



MEMORANDUM OF AGREEMENT

TO ESTABLISH

CENTRES FOR NARMADA RIVER BASIN MANAGEMENT STUDIES

BETWEEN

**D/o WATER RESOURCES, RIVER DEVELOPMENT AND
GANGA REJUVENATION, MINISTRY OF JAL SHAKTI
(THROUGH NATIONAL RIVER CONSERVATION DIRECTORATE)**

AND



cGanga

**INDIAN INSTITUTE OF TECHNOLOGY KANPUR
(THROUGH CENTRE FOR GANGA RIVER BASIN MANAGEMENT AND STUDIES)**

AND

**IIT GANDHINAGAR & IIT INDORE
(Consortium Institutes)**

February, 2024



MEMORANDUM OF AGREEMENT

between

**Department of Water Resources, River Development and Ganga
Rejuvenation, Ministry of Jal Shakti, Government of India
(through NRCD)**

&

**IIT Kanpur and Consortium of IIT Gandhinagar & IIT Indore
to establish**

Centres for Narmada River Basin Management Studies

This Memorandum of Agreement (herein after referred to as MoA) is signed between Department of Water Resources, River Development and Ganga Rejuvenation (D/o WR, RD & GR), Ministry of Jal Shakti, Government of India (through National River Conservation Directorate; hereinafter referred to as NRCD), Indian Institute of Technology Kanpur (herein after referred to as IIT Kanpur), and Consortium of Indian Institute of Technology, Gandhinagar (herein after referred to as IIT Gandhinagar or Consortium Institute, CI) having its registered office at Palaj, Gujarat & Indian Institute of Technology, Indore (herein after referred to as IIT Indore or Consortium Institute, CI) having its registered office at Simrol, Madhya Pradesh to establish Centres for Narmada River Basin Management Studies with the mandate of preparing Narmada River Basin Management Plan [NRBMP] and providing continual support in implementation and dynamic evolution of the Plan. For the consortium, IIT Gandhinagar shall act as Lead Institute and IIT Indore shall be the Fellow Institute. IIT Kanpur shall participate through Centre for Ganga River Basin Management and Studies (herein after referred to as cGanga). Each of the consortium institutes will nominate a Faculty Member as Coordinator for the institute.

Whereas Head cGanga, IIT Kanpur or his/her nominee shall execute the activities assigned to cGanga in this MoA. He/She and his/her team at IIT Kanpur shall execute the obligations of non-disclosure of Confidential Information received from NRCD and Consortium Institutes.

Whereas Coordinator of the Lead Institute shall prepare and submit to cGanga and NRCD the responsibilities assigned to each CI in the first fortnight of every year.

Whereas Coordinator, IIT Gandhinagar shall be responsible for delivering and reporting on the activities assigned to IIT Gandhinagar in this MoA. He/She and his/her team at IIT Gandhinagar shall execute the obligations of non-disclosure of Confidential Information received from NRCD and Consortium Institutes.

Whereas Coordinator, IIT Indore shall be responsible for delivering and reporting on the activities assigned to IIT Indore in this MoA. He/She and his/her team at IIT Indore shall execute the obligations of non-disclosure of Confidential Information received from NRCD and Consortium Institutes.



1. Preamble

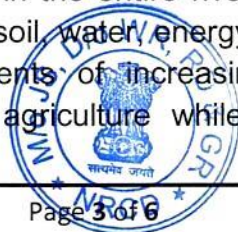
The river Narmada is of unique importance to India for geographical, historical, socio-cultural, and economic reasons. The river has been facing serious threat due to discharge of increasing quantities of sewage, trade effluents and other pollutants largely on account of rapid urbanization, industrialization and agricultural growth. The challenge is compounded by competing demands of river water and other river resources needed for healthy functioning of rivers on the one hand, and for irrigation, industrial usage, power generation, and domestic needs on the other hand.

There is, therefore, a need to ensure effective abatement of pollution and conservation of the river Narmada by adopting a river basin approach to promote inter-sectoral coordination for comprehensive planning and management. It is equally important to maintain adequate flows of water, sediments and nutrients, stream power, and river space in river Narmada and its tributaries with the dual objectives of preserving natural ecosystems and achieving sustainable development. The issues of concern and challenges are similar to those faced by the National River Ganga for which the collective efforts of the Central and State Government for effective abatement of pollution and conservation of the river Ganga were necessary, and a cogent management plan had to be evolved. Hence, a Consortium of 7 "Indian Institute of Technology's(IITC) led by IIT Kanpur was tasked with the preparation of the Ganga River Basin Management Plan.

The Ganga River Basin Management Plan (GRBMP-2015) was thus prepared by IITC in 2015, enabling the government to launch a systematic approach to restore and conserve River Ganga. Furthermore, in order to advice and provide continual scientific input to the government, IIT Kanpur was assigned the responsibility of identifying relevant persons from premier and national scientific and technology institutes and creating a Consortium of such institutes to provide continual scientific input for implementation and dynamic evolution of GRBMP through the Centre for Ganga River Basin Management and Studies. In select cases, international experts and organizations were also allowed to be invited on a case-to-case basis to contribute to the enhancement of the plan and its implementation. Given the success of this approach, a similar methodology is now being adopted to restore and conserve River Narmada.

2. Objectives of the Narmada River Basin Management

The objective of the integrated river basin management of River Narmada is the restoration and maintenance of wholesomeness of the river system and improvement of its ecological health with due regard to resolution of conflict of interest in anthropogenic land and water uses in the entire river basin. This entails adequate provision for natural resources (e.g. soil, water, energy, flora and fauna) conservation and accommodating the requirements of increasing urbanization, infrastructure development, industrialization and agriculture while ensuring that the following



fundamental aspects of the river system are protected:

- a) Continuous river flow (Aviral Dhara)
- b) Unpolluted river flow (Nirmal Dhara)
- c) Longitudinal and lateral connectivity
- d) Adequate space for all essential river functions
- e) Functioning of the river as an ecological entity

3. Mandate

The mandate of the Centers for Narmada River Basin Management Studies is to collate and gather knowledge for preparing and dynamically evolving the Narmada River Basin Management Plan that should provide Action Plans with specific projects to be taken up at different levels of priority, policy interventions and management actions along with financial implications. The Action Plans should include interventions for implementation in a phased manner delineating short term, medium term and long-term measures. The plan should contain financial, social, economic and environmental implications including measurable and verifiable indicators for ascertaining beneficial and positive impact on the river system. The Action Plans will consist of many reports and database management system as per the Framework Document in **Annexure-I**. In addition, the Consortium Institutes shall also be required to advise and assist the government in technical issues related to the particular river and in overcoming unforeseen difficulties in implementing the recommendations of the Plan.

The overall task will involve certain core activities given in **Annexure-II** for which the Consortium Institutes shall be required to maintain a minimum infrastructure to meet assigned responsibilities. This shall be supported by NRCD through committed grants. Certain other activities as given in **Annexure- III** may emerge on a need basis for which financial support may be arranged by concerned authorities/agencies.

4. Duties & Responsibilities

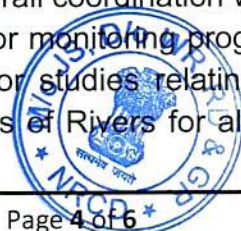
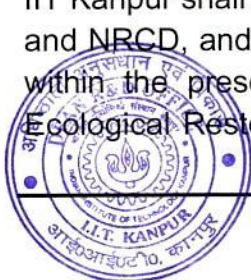
The duties and responsibilities of different entities to this MoA shall be broadly as under: -

D/o WR, RD&GR/NRCD

NRCD shall execute the responsibilities on behalf of the D/o WR, RD&GR in the Ministry of Jal Shakti. NRCD will provide administrative support for obtaining information/secondary data as and when required for conducting the studies.

IIT Kanpur

IIT Kanpur shall be responsible for overall coordination with the Consortium Institutes and NRCD, and act as a secretariat for monitoring progress to ensure deliverables within the prescribed time frame. For studies relating to Sustainable Agriculture, Ecological Restoration and Economics of Rivers for all six river basins, specialized



Member Institutes shall be involved by IIT Kanpur from its funds. IIT Kanpur shall also be responsible for organizing meetings of the Stakeholder Advisory Committee (**Annexure-IV**), Scientific & Technical Steering Committee (**Annexure-V**), and Joint Review Committee (**Annexure-VI**) as per the scheduled timelines and for making payments towards travel/honorarium to members of the committees.

IIT Gandhinagar and IIT Indore (Consortium Institutes)

Consortium Institutes shall nominate suitable faculty members, scientific/ technical staff and other officers as may be needed for accomplishing the tasks within the stipulated period. They shall also utilize the infrastructure and facilities such as libraries and laboratories as per requirements on payment basis if needed. They may also deploy competent Bachelor's, Master's and Doctoral scholars in the project, which will also help develop a pool of talented and qualified scientist and other specialists in the field of river conservation. The Institutes shall also be responsible for notifying the required actions, and achieving and monitoring their progress to ensure deliverables within the prescribed time frame. All scientific/ technical analyses, report-writing and other knowledge-based activities will be carried out by the institutional members themselves, but sundry related works such as data collection, may be outsourced to competent external persons/ organizations.

5. Disbursement of Financial Resources

NRCD shall release funds to the Consortium Institutes who will be responsible for utilizing funds in carrying out Condition Assessment studies and for preparing and dynamically evolving Narmada River Basin Management Plan. The Institutes shall submit Utilization Certificate (UC) to NRCD and place fresh demand for grants.

6. Support, Supervision & Monitoring

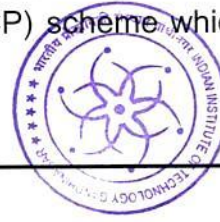
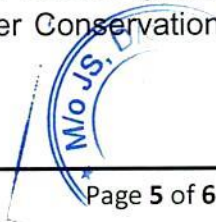
The work carried out by the Consortium Institutes shall be supported, supervised and monitored through the following committees.

- a) Stakeholder Advisory Committee
- b) Scientific & Technical Steering Committee
- c) Joint Review Committee

The information for the meetings, agenda papers, proceedings, and circulation of progress report, etc. shall be coordinated by Member Secretary of respective committees with support from cGanga, IIT Kanpur.

7. Duration of the Agreement

The duration of this MoA will be for a period of 5 years from the date of its signing. However, NRCD is committed to release grants on annual basis for three years or continuation of the National River Conservation Plan (NRCP) scheme whichever is earlier.



8. Modifications to the Agreement

The Agreement including its duration can be modified based on needs and through mutual consent of the Consortium Institutes, IIT Kanpur and the NRCD.

9. Limitation of Liability

Neither Party, nor any of their affiliates nor their or their affiliates respective directors, officers, employees, subcontractors or agents shall be liable to the other Party for any special, incidental, indirect or consequential damages (including, but not limited to, contract, negligence and tort liability) in connection with or arising out of this MoA.

10. Achieving Self-Sufficiency

Consortium Institutes shall endeavor to reach a level of financial self-sufficiency to act as a knowledge center for the respective river basin by generating income streams through knowledge and capabilities developed on River Science and Management.

11. Budget and Activities

Budget for core activities is listed in Annexure-VII.

12. Confidentiality

All parties shall observe confidentiality and secrecy of documents, information and other data while conducting the studies for the duration of this MoA.

13. Settlement of Problems

Any problem arising out of implementation of the studies shall be settled amicably through coordination or negotiation amongst all parties.

14. Seal of Parties

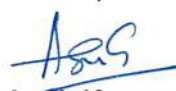
The parties have signed this agreement on the 28th day of February month of year 2024.


Suhas S Joshi
Director, IIT Indore
Fellow Institute

(for Consortium Institutes)

सुहास एस. जोशी | **Suhas S. Joshi**
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Indian Institute of Technology Kanpur

जी. अशोक कुमार / G. ASOK KUMAR
परियोजना निदेशक / Project Director
एन. आर. सी. डी. / N. R. C. D.
जल शक्ति मंत्रालय / Ministry of Jal Shakti
जल संसाधन, नदी विकास एवं गंगा संरक्षण विभाग
Department of Water Resources, R.D. & G.R.
भारत सरकार, नई दिल्ली / Govt. of India, New Delhi

Framework Document for River Basin Condition Assessment and Management Plan

(For taking up rejuvenation and conservation measures under NRCP)

Note: This Annexure may be reviewed and revised by JRC from time to time based on inputs from Consortium Institutes and STSC.

1. Background

India is bestowed with 4% of world's water resources (India-WRIS 2015) and 2.4% of the world's land resources (GRBMP Mission 4 – Sustainable Agriculture; cGanga and NMCG (2015) Ganga River Basin Management Plan (GRBMP)- Extended Summary; Volume 1: Main Plan Document; Volume 2: Mission Reports; Volume 3: Thematic Reports). Rivers have been the heart and soul of India's growth and culture. Many of the large river systems are perennial, but some of their tributaries are seasonal. Besides the Ganga and Brahmaputra systems, the other major river systems are Sabarmati, Mahi, Narmada, Tapi, Brahmani, Mahanadi, Godavari, Krishna, Pennar and Cauvery. Over the decades, booming industrial and agricultural growth, population growth, rapid urbanization, infrastructural developments, etc. have had considerable impact on India's natural resource base and waste generation. This has often had a damaging impact on the ecological status of India's numerous rivers, water bodies and other ecosystems.

