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NAMAMI GANGE

Pollution Accidents and Crisis Management

Part 2: Proposal for efficient Crisis Management due to pollution accidents in Ganga Basin

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Abbreviations

AEWS	Accident Emergency Warning System
APC	Accident Prevention and Control
CETP	Effluent Treatment Plants
CPCB	Central Pollution Control Boards
DG	Director General
DGC	District Ganga Committees
EPA	Environment Protection Act
ETF	Empowered Task Force
GIZ	Gesellschaft für Internationale Zusammenarbeit
GPI	Grossly Polluting Industries
GTF	Ganga Task Force
GW	Groundwater
ICPDR	International Commission for the Protection of the Danube River MoEF&CC Ministry of Environment, Forest & Climate Change
MoEF&CC	Ministry of Environment, Forest & Climate Change
NCG	National Ganga Council
NGRBA	National Ganga River Basin Authority
NMCG	National Mission for Clean Ganga
OCEMS	Online Continuous Effluent Monitoring System
PCC	Pollution Control Committees
PIAC	Principal International Alert Centres
RBO	River Basin Organisation
RTWQMS	Real Time Water Quality Monitoring Stations
SGC	Stage Ganga Committees
SMCG	State Mission for Clean Ganga
SPCB	State Pollution Control Board
SPMG	Stage Level Program Management Groups
STP	Sewage Treatment Plants
UBA	Umweltbundesamt (Federal Environment Agency, Germany) WA Water Associations (Germany)
WA	Water Associations (Germany)

Introduction

The River Ganga and its tributaries are a source of livelihood for over 450 million people (census 2001). The Indian part of Ganga Basin is spread over 861,404 km^2 and covers a total of 11 states. Water quality of river Ganga and its tributaries is of crucial concern for different users, as it is both an ecological and economic resource of central importance for human society. Rapidly increasing population, urbanisation and exponential growth of industrialisation have exposed the water resources, particularly the rivers, to various forms of degradation. The mighty Ganga River basin also witnesses such pressure factors including the accidental/occasional pollution incidences, in its different stretches/sub-basins. Efforts to clean the Ganga go back almost 30 years and have included different strategic approaches and cooperation arrangements, as well as studies and analyses. In 2014, the Indian Government launched the "Namami Gange Programme", as an integrated conservation mission, to accomplish the objective of effective abatement of pollution, conservation, and rejuvenation of the Ganga. The National Mission for Clean Ganga (NMCG) was established as nodal agency to implement the Namami Gange Programme. NMCG is an authority under the Indian Ministry of Jal Shakti (Water Ministry).

Over the time, the NMCG has grown as an organisation based on the changing requirement of the sector. In the year 2016, the Ministry of Jal Shakti, through a gazette notification, established NMCG as an authority. This notification has provided a framework to the NMCG to expand and act as a fully functional RBO.

In this line, NMCG has started to take first steps to adapt its structures and work processes to develop into a river basin organisation. However, in order to become a full-fledged river basin organisation, there are opportunities to bring changes in the organizational structure and work processes to the necessary extent, in line with the authority notification.

The structures responsible at national, state level, and in particular the district levels for the Ganga in Uttarakhand and Uttar Pradesh, will require the necessary technical and personnel capacities for integrated river basin management and the associated planning, implementation, and monitoring processes.

Over the period of time, it is observed that chances of pollution accidents in Ganga Basin are on the rise. Pollution accidents in the river basin can cause widespread damage to the river ecosystem and harm people's health and the state of local economies downstream. Consequently, measures to prevent accidental pollution and to improve response capabilities are very much needed to manage such crisis. Accidental pollution demands a proper crisis management set-up to deal with events which occurs suddenly, creates stress, and demands quick reaction at different organizational and operational levels.

The establishment of the appropriate institutional arrangement for Indian water authorities including NMCG are not a trivial process. There is no "one-size-fits-all" solution and, hence, the specific national context needs to be analysed and fully considered, when approaching and organising institutional set-ups and coordination mechanisms on/ between any implementation level (national/ regional/ interstate/ international).

Accordingly, it is realized that the responsibilities must be clarified and concepts be developed to effectively manage crisis situations, due to pollution accidents in the Ganga Basin. Thus, a proposal to identify NMCG`s responsibilities related to crisis management of pollution accidents is to be developed.

The proposal is based on literature review as well as discussions with GIZ (contracting authority) and NMCG at a meeting in February 2022.

The following questions were discussed during this meeting:

- What is the crisis handling mechanism in place at institutional/organisational level at NMCG?
- What is the role of NMCG during a situation of crisis arising from pollution accidents (industrial and domestic) in the Ganga Basin?
- What is the current practise for handling crisis situation by various relevant actors in the Ganga Basin? Who are relevant actors currently involved in crisis situations?
- How does NMCG foresee its role as a steering and coordinating authority with the actors involved for better implementation of technical, social and safeguard measures?
- What could be the potential strategies that should be in place at different levels (NMCGs, SPMG, DGCs) to better address crisis due to accidental pollution?

2. Existing Systems And Institutional Mechanisms Towards Crisis Management & Current Role of NMCG

In this chapter the existing systems and institutional mechanisms and the current role of NMCG during a situation of crisis in the Ganga Basin should be addressed.

The following questions should be considered as guidance questions during the discussion with NMCG and for preparing this chapter.

- What is the crisis handling mechanism in place at institutional/organisational level at NMCG?
- What is the role of NMCG during a situation of crisis arising from pollution accidents (industrial and domestic) in the Ganga Basin?

Certain measures have been initiated to expedite the implementation process. National Mission for Clean Ganga (NMCG) has been restructured and strengthened recently, so that it is empowered to discharge its functions in an independent and accountable manner and also to sanction and complete various projects on fast track. Under Namami Gange Programme, provision has been kept for long term (10–15 years) operation and maintenance of the assets created, so as to ensure that the assets created are permanent and operate in a sustainable manner (Press Information Bureau. Government of India. Ministry of Water Resources, River Development and Ganga Rejuvenation, 2018).

With the Namami Gange Programme, for the first time in the history of independent India, a holistic and integrated approach was taken to make River Ganga „Aviral" and „Nirmal" ("Aviral Dhara" = "Continuous Flow", "Nirmal Dhara" = "Unpolluted Flow", https://nmcg.nic.in/grbmp.aspx) again. The Namami Gange Programme was launched with an integrated goal of development of sewage treatment infrastructure, river front development, river surface cleaning, biodiversity protection, afforestation, public awareness, industrial effluent monitoring and Ganga Gram development among others. The launch of the Namami Gange Programme marked a paradigmatic shift, by first acknowledging the severity of the threat to Ganga and then planning to rejuvenate the river, rather than just limiting the efforts for the abatement of domestic and industrial pollution in a phased manner.

National Mission for Clean Ganga (NMCG) was registered as a society on 12th August 2011 under the Societies Registration Act 1860. It acted as implementation arm of National Ganga River Basin Authority (NGRBA) which was constituted under the provisions of the Environment (Protection) Act (EPA), 1986. The Act envisages five-tiered structure at national, state and district level to take measures for prevention, control and abatement of environmental pollution in river Ganga and to ensure continuous adequate flow of water, so as to rejuvenate the river Ganga as below:

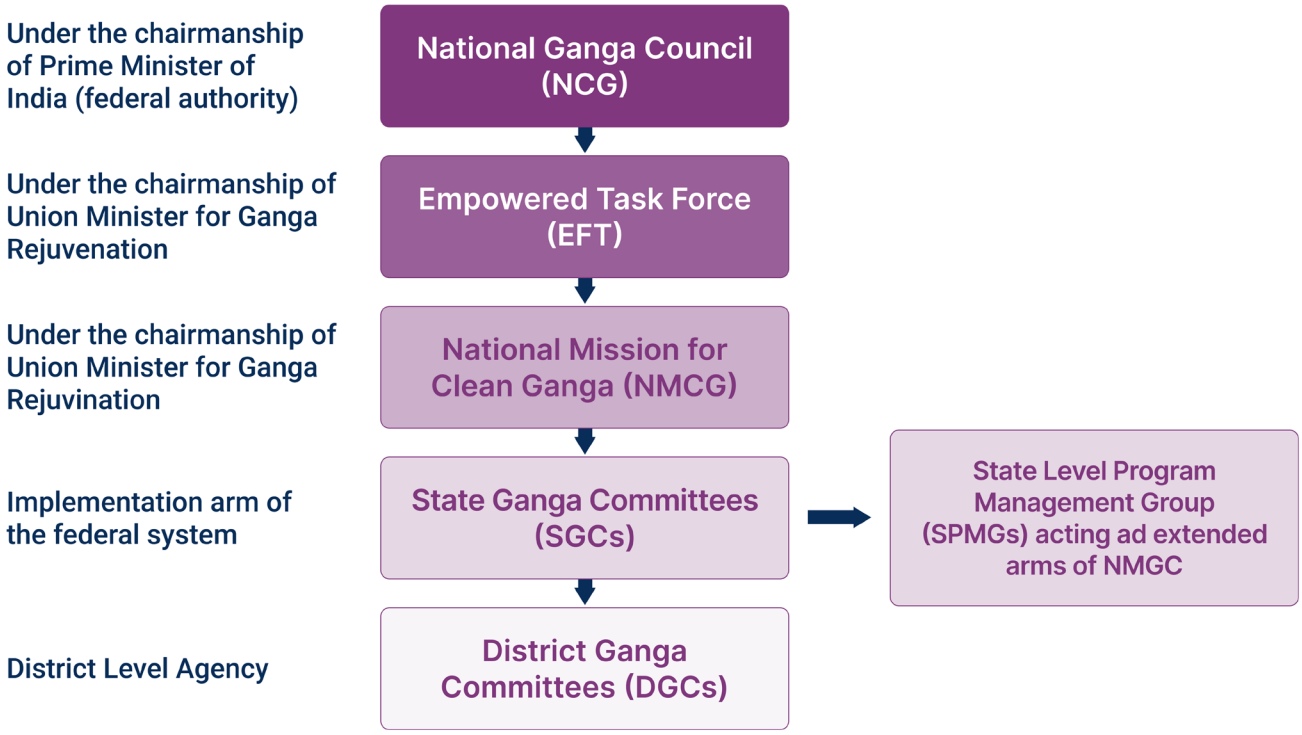

Figure 1: Five-tiered structure of pollution control of river Ganga (NMGC, 2021)

