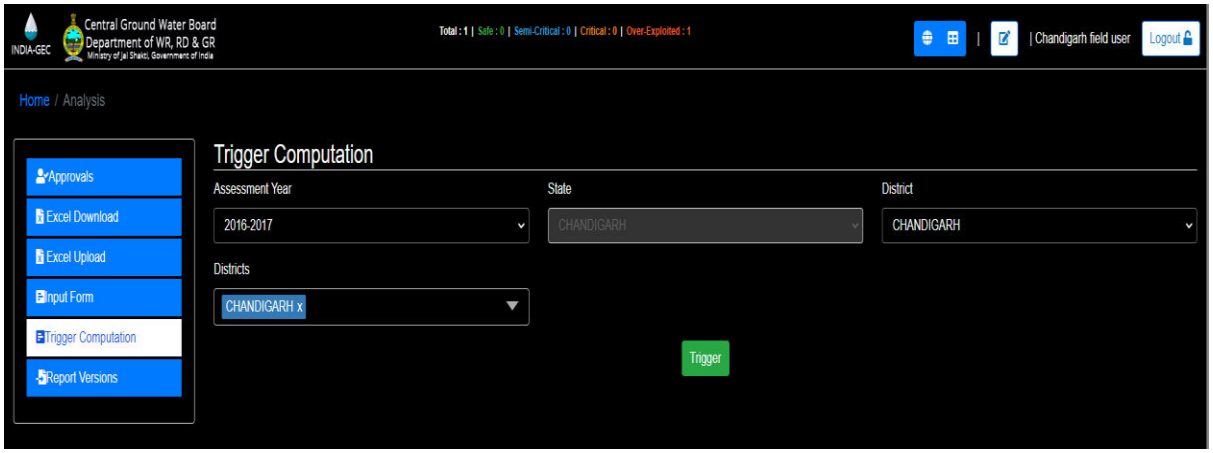


Figure 132: Trigger Computation

User has to now go to the Data Submission tab and verify the computed results by clicking on the “View Data” icon.

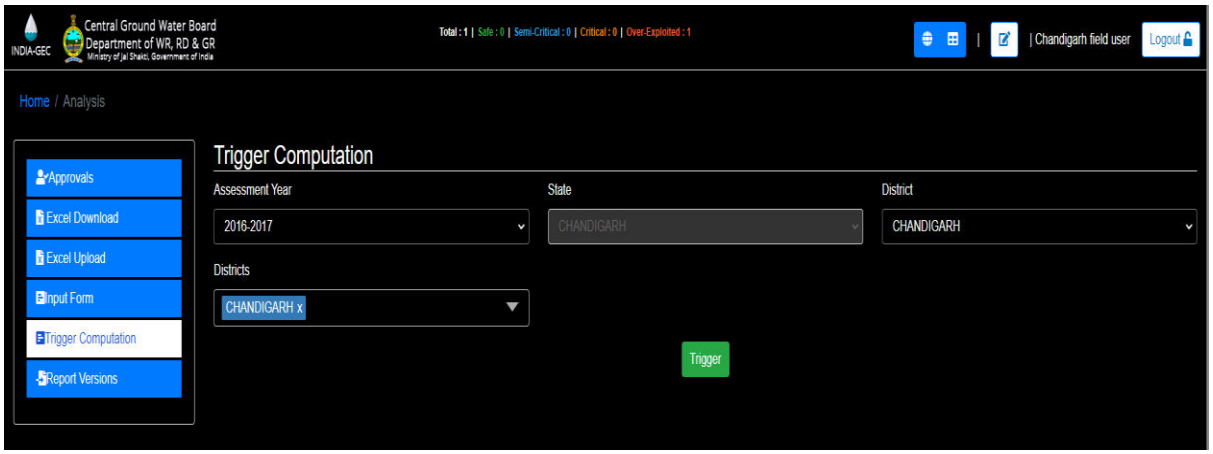


Figure 133: View Data Popup

Once he is satisfied with the output user needs to submit the data for approval

Figure 134: Pending Approvals

10.3 Stage 3: Approval Process

As soon as field user submit the data for approval, the computed report moves to district level for approval. Here the district can verify the submitted data and also the computed report and can either approve or reject the data. Once approve the data will move to State Admin. In case district admin rejects the data, it will go back to Field User for modification.