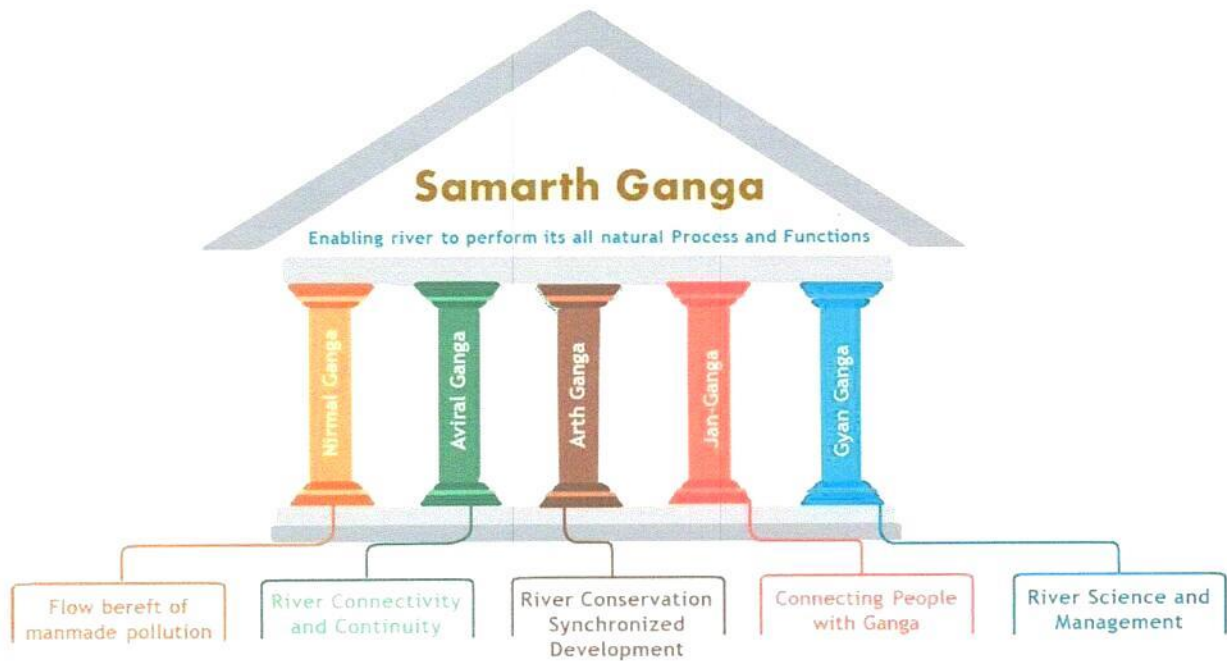
In the above backdrop the Ganga River Basin Management Plan (GRBMP) was prepared in 2015 to comprehensively restore and conserve India's National River Ganga. The GRBMP provided a framework in the government's endeavor to conserve and restore the Ganga River through the National Mission for Clean Ganga (NMCG). Subsequent discourses and reaching out to diverse experts led to further developments in comprehending and addressing the various river-related issues in the country through identification of the roles of river basin ecosystems, importance of natural resource management and ecosystem goods and services of rivers, multi-stakeholder participation in river management, importance of small (lower order) rivers/ tributaries, waterbodies and other basin ecosystems, and impact of alternative developmental processes in synchronizing river conservation with development. This advanced knowledge informs the design of the programme for rejuvenating and conserving Rivers.

2. Objectives

Every river in nature is characterized by two river functions that together define its hydrological, chemical, geological, spatial, and ecological integrity. Rivers impacted by human activities in the river basin – and sometimes within the river channels themselves – may lose



some of their functional capabilities, which compromises their integral nature. River restoration, therefore, is necessarily the means to make such rivers functionally able (or capable) once again to ensure optimal ecosystem services for human benefits. This is the basic concept of Samarth (meaning “Able”) Ganga as applied to River Ganga, but also to any other river since Ganga denotes all rivers in the Indian context. Since the success of this restoration and conservation process is dependent on a convergence of the vision of an able river, scientific understanding, developmental actions and people’s involvement, Samarth Ganga rests on the five pillars of concerted action as depicted in the accompanying figure.

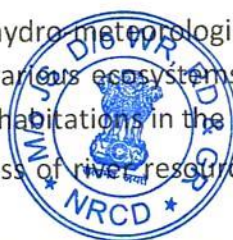


The 5 pillars on which Samarth Ganga is founded.

The main objective of establishing the Centre is to develop an integrated river basin management plan for restoration and conservation of the wholesomeness of the river by improving their ecological health substantially which have been significantly affected by the competing human demands for river resource uses in the entire river basin. This entails assessment of existing conditions of the river and preparation of a road map/plan for comprehensive rejuvenation and conservation of the riverine ecosystems in their entirety by analyzing anthropogenic impacts on them in detail. In achieving this objective, both essential and desirable characteristics of river such as continuous flow, un-polluted flow, longitudinal and lateral connectivity, and river as an ecological entity need to be included.

The specific objectives include:

- a) To assess the geo-morphological, hydro-meteorological, bio-physical, socio- cultural, and socio-economic condition of various ecosystems (wetlands, forests, grasslands, agro-ecosystems. etc.) and human habitations in the entire river basin.
- b) To assess the insufficiency or excess of river resources (especially water, sediment,



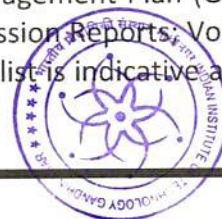
nutrients, flora and fauna, energy, and space) and of pollutants and other harmful materials in different river stretches and tributaries, and identification of stretches where they have been significantly affected by anthropogenic factors.

- c) To assess the ecosystem goods and services available from the river and its tributaries for the given river resources and pollutants, and the change in these goods and services over time due to anthropogenic factors.
- d) To assess the impact of anthropogenic activities including agricultural, industrial, urbanization, infrastructure, forestry, groundwater abstraction, etc. on the riverine ecosystems and its trends.
- e) To assess/ identify non-local and/ or natural adversities (such as geological processes, climate change, etc.) affecting the river basin.
- f) To formulate suitable interventions for restoring the wholesomeness of the river including alternative measures in view of possible implementation constraints.

3. Scope of work

Major rivers and their tributaries need to be holistically studied adopting a basin- wide approach considering the major human activities that have been affecting the river ecosystems such as industrialization, urbanization, lifestyle changes, agricultural & other rural activities, deforestation/ denudation, dams/ barrages, engineering flood control measures, infrastructural developments, etc. The Consortium should comprehensively assess all such factors to identify the existing conditions affecting the river ecosystem and suggest future course of actions for their remediation. For each major river and its tributaries, an assessment of its ecological status is to be carried out with verifiable ecological, hydrological, and geomorphological indicators/ parameters (quantitative and qualitative). Spatial and temporal inter-connections between surface waters, groundwater, soil/ sediment, and terrestrial flora and fauna as well as biodiversity of the different ecosystems in the river basin and their eventual contribution to the natural resource base of the river network should be established to evaluate the goods and services expected from hypothetically (or previously) un-impacted (reference state) state of rivers. For resources that mainly come into the river from the larger basin (such as water and sediment) a mass balance (water balance, sediment budget, etc.) over the entire basin and over sufficiently long duration is needed. The impact of human activities in the basin and of direct human interventions in the river networks may then be assessed to evaluate the anthropogenic effects on the river ecosystems and their goods and services in different stretches and at different times. The results may be further qualified by any natural or global factors (e.g. climate change, plate tectonics) that are found to affect the rivers. The role of different stakeholders of the rivers and their importance and roles in reviving and conserving the rivers need to be identified. Along with any additional factors that may be relevant, these findings may be synthesized to formulate a cohesive action plan for integrated basin management of each river.

Some specific themes that may be considered for assessment are enlisted for specific thematic areas vide Appendix-I to this Annexure – broadly in line with Ganga River Basin Management Plan – 2015 (GRBMP – 2015; Ganga River Basin Management Plan (GRBMP)- Extended Summary; Volume 1: Main Plan Document; Volume 2: Mission Reports; Volume 3: Thematic Reports) prepared by Consortium of IITs. However, the list is indicative and may



be modified by the consortium to meet the overall objectives of the study.

4. River Basin Organizations and Strategic Plan

Study river basin organizations across the globe and suggest suitable organization, process and strategies for achieving the objective of rejuvenating and conserving the riverine ecosystems keeping national and local practices, legislative framework, institutional strengths and weaknesses, and stakeholder roles in mind. The Consortium may review the current legislations (both central and state government) in place in environment protection, rules, regulations from statutory bodies, orders and judgments passed by various courts and tribunals in the country, policies, programmes, etc. for arriving at suitable rejuvenation and conservation strategy.

The focus of the study may include:

- Enhancement of and inclusion in central/state plans, projects and resources based on basin-wide perspectives to enable river conservation-synchronized development.
- Defining the parameters of and strengthening regional cooperation for the management of interstate rivers.
- Comprehensive monitoring, dissemination and communication of the River Network and Basin conditions.
- Stakeholder-inclusive and Accountable River Basin Organizations.

While preparing the strategic plan the Consortium may:

- Align with the Strategic Indicators and with Sustainable Development Goals, where relevant to water-related or renewable resource related issues.
- Ensure clarity of meaning, reflecting the Monitoring Parameters that are needed for each issue.
- Only include matters that most resonate with the Basin needs, particularly in relation to resource balance and ecosystem health.
- Distinguish, wherever needed, between overarching outcomes and concepts such as resilience, sustainability, the water, food, and energy nexus, etc. and specific indicators that enable an assessment of status and trends.

5. Data Interpretation and Presentation

River Restoration and Conservation is a cyclic process involving many steps as per Data Framework given in Appendix II (Concise Manual and Guide for River Restoration and Conservation, cGanga and NMCG (2019)) The first three steps, namely Understanding, Communication and Negotiation are critical to the overall success, and needs to be done scientifically as well as by engaging with all stakeholders through synthesis of available information and evidence. As such data and information collection, its analysis, and interpretation is the most crucial and resource intensive.

This assignment is pegged basically on secondary data. Wherever possible the Consortium may use GIS data available to analyze and present the report by using Satellite ortho-imagery for recent 3 years pre & post monsoon, High Resolution Multispectral Scanner (MSS) satellite



image of 50 cm} including current year. Other relevant data for the individual components mentioned above can be collected from the respective government agencies. In case any specific data required for analysis is to be purchased, the Consortium may indicate the same in the approach and methodology to be submitted along with indicative cost of the same. Such data will be purchased during the course of the assignment by NRCD and provided to the Consortium or may be purchased by Consortium Institutions that may be reimbursed. Prior approval for all such purchases shall be obtained from NRCD. Further for collecting primary data on river water quality, drain water quality, etc., the consortium may propose the same in selected stretches/points depending on the criticality of such information.

The Consortium is expected to comprehensively assess the status and specify corrective actions with indicative cost for revival of each component. While addressing the issues, reversible and irreversible conditions have to be clearly brought out in the reports. Also, all interventions that are currently in vogue under various schemes of Central/State/Local Governments and by Non-Governmental Organizations should be taken into consideration while preparing final recommendations. Further the report should indicate the approach for project structuring such as direct government investment, Private investment as part of business or through Corporate Social Responsibility route, and Public Private Partnerships.

The focus of the study may include:

- Basin maps – Drainage, land use/ land cover, soil maps
- All data should be submitted in digital format (e.g. as “.shp”; “.xlsx”; “.dwg”, etc. files) wherever possible or in soft version (e.g. as “.doc”, “.pdf”, “.jpg”, etc. files) with proper data tagging and metadata records. An illustration of this effect is provided in Appendix II.

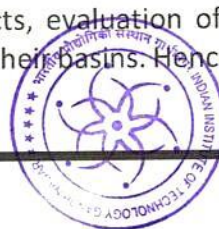
6. Assumptions & Constraints

The proposed study involves two implicit assumptions, namely:

- a) Healthy ecosystems within the river basin have positive impacts on rivers through a naturally balanced supply of renewable resources and moderation of harmful inputs, but disturbed/ impacted ecosystems have limited ability to carry out these functions, and hence can affect rivers adversely.
- b) Anthropogenic activity generally impacts rivers negatively or neutrally. However, it is possible for anthropogenic interventions to also have positive impacts on river ecosystems – hence interventions can be designed to meet this target.

The work of preparing river basin management plan is envisaged to have the following main constraints:

- a) The work is intended to be carried out primarily by analyzing secondary data. However, requisite secondary data may not exist in sufficient detail for all river resources, status of ecosystems, diverse human impacts, evaluation of ecosystem services, and historical information about the rivers and their basins. Hence, wherever



necessary, and feasible within the given timeframe, primary data may be collected for which the additional expenses will be borne by NRCD provided prior approval is taken. As far as possible, the need for such data collection should be communicated to NRCD within the First Year of commencement of the work.

- b) The legal and institutional framework and financial constraints within which the river restorations can be carried out may be complex and difficult to fully assess. Hence different technological intervention options may be considered and compared with respect to their relative merits and demerits.