The National Ganga council is a policy body under the chairmanship of the Prime Minister of India (federal authority). It has been given overall responsibility for the superintendence of pollution prevention and rejuvenation of River Ganga Basin, including Ganga and its tributaries. Under the chairmanship of Union Minister for Ganga Rejuvenation (ground force appointed by the central ministry) the Empowered Task Force (ETF), consisting of Secretary of concerned ministries, can interact with states and other ministries.

The National Mission for Clean Ganga acts as the implementation arm of the federal system. It has a two-tier management structure and comprises of Governing Council and Executive Committee. Both of them are headed by the Director General (DG) of NMCG (NMCG, 2022). The State Ganga Committees acts as a state-level agency. It deploys experts from state departments. One mandate of SGSs is to deal with permissions. Similar to structure at national level, State Programme Management Groups (SPMGs) acts as implementing arm of State Ganga Committees.

For effective implementation of the projects under the overall supervision of NMCG, the State Level Program Management Groups (SPMGs) are also headed by senior officers of the concerned States. They are responsible for detailed project management and ensuring the goal achievement of the Namami Gange Program.

The constitution of District Ganga Protection Committees, also known as District Ganga Committees, was made compulsory as per clause 53 (1) of the NMCG Authority order notified on 7th October 2016. A 13-member Committee with District Collector as its Chairperson was mandated to "prevent, control and abate pollution in River Ganga" and "take suitable administrative and other measures to give effect to the provisions of the Authority order. District Ganga Committees (DGCs) are responsible, e.g. for information of higher authorities, for mitigation plans and locally monitoring. It is compulsory for the DGC to meet every three months and keep reporting to higher authorities about the actions planned and undertaken. There are also provisions for stringent monitoring of the execution of plans, programmes and projects by the state governments (Rajiv Ranjan Mishra, 2021).

In addition to this, the DGCs are also required to conduct Ganga Safety Audits in coordination with State Ganga Committees (SGCs). These meetings include possible threats on river quality from point and non-point sources, as well as water quantity issues. Remedial actions are proposed, results documented on the website. Actions are delegated to different authorities on district levels. The DGC comprises members as shown in Table 1.

Table 1: Members of District Ganga Committees

Stakeholder	Post
Director Collector	Chairperson
Two Nominated representatives from municipalities and gram panchayats	Members
One representative each from ▪ Public works ▪ Irrigation ▪ Public Health Engineering ▪ Rural Drinking Water Department ▪ State Pollution Control Board	Members, ex-officio
Two environmentalists associated with river Ganga protection	Members
One Representative of local industry	Member
One Divisional Forest Officer	Member, ex-officio
One district official to be nominated by DC	Member

Source: NMCG Authority order available at nmcg.nic.in

Actions in case of an accident, communication with Task Forces during emergencies

In case of an accident, situational actions are based on district's boundaries (political/ administrative boundaries. Accidents are being looked after by concerned SMCGs/DGCs, local authorities and State Pollution Control Boards and reported to NMCG if required.

There are various mechanisms being set up at NMCG at State and district levels through various executive agencies/stakeholders, which are dealing with various unusual accidents /emergencies. NMCG coordinates at its various institutional levels, such as State level with the State Mission for Clean Ganga (SMCGs) and District Ganga Committees (DGCs), along with the regulatory institutions such as Central Pollution Control Boards and State Pollution Control Board, through which the projects related to monitoring and regulation of industries, CETPs, STPs and drains and water quality monitoring (manual and real time) are executed.

Further, Central Pollution Control Board (CPCB) is in contact and coordinates with State Pollution Control Boards (SPCBs) and its regional offices in case of any emergencies and accidental discharges. CPCB also implements certain actions with the help of District Administration, whenever required.

Besides, NMCG is also coordinating with Ganga Task Force (GTF) battalion, who are also reporting to NMCG about various unusual incidents. Appropriate remedial action is taken by the concerned departments of NMCG or various executing agencies.

There is a system of real time data transmission from Grossly Polluting Industries (GPIs) through an Online Continuous Effluent Monitoring System (OCEMS), which is established for compliance verification. Continuous Real time effluent/ emission data is transmitted to CPCB/SPCBs servers. Online moni- toring system alerts are generated through SMS for each exceedance regarding discharge norms. Based on SMS alerts generated for each exceedance regarding discharge norms, CPCB carries out physical inspection of the selected GPIs, having high number of alerts and takes necessary action.

Water quality of River Ganga is also carried out through a network of 97 manual and 36 Real Time Water Quality Monitoring Stations (RTWQMS). 40 additional RTWQMS are also planned to be set up.

An online monitoring system for effluent quality of STPs in Uttarakhand and its connection with the Central Software Platform "Ganga Tarang" has been set-up in coordination with GIZ-SGR. Executing agencies- UKPJN and UJS personnel have been trained on it. As to date, 20 STPs are connected to Ganga Tarang and are being regularly used by SPMG officials, UKPJN and UJS officials as well as plant operators for remote monitoring of treated water quality and also to take timely corrective actions during operational issues of STPs.

Analysis of manual, as well as real time water quality data analysis, is being done at regular intervals. Data analysis and trends have been generated using last few years data and is also being used in reporting. Instances of trends, wherein water quality parameters exceed the standard criteria, are examined for reasons of such occurrences. Measures are planned accordingly for abatement of pollution from such sources.

Analysis of manual, as well as real time water quality data analysis, is being done at regular intervals. Data analysis and trends have been generated using last few years data and is also being used in reporting. Instances of trends, wherein water quality parameters exceed the standard criteria, are examined for reasons of such occurrences. Measures are planned accordingly for abatement of pollution from such sources.

Review of an accident in the aftermath of the event

Accidents are reviewed at senior level at the level of Executive Director (Technical/ Projects) at NMCG under the overall guidance of Director General, NMCG which are also reviewed at Secretary /Hon'ble Minister level, in some critical cases.

Responsibility for determining design standards (in terms of effluent environmental discharge norms) for industrial and domestic plants

Stringent monitoring, regulation and enforcement towards compliance of Grossly Polluting Industries against regulatory framework mandated under Consent mechanism issued in respect of provisions of Water (Prevention and Control of Pollution) Act, 1974, is undertaken through CPCB, State Pollution Control Board (SPCBs) and Pollution Control Committees (PCC).

Industry specific effluent/emission standards are notified by Ministry of Environment, Forest & Climate Change under Schedule-I: 'Standards for Emission or Discharge of Environmental Pollutants from Various Industries' of Environment Protection Act, 1986. State Pollution Control Boards and Pollution Control Committees in States and Union Territories respectively, are to ensure compliance of these stand- ards. Similarly, the regulatory sewage standards are also notified by MoEF&CC.

3. Roles & Responsibilities of Stakeholders Involved & Existing Cooperation with NMCG In Terms of Managing Crisis Towards Pollution Accidents

In this chapter roles and responsibilities of stakeholders involved and existing cooperation with NMCG shall be described. The relevant questions here were:

- What is the current practise for handling crisis situation by various relevant actors in the Ganga Basin?
- Who are relevant actors currently involved in crisis situations?

Stakeholders in the Ganges basin are listed by analysing the rich picture, personal observations and experiences, literature review, and media reports. While identifying the stakeholders, the following guiding questions, based on (International Institute for Environment and Development IIED, 2005), were kept in mind:

- Who are the potential beneficiaries?
- Who are adversely affected?
- Who has existing rights?
- Who is voiceless?
- Who resent to changes and mobilise resistance?
- Who is responsible for planning?
- Who has money, skill or key information?
- Whose behaviour has to change for success?

Developing a stakeholder platform requires a patient iterative process of identifying stakeholders, their interests, building trust, empowering weak stakeholders and, for powerful stakeholders, to accept new rights and roles for other stakeholders. The significant aspects of multi-layered and multiple stakeholders on Ganga River Basin need to be identified.

In a multiple stakeholder scenario, the stakeholders frame and express objectives in different ways, as per their stake and interest. Failure to involve them in equitable manner in decision-making processes leads to sub-optimal and sometimes unethical outcomes. Thus, recognition and identification of concerns of stakeholders is much required.