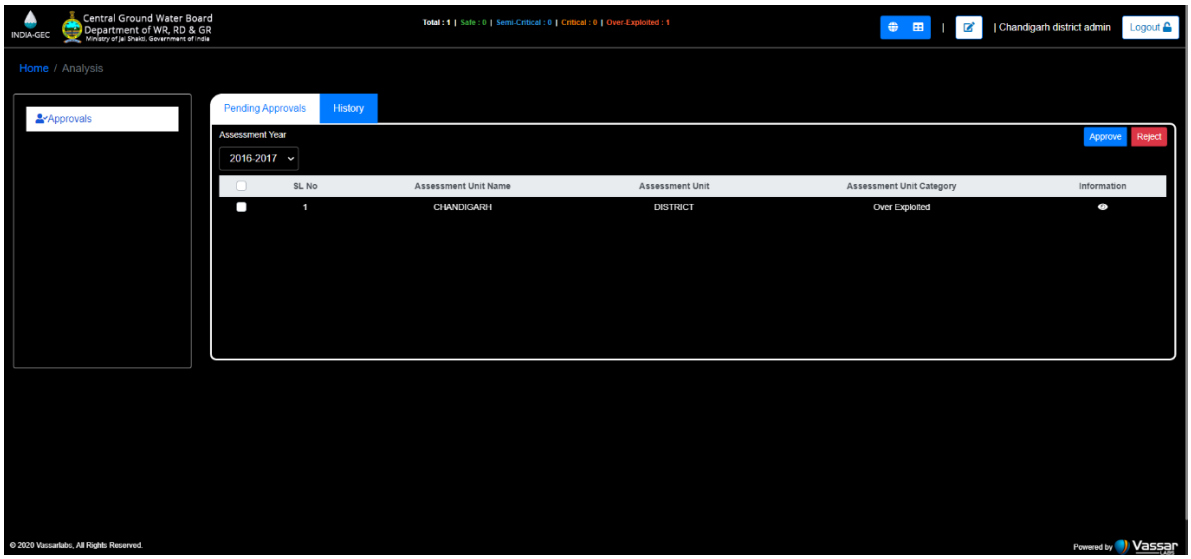


Figure 135: District Admin Approval

After District has approved the report it moves to State Admin for approval. State admin can again either reject or approve the data. In case state admin rejects the data it will go back to District Admin for modification. Once State Admin has approved all the assessment units, a state approval will be shown under “Submit to SLC” tab where user can now submit the complete stytet data to the State SLC committee for approval.

Figure 136: State Admin Approval

Figure 137: Submit to SLC

Once state has approved the state level report will now move to SLC Admin login where the SLC committee needs to either approve or reject the whole state's data.

Figure 138: SLC Admin Approval

After SLC the report moves to CGWB admin where user again can either approve or reject the whole state's report