7. Deliverables

- I. Inception Report identifying the substantive issues of the study, proposed methodology, perceived constraints, specific river stretches, tributaries and ecosystems to be quantitatively assessed, and proposed timeline (with milestones giving verifiable and measurable indicators).
- II. Comprehensive assessment of the hydrological, geomorphological and ecological status of the river, river basin and its main ecosystems.
- III. Maps, tables, illustrations, etc. delimitating river resources and ecosystem goods and services available from different stretches of the main-stem river and its major tributaries, indicating stretches with significantly affected resources and diminished ecosystem goods and services.
- IV. Scientific assessment of environmental flows (flow quantities with depths, widths, etc. as relevant) for different river stretches and major tributaries.
- V. Estimating sustainable river resource uses for both the renewable resources that come mainly from the basin – such as water, sediment, and nutrients – and those generated within or intrinsic to the river – such as kinetic energy (stream power), river space (including flow channel, riverbanks, floodplains and hyporheic zone), flora, fauna and biodiversity, and genetic resources.
- VI. Formulation of measures to conserve and/or moderate key ecosystems in the river basin such as wetlands, forests, and agro-ecosystems.
- VII. Formulation of measures to contain or nullify the negative impacts of ongoing or pre-existing anthropogenic activities in the basin, and also of any non-local or natural adversities as a Strategic Plan for implementation.
- VIII. URMP, Urban River Management Plans (i.e. how to manage rivers in various Urban Centers), and RRMP, Rural River Management Plans (i.e. how to manage rivers in various Rural clusters) delineating how various central, state, and local governments policies and programmes could be better coordinated and optimally utilized to manage rivers in Urban and Rural areas.

IX. A time-bound Strategic Plan for implementation of the measures along with



measurable and verifiable indicators for monitoring, evaluation, and feedback control through a well-defined mechanism of participation by all key shareholders for rejuvenation and conservation of rivers.

- X. Identification of key shareholders (Central Govt., State Govt., Local Bodies, local communities, civil society organisations, businesses, and citizens, etc.) of the rivers and their roles in river restoration and conservation, and the Desired Institutional Framework and any Policy and/or Legislative changes desired for successful implementation of the Strategic Plan.



Appendix IA to Annexure I

Indicative List of Possible Works/ Reports

Mission 1: Collection and Collation of Information of the River Basin			
S No.	Task Description	Source/ Methodology	Deliverables
1.0.	Basin Demography		Consolidated Report (Word, PDF)
1.1.	Urban and Rural census data at various administrative levels (District, Block, Tehsil, Gram Panchayat, Villages, Municipal Corporation, Municipal Council, Town area and Wards)	Ministry of Home Affairs, GoI	Data (Excel file)
1.2.	Information of Class I-VI towns	Ministry of Home Affairs, GoI	Data (Excel, Shapefiles)
1.3.	Demographic data of notified and non-notified slums	To be evolved by CIs in consultation with cGanga	Data (Excel file)
2.0.	River at a Glance		Consolidated Report (Word, PDF)
3.0.	Basin Administrative Delineation		
3.1.	Boundaries of District, Block, Tehsil, Gram Panchayat, and Villages	Survey of India, Revenue department, Rural development department	Data (Shapefiles)
3.2.	Boundaries of ULBs (Municipal Corporation, Municipal Council, Town Area) and Wards	Urban Development Department/Local Governments	Data (Shapefiles, drawing files)
3.3.	Boundaries of Notified and Non- notified Slums	To be evolved by CIs in consultation with cGanga	Data (Shapefiles, drawing files)
4.0.	River Atlas		Consolidated Report (Word, PDF)
4.1.	Present: Trace of all drains, rivulets, streams, and rivers	Preparation of verified stream network. Verification will be done through SOI maps, local, regional, and national level reports.	Data (Shapefiles)
4.1.1	Database of stream network	Preparation of excels having information of origin (coordinates, elevation, village, block, tehsil, district) and Confluence (coordinates, elevation, village, block, tehsil, district) points, and length, name of sub basin, major basin of each stream	Data (Excel files)
4.2.	Reference: Trace of all drains, rivulets, streams and rivers	Preparation of stream network (say using high-resolution satellite imagery (Corona or better)). Verification may be done through SOI maps, local, regional, and national level maps/reports	Data (Shapefiles)
4.2.1	Database of stream network	Preparation of excels having information of origin (coordinates, elevation, village, block, tehsil, district), confluence (coordinates, elevation, village, block, tehsil, district) points, length, name of sub basin, major basin of each stream	Data (Excel files)
4.3.	Target: Trace of all drains, rivulets, streams and rivers	By consultation among group on reference and present condition data	



Mission 1: Collection and Collation of Information of the River Basin (Continued)

S No.	Task Description	Source/ Methodology	Deliverables
5.0.	Basin Boundaries (up to first order stream network)	Delineation from prepared stream network using SRTM 30 m or any other available better resolution data/information	Data (Shapefiles)
6.0.	Waterbodies Atlas		Consolidated Report (Word, PDF)
6.1.	Present: Location and spread (pre and post monsoon or minimum and maximum) of Reservoirs, Ponds, Lakes, Wetlands, Water Harvesting Structure (Existing and Abandoned), Information and mapping of surface agricultural runoff drains etc.), say using high-resolution satellite imageries (Cartosat, Sentinel or better etc.), Sol toposheets, Surveys carried out for Smart Cities Programmes or any such other programme of Central, State or Local Government including using drone, Lidar, etc.	To be evolved by CIs in consultation with cGanga	Data (Shapefiles: point, line and polygons, Drone Survey Outputs: ortho-mosaic, DEM, DSM, Contour and point cloud, Lidar: .las file)
6.1.1	Present: Database of waterbodies	Preparation of excels having information of location (coordinates, village, block, tehsil, district), area, name of sub basin, major basin etc.	Data (Excel files)
6.2.	Reference: Location and spread (pre and post monsoon or minimum and maximum) of Reservoirs, Ponds, Lakes, Wetlands, Water Harvesting Structure (Existing and Abandoned), Information and mapping of surface agricultural runoff drains etc.) say using high-resolution satellite imageries (Corona or better) and Sol toposheets and historical/anecdotal information	To be evolved by CIs in consultation with cGanga	Data (Shapefiles: point, line and polygons)
6.2.1	Reference: Database of waterbodies	Preparation of excels having information of location (coordinates, village, block, tehsil, district), area, name of sub basin, major basin etc.	Data (Excel files)
6.3.	Target: Location and spread (pre and post monsoon or minimum and maximum of Reservoirs, Ponds, Lakes, Wetlands, Water Harvesting Structure	Consultation with stakeholders considering present and reference condition	



Mission 1: Collection and Collation of Information of the River Basin (Continued)

S No.	Task Description	Source/ Methodology	Deliverables
7.0.	Land Use/Land Cover		Consolidated Report (Word, PDF)
7.1.	Present: Land Uses, say using high-resolution satellite imageries (Cartosat, Sentinel or better etc.), Sol toposheets, Surveys carried out for Smart Cities Programmes or any such other programme of Central, State or Local Government including using drone, Lidar, etc.	To be evolved by CIs in consultation with cGanga	Data (Shapefiles: point, line and polygons)
7.2.	Reference: Land Uses, say using high-resolution satellite imageries (Corona or better) and Sol toposheets and historical/anecdotal information	To be evolved by CIs in consultation with cGanga	Data (Shapefiles: point, line and polygons)
7.3.	Target Condition of Land Uses	Consultation with stakeholders considering present and reference condition	
7.4.	Present: Land Cover, say using high-resolution satellite imageries (Cartosat, Sentinel or better etc.), Sol toposheets, Surveys carried out for Smart Cities Programmes or any such other programme of central, State or Local Government including using drone, Lidar, etc.	To be evolved by CIs in consultation with cGanga	Data (Shapefiles: point, line and polygons)
7.5.	Reference: Land Cover, say using high-resolution satellite imageries (Corona or better) and Sol toposheets and historical/anecdotal information	To be evolved by CIs in consultation with cGanga	Data (Shapefiles: point, line and polygons)
7.6.	Target Condition of Land Cover	Consultation with stakeholders considering present and reference condition	
8.0.	Biological profile of Basin		Consolidated Report (Word, PDF)
8.1.	Present: Status of Aquatic flora (Periphyton and Phytoplankton)	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, University thesis and dissertation	Data (Excel file), Report (PDF)
8.2.	Present: Status of Aquatic fauna (Zooplankton and Zoobenthos, Fish and fisheries, Higher vertebrates)	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, annual reports published by National Institutes such as CIFRI, ZSI and Related Departments (Department of Fisheries)	Data (Excel file), Report (PDF)
8.3.	Present: Status of Riparian flora	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, annual reports published by National Institutes such as BSI	Data (Excel file), Report (PDF)
8.4.	Present: Status of Riparian fauna	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, annual reports published by National Institutes such as ZSI	Data (Excel file), Report (PDF)



Mission 1: Collection and Collation of Information of the River Basin (Continued)

S No.	Task Description	Source/ Methodology	Deliverables
8.5.	Present: Status of Terrestrial flora	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, annual reports published by National Institutes such as BSI, FRI and Related Departments (Department of Forestry, Forest Survey of India (FSI))	Data (Excel file), Report (PDF)
8.6.	Present: Status of Terrestrial fauna	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, annual reports published by National Institutes such as ZSI	Data (Excel file), Report (PDF)
8.7.	Reference: Status of Aquatic flora (Periphyton and Phytoplankton)	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, University thesis and dissertation	Data (Excel file), Report (PDF)
8.8.	Reference: Status of Aquatic fauna (Zooplankton and Zoobenthos, Fish and fisheries, Higher vertebrates)	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, annual reports published by National Institutes such as CIFRI, ZSI and Related Departments (Department of Fisheries)	Data (Excel file), Report (PDF)
8.9.	Reference: Status of Riparian flora	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, annual reports published by National Institutes such as BSI	Data (Excel file), Report (PDF)
8.10.	Reference: Status of Riparian fauna	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, annual reports published by National Institutes such as ZSI	Data (Excel file), Report (PDF)
8.11.	Reference: Status of Terrestrial flora	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, annual reports published by National Institutes such as BSI, FRI and Related Departments (Department of Forestry, Forest Survey of India (FSI))	Data (Excel file), Report (PDF)
8.12.	Reference: Status of Terrestrial fauna	Data collected from secondary sources i.e., Publications, reports, unpublished scientific articles, annual reports published by National Institutes such as ZSI	Data (Excel file), Report (PDF)
8.13.	Target: Desired state of Aquatic flora (Periphyton and Phytoplankton)	Consultation with stakeholders considering present and reference condition	Data (Excel file), Report (PDF)



Mission 1: Collection and Collation of Information of the River Basin (Continued)

S No.	Task Description	Source/ Methodology	Deliverables
8.14.	Target: Desired state of Aquatic fauna (Zooplankton and Zoobenthos, Fish and fisheries, Higher vertebrates)	Consultation with stakeholders considering present and reference condition	Data (Excel file), Report (PDF)
8.15.	Target: Desired state of Riparian flora	Consultation with stakeholders considering present and reference condition	Data (Excel file), Report (PDF)
8.16.	Target: Desired state of Riparian fauna	Consultation with stakeholders considering present and reference condition	Data (Excel file), Report (PDF)
8.17.	Target: Desired state of Terrestrial flora	Consultation with stakeholders considering present and reference condition	Data (Excel file), Report (PDF)
8.18.	Target: Desired state of Terrestrial fauna	Consultation with stakeholders considering present and reference condition	Data (Excel file), Report (PDF)
8.19.	Morphological characters, habitat and niche preference, reproductive and breeding behaviour, food and feeding and migratory behavior of the focal species	Consultation with stakeholders & from the collected secondary information	Report (PDF)
9.0.	Climatologic/ Meteorological Data		Consolidated Report (Word, PDF)
9.1.	Meteorological data (Micro and Macro level) of parameters like Solar Radiation, Temperature (Max), Temperature (Min), Temperature (Mean), Wind Speed, Wind Direction, Cloud Cover, Rainfall, Snowfall, Relative Humidity of highest frequency preferably daily from the date of monitoring started	IMD weather data of all stations, Local weather monitoring stations, Climate Engine, NASA-LAADS DAAC	Data (Excel files, Shapefiles)
9.2.	Collection of different GCMs and RCMs data for the basin from different sources	IPCC Data	Data (Excel files)
9.3.	Drought data from date of monitoring	To be evolved by CIs in consultation with cGanga	Data (Excel files)
10.0.	Lithological profile		Consolidated Report (Word, PDF)
10.1.	Present: Lithological map, litho-logs, soil layer information (type of soil, macro, micro, secondary and other nutrient condition) to determine the type of soils and rocks in the basin	GSI, CGWB	Data (Excel data and Shapefiles)
10.2.	Present: Aquifer map	GSI, CGWB	Data (Excel data and Shapefiles)
10.3.	Reference: Lithological map, litho-logs, soil layer information (type of soil, macro, micro, secondary and other nutrient condition) to determine the type of soils and rocks in the basin	To be evolved by CIs in consultation with cGanga	Data (Excel data and Shapefiles)
10.4.	Reference: Aquifer map	To be evolved by CIs in consultation with cGanga	Data (Excel data and Shapefiles)
10.5.	Target: Lithological map, litho-logs, soil layer information (type of soil, macro, micro, secondary and other nutrient condition) to determine the type of soils and rocks in the basin	Consultation with stakeholders considering present and reference condition	Data (Excel data and Shapefiles)