Identified Stakeholders:

- National Mission for Clean Ganga (NMCG): Key agency and main implementation partner for Ganga/Ramganga River Basin Management Plan
- Central Water Commission, New Delhi: To get Hydrological data, HFL, E-Flows monitoring mechanism and information about Online WQM Stations
- Uttar Pradesh Pollution Control Board (Regional Office, Moradabad): To get information about industrial pollution, existing status of pollution prevention & its control, Industrial Risk mapping. UPPCB will also be the key source of water quality data
- Uttarakhand Pollution Control Board (Regional Office, Kashipur): To get information about industrial pollution, existing status of pollution prevention & its control, Industrial Risk mapping. UKPCB will also be the key source of water quality data
- Central Pollution Control Board, New Delhi: To understand existing and upcoming policies & action plans for control of pollution in Ramganga river basin and to get Water Quality Data & information about Online WQM Stations
- Hydropower dam management agency -Kalagarh, Baur and Baigul dams- (Uttarakhand Jal Vidyut Nigam): To get Hydrological information/E-Flows Release, frequency of sediment flushing etc.
- Irrigation and water Resource department, Uttar Pradesh & Uttarakhand: To get Hydrological information, High Food Level & E-Flows Release, Sediment Flushing etc.
- WWF India, New Delhi (Site Office Located at Moradabad): Actively working on integrated management of Ramganga river and biodiversity conservation. A key data source for biodiversity features & hot spots, basin wetlands and water quality data
- Municipal agencies (Moradabad, Bareilly, Shahjahanpur, Kannauj, Kashipur): To get Information about landfill sites, drains and other operational issues in managing Ramganga river water quality
- Industrial associations (Sugar, Pulp & Paper, Electroplating, Textile, etc): Need to visit industries and collect data to assess accidental pollution risks, operational issues during management of industrial liquid and Hazardous waste
- State Forest Department: To understand LULC changes recorded in the past, ongoing CAT Plan to control soil and silt erosion (if any)
- Central Ground Water Board- Regional Office: To get information and data related to the groundwater abstraction and variation in GW table and any ongoing scheme for GW management
- Uttar Pradesh Jal Nigam (agency responsible for water supply & Sewage Management: To get information about the existing status of water and wastewater treatment system, augmentation plan, key issues and suggestions.

- Uttarakhand Jal Nigam (agency responsible for water supply & Sewage Management: To get information about the existing status of water and wastewater treatment system, augmentation plan, key issues and suggestions.
- Uttarakhand Peyjal Nigam & Uttarakhand Jal Sansthan (agency responsible for water supply & Sewage Management: To get information about the existing status of water and wastewater treatment system, augmentation plan, key issues and suggestions.

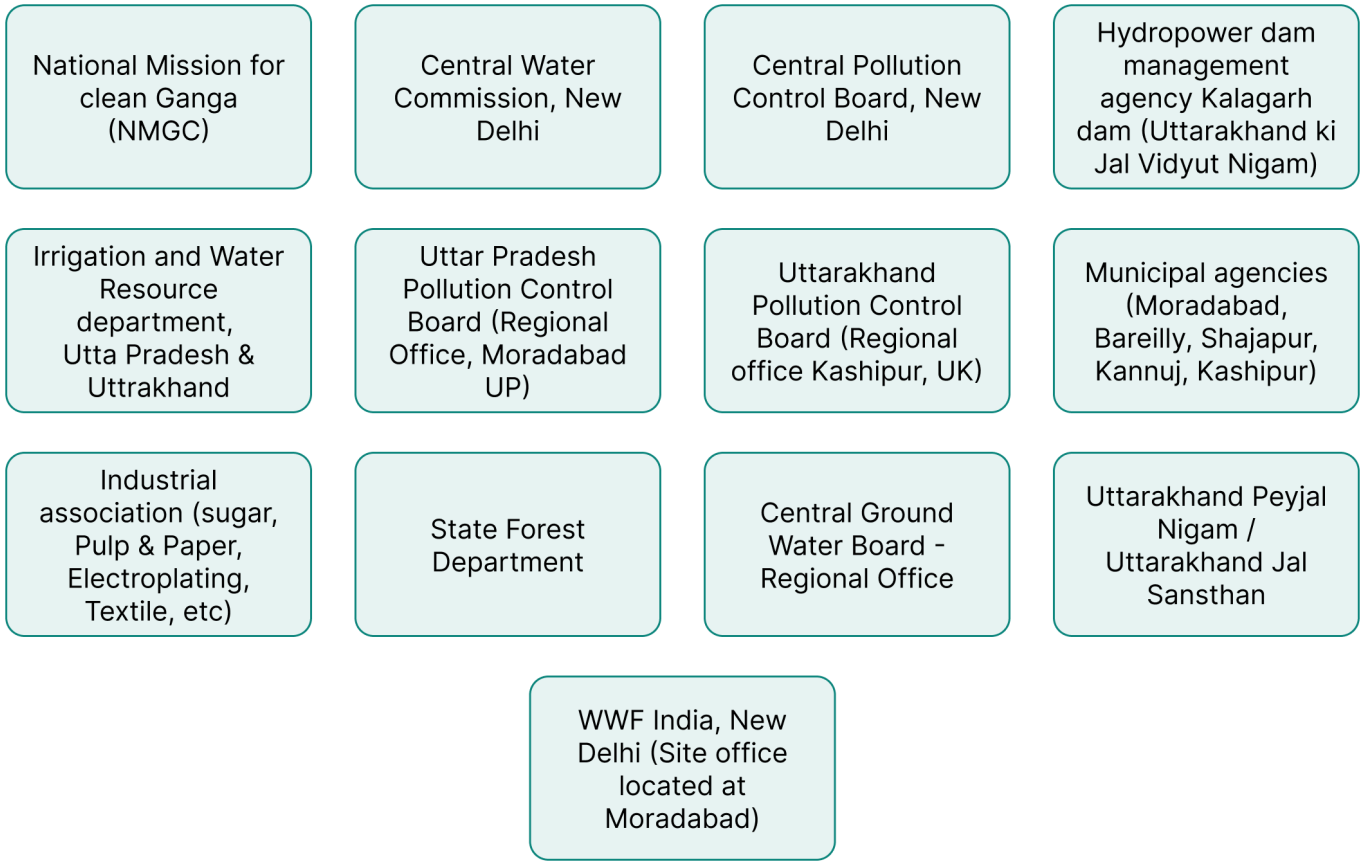

Figure 2: Stakeholder Mapping for Uttar Pradesh and Uttarakhand

Table 2: Ganga basin stakeholders on a macro to micro continuum

Level	Stakeholders	Interest of stakeholders	Influence of stakeholders
National	▪ Central government / agencies ▪ National Ganga River Basin Authority (NGRBA) ▪ National Mission for Clean Ganga (NMCG) ▪ Researchers ▪ Civil society organization (NGOs) ▪ Politicians ▪ Waterways authorities	▪ Tourism ▪ Policy formulation ▪ Ecosystem restoration ▪ Biodiversity ▪ conservation ▪ Advocacy and ▪ awareness ▪ Policy for Water development work ▪ Policy for Waterways development	Policy level
Regional	▪ Government Departments (Water Resources, Fisheries, Mining, Urban Development) ▪ Media ▪ Agribusiness sector ▪ Real estate sector ▪ Protected areas	▪ Water use ▪ Fish resource exploitation ▪ Promotion of intensive farming ▪ Issue identification and highlighting ▪ Construction activities in floodplain	Enforcement through penalty
Local off site	▪ Farmers ▪ Wetland users ▪ Fishermen societies ▪ Religious institutions ▪ Village institutions ▪ Municipal bodies ▪ Industries	▪ Water and land use ▪ Regulating the resource uses ▪ Conflict resolution ▪ Water supply ▪ Waste disposal	Enforcement through penalty
Local on site	▪ Riverine fishing community ▪ Sand miners ▪ Water development sector ▪ Tourism ▪ Riparian farmers	▪ Sand and other physical resources ▪ Fishing and aquaculture ▪ Maintenance of water level ▪ Water diversion and use ▪ Cultural and natural scenic beauty sites	Enforcement through penalty

As per the analysis, sand miners, real estate sector, riparian farmers, water ways authorities, riverine fishing communities, tourists, industries, wetland users, municipal bodies and water development agencies are the primary stakeholders.

After decades of centralized planning in water resources management in India, the long-impending need for devolution of power was fulfilled with the administrative empowerment of the DGCs.

The decision-making has become informed and a sense of ownership has become stronger as evident from the enthusiastic involvement of all local stakeholders in DGC meetings in the key States of Uttarakhand and Uttar Pradesh among others. This structure is futuristic and will be able to lay foundation for further in-depth implementation of rejuvenation activities and to expand to new integrated activities.

The new structure of NMCG attempts to bring together all stakeholders on one platform, to take a holistic approach towards the task of Ganga cleaning and rejuvenation. Capacities in technical topics (Risk maps, pollution simulation, operational model of River Ganga, hydrology, water quality) and technical expertise.

Under the Namami Gange programme, Pollution hotspot mapping, monitoring of pollution sources (i.e GPIs, drains etc.) is being conducted through CPCB/SPCBs.