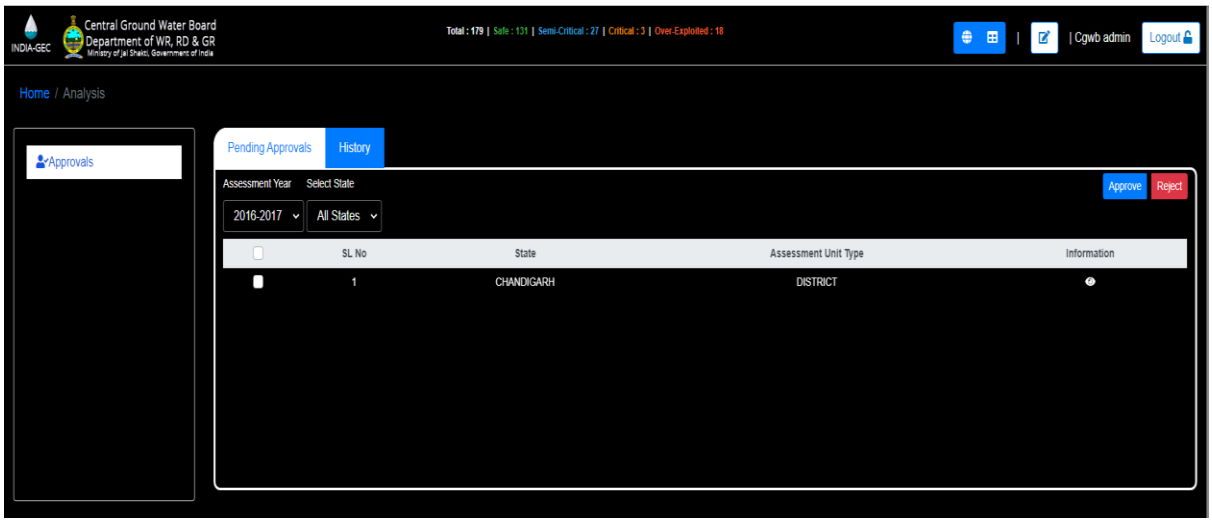


Figure 139: CGWB Admin Approval

After CGWB, the report moves to CLEG admin user for approval.

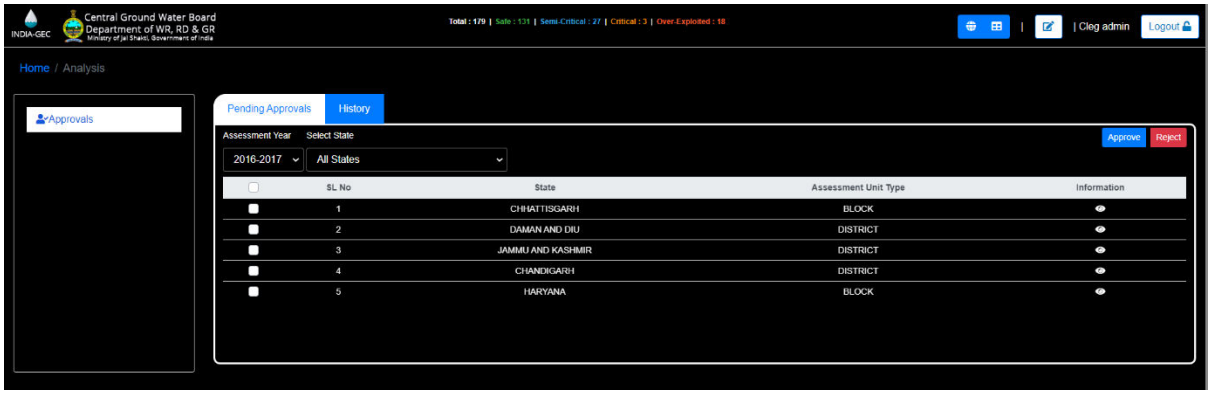


Figure 140: CLEG Admin Approval

After CLEG, the report moves to Ministry admin user for approval.

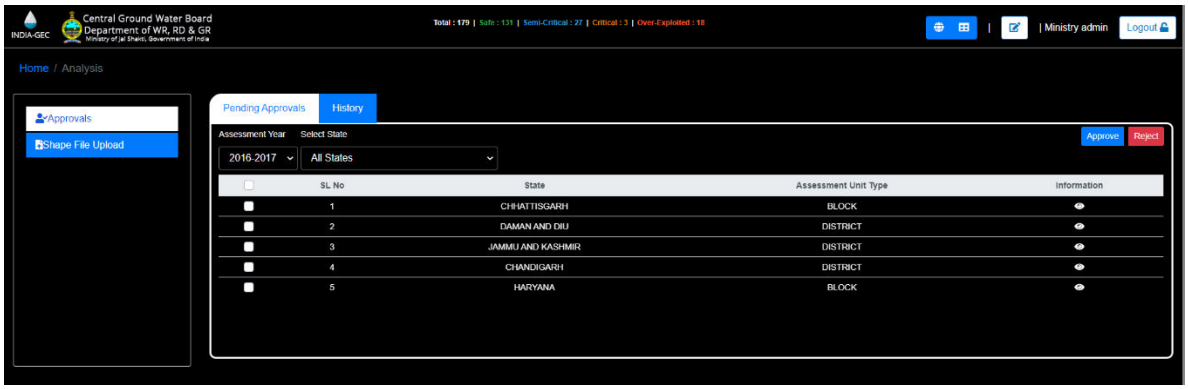
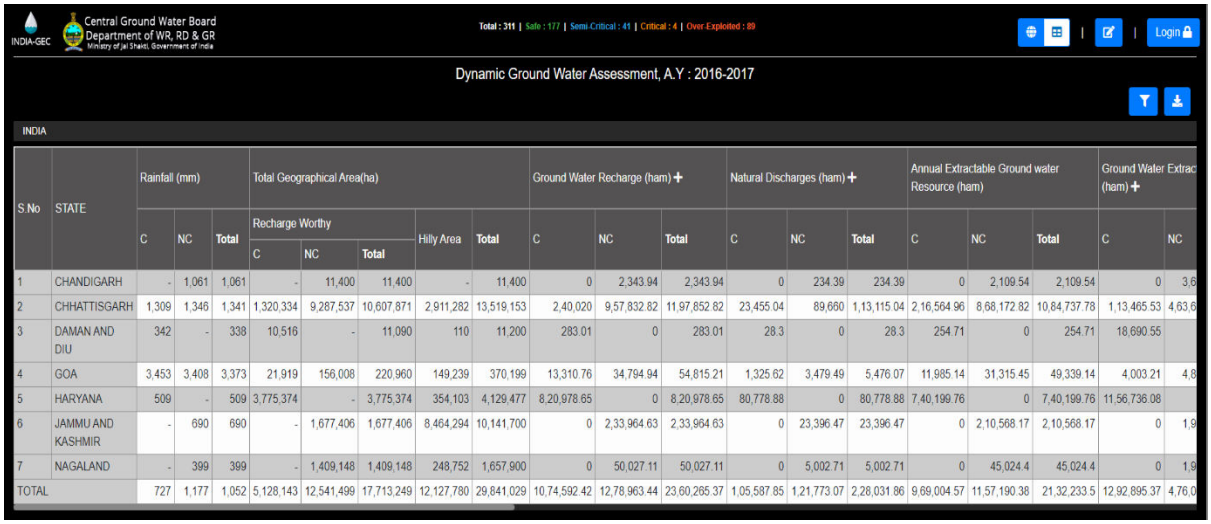