Mission 1: Collection and Collation of Information of the River Basin (Continued)			
S No.	Task Description	Source/ Methodology	Deliverables
11.0.	Hydraulic		Consolidated Report (Word, PDF)
11.1.	Present: Cross Sections of the mainstream, major tributaries and drains of the river to determine the hydraulic parameters like bed slope, water surface slope, surface roughness and channel velocity	Existing data from CWC, Irrigation Department	Data (Excel file: lat, long, elevation/northing, easting, elevation)
11.2.	Present: Longitudinal section of the mainstream, major tributaries and drains of the river	Existing data from CWC, Irrigation Department	Data (Excel file)
11.3.	Present: Infrastructure in/on rivers (e.g. Bridge, Dam, Barrage, Intake wells, Canal of take, Sewer Outfall, Ghats, etc.)	Existing data from CWC, Irrigation Department	Data (Excel file, Shapefile)
11.4.	Reference: Cross Sections of the mainstream, major tributaries and drains of the river to determine the hydraulic parameters like bed slope, water surface slope, surface roughness and channel velocity	Existing data from CWC, Irrigation Department	Data (Excel file: lat, long, elevation/northing, easting, elevation)
11.5.	Reference: Longitudinal section of the mainstream, major tributaries and drains of the river	Existing data from CWC, Irrigation Department	Data (Excel file)
11.6.	Reference: Infrastructure in/on rivers (e.g. Bridge, Dam, Barrage, Intake wells, Canal of take, Sewer Outfall, Ghats, etc.)	Existing data from CWC, Irrigation Department	Data (Excel file, Shapefile)
12.0.	Hydrologic		Consolidated Report (Word, PDF)
12.1.	DEM of highest resolution (10 m or better)	ISRO, World DEM	Data (TIFF file)
12.2.	Gauge and discharge data of the mainstream, major tributaries and drains of the river including HFL value and inter-basin transfers of highest frequency preferably daily from the date of monitoring started	CWC/State	Data (Data (Excel file, Shapefile): location of monitoring)
12.3.	Data of Evaporation, evapotranspiration, percolation, Infiltration, and Interception of highest frequency from date of monitoring started	To be evolved by CIs in consultation with cGanga	Data (Excel file)
12.4.	Groundwater data (location, levels, and abstraction) from the date of monitoring started	From CGWB/ State GW Department	Data (Excel file, Shapefiles)
12.5.	Sediment load (Coarse, medium, and fine grained) data (load, variation along stream length, sources in basin and inflow rate into the river) of highest frequency preferably daily from the date of monitoring	CWC/ State monitoring station data	Data (Excel file)
13.0.	Physio-chemical and Biological		Consolidated Report (Word, PDF)
13.1.	Surface water quality data of parameters like Temperature, pH, Turbidity, Colour, EC, TS, TSS, TDS, VSS, FSS, VDS, FDS, Alkalinity, Hardness, DO, BOD, COD, TC, TOC, AN, TKN, Nitrite, Nitrate, P, Heavy Metals, Pesticides, Total coliform, and Faecal coliform of highest frequency preferably daily from the date of monitoring started with locations of monitoring	CWC	Data (Excel file, Shapefile)



Mission 1: Collection and Collation of Information of the River Basin (Continued)

S No.	Task Description	Source/ Methodology	Deliverables
13.0.	Physio-chemical and Biological		Consolidated Report (Word, PDF)
13.1.	Surface water quality data of parameters like Temperature, pH, Turbidity, Colour, EC, TS, TSS, TDS, VSS, FSS, VDS, FDS, Alkalinity, Hardness, DO, BOD, COD, TC, TOC, AN, TKN, Nitrite, Nitrate, P, Heavy Metals, Pesticides, Total coliform, and Faecal coliform of highest frequency preferably daily from the date of monitoring started with locations of monitoring	CWC	Data (Excel file, Shapefile)
13.2.	Groundwater quality data of parameters like Temperature, pH, Turbidity, Colour, EC, TS, TSS, TDS, VSS, FSS, VDS, FDS, Alkalinity, Hardness, DO, BOD, COD, TC, TOC, AN, TKN, Nitrite, Nitrate, P, Heavy Metals, Pesticides of highest frequency preferably daily from the date of monitoring started with locations of monitoring	CGWB / State GW Department	Data (Excel file, Shapefile)
13.3.	Soil data of parameters like Temperature, pH, Moisture, Colour, Volatile (Organic), Fixed (Ash/Inorganic), Carbon Content, AN, TKN, Chloride, Sulphate, Carbonate, Nitrite, Nitrate, P, K, Na, Ca, Mg, Heavy Metals, Pesticides, Total coliform, and Faecal coliform of highest frequency preferably daily from the date of monitoring started with locations of monitoring	To be evolved by CIs in consultation with cGanga	Data (Excel file, Shapefile)
13.4.	Rock data parameters like Colour, Volatile (Organic), Fixed (Ash/Inorganic), Carbon Content, AN, TKN, Chloride, Sulphate, Carbonate, Nitrite, Nitrate, P, K, Na, Ca, Mg, Heavy Metals of highest frequency preferably daily from the date of monitoring started with locations of monitoring	To be evolved by CIs in consultation with cGanga	Data (Excel file, Shapefile)
13.5.	Target: Water quality parameters	Consultation with stakeholders considering present and reference condition	Data (Excel file)
13.6.	Target: Groundwater quality parameters	Consultation with stakeholders considering present and reference condition	Data (Excel file)
13.7.	Target: Soil quality parameters	Consultation with stakeholders considering present and reference condition	Data (Excel file)
13.8.	Target: Quality parameters of rocks	Consultation with stakeholders considering present and reference condition	Data (Excel file)
14.0.	Water Demand and Supply		Consolidated Report (Word, PDF)
14.1.	Domestic water requirement (LPCD)	Jal Nigam, Municipal Corporation, Nagar Nigam	Data (Excel file)
14.2.	Industrial water requirement	CPCB, State PCB	Data (Excel file)



Mission 1: Collection and Collation of Information of the River Basin (Continued)

S No.	Task Description	Source/ Methodology	Deliverables
14.3.	Agricultural water requirement	Irrigation Department	Data (Excel file)
14.4.	Sources of water supply within delineated administrative and natural boundaries	Municipal Corporation, Nagar Nigam	Data (Excel file, Shapefile)
14.5.	Details of storage, public and private infrastructures, pumping, supply network and WTPs within delineated administrative and natural boundaries	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file, Shapefile)
15.0.	Industrial profile within delineated administrative and natural boundaries		Consolidated Report (Word, PDF)
15.1.	Details of Industries (location, type, raw material, products, by-products, waste generated, treatment facility, green belt, etc.)	CPCB, State PCB	Data (Excel file, Shapefile)
15.2.	Information of industrial clusters	CPCB, State PCB	Data (Excel file, Shapefile)
15.3.	Target (Projected)	Consultation with stakeholders considering present and reference condition	Data (Excel file)
16.0.	Pollution load within delineated administrative and natural boundaries		
16.1.	Load		Consolidated Report (Word, PDF)
16.1.1	Domestic wastewater load	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file)
16.1.2	Status of sewerage network and household connections	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file, Shapefiles, Drawings)
16.1.3	Information of interception and diversions	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file, Shapefiles, Drawings)
16.1.4	Location of pumping stations and their status	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file, Shapefiles, Drawings)
16.1.5	Information of drains (domestic and industrial), their discharge and quality data	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file, Shapefiles, Drawings)
16.1.6	Industrial wastewater load	CPCB, State PCB, secondary sources like reports, articles etc.	Data (Excel file)
16.1.7	Quantity of solid waste generation	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file)
16.1.8	Composition of solid waste	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file)
16.1.9	Details about collection, transportation and disposal facilities	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file)



Mission 1: Collection and Collation of Information of the River Basin (Continued)			
S No.	Task Description	Source/ Methodology	Deliverables
16.2.	Treatment		Consolidated Report (Word, PDF)
16.2.1	Details of STPs (Location, Technology, Capacity, current utilization, Flow, quality parameters, sludge management, etc.)	CPCB, State PCB, secondary sources like reports, articles etc.	Data (Excel file/ Pre-designed Layout)
16.2.2	Details of CETPs (Location, technology, capacity, current utilization, flow, quality parameters, sludge management etc.)	CPCB, State PCB, secondary sources like reports, articles etc.	Data (Excel file/ Pre-designed Layout)
16.2.3	Information of dumping sites	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file), Report (Word file)
16.2.4	Information of legacy waste	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file), Report (Word file)
16.2.5	Information of successful solid waste management models	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file), Report (Word file)
16.2.6	Waste to energy, waste to compost, their pros and cons, and economic viability of the current management practices	Municipal Corporation, Nagar Nigam, secondary sources like reports, articles etc.	Data (Excel file), Report (Word file)
17.0.	Agricultural profile within delineated administrative and natural boundaries (Historical since records are available)		Consolidated Report (Word, PDF)
17.1.	Geographical delineation of significant agricultural area in the basin	State agricultural Department, secondary sources like annual reports, articles, etc.	Data (Excel file, Shapefile)
17.2.	Total agricultural land distribution under different types of farming practices	State agricultural Department, secondary sources like annual reports, articles, etc.	Data (Excel file)
17.3.	Cropping pattern and intensity	State agricultural Department, secondary sources like annual reports, articles, etc.	Data (Excel file)
17.4.	Irrigated land and major irrigation sources with groundwater drawdown information	State agricultural dept, Irrigation dept, secondary sources like annual reports, articles, etc.	Data (Excel file)
17.5.	Irrigation pattern	State agricultural dept, Irrigation dept, secondary sources like annual reports, articles, etc.	Data (Excel file)
17.6.	Crop production and average yield	State agricultural Department, secondary sources like annual reports, articles, etc.	Data (Excel file)
17.7.	Chemical fertilizer & plant protectant distribution and utilization	State agricultural Department, secondary sources like annual reports, articles, etc.	Data (Excel file)
17.8.	Agricultural manpower, land and livestock holdings	State agricultural Department, secondary sources like annual reports, articles, etc.	Data (Excel file)
17.9.	Operational government schemes for sustainable agriculture	State agricultural Department, secondary sources like annual reports, articles, etc.	Data (Excel file)



Mission 1: Collection and Collation of Information of the River Basin (Continued)			
S No.	Task Description	Source/ Methodology	Deliverables
17.10.	Major agro-ecosystem concerns of the basin	To be evolved by Cls in consultation with cGanga	Data (Excel file)
17.11.	Existing or potential measures of sustainable agriculture and their economic viability	To be evolved by Cls in consultation with cGanga	Data (Excel file)
17.12.	Nutrient and sediments load	To be evolved by Cls in consultation with cGanga	Data (Excel file)
17.13.	Flow/ nutrient trapping structures	To be evolved by Cls in consultation with cGanga	Data (Excel file)
17.14.	Agricultural management practices (tillage and reconsolidation, no-tillage and surface residues, raised bed farming, urea deep placement, SRI in paddy cultivation, plants and crop rotations, inter-cropping, Irrigation supply systems, farm irrigation & micro- irrigation, manure and fertilization practices, grazing management, terrace farming, pest management, etc.)	To be evolved by Cls in consultation with cGanga	Data (Excel file)
17.15.	Identification of agricultural factors affecting the river and proposed corrective measures	To be evolved by Cls in consultation with cGanga	Data (Excel file)
17.16.	Suitable locations for forestation, orchards and organic farming	To be evolved by Cls in consultation with cGanga	Data (Excel file, Shapefile, KML)
18.0.	Geological Profile		
18.1.	Present: Excavations, explosions and mining activities in the basin	Mining Department	Data (Excel file, Shapefile)
18.2.	Present: Tunneling data	To be evolved by Cls in consultation with cGanga	Data (Excel file, Shapefile)
18.3.	Present: Fracking zone	To be evolved by Cls in consultation with cGanga	Data (Excel file, Shapefile)
18.4.	Present: Deforestation	To be evolved by Cls in consultation with cGanga	Data (Excel file, Shapefile)
18.5.	Present: River bed mining	To be evolved by Cls in consultation with cGanga	Data (Excel file, Shapefile)
18.6.	Present: Hill slope change	To be evolved by Cls in consultation with cGanga	Data (Excel file)
18.7.	Present: Natural geological disasters i.e., earthquakes, landslides, avalanches, sinkholes, tsunamis, etc.	To be evolved by Cls in consultation with cGanga	Data (Excel file)
18.8.	Reference: Excavations, explosions and mining activities in the basin	To be evolved by Cls in consultation with cGanga	Data (Excel file, Shapefile)
18.9.	Reference: Tunneling data	To be evolved by Cls in consultation with cGanga	Data (Excel file, Shapefile)
18.10.	Reference: Fracking zone	To be evolved by Cls in consultation with cGanga	Data (Excel file, Shapefile)
18.11.	Reference: Deforestation	To be evolved by Cls in consultation with cGanga	Data (Excel file, Shapefile)
18.12.	Reference: River bed mining	To be evolved by Cls in consultation with cGanga	Data (Excel file, Shapefile)
18.13.	Reference: Hill slope change	To be evolved by Cls in consultation with cGanga	Data (Excel file)
18.14.	Reference: Natural geological disasters i.e., earthquakes, landslides, avalanches, sinkholes, tsunamis, etc.	To be evolved by Cls in consultation with cGanga	Data (Excel file)