Water pollution of river Ganga is measured and assessed via manual monitoring of its water quality at 97 locations by 5 State Pollution Control Boards (Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal) in association with Central Pollution Control Board (CPCB). Besides 36 Real Time Water Quality Monitoring Stations (RTWQMS) on river Ganga and its tributaries are set up in 2017 of which 18 stations are on main stream of River Ganga, 9 on its tributaries and 9 on its drains. In addition to these 36 RTWQMS, the installation of 40 new RTWQM stations is under progress. Both manual and real-time monitoring stations provide river water quality, regarding to outdoor bathing criteria, notified by MoEF &CC.

There are various specialists/consultants employed at NMCG for various specific tasks and activities. Besides, there are various knowledge partners and stakeholders associated with NMCG such as cGanga, CPCB/SPCBs, international partners such as GIZ, India–EU Water Partnership (IEWP), PTB, collaboration with other countries and organisations etc., wherein consultations with national and international experts is conducted time to time on the relevant subjects.

Environmental standards

Mainly various types of environmental standards are notified by Ministry of Environment Forests and Climate Change (MoEF&CC), however, the specific/stringent standards may be notified by the concerned State Pollution Control Boards, as deemed necessary.

4. Good Practices Implemented by the International/ European River Basin Organizations in Crisis Management Area

4.1 Case Study Danube: AEWS Accident Emergency Warning System

The Accident Emergency Warning System (AEWS) of the Danube River Basin is activated whenever there is a risk of transboundary water pollution, or threshold danger levels of certain hazardous substances are exceeded. The AEWS sends out international warning messages to countries downstream to help the authorities put environmental protection and public safety measures into action (ICDPR, 2022).

The system underwent a major test in 2000, during the Baia Mare and Baia Borsa spill accidents on the Tisa River. The system effectively enabled the timely activation of measures that prevented more extensive damage to people and ecosystems downstream along the Tisa River (ICDPR, 2022).

Objectives of the Danube AEWS

The general objective of the AEWS is to increase public safety and protect the environment in the event of an accidental pollution by providing early information for potentially affected riparian countries (ICPDR, 2018).

In more detail, the objectives of the Danube AEWS are:

- A prompt receiving, processing and transmission of information of a pollution caused by dangerous substances, which entered surface waters accidentally and which may cause significant adverse transboundary impact;
- A prompt dealing with and communication of information on emergencies, that may take place in the rivers of the Danube River Basin.

The system must have the capability to warn the national services in charge of handling emergencies promptly so that they can take action to:

- contain the danger;
- ascertain the cause;
- find those responsible for an accident;
- rectify the damage;
- avoid other consequences.

International AEWS Structure

The AEWS operates on a network of Principal International Alert Centres (PIACs) in each of the participating countries (see Figure 3).

Principal International Alert Centres (PIACs) in these countries are the central points of the basin-wide cooperation. The ICPDR Secretariat maintains the central basin-wide AEWS website and communication system. The activities regarding the Danube Accident Emergency Warning System are supervised by the Accident Prevention and Control (APC) Expert Group. The Danube AEWS has a flexible structure and may be extended in the future, if necessary. At present, it is used also by the International Sava River Basin Commission as the warning system for the Sava River Basin.

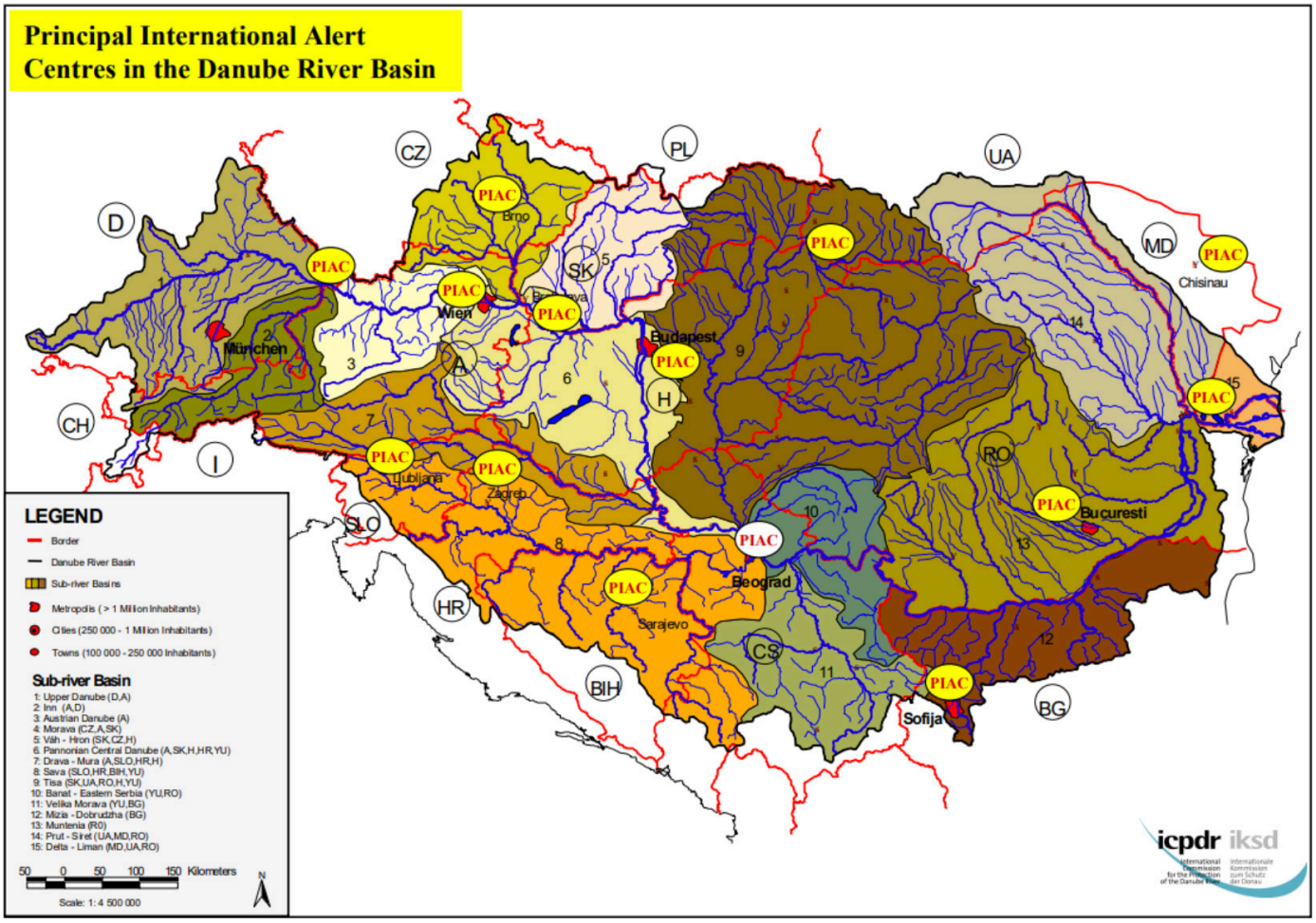

Figure 3: Overview map with Principal International Alert Centres in the Danube River Basin

In the concept of the Danube AEWS each country involved has its own national AEWS, which covers the national action policy in reaction to an accidental pollution of the Danube and its tributaries. This national AEWS consists of one or more Alert Centres. The structure and operation of national AEWS is fully in competence of the country and not subject of this proposal.

Within each national AEWS there are organisations and institutes, that put in place their own warning procedures (and national manuals). On top of this structure of national Alert Centres, each of the Danube riparian states has one Principal International Alert Centre (PIAC), except for Ukraine which has two PIACs, one for each part of the Ukrainian DRB.

These PIACs are made up of three basic units:

- Communication Unit (operating 24 hours a day), which sends and receives warning messages.
- Expert Unit, which evaluates the possible transboundary impact of any accident using the database of dangerous substances and the Danube Basin Alarm Model.
- Decision Unit, which decides when international warnings are to be sent.

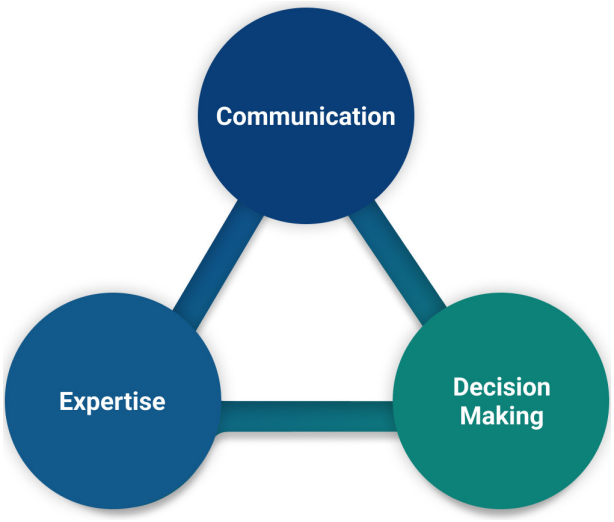

Figure 4: Basic units of Principal International Alert Centres (PIACs)

The following activities within a PIAC can be identified, once a (potential) accidental pollution has been reported:

1. Receipt of the first report on a (potential) accidental pollution.
2. Registration of the reported incident or pollution.
3. Assessment of the possible impact of the reported pollution. If necessary, consultation with external experts to acquire their opinion on the possible impact of the polluting substance.
4. Raising an alert to another PIAC by creating an incident report in the AEWS website if there is an indication of a possible transboundary impact or if the emission thresholds were exceeded.
5. Decision on which actions, for various authority levels, are to be taken in combating the pollution and which authorities are to be informed or warned:
    - notification of national, regional and district authorities for combating the reported situation (through national AEWS);
    - initiation of national or regional alarm plans (through national AEWS)

6. Providing follow-up information to the other PIAC by updating the incident report in the AEWS website if additional information on the pollutant substance or other details on the accident become available.
7. Decision on whether the alert situation is over.
8. Ending the alert by setting the "End-of-Alert" status of the incident report in the AEWS website

To improve the international communication and the registration of all accident-related information and to assist in a prompt judgement of the possible impact of reported accidents the following tools are available to the PIAC:

1. AEWS website:

For international communication of pollution incidents and other information between Communication Units an Internet-based communication network is available (www.danube.aews.org). The communication equipment required by each PIAC consists of a standard web browser connected to Internet. Mobile phone(s) with Short Message Service (SMS) functionality and a printer are also recommended. A telefax machine should be available as backup communication in case of unavailability of Internet connection.