Figure 141: Ministry Admin Approval

10.4 Stage 4: Output on GIS and MIS View

As soon as the approval completes, the report is published on GIS and MIS View for public viewing.



S.No	STATE	Rainfall (mm)			Total Geographical Area(ha)					Ground Water Recharge (ham)			Natural Discharges (ham)			Annual Extractable Ground water Resource (ham)			Ground Water Extrac (ham)	
		C	NC	Total	Recharge Worthy			Hilly Area	Total	C	NC	Total	C	NC	Total	C	NC	Total	C	NC
					C	NC	Total													
1	CHANDIGARH	-	1,061	1,061	-	11,400	11,400	-	11,400	0	2,343.94	2,343.94	0	234.39	234.39	0	2,109.54	2,109.54	0	3,6
2	CHHATTISGARH	1,309	1,346	1,341	1,320,334	9,287,537	10,607,871	2,911,282	13,519,153	2,40,020	9,57,832.82	11,97,852.82	23,455.04	89,660	1,13,115.04	2,16,564.96	8,68,172.82	10,84,737.78	1,13,465.53	4,63,6
3	DAMAN AND DIU	342	-	338	10,516	-	11,090	110	11,200	283.01	0	283.01	28.3	0	28.3	254.71	0	254.71	18,690.55	
4	GOA	3,453	3,408	3,373	21,919	156,008	220,960	149,239	370,199	13,310.76	34,794.94	54,815.21	1,325.62	3,479.49	5,476.07	11,985.14	31,315.45	49,339.14	4,003.21	4,8
5	HARYANA	509	-	509	3,775,374	-	3,775,374	354,103	4,129,477	8,20,978.65	0	8,20,978.65	80,778.88	0	80,778.88	7,40,199.76	0	7,40,199.76	11,56,736.08	
6	JAMMU AND KASHMIR	-	690	690	-	1,677,406	1,677,406	8,464,294	10,141,700	0	2,33,964.63	2,33,964.63	0	23,396.47	23,396.47	0	2,10,568.17	2,10,568.17	0	1,9
7	NAGALAND	-	399	399	-	1,409,148	1,409,148	248,752	1,657,900	0	50,027.11	50,027.11	0	5,002.71	5,002.71	0	45,024.4	45,024.4	0	1,9
TOTAL		727	1,177	1,052	5,128,143	12,541,499	17,713,249	12,127,780	29,841,029	10,74,592.42	12,78,963.44	23,60,265.37	1,05,587.85	1,21,773.07	2,28,031.86	9,69,004.57	11,57,190.38	21,32,233.5	12,92,895.37	4,76,0