Mission 1: Collection and Collation of Information of the River Basin (Continued)			
S No.	Task Description	Source/ Methodology	Deliverables
19.0.	Aerial/ drone surveys, Aerial photographs		Data (Raw images, processed data: ortho mosaic, DSM, DEM, Las file)
20.0.	Topographic maps	Sol	Data (PDFs, Shapefile)
20.1.	Contour map (1m or better)	Sol	Data (Shapefile)
21.0.	Revenue map	Revenue Department	Data (PDFs, Shapefile)
22.0.	Infrastructure and Planning		Consolidated Report (Word, PDF)
22.1.	Developmental Plan	Nagar Nigam, Smart City Mission programme, and from secondary sources like DPRs, Annual reports etc.	Data (Shapefile, Drawings)
22.2.	Water supply network Plan	Nagar Nigam, Municipal Corporation, and from secondary sources like DPRs, Annual reports etc.	Data (Shapefile, Drawings)
22.3.	Sewerage and Drainage Network plan	Nagar Nigam, Municipal Corporation, and from secondary sources like DPRs, Annual reports etc.	Data (Shapefile, Drawings)
22.4.	Sanitation Plan	Nagar Nigam, Municipal Corporation, and from secondary sources like DPRs, Annual reports etc.	Data (Shapefile, Drawings)
22.5.	Riverfront Development Plan	Nagar Nigam, Municipal Corporation, and from secondary sources like DPRs, Annual reports etc.	Data (Shapefile, Drawings)
23.0.	Geomorphological Mapping		Consolidated Report (Word, PDF)
23.1.	Present: Active and passive flood plain mapping	From SENTINEL images or better with SAR	Data (Shapefile)
23.2.	Present: River island mapping	From SENTINEL images or better with SAR	Data (Shapefile)
23.3.	Reference: Active and passive flood plain mapping	From CORONA images or better	Data (Shapefile)
23.4.	Reference: River island mapping	From CORONA images or better	Data (Shapefile)



MISSION 2: Aviral Dhara			
TASK	Task Description	Source/ Methodology	Deliverables
1.	Water Balance/ Accounts/Budget as per delineated administrative and natural boundaries	Water budget of watersheds	Water Budget Report (Word, PDF)
1.1.	Estimation of water balance and water budget based on data collected	To be evolved by CIs in consultation with cGanga	Data (Excel file)
2.	Hydrological Modeling	Identification & quantification of significantly impacted and/or critical hydrological components affecting	Data (SWAT Model), Report (Word, PDF)
2.1.	Watershed Simulation and discharge estimation	To be evolved by CIs in consultation with cGanga	Data (Excel file)
2.3.	Calibration and Validation of the model as per delineated administrative and natural boundaries	To be evolved by CIs in consultation with cGanga	Data (Excel file)
3.	Hydraulic Modeling of rivers/streams outlined in River Atlas	Stream flows at ungauged stations	
3.1.	Analysis of cross sections and estimation of stage-discharge relation at major locations in river, major tributaries and drains	To be evolved by CIs in consultation with cGanga	Data (Excel file, HECRAS model)
4.	E-Flows Assessment	E-flows recommendations for maintaining river health	Report (Word, PDF)
4.1.	Virgin/ unimpacted flows, present flows, depth, width of flow required for keystone species/ and other critical species	To be evolved by CIs in consultation with cGanga	Data (Excel file)
5.	Sediment budget	Identification of critical erosion & deposition zones of rivers (with quantitative estimates where possible) and likely river instabilities	Report (Word, PDF)
5.1.	Assessment of sediment load data to evaluate sediment budget	To be evolved by CIs in consultation with cGanga	Data (Excel file)
6.	Climate Change Assessment	Assessment of impact of climate change on water availability and on different hydrologic components and also upon the water level of the river	Report (Word, PDF)
6.1.	Assessment and processing of different GCMs and RCMs data to study the change in climatic conditions over the years and predicting future changes	To be evolved by CIs in consultation with cGanga	Data (Excel Files, Shapefiles)



MISSION 3: Nirmal Dhara

TASK	Task Description	Source/ Methodology	Deliverables
1.	Pollutant source mapping within delineated administrative and natural boundaries	Identification of pollution hot spots	Data (Shapefiles)
2.	Management plan for domestic wastewater within delineated administrative and natural boundaries	Framework for assessment of existing domestic waste management practices in rural and urban sectors	Report (Word, PDF)
2.1.	Provisions of treated wastewater reuse	To be evolved by CIs in consultation with cGanga	Data (PDFs, excel file)
2.2.	Economic viability of the current management practices	To be evolved by CIs in consultation with cGanga	Data (PDFs, excel file)
2.3.	Future plan for management of wastewater	To be evolved by CIs in consultation with cGanga	Data (PDFs, excel file)
3.	Management plan for industrial wastewater within delineated administrative and natural boundaries	Framework for assessment of existing industrial waste management practices in rural and urban sectors	Report (Word, PDF)
3.1.	Provisions of treated wastewater reuse	To be evolved by CIs in consultation with cGanga	Data (PDFs, excel file)
3.2.	Economic viability of the current management practices	To be evolved by CIs in consultation with cGanga	Data (PDFs, excel file)
3.3.	Future plan for management of wastewater	To be evolved by CIs in consultation with cGanga	Data (PDFs, excel file)
4.	Management plan for solid waste within delineated administrative and natural boundaries	Framework for assessment of existing solid waste management practices in rural and urban sectors	Report (Word, PDF)
4.7.	Waste to energy, waste to compost, their pros and cons, and economic viability of the current management practices	To be evolved by CIs in consultation with cGanga	Data (PDFs, excel file)
4.8.	Future plan for solid waste management	To be evolved by CIs in consultation with cGanga	Data (PDFs, excel file)
4.9.	Economics of sustainable solid waste management	To be evolved by CIs in consultation with cGanga	Data (PDFs, excel file)
5.	Plan for rejuvenation of water bodies within delineated administrative and natural boundaries	Effective use plan of waterbodies in the basin	Report (Word, PDF)
5.1.	Existing and proposed interventions	To be evolved by CIs in consultation with cGanga	Data (Shapefiles, Drawings)
5.2.	Water Bodies connected to the canal network	To be evolved by CIs in consultation with cGanga	Data (Shapefiles, Drawings)
5.3.	Existing or proposed river rejuvenation projects and their economic viability.	To be evolved by CIs in consultation with cGanga	Data (PDFs, excel file)
6.	Mapping of agricultural runoff and nutrient cycling within delineated administrative and natural boundaries	Impact evaluation of agriculture runoff on existing waterbodies, identify the current and possible practices affecting natural nutrient recycling	Report (Word, PDF)
7.	Identification of major threats and challenges for attaining Nirmal Dhara within delineated administrative and natural boundaries	Conservation, Management Strategies, and Policy Measures	Data (PDFs)
8.	Mapping of various stakeholders, schemes, and economics involved within delineated administrative and natural boundaries	Impact assessment of existing and proposed governance schemes and policies	Consolidated Report (Word, PDF)
8.1.	Mapping of various stakeholders and their roles	To be evolved by CIs in consultation with cGanga	Data (PDFs, Excel files)
8.2.	Mapping of government and non- government schemes and availability of funds under different schemes	To be evolved by CIs in consultation with cGanga	Data (PDFs, Excel files)
9.	Mapping of best practices in Solid-Liquid waste management – National and International	Case studies	Data (PDFs)



MISSION 4: Ecological Restoration			
TASK	Task Description	Source/ Methodology	Deliverables
1.	Comparing status of present and reference conditions of aquatic flora and fauna within delineated administrative and natural boundaries	Basin wise/ River wise inventory of the aquatic flora and fauna	Data (Excel files)
2.	Comparing status of present and reference conditions of riparian flora and fauna within delineated administrative and natural boundaries	Basin wise/ River wise inventory of the riparian flora and fauna	Data (Excel files)
3.	Comparing status of present and reference conditions of terrestrial flora and fauna within delineated administrative and natural boundaries	Basin wise/ River wise inventory of the terrestrial flora and fauna	Data (Excel files)
4.	Identification of the major threats to biodiversity in the basin within delineated administrative and natural boundaries	Identification of necessary conservation management strategies and policy measures	Report (Word, PDF)
4.1	Major threats and policy steps	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)
4.2	Management and conservation challenges and measures of restoration	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)

MISSION 5: Sustainable Agriculture			
TASK	Task Description	Source/ Methodology	Deliverables
1.	Assessment of gross agricultural structure of the basin within delineated administrative and natural boundaries	Potential for agriculture development in the basin	Report (Word, PDF), Data (Shapefile)
2.	Nutrient and sediments load management within delineated administrative and natural boundaries	Identify the current and possible practices affecting natural nutrient recycling	Report (Word, PDF)
3	Agricultural management practices (tillage and reconsolidation, no-tillage and surface residues, raised bed farming, urea deep placement, SRI in paddy cultivation, plants and crop rotations, inter-cropping, irrigation supply systems, farm irrigation & micro-irrigation, manure and fertilization practices, grazing management, terrace farming, pest management, etc.)	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)
4	Suitable locations for forestation, orchards and organic farming	To be evolved by CIs in consultation with cGanga	Data (Shapefiles, KML)
3.	Identification of agricultural factors affecting the river and proposed corrective measures within delineated administrative and natural boundaries	Impact assessment of current agricultural practices on the existing water nexus of the basin	Report (Word, PDF)



MISSION 6: Geological Safeguarding

TASK	Task Description	Source/ Methodology	Deliverables
1	Mapping of the potential natural and anthropogenic threats to the geological base of river basin	Potential activities impacting geological identity of the basin	Report (Word, PDF)
2	River channel migration zone mapping	Channel migration model; prediction of future channel alignment	Data (Shapefile)
3	Groundwater exploitation and status	Identification of zones facing severe water scarcity (current and future)	Report (Word, PDF), Data (Excel files)
3.1	Extensively modified riverbank	To be evolved by CIs in consultation with cGanga	Data (Shapefile)
3.2	Ground water drafting status	To be evolved by CIs in consultation with cGanga	Data (Excel file)
3.3	Information of large water structures	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
4	Identification of the major threats and challenges for safeguarding a geological repositior	Conservation management strategy, and policy measures	Report (Word, PDF)

Mission 7: Basin Protection from Natural Disasters

TASK	Task Description	Source/ Methodology	Deliverables
1	Flood hazard modelling	Identification of flood risk	Report (Word, PDF), Data (Shapefile)
1.1	Past flood scenarios	To be evolved by CIs in consultation with cGanga	Data (Excel, Word, PDF)
2	Drought estimation and monitoring	Identification of drought risk	Report (Word, PDF), Data (Shapefile)
2.1	Identification and type of drought (meteorological/agricultural/Hydrological drought)	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)
2.2	Drought modelling (SPI, ManiKandal method, etc.)	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
3	Cyclone monitoring information	Identification of cyclone risk	Report (Word, PDF), Data (Shapefile)
3.1	Predicted path of the cyclone	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
3.2	Hourly meteorological changes	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
4	Landslide susceptibility mapping	Identification of high-risk landslide disaster hotspots, monitoring, risk assessment and management	Report (Word, PDF), Data (Shapefile)
4.1	Slope and aspect map	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
4.2	Structural mapping (Fold, fault, joint, lineament, shear zones)	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
4.3	Drainage density map	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
4.4	Valley buffer map	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
4.5	Soil texture map	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
4.6	Groundwater level	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
5	Identification of the major threats and challenges for basin protection from natural disasters	Conservation management strategy, and policy measures	Report (Word, PDF)



Mission 8: River Hazard Management

TASK	Task Description	Source/ Methodology	Deliverables
1	Bank erosion modelling	Spatio-temporal rate of bank erosion and estimation of morphological changes in natural rivers	Report (Word, PDF), Data (Shapefile)
1.1	Structural map of the region (major and minor structures)	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
1.2	Groundwater flow map (influent and effluent relationship to the river)	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
1.3	Riparian and floodplain mapping (Historical migration path of the channel)	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
1.4	Riparian vegetation	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
1.5	Channel sinuosity and channel multiplicity	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
1.6	Soil textural data	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
1.7	Triaxial shear test data of bank soil	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)
2	Flood hazard modelling and mapping	Identification of flood risk	Report (Word, PDF), Data (Shapefile)
2.1	Active and passive flood plain mapping	To be evolved by CIs in consultation with cGanga	Report (Word, PDF), Data (Shapefile)
3	Flood management techniques	Impact assessment of currently used techniques for flood risk mitigation	Report (Word, PDF)
4	Identification of the major threats and challenges for rivers	Conservation management strategy, and policy measures	Report (Word, PDF)

Mission 9: Environmental Knowledge Building and Sensitization

TASK	Task Description	Source/ Methodology	Deliverables
1	Learnings from the work done in other Indian basins	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)
2	Learnings from the work done in other International basins	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)
3	Approaches and activities to river-people connect	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)
4	Legal constraints such as inter-state agreements	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)
5	Social environment (water-related institutions, interest groups, public awareness)	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)
6	Developing Protocol for Initiating Monitoring and Feedback of Various Implementation Strategies/ Plans/ Programmes/ Projects within delineated administrative and natural boundaries including estimates of resources (human, financial, etc.) required and their management	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)
7	Designing a pilot for initiating Monitoring and Feedback	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)
8	Implementing pilot(s) for Monitoring and Feedback	To be evolved by CIs in consultation with cGanga	Report (Word, PDF)



Schedule of Activities

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MISSION 2: Aviral Dhara

[illegible]

MISSION 3: Nirmal Dhara

[illegible]

MISSION 4: Ecological Restoration

[illegible]

MISSION 5: Sustainable Agriculture

[illegible]

MISSION 6: Geological Safeguarding

[illegible]

Mission 7: Basin Protection from Natural Disasters

[illegible]

Mission 8: River Hazard Management

[illegible]

Mission 9: Environmental Knowledge Building and Sensitization

[illegible]