Reports on pollution incidents and other information are entered into web forms and transmitted through the Internet. All entered information is stored and made accessible via the AEWS website. The relevant recipients are notified about new and updated information via e-mail and/or SMS messages. They can view the full information, confirm receipt and follow up via the web browser.

2. Hazardous substances database (integrated into AEWS website):

The Expert Unit may use a database maintained by Federal Environment Agency (Umweltbun- desamt, UBA) in Germany, that contains data of polluting substances. All substances, already al- located to a water hazard class or classified as non-hazardous to water, can be searched using the UBA's online database Rigoletto or directly within the AEWS. The substances are classified for their water-hazardous properties.

4.2 Rhine Alarm Plan

Accidental pollution related to human activities is inevitably. In case something happens, the responsible people deciding on measures, have to receive the most recent, relevant and accurate information on the precise situation. On the river Rhine this information is collected via two information networks.

(a) the alarm network

Accidental water pollution can be detected by people (citizens, shippers, water policemen), and/or by water quality monitoring stations. The Rhine has a set of these stations. [...]. A large number of water quality parameters is continuously monitored: temperature, turbidity, acidity, oxygen, ammonium, electro conductivity, chloride, fluoride. Micropollutants are monitored as well: heavy metals (cadmium, copper, lead, zinc) and organic micropollutants.

In order to detect unknown pollution bio-alarm systems are operational (fish, daphnia) or will be applied (algae, bacteria). Every alarm is verified and transmitted to an alarm station. The International Commission for the Protection of the Rhine against Pollution (ICPR) installed a network for warning and alarming. [...] Each station tries to find out which substances were discharged, how much was spilled in the water and for how long the discharge lasted. Each station is responsible for the further distribution of information to downstream stations.

(b) the hydrological network

Information on the hydrological situation of the river basin is collected on a daily basis by the national water authorities. Generally, the required meteorological information is obtained from the national weather services. Depending on the hydrological situation and the location in the basin, the information is updated every 6 to 24 hours. Forecasts of rainfall and river flows are also available. Hydrological information of the river is essential for a good forecast of the travel time of pollutants. This forecast is made by the alarm stations, using the Rhine Alarm Model.

In case of an alarm warning, the responsibilities along the river network are clearly specified. Seven international main warning centres (IHWZ) are implied: Amt für Umwelt und Energie des Kantons Basel- Stadt, Basel (R1); Préfecture du Bas-Rhin, Strasbourg (R2) Landespolizeidirektion Göppingen, Führungsund Lagezentrum (R3); Wasserschutzpolizeistation Wiesbaden (R4); Lagezentrum des Ministeriums dses Inneren, für Sport und Infrastruktur, Mainz (R5); Bezirksregierung Düsseldorf (R6), Rijkswaterstaat directie Oost-Nederland, Arnheim (R7), and the secretariat of the International Commission for the Protection of the Rhine (S).

As, along its way, river Rhine is the border between 4 countries, this clear definition is of extreme importance. For this reason, the river has a longitudinal structure, based on river kilometrage and additionally a distinction between left and right riverbank (Figure 5). So, for each point on the river, a responsible authority can be easily found.

- Of course, this clear structure goes much deeper, as
- All information and documents are shared openly and within all languages used in the countries along the river,
- Pathways for communications are clearly specified and information (such as warning) are handed over from one authority to the next one, following pre-defined paths in the direction of flow,
- All above mentioned criteria and structures are applied identical in all countries,
- Clear communication protocols are used for sharing important information and making sure that all relevant institutions receive the information.
- The Rhine-Alarm plan is constantly reviewed and, if needed, updated by a commission of all countries, which having frequent meeting over time.

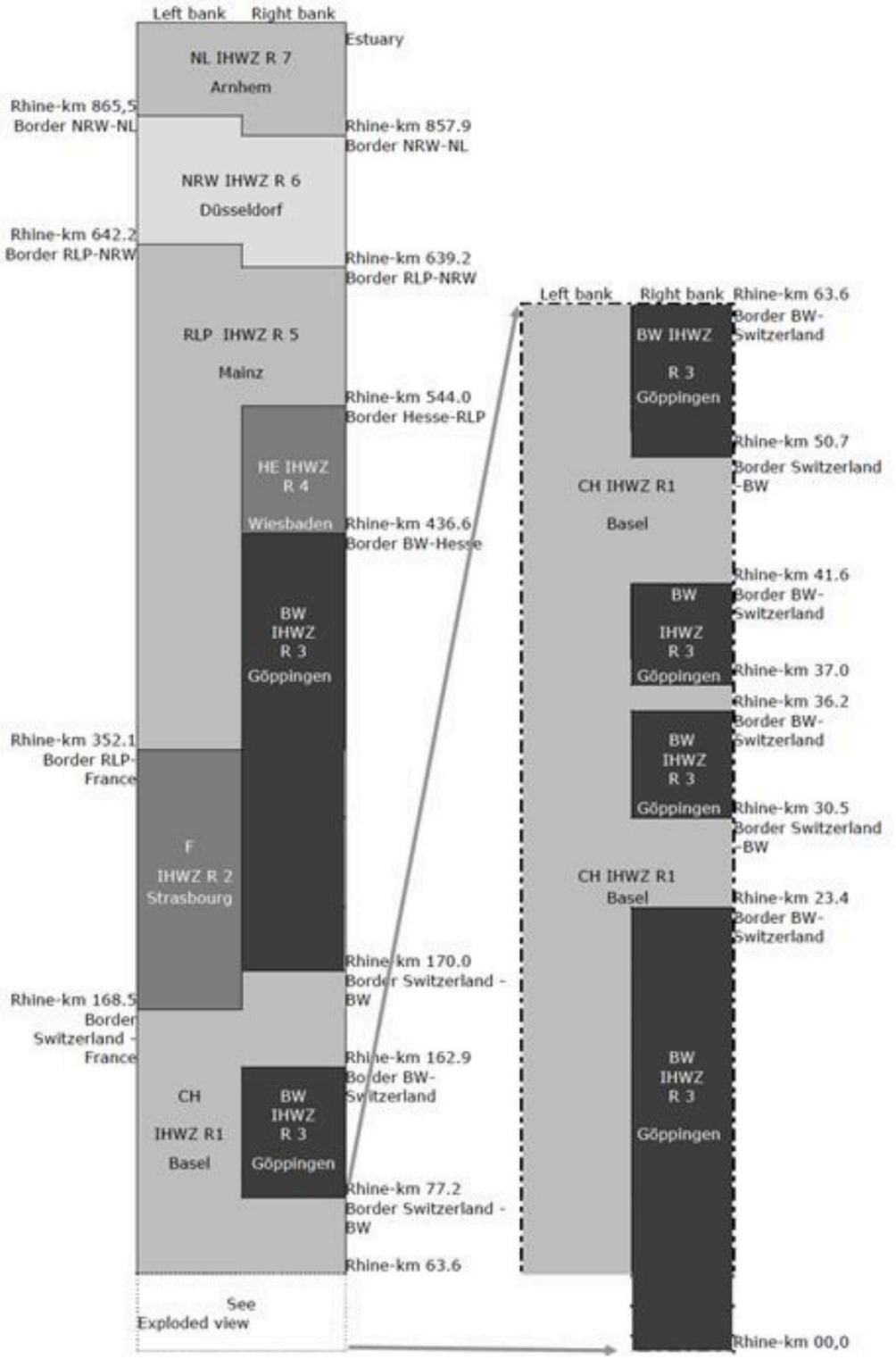

Figure 5: Areas of responsibility of the international main warning centres according to the Warning and Alarm Plan Rhine (IKSR/CIPR/ICBR, International Warning and Alarm Plan Rhine, State: 01.01.14)

4.3 German Water Associations as example for crisis management

In most Federal States in Germany, the water management administration follows the three-tier structure of the general administration, although the allocation of tasks varies from State to State:

Supreme authority

- Land ministry with the business area of water management; usually Ministry of the Environment.
- Tasks: Control of water management and higher-level administrative procedures.

Intermediate authority

- District governments, regional councils.
- Tasks: Regional water management planning, significant water law procedures, administrative procedures.