Figure 142: MIS View

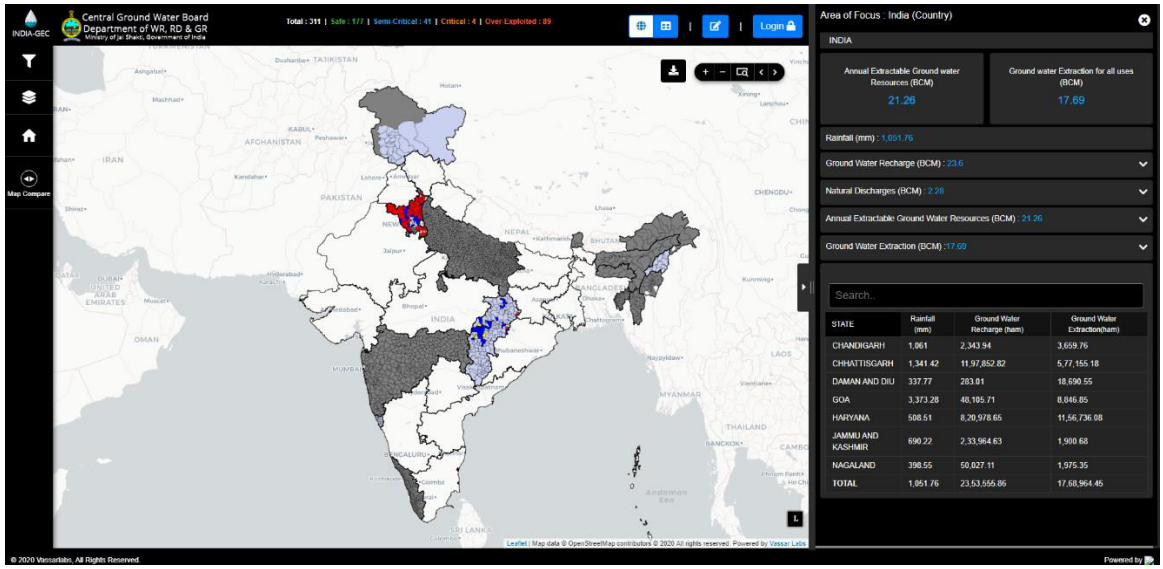


Figure 143: GIS View

Users also has an option to download the reports and maps.