Appendix IC to Annexure I

Quarter wise List of Deliverable

Year	Quarter	Reports/Datasets to be Submitted	Outcomes
Year 1	Quarter 1	River Basin at a Glance	Provide an overview of salient features of some significant aspects and critical issues relating to rejuvenation and conservation of important rivers in the basin
	Quarter 2	Basin Demography	Population characteristics and trends within urban and rural areas to assess and analyze resource utilization (land, water, energy, etc.) and residue/waste generation (solid, liquid and gaseous) for impact on river systems and strategizing for remedial actions.
		Aerial/ drone surveys, Aerial photographs	Mapping the river's course, its tributaries, and the surrounding landscape for understanding the river basin's geography and how it changes over time due to natural or human-induced factors
	Quarter 3	Lithological profile	Landslide assessment
		Hydraulic data	For Hydraulic model
		Hydrologic data	For Hydrologic model
		Infrastructure and Planning Report	Identifying critical habitats, biodiversity hotspots, and ecologically sensitive areas within the river basin that need protection or restoration. guide the development of flood control strategies, such as the construction of levees, dams, or drainage systems,
		Geomorphological Mapping	Estimation of spatio-temporal rate of bank erosion and morphological changes in natural rivers
	Quarter 4	River Atlas	Collection and collation of information about geography of all drains, rivulets, streams and rivers in the basin
		Climatologic/ Meteorological Data	Climate model
		Geological Profile	Estimation of potential activities impacting geological identity of the basin
		Topographic maps	To understand the river's flow characteristics, drainage patterns, which are essential for managing water resources and predicting flood zones.
		Revenue map	By showing land use patterns, revenue maps help in identifying areas that are over-exploited or at risk of environmental degradation, guiding conservation, planning agriculture development projects and sustainable land use strategies.
		Learnings from the work done in other Indian basins	Best Practices in Water Management, Ecosystem Restoration Efforts, Policy and Governance Models, Technological Innovations,
		Learnings from the work done in other international basins	Best Practices in Water Management, Ecosystem Restoration Efforts, Policy and Governance Models, Technological Innovations, etc.
		Approaches and activities to river-people connect	Community Engagement Strategies,
		Legal constraints such as inter-state agreements	Provide framework and guidelines for collaboration and conflict resolution between multiple jurisdictions
		Social environment (water-related institutions, interest groups, public awareness)	Implementation of policies on ground and creating public awareness
		Developing Protocol for Initiating Monitoring and Feedback of Various Implementation Strategies/ Plans/ Programmes/ Projects	The protocol outlined in the report can be used as a guideline for implementing various projects and programs in the river basin, ensuring they are carried out as planned and meet their intended objectives; performance evaluation; feedback; stakeholder engagement



Year	Quarter	Reports/Datasets to be Submitted	Outcomes
Year 2	Quarter 1	Water Demand and Supply Report	availability of water resources and the demand from various sectors such as agriculture, industry, and domestic use. This information is crucial for managing water allocations and ensuring sustainable use of water resources.
		Agricultural Profile	Crop planning and sustainable farming practices that are most likely to succeed in the river basin.
		Flood hazard model	Identification of flood risk
	Quarter 2	Waterbodies Atlas	provides detailed information about various waterbodies within the basin, such as rivers, lakes, ponds, reservoirs, and wetlands. can guide the management and allocation of water resources, helping to balance the needs of different users such as agriculture, industry, domestic consumption.
		Pollution load Report	pinpointing the exact sources of pollution, whether they are industrial discharges, agricultural runoff, sewage outflows, or other sources. This is crucial for targeting cleanup and prevention efforts.
		Hydraulic Model	Stage Discharge relation at ungauged stations
		Climate Change Assessment Report	With potential changes in precipitation patterns and water availability, the report can guide the sustainable management of water resources, for agricultural, industrial, and domestic needs.
		Pollutant source map	Identification of pollution hot spots
		Designing a pilot for initiating Monitoring and Feedback	providing a blueprint for how to set it up, what parameters to monitor, and how to collect and analyze data; serve as a training ground for engaging local stakeholders
	Quarter 3	Land Use/Land Cover	The LULC report can be used in water resource management by showing how different land uses and land cover impact water quality and availability.
		Biological Profile of Basin	The profile can guide ecological restoration efforts by providing insights into the native species and habitats that need to be preserved or restored.
		Physio-chemical and Biological Profile	The physio-chemical data (like pH, turbidity, dissolved oxygen levels, and presence of pollutants) is crucial for assessing and managing the water quality of the river. This information guides actions to address pollution and ensure the river water meets standards for various uses.
		Industrial profile Report	comprehensive information about the types, distribution, and impacts of industries within the basin area for water usage by the industries, pollution levels, waste generation, and resource usage.
		Water Balance/ Accounts/Budget as per delineated administrative and natural boundaries	Water budget of watersheds
		Hydrological Model	Identification & quantification of significantly impacted and/or critical hydrological components affecting stream flows
		Assessment of gross agricultural structure of the basin	Potential for agriculture development in the basin
		Nutrient and sediments load management	Identify the current and possible practices affecting natural nutrient recycling
		Flood management techniques	Impact assessment of currently used techniques for flood risk mitigation



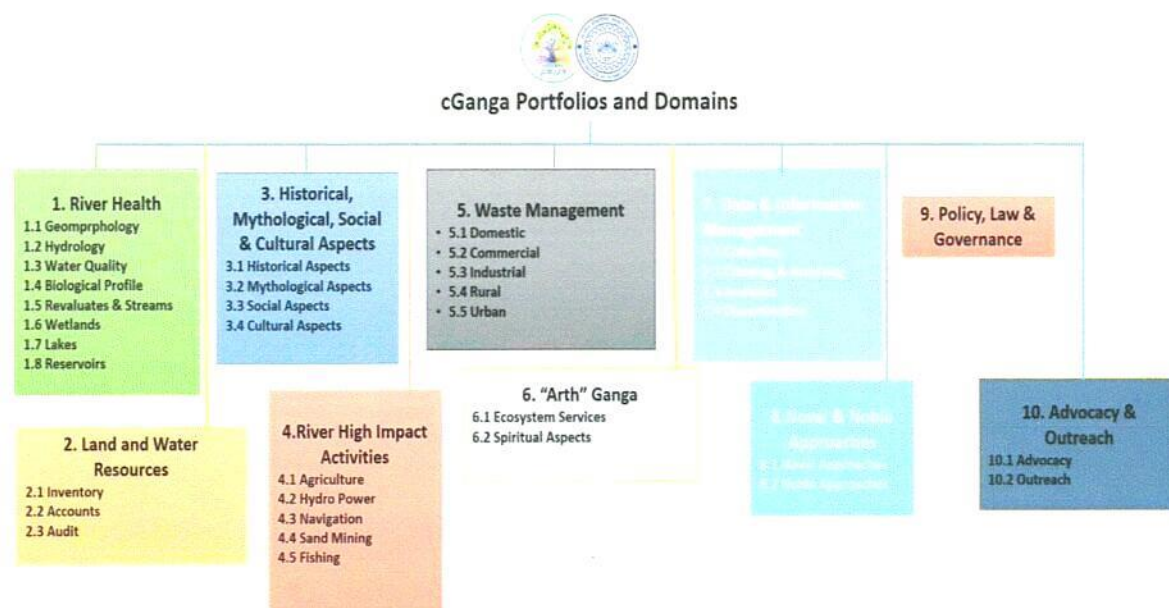
Year	Quarter	Reports/Datasets to be Submitted	Outcomes
Year 3	Quarter 4	Identification of major threats and challenges for attaining Nirmal Dhara	Conservation, Management Strategies, and Policy Measures
		Mapping of best practices in Solid-Liquid waste management – National and International	guide the development or enhancement of infrastructure, such as modern recycling facilities, waste-to-energy plants,
		Map of suitable locations for forestation, orchards and organic farming	Map can guide afforestation efforts for better water management (reduce runoff, enhance groundwater recharge, and improve water quality by minimizing chemical inputs.).
		Identification of the major threats and challenges for basin protection from natural disasters	Conservation management strategy, and policy measures
		Identification of the major threats and challenges for rivers	For conservation management strategy, and policy measures
	Quarter 1	E-Flows Assessment Report	Recommendations for maintaining river health
		Sediment budget Report	Identification of critical erosion & deposition zones of rivers (with quantitative estimates where possible) and likely river instabilities
		Management plan for domestic wastewater	Assessment of existing domestic waste management practices in rural and urban sectors
		Management plan for industrial wastewater	Assessment of existing industrial waste management practices in rural and urban sectors
		Management plan for solid waste	Assessment of existing solid waste management practices in rural and urban sectors
		Plan for rejuvenation of water bodies	Effective use plan of waterbodies in the basin
		Mapping of agricultural runoff and nutrient cycling	Monitor and manage water quality in the river basin, setting standards and implementing policies to control nutrient levels in water bodies.
		Mapping of various stakeholders, schemes, and economics involved	Impact assessment of existing and proposed government schemes and policies
		Report on Identification of the major threats to biodiversity in the basin, management, conservation challenges and measures of restoration	Detailed insights into the specific threats to biodiversity in the river basin, such as pollution, habitat loss, invasive species, or climate change. This information is essential for developing targeted mitigation strategies.
		Agricultural management practices	Potential for agriculture development in the basin
		Mapping of the potential natural and anthropogenic threats to the geological base of river basin	Identify potential activities impacting geological identity of the basin
		Groundwater exploitation and status	Identification of zones facing severe water scarcity (current and future)
		Identification of the major threats and challenges for safeguarding a geological repository	assessment of potential risks, such as seismic activity, flooding, soil erosion, or human-induced threats, enabling the development of comprehensive risk mitigation and management plans.
	Quarter 2		
	Quarter 3	Identification of agricultural factors affecting the river and proposed corrective measures	Impact assessment of current agricultural practices on the existing water nexus of the basin
	Quarter 4	Implementing pilot(s) for Monitoring and Feedback	Utilize findings from the pilot projects to influence policy and decision-making. The report should provide a basis for advocating for effective river basin management policies.



Appendix II to Annexure I

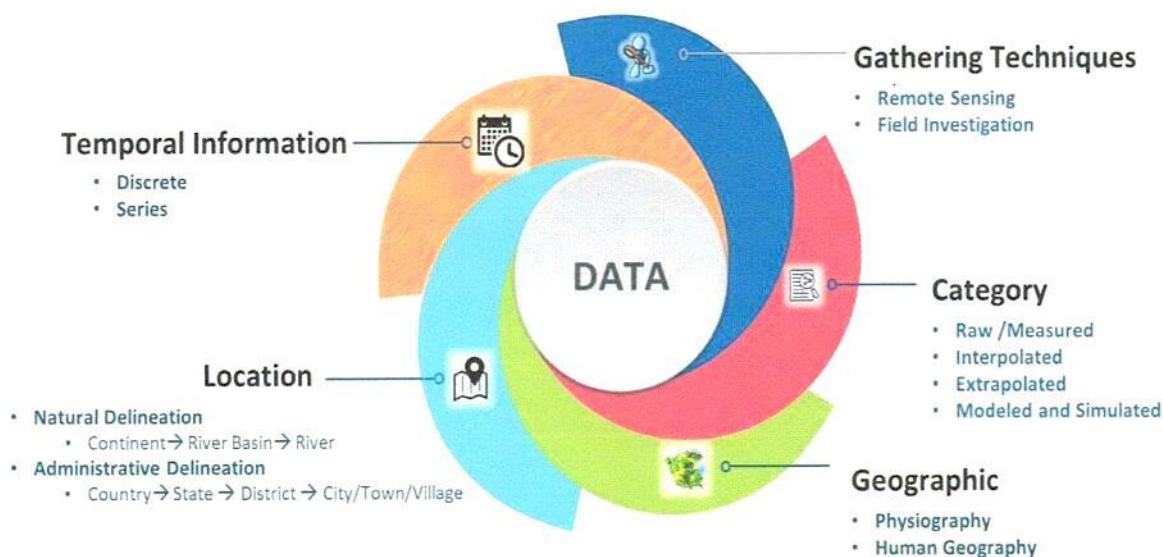
Cyclic Framework for River Restoration and Conservation Efforts

River Restoration and Conservation (RRC) is a dynamic as well as cyclic process involving many steps as elaborated in RRC manual (Concise Manual and Guide for River Restoration and Conservation, cGanga and NMCG (2019)). Following illustrations could be used as an indicative means for collation of information for preparing River Basin Management Plans.