Lower instance

- Lower water authorities are the districts and independent cities.
- Tasks: Water law procedures, monitoring of water bodies and official decisions, e.g. on wastewater discharges.

A distinction must be made between the water authorities that make water law decisions and the technical offices (state offices, state institutes, environmental offices, water management offices). They primarily perform advisory and expert functions. In order to coordinate common issues, the highest State authorities in the field of water management have joined together to form the Länderarbeitsgemein- schaft Wasser (LAWA).

Water management in the municipalities

The municipalities have important tasks in environmental protection through the implementation of federal and state environmental laws, but above all within the framework of their constitutionally guaranteed self-administration.

The traditional compulsory tasks of the municipalities includes the supply of drinking water and the disposal of wastewater, in accordance with the water laws of the German states. In order to cover the costs, they levy sewage charges or wastewater charges on the end users, both industrial and private. These costs are charged per emitted volume and are constantly updated, if more complexe and expensive treatment is required. As owners of smaller water bodies, they are also responsible for their management.

The municipalities have various forms of operation at their disposal for the independent and effective implementation of water supply and wastewater disposal.

A special role is played by the cooperation of municipalities in water associations, which is mostly voluntary in Germany and in some cases also regulated by law by the state, in order to organise the organisation of water supply and wastewater treatment as well as watercourse maintenance [...] and also with regard to watercourse protection (BMUV, 2022). This aggregation process optimizes towards competence and cost effectiveness, especially for small municipalities.

These associations differ in terms of regional scope, organisational form and task. In the state of North Rhine-Westphalia (NRW) the so-called special-law water associations perform, legally assigned, state tasks within the framework of water management, such as the purification of wastewater, renaturation, maintenance and management of water bodies. In order to ensure that these water management tasks are carried out in a uniform manner throughout the state, the special-law water associations are subject to direct legal supervision by the NRW Ministry of the Environment. This supervision includes the control of the economic management and ensures that the association fulfils the tasks and duties incumbent upon it, in accordance with applicable law and in line with the water management objectives of the state (MULNV NRW, 2022).

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In Figure 6 an example on possible crisis management structures for Ramganga River Basin is given. There are four areas towards crisis management or crisis management mechanisms. Prevention is about design standards, supervision, or to deal with non-compliance. River Basin Organisations often closely interact with the regulatory authorities like the Ministry. The next point, preparedness includes moni- toring. Usually, several institutions carrying out monitoring are located in a catchment area, so monitoring is not conducted centrally at one location. However, these monitoring centres should report centrally to one organisation (such as NMCG), so that data are shared and interconnection is given. The response mechanisms in case of an accident are also decentralized. There should be focal points with good local knowledge, in which (short) notification chains, alarm coordination etc, have been established. In the last step, the review of the accidents, all units are involved.

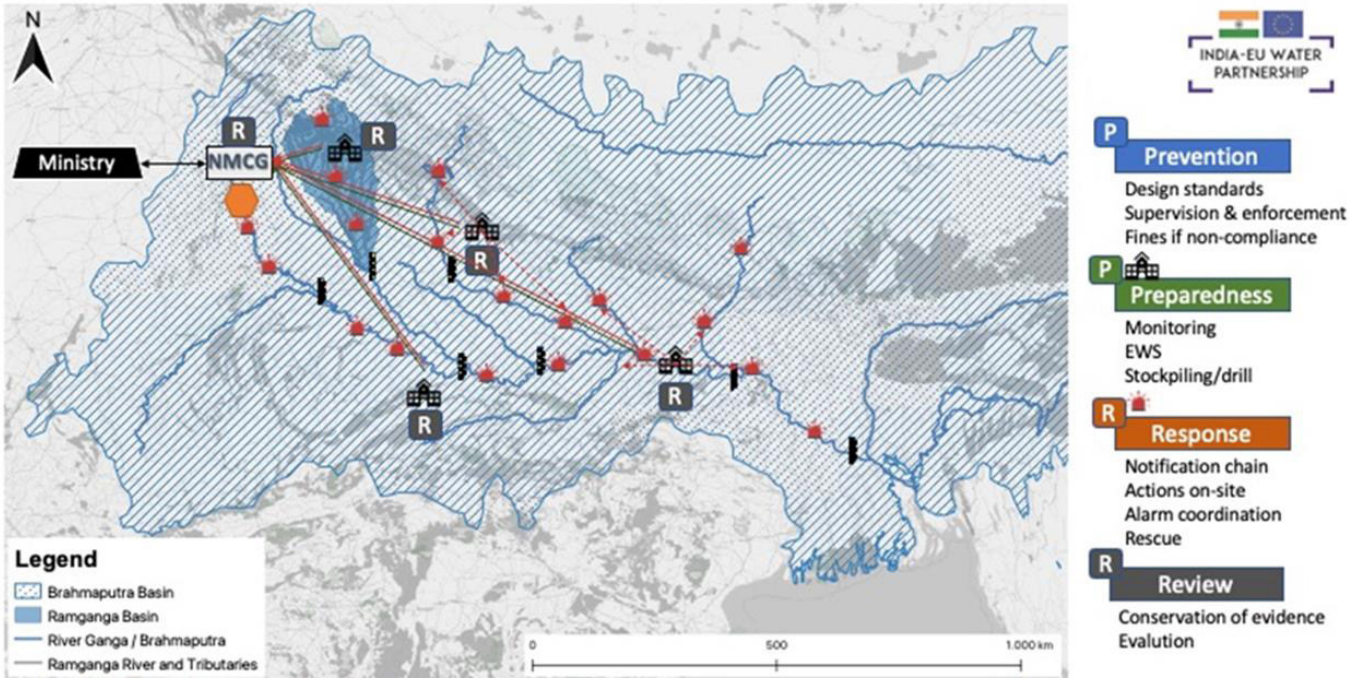

Figure 6: Map of Brahmaputra Basin, example for crisis management structures

Figure 7 and Figure 8 show an example of the complex structure of Water Associations in Germany. They work closely together with regulatory authorities and are responsible for classic water management tasks, such as ensuring flood protection along watercourses, provision of water for drinking water production and disposal of wastewater from industry and private sources. Water authorities also have the mandate to deal with river basin management. Water associations can be seen as representative for the decentralized organisation from the example above. They work closely together with regulatory authorities and often are operators of monitoring systems. They launch the notification chain, prepare risk and action maps and they have the duty to employ personnel in 24/7 shifts for incident management (in the departments on Wastewater and Water management, Figure 8).

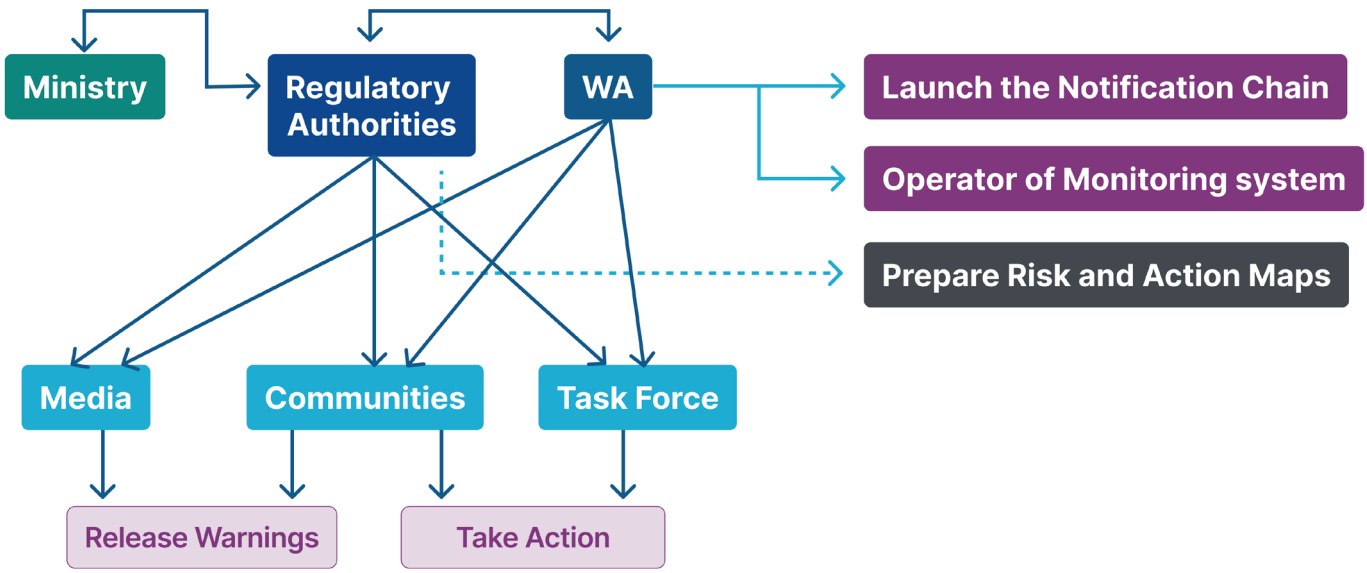

Figure 7: Communication channels crisis management – example Water Associations in Germany