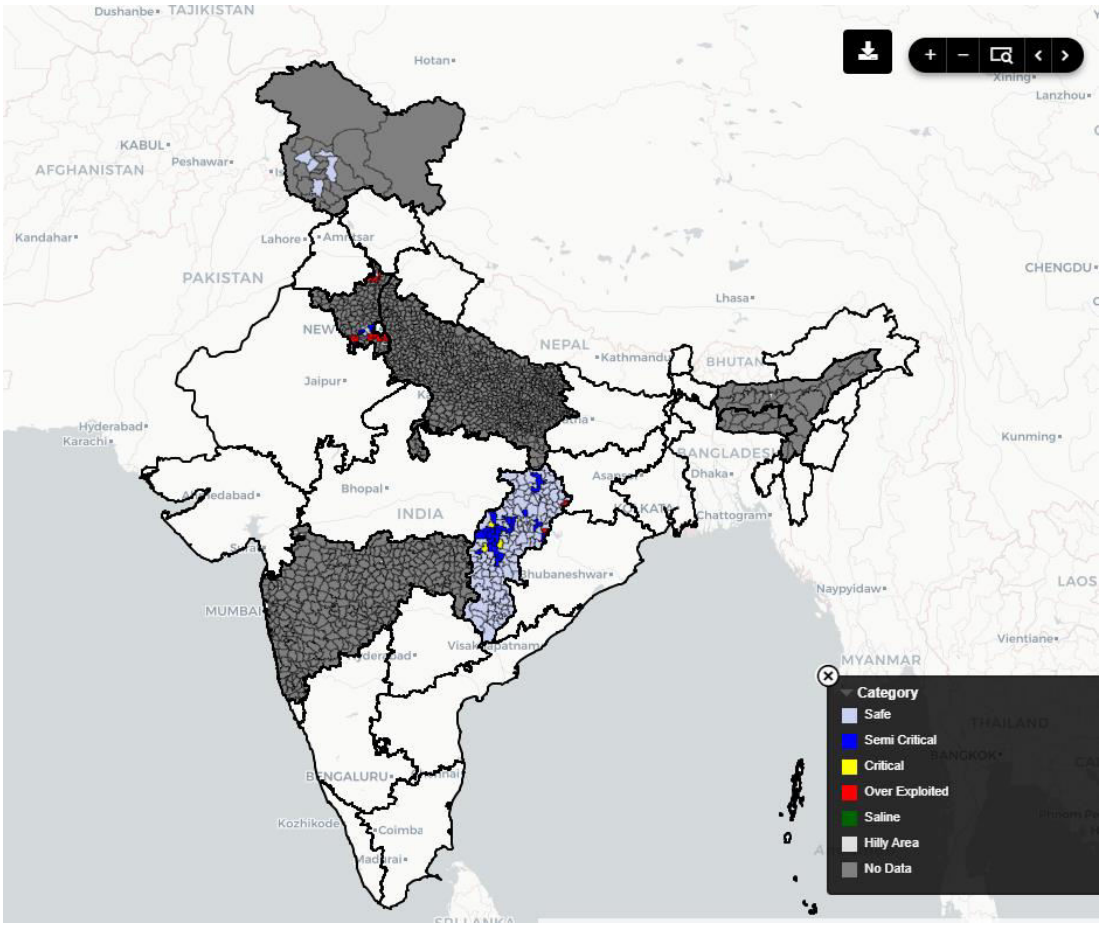


Figure 144: Map Download

DYNAMIC GROUND WATER RESOURCES OF INDIA, 2017

ANDHRA PRADESH

S. No.	District	Ground Water Recharge					Total Natural Discharges	Annual Extractable Ground Water Resource	Current Annual Ground Water Extraction				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)
		Monsoon Season		Non-monsoon Season		Total Annual Ground Water Recharge			Irrigation	Industrial	Domestic	Total			
		Recharge from rainfall	Recharge from other sources	Recharge from rainfall	Recharge from other sources										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	States														
1	Anantapur	89200.23	46136.12	1013.97	50415.31	186765.62	9338.31	177427.31	142953.85	612.86	14272.07	157838.79	21623.75	59410.09	88.96
2	Chittoor	115718.55	32389.60	1204.19	38028.60	187340.94	9367.06	177973.88	95256.50	838.80	8758.49	104853.79	13528.83	89858.36	58.92
3	East Godavari	104140.05	95383.56	3714.55	50847.53	254085.69	12704.33	241381.36	41688.32	6101.44	3316.71	51106.47	4226.85	193656.03	21.17
4	Guntur	52942.86	57011.90	2547.96	18800.39	131303.10	6565.15	124737.95	39174.72	119.02	8823.34	48117.07	14159.10	79051.91	38.57
5	Kadapa	93311.68	15859.52	2048.53	11177.61	122407.34	6120.40	116286.94	74888.06	1240.70	3733.71	79862.47	6110.25	56568.63	68.68
6	Krishna	52891.68	70806.39	21641.60	17375.91	162715.57	8135.80	154579.78	47223.03	3360.60	6412.20	56995.83	7402.78	98790.07	36.87
7	Kurnool	90024.09	43892.80	1203.46	26774.23	161894.57	8094.75	153799.81	63291.48	510.30	10498.38	64300.17	16377.90	94278.99	41.81
8	Nellore	128089.98	46637.76	5.16	93668.83	268401.73	13420.14	254981.59	90301.92	221.04	6187.09	96710.05	11024.36	159531.34	37.93
9	Prakasam	39372.56	26669.85	56344.85	36593.00	158980.26	7949.05	151031.21	54372.39	467.91	9789.35	64629.64	17557.06	94941.54	42.79
10	Srikakulam	34847.68	35719.34	17837.37	19681.53	108085.91	5404.34	102681.56	40762.37	302.49	8445.49	49510.36	17007.28	63919.93	48.22
11	Visakhapatnam	61906.83	10809.63	6823.31	2690.68	82230.45	4538.54	77691.90	12608.08	201.48	6295.00	19104.57	7980.54	59560.86	24.59
12	Vizianagaram	59226.39	21945.67	6795.39	17486.23	105463.67	5272.77	100180.90	20595.54	47.68	463.74	21106.97	4922.00	77587.51	21.07
13	West Godavari	74662.56	58478.66	48.11	58931.01	192120.35	9606.03	182514.32	71924.15	381.24	3261.65	75567.04	6028.80	113241.04	41.40
	Total (Ham)	996335.139	561750.790	121228.409	442470.837	2121785.174	106516.652	2015268.516	785040.421	14405.56730	90257.225	889703.213	147949.501	1231396.289	44.15
	Total (Bcm)	9.963	5.618	1.212	4.425	21.218	1.065	20.153	7.850	0.144	0.903	8.897	1.479	12.314	44.15