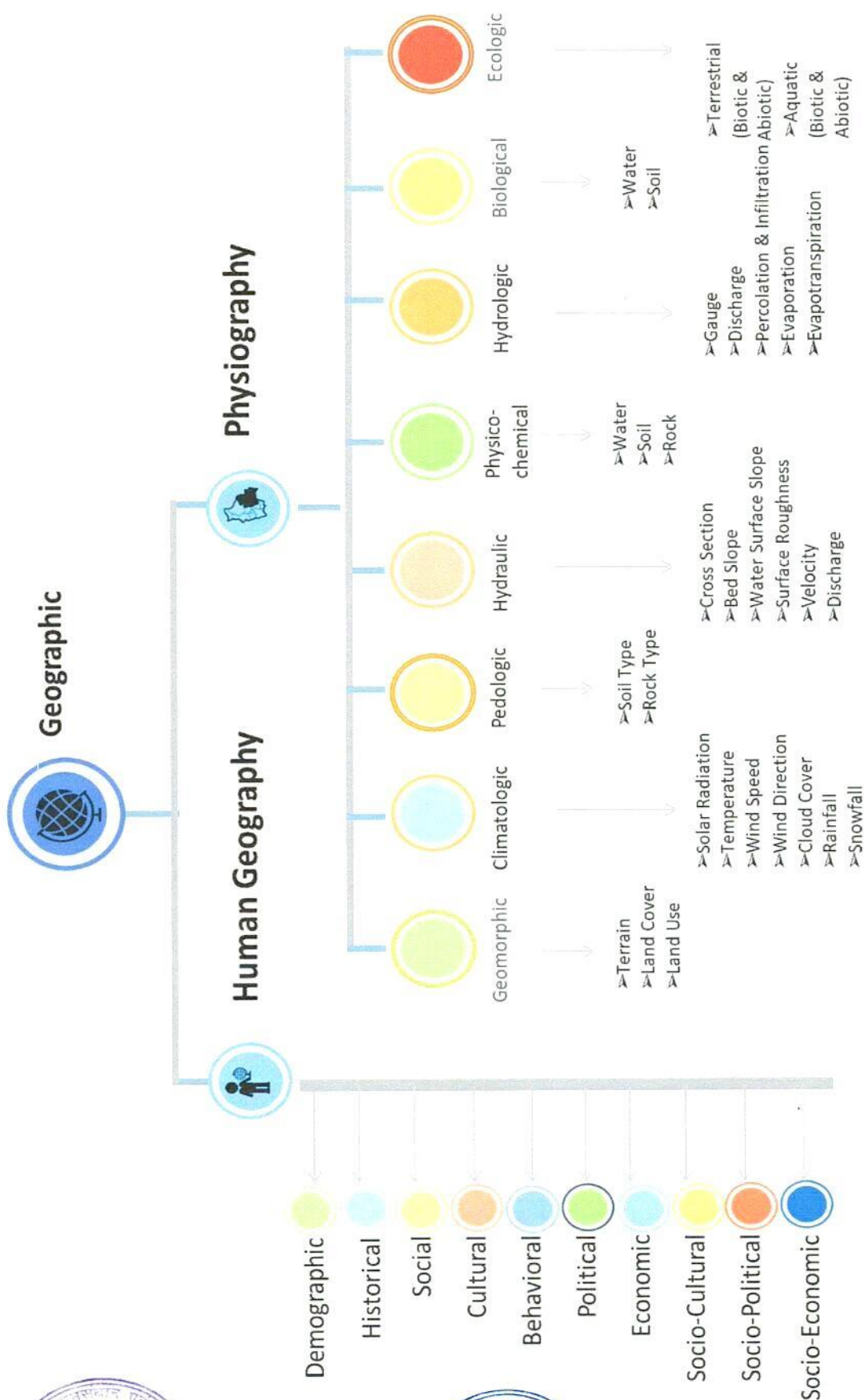
A:

Typical Portfolios and Domains for River Basin Planning



B: Data and Information Management Framework





C: Typical Classification of Data Required for River Basin Planning



D: Indicative Data and Information Classification, Tagging and Metadata Framework

Category Sub-category

1. Name of the Organization/Agency Collating Data

2. Source

- 2.1 Central Pollution Control Board, India
- 2.2 Central Water Commission, India
- 2.3 Central Ground Water Board, India
- 2.4 cGanga (IITK), India
- 2.5 Survey of India
- 2.6 National Informatics Centre, India
- 2.7 Google Earth, USA
- 2.8 United States Geological Survey
- 2.9 National Remote Sensing Centre, India
- 2.10 State Pollution Control Board, Madhya Pradesh
- 2.11 National Mission for Clean Ganga, India
- 2.12 In-person (Name)
- 2.13 Other (Please Specify)

3. Provided by

- 3.1 Central Pollution Control Board (CPCB)
- 3.2 Central Water Commission (CWC)
- 3.3 cGanga (IITK)
- 3.4 Google Earth
- 3.5 National Informatics Centre
- 3.6 National Mission for Clean Ganga (NMCG)
- 3.7 National Remote Sensing Centre
- 3.8 State Pollution Control Board (SPCB)
- 3.9 Survey of India
- 3.10 United States Geological Survey (USGS)
- 3.11 World Wide Fund for Nature, India
- 3.12 Other (Please Specify)

4. Gathering Technique

- 4.1 Field Investigation / Ex-Situ
- 4.2 Field Investigation / In-Situ
- 4.3 Remote Sensing / Aerial
- 4.4 Remote Sensing / LIDAR
- 4.5 Remote Sensing / Satellite
- 4.6 Other (Please Specify)

5. Data Type

- 5.1 Extrapolated
- 5.2 Interpolated



- 5.3 Modelled and Simulated
- 5.4 Raw/ Measured
- 5.5 Other (Please Specify)
- 6. **Geographic**
 - 6.1 Physiography
 - 6.1.1 Geomorphic
 - 6.1.1.1 Terrain
 - 6.1.1.1.1 Point
 - 6.1.1.1.1.1 Confluence
 - 6.1.1.1.1.2 District
 - 6.1.1.1.1.3 Industry
 - 6.1.1.1.1.4 Institution
 - 6.1.1.1.1.5 Monitoring / Observation Site
 - 6.1.1.1.1.6 Mountain Peak
 - 6.1.1.1.1.7 Reservoir / Lake/ Pond
 - 6.1.1.1.2 Line
 - 6.1.1.1.2.1 Border
 - 6.1.1.1.2.2 Bridge
 - 6.1.1.1.2.3 Canal
 - 6.1.1.1.2.4 Drain
 - 6.1.1.1.2.5 Railway Track
 - 6.1.1.1.2.6 River stretch
 - 6.1.1.1.2.7 Road
 - 6.1.1.1.2.8 Runway
 - 6.1.1.1.3 Area
 - 6.1.1.1.3.1 River Basin
 - 6.1.1.1.3.2 Wetland
 - 6.1.1.1.3.3 Reservoir/Lake/Pond
 - 6.1.1.1.3.4 Mountain/Hill
 - 6.1.1.1.3.5 District
 - 6.1.1.1.3.6 City/Town
 - 6.1.1.1.3.7 Village
 - 6.1.1.1.3.8 Gram Panchayat
 - 6.1.1.1.4 Volume
 - 6.1.1.1.4.1 Storage Capacity
 - 6.1.1.1.4.2 Snow/Ice Cover
 - 6.1.1.1.5 Land Cover
 - 6.1.1.1.5.1 Snow/Ice
 - 6.1.1.1.5.2 Water
 - 6.1.1.1.5.3 Rock
 - 6.1.1.1.5.4 Soil
 - 6.1.1.1.5.5 Vegetation
 - 6.1.1.1.6 Land Use
 - 6.1.1.1.6.1 Barren
 - 6.1.1.1.6.2 Agriculture
 - 6.1.1.1.6.3 Constructed
 - 6.1.1.1.6.4 Urban
 - 6.1.1.1.6.5 Rural



6.1.1.1.6.6 Classified (Cantonment)

6.1.1.1.6.7 Forest

6.1.2 Pedologic

6.1.2.1 Soil Type

6.1.2.2 Rock Type

6.1.3 Climatologic

6.1.3.1 Solar Radiation

6.1.3.2 Temperature

6.1.3.3 Wind Speed

6.1.3.4 Wind Direction

6.1.3.5 Cloud Cover

6.1.3.6 Rainfall

6.1.3.7 Snowfall

6.1.4 Hydrologic

6.1.4.1 Gauge

6.1.4.2 Discharge

6.1.4.3 Percolation/Infiltration Rate

6.1.4.4 Evaporation

6.1.4.5 Evapotranspiration

6.1.5 Hydraulic

6.1.5.1 Cross Section

6.1.5.2 Bed Slope

6.1.5.3 Water Surface Slope

6.1.5.4 Surface Roughness

6.1.5.5 Velocity

6.1.5.6 Gauge

6.1.5.7 Discharge

6.1.6 Physiochemical Characteristics

6.1.6.1 Water

6.1.6.1.1 Temperature

6.1.6.1.2 pH

6.1.6.1.3 Turbidity

6.1.6.1.4 Colour

6.1.6.1.5 Electrical Conductivity (EC)

6.1.6.1.6 Total Solids (TS)

6.1.6.1.7 Total Suspended Solids (TSS)

6.1.6.1.8 Total Dissolved Solids (TDS)

6.1.6.1.9 Volatile Suspended Solids (VSS)

6.1.6.1.10 Fix Suspended Solids (FSS)

6.1.6.1.11 Volatile Dissolved Solids (VDS)

6.1.6.1.12 Fixed Dissolved Solids (FDS)

6.1.6.1.13 Alkalinity

6.1.6.1.14 Hardness

6.1.6.1.15 Dissolved Oxygen (DO)

6.1.6.1.16 Biochemical Oxygen Demand (BOD)

6.1.6.1.17 Chemical Oxygen Demand (COD)

6.1.6.1.18 Total Carbon (TC)

6.1.6.1.19 Total Organic Carbon (TOC)



- 6.1.6.1.20 Ammonical Nitrogen (AN)
- 6.1.6.1.21 Total Kjeldahl Nitrogen (TKN)
- 6.1.6.1.22 Nitrite
- 6.1.6.1.23 Nitrate
- 6.1.6.1.24 Phosphorus (P)
- 6.1.6.1.25 Heavy Metals
- 6.1.6.1.26 Pesticides
- 6.1.6.2 Soil
 - 6.1.6.2.1 Temperature
 - 6.1.6.2.2 pH
 - 6.1.6.2.3 Moisture
 - 6.1.6.2.4 Colour
 - 6.1.6.2.5 Volatile (Organic)
 - 6.1.6.2.6 Fixed (Ash/Inorganic)
 - 6.1.6.2.7 Carbon Content
 - 6.1.6.2.8 Ammonical Nitrogen
 - 6.1.6.2.9 Total Kjeldahl Nitrogen
 - 6.1.6.2.10 Chloride
 - 6.1.6.2.11 Sulphate
 - 6.1.6.2.12 Carbonate
 - 6.1.6.2.13 Nitrite
 - 6.1.6.2.14 Nitrate
 - 6.1.6.2.15 Phosphorus (P)
 - 6.1.6.2.16 Potassium
 - 6.1.6.2.17 Sodium
 - 6.1.6.2.18 Calcium
 - 6.1.6.2.19 Magnesium
 - 6.1.6.2.20 Heavy Metals
 - 6.1.6.2.21 Pesticides
- 6.1.6.3 Rock
 - 6.1.6.3.1 Colour
 - 6.1.6.3.2 Volatile (Organic)
 - 6.1.6.3.3 Fixed (Ash/Inorganic)
 - 6.1.6.3.4 Carbon Content
 - 6.1.6.3.5 Ammonical Nitrogen
 - 6.1.6.3.6 Total Kjeldahl Nitrogen
 - 6.1.6.3.7 Chloride
 - 6.1.6.3.8 Sulphate
 - 6.1.6.3.9 Carbonate
 - 6.1.6.3.10 Nitrite
 - 6.1.6.3.11 Nitrate
 - 6.1.6.3.12 Phosphorus (P)
 - 6.1.6.3.13 Potassium
 - 6.1.6.3.14 Sodium
 - 6.1.6.3.15 Calcium
 - 6.1.6.3.16 Magnesium
 - 6.1.6.3.17 Heavy Metals
- 6.1.7 Biological Characteristics



- 6.1.7.1 Water
 - 6.1.7.1.1 Fecal Coliform
 - 6.1.7.1.2 Total Coliform
- 6.1.7.2 Soil
 - 6.1.7.2.1 Fecal Coliform
 - 6.1.7.2.2 Total Coliform
- 6.1.8 Ecologic
 - 6.1.8.1 Terrestrial
 - 6.1.8.1.1 Biotic
 - 6.1.8.1.1.1 Flora
 - 6.1.8.1.1.1.1 Shrubs
 - 6.1.8.1.1.1.2 Trees
 - 6.1.8.1.1.2 Fauna
 - 6.1.8.1.1.2.1 Microbial
 - 6.1.8.1.1.2.2 Vertebrates
 - 6.1.8.1.1.2.3 Invertebrates
 - 6.1.8.1.2 Abiotic
 - 6.1.8.1.2.1 Habitat
 - 6.1.8.1.2.2 Climatic
 - 6.1.8.1.2.3 Inorganic
 - 6.1.8.1.2.4 Organic
 - 6.1.8.2 Aquatic
 - 6.1.8.2.1 Flora
 - 6.1.8.2.1.1 Phytoplankton
 - 6.1.8.2.1.2 Periphyton
 - 6.1.8.2.2 Fauna
 - 6.1.8.2.2.1 Microbes
 - 6.1.8.2.2.2 Zooplankton
 - 6.1.8.2.2.3 Zoobenthos
 - 6.1.8.2.2.4 Micro Invertebrates
 - 6.1.8.2.2.5 Higher Invertebrates
- 6.2 Human Geography
 - 6.2.1 Demographic
 - 6.2.2 Historical
 - 6.2.3 Social
 - 6.2.4 Cultural
 - 6.2.5 Behavioral
 - 6.2.6 Political
 - 6.2.7 Economic
 - 6.2.8 Socio-Cultural
 - 6.2.9 Socio-Political
 - 6.2.10 Socio-Economic