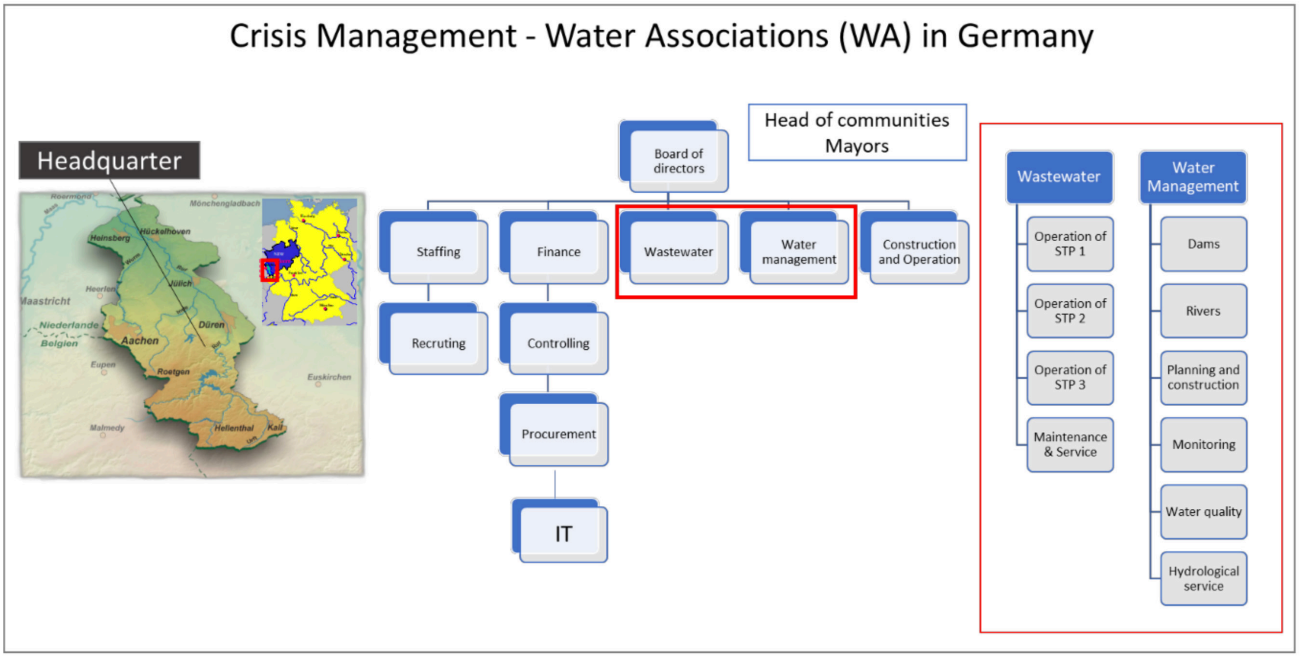

Figure 8: Example for structure of Water Associations in Germany

As an example of crisis management, the concept of the WVER (Water association Eifel-Rur in NRW) is described below. For incident/ accident management, there are special requirements for a communication and action concept for extraordinary events/crises. Therefore, the compulsory reports of the WVER to the authorities are supplemented by proactive communication with municipalities, districts (and companies). This information is the basis for appropriate decisions by the responsible authorities, but also vice versa. In the event of an incident, the action plan specifies secure escalation levels that are synchronised between the WVER / municipalities / districts. This is achieved by a bidirectional exchange of information on emerging incidents as early as possible, which also enables coordinated communication with the media and the public. The procedure should be uniform throughout the association. This requires intensive coordination with all districts and municipalities represented in the association (derived from (Dr.-Ing. J. Reichert WVER, 2022)). Figure 9 shows the draft of an interaction scheme.

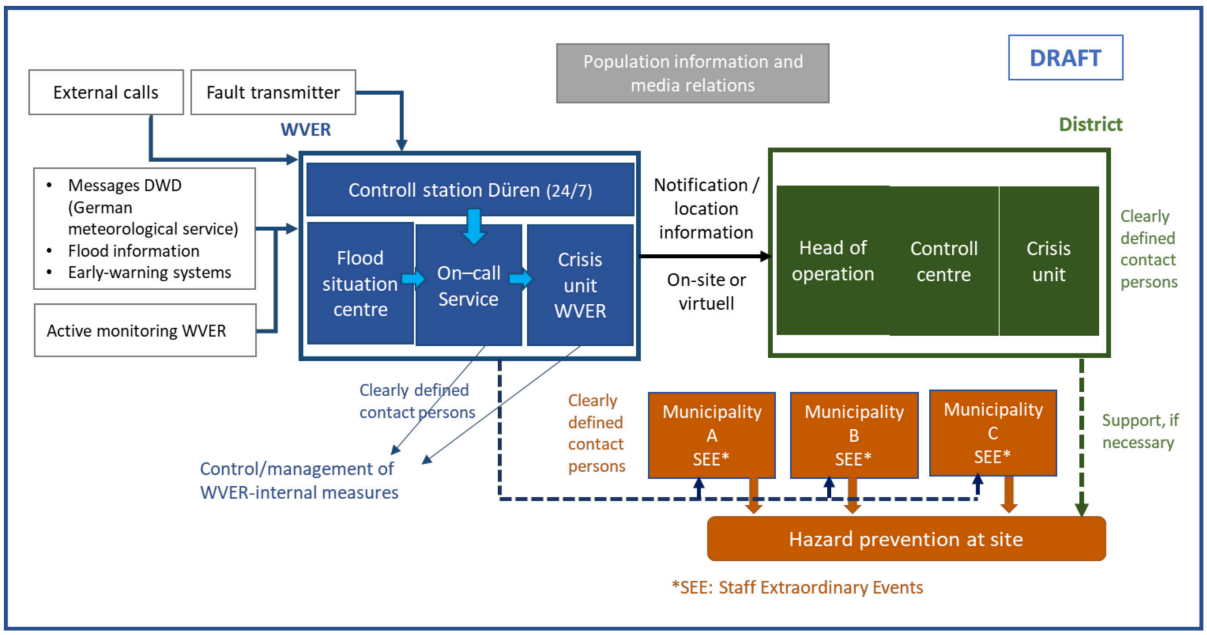

Figure 9: Interactions in the event of an incident with relevance to the whole district (derived from (Dr.Ing. J. Reichert WVER, 2022) (Draft 01/2022))

5. Suggestive Measures / Approaches Including NMCG's Responsibilities Related to Crisis Management of Pollution Accidents

Input for this chapter results from literature review, discussion with NMCG as well as information from international and German practise. Questions discussed with NMCG, which are relevant for this chapter, are the following:

- How does NMCG foresee its role as a steering and coordinating authority with the actors involved for better implementation of technical, social and safeguard measures?
- What, according to NMCG, could be the potential strategies that should be in place at different levels (NMCGs, SPMG, DGCs) to better address crisis due to accidental pollution?

Conclusions for NMCG`s role and responsibilities related to crisis management are:

- The National Mission for Clean Ganga (NMCG) being the national agency charged with the role, responsibility and powers to facilitate the task of rejuvenation, protection and management of River Ganga and its tributaries. In terms of regulatory framework, NMCG compliments the designated authorities - CPCB and SPCBs. NMCG may take the lead and steer the competence and tasks of other authorities and agencies depending on their specific task and distance. An example would be to engage CPCB for setting up standards and databases for hazardous substances, as this field is one of CPCPs core competences. Also processing and managing basin wide monitoring network could be a task for CPCB. However, building and maintaining monitoring stations and employing and coordinating local measurement staff should be carried out to more local stakeholders, that are geographically closer to the area of interest. Distributing these tasks by setting an overall organizational strategy for the whole basin should be a major responsibility of NMCG. Preventing unclear allocation of responsibilities or double allocation of responsibilities is crucial and should be avoided at any costs. This includes setting of a fixed chain of information, both upwards and downwards. Both measures are key factor for effective and fast response in case of an accident.
- According to Paragraph 7 of the NMCG Authority Notification, NMCG is responsible for Emergency measures in case of pollution of River Ganga or its tributaries (NMCG, 2016): If any poisonous, noxious or polluting matter is present or has entered into the River Ganga due to any accident or other unforeseen act or event, and it is necessary or expedient to take immediate action, the National Mission for Clean Ganga shall take immediate action for carrying out such operations or direct for carrying out such operations by the specified State Ganga Committee or specified District Ganga Committee or local authority or any other authority or Board or Corporation, as it may consider necessary for all or any of the following purposes, namely:
    - → the manner of removing the matter from River Ganga and disposing it off in such a manner as it may specify, as also, for carrying out such operations as is considered appropriate for mitigation or removal of any pollution caused by such matter;

- → issuing directions restraining or prohibiting any person concerned from discharging any poisonous, noxious or polluting matter in the River Ganga;
- → undertaking any additional work or functions as may be necessary to address such emergency.