DYNAMIC GROUND WATER RESOURCES OF INDIA, 2017

ARUNACHAL PRADESH

S. No.	District	Ground Water Recharge					Total Natural Discharges	Annual Extractable Ground Water Resources	Current Annual Ground Water Extraction				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction (%)
		Monsoon Season		Non-monsoon Season		Total Annual Ground Water Recharge			Irrigation	Industrial	Domestic	Total			
		Recharge from rainfall	Recharge from other sources	Recharge from rainfall	Recharge from other sources										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Anjaw	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area
2	Changlang	12375.64	696.00	13629.49	71.16	26772.29	2849.44	23922.85	0.00	0.00	174.00	174.00	571.87	23350.98	0.73
3	Dibang Valley	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area
4	East Kameng	7281.63	233.00	2413.44	0.00	9928.07	992.81	8935.26	0.00	0.00	25.00	25.00	169.06	8766.20	0.28
5	East Siang	56206.01	5327.00	20135.02	670.93	82338.96	13307.12	69031.84	0.00	0.00	65.00	65.00	176.16	68855.68	0.09
6	Kurung Kumey	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area	Hilly area
7	Lohit	55018.30	2311.00	31078.96	0.00	88408.26	8840.83	79567.43	0.00	0.48	218.00	218.48	666.00	78900.96	0.27
8	Lower Dibang Valley	39162.24	1749.00	20240.30	0.00	61151.54	6115.15	55036.39	0.00	0.00	32.00	32.00	62.40	54973.98	0.06
9	Lower Subansiri	1358.90	1227.00	729.69	78.74	3394.33	738.65	2655.68	0.00	0.00	18.00	18.00	105.20	2550.48	0.68
10	Papum Pare	6076.25	1950.00	3165.94	3.53	11195.72	1449.26	9746.46	0.00	14.40	85.00	99.40	492.34	9239.72	1.02

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Figure 145: Report Download

11.0 Glossary

Heat map / Choropleth map: Representation of data in the form of a map or diagram in which data values are represented as colors. It gives spatial distribution of the data set.

Ground water recharge worthy area: This is the potential area in a taken location that is capable of ground water recharge

BCM: Billion Cubic Metres

Ha.m: Hectares meters

Lpcd: Litres per capita per day

Units

Rainfall: millimeter (mm)

Area: Hectare (Ha)

Recharge: Hectare Meter(ha.m)

Ground Water Level: Meter(m)

Recharge Factor: Meter/day

Environmental Flows: Hectare Meter(ha.m)

Annual Extractable Ground Water Resource, Net Annual Ground Water Availability for Future Use, In-Storage, Static Ground Water Resources, Additional Potential Resources under Specific Conditions, Total Ground Water Availability in Unconfined Aquifer: Hectare Meter (ha.m)

Ground Water Extraction for Irrigation, Domestic and Industrial: Hectare Meter (ha.m)

Stage of Ground Water Extraction: Percentage

Specific Yield: Percentage

Rainfall Infiltration Factor: Percentage

Return Flow Factor: Percentage

12.0 References

1. GEC 2015 Methodology Document
   http://cgwb.gov.in/Documents/GEC2015_Report_Final%2030.10.2017.pdf

2. GWRA 2017 National Compilation Report
   http://cgwb.gov.in/GW-Assessment/GWRA-2017-National-Compilation.pdf

3. Ground Water Resource Estimation presentation by Dr. A.V.S.S.Anand
   https://www.slideshare.net/avssanand/ground-water-resources-estimation-by-gec-2015-methodology

4. APGRACE
   http://apgrace.vassarlabs.com/gec%3Fstate=Andhra%20Pradesh&year=2016-2017