Location

7.1 Natural Delineation

7.1.1 River Basin

7.1.1.1 First Order River Basin

7.1.1.1.1 Chandrabhaga



7.1.1.1.2 Saraswati
7.1.1.2 Second Order River Basin

7.1.1.2.1 Kanh

7.1.1.3 Third Order River Basin

7.1.1.3.1 Punpun

7.1.1.3.2 Kali

7.1.1.3.3 Parbati

7.1.1.3.4 Penner

7.1.1.3.5 Palar

7.1.1.3.6 Vaigai

7.1.1.3.7 Vellar

7.1.1.3.8 Ponnaiyar

7.1.1.3.9 Noyyal

7.1.1.3.10 Gomai

7.1.1.3.11 Panzara

7.1.1.3.12 Purna

7.1.1.3.13 Kolar

7.1.1.3.14 Tawa

7.1.1.3.15 Sabarmati

7.1.1.3.16 Zuari

7.1.1.3.17 Ulhas

7.1.1.3.18 Mithi

7.1.1.3.19 Mandovi

7.1.1.4 Fourth Order River Basin

7.1.1.4.1 Gandak

7.1.1.4.2 Punpun

7.1.1.4.3 Kosi

7.1.1.4.4 Chambal

7.1.1.4.5 Betwa

7.1.1.4.6 Alaknanda

7.1.1.4.7 Bhagirathi

7.1.1.4.8 Sutlej

7.1.1.4.9 Beas

7.1.1.4.10 Subarnarekha

7.1.1.5 Fifth Order River Basin

7.1.1.5.1 Mahananda

7.1.1.5.2 Indus

7.1.1.5.3 Chambal

7.1.1.5.4 Yamuna

7.1.1.5.5 Ganga

7.1.1.5.6 Gandak

7.1.1.5.7 Brahmaputra

7.1.1.5.8 Gomti

7.1.1.5.9 Ghaghara

7.1.1.5.10 Ramganga

7.1.1.5.11 Chenab

7.1.1.5.12 Jhelum

7.1.1.5.13 Ravi



- 7.1.1.5.14 Sutlej
- 7.1.1.5.15 Beas
- 7.1.1.5.16 Periyar
- 7.1.1.5.17 Periyar
- 7.1.1.5.18 Wainganga
- 7.1.1.5.19 Painganga
- 7.1.1.5.20 Vedavathi
- 7.1.1.5.21 Bhima
- 7.1.1.5.22 Indrayani
- 7.1.1.5.23 Pavana
- 7.1.1.5.24 Ghataprabha
- 7.1.1.6 Sixth Order River Basin
 - 7.1.1.6.1 Yamuna
 - 7.1.1.6.2 Ganga
 - 7.1.1.6.3 Brahmaputra
- 7.1.1.7 Seventh Order River Basin
 - 7.1.1.7.1 Yamuna
 - 7.1.1.7.2 Ganga
 - 7.1.1.7.3 Brahmaputra
- 7.1.2 River
 - 7.1.2.1 First Order River
 - 7.1.2.1.1 Chandrabhaga
 - 7.1.2.1.2 Saraswati
 - 7.1.2.2 Second Order River
 - 7.1.2.2.1 Kanh
 - 7.1.2.3 Third Order River
 - 7.1.2.3.1 Punpun
 - 7.1.2.3.2 Kali
 - 7.1.2.3.3 Parbati
 - 7.1.2.3.4 Penner
 - 7.1.2.3.5 Palar
 - 7.1.2.3.6 Vaigai
 - 7.1.2.3.7 Vellar
 - 7.1.2.3.8 Ponnaiyar
 - 7.1.2.3.9 Noyyal
 - 7.1.2.3.10 Gomai
 - 7.1.2.3.11 Panzara
 - 7.1.2.3.12 Purna
 - 7.1.2.3.13 Kolar
 - 7.1.2.3.14 Tawa
 - 7.1.2.3.15 Sabarmati
 - 7.1.2.3.16 Zuari
 - 7.1.2.3.17 Ulhas
 - 7.1.2.3.18 Mithi
 - 7.1.2.3.19 Mandovi
 - 7.1.2.4 Fourth Order River
 - 7.1.2.4.1 Gandak
 - 7.1.2.4.2 Punpun



- 7.1.2.4.3 Kosi
- 7.1.2.4.4 Chambal
- 7.1.2.4.5 Betwa
- 7.1.2.4.6 Alaknanda
- 7.1.2.4.7 Bhagirathi
- 7.1.2.4.8 Sutlej
- 7.1.2.4.9 Beas
- 7.1.2.4.10 Subarnarekha

7.1.2.5 Fifth Order River

- 7.1.2.5.1 Mahananda
- 7.1.2.5.2 Indus
- 7.1.2.5.3 Chambal
- 7.1.2.5.4 Yamuna
- 7.1.2.5.5 Ganga
- 7.1.2.5.6 Gandak
- 7.1.2.5.7 Brahmaputra
- 7.1.2.5.8 Gomti
- 7.1.2.5.9 Ghaghara
- 7.1.2.5.10 Ramganga
- 7.1.2.5.11 Chenab
- 7.1.2.5.12 Jhelum
- 7.1.2.5.13 Ravi
- 7.1.2.5.14 Sutlej
- 7.1.2.5.15 Beas
- 7.1.2.5.16 Periyar
- 7.1.2.5.17 Periyar
- 7.1.2.5.18 Wainganga
- 7.1.2.5.19 Painganga
- 7.1.2.5.20 Vedavathi
- 7.1.2.5.21 Bhima
- 7.1.2.5.22 Indrayani
- 7.1.2.5.23 Pavana
- 7.1.2.5.24 Ghataprabha

7.1.2.6 Sixth Order River

- 7.1.2.6.1 Yamuna
- 7.1.2.6.2 Ganga
- 7.1.2.6.3 Brahmaputra

7.1.2.7 Seventh Order River

- 7.1.2.7.1 Yamuna
- 7.1.2.7.2 Ganga
- 7.1.2.7.3 Brahmaputra

7.2 Administrative Delineation

7.2.1 Country

- 7.2.1.1 India
- 7.2.1.2 Nepal
- 7.2.1.3 Bangladesh
- 7.2.1.4 Bhutan
- 7.2.1.5 China



7.2.1.6 Mayamar

7.2.1.7 Sri Lanka

7.2.1.8 Pakistan

7.2.2 State

7.2.2.1 Andhra Pradesh

7.2.2.2 Arunachal Pradesh

7.2.2.3 Assam

7.2.2.4 Bihar

7.2.2.5 Chhattisgarh

7.2.2.6 Goa

7.2.2.7 Gujarat

7.2.2.8 Haryana

7.2.2.9 Himachal Pradesh

7.2.2.10 Jharkhand

7.2.2.11 Karnataka

7.2.2.12 Kerala

7.2.2.13 Madhya Pradesh

7.2.2.14 Maharashtra

7.2.2.15 Manipur

7.2.2.16 Meghalaya

7.2.2.17 Mizoram

7.2.2.18 Nagaland

7.2.2.19 Odisha

7.2.2.20 Punjab

7.2.2.21 Rajasthan

7.2.2.22 Sikkim

7.2.2.23 Tamil Nadu

7.2.2.24 Telangana

7.2.2.25 Tripura

7.2.2.26 Uttarakhand

7.2.2.27 Uttar Pradesh

7.2.2.28 West Bengal

7.2.3 District

7.2.3.1 Rural

7.2.3.1.1.1 Gram panchayat

7.2.3.1.1.2 Village

7.2.3.2 Urban

7.2.3.2.1.1 Town

7.2.3.2.1.2 Block

8. Temporal Information

8.1 Discrete

8.2 Time Series

8.2.1 Duration

8.2.1.1 From Date

8.2.1.2 Till Date

8.2.2 Frequency

8.2.2.1 Hourly

8.2.2.2 Daily



- 8.2.2.3 10 Daily
- 8.2.2.4 Monthly
- 8.2.2.5 Seasonal
- 8.2.2.6 Annual

9. File Format

- 9.1 .xlsx/ .xls
- 9.2 .dwg
- 9.3 .pdf
- 9.4 .jpeg/ .jpg
- 9.5 .shp
- 9.6 .doc

10. Received on (Date)



(The List is Indicative and Not Exhaustive)



Annexure II

Core Activities

1. Preparation of detailed river basin management plan within the plan period of 3 years.
2. Finalizing interventions for implementation in phased manner delineating short term, medium term and long-term action plans. These would contain financial, social, economic, and environmental implications including measurable and verifiable indicators for ascertaining beneficial and positive impact on the river system.
3. Review, incorporate and respond to comments and suggestions made by various stakeholders, ministries (central government and various state governments), etc. on the RBMP.
4. Dynamically evolve the RBMP based on (i) feedback from implementation of its recommendations, (ii) availability of additional information/data, and (iii) advances in the state-of-the-art.
5. Interface with finance, economics and legal industry to develop robust techno- commercial models.
6. Establish a dedicated facility to (i) develop improved monitoring protocols, (ii) explore new techniques for knowledge and data/information acquisition, security, transfer and dissemination, (iii) ensure community involvement, etc.
7. Create specialist expertise in area of River Health that can develop as an export industry.
8. Establish an advocacy forum for the RBMP.
9. Any other activity relating to water and river systems that is of national importance.

Note: This Annexure may be reviewed and modified by JRC from time to time based on inputs from Consortium Institutes and STSC.



Annexure III

Other Activities

1. Coordinating the preparation of Urban River Management Plans (URMPs) which are essential pre-requisites for identifying and executing actionable items for stretches of rivers flowing through Class I and class II towns.
2. For effective implementation, the institution may be required to develop specific work plans for identified activities.
3. Provide expert input and coordinate scientific aspects of various surveys, monitoring, etc. to be carried out by various agencies.
4. Institution may be requested to recommend on specific technical issues and take up pilots, if necessary.
5. Coordinating implementation and monitoring of Action Plans and status of the river and/or its tributaries in select stretches.
6. Any other assignment related to the river that may be deemed necessary by the Ministry/NMCG.

Note: This Annexure may be reviewed and modified by JRC from time to time based on inputs from Consortium Institutes and STSC.



Annexure IV

Stakeholder Advisory Committee (SAC)

Constitution	Role
1. Chair: Secretary, MoWR, RD & GR, Jal Shakti, Gol 2. Project Director, NRCD; Member 3. Chief Secretary or Nominee (not below rank of Principal Secretary); Member <i>CG, OR, MP, GU, MH, AP, TG, KA, KL, TN</i> 4. Chairman/Member Secretary State PCB; Member <i>CG, OR, MP, GU, MH, AP, TG, KA, KL, TN</i> 5. Chairman CWC or Nominee (not below rank of Member CWC); Member 6. Chairman CGWB or Nominee (not below rank of Member CGWB); Member 7. Chairman / Member Secretary CPCB; Member 8. Director, Indian Institute of Forest Management, Bhopal or Nominee (not below the rank of ADG); Member 9. Director, Wild Life Institute of India, Dehradun; Member 10. CEO or Nominee, WWF-India; Member 11. Representative of any other NGO/CSO (to be nominated by MoJS); Member 12. Chairman Scientific & Technical Steering Committee; Member 13. Team Leads of Consortium Institutes as permanent invited members; Member 14. Member Secretary: JS (NRCD), DoWR, RD & GR, MoJS	Provide vision, wisdom and expectations of the Central, State Governments and Local Governments on River Basin Management Plans; Facilitate flow of data and information available with government, non-government, private, public-sector organisations, municipal corporations, Gram Panchayats, etc.



Annexure V

Scientific & Technical Steering Committee (STSC)

Constitution	Role
1. Chair: Vinod Tare, Founding Head, cGanga, IIT Kanpur 2. A K Gosain, Founder & Director, INRM Consultants Private Limited & Former Professor, IIT Delhi; Member 3. Rakesh Khosa, IIT Delhi; Member 4. Mohammad Jawed, IIT Guwahati; Member 5. Indrajit Dube, Vice Chancellor, National Law University, Meghalaya; Member 6. Riddhi Singh, IIT Bombay; Member 7. Balaji Narsimhan, IIT Madras; Member 8. A A Kazmi, IIT Roorkee; Member 9. Saumitra Mukherjee, JNU, New Delhi; Member 10. M S Mohankumar, Former IISc Bangalore & Adjunct Professor, IITM, Chennai; Member 11. President/CEO or Nominee, Centre for Policy Research; Member 12. Rajiv Ranjan Mishra, Former DG, NMCG & IIT Roorkee; Member 13. G Asok Kumar, PD NRCD & DG NMCG; Member 14. Executive Director – Technical, NMCG; Member 15. Member Secretary, CPCB; Member 16. Director, River Data Directorate, CWC; Member 17. Member Secretary: Director, NRCD, MoJS	Advise and Evaluate works on Scientific and Technical Aspects of River Basin Management Plan carried out by Consortium Institutes; and coordinate with Stakeholder Advisory Committee (SAC) and Joint Review Committee (JRC) to oversee the functioning of the Consortium.

Note: This Annexure may be reviewed and modified by JRC from time to time based on inputs from Consortium Institutes and TSC.



Annexure VI

Joint Review Committee (JRC)

Constitution	Role
1. Chair: Project Director, NRCD 2. Director, Lead Institute; Member 3. Director, Fellow Institute; Member 4. ED (Technical), NMCG; Member 5. Representative of the Concerned State Government dealing with Water Resources; Member 6. Representative of the Concerned State Government dealing with Water Resources; Member 7. JS, NRCD; Member 8. Chair STSC, Member Advisor	Review the work of Consortium Institutes and make recommendations on release of grants based on inputs from STSC