- The NMCG, as a national institution, can provide guidance to regulatory authorities such as SGCs and DGCs and participate in the legislative process. NMCG should act as a hub, to ensure regulatory processes are handled similar between different state and district levels.
- NMCG acts as facilitator for state and district level authorities and is providing support on technical level as well. An important part of this work is setting standards for procedures, workflows, equipment etc., that are followed by all involved institutions. This ensures smooth communication and comparable results. Providing technical support also means to provide centralized communication and data exchange platforms. Even though some districts may use slightly different monitoring stations from different brands, all final data should be aggregated in a centralized web platform, provided and maintained by NMCG. Also providing a central service (App, e-mail server, etc.) for warning and communication during an accident or crisis. Technological support of DGCs is considered necessary, they need to be strengthened with technological equipment for proper implementation.
- Well-structured exchange and communication between the different levels/ authorities are crucial for crisis management. This includes not only communication during a crisis, this requires also regular meetings for e.g. updates, coordination and safety audits between different levels. These communication channels and responsibilities must be clearly defined, e.g.:
  - → who reports the accident,
  - → who receives the information,
  - → who starts activities,
  - → what kind of activity,
  - → who is following up,
  - → which technology is used for communication (e.g. e-mail, SMS, phone, app)?
  - → To ensure smooth flow of the communication and action chain, the required skills must be well prepared and trained regularly between all involved institutions and stakeholders. This includes not only a defined communication path (e.g. e-mail), but also clear instructions for the communication itself (e.g. exact wording: 'warning' vs. 'information', use always the same e-mail header, etc.), to avoid miscommunication or random faults (e.g. e-mail is sorted as SPAM). Examples of such pre-defined communication sheets from the Rhine alarm plan can be found in the Annexure. These sheets are prepared for telefax and must be adapted to other technologies, such as e.g. e-mail. It goes without saying that this communication chain requires 24/7 available staff on all nodes of the communication chain.

- As National Authority, NMCG is acting beyond district and state borders. As River Ganga crosses various borders and administrative boundaries, a national institution is required for overall planning. This planning must be done centralized and task and responsibilities must be accordingly distributed to lower levels, which includes the following organizational actions:
    - → Inventory of stakeholders
    - → Inventory of equipment, exchange platforms, databases
    - → Inventory of River Ganga, including full mapping and metering
    - → Division of River Ganga in smaller, more regional river units
    - → Implementation of standardized procedures(including organization structure, responsibilities, communication, action plans, etc.), which could be applied in all river units
    - → Assign stakeholders to river units, including clear assignments of tasks and responsibilities within the unit
    - → Assure clear communication and coordination between river units
    - → Assign budget, inventory, and other resources to river units
    - → Regular training and audits of the system
- With the administrative empowerment of the DGCs, the long-demanded decentralisation was implemented. The decision-making has become informed and a sense of ownership has become stronger as evident from the enthusiastic involvement of all local stakeholders in DGC meetings in the key States of Uttarakhand and Uttar Pradesh among others. This structure is futuristic and will be able to lay foundation for further in-depth implementation of rejuvenation activities and also to expand to new integrated activities.
- NMCG and regulatory authorities must work hand in hand to ensure highest possible efficiency in this complex field, with several different layers within the field of Crisis Management. It is mandatory to coordinate tasks and responsibilities between NMCG and regulatory authorities, to prevent some tasks being conducted twice and some being forget. A clear structures allocation of tasks and responsibilities, affirmed by NMCG and regulatory authorities is the basis a successful Crisis Management. This requires clear communication procedures and regular meetings on relevant topics, which are conducted in working groups. These working groups should be organized and coordinated topic specific by NMCG and should regularly bring all relevant stakeholders together. Examples of possible workgroups could be:
    - → Crisis communication
    - → Monitoring
    - → Industrial compliance
    - → Guidelines and regulatory frameworks

Two examples on how such workgroups look like, can be found in Figure 10. These working groups may also be split further into more regional units, where local processes within a crisis scenario are covered.

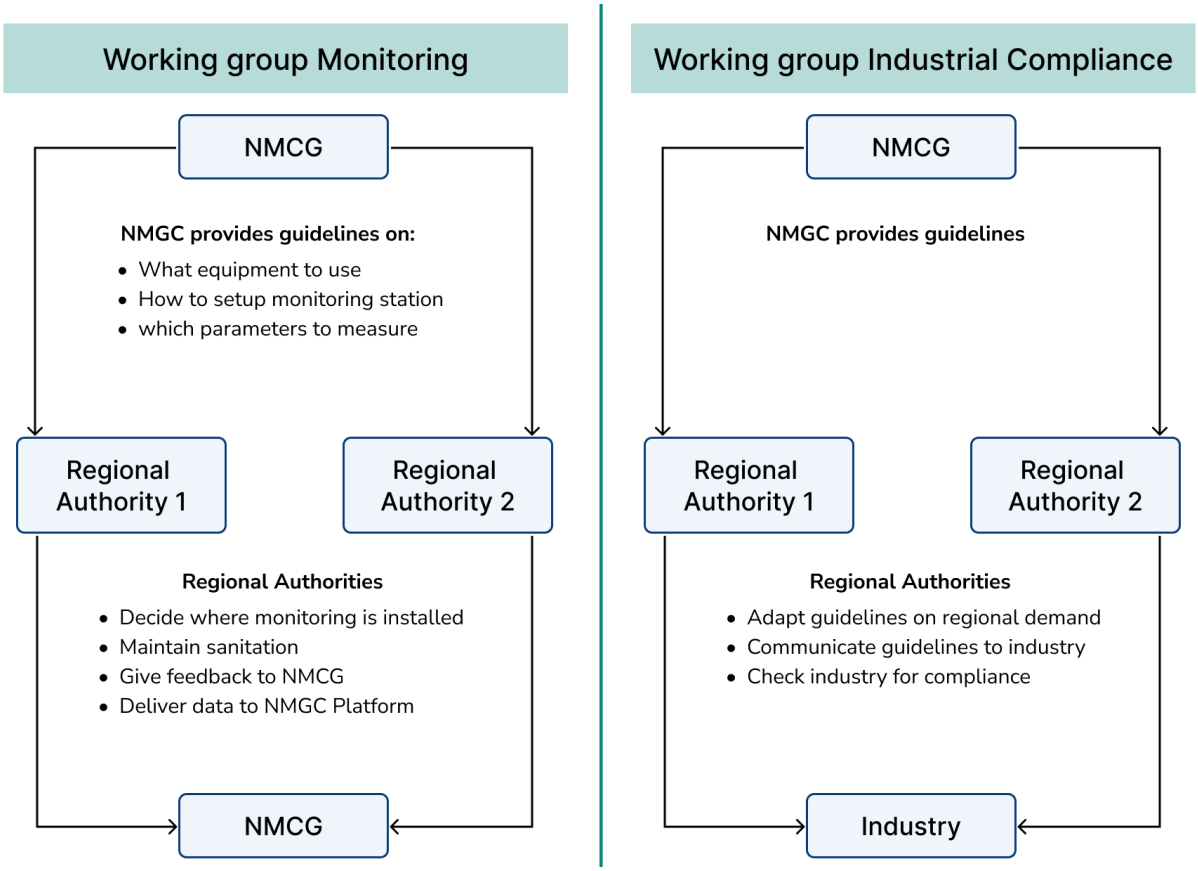

Figure 10: Example of working groups within Crisis Management system, organized and facilitated by NMCG to meet regularly and discuss and optimize internal procedures.

Additional measures/activities to better address crisis due to accidental pollution:

- Improvement of dissemination mechanisms are considered as necessary. Updates must be clear and visible for all relevant stakeholders. This is enabled through the already mentioned tools such as centralized web platforms and workgroups, where relevant information can be easily distributed among all relevant stakeholders and direct feedback can be given within the working groups.
- An enabling system towards imposition of penalty for defaulters, which requires regulatory framework, provided by NMCG and implementation through regional authorities. NMCG must play an important role on centralization, which keeps regulations on regional level similar, to prevent different rules between states or districts. This does also apply for penalties. Fees must be equally in all states and district, but also control intervals and enforcement should be the same, to prevent industries moving from place to another.
- To achieve all above-mentioned points, additional resources in terms of manpower/ logistics, especially in the field of coordination and IT, are required.
- The measures suggested should be in tune to the existing institutional set up and legislative structure.

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Annexure

Example – Standard report pattern Alarm Plan Ramganga river (from Alarm Plan Rhine: Standard report pattern for telefax)

International Warning and Alarm System, Ramganga River

SOS - Ramganga River Very Urgent

Reporting Authority Name | Telephone | Fax

- ☐ Warning
- ☐ Information
- ☐ Search Report
- ☐ All Clear Signal
- ☐ End Search Report

First Report ☐

Date | Reporting Person | Concern

References / Processing Number

Following Report ☐

Annexes | Number of Pages

Please hand out directly

Reporting Scheme for Passing on Reports

SOS - Ramganga River Very Urgent

(A) Declaration of

Warning Centre | Name | Date | Time

(B) Event

Accident ☐ Breakdown ☐ Increased Concentration ☐

(C) Place

Place | Date | Time

River | km

Bank Side: Left ☐ Middle ☐ Right ☐

Water level cm | Run off $m^{3/4}$ | Gauging Station

(D) Information on Substance

Substance Name | Concentration | CAS Nr.

Measured ☐ Calculated ☐ | Duration of Discharge | Discharged Qty

(E) Extent of Pollution

Fish Death ☐ Water coloration ☐ Order Development ☐

Floating Substance

Length | Width

(F) Measures Taken

(G) Media Reaction

(H) Further Information

As soon as the danger is over, the following report is to be issued following a warning

SOS - Ramganga River Very Urgent

All Clear Signal

(I) Place

Place | Date | Time

River | km

Bank Side: Left ☐ Middle ☐ Right ☐

(J) All Clear Signal

River Section Concerned | From river km | To river km

